

**SUSTAINABILITY OF FARMING SYSTEMS IN  
SELECTED AGRO-CLIMATIC ZONES OF  
KARNATAKA**

**SUNITHA, A. B.**

**PALB 2019**

**DEPARTMENT OF AGRICULTURAL EXTENSION  
UNIVERSITY OF AGRICULTURAL SCIENCES  
BENGALURU – 560065**

**2015**

**SUSTAINABILITY OF FARMING SYSTEMS IN  
SELECTED AGRO-CLIMATIC ZONES OF  
KARNATAKA**

**SUNITHA, A. B.**

**PALB 2019**

*Thesis submitted to*

*University of Agricultural Sciences, Bengaluru*

*in the partial fulfillment for the award of the degree of*

**DOCTOR OF PHILOSOPHY**

in

**AGRICULTURAL EXTENSION**

**BENGALURU**

**OCTOBER, 2015**



*Affectionately Dedicated to My Beloved  
Parents*

*sri BYRAREDDY, A. B. and Smt. JAYAMMA*

*and*

*My Advisor Dr. D. NANJAPPA*

**DEPARTMENT OF AGRICULTURAL EXTENSION  
UNIVERSITY OF AGRICULTURAL SCIENCES  
GKVK, BENGALURU-560065**

**CERTIFICATE**

This is to certify that the thesis entitled “ **Sustainability of Farming Systems in selected Agro-Climatic Zones of Karnataka**” submitted in partial fulfillment of the requirements of **DOCTOR OF PHILOSOPHY in AGRICULTURAL EXTENSION** to the **UNIVERSITY OF AGRICULTURAL SCIENCES, BENGALURU** is a bonafide record of research work carried out by **Ms. SUNITHA, A. B., ID No. PALB 2019**, during the period of her study in this university under my guidance and supervision and the thesis has not previously formed the basis of the award of any degree, diploma, associateship, fellowship or other similar titles.

Place: BENGALURU

Date: 29<sup>th</sup> October, 2015

  
(D. NANJAPPA)

Professor and Major Advisor

**APPROVED BY:**

Chairperson :

  
\_\_\_\_\_  
(D. NANJAPPA)

Members :

  
\_\_\_\_\_  
(M. J. CHANDRE GOWDA)

\_\_\_\_\_  
(S. V. SURESHA)

  
\_\_\_\_\_  
(G. N. NAGARAJA)

  
\_\_\_\_\_  
(P. N. SUBBAREDDY)

  
\_\_\_\_\_  
(H. S. SURENDRA)

  
**D. M. CHANDARGI**  
External examiner

## ACKNOWLEDGEMENT

*It is my hearts turn to express my deepest sense of gratitude to all those who have directly and indirectly helped me in this endeavour.*

*At the very outset, I feel inadequacy of words to express my profound indebtedness and deep sense of gratitude to my esteemed Chairman **Dr. D. Nanjappa**, Professor and former head, Department of Agril. Extension, University of Agricultural Sciences, Bengaluru, for his guidance, counseling and personal affection. It was really a great pleasure and privilege for me to be associated with him during my PhD Degree Programme.*

*It gives me immense pleasure to express my heartfelt thanks to the members of my Advisory Committee **Dr. M. J. Chandre Gowda**, Principal Scientist of Agricultural Extension, Zonal Project Directorate-8, Hebbal, Bengaluru, **Dr. S. V. Suresha**, Co-ordinator, Bakery Training Unit, University of Agricultural Sciences, Hebbal, Bengaluru, **Dr. G. N. NAGARAJA** Professor, Department of Agricultural Marketing, Co-operation & Business Management, UAS, GKVK, Bengaluru, **Mr. H. S. Surendra**, Associate Professor of Statistics, Department of Agricultural Statistics, Applied Mathematics and Computer Science, University of Agricultural Sciences, Bengaluru and **Mr. P. N. Subbareddy**, Associate professor of Sociology, Department of Agricultural Extension, University of Agricultural Sciences, Bengaluru, for their valuable counsel, note-worthy guidance and cordial co-operation during the course of investigation.*

*I bow my head with overwhelming respect and thanks to all teachers of the Department of Agricultural Extension, for their valuable suggestions and support during the course of my studies.*

*It gives me immense pleasure to express my heartfelt thanks to **Dr. N. R. Gangadharappa**, Professor and Head of the department, Department of Agril. Extension.*

*I owe a lot to my parents, brothers and sisters, without whose affection, support and sacrifice, this study would scarcely have been accomplished.*

*Selfless live is the dearest one on this planet. I cannot express more words of thanks to my beloved **Parents – Sri Byrareddy, A. B. and Smt. Jayamma, brothers and sisters** for their boundless love, abundant affection and continuous encouragement. I sustain myself and gratitude cannot be repaid through words. I wish to express my deep sense of gratitude and heartfelt thanks.*

*I use this opportunity to sincerely thank my dearest classmates for their lovely friendship, love, help and care and for making the three years study very much enjoyable and memorable.*

*Words could not help me when I need to thank my dear friends, **Nethu, Ash, Deeps, Veena akka, Johar akka, Ashu and Suresh** for the great support they gave me.*

*I fondly thank my senior friends who provided me their valuable guidance and to my junior friends **Sudha, Sowjanya, Chaitra, Kowsalya, Madhu and Department of Agril. Extension non-teaching staff Mr. Rangaswamy, Mr. Mallikarjun, Mr. Shivlingaiah and Mr. Ranganna** for all their help and co-operation.*

*I am overwhelmed with gratitude to the respondents of my study, without whose co-operation, this study would not have been fruitful.*

October, 2015  
Bengaluru

**(Sunitha, A. B.)**

# **SUSTAINABILITY OF FARMING SYSTEMS IN SELECTED AGRO-CLIMATIC ZONES OF KARNATAKA**

**SUNITHA, A. B.**

## **ABSTRACT**

Sustainability of farming systems is the mechanism of farmer's management of the soil, water and other resources, relying on farm and other additional inputs to maintain the productivity of his farming system in the long run without affecting the production environment of his farm. With this operational definition the study was conceptualized with the objectives to develop sustainability index for measuring sustainability of farming systems, sustainability level of irrigated and rainfed farming systems, relationship between profile of farmers and sustainability level, constraints of farmers in achieving sustainability of farming systems, their suggestions and few case studies of farming systems practiced in the selected agro-climatic zones. The study was conducted in eastern and southern dry zones of Karnataka. Gubbi taluk in Tumkur district, Mandya taluk in Mandya district having highest irrigation and Srinivasapura taluk in Kolar district and Gundlupet taluk in Chamarajnar district having highest rainfed were purposively selected. The sample of the study included 120 farmers. The findings revealed that the farmers in the irrigated (40.00 %) and rainfed (46.67 %) situations of the two zones belonged to medium level of sustainability. Further, in the irrigated farming system of the two zones exhibited that 46.67 per cent of eastern dry zone and 60.00 per cent of southern dry zone farmers belonged to medium level of sustainability. In the rainfed farming system of two zones revealed that 46.67 per cent of eastern dry zone and 43.33 per cent of southern dry zone farmers belonged to medium level of sustainability. A significant relationship between education, family size, level of aspiration, achievement motivation, management orientation, risk orientation, value orientation, farming commitment, social participation, innovative proneness, extension contact, extension participation with the sustainability of irrigated farming system. In rainfed farming system education, family size, level of aspiration, economic motivation, achievement motivation, management orientation, farming commitment, decision making pattern, cosmopolitanism, extension contact and mass media use had positive relationship with sustainability level. Major constraints faced by farmers of irrigated farming system were high cost of inputs, lack of knowledge regarding pest and diseases and non-availability of inputs. In rainfed farming system, lack of water for irrigation, high cost of inputs and non-availability of inputs. The major suggestion by the farmers of irrigated farming system was dependency on hired labour is more so development departments should give importance for farm mechanization (90.00 %). Arranging irrigation facilities for cultivation (90.00 %) was the major suggestion by the farmers of rainfed farming system.

October, 2015

Department of Agricultural Extension  
University of Agricultural Sciences  
Bengaluru – 560065

(D. NANJAPPA)  
Major Advisor

## ಕರ್ನಾಟಕದ ಆಯ್ದ ಕೃಷಿ ಹವಾಮಾನ ವಲಯಗಳಲ್ಲಿ ಕೃಷಿ ವ್ಯವಸ್ಥೆಯ ಸುಸ್ಥಿರತೆ

ಸುನೀತ, ಎ.ಬಿ.

### ಸಾರಾಂಶ

ಈ ಅಧ್ಯಯನವನ್ನು ಕರ್ನಾಟಕದ ಎರಡು ಕೃಷಿ ಹವಾಮಾನ ವಲಯಗಳಾದ ಪೂರ್ವ ಮತ್ತು ದಕ್ಷಿಣ ಒಣ ವಲಯಗಳಲ್ಲಿ ನಡೆಸಲಾಯಿತು. ಈ ಅಧ್ಯಯನವು ೧೨೦ ರೈತರನ್ನು ಒಳಗೊಂಡಿದೆ. ಈ ಅಧ್ಯಯನದಿಂದ ತಿಳಿಯುವುದೇನೆಂದರೆ ನೀರಾವರಿ (ಶೇ. ೪೦.೦೦) ಮತ್ತು ಮಳೆ ಆಧಾರಿತ (ಶೇ. ೪೬.೬೭) ಪರಿಸ್ಥಿತಿಯ ಎರಡು ಕೃಷಿ ವಲಯಗಳಲ್ಲಿ ಬಹುತೇಕ ರೈತರು ಸಾಧಾರಣ ಮಟ್ಟದ ಸುಸ್ಥಿರತೆಗೆ ಸೇರಿರುತ್ತಾರೆ. ನೀರಾವರಿ ಕೃಷಿ ವ್ಯವಸ್ಥೆಯ ಎರಡು ವಲಯಗಳಲ್ಲಿ ತಿಳಿಯುವುದೇನೆಂದರೆ ಪೂರ್ವ ಒಣ ವಲಯದಲ್ಲಿ ಶೇ. ೪೬.೬೭ ರಷ್ಟು ರೈತರು ಮತ್ತು ದಕ್ಷಿಣ ಒಣ ವಲಯದಲ್ಲಿ ಶೇ. ೬೦.೦೦ ರಷ್ಟು ರೈತರು ಸಾಧಾರಣ ಮಟ್ಟದ ಸುಸ್ಥಿರತೆಗೆ ಸೇರಿರುತ್ತಾರೆ. ಮಳೆ ಆಧಾರಿತ ಕೃಷಿ ವ್ಯವಸ್ಥೆಯ ಎರಡು ವಲಯಗಳಲ್ಲಿ ತಿಳಿಯುವುದೇನೆಂದರೆ ಪೂರ್ವ ಒಣ ವಲಯದಲ್ಲಿ ಶೇ. ೪೬.೬೭ ರಷ್ಟು ರೈತರು ಮತ್ತು ದಕ್ಷಿಣ ಒಣ ವಲಯದಲ್ಲಿ ಶೇ. ೪೩.೩೩ ರಷ್ಟು ರೈತರು ಸಾಧಾರಣ ಮಟ್ಟದ ಸುಸ್ಥಿರತೆಗೆ ಸೇರಿರುತ್ತಾರೆ. ಶಿಕ್ಷಣ, ಕುಟುಂಬದ ಗಾತ್ರ, ಮಹತ್ವಾಕಾಂಕ್ಷೆ ಮಟ್ಟ, ಸಾಧನೆಯ ಪ್ರೇರಣೆ, ನಿರ್ವಹಣೆ ದೃಷ್ಟಿಕೋನ, ಅಪಾಯ ದೃಷ್ಟಿಕೋನ, ಮೌಲ್ಯ ದೃಷ್ಟಿಕೋನ, ಕೃಷಿ ಬದ್ಧತೆ, ಸಾಮಾಜಿಕ ಭಾಗವಹಿಸುವಿಕೆ, ನವೀನತೆ, ವಿಸ್ತರಣೆಯ ಸಂಪರ್ಕ, ವಿಸ್ತರಣೆ ಭಾಗವಹಿಸುವಿಕೆ ಮತ್ತು ನೀರಾವರಿ ಕೃಷಿ ವ್ಯವಸ್ಥೆಯ ಸುಸ್ಥಿರತೆ ನಡುವೆ ಸಕಾರಾತ್ಮಕ ಮತ್ತು ಅರ್ಥಪೂರ್ಣವಾದ ಸಂಬಂಧವನ್ನು ಹೊಂದಿವೆ. ಮಳೆ ಆಧಾರಿತ ಕೃಷಿ ವ್ಯವಸ್ಥೆಯಲ್ಲಿ ಶಿಕ್ಷಣ, ಕುಟುಂಬದ ಗಾತ್ರ, ಮಹತ್ವಾಕಾಂಕ್ಷೆ ಮಟ್ಟ, ಸಾಧನೆಯ ಪ್ರೇರಣೆ, ನಿರ್ವಹಣೆ ದೃಷ್ಟಿಕೋನ, ಕೃಷಿ ಬದ್ಧತೆ, ನಿರ್ಧಾರ ಮಾಡುವ ಮಾದರಿ, ನಗರಗಳೊಂದಿಗೆ ಸಂಬಂಧ, ವಿಸ್ತರಣೆ ಸಂಪರ್ಕ, ಸಮೂಹ ಮಾಧ್ಯಮ ಬಳಕೆ ಮತ್ತು ಸುಸ್ಥಿರತೆ ನಡುವೆ ಸಕಾರಾತ್ಮಕ ಮತ್ತು ಅರ್ಥಪೂರ್ಣವಾದ ಸಂಬಂಧವನ್ನು ಹೊಂದಿದೆ. ಪರಿಕರಗಳ ಹೆಚ್ಚಿದ ಬೆಲೆಯು ನೀರಾವರಿ ಕೃಷಿ ವ್ಯವಸ್ಥೆಯ ಪ್ರಮುಖ ನಿರ್ಭಂದನೆಯಾಗಿದ್ದು ಮತ್ತು ನೀರಾವರಿಗೆ ನೀರಿನ ಸಮಸ್ಯೆಯು ಮಳೆ ಆಧಾರಿತ ಕೃಷಿ ವ್ಯವಸ್ಥೆಯ ಪ್ರಮುಖ ನಿರ್ಭಂದನೆಯಾಗಿದೆ. ನೇಮಕ ಕಾರ್ಮಿಕರ ಅವಲಂಬನೆ ಹೆಚ್ಚಾಗಿರುವುದರಿಂದ ಅಭಿವೃದ್ಧಿ ವಿಭಾಗಗಳು ಕೃಷಿ ಯಾಂತ್ರಿಕರಣಕ್ಕೆ ಪ್ರಾಮುಖ್ಯತೆ ನೀಡಬೇಕಾಗಿದೆ ಎನ್ನುವುದು ನೀರಾವರಿ ಕೃಷಿ ವ್ಯವಸ್ಥೆಯ ರೈತರುಗಳ ಸಲಹೆಯಾಗಿದ್ದು ಮತ್ತು ಕೃಷಿಗೆ ನೀರಾವರಿ ಸೌಲಭ್ಯವನ್ನು ಒದಗಿಸುವುದು ಮಳೆ ಆಧಾರಿತ ಕೃಷಿ ವ್ಯವಸ್ಥೆಯ ರೈತರುಗಳ ಸಲಹೆಯಾಗಿದೆ.

ಅಕ್ಟೋಬರ್, ೨೦೧೫

ಕೃಷಿ ವಿಸ್ತರಣಾ ವಿಭಾಗ

ಕೃಷಿ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

ಜಿ. ಕೆ. ವಿ. ಕೆ.ಬೆಂಗಳೂರು - ೬೫.

(ಡಿ. ನಂಜಪ್ಪ)

ಪ್ರಧಾನ ಮಾರ್ಗದರ್ಶಕರು

## CONTENTS

| <b>CHAPTER</b> | <b>TITLE</b>           | <b>PAGE No.</b> |
|----------------|------------------------|-----------------|
| I              | INTRODUCTION           | 1-5             |
| II             | REVIEW OF LITERATURE   | 6-40            |
| III            | METHODOLOGY            | 41-71           |
| IV             | RESULTS AND DISCUSSION | 72-122          |
| V              | SUMMARY                | 123-129         |
| VI             | REFERENCES             | 130-144         |
|                | APPENDICES             | 145-172         |
|                | PUBLICATIONS           | 173-183         |

## LIST OF TABLES

| Table No. | Title   | Page No. |
|-----------|---|----------|
| 3.1       | Selection of sample for the study   | 43       |
| 3.2       | Variables and their empirical measurement   | 44       |
| 3.3       | Dimension wise mean response from the experts on sustainability of farming systems                            | 46       |
| 3.4       | Indicator wise relevancy score under different dimensions of sustainability of farming systems                | 47       |
| 3.5       | Scale values for fifteen indicators under different dimensions of sustainability of farming systems           | 48       |
| 4.1       | Personal and socio-economic characteristics of farmers  | 76       |
| 4.2       | Psychological characteristics of Farmers  | 77       |
| 4.3       | Communication characteristics of farmers  | 81       |
| 4.4       | Distribution of respondents according to sustainability level in irrigated and rainfed farming systems        | 84       |
| 4.5       | Distribution of respondents according to sustainability level in eastern and southern dry zones               | 84       |
| 4.6       | Distribution of respondents according to ecological safety dimension in irrigated and rainfed farming systems | 86       |
| 4.7       | Distribution of respondents according to ecological safety dimension in eastern and southern dry zones        | 86       |
| 4.8       | Distribution of respondents according to economic security dimension in irrigated and rainfed farming systems | 88       |
| 4.9       | Distribution of respondents according to economic security dimension in eastern and southern dry zones        | 88       |
| 4.10      | Distribution of respondents according to social stability dimension in irrigated and rainfed farming systems  | 89       |
| 4.11      | Distribution of respondents according to social stability dimension in eastern and southern dry zones         | 91       |

| <b>Table No.</b> | <b>Title</b>  | <b>Page No.</b> |
|------------------|---|-----------------|
| 4.12             | Comparison of different dimensions of sustainability between irrigated and rainfed farming systems                      | 92              |
| 4.13             | Comparison of different dimensions of sustainability of irrigated farming system between eastern and southern dry zones | 93              |
| 4.14             | Comparison of different dimensions of sustainability of rainfed farming system between eastern and southern dry zones   | 93              |
| 4.15             | Comparison of different indicators of sustainability between irrigated and rainfed farming systems                      | 95              |
| 4.16             | Relationship between independent variables and sustainability of irrigated and rainfed farming systems                  | 101             |
| 4.17             | Multiple regression analysis of independent variables with sustainability of irrigated farming system                   | 102             |
| 4.18             | Multiple regression analysis of independent variables with sustainability of rainfed farming system                     | 104             |
| 4.19             | Direct, indirect and largest indirect effects of independent variables on sustainability of irrigated farming system    | 106-107         |
| 4.20             | Direct, indirect and largest indirect effects of independent variables on sustainability of rainfed farming system      | 108-109         |
| 4.21             | Constraints faced by the farmers in achieving sustainability under irrigated farming system                             | 110             |
| 4.22             | Constraints faced by the farmers in achieving sustainability under rainfed farming system                               | 111             |
| 4.23             | Suggestions by farmers to achieve sustainability in irrigated farming system  | 112             |
| 4.24             | Suggestions by farmers to achieve sustainability in rainfed farming system  | 113             |

## LIST OF FIGURES

| Figure No. | Title  | Between Pages |
|------------|--|---------------|
| 2.1        | Conceptual Model of the study  | 40-41         |
| 3.1        | Map of the study area  | 42-43         |
| 4.1        | Distribution of respondents according to sustainability level in irrigated and rainfed farming systems                             | 85-86         |
| 4.2        | Distribution of respondents according to sustainability level in eastern and southern dry zones of irrigated farming system        | 85-86         |
| 4.3        | Distribution of respondents according to sustainability level in eastern and southern dry zones of rainfed farming system          | 85-86         |
| 4.4        | Distribution of respondents according to ecological safety dimension in irrigated and rainfed farming systems                      | 87-88         |
| 4.5        | Distribution of respondents according to ecological safety dimension in eastern and southern dry zones of irrigated farming system | 87-88         |
| 4.6        | Distribution of respondents according to ecological safety dimension in eastern and southern dry zones of rainfed farming system   | 87-88         |
| 4.7        | Distribution of respondents according to economic security dimension in irrigated and rainfed farming systems                      | 89-90         |
| 4.8        | Distribution of respondents according to economic security dimension in eastern and southern dry zones of irrigated farming system | 89-90         |
| 4.9        | Distribution of respondents according to economic security dimension in eastern and southern dry zones of rainfed farming system   | 89-90         |
| 4.10       | Distribution of respondents according to social stability dimension in irrigated and rainfed farming systems                       | 91-92         |
| 4.11       | Distribution of respondents according to social stability dimension in eastern and southern dry zones of irrigated farming system  | 91-92         |

| <b>Figure No.</b> | <b>Title</b>  | <b>Between Pages</b> |
|-------------------|---|----------------------|
| 4.12              | Distribution of respondents according to social stability dimension in eastern and southern dry zones of rainfed farming system | 91-92                |
| 4.13              | Comparison of different dimensions of sustainability between irrigated and rainfed farming systems                              | 93-94                |
| 4.14              | Comparison of different dimensions of sustainability of irrigated farming system between eastern and southern dry zones         | 93-94                |
| 4.15              | Comparison of different dimensions of sustainability of rainfed farming system between eastern and southern dry zones           | 93-94                |
| 4.16              | Comparison of different indicators of sustainability between irrigated and rainfed farming systems                              | 95-96                |
| 4.17              | Empirical model of irrigated and rainfed farmers on sustainability of farming systems   | 101-102              |
| 4.18              | Direct, indirect and largest indirect effects of independent variables on sustainability of irrigated farming system            | 107-108              |
| 4.19              | Direct, indirect and largest indirect effects of independent variables on sustainability of rainfed farming system              | 109-110              |

## LIST OF PLATES

| <b>Plate No.</b> | <b>Title</b>   | <b>Between Pages</b> |
|------------------|--|----------------------|
| 1                | Sheep rearing of Mr. Chikkaboregowda's farm                | 115-116              |
| 2                | Poultry farm of Mr. Chikkaboregowda's farm                 | 115-116              |
| 3                | Compost preparation tank of Mr. Chikkaboregowda's farm     | 115-116              |
| 4                | Bore well for irrigation of Mr. Chikkaboregowda's farm     | 115-116              |
| 5                | Fertigation tank of Mr. Chikkaboregowda's farm             | 115-116              |
| 6                | Mulching in sugarcane field of Mr. Chikkaboregowda's farm  | 115-116              |
| 7                | Livestock of Mr. Chikkaboregowda's farm                    | 115-116              |
| 8                | Water storage tank with fish of Mr. Chikkaboregowda's farm | 115-116              |
| 9                | Paddy field of Mr. Jaishankar's farm                       | 117-118              |
| 10               | Sugarcane field of Mr. Jaishankar's farm                   | 117-118              |
| 11               | Sheep and goat rearing of Mr. Jaishankar's farm            | 117-118              |
| 12               | Local cows of Mr. Jaishankar's farm                        | 117-118              |
| 13               | Agricultural implements of Mr. Krishnareddy's farm         | 119-120              |
| 14               | Mango + cotton intercrop of Mr. Krishnareddy's farm        | 119-120              |
| 15               | Mulberry garden of Mr. Krishnareddy's farm                 | 119-120              |
| 16               | Eucalyptus of Mr. Krishnareddy's farm                      | 119-120              |
| 17               | Goat rearing of Mr. Krishnareddy's farm                    | 119-120              |
| 18               | Mango + coriander of Mr. Krishnareddy's farm               | 119-120              |
| 19               | Tomato crop of Mr. Krishnareddy's farm                     | 119-120              |
| 20               | Drip irrigation of Mr. Krishnareddy's farm                 | 119-120              |
| 21               | Sheep rearing of Mr. Narayanaswamy's farm                  | 122-123              |
| 22               | Mango farm of Mr. Narayanaswamy's farm                     | 122-123              |
| 23               | Pits for mango planting of Mr. Narayanaswamy's farm        | 122-123              |
| 24               | Water storage tank of Mr. Narayanaswamy's farm             | 122-123              |

### INTRODUCTION

*Tomorrow's environment depends on how we act today: The word sustainable is intended to reflect a policy and strategy for continued economic and social development without detrimental to the environment, as all human activities are dependent on the carrying capacity of the eco-system.*

**- Commission of European Communities, 1992a**

Agriculture is a unique production process based on the growth of plants. When a fertile seed falls on the soil having sufficient moisture, it germinates. The young plant grows making use of the moisture and nutrients in the soil and produces abundant grains, which the man exploits as food for himself. In the primitive agriculture man had accepted the existing conditions of soil, topography, rainfall, species of plant etc., and was harvesting what the nature had given. Rapid changes in economic, technical and demographic conditions have brought in increasingly more number of small holder farming systems in to focus. The need based research and field extension work have focused on modern agriculture with higher use of external inputs, like agro-chemicals, hybrid seeds, fuel based mechanization, etc. the primary aim of their efforts has been to increase the yields of food and fiber crops.

The population growing at an increasing rate pushed up demand for food and therefore the "green revolution" came to the rescue of many countries in the world, including India. The green revolution technology gave much needed relief from the begging bowl diplomacy. But, it has also yielded some refuses which have acquired serious magnitudes. Soil fatigue, water table depletion, regional imbalance, social disparities, environmental degradation and disintegration of social system are some of the refuses.

In this context of growing population in India, the need for efforts in doubling agricultural production and promoting agrarian prosperity is obvious. The task will, however, be not easy, since several ecological, economic and sociological problems are being faced on the farm front. Fortunately, there is a growing interest in promoting sustainable agriculture, which is also referred to by other names as alternative farming, regenerative agriculture, natural farming and organic farming.

Sustainability of agriculture has been interpreted in a number of ways in the recent literature. It is not a new concept. Organic methods of farming which respected the integrity of the soil and related ecological systems have been referred to as sustainable.

The word sustainable is derived from the Latin, *sustinere*, meaning to keep in existence, implying permanence or long-term support. In the context of agricultural production, Ikerd (1993) defines sustainability as farming systems that are: "...capable of maintaining their productivity and usefulness to society indefinitely. Such systems... must

be resource-conserving, socially supportive, commercially competitive and environmentally sound".

Attempting to arrive at a more precise, operational definition of sustainable agriculture is extremely problematic, partly because there is such a range and number of parties involved in the debate. This is not surprising, as there would appear to be little point in advocating a "non sustainable agriculture" and so all relevant groups are fighting it out in the sustainable camp (Francis and Youngberg, 1990). Even the chemical companies can claim that farmers should purchase their agrochemical products to improve their financial sustainability (Buttel, 1993, Whitby and Adger, 1996). Therefore the debate over how to achieve sustainability is plagued by fundamental disputes and disagreements over which elements of production are acceptable and which are not. The complex nature of the interrelationships between agricultural production and the natural environment means that "we are a long way from knowing just what methods and systems in diverse locations will really lead to sustainability" (Youngberg and Harwood, 1989).

It should also be remembered that environmental changes are not always gradual, piecemeal processes, but are sometimes sudden and abrupt (Conway 1985). Recent ecological findings give a picture of a complex and dynamic entity, characterized by uncertainties, non-linearities, positive feedbacks, chaos and jump processes (Henning *et al.* 1991). Consequently, within this framework it is extremely difficult to determine whether certain agricultural practices are sustainable or not. Furthermore, it is only in retrospect that sustainable techniques can be truly identified. The identification of technologies as sustainable today is questionable, since such identification is based on hypotheses regarding the sustainable management of natural resources, maintaining their productive capacity through time. This implies a constant process of monitoring and reevaluation.

The approach adopted here considers sustainability as a "situated concept" (Caceres 1996), and is at odds with other approaches to sustainability that focus on the description and development of sustainable farming practices irrespective of the socio-productive features of the farming systems in which they are used. Thus, sustainability cannot be associated with any particular set of farming practices or methods (Ikerd, 1993), since the ability of a certain technology to behave as "sustainable", will mostly depend on the peculiarities of the context in which it is used. Crucially, systems that are sustainable for one farmer or farm at one point of time may not be sustainable for another farmer or farm at another point of time (Ikerd, 1993). What is a sustainable technique will vary both temporally and spatially.

Farming systems aim for increased productivity, profitability, food and nutritional security, sustainability, recycling of unutilized resource, generation of income round the year, adoption of new technology, solving energy fuel and fodder crisis and increased employment generation. The objectives of farming system in general are converging on to the development of suitable location specific farm technology to raise and sustain the

total farm productivity in terms of food, feed, fodder and fuel and to meet the felt needs of the farmers.

Farming system is a complex inter-related matrix of soil, plants, animals, implements, power, labour, capital and other inputs controlled in part by farm families and influenced by varying degrees of political, economic, institutional and social forces that operate at many levels. In other words farming system is defined as unique and reasonably stable arrangement of farm enterprises that the household manages according to its physical, biological, economic and socio-cultural environment in accordance with the household's goals, preferences and resources. Conceptually it refers to a set of elements or components that are interrelated which interact among themselves. At the center of the interaction is the farmer exercising control and choice regarding the type and result of interaction. It is a resource management strategy to achieve economic and sustained production to meet diverse requirement of farm household while preserving resource base and maintaining a high level of environmental quality. For example it represents integration of farm enterprises such as cropping systems, animal husbandry, fisheries, forestry, sericulture and poultry etc., for optimal utilization of resources bringing prosperity to the farmer.

In farming system, the farm is viewed in a holistic manner. Farming enterprises include crops, dairying, poultry, fishery, sericulture, piggery and apiary tree crops etc. a combination of one or more enterprises with cropping when carefully chosen planned and executed gives greater dividends than a single enterprise, especially for small and marginal farmers. Farm as a unit is to be considered and planned for effective integration of the enterprises to be combined with crop production activity, such that the end-products and wastes of one enterprise are utilized effectively as inputs in other enterprise. For example the wastes of dairying viz., dung, urine, refuse etc are used in preparation of FYM or compost which serves as an input in cropping system.

Sustainability is the objective of the farming system where production process is optimized through efficient utilization of inputs without infringing on the quality of environment with which it interacts on one hand and attempt to meet the national goals on the other. The concept has an undefined time dimension. The magnitude of time dimension depends upon ones objectives, being shorter for economic gains and longer for concerns pertaining to environment, soil productivity and land degradation.

There are three major groups of factors, which in combination determine the type of farming system employed by farmers in a given region. Factor A: represent the physical and biological elements which set limits to the type of agricultural produce to be produced in the given region. The physical elements include land, soil quality, topography, climate, water, location, distance etc. The biological elements include crops and livestock physiology, diseases etc., which determine the potential farm enterprises. These elements can be altered by limited intervention by the farmers and scientists. For instance scientists can evolve improved production technology and farmers can adopt it partially or in full package. Factor B: represents endogenous human elements, which greatly influence the type of farming system adopted in a particular region. The system

revolves around the farmer whose family and means of livelihood are intricately linked. The farm family has available resources under their control in terms of land, labour, capital and management. The quantity and quality of these resources are conditioned by the characteristics of the family (size, age etc), education and management skills, available labour, capital, power, attitudes and goals of the family. The farmers' goals and attitudes are initial factors that determine the nature of farming system specially where there is a range of alternative operations and enterprises to increase productivity consistent with existing technical elements. The farmer could combine available resources in a manner that will maximize the goals of the family. Factor C: represents the exogenous human variables, which govern the allocation of available resources by the farmers. Farm producers need incentives to change their farming methods and production patterns in desirable directions.

In the light of above, there is a need to quantify sustainability of farming systems and to make the concept operational duly incorporating its economical viability, environmental sustainability and social equity. Many individuals and organizations have attempted to identify certain indicators and then to work out an index for measuring sustainability at macro level (Anon., 1990 and Anon., 1991a). Chandregowda (1996) made an in-depth farm level analysis of rice farming sustainability, Naghbushanam (1997) analyzed the sustainability of agriculture in watershed environment and Chandra Naik (2002) studied the sustainability of cotton farming systems. However, such micro level studies on sustainability for different agricultural crops are meager. The felt need of the day is increasing and stabilizing the productivity level of farming systems and this could be achieved by generating appropriate low cost and high production sustainable technologies. Sustainability level in any farming system indicates the type and extent of agricultural and allied farm technologies available.

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

### **Objectives of the study**

1. To develop sustainability index for measuring sustainability of farming systems practiced by farmers.
2. To study the sustainability of irrigated and rainfed farming systems in selected agro-climatic zones.
3. To study the relationship between profile of farmers and sustainability level of irrigated and rainfed farming systems.
4. To document the constraints of farmers in achieving sustainability of farming systems and to know their suggestions.
5. To document few case studies of farming systems practiced in the selected agro-climatic zones.

## **Scope of the study**

Sustainability of farming systems is a complex concept and there are different viewpoints among scholars about its dimensions. Nonetheless various parameters for measuring agricultural sustainability have been proposed. A large number of indicators have been developed but they do not cover all dimensions and levels. Therefore, indicators used for agricultural sustainability should be location specific. They should be constructed within the context of the contemporary socio-economic and ecological situation. This study elicits components to measure sustainability of farming system and to study the sustainability of farming systems in the selected agro-climatic zones. Some recommendations to select indicators in order to better measure agricultural sustainability are also presented.

The operational efficiency of various indicators of sustainability of farming systems under irrigated and rainfed situations was programmed to be quantified to make the concept adoptable. The indicators developed will be used to measure the level of sustainability achieved by the farmers in irrigated and rainfed situation under major farming systems in the selected agro-climatic zones of the study. It will also throw light on the constraints faced by the farmers in achieving the sustainability and to know the suggestions by them to improve the sustainability. Further, case studies were also documented to know the possible reasons for higher or lower sustainability.

## **Limitation of the study**

The study was conducted by the student and the constraints like time and physical facilities remained operative. In spite of this, the researcher has made valiant efforts to select a representative sample for the study. However, the results of the study could be generalized only to similar situations elsewhere, in the state or the country.

## **Presentation of the study**

The first chapter deals with the introduction, wherein the objectives of the study are presented. It also throws light on the scope and limitations of the study. The second chapter viz., review of literature deals with the review of available and related studies in the field of the present study. The third chapter presents the methodology adopted for the study. The location of the study area, sampling procedure followed, quantification of the variables selected for the study, procedure involved in test construction, statistical tests employed etc. The fourth chapter contains the results and discussion of the study. The fifth chapter summarizes the findings of the study with the implications of the findings. The sixth and the last chapter indicate the references and appendices.

### REVIEW OF LITERATURE

Past studies pave way for future research endeavour. An acquaintance with earlier pertinent studies has been felt necessary for better understanding of the problem and to develop appropriate research methodology. After thorough reviewing of all the available literature from different sources, it was observed that the relevant studies on sustainability of farming systems were limited. Hence, an attempt has been made to orient also on the theoretical views of different authors on the subject and some closely related results were reported. Keeping in view of the objectives of the study, the available related literature is presented under the following sections.

- 2.1 The concept of sustainability and sustainable agriculture
- 2.2 The concept of farming system
- 2.3 Dimensions and indicators/components for measuring sustainable farming
- 2.4 Personal, socio-economic, psychological and communication characteristics of farmers
- 2.5 Relationship of independent variables with sustainability of farming system and its dimensions/ components
- 2.6 Constraints faced by farmers in farming
- 2.7 Conceptual frame work
- 2.8 Hypotheses

#### **2.1 The concept of sustainability and sustainable agriculture**

Sustainable agriculture has emerged as the most agreed upon term to synthesize a variety of concepts and perspectives associated with agricultural practices that differ from those of conventional production. This concept is of recent origin and has become a buzz word for agricultural programmes in education, extension, research and government polices to take stock of their effects on natural resources. The concept has been expressed in many ways by many scientists in different situations, which follow here under.

Conway (1985) defined sustainability as “the ability of a system to maintain productivity in spite of a major disturbance, such as caused by intensive stress or a large perturbation”.

Anonymous (1987) defined sustainability as “*development which meets the needs of the present without compromising the ability of future generations to meet their own needs.*”

Sustainable agriculture can be defined as “integrated system of agriculture production and is less dependent on high inputs of energy and synthetic chemicals” (Edwards, 1987).

Conway and Barbier (1988) defined agricultural sustainability as “the ability to maintain productivity whether a field or farm or nation in the face of stress or shock”.

Ainsworth (1989) stated that the only sustainable agriculture is profitable agriculture – short and sweet.

The consultative group on international agricultural research defines sustainable agriculture as that “which involves the successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of environment and conserving natural resources” (Anon., 1989a).

Sustainable agriculture is one that, over a long term, enhances environmental quality and the resource base on which agriculture depends; provides for basic human food and fiber needs; is economically viable and enhances the quality of life for farmers and society as a whole (Anon., 1989b).

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

Harwood (1990) defined sustainable agriculture as “a system that can evolve indefinitely toward greater human utility, greater efficiency of resource use and a balance with the environment which is favorable to humans and most other species”.

Francis and Youngberg (1990) describe the philosophy of sustainable agriculture as “being one where concern over long-term impacts on the environment and other species guide the application of prior experience and the latest scientific advances to create integrated, resource-conserving, equitable farming systems”.

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

Abrol and Katyal (1990) opined that in simplistic terms, sustainable agriculture implies “endurance of productivity level through certain agricultural practices over a period of time”.

Singh and Rajendra (1990) defined sustainable agriculture as “the one which makes use of low cost inputs, less amount of chemical fertilizers, maintain soil fertility and ecological harmony”. Further, these should maintain or increase the biological productivity.

The term ‘organic farming’ was first used by the Lord North Broune and the phrase ‘Sustainable Agriculture’ was coined by Lady Eve Balfour (Rodale, 1990).

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

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

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

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

Anonymous (1992b) stated that tomorrow’s environment depends on how we act today, the word sustainable is intended to reflect a policy and strategy for continued economic and social development without detriment to the environment, as all human activities are dependent on the carrying capacity of the ecosystem.

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

Fresco and Kroonenburg (1992) “...in order to be sustainable, land use must display a dynamic response to changing ecological and socio-economic conditions”.

Lyson and Welsh (1993) quoted that the narrow focus on the production function on the inputs of land, labour, capital and management and the use of on-farm profitability as the primary elements of sustainability.

Anonymous (1993) lays the following principles for sustainable agriculture. They are (1) agriculture is sustainable when it is ecologically sound, economically viable, socially just and culturally appropriate, (2) sustainable agriculture preserves bio-diversity, conserves and improves the chemical, physical and biological qualities of the soil, and (3) sustainable agriculture uses locally available resources, minimizes the use of external and purchased inputs, thereby increasing local independence and self-sufficiency.

Ikerd (1993) defines a sustainable agriculture as “capable of maintaining its productivity and usefulness to society over the long run. . . .it must be environmentally-

sound, resource-conserving, economically viable and socially supportive, commercially competitive, and environmentally sound”.

Lawrence (1994) defined that a concept of sustainable agriculture “which is achieved through rural resource use systems characterized by resilience of resource base, conservation of resource base, equity of resource access, integration into existing social organization, enhanced innovative capacity of farmers and constant increased productivity”.

Goodland (1995) defined ecological sustainability as “the maintenance of the global ecosystem or of “natural capital” (the stock of environmentally provided assets which provide a flow of useful goods or services) both as a “source” of inputs and as a “sink” for waste”.

Lampkin and Measures (1995) noted that “the term ‘sustainable’ is used in its widest sense, to encompass not just conservation of non-renewable resources (soil, energy, minerals) but also issues of environmental, economic and social sustainability.”

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

MacCormack (1995) defined sustainability as “goal of ‘closed system’ farming, meaning that farms approach self-sufficiency and require little outside input”.

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

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

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

Paroda (1995) defined sustainable agriculture as “the appropriate use of crop and livestock systems and the agricultural inputs supporting their activities, which maintain economic and social viability, while preserving the high productivity and quality of the land”.

Anonymous (1996) defined sustainable agriculture as “agricultural production and peasant livelihood that contributes to the rehabilitation and maintenance of ecological

balance and the environment, with just economic returns, promoting a better quality of life for farmers and consumers and fostering the development of local institutions for the benefit and survival of all human kind”.

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

Hansen and Jones (1996) defined sustainability as “the ability of a dynamic, stochastic, purposeful system to continue into the future”.

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

Pretty (1996) identifies a number of goals of sustainable agriculture, which include: a more thorough incorporation of natural processes, a reduction in the use of off-farm, external and non-renewable resources, more equitable access to resources, greater productive use of local knowledge and practices, greater self-reliance for farmers and rural populations, a better match between production practices and climate and landscape and profitable and efficient production with an emphasis on conservation of the soil, water, energy and biological resources.

Lakshminarayan (1997) defined sustainability of sugarcane farming as “the degree to which the farmers manage soil and water relying mainly on 'on farm' resources (i.e., the use of locally available resources, non-cash and low cost inputs/technologies and minimizing the use of chemicals) to maintain or enhance productivity without affecting the production environment”.

Subbarao (1999) reported that Rio-declaration (1992) emphasized four cardinal principles most relevant to sustainable agriculture as follows: 1) Environmental policies must form an integral part of development polices and strategies, 2) Human beings are the centre of concern for sustainable development and environmental issues are best handled with the participate co-operation of all concerned, 3) No development can be considered complete unless it meets the criteria of productivity, equity and environmental safety for the present and future generations and 4)To ensure development and sustainability it is necessary to remove all negative factors leading to unsustainability.

Hegde (2000) said that sustainable agriculture is “a set of farming practices which can continue to maintain the farm productivity, efficiency and productivity in the long run, without depleting the natural resources and environment”.

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

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

Kumaraswamy (2001) emphasised on the philosophy of sustainable agriculture. He said that the philosophy of sustainable agriculture is to maximize crop production through scientific methods of farming, growing crop varieties of high yielding and high quality potential and using optimum inputs of manures, fertilizers, bio-fertilizers and agricultural chemicals without exploiting and polluting the natural resources of soil, water and environment. Sustainable agriculture must be in harmony with the environment without exploiting and exhausting the natural resources.

Further, Kumaraswamy (2001) enumerated the principles of sustainable agriculture as follows: 1) Conservation of natural resources like soil and water is an essential part, 2) Cost effective environment friendly weed control measures, 3) Efficient soil oriented and crop oriented water management, 4) Environment protection, 5) High yielding and high quality varieties of crops must be chosen and grown, 6) Improved agronomic practices from land preparation to efficient harvest technology must be adopted and 7) Integrated soil fertility management practices to improve the physical, chemical and biological properties of the soil using organic manures, fertilizers and bio-fertilizers must be followed.

Anonymous (2004) views that for the achievement of sustainable agriculture; the basic long-term challenge is to produce sufficient food and industrial crops efficiently, profitably and safely, to meet a growing world demand without degrading natural resources and the environment.

Kaine and Tozer (2005) defined economic sustainability as the ability of the system to continue into the future.

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

Farming can cause ecological damage or improve it through abuse or judicious use of soil and water. To be economically viable, it should give secured returns, enhanced yield per unit area and per unit of investment. To be socially just and humane, farming should offer sufficient food to the depending members of the family, should be done within the naturalistic and non-naturalistic inputs possessed by the farm family. While

doing so, the production environment has to be safeguarded which implies to protect the air, natural predators and decomposers of soil organic matter, which is achieved through judicious use of pesticides and chemicals.

The studies mentioned above highlighted the concept of sustainable agriculture. It is evident from these studies that sustainable agriculture stresses on better use of internal inputs, restricted use of synthetic pesticides and chemical fertilizers so that the productivity of the crops can be maintained at lesser cost besides protecting the natural resource base.

On this very foundation, the present operational definition of “Sustainability of Farming system” has been arrived.

## **2.2 The concept of farming system**

Norman (1978) has defined the farming system as the pattern of resource allocation and processes of resource use in a farming unit. Farming unit gives the flexibility to apply it in any specific instance to a geographical unit, an economic unit or to a unit displaying a particular technical pattern of resource use.

According to Shanner *et al.* (1982) farming system is an approach to agricultural research and development that views the whole farm as a system and focuses on (i) the inter-dependencies between the components under the control of members of the household and (ii) how these components interact with the physical, biological and socio-economic factors which is not under the control of households.

Maji (1991) referred farming system specifically to a crop combination or enterprise-mix in which the products and or the by-products of one enterprise serves as the input for the production of other enterprise(s). It takes into account the consumption needs of the family, the economic factors like relative profitability of the technically feasible enterprises, availability of farm resources, infrastructure and institutions such as irrigation, marketing facilities including storage and transportation and credit, besides the agro-biological considerations, viz., interdependence if any among the various enterprises and the preferences of the individual farmers.

Swaminathan (1996) lists the principle components of intensive integrated farming systems (IIFS) as seven pillars that include soil health care, water harvesting and management, crop and pest management, energy management, post-harvest management, choice of crops, farm animals and other components of the farming system and information, skill, organisation and management empowerment.

Rangaswamy (1999) stated that the concept of “farming system” has got more relevance in the present day farming to reap better harvest in the long range by maintaining a productive resource base on a holistic approach. The IFS approach introduces a change in the farming techniques for maximum production in the cropping pattern and takes care of optimal utilization of resources. The farm wastes are better recycled for productive purposes. A judicious mix of agriculture enterprises like dairying,

poultry, mushroom, piggery, fishery etc. suited to the local agro-climatic situations and socio-economic status of farmer would bring in prosperity in the farming.

### **2.3 Dimensions and indicators/components for measuring sustainable farming**

Sustainable farming is the prime concern for rural development in the country. For understanding the means and how the clientele system adopts the different practices to achieve the goal of sustainable farming is the question. The measurement of sustainable farming could be attempted through relevant indicators to the situation, which can be used as tool to understand the direction in which the agriculture development is progressing. These indicators differ from one environment to another. Many authors have attempted to explain this aspect theoretically in many ways under different situations. The views of environmentalists and social scientists on sustainable farming have been reviewed and presented in this section.

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

Khosla (1987) stated that sustainable development was characterized by factors like resource conserving, equitability, economically efficient, waste reducing, socially compatible, employment generating, self-reliant and need fulfilling.

Hailu (1988) opined that the sustainability of food production system involves both environmental and socio-economic dimensions. A system will prove sustainable only if it can;

- Maintain or enhance environmental quality and remain robust against external stress or major disturbance.
- Satisfy society's future demands for food and fibre and
- Assure the economic and social wellbeing of producer.

Keenay (1989) felt that environmental soundness, profitability, productivity and maintenance of social fabric of rural community as the primary concern of sustainable agriculture.

Dally and Cobb (1989) have proposed the Index of Sustainable Economic Welfare (ISEW) by taking into account not only average consumption but also its distribution across social groups and more importantly the long-term deterioration in environmental assets like soil, water, air and ozone. However, the ISEW has the limitation of demanding intensive data, particularly time series information on a number of social, economic and environmental magnitudes.

Lynam and Herdt (1989) proposed that sustainable growth perspective can be operationalised and measured by looking at the changes in yields and total factor productivity explained in terms of changes in the level of inputs, technical changes and changes in resource quality.

Swaminathan (1989) opined that prevention of soil erosion, conservation and management of water resources, conservation of biological diversity using in-situ, ex-situ, in vitro and in-viva methods and promoting the spread and development of economically viable and ecologically sound farm techniques are the main components of a sustainable agricultural system.

The International Federation of agricultural Producers (IFAP) seminar for developing farm leaders concluded that the three interlinked aspects of sustainable agriculture are; (i) sound environmental management, (ii) conservation of natural resource base and (iii) attainment and continued satisfaction of human needs (Anon., 1990). Further, the seminar identified the following characteristics of sustainable agriculture system; (1) stability in past tolerance, (2) regeneration capacity, (3) productivity and profitability, (4) resiliency to external stress, (5) appropriateness to the needs and skills, (6) self-reliance for inputs and (7) non-disruptiveness of social setting.

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

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

Lal and Miller (1990) pointed out that some of the manipulable components for attaining sustainability are (a) improved cultivars and cropping systems, (b) conserving tillage and crop residue management, (c) application of fertilizers and organic amendments and (d) water management.

Ray (1990) highlighted that the means to achieve greater agriculture sustainability include (1) biological diversity, (2) crop rotation, (3) animal integration, (4) the soil as biological system, (5) knowledge based farming, (6) human scale farm size and (7) minimal dependence on non-renewable resources.

Anonymous (1991) mainly emphasized productivity, security, continuity, adaptability and integrity as indicators of sustainability.

Conway *et al.* (1991) believed that sustainability should necessarily exhibit less specialization and less dependency on outside inputs.

Swaminathan (1991) proposed sustainable living security index (SLSI) claimed to be the legitimate indicator of sustainable development of agriculture (SDA) because of its intimate linkage with welfare goals like poverty alleviation, meeting basic needs, human development and quality of life.

Dunlop *et al.* (1992) viewed that nine dimensions viz., (1) protect and enhance soil fertility, (2) ensure supply of safe and whole food, (3) improve site specific knowledge of farmers, (4) enhance environment and wild life habitat, (5) increased

diversity, (6) improved farm economy, (7) reduced agri-chemical use, (8) reduced energy use and (9) reduced purchase of inputs have been considered as most important in explaining the concept of sustainable agriculture.

The sustainability of a cropping system was according to the resources involves biological, physical or socio-economic factors and the degree to which a given resource is subject to degradation determines the sustainability of the system (Anon., 1992).

Izac *et al.* (1992) pointed out that sustainable agriculture contain three equally important components namely environmental quality and ecological soundness, plant and animal productivity and socio-economic viability.

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

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

Smyth and Dumanski (1993) reported that an international working group has concluded that the maintenance or enhancement of productivity, reduced risk, natural resources conservation, promotion of economic viability and social acceptability are essential conditions for sustainable land management.

Van Den Ban (1993) was of the view that indigenous knowledge and competence that enable farmers to depend upon their own ability to take decisions as a precondition for effective operation of sustainable agriculture.

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

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

Lawrence (1994) for evaluating appropriate technologies proposed the indicators for sustainable agriculture (i) ecological indicators (ii) economic indicators and (iii) social indicators.

Yunlong and Smith (1994) have also suggested that agricultural sustainability should be assessed from the perspectives of ecological soundness, social acceptability, and economic viability. 'Ecological soundness' refers to the preservation and improvement of the natural environment. 'Economic viability' refers to maintenance of yields and productivity of crops and livestock and 'social acceptability' refers to self-reliance, equality and improved quality of life.

Chandregowda (1996) identified and used nine components like integrated nutrient management, water management, integrated pest management, crop yield security, information self reliance, input self-sufficiency, family food sufficiency, land productivity and input productivity, to evaluate the sustainability of rice production.

Hansen and Jones (1996) reveal that any factor that influences means, trends, variability, autocorrelation or goal levels may influence sustainability. A host of factors influences the balance between income and expenditure that determines the mean level of farm wealth. Soil degradation, depletion of scarce resources, technological innovation and trends in prices can affect trends in farm state variables. Variability is influenced by weather patterns, price volatility and the occurrence of catastrophic events. Credit availability, market access and the ability to store agricultural products have positive effects on autocorrelation of farm wealth. Finally, a household's tolerance to difficulty, alternative sources of livelihood and lenders' policies can influence goal thresholds.

Kutty (1996) proposed six important dimensions like resource use efficiency, environmental soundness, economic viability, technological appropriateness, economic feasibility and local adaptability for sustainable agriculture.

Smith and McDonald (1998) in their study on assessing the sustainability of agriculture at the planning stage attached importance to the economic aspects of sustainability, such as net present value, benefit cost ratio and profitability.

Nagaraj and Chandrashekar (2000) worked out sustainability index by considering indicators, which influence the quality of resource base, production system and human health and animal health. These three indicators were considered to represent the impact on resource base viz., soil quality or productivity, water quality and biomass production, which includes population of aquatic flora and fauna. In respect of production system, the indicators considered to measure sustainability are, agricultural productivity, cost of production and income per acre. To capture impact on human and animal health, the indicators include annual expenditure on animal and human health, labor productivity and livestock price.

Tellarini and Caporali (2000) and De Jager et al. (2001) combined environmental and economic aspects in evaluating agricultural sustainability in Italy and Kenya respectively.

Ramanna and Chandrakandhan (2001) reported that the essential components of sustainable agriculture are: 1) Integrated fertility management: It involves restricted use of chemical fertilizers and attempt to meet the nutrient needs of crops with organic materials such as farmyard manure, composts, green manure, sewage, sludge, maximum use of crop residues and use of bio-fertilizers and inclusion of legumes in the crop rotations, 2) Integrated pest management: Pest control by cultural, mechanical, biological and genetic control of insect pests, 3) Integrated disease and weed management by reducing the dose of chemical, 4) Integrated water management: Water is a scarce resource for Indian agriculture and it should be utilized most optimally. All efforts should be made to harness all water resources and their profitable use in the crop production in order to achieve better water use efficiency and 5) Integrated farming system: Farming system integrates all farming enterprises such as crop production, livestock, poultry, forestry, bee keeping *etc.* in most compatible manner without dislocating the ecological balance.

Chandra Naik (2002) constructed a sustainability index to measure sustainability of cotton farming and identified 10 indicators viz., integrated pest management, water management, integrated nutrient management, input to output ratio, environmental soundness, information self reliance, stability of yield, cotton based cropping system, land productivity and input self-sufficiency.

Hayo and Jean Petit (2002) in their study they compares and analyses 12 indicator-based approaches to assessing environmental impact or environmental sustainability at the farm level. The indicators they selected to evaluate environmental sustainability were the farmer sustainability index, Sustainability of energy crops, Ecopoints, LCA for agriculture, Agro-ecological indicators, Agro-ecological system attributes, Operationalising sustainability, Multi-objective parameters, Environmental management for agriculture, Solagro diagnosis, LCA for environmental farm management and Indicators of farm sustainability.

According to three components of sustainability, Zhen and Routray (2003) proposed operational indicators for measuring agricultural sustainability. The indicators under economic dimension are crop productivity, net farm income, benefit-cost ratio of production, per capita food grain production, whereas in social dimension, food self-sufficiency, equality in income and food distribution, access to resources and support services and farmers knowledge and awareness of resource conservation. Amount of fertilizers / pesticides used per unit of cropped land, amount of irrigation water used per unit of cropped land, soil nutrient content, depth of groundwater table, quality of groundwater for irrigation, water use efficiency and nitrate content of groundwater and crops are the indicators of ecological dimension for measuring agricultural sustainability.

Golam Rasul and Gopal Thapa (2004) had selected 12 indicators, representing ecological, economic and social dimensions of agricultural sustainability for the evaluation of conventional and ecological agricultural systems. Ecological sustainability was assessed based on five indicators: land-use pattern, cropping pattern, soil fertility management, pest and disease management, and soil fertility status. Land productivity, yield stability and profitability from staple crops were considered the indicators of economic viability. Social acceptability was assessed in terms of input self-sufficiency, equity, food security and the risks and uncertainties involved in crop cultivation.

Emma *et al.* (2009) proposed three indicators to measure the sustainability in their study on towards measurement of farm sustainability – an Irish case study. Economic indicators viz., viability, importance of direct payments and market return. Environmental indicators like air quality, water quality and social indicators were demographic viability & isolation.

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

Having agreed to this, measuring sustainability of farming may invariably cover the said three dimensions. While doing so some of the past efforts ended up in too much comprehensiveness which is by itself a limitation. Any approach that attempts to capture everything about the concept at once, that too in a single index, inevitably faces the risk of having methodological complexities and requirement of elaborate data.

So, the researcher's endeavour was to develop a procedure and an index to measure sustainability of farming system which is necessarily a farm level approach, highly flexible, easily adoptable to any farming system in a farm as a whole with least possible modifications.

## **2.4 Personal, socio-economic, psychological and communication characteristics of farmers**

### **2.4.1 Age**

Karpagam (2000) conducted a study on knowledge and adoption behavior of Turmeric growers in Erode district of Tamil Nadu and indicated that; majority (70.83 %) of the turmeric growing farmers belonged to middle age group.

Chandra Naik (2002) conducted a study on an analysis of sustainability of cotton farming systems and stated that in general 48.33 per cent of the irrigated cotton growers belonged to middle age category, followed by old age (35.00 %) and young age (16.67 %). In case of rainfed cotton growers, 43.33 per cent of respondents belonged to middle age, followed by young (33.33 %) and old (23.34 %) age categories.

Maraddi (2006) in his study on an analysis of sustainable cultivation practices followed by sugarcane growers in Karnataka revealed that 65 per cent of the respondents were middle aged, whereas nearly 23 and 12 per cent of the respondents belonged to young age and old age groups, respectively.

Nagadev and Venkataramaiah (2007) while studying the characteristics of integrated pest management (IPM) by dry land paddy farmers in Maharashtra state reported that majority (66.00 %) of respondents were middle aged, followed by old (19.33 %) and young (14.67 %) respectively.

Chandrani Saha (2008) studied on sustainability of farming system and livelihood security among rural households in Tripura and reported that most of the farmers belonged to either middle age group (38.33 %) or old age group (38.33 %) and 23.33 per cent of the farmers belonged to young age group.

Mahatab Ali (2010) in his study on knowledge and adoption of aerobic rice growers in eastern dry zone of Karnataka state reported that 62.22 per cent of the respondents were middle aged and 22.22 per cent of them were old aged, which implied that around 75.00 per cent of the respondents were above the age group of 36 years.

Lavanya (2010) conducted a study on assessment of farming systems efficiency in Theni district of Tamil Nadu and reported that a great majority of the paddy farmers and coffee growers belonged to middle age group. The pooled data revealed that more than half (55.90 %) of the farmers were middle aged.

Rokonuzzaman (2013) conducted study in Sherpur district of Bangladesh on Training needs of tribal people regarding income generating activities and reported that more than half (52.63 %) of them were middle aged followed by young aged (43.16 %) groups.

From the above reviews, it could be inferred that majority of the studies revealed that respondents belonged to middle age category.

#### **2.4.2 Education**

Chandra Naik (2002) conducted a study on an analysis of sustainability of cotton farming systems and indicated that 48.33 per cent of irrigated and 38.33 per cent of rainfed cotton growers had medium level of education, followed by low (35.00 % and 33.33 %) and high (16.67 % and 28.34 %) levels of education, respectively.

Vedamurthy (2002) carried out a study on management of arecanut gardens and marketing pattern preferred by the arecanut farmers of Shimoga district of Karnataka and reported that 38.66 per cent of the arecanut growers studied up to high school. Almost equal per cent of farmers were educated up to primary school (13.33 %) and college (14.66 %), whereas only 8 per cent of the respondents were illiterates and 6.66 per cent of the farmers were graduates.

Raghunandan (2004) conducted a study on knowledge and adoption level of soil and water conservation practices by farmers in northern Karnataka and revealed that one fourth (25.26 %) of the respondents were illiterates, 22.50 per cent studied up to primary school, 20.00 per cent up to middle school, 15.00 per cent up to high school, 11.25 per cent of respondents up to pre-university and 5 per cent had graduation.

Maraddi (2006) in his study on an analysis of sustainable cultivation practices followed by sugarcane growers in Karnataka revealed that 35.56 per cent of the respondents were educated up to primary school followed by middle school (30.56 %), illiterate (16.11 %) and secondary (13.89 %), whereas only 3.89 per cent of the respondents were educated up to collegiate level.

Reddy (2006) in his study on Knowledge and adoption of integrated pest management practices among vegetable growers of Gadag district in northern Karnataka observed that more number of the respondents had middle school (29.17 %) and primary school education (25.83 %), whereas high school and higher secondary school was noticed with 12.50 and 11.63 per cents of respondents respectively. And only 3.33 per cent were noticed to possess graduation but the illiterates were to the extent of 16.67 per cent.

Chandrani Saha (2008) conducted a study on sustainability of farming system and livelihood security among rural households in Tripura and reported that 70.00 per cent of respondents belonged to medium education level followed by 18.33 per cent in high and 11.66 per cent in low education levels.

Yeshwanth Kumar Naik (2008) conducted a study on knowledge and adoption of integrated crop management practices by the participants of FFS in Bellary district. It was indicates that 34.00 per cent of maize FFS participants studied up to middle school' followed by high school (30.00 %), primary school (16.00 %), 'degree' (10.00 %) and 'PUC' (6.00 %) only 4.00 per cent of the respondent were illiterate.

Mahatab Ali (2010) in his study on knowledge and adoption of aerobic rice growers in eastern dry zone of Karnataka state observed that 47.78 per cent of the respondents had medium education level i.e. educated up to high school followed by 41.11 per cent of them had their education from primary school.

Lavanya (2010) taken up a study on assessment of farming systems efficiency in Theni district of Tamil Nadu and observed that most of paddy farmers (45.00 %) had medium level education whereas half of the coffee growers (50.00 %) had low level education. The pooled data revealed that 40 per cent of the farmers had education up to primary school.

From the above reviews it can be inferred that most of the studies revealed that respondents were literate having primary to high school level of education.

### **2.4.3 Family Size**

Raghunandan (2004) based on his study on knowledge and adoption level of soil and water conservation practices by farmers in northern Karnataka reported that majority of the respondents belonged to medium sized families (62.85 %), followed by big families (25.00 %) and small families (13.75 %).

Chandrani Saha (2008) in his study on sustainability of farming system and livelihood security among rural households in Tripura and observed that around two third of the farmers (66.64 %) fall under medium family size, 24.16 per cent had large family size and only 9.16 per cent of the respondents belonged to small family size.

Ganeshprasad (2006) reported that most of the turmeric growers in Chamarajnar district were having nuclear family (63.33 %).

Mahatab Ali (2010) in his study on knowledge and adoption of aerobic rice growers in eastern dry zone of Karnataka state reported that two third (61.11 %) of the respondents' belonged to small and medium family size and the rest (38.89 %) of them had large family size.

Lavanya (2010) conducted a study on assessment of farming systems efficiency in Theni district of Tamil Nadu and reported that the pooled data indicated that 46.7 per cent of the farmers had big family of more than five members. Whereas 45.00 per cent and 48.30 per cent of the paddy farmers and coffee growers had big family, respectively.

Raksha *et al.* (2012) in their study conducted in Hisar district stated that 62.00 per cent of the respondents had small family size followed by medium (29.00 %) and low (9.00 %) family size groups.

Rokonuzzaman (2013) conducted study in Sherpur district of Bangladesh and noticed that 47.37 per cent of them had small family size followed by medium family size (43.16 %) and large family size (9.47 %), respectively.

A perusal of the quoted literature brings the fact to light that majority of the studies revealed that respondents possessed small to medium families.

### **2.4.4 Farming Experience**

Natkar (2001) in his study found that, majority of the respondents belonged to medium farming experience (48.00 %) followed by high (45.00 %) and low (7.00 %) farming experience respectively.

Bheemappa (2001) conducted study in Tunga Bhadra Project (TBP) area and found that majority of the respondents had medium level of farming experience (51.67 %) followed by high (45.83 %) and low (2.50 %) farming experience respectively.

Chandra Naik (2002) conducted a study on an analysis of sustainability of cotton farming systems and stated that half of the irrigated cotton growers (50.00 %) had high cotton farming experience, in contrast to medium cotton farming experience of rainfed growers (36.67 %).

Maraddi (2006) in his study on an analysis of sustainable cultivation practices followed by sugarcane growers in Karnataka revealed that medium farming experience (13 – 35 years) was possessed by 54.45 per cent sugarcane growers followed by low experience (<13 years) 24.44 per cent and high experience (>35 years) by 21.11 per cent.

The preceding reviews highlight the fact that most of the studies revealed that farmers had medium to high farming experience.

#### **2.4.5 Landholdings**

Vinay Kumar (2005), in his study on knowledge and adoption of Rose growing farmers in Bangalore and Belgaum districts of Karnataka revealed that 41.67 per cent of the rose growers were under semi-medium (5.01 to 10 acres of land holding) followed by 30.00 per cent medium (10.01 to 25 acres), 21.67 per cent small (2.51 to 5 acres) and 6.67 per cent marginal (up to 2.5 acres) land holding categories.

Asha Devi (2006) conducted a study on marketing behavior and profitability of different farm enterprises among various categories of farmers and reported that majority of the respondents belonged to marginal farmers (43.75 %), followed by small farmers (33.75 %) and big farmers (22.50 %).

Maraddi (2006) in his study on an analysis of sustainable cultivation practices followed by sugarcane growers in Karnataka revealed that 45.55 per cent of the sugarcane growers belonged to the category of medium farmers followed by small farmers (22.77 %) and semi-medium farmers (16.66 %) and big farmers (15.00 %). None of the farmers belonged to the category of marginal farmers.

Sidram (2008) carried out a study on analysis of organic farming practices in Pigeon pea in Gulbarga district of Karnataka state and reported that majority (60.83 %) of the respondents belonged to big land holders category followed by 23.33 and 15.83 per cent of the respondents belonged to medium and small land holders categories, respectively.

Mahatab Ali (2010) reported that a majority (68.89 %) of the respondents belonged to big farmers, whereas 16.67 per cent were small farmers and 14.44 per cent of the aerobic rice growers belonged to marginal farmers category.

Lavanya (2010) in her study on assessment of farming systems efficiency in Theni district of Tamil Nadu and indicated that the pooled data showed that around 45 per cent of farmers had medium size of land holdings. It could be noticed from the results that equal number (45.00 %) of paddy farmers and coffee growers had medium size of land holdings.

Rokonuzzaman (2013) conducted study in Sherpur district of Bangladesh and reported that more than half (58.94 %) of them were small farmers after that marginal farmers (37.89 %) and landless (3.16 %).

The above studies revealed that majority of the respondents had medium to big land holdings.

#### **2.4.6 Level of aspiration**

Narendran (2000) studied the occupational aspirations of rural youth in Kolar district and reported that professional occupation was the first aspired occupation of the school going rural youth followed by glamour occupation, management occupation, agriculture, white-collar jobs and skilled jobs. None of the school going rural youth aspired for unskilled occupation. In case of non-school going rural youth, management occupation was the first aspired occupation followed by agriculture, glamour occupation, white-collar jobs, professional occupation, skilled jobs and unskilled jobs based on their level of aspiration.

Bheemappa (2001) reported that, 19.17 per cent migrant and 10.00 per cent of non-migrant farmers had high level of aspiration and medium and low level of aspiration was noticed by 67.50 per cent and 13.33 per cent of migrant farmers respectively as compared to non-migrant farmers (72.50 % and 17.50 %) respectively.

Bhanu (2006) revealed that, all eight enterprises selected are important to rural youth, but rural youth have shown preference for agriculture (crop production), dairy, poultry, sericulture and bee keeping, as I, II, III, IV and V ranks respectively. Whereas, rabbit rearing, small scale industry and piggyery occupied VI, VII and VIII rank, respectively.

Hadagali vishwanath (2013) in his study reported that, 55 per cent of the rural youth practicing agriculture do not aspire to increase the land holding. Regarding the purchase of the agricultural implements, majority (68.33 %) of the rural youth aspire for basic implements. Majority 72 per cent of the rural youth aspire to increase the crop production by 50 per cent. He also revealed that, 36.67 per cent of the rural youth practicing agriculture had high level of aspirations, whereas, 33.33 and 30.00 per cent of the rural youth had medium and low level of aspirations, respectively.

It could be generalized from majority of the studies that respondents belonged to medium level of aspiration.

#### **2.4.7 Economic motivation**

Bheemappa (2001) conducted a study in TBP command area of Karnataka and reported that 15.83 per cent of migrant and 11.56 per cent of non-migrant farmers were having high economic motivation, 64.17 per cent migrant and 69.17 per cent of non-migrant farmers exhibited medium level and only 20.00 per cent migrant and 19.17 per cent of non-migrant farmers were having low economic motivation.

Chandra Naik (2002) conducted a study on analysis of sustainability of cotton farming systems and revealed that a majority of the respondents under both the types had medium (46.67 % and 43.33 %) level of economic motivation, followed by high (36.66 % and 40.00 %) and low (16.67 % and 16.67 %) levels of economic motivation in irrigated and rainfed cotton growers.

Reddy Prasad (2003) studied on differential innovation decision and attitude of rice growing farmers towards eco-friendly technologies in Andhra Pradesh and concluded that majority of the rice farmers (64.90 %) fall under medium economic motivation followed by low (19.20 %) and high (15.90 %).

Sandesh (2004) in his study on profile of Kannada farm magazine readers in Karnataka reported that, majority (51.67 %) of the respondents belonged to medium level of economic motivation. Whereas, 28.33 per cent and 20.00 per cent of the respondents belonged to high and low level of economic motivation categories, respectively.

Pottappa (2008) conducted a study on knowledge and adoption of potato growers in Chikkaballapur district and reported that majority of the potato growers had high economic orientation.

Raksha *et al.*, (2012) conducted a study in Hisar district identified that 57.00 per cent of respondents had high economic motivation which is followed by medium (34.00%) and low (9.00%) economic motivation categories.

From the above reviews, it could be inferred that majority of studies reported that respondents belonged to medium level of economic motivation.

#### **2.4.8 Achievement motivation**

Bheemappa (2001) in his study on comparative analysis of knowledge and technological gap in adoption of Paddy and Cotton cultivation practices observed that the incidence of high level of achievement motivation was seen with 25.84 per cent of migrant and 15.00 per cent of non-migrant farmers, followed by medium achievement motivation with 58.33 per cent migrant and 63.33 per cent of non-migrant farmers, and only 15.83 and 21.67 per cent of the migrant and non-migrant farmers had low achievement motivation respectively.

Budihal (2001) carried out a study on utilization pattern of Cotton production technology by farmers of northern Karnataka and revealed that 72.50 per cent of the respondents were in the medium category while 17.08 per cent and 10.42 per cent of the respondents were in the high and low categories of achievement motivation respectively.

Chandra Naik (2002) conducted a study on analysis of sustainability of cotton farming systems and stated that comparatively higher percentage (41.67 % and 38.33 %) of irrigated and rainfed cotton growers belonged to medium achievement motivation category, while 41.66 per cent of irrigated cotton growers belonged to high category and 33.33 per cent of rainfed cotton growers were observed under low achievement category.

Maraddi (2006) in his study on an analysis of sustainable cultivation practices followed by sugarcane growers in Karnataka revealed that the incidence of medium level of achievement motivation was seen with 59.45 per cent of farmers followed by low achievement motivation with 27.22 per cent of farmers and only 13.33 per cent of farmers had high achievement motivation.

Chandrani Saha (2008) carried out a study on sustainability of farming system and livelihood security among rural households in Tripura and reported that 57.50 per cent of the respondents belonged to medium achievement motivation category followed by high (28.33 %) and low (14.16 %) categories.

Gopala (2010) conducted a study on knowledge and adoption of participant and non-participant maize growers of FFSs in Chickaballapur district and revealed that majority (46.67 %) of the participants belonged to high achievement motivation category whereas, 33.33 per cent and 20.00 per cent of them belonged to low and medium achievement motivation categories, respectively. The results revealed that about 36.67 per cent of non-participants belongs to medium achievement motivation category followed by 33.33 per cent and 30.00 per cent belonged to high and low achievement motivation categories, respectively.

It could be generalized from the above reviews that majority of the studies reported that respondents belonged to medium level of achievement motivation category.

#### **2.4.9 Management orientation**

Chandra Naik (2002) conducted a study on analysis of sustainability of cotton farming systems and stated that almost an equal percentage that is 43.33 per cent of irrigated cotton growers and 40.00 per cent of rainfed cotton growers belonged to medium management orientation category, followed by high (35.00 % and 36.67 %) and low (21.67 % and 23.33 %) level of management orientation among irrigated and rainfed farmers.

Maraddi (2006) in his study on an analysis of sustainable cultivation practices followed by sugarcane growers in Karnataka observed that 42.78 per cent of the respondents had medium management orientation, whereas lesser level of management orientation was noticed among 38.33 per cent of the respondents while 18.89 per cent of the farmers possessed a high level of management orientation.

Chandrani Saha (2008) in her study on sustainability of farming system and livelihood security among rural households in Tripura indicated that 40.83 per cent of the farmers had high management orientation whereas 33.33 per cent and 25.83 per cent had low and medium management orientation respectively.

Lavanya (2010) conducted a study on assessment of farming systems efficiency in Theni district of Tamil Nadu and reported that 66.70 per cent of the paddy farmers and 50.00 per cent of coffee growers had medium level of management orientation. Further, it

was observed that 58.30 per cent of farmers had medium level of management orientation when pooled data was analyzed.

The above reviews revealed that majority of the studies reported that respondents had medium level of management orientation.

#### **2.4.10 Risk orientation**

Natkar (2001) in his study on attitude and use of farm journal by the subscribers/farmers in northern Karnataka and their profile indicated that the subscriber farmers belonged to high risk orientation category (67.50 %) followed by medium (16.87 %) and low risk orientation (15.36 %) categories.

Chandra Naik (2002) conducted a study on an analysis of sustainability of cotton farming systems and reported that majority (50.00 % and 48.33 %) of irrigated and rainfed cotton growers possessed medium risk orientation, followed by high (35.00 % and 18.34 %) and low (15.00% and 33.33 %) risk orientation among irrigated and rainfed farmers.

Nagesh (2005) conducted a study on entrepreneurial behavior of vegetable seed producing farmers of Haveri district and revealed that 56.7 per cent of the respondents had medium risk orientation followed by 22.5 and 20.8 per cent of the respondents having low and high risk orientation, respectively.

Maraddi (2006) in his study on an analysis of sustainable cultivation practices followed by sugarcane growers in Karnataka revealed that the high level of risk orientation was observed with 18.89 per cent of sugarcane growers, whereas medium level of risk orientation was possessed by 48.89 per cent and remaining 32.22 per cent of sugarcane growers had low risk orientation.

Chandrani Saha (2008) undertaken a study on sustainability of farming system and livelihood security among rural households in Tripura and expressed that 70.00 per cent of the respondents belonged to medium risk orientation category followed by high (21.66%) and low (8.33%) risk orientation category.

Yeshwanth Kumar Naik (2008) conducted a study on knowledge and adoption of integrated crop management practices by the participants of FFS in Bellary district. It was indicated that 36.00 per cent of the maize FFS participants belonged to 'low level' of risk orientation, followed by 'high' (34.00 %) and 'medium' level of risk orientation (30.00 %). It was also indicated that 48.00 per cent of groundnut FFS participants had 'medium risk orientation' followed by 'high' (32.00 %) and 'low' (20.00 %) risk orientation ability.

Mahatab Ali (2010) in his study on knowledge and adoption of aerobic rice growers in eastern dry zone of Karnataka state reported that nearly half (51.11 %) of the aerobic rice growers had high level of risk orientation whereas nearly one third (28.89 %)

and 20 per cent of the respondents had medium and low levels of risk orientation, respectively.

Lavanya (2010) conducted a study on assessment of farming systems efficiency in Theni district of Tamil Nadu and reported that 45.00 per cent of the paddy farmers and 51.70 per cent of coffee growers had medium risk orientation. It was also noticed from the pooled data that 48.30 per cent of farmers had medium level of risk orientation.

Raksha *et al.* (2012) conducted study in Hissar district and stated that 53.00 per cent of respondents had high risk orientation which is followed by medium (36.00 %) and low (11.00 %) risk orientation classes.

Above mentioned reviews indicated that the majority of the studies reported that respondents had medium level of risk orientation categories.

#### **2.4.11 Value orientation**

Chandra Naik (2002) conducted a study on an analysis of sustainability of cotton farming systems and stated that 38.33 per cent of irrigated cotton growers had medium level of value orientation, followed by high (33.34 %) and low (28.33 %). In contrast, an equal number of rainfed cotton cultivators had high and medium (36.67%) level of value orientation followed by low (26.66 %).

Anitha (2004) in her study on entrepreneurial behavior and market participation of farm women in Bangalore rural district of Karnataka reported that 30.00 per cent farm women had high value orientation, followed by equally distributed in medium and low value orientation (35.00 %).

Sowmya (2009) conducted a study on entrepreneurial behavior of rural women in Mandya district of Karnataka and reported that 53.33 per cent of rural women had medium level of value orientation followed by high (30.87 %) and low (15.83 %) value orientation.

Mamathalakshmi (2013) reported in her study on an analysis of livelihood security among agricultural labourers in Karnataka that in rain fed situation 54.29 per cent fell under high value orientation group, followed by medium (27.14 %) and low (18.57 %) value orientation groups. In irrigated region 60.00 per cent fell under low value orientation group, followed by medium (25.71 %) and high (14.29 %) value orientation groups. Similarly, in plantation region 45.71 per cent fell under medium value orientation group, followed by low (31.43 %) and high (22.86 %). With regards to pooled situation, 36.67 per cent fell under low value orientation group, followed by medium (32.86 %) and high (30.47 %).

It can be concluded based on the past studies that most of the respondents belonged to high to medium level of value orientation category.

#### **2.4.12 Farming commitment**

Chandra Naik (2002) conducted a study on analysis of sustainability of cotton farming systems and stated that a large majority of irrigated cotton growers were observed under medium cotton farming commitment category (50.00 %). In case of rainfed cotton growers, as high as 40.00 per cent of the respondents were concentrated under high cotton farming commitment category, followed by medium (36.67 %) and low (23.33 %) categories.

An overview of the previous study revealed that farmers had medium level of farming experience.

#### **2.4.13 Decision making pattern**

Suresh (2004) carried out a study on entrepreneurial behavior of milk producers in Chittoor district of Andhra Pradesh and found that majority of the milk producers had medium level of decision making ability (65.83 %) followed by low and high with 21.67 and 12.50 per cent, respectively.

Chaudhari (2006) in his study on entrepreneurial behavior of dairy farmers in Dharwad and Belgaum district reported that half of the both trained (52.00 %) and untrained (49.00 %) dairy farmers had moderate decision making ability, whereas 31.00 per cent of trained and only 12.00 per cent of untrained dairy farmers belonged to good decision making ability and 17.00 per cent of trained and 39.00 per cent of untrained dairy farmers belonged to poor decision making ability.

Nagesh (2006) in his study on entrepreneurial behavior of pomegranate growers in Bagalkot district of Karnataka revealed that nearly half of the respondent farmers (47.50 %) belonged to intermediate category, followed by 26.66 and 25.84 per cent of the respondents belonged to rational and less rational decision making categories, respectively.

Ravi (2007) carried out a study on entrepreneurial behavioral characteristics of SC and ST farmers of Gulbarga district and reported that 38.75 per cent of the farmers had low farm decision making followed by high (33.12 %) and medium (28.13 %) farm decision making ability category.

Sidram (2008) in his study on analysis of organic farming practices in Pigeon pea in Gulbarga district of Karnataka state found that 46.67 per cent of the respondents belonged to high decision making ability category with mean score of 10.55 followed by 34.17 and 19.17 per cent of respondents belonged to medium and low decision making ability categories with mean scores of 7.46 and 5.69, respectively.

The above mentioned studies revealed that farmers belonged to medium to high decision making ability.

#### **2.4.14 Innovativeness**

Chandra Naik (2002) conducted a study on an analysis of sustainability of cotton farming systems and indicated that nearly half of the irrigated cotton growers (46.67 %) had medium level of innovativeness, followed by high (35.00 %) and low (18.33 %) level of innovativeness. Further, an equal number of rainfed cotton growers belonged to high (40.00 %) and medium (40.00 %) level of innovativeness followed by low level (20.00 %) category.

Nagesh (2006) in his study on entrepreneurial behavior of Pomegranate growers in Bagalkot district of Karnataka reported that majority of the respondents were in medium innovativeness category, however only 20.00 and 15.84 per cent of the respondents belonged to low and high innovativeness categories.

Maraddi (2006) in his study on analysis of sustainable cultivation practices followed by sugarcane growers in Karnataka noticed that the medium innovative proneness was exhibited by 55 per cent of farmers while 27.22 per cent of farmers had low level of innovative proneness. However, high innovative proneness was noticed in 17.78 per cent farmers.

Reddy (2006) conducted a study on knowledge and adoption of integrated pest management practices among vegetable growers of Gadag district in northern Karnataka and reported that majority (72.50 %) of the respondents had medium innovativeness. But a less percentage of respondents were noticed in high innovativeness (15.00 %) and low innovativeness (12.50 %) categories.

Chandrani Saha (2008) carried out a study on sustainability of farming system and livelihood security among rural households in Tripura, explained that 65.00 per cent of respondents had medium innovativeness, followed by high (28.33 %) and low (6.66 %).

Yeshwanth Kumar Naik (2008) conducted a study on knowledge and adoption of integrated crop management practices by the participants of FFS in Bellary district. It was indicates that more than half (52.00 %) of maize FFS participants were found in 'high innovativeness' category, while 'low' and 'medium innovativeness categories' were equally distributed (24.00 %) among maize FFS participants.

Mahatab Ali (2010) in his study on knowledge and adoption of aerobic rice growers in eastern dry zone of Karnataka state reported that nearly half (46.67 %) of the aerobic rice growers belonged to medium level of innovativeness category followed by 22.22 per cent belonging to high level of innovativeness.

Lavanya (2010) in her study on assessment of farming systems efficiency in Theni district of Tamil Nadu and noticed that more than half (55.00 %) of the paddy farmers had medium level of innovativeness whereas 40 per cent of the coffee growers had low level of innovativeness. The pooled data showed that 40 per cent of the total farmers had medium innovativeness.

From the above studies, it could be concluded that majority of the studies revealed that respondents belonged to medium level of innovation category.

#### **2.4.15 Social participation**

Vijay Kumar (2000) conducted a study on sugarcane growers in Belgaum district of Karnataka and found that 29.00 per cent of the respondents were members of co-operative society and 2.00 per cent were office bearers. Whereas, 8.00 per cent of the farmers were members of youth club and 5.33 per cent of the respondents were members of gram panchayat.

Chandra Naik (2002) conducted a study on analysis of sustainability of cotton farming systems and stated that 46.67 per cent of irrigated cotton growers belonged to medium social participation category, followed by high (33.33 %) and low (20.00 %) categories. He also observed that most of the rainfed growers belonged to medium social participation category (38.67 %), followed by low (33.33 %) and high (28.00 %) level of social participation.

Chandra Charan (2003) in a study on Sujala watershed project beneficiary farmers in Dharwad district and reported that, only 4.00 and 2.66 per cent of the farmers were members and office bearers, respectively of gram panchayats whereas 30.00 per cent and 43.33 per cent of the respondent farmers attended the meetings regularly and occasionally, respectively.

Chandrani Saha (2008) in her study on sustainability of farming system and livelihood security among rural households in Tripura indicated that more than half of the respondents had medium participation (59.16 %) in any social organization while only 22.50 per cent and 18.33 per cent had low and high social participation, respectively.

Lavanya (2010) taken up a study on assessment of farming systems efficiency in Theni district of Tamil Nadu and noticed that the pooled data 39.20 per cent of the farmers had low social participation. Whereas 41.70 per cent of the paddy farmers had high level of social participation and half of the coffee growers had medium level of social participation.

Rokonuzzaman (2013) conducted study in Sherpur district of Bangladesh and disclosed that majority (73.68 %) of the respondents had very low social organization participation subsequently 24.21 per cent had low social participation and negligible per cent (1.05 %) were under medium social organization.

An overview of the previous studies revealed that majority of the studies reported that farmers exhibited low to medium social participation level.

#### **2.4.16 Cosmopolitaness**

Shashidhar (2004) conducted study on influencing factors and constraints in drip irrigation by horticulture farmers of Bijapur district of Karnataka and found that 41.50

per cent of the farmers visited town occasionally followed by 37.50 per cent once in 15 days. Whereas, respondents visited to town for the personal or domestic purpose were 54.10 per cent followed by 35.00 per cent for new technology or agricultural purpose.

Ganesh Prasad (2006) indicated that majority of the turmeric growers in Chamarajnagar district had medium levels of cosmopolitaness (40.83 %).

Lavanya (2010) conducted a study on assessment of farming systems efficiency in Theni district of Tamil Nadu and reported that 41.7 per cent and 38.3 per cent of the paddy farmers and coffee growers had high cosmopolitaness. It was also observed from the pooled data that around 40 per cent of farmers had high cosmopolitaness.

Mahatab Ali (2010) in his study on knowledge and adoption of aerobic rice growers in eastern dry zone of Karnataka state reported that about 70.00 per cent of the respondents belonged to medium level of cosmopolitaness followed by high (23.33 %) and low (6.67 %) levels of cosmopolitaness, respectively.

Rokonuzzaman (2013) conducted study in Sherpur district of Bangladesh and accounted that nearly half (48.42 %) of respondents had high cosmopolitaness subsequently very low cosmopolitaness (40.00 %) and medium cosmopolitaness (11.58 %).

The above mentioned studies revealed that farmers belonged to medium to high level of cosmopolitaness.

#### **2.4.17 Extension contact**

Sophia Sathyavathi (2001) conducted a study on knowledge and adoption of sustainable cultivation practices of sugarcane and cotton by farmers of Cuddalore district of Tamil Nadu and revealed that all the sugarcane growers were aware of the cane officers, among them 97.5 per cent contacted them regularly, 75.75 per cent of cotton growers were aware of agriculture development officer.

Chandra Naik (2002) conducted a study on analysis of sustainability of cotton farming systems and stated that almost equal number of irrigated cotton growers (40.00 % and 36.67 %) had medium and high extension agency contact. In case of rainfed cotton growers, 43.33 per cent of respondents had medium and 35.00 per cent had low extension agency contact.

Gopala (2010) conducted a study on knowledge and adoption of participant and non-participant maize growers of FFSs in Chickaballapur district and observed that 43.33 per cent of the participants were having medium extension contact followed by 35.00 per cent and 21.67 per cent of them belonged to high and low extension contact, respectively. In case of non-participants, it is observed that 36.67 per cent of the non-participants were having low extension contact followed by 33.33 per cent and 30.00 per cent of them belonged to high and medium extension contact.

Lavanya (2010) conducted a study on assessment of farming systems efficiency in Theni district of Tamil Nadu and reported that 60.00 per cent of the paddy farmers and 75.00 per cent of coffee growers had medium level of extension contact. Whereas in pooled data also more than half (67.5 %) of respondents had medium level of extension contact.

Mahatab Ali (2010) in his study on knowledge and adoption of aerobic rice growers in eastern dry zone of Karnataka state reported that half (50.00 %) of the respondents had medium extension contact, whereas 41.11 and 8.89 per cent of the aerobic rice growers had low and high extension contact, respectively.

It can be concluded based on the past studies that the respondents belonged to medium level of extension contact.

#### **2.4.18 Extension participation**

Sunil Kumar (2004) in his study in Belgaum district of Karnataka revealed that 23.00 per cent of respondents participated regularly in agricultural exhibition followed by demonstrations (20.83%). 66.67 per cent of respondents never attended in activities like training, educational tour (94.17 %) and field visits (92.05 %).

Chandrani Saha (2008) undertaken a study on sustainability of farming system and livelihood security among rural households in Tripura and expressed that 65.00 per cent of the respondents belonged to medium extension system link category followed by high (22.50 %) and low (12.50 %) categories.

Pottappa (2008) conducted a study on knowledge and adoption of potato growers in Chikkaballapur district and indicated that more than one-third (39.16 %) of the respondents had medium extension participation, whereas 36.67 and 24.17 per cent of the potato growers had high and low extension participation, respectively.

Yeshwanth Kumar Naik (2008) conducted a study on knowledge and adoption of integrated crop management practices by the participants of FFS in Bellary district. It was indicated that majority (58.00 %) of the maize FFS participants belonged to 'high extension participation' category followed by 'low' and 'medium' extension participation categories (18.00 % and 14.00 %), respectively.

Gopala (2010) conducted a study on knowledge and adoption of participant and non-participant maize growers of FFSs in Chickaballapur district and revealed that 43.33 per cent of the participants had low extension participation while 40.00 per cent of the respondents had high extension participation and 16.67 per cent of the participants had high extension participation. Regarding non participants, majority (73.33 %) of respondents had low and medium level of extension participation followed by 26.67 per cent had high level of extension participation.

Lavanya (2010) conducted a study on assessment of farming systems efficiency in Theni district of Tamil Nadu and reported that among paddy farmers, 15.00, 71.70 and

13.30 per cent of farmers had low, medium and high level of extension participation, respectively. Whereas, among coffee growers 8.30 per cent were in low category followed by medium (65.00 %) and high (26.70 %) categories.

Mahatab Ali (2010) in his study on knowledge and adoption of aerobic rice growers in eastern dry zone of Karnataka state reported that two fifth (47.78 %) of the respondents had medium extension participation, whereas 32.22 and 20.00 per cent of the aerobic rice growers had high and low extension participation, respectively.

Past reviews have conclusively demonstrated that most of the studies indicated that there was low to medium level of extension participation.

#### **2.4.19 Mass media use**

Chandra Naik (2002) conducted a study on sustainability of cotton farming systems and stated that among irrigated cotton growers, less than half (41.67 %) of the respondents belonged to medium mass media use, followed by high (33.33 %) and low (25.00 %) mass media use. While among rainfed cotton growers half (50.00 %) of the respondents belonged to medium mass media use, followed by low (33.33 %) and high (16.67 %) mass media use.

Moulasab (2004) in his study on knowledge and adoption of improved cultivation practices by Mango growers of north Karnataka found that 74.17 per cent of the respondents possessed television followed by 32.50 and 6.6 per cent of the respondents subscribed to farm magazines and newspapers, respectively. Among these 43.33 per cent of the respondents were occasional viewers of television.

Vinay Kumar (2005) carried out a study on knowledge and adoption of Rose growing farmers in Bangalore and Belgaum districts of Karnataka and reported that 76.67 per cent of respondents owned television followed by 65.00 per cent of them possessed radio sets and newspapers were subscribed by only 13.33 per cent of the respondents.

Patil (2005) conducted a study on knowledge, extent of participation and benefits derived by participant farmers of the watershed development programme in Raichur district and revealed that 80 per cent of the respondents possessed radio and 54 per cent television, while 40.61 per cent of them subscribed newspaper. Further, in case of radio it is reported that 22 per cent of them listened to agricultural programme regularly; in case of television 25.34 per cent of respondents viewed the agricultural programme regularly.

Nagadev and Venkataramaiah (2007) in their study revealed that majority (74.00 %) of respondents had medium media utilization, followed by low (16.00 %) and high (10.00 %) media utilization, respectively.

Mahatab Ali (2010) in his study on knowledge and adoption of aerobic rice growers in eastern dry zone of Karnataka state reported that nearly 78.00 per cent of the respondents were in the category of medium to high levels of mass media exposure.

It can be concluded from the above mentioned studies that respondents possessed medium to high level of mass media use.

## **2.5 Relationship of independent variables with sustainability of farming system and its dimensions / components**

Syamala (1988) observed that innovative proneness had significant positive relationship with the adoption of different farming systems.

Shailaja (1990) found a positive and significant relation of education, extension contact, extension participation, economic motivation, achievement motivation and innovative proneness of farm women with their farm productivity.

Narwal and Dixit (1991) found positively significant relation between extension participation and attitude of dairy farmers towards feeding practices in buffaloes of Hisar district of Haryana.

Subramanian (1992) reported that the difference between adoption of different farming systems by farmers with respect to innovation proneness and adoption was significant.

Jayale and Nachane (1995) reported that farmer's family size was found to have significant positive correlation with sustainability of the orchard plantation.

Chandregowda and Jayaramaiah (1996) found that farmer's age, aspiration and economic motivation had a positive and significant relationship with the adoption of integrated nutrient management practices in rice farming.

Shinde *et al.* (1999) in their study on multivariate analysis of adoption of animal husbandry management practices by dairy farmers showed that cosmopolitaness had significant correlation with adoption of improved animal husbandry management practices.

Tasneemasultana (2001) observed that education, extension contact, extension participation and mass media participation had positive and significant relationship with participation level of beneficiaries.

Chandra Naik (2002) conducted a study on an analysis of sustainability of cotton farming systems and indicated that the characteristics of irrigated cotton growers like age, socio-economic status, social participation, cotton farming experience, herd size, value orientation, management orientation, achievement motivation, risk orientation and extension agency contact had positive and significant relationship with sustainability of cotton farming, whereas education, economic motivation, innovativeness, cotton farming commitment and mass media use had positive but non-significant relationship. With regards to the results of rainfed cotton farmers, the variables like socio-economic status, social participation, economic motivation, innovativeness, value orientation and

management orientation had positive and significant relationship, whereas education had negative but non-significant relation with sustainability of cotton farming.

Malthesh (2004) in his analysis of relationship of socioeconomic variables with dependent variables revealed that the factors such as education, landholding, family size, cosmopolitaness, livestock possession, cropping pattern, scientific orientation, innovativeness was found positive and significant relationship with all the dependent variables such as extension use efficiency, economic performance and employment generation.

Vani (2005) reported that there was a significant association between variables such as social participation, scientific orientation and economic orientation at one per cent level and land holding and innovativeness at five per cent level with annual income.

Nagesh (2006) revealed that characters such as education, land holding, annual income, mass media participation, extension participation and scientific orientation were positively and significantly correlated with entrepreneurial behavior. Stepwise regression analysis indicated that all the components of entrepreneurial behavior found to be highly significant.

Shashidhar (2006) in his study found that 10 out of 15 variables, namely, achievement motivation, innovative proneness, scientific orientation, risk orientation, economic motivation, extension participation, institutional participation, cosmopolitaness, mass media utilization and attitude towards chemical fertilizers exhibited positive significant relationship with adoption of eco friendly technologies. On the other hand the characters such as age, education, land holding, annual income and deferred gratification did not show significant relationship with adoption of eco-friendly technologies.

Venkata Shiva Reddy (2006) revealed that all the selected entrepreneurial characteristics namely, innovativeness, farm decision making, achievement motivation, risk taking ability, information seeking behavior and cosmopolitaness were positively and significantly related with the adoption of integrated pest management practices in both tomato and cabbage crops.

Thippeswamy (2007) in his study on knowledge and adoption of plant protection measures in coconut cultivation of farmers of Chitradurga district reported that variables like education, land holding, source of irrigation, annual income, social participation, mass media utilization, extension participation, economic motivation and innovative proneness had significant relationship with adoption level of plant protection measures of coconut crop.

Chandrani Saha (2008) conducted a study in Tripura about sustainability of farming system and livelihood security. She identified that age, family size, risk orientation, farming experience and level of aspiration were significantly related with adoption of sustainability of farming system.

Malathesh *et al.* (2009) reported that the results of multiple regression values of socio-personal and psychological variables in predicting the employment generation depicted that among 12 variables, scientific orientation was found to be highly significant at one per cent level while land holding was found to be significant at five per cent level under crop only farming system, land holding was found to be significant at one per cent level while three variables viz., age, social participation and innovativeness were significant at five per cent level under crop + dairy, livestock possession and cropping intensity were found to be very highly significant under crop + dairy + sericulture, whereas, land holding, risk willingness and cropping intensity were found highly significant under crop + sericulture farming system.

Lavanya (2010) carried out an investigation on assessment of farming system efficiency in Theni district of Tamil Nadu and reported that among the paddy farmers age, family size, livestock possession, cropping intensity and risk willingness had positive and significant relationship with farming system efficiency at one per cent level of significance. Whereas, social participation and management orientation had positive significant relationship at five percent level of significance. In case of coffee growers, the variables such as family size, livestock possession, cosmopolitaness, management orientation and innovativeness had positive and significant relationship with farming system efficiency at one per cent level of significance. Cropping intensity had positive and significant relationship but land holding had negative and significant relationship with farming system efficiency at five per cent level of significance.

It is evident from the reviews cited above that most of the personal, socio-economic, psychological and communication variables were having a relationship on sustainability of farming system or its dimensions/components.

## **2.6 Constraints faced by farmers in farming**

Anonymous (1986) reported that the small size of farm holdings constituted a large segment of the arable land in Kerala and the small farmers have little access to appropriate farm equipments, especially power machines. The report has identified the following constraints: economic and social-cultural limitations, lack of foreign exchange to import equipment, low quality of locally manufactured equipment, shortage of rural artisans to supply tools and implements and unsuitability of imported machines to the resource endowments of the State.

Lokhandae and Wangikar (1991) conducted a study on grape growers in Osmanbad district of Maharashtra and reported that non-availability of improved cuttings in time; less resistance to diseases and high cost of fertilizers were the major constraints.

Hemakumari (1992) reported that the major problems in the production and marketing of chrysanthemum flowers in East Godavari district of Andhra Pradesh were the lack of technical knowledge about the package of practices and non-existence of regulated market in nearby places.

Nithyashree (1992) pointed out that main constraints in the adoption of improved practices by the coffee growers of Chickmangalore district in the order of its importance were non availability and high cost of labour, non-availability of desired fertilizers, non-availability of water for sprinkler irrigation and processing, high processing cost, inadequate drying yard facilities, high rate of fertilizer, insecticides and pesticides, no facility for soil testing, no proper extension guidance and high cost of transportation.

Hiremath (1993) identified that cent per cent of the farmers expressed the problems relating to production and marketing of lime like absence of processing facility, cold storage facility and fluctuations in prices.

Srinivasreddy (1995) conducted a study in Kolar district of Karnataka on mango growers and reported that problems faced by mango growers were occurrence of more pest and disease incidences, high cost of fertilizers, high cost of plant protection chemicals, non-availability of labourers, lack of technical guidance, and occurrence of rain during harvest and problem of weed.

Bonny (1996) surveyed the constraints in commercial production of vegetables in Panachery and Puthur of Kerala state and reported that increased cost of plant protection chemicals was perceived as the most important factor by the respondents followed by inadequate market facilities, poor storage and other post-harvest facilities, insufficient capital and high labour costs.

Chandrashekara *et al.* (1996) reported that lack of adequate money to carry out the operations in time (84.10 %), lack of sufficient time for farm work (36.40 %), practicing age old traditional cultural methods (68.10 %) and poor guidance from government agencies (59.40 %) were regarded as important problems in attaining high yield by Kerala coffee growers.

Govinda Reddy *et al.* (1997) identified the problems of mango growers in Srinivaspur region of Karnataka. The major constraints faced by them were lack of technical know-how, lack of awareness on drip irrigation technology, non-availability of credit and labour, high cost of inputs, high incidence of pests and diseases and non-availability of quality grafts. The major constraints in mango exports were lack of nearby processing units, storage facilities, pre-cooling units, knowledge in chemical treatments of units, regulated markets and improved harvest. Exploitation by middle men, lack of grading etc., were other problems.

Patel *et al.* (1997) in their study on marketing efficiency of Anand vegetable market in Gujarat reported that lack of storage facilities, delay in payment of sale proceeds, high cold storage charges, monopoly of few middlemen and need of timely problems faced by the cabbage and cauliflower growers.

Shrivastava *et al.* (1998) conducted a study on chilli growers in Kheda district of Gujarat and reported that incidence of more pest and disease, high cost of pesticides and

non-availability of plant protection equipment and inadequacy of labour were the problems faced by 96.67, 98.33, 36.67 and 30.00 per cent respondents, respectively.

Anil Kumar and Arora (1999) in their study on post-harvest management of vegetables in Uttar Pradesh hills found that non-availability of cold storage, highly perishable nature of the vegetables, low market demand at the time of storage and hence non-profitability of storing vegetables were the major problems perceived by farmers in vegetable storage. Problem of high fluctuation in market price, followed by high transportation cost (62.53 %) labour shortage and high wages (55.53 %) and lack of irrigation facilities and power shortage (46.66 %).

Radhakrishnan *et al.* (1999) conducted a study on constraints faced by mango growers and revealed that 78.30 per cent of farmers expressed high cost of inputs like grafts, fertilizers and pesticides was the fore most constraint, followed by more incidences of pests and diseases.

Ravishankar and Katteppa (2000) conducted a study on potato growers in Chickamangalur district of Karnataka state. They reported that 94.16 per cent of respondents faced the problem of lack of technical guidance, followed by more pest and disease incidence (90.00 %), high cost of fertilizers (83.33 %), high cost of plant protection chemicals (85.00 %) and non-availability of fertilizers in time (81.66 %).

Waman and Patil (2000) conducted a study on onion growers in Nasik district of Maharashtra and revealed that difficulty in identifying pests and disease (54.66 %) and non-curable nature of onion diseases with pesticides (42.00 %) were the major problems.

Sadaphal *et al.* (2001) reported that majority of the respondents (99.00 %) had faced the constraints while marketing the white onion. Cent per cent the respondents reported the problem that they could not get reasonable price while 45.45 per cent had reported the problem of non-availability of transport facilities.

Girase *et al.* (2004) reported that majority (89.33 %) of the respondents expressed that the lack of knowledge about Trichocards, chrysopa, feromone traps. *Bacillus Turangensis* (BT) and neem seed oil was the major constraints in adoption of Bio-control pest management practices. Similarly, 80.66 per cent cotton growers suffered from non-availability of skilled labour for spraying insecticides. While, 72.00 per cent reported that they lack knowledge about exact concentration of insecticides and pesticides.

Keshvamurthy (2005) in his study on contract farming in Gherkin production revealed that cent percent farmers expressed the labour problem, followed by delayed payments (94.16 %). The other constraints were low contract price (83.33 %), high rejection rate (85.83 %), problems of pest and diseases (77.00 %) and manipulations of norms by firms (30.00 %).

Tarde *et al.* (2006) in their study on constraints faced by the vegetable growers in adoption of improved technologies of vegetable cultivation reported that majority of the farmers surveyed faced the problems like difficulty in taking bahar during rainy (77.10 %) and summer season (74.30 %), long distance of market (90.30 %), unremunerative price for fruits (88.00 %) and fluctuations of price (84.50 %). Therefore majority (90.30 %) of the farmers suggested that proper provision be made for obtaining remunerative prices. More than two third of the respondents suggested that commission rates of middlemen should be reasonable (70.30 %).

Maraddi (2008) in his study on constraints perceived and suggestions expressed by sugarcane growers in adoption of sustainable cultivation practices identified that cent per cent of respondents perceived constraints of high cost of complex fertilizers and non-availability of required quantity of FYM followed by high woolly aphid incidence, non-availability of labour and high labour charges and irregular supply of electricity. Majority of respondents (62.77 %) belonged to medium technological gap followed by high technological gap category (28.80 %).

Shivamurthy *et al.* (2008) conducted a study on constraints of farmers cultivating rainfed paddy in eastern dry zone of Karnataka and reported that shortage of water supply (100.00 %), high cost of inputs (98.00 %) , drought proneness of the area (90.00 %) and high cost of cultivation (89.00 %) were the major constraints expressed by farmers in rain fed paddy cultivation.

Nirmala and Muthuraman (2009) in their study on economic and constraint analysis of rice cultivation in Kaithal district of Haryana broadly categorized the constraints into institutional, bio-physical, technical, soil related problems, agricultural machinery related problems and socio-economic problems. Pests and disease incidence (80.00 %), lack of remunerative price (75.00 %), labour shortage (65.00 %) were the major constraints in rice production in Kaithal district of Haryana state. The farmers of the district reported salinity problem (36.00 %).

Varadaraju *et al.* (2009) conducted a study on adoption of production technologies by tomato growers in Chintamani taluk of Chikkaballapura district of Karnataka state found that cent per cent of tomato growers had the problems of fluctuation in market price for their produce, over 60.00 per cent of tomato growers faced problems such as lack of technical know-how (81.00 %), inadequate and untimely supply of inputs (75.00 %) and exploitation by middle men (61.00 %). The other problems faced by less than one third of the tomato growers were high wage rate (32.00 %), lack of storage facilities (25.00 %) and high transportation cost.

Lavanya (2010) carried out an investigation on assessment of farming system efficiency in Theni district of Tamil Nadu and reported that among constraints faced by paddy farmers in farming, high cost of inputs, non-availability of inputs and lack of knowledge regarding pest and diseases were the major production constraints. Regarding financial constraints, lack of own resources, inadequate credit and inadequate subsidy were the major constraints. Lack of SHG, lack of knowledge about sustainable farming

practices, lack of tools and implements and lack of mechanization were the major institutional, situational, infrastructural and technical constraints experienced by paddy farmers.

From the above studies, it could be concluded that high cost of inputs, labour shortage, lack of technical knowledge, lack of water for irrigation and incidence of pest and diseases were the major constraints faced by farmers in farming.

## **2.7 Conceptual frame work**

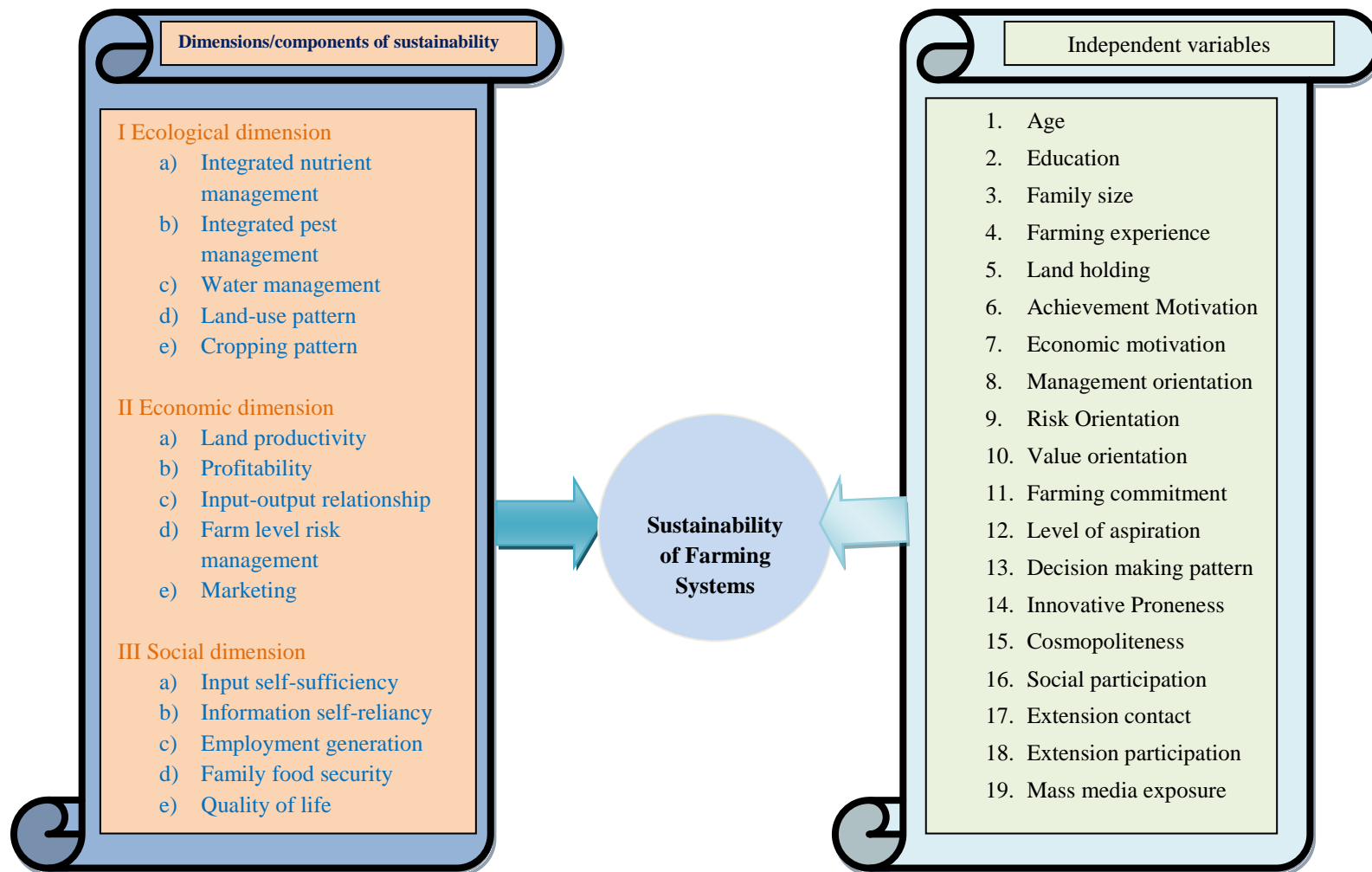
Conceptual model represents the researcher's understanding of a particular set of circumstances and of the simplifications which he feels may be made to inherently complex relationships. Researcher's intuition supported by past works formed the basis for conceptual framework developed for the study.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

Independent variables are conceived as those which precede the others in the order of time and which theoretically expected to lead or to be followed by certain other variables. In the present study, personal, socio-economic, psychological and communication variables of farmers were considered as independent variables.

The dependent variable is the one that is being predicted from independent variables. Sustainability of farming system was the dependent variable in the present study. The conceptual model is depicted in Fig.2.1.

## **2.8 Hypotheses**

- H<sub>1</sub>: Sustainability of farming systems is inclusive of several dimensions and components.
- H<sub>2</sub>: Sustainability of farming systems differ from irrigated system to rainfed system.
- H<sub>3</sub>: Different dimensions of sustainability differ in irrigated and rainfed farming systems.
- H<sub>4</sub>: Sustainability of farming systems has a relationship with personal, socio-economic, psychological and communication variables of farmers.
- H<sub>5</sub>: Sustainability of farming systems is influenced by personal, socio-economic, psychological and communication variables of farmers.
- H<sub>6</sub>: Sustainability of farming systems differs in different zones of study.



**Fig. 2.1: Conceptual frame work of the study**

The methodology used in conducting the study has been presented in this chapter under the following headings:

- 3.1 Locale of the study
- 3.2 Research design
- 3.3 Research variables
- 3.4 Operationalisation and measurement of sustainability of farming system
- 3.5 Measurement of independent variables
- 3.6 Constraints faced by the farmers in achieving sustainability of farming systems
- 3.7 Suggestions by the farmers for achieving sustainability of farming systems
- 3.8 Development of interview schedule
- 3.9 Collection of data
- 3.10 Analysis of data

### **3.1 Locale of the study**

#### **3.1.1 Selection of Agro-Climatic Zones**

As the study was focused on the sustainability of farming systems in irrigated and rainfed situations, it was preferred to conduct the study in two agro-climatic zones of Karnataka viz., eastern and southern dry zones. Eastern dry zone consists of entire districts of Bangalore Rural, Bangalore Urban, Kolar, Chikkaballapur, Ramanagar and parts of Tumkur. Southern dry zone consists of entire districts of Chamarajnagar, Mandya and parts of Mysore, Tumkur and Hassan.

#### **3.1.2 Selection of Taluks**

Based on the highest irrigated and highest rainfed area in each agro-climatic zone, taluks were finalized (irrigated and rainfed area given in appendix V). From each of the selected zones, one taluk representing highest irrigated and one taluk representing highest rainfed area were identified. In eastern dry zone Gubbi taluk of Tumkur district representing highest irrigated area and Srinivasapura taluk of Kolar district representing highest rainfed area were selected. In southern dry zone Mandya taluk of Mandya district having highest irrigated area and Gundlupet taluk of Chamarajnagar district having highest rainfed area were selected.

In Eastern dry zone of Gubbi taluk, total cropped area is 69049 ha out of which 31585 ha is irrigated area and in Srinivasapura taluk, total cropped area is 43119 ha out of which 39140 ha is rainfed area. While in southern dry zone of Mandya taluk, total

cropped area is 32463 ha out of which 26009 ha is irrigated area and in case of Gundlupet taluk, total cropped area is 76155 ha out of which 62652 ha is rainfed area.

### **3.1.3 Selection of Hoblies**

Two hoblies representing highest irrigated and two hoblies representing highest rainfed area in each selected taluks were identified. Kasaba and Kadaba in Gubbi taluk, Kasaba and Kottathi in Mandya taluk having highest irrigation & Ronuru and Nelavanki in Srinivasapura taluk & Terkanambi and Hangla in Gundlupet taluk having highest rainfed were thus, selected.

### **3.1.4 Selection of Villages**

Three villages were further selected for the study from each of the selected hoblies based on the highest irrigated and rainfed area. The villages thus selected were Hodaluru, Heruru and Kittada kuppa from Kasaba hobli, B Kodihalli, Karegowdanahalli and Kadashettyhalli from Kadaba hobli of Gubbi taluk, Hosabudanur, Umdahalli and Sathnur from Kasaba hobli, Kottatti, Hullukere and Bevinahalli from Kottatti hobli of Mandya taluk, Ronuru, Dimbala and Neelaturu form Ronuru hobli, Lakshmipura, Paccharamakalahalli and Kondsandra from Nelavanki hobli of Srinivasapura taluk, Terknambi, Lakkuru and Guruvinapura from Terknambi hobli, Hangla, Devarahalli and Siddaihnapura from Hangla hobli of Gundlupet taluk (Table 3.1).

### **3.1.5 Selection of Respondents**

Considering all farmers in the selected villages, a list of farmers who had raised the crops considered in the said farming system consecutively for three years was prepared. From each of the 24 villages selected, 5 farmers were randomly selected.

## **3.2 Research design**

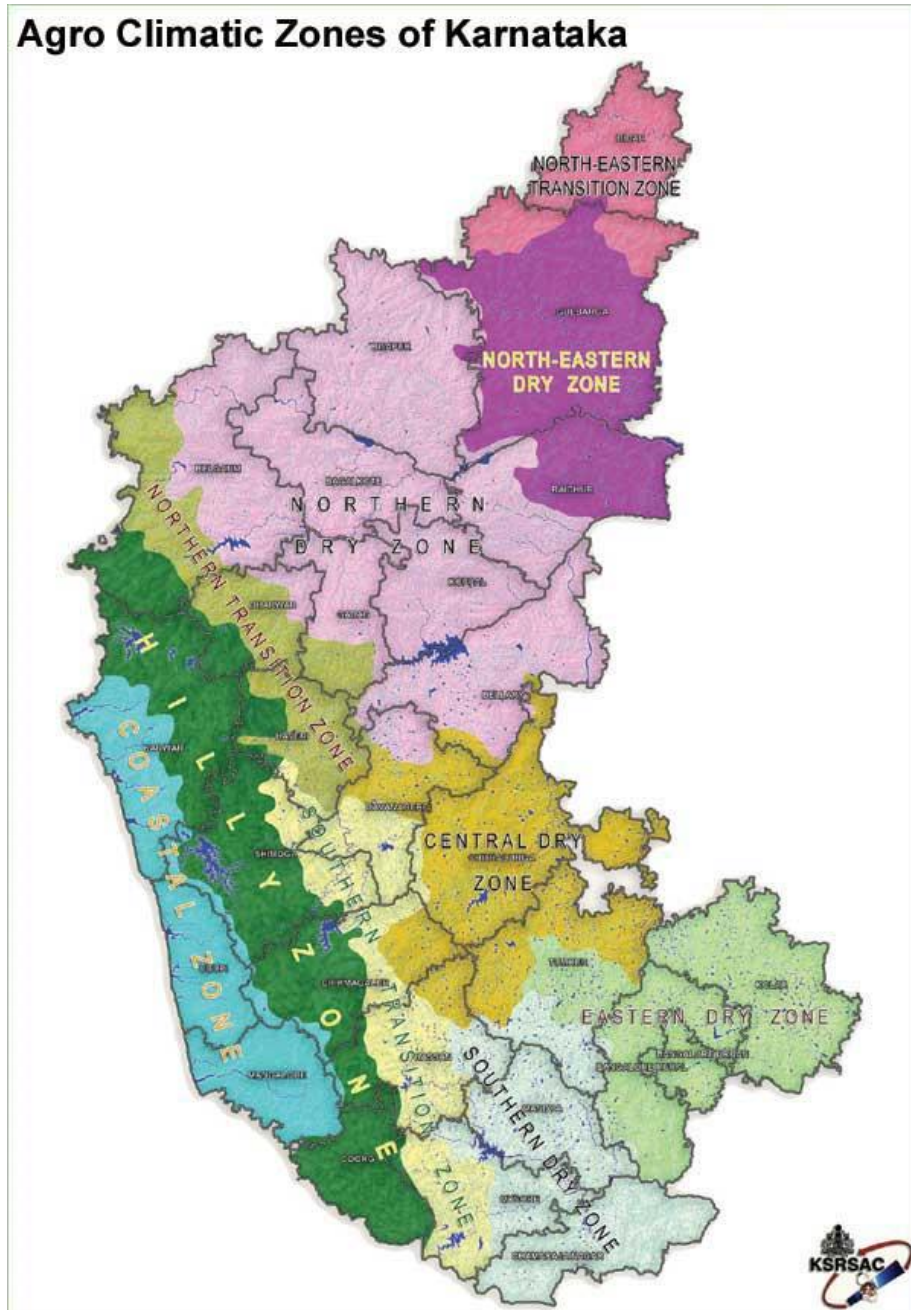
The design of research is the most important and crucial aspect of research methodology. To put it in Kerlinger's (1978) words, 'Research design is the plan, structure and strategy of investigation, so as to obtain answers to research questions and to control variance'. The plan is the overall scheme or programme of conducting of the research study.

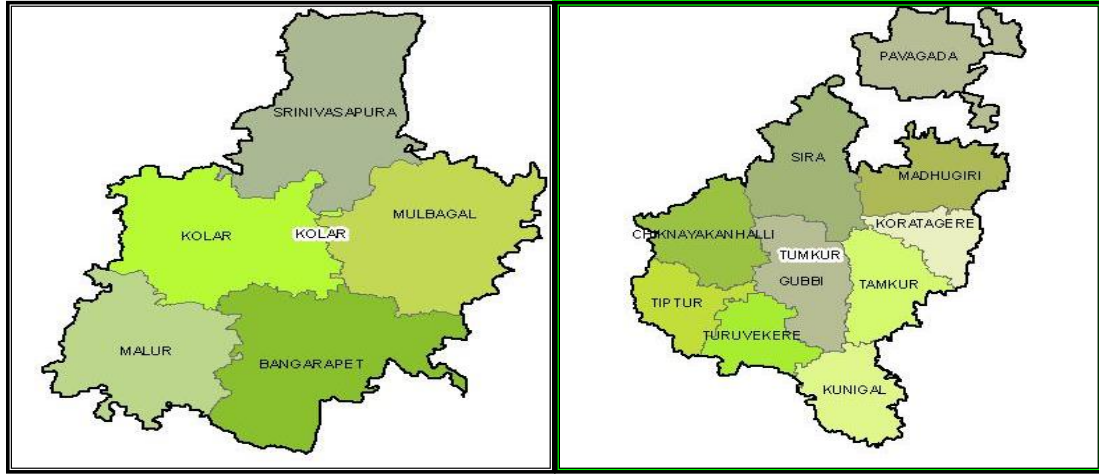
For this study, "ex-post facto" design was used. In this design, the researcher instead of creating a treatment evaluated the effects of a statistically occurring phenomenon after the occurrence. Sustainability of farming system being an already occurring phenomenon in the study area, the above mentioned design was employed.

## **3.3 Research variables**

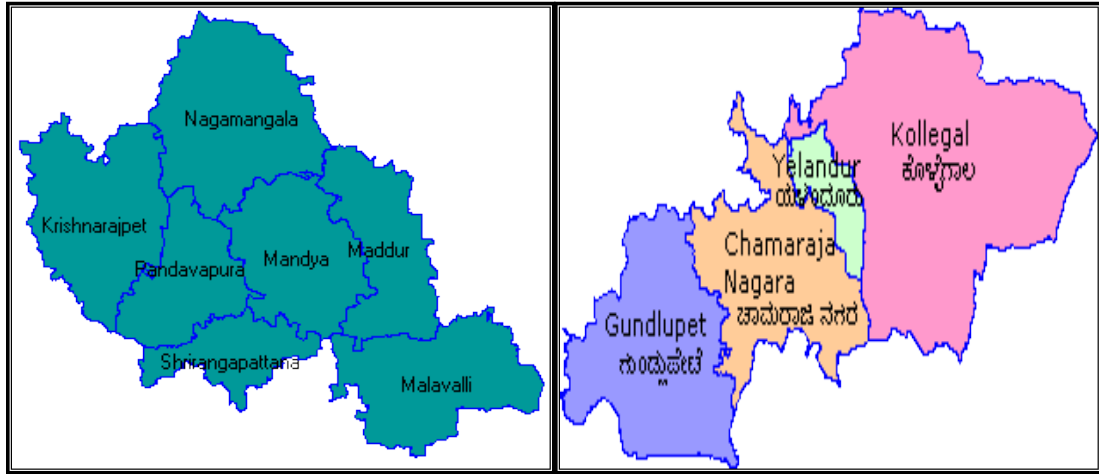
The importance of any research study mainly depends on the variables taken into account. By pursuing through the related literature and discussions had with scientists of University of Agricultural Sciences, Bengaluru, the sustainability of farming system was identified as the dependent variable. Further, nineteen independent variables were identified for the study to know their influence on the dependent variables.

# Agro Climatic Zones of Karnataka





**EASTERN DRY ZONE (SRINIVASAPURA & GUBBI)**



**SOUTHERN DRY ZONE (MANDYA & GUNDLUPET)**

**Fig. 3.1: Map of the study area**

**Table 3.1: Selection of sample for the study**

| Sl. No.      | Agro-climatic zones & Districts                 | Farming system | Taluk (District)            | Hobli    | Villages         | No. of farmers selected |
|--------------|---|----------------|-----------------------------|----------|------------------|-------------------------|
| 1            | Eastern Dry Zone<br>Tumkur and Kolar            | Irrigated      | Gubbi<br>(Tumkur)           | Kasaba   | Hodaluru         | 5                       |
|              |   |                |                             |          | Heruru           | 5                       |
|              |   |                |                             |          | Kittada kuppa    | 5                       |
|              |   | Rainfed        | Srinivaspura<br>(Kolar)     | Kadaba   | B. Kodihalli     | 5                       |
|              |   |                |                             |          | Karegowdanahalli | 5                       |
|              |   |                |                             |          | Kadashettyhalli  | 5                       |
| Rainfed      | Srinivaspura<br>(Kolar)                         | Ronuru         | Ronuru                      | 5        |                  |                         |
|              |   |                | Dimbala                     | 5        |                  |                         |
|              |   |                | Neelaturu                   | 5        |                  |                         |
| 2            | Southern Dry Zone<br>Mandya and<br>Chamrajnagar | Irrigated      | Mandya<br>(Mandya)          | Kasaba   | Hosabudanur      | 5                       |
|              |   |                |                             |          | Umdahalli        | 5                       |
|              |   |                |                             |          | Sathnur          | 5                       |
|              |   | Rainfed        | Gundlupet<br>(Chamrajnagar) | Kottatti | Kottatti         | 5                       |
|              |   |                |                             |          | Hullukere        | 5                       |
|              |   |                |                             |          | Bevinahalli      | 5                       |
| Rainfed      | Gundlupet<br>(Chamrajnagar)                     | Terknambi      | Terknambi                   | 5        |                  |                         |
|              |   |                | Lakkuru                     | 5        |                  |                         |
|              |   |                | Guruvinapura                | 5        |                  |                         |
| Rainfed      | Gundlupet<br>(Chamrajnagar)                     | Hangala        | Hangla                      | 5        |                  |                         |
|              |   |                | Devarahalli                 | 5        |                  |                         |
|              |   |                | Siddaiahnapura              | 5        |                  |                         |
| <b>Total</b> | 2   | 2              | 4                           | 8        | 24               | 120                     |

The variables selected for analysis together with their mode of measurement are enumerated below.

**Table 3.2: Variables and their empirical measurement**

| Sl. No.    | Variables                        | Empirical measurement                     |
|------------|----------------------------------|---|
| <b>I.</b>  | <b>Dependent variable</b>        |   |
| 1          | Sustainability of Farming System | Index developed for the study             |
| <b>II.</b> | <b>Independent variables</b>     |   |
| 1          | Age                              | Chronological age of the respondents      |
| 2          | Education                        | Schedule developed for the study          |
| 3          | Family size                      | Schedule developed for the study          |
| 4          | Farming experience               | Schedule developed for the study          |
| 5          | Landholdings                     | Schedule developed for the study          |
| 6          | Level of aspiration              | Scale of Cantrill (1965)                  |
| 7          | Economic motivation              | Scale of Supe (1969)                      |
| 8          | Achievement motivation           | Procedure followed by Gopala (2010)       |
| 9          | Management orientation           | Scale developed by Samantha (1977)        |
| 10         | Risk orientation                 | Scale developed by Nagaraja (1989)        |
| 11         | Value orientation                | Scale of Alexander (1982)                 |
| 12         | Farming commitment               | Scale of Ramegowda (1991)                 |
| 13         | Decision making pattern          | Procedure followed by Chandregowda (1996) |
| 14         | Social participation             | Procedure developed by Trivedi (1963)     |
| 15         | Cosmopolitaness                  | Procedure developed by Desai (1981)       |
| 16         | Innovativeness                   | Scale developed by Feaster (1968)         |
| 17         | Extension Contact                | Procedure followed by Byrareddy (1971)    |
| 18         | Extension participation          | Procedure followed by Dhaliwal (1963)     |
| 19         | Mass media exposure              | Procedure developed by Trivedi (1963)     |

### 3.4 Operationalisation and measurement of sustainability of farming systems

#### 3.4.1 Sustainability

The ability of an agro-ecosystem practiced by the farmer in maintaining production through time in the face of long term ecological constraints and socio economic pressures.

### **3.4.1 Farming System**

Complex inter-related matrix of soil, plants, animals, implements, power, labour, capital and other inputs controlled in part by farm families and influenced by varying degrees of political, economic, institutional and social forces that operate at many levels.

### **3.4.1 Operationalisation of Sustainability of Farming Systems**

Sustainability of farming systems is operationalised as the farmer's management of the soil, water and other resources, relying on farm and other additional inputs to maintain the productivity of his farming system in the long run without affecting the production environment of his farm.

### **3.4.2 Measurement of Sustainability of Farming Systems**

The sustainability in general and sustainable farming in particular have been widely used and defined to suit the situation and purpose for which it was used. The biggest problem faced by every attempt was to measure this concept as a variable based on same standard indicators. However, there is unanimity in the understanding that sustainability of farming system is a composite of three dimensions viz., ecological safety, economic security and social stability. Many authors have indicated that the components that have been identified were based on secondary data and were also not further operationalised. Hence, the researcher's thrust was to identify components that truly reflect farm level sustainability, amenable to operationalisation, accessible to farmer's information domain and more importantly take stock of the conflicting and synergetic effect of these components.

An attempt has been made to measure the level of sustainability of farming system by considering all the factors suggested by previous researchers. The details of procedure adopted are presented below:

**3.4.2.1 Item Pooling:** Based on the review of literature as well as discussion with the experts in the field, 21 indicators were enlisted in accordance with the situation existed in farming system. These items were mainly concerned with consequences by using the cultivation practices, animal husbandry management and other aspects of any subsidiary occupation in farming covering widely from environmental effects to the social aspects.

**3.4.2.2 Item Scrutiny:** The indicators selected were discussed with the resource persons who had knowledge and experience in farming and then scrutinized for this amenability for operationalisation and measurement. Based on this exercise 21 indicators were retained as contributing factors to sustainability of farming system.

**3.4.2.3 Judges Rating on Indicators:** The final list of indicators was subjected to relevancy rating of 50 judges of the concerned area. The judges were of the cadre of Assistant Professors and above in the area of Agricultural Extension, Agricultural Economics, Agricultural Marketing, Co-operation and Business management, Agricultural Statistics, Applied Mathematics and Computer Science, Agronomy, Agricultural Entomology, Plant Pathology, Soil Science and Horticulture in the

University of Agricultural Sciences, KVK's, and ICAR institutes. The experts were requested to indicate whether each of the components sent to them were relevant and suitable for inclusion in the scale to measure the sustainability index of farmers on a four point relevancy continuum, viz., **Most Relevant, Relevant, Somewhat Relevant and Not Relevant with 4, 3, 2 and 1** scores respectively as indicated in Appendix-I. They were also requested to add new indicators, which tend to measure the sustainability, if any they consider relevant. The responses had from the judges were scored and the relevancy co-efficient of indicator (RC) was worked out using the following formula:

$$RC_i = \frac{\text{Total score of all the judges on 'i'th indicator}}{\text{Maximum score on the continuum X Total number of judges}}$$

All those components with the relevancy co-efficient of 0.75 and above were selected for the development of sustainability index. Fifteen indicators have passed the above criteria, are listed below with their relevancy coefficient:

**Table 3.3: Dimension wise mean response from the experts on sustainability of farming systems**

| No. | Dimensions | Sample (n) | Components | Max. Score | Response |          |      |        |
|-----|------------|------------|------------|------------|----------|----------|------|--------|
|     |            |            |            |            | Mean     | Mean (%) | SD   | SD (%) |
| I   | Ecological | 50         | 6          | 18         | 15.80    | 87.78    | 2.28 | 12.6   |
| II  | Economic   | 50         | 6          | 18         | 15.04    | 83.56    | 2.15 | 11.9   |
| III | Social     | 50         | 9          | 27         | 20.72    | 76.74    | 4.39 | 16.3   |

**3.4.2.4 Computation of Scale Values:** In order to compute the scale values for each of the identified components, their relative importance in the sustainable farming system was worked out by adopting normalized ranking method recommended by Guilford (1954).

A list of 30 experts working in the University of Agricultural Sciences, Bengaluru was prepared and considered for seeking opinion. The judges were requested to give rank to the 15 selected indicators of sustainability based on the relative importance of the indicators. After getting the ratings from the judges, they were used in calculation of scale values (Appendix-II).

The components were ranked based on their relative importance later ranks were converted to rank values using the formula:

$$R_i = (n-r_i+1)$$

Where,  $R_i$  = Rank values

$n$  = Number of indicators

$r_i$  = Ranks given by judges to fifteen indicators

**Table 3.4: Indicator wise relevancy score under different dimensions of sustainability of farming systems**

| Sl. No.    | Component                      | Relevancy coefficient |
|------------|--------------------------------|-----------------------|
| <b>I</b>   | <b>ECOLOGICAL DIMENSION</b>    |                       |
| 1          | Integrated Nutrient Management | 0.953                 |
| 2          | Integrated Pest Management     | 0.933                 |
| 3          | Water Management               | 0.920                 |
| 4          | Land-use Pattern               | 0.847                 |
| 5          | Cropping Pattern               | 0.867                 |
| <b>II</b>  | <b>ECONOMIC DIMENSION</b>      |                       |
| 1          | Land Productivity              | 0.887                 |
| 2          | Profitability                  | 0.893                 |
| 3          | Input – Output Relationship    | 0.860                 |
| 4          | Farm Level Risk Management     | 0.787                 |
| 5          | Marketing                      | 0.860                 |
| <b>III</b> | <b>SOCIAL DIMENSION</b>        |                       |
| 1          | Input self-sufficiency         | 0.813                 |
| 2          | Information self- reliance     | 0.753                 |
| 3          | Employment generation          | 0.800                 |
| 4          | Family Food Security           | 0.880                 |
| 5          | Quality of life                | 0.760                 |

The calculation of scale values consisted of working out the centile position ‘p’ based on the formula recommended by Guilford (1954), working out ‘c’ scale values, calculating ‘R<sub>j</sub>’ value and finally determining the scale of (R<sub>c</sub>) (Appendix-IV):

$$P = \frac{(R_i - 0.5)100}{n}$$

$$R_c = 2.357 \times R_j - 7.01$$

Where, P= Centile position

C= Values determined to each centile value

R<sub>i</sub>= Rank value

n = Number of indicators

The computed scale values for fifteen indicators were as follows:

**Table 3.5: Scale values for fifteen indicators under different dimensions of sustainability of farming systems**

| Sl. No.                  | Component                      | Scale value  |
|--------------------------|--------------------------------|--------------|
| <b>I</b>                 | <b>ECOLOGICAL DIMENSION</b>    |              |
| 1                        | Integrated Nutrient Management | 8.78         |
| 2                        | Integrated Pest Management     | 5.48         |
| 3                        | Water Management               | 6.42         |
| 4                        | Land-use Pattern               | 7.13         |
| 5                        | Cropping Pattern               | 5.80         |
| <b>II</b>                | <b>ECONOMIC DIMENSION</b>      |              |
| 1                        | Land Productivity              | 8.39         |
| 2                        | Profitability                  | 3.91         |
| 3                        | Input – Output Relationship    | 5.48         |
| 4                        | Farm Level Risk Management     | 3.91         |
| 5                        | Marketing                      | 3.28         |
| <b>III</b>               | <b>SOCIAL DIMENSION</b>        |              |
| 1                        | Input self-sufficiency         | 5.56         |
| 2                        | Information self-reliancy      | 1.08         |
| 3                        | Employment generation          | 1.87         |
| 4                        | Family Food Security           | 3.44         |
| 5                        | Quality of life                | 1.08         |
| <b>Total Scale value</b> |                                | <b>71.60</b> |

The scale values were used to arrive at sustainability index for each farmer.

### **3.4.3 Measurement of components of sustainability of farming systems**

**3.4.3.1. Integrated nutrient management (INM):** It refers to efficient and judicious supply, use or management of all the major components of plant nutrient sources: chemical fertilizers in conjunction with animal manures, compost, green manures, legumes in cropping system, bio-fertilizers, crop residues, or recyclable waste and other locally available nutrient sources for sustaining soil fertility, health and productivity.

List of items were identified under manurial management and fertilizer application. For each item, as against the recommended level, the farmers were assigned two score for following the recommended level, one score for more or less than the

recommended level hence, the maximum possible scores were worked out. Later the integrated nutrient management index has been worked out by using the following formula:

$$\text{Integrated nutrient management index} = \frac{\text{Actual score obtained}}{\text{Max. possible score}} \times 100$$

**3.4.3.2. Integrated Pest Management:** It refers to use of simpler and economically safer measures for the pest [insects, diseases, nematodes and weeds] control in reducing environmental pollution and other problems caused by excessive and indiscriminate use of pesticide.

List of items were identified under insect, disease, nematode and weed management. For each item, as against the recommended level, the farmers were assigned two score for following the recommended level, one score for more or less than the recommended level hence, the maximum possible scores were worked out. Later the integrated pest management index has been worked out by using the following formula:

$$\text{Integrated pest management index} = \frac{\text{Actual score obtained}}{\text{Max. possible score}} \times 100$$

**3.4.3.3. Water management (WM):** Water management, including rainfall and irrigation water, such that it is judiciously utilized for enhancing crop production on a sustainable basis and does not degrade land resource due to its misuse.

List of items were identified under water management. For each item, as against the recommended level, the farmers were assigned two score for following the recommended level, one score for more or less than the recommended level hence, the maximum possible scores were worked out. The water management index was worked out by using the formula:

$$\text{Water management index} = \frac{\text{Actual score obtained}}{\text{Max. possible score}} \times 100$$

#### **3.4.3.4. Cropping pattern**

This is operationally defined as the number and combinations of crops grown under different seasons in a year.

To measure this variable the cropping intensity was worked out. Crops grown during previous year of the study were considered for the purpose and were worked out by using the formula:

$$\text{Cropping intensity (CI)} = \frac{\text{Net cultivated area}}{\text{Gross cultivable area}} \times 100$$

This formula was used to calculate, to what extent respondents were utilizing their lands for crop production during the last year.

**3.4.3.5. Land use Pattern:** It refers to details of land, including net area sown, forestry component and land put to non-agricultural uses corresponding to previous year.

$$\text{Land use pattern index} = \frac{\text{Net area sown} + \text{Forest land} + \text{land put to non agricultural uses}}{\text{Total available area}} \times 100$$

**3.4.3.6. Land productivity (LP):** Land productivity was operationalised as yield per unit of land expressed in terms of quintals/tones per acre. Productivity was taken as the average of the past three years to give weightage to productivity over a period of time.

$$\text{Land productivity index} = \frac{\text{Total quantity of produce}}{\text{Total area under cultivation}}$$

**3.4.3.7. Input Output Relationship (Productivity):** It is defined as the ratio of net output produced to input of resource used in the process of production. To calculate input output relationship the productivity (yield) data has been used from crop production and livestock production.

The productivity score was calculated by giving score one to every 96 kg of paddy, every 1.35 tonnes of sugarcane, every 250 kg of mango, every 185 kg of ragi, every 60 kg of groundnut, every 84 kg of horse gram, every 8 kg of live weight of goat, every 30 kg of live weight of poultry bird and every 100 liter of milk. These scores are equated based on money value of each component which has 10% variation. Thus the productivity was calculated in the farming system.

**3.4.3.8. Profitability:** It is defined as the net income of the farmer from agriculture and allied enterprises expressed in rupees.

This variable was measured by using the procedure developed by Shivaprasad (1982) where the net income of the farmer from agriculture and allied enterprises was taken into consideration to measure the profitability.

$$\text{Net income} = \frac{\text{Gross income}}{\text{Cost of cultivation}}$$

**3.4.3.9. Farm Level Risk Management:** It refers to strategies adopted by farmers in managing the variability or outcomes which are measurable in the quantitative components including a) Yield risk b) Risk of fall in price of products and c) Risk of increase of input prices.

Score ‘One’ was assigned for strategy adopted and ‘Zero’ for strategy not adopted for each component and the maximum and minimum possible scores were worked out. Later the farm level risk management index has been worked out by using the following formula:

$$\text{Farm Level Risk Management index} = \frac{\text{Actual score obtained}}{\text{Max. possible score}} \times 100$$

**3.4.3.10. Marketing:** This was operationalised as plan and utilization of the available marketing facilities viz., a) Local market b) Regulated markets and c) Agricultural marketing co-operative societies d) Storage facilities e) Transportation facilities and marketing strategies like pre harvest, contract farming, direct marketing and stored marketing.

List of statements were identified for measuring marketing. Responses were elicited as adequate (score 3), moderate (score 2) and inadequate (score 1) and for marketing strategies yes (score 1) or no (score 0) was assigned. The maximum possible scores were worked out and later the marketing index has been worked out by using the following formula:

$$\text{Marketing index} = \frac{\text{Actual score obtained}}{\text{Max. possible score}} \times 100$$

**3.4.3.11. Input self sufficiency (ISS):** This was operationalised as the extent to which farmer meets input requirement of farming from own /farm generated resources (other than purchased/outside inputs). It was taken as the ratio of value of owned inputs to the total value of inputs used in farming. Value of inputs was worked out at the prevailing rates. To calculate input self sufficiency the data has been used from crop production and livestock production (value of own source and value of own and purchased inputs used).

The input self-sufficiency index (ISSI) was calculated by using the following formula:

$$\text{Input self-sufficiency index} = \frac{\text{Value of owned input}}{\text{Total value of inputs used}} \times 100$$

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

**3.4.3.12. Information self-reliance (ISR):** This was operationalised as the ability of the farmer and his family to possess information related to planning and practicing farm activities and to rely upon that at the time of decision making for successful farming. The quantification of ISR was done by following procedure developed by Chandregowda (1996) with slight modifications.

A list of statements was identified under information self-reliance. It was measured on a three point continuum of reliance dependency ranging from 'completely self-reliant', 'partially self-reliant' and 'completely dependent', with a score of two, one and zero, respectively. Later the minimum possible scores were worked out.

The information self-reliance was obtained by using the following formula:

$$\text{Information self reliance index} = \frac{\text{Actual score obtained}}{\text{Max. possible score}} \times 100$$

Theoretically an information self-reliance value of 100 indicates a farmer who is completely self-reliant for information and a value of zero would indicate a farmer who is completely dependent on others for information.

**3.4.3.13. Employment generation:** Extent of employment generated (man days per year) for family members as well as hired labour by taking into consideration all activities of the farm.

This variable was measured by utilizing the slight modified procedure adopted by Dixit (1992) and Lavanya (2010). It consisted of calculating the deferential employment generated in man days per year by taking into consideration of employment status under different selected farming systems. To calculate employment generation the data has been used from crop production and livestock production (number of male and female labours for agriculture and allied sectors).

The man days were calculated by following the procedure of one man day or woman day is equal to eight hours of work. Based on the wages paid for man days and woman days, the woman days were converted into man days following the standard procedure and then total man days were obtained and used for further analysis.

$$1 \text{ man day} = \frac{\text{Men wages/ day}}{\text{Women wages/day}}$$

The above formula was employed to convert woman days to man days. The man days generated from different enterprises were summed up and then score one was given to every 12 man days.

**3.4.3.14. Family Food Security:** This was operationalised as the extent to which farm family is able to produce sufficient food (cereals & millets, pulses and oilseeds) to meet their family needs and requirements for healthy life.

$$\text{Family Food Security index} = \frac{\text{Total Quantity Produced}}{\text{Total Quantity Consumed}} \times 100$$

Theoretically a family food security value of 100 indicates a farm family is producing sufficient food for their consumption and a value of zero would indicate a farm family entirely depends on others for the consumption requirements.

**3.4.3.15. Quality of life:** This was operationalised as the general wellbeing of farmers during the farm practices/activities; it includes financial, psychological and social dimensions.

#### **Development of scale on quality of life of farmers**

Based on the review of literature as well as discussion with the experts in the field, 12 statements were identified. The list of statements was subjected to relevancy rating of 30 judges of the concerned area. The judges were of the cadre of Assistant Professors and above in the area of Agricultural Extension. Agricultural Economics,

Agricultural Marketing, Co-operation and Business Management, Agricultural Statistics, Applied Mathematics and Computer Science, Agronomy, Agricultural Entomology, Plant Pathology, soil Science and Horticulture in the University of Agricultural Sciences, Bangalore. The experts were requested to indicate whether each of the statements sent to them were relevant and suitable for inclusion in the scale to measure the quality of life of farmers on a four point relevancy continuum, viz., **Most Relevant, Relevant, Somewhat Relevant and Not Relevant with 4, 3, 2 and 1** scores respectively as indicated in Appendix-III. They were also requested to add new statements, which tend to measure the quality of life, if any they consider relevant. The responses had from the judges were scored and the relevancy co-efficient of statements (RC) was worked out using the following formula:

$$RC_i = \frac{\text{Total score of all the judges on 'i'th indicator}}{\text{Maximum score on the continuum X Total number of judges}}$$

All those statements with the relevancy co-efficient of 0.75 and above were selected for the development of scale on quality of life. Seven statements have passed the above criteria, are listed below with their relevancy coefficient:

| Sl. No. | Statements  | Relevancy coefficient |
|---------|---|-----------------------|
| 1       | Basic necessities of my family are achieved from the existing combination of farm components  | 0.91                  |
| 2       | Farming is a thankless profession and has made my life miserable                              | 0.84                  |
| 3       | Farming offers an opportunity to live closely with the nature and keeps me emotionally stable | 0.89                  |
| 4       | Income generated from farm is sufficient to meet my family needs                              | 0.91                  |
| 5       | Vagaries of monsoon have made my life stressful   | 0.84                  |
| 6       | Farming system supports my family to lead a healthy life                                      | 0.80                  |
| 7       | Status accorded to a farmer in the society is demoralizing                                    | 0.86                  |

Quality of life was measured on a five point continuum ranging from 'Strongly Agree', 'Agree', 'Undecided', 'Disagree' and 'Strongly Disagree', with a score of 5, 4, 3, 2 and 1, respectively.

The quality of life was obtained by using the following formula:

$$\text{Quality of life index} = \frac{\text{Actual score obtained}}{\text{Max. possible score}} \times 100$$

Theoretically a quality of life value of 100 indicates a farmer’s quality of life as ‘good’ and a value of zero would indicate a farmer’s quality of life as ‘poor’.

### 3.4.4 Computation of Sustainability Index

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

$$U_{ij} = \frac{Y_{ij} - \text{Min } Y_j}{\text{Max } Y_j - \text{Min } Y_j}$$

Where

- $U_{ij}$  = Unit standard score of the  $i^{\text{th}}$  respondent on  $j^{\text{th}}$  component
- $\text{Min } Y_j$  = Minimum score on the  $j^{\text{th}}$  component
- $\text{Max } Y_j$  = Maximum score on the  $j^{\text{th}}$  component
- $Y_{ij}$  = Score of the  $i^{\text{th}}$  respondent on  $j^{\text{th}}$  component

These unit values ranged from 0 to 1, when  $Y_{ij}$  is minimum, unit value is ‘0’ and when  $Y_{ij}$  is maximum unit value is 1.

Then, these unit values of each respondent could be multiplied by respective component scale values, summed up, divided by total scale value and multiplied by 100 to get sustainability index for each respondent.

$$S_i = \frac{\sum U_{ij} \times S_j}{\text{Total scale value}} \times 100$$

Where

- $S_i$  = Sustainability index of  $i^{\text{th}}$  respondent
- $U_{ij}$  = Unit standard scores of the  $i^{\text{th}}$  respondent on  $j^{\text{th}}$  component
- $S_j$  = Scale value of  $j^{\text{th}}$  component
- Total scale value = 71.6
- $i$  = 1,.....120
- $j$  = 1,.....15

Based on the total score of the respondents on overall sustainability of farming system, the respondents were classified into three categories namely, low, medium and high, with mean and standard deviation as a measure of check.

| Category                            | Score       |
|-------------------------------------|-------------|
| Low (mean – ½ SD)                   | < 38.74     |
| Medium (mean – ½ SD to mean + ½ SD) | 38.74-48.70 |
| High (mean + ½ SD)                  | >48.70      |

Mean= 43.72

SD= 9.96

After working out the overall sustainability index, the indices of the dimensions were obtained by using a similar procedure as was followed in obtaining sustainability index.

$$\text{Ecological Safety Index for the } i^{\text{th}} \text{ farmer} = \frac{\text{INMI}_i \times \text{XS.V} + \text{IPMI}_i \times \text{XS.V} + \text{WMI}_i \times \text{XS.V} + \text{CPI}_i \times \text{XS.V} + \text{LUPI}_i \times \text{XS.V}}{\text{Total scale value of these indicators (33.61)}} \times 100$$

Where,  $\text{INMI}_i$  = Integrated Nutrient Management Index for  $i^{\text{th}}$  farmer  
 $\text{IPMI}_i$  = Integrated Pest Management Index for  $i^{\text{th}}$  farmer  
 $\text{WMI}_i$  = Water Management Index for  $i^{\text{th}}$  farmer  
 $\text{CPI}_i$  = Cropping Pattern Index for  $i^{\text{th}}$  farmer  
 $\text{LUPI}_i$  = Land Use Pattern Index for  $i^{\text{th}}$  farmer

Based on the total score of the respondents on ecological safety dimension, the respondents were classified into three categories namely, low, medium and high, with mean and standard deviation as a measure of check.

| Category                            | Score       |
|-------------------------------------|-------------|
| Low (mean – ½ SD)                   | <40.27      |
| Medium (mean – ½ SD to mean + ½ SD) | 40.27-53.92 |
| High (mean + ½ SD)                  | >53.92      |

Mean= 47.09

SD= 13.66

$$\text{Economic Security Index for the } i^{\text{th}} \text{ farmer} = \frac{\text{LP}_i \times \text{XS.V} + \text{P}_i \times \text{XS.V} + \text{IOR}_i \times \text{XS.V} + \text{FLRMI}_i \times \text{XS.V} + \text{MI}_i \times \text{XS.V}}{\text{Total scale value of these indicators (24.97)}} \times 100$$

Where,  $\text{LP}_i$  = Land Productivity of  $i^{\text{th}}$  farmer  
 $\text{P}_i$  = Profitability of  $i^{\text{th}}$  farmer  
 $\text{IOR}_i$  = Input Output Relationship of  $i^{\text{th}}$  farmer  
 $\text{FLRMI}_i$  = Farm Level Risk Management Index for  $i^{\text{th}}$  farmer  
 $\text{MI}_i$  = Marketing Index for  $i^{\text{th}}$  farmer

Based on the total score of the respondents on economic security dimension, the respondents were classified into three categories namely, low, medium and high, with mean and standard deviation as a measure of check.

| Category                            | Score       |
|-------------------------------------|-------------|
| Low (mean – ½ SD)                   | <35.15      |
| Medium (mean – ½ SD to mean + ½ SD) | 35.15-49.44 |
| High (mean + ½ SD)                  | >49.44      |

Mean= 42.30

SD= 14.28

$$\text{Social Stability Index for the } i^{\text{th}} \text{ farmer} = \frac{\text{ISSI}_i \times \text{XS.V} + \text{ISRI}_i \times \text{XS.V} + \text{EG}_i \times \text{XS.V} + \text{FFSI}_i \times \text{XS.V} + \text{QLI}_i \times \text{XS.V}}{\text{Total scale value of these indicators (13.03)}} \times 100$$

Where,  $\text{ISSI}_i$  = Input Self Sufficiency Index for  $i^{\text{th}}$  farmer  
 $\text{ISRI}_i$  = Information Self Reliancy Index for  $i^{\text{th}}$  farmer  
 $\text{EG}_i$  = Employment Generation of  $i^{\text{th}}$  farmer  
 $\text{FFSI}_i$  = Family Food Security Index for  $i^{\text{th}}$  farmer  
 $\text{QLI}_i$  = Quality of Life Index for  $i^{\text{th}}$  farmer

Based on the total score of the respondents on social stability dimension, the respondents were classified into three categories namely, low, medium and high, with mean and standard deviation as a measure of check.

| Category                            | Score       |
|-------------------------------------|-------------|
| Low (mean – ½ SD)                   | <32.26      |
| Medium (mean – ½ SD to mean + ½ SD) | 32.26-43.16 |
| High (mean + ½ SD)                  | >43.16      |

Mean=37.71

SD=10.90

### 3.4.5 Reliability and validity of the sustainability index

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

#### Reliability

Reliability refers to precision of the instrument constructed for any purpose. It is otherwise called the extent to which repeated measurement produces the same result. Any newly constructed index has to be tested for its reliability before it is used. In the present study, the reliability of sustainability index was determined by split-half method.

In order to find out the reliability, the sustainability index was divided into two halves, based on odd and even numbered questions and administered to 30 respondents. The two sets of scores of same respondents were correlated. The co-efficient of correlation was found to be 0.918, which was found to be significant at 1 per cent level of probability, indicating high reliability of scale. It was concluded that the sustainability index constructed was reliable.

#### 1. Half test reliability formula

$$r_2^1 = \frac{(N * \sum XY) - (\sum X)(\sum Y)}{\sqrt{[N * \sum X^2 - (\sum X)^2] - [N * \sum Y^2 - (\sum Y)^2]}}$$

Where,

$\sum X$ =sum of the scores of the odd number items

$\sum Y$ =sum of the scores of the even numbers items

$\sum X^2$ = sum of the squares of the odd number items

$\sum Y^2$ = sum of the squares of the even number items

## 2. Whole test reliability formula

$$r_{11} = \frac{2 \cdot r_{1/2}}{1 + r_{1/2}}$$

Where,

$r_{1/2}$  = half test reliability

## 3. Validity formula

$$V = \sqrt{r_{11}}$$

### Validity

The true value of the sustainability index is reflected by its validity. Also, the usefulness of the index must be evaluated by determining its validity. An index is said to be valid if it stands for one's reasoning. Validity could be established through the following way.

#### Content validity:

Content validity in the current study was established in two ways. First, the items selected for inclusion in sustainability index were based on extensive review of literature. Secondly, the opinion of the panel of judges was obtained to find out whether the items suggested were relevant for inclusion in the index or not. Hence, it was concluded that the index was valid owing to the judgment given by the majority of the judges regarding content validity.

### 3.5 Operationalisation and measurement of independent variables

The details of operationalisation of the independent variables selected for the present study and their measurement are given in the succeeding paragraphs.

#### 3.5.1 Age

Age was measured as the number of years completed by the respondent at the time of investigation. Based on the completed years the respondents were classified as young, middle and old age.

| Category | Age         |
|----------|-------------|
| Young    | <35 years   |
| Middle   | 35-50 years |
| Old      | >50 years   |

### 3.5.2 Education

It refers to the formal education level of the respondents. This was quantified by using the items and weights used by Trivedi (1963). The different levels of education and their weights are as follows:

| Categories            | Education                                     | Score |
|-----------------------|---|-------|
| Illiterate            | Can't read and write                          | 0     |
| Can read and write    | Functionally literate                         | 1     |
| Primary School        | 1 <sup>st</sup> to 4 <sup>th</sup> Standard   | 2     |
| Middle School         | 5 <sup>th</sup> to 7 <sup>th</sup> Standard   | 3     |
| High School           | 8 <sup>th</sup> to 10 <sup>th</sup> Standard  | 4     |
| Pre-University Course | 11 <sup>th</sup> to 12 <sup>th</sup> Standard | 5     |
| Graduation            | Above 12 <sup>th</sup> Standard               | 6     |

Based on the scoring procedure, the maximum score an individual could obtain was 6 and the minimum was 0.

### 3.5.3 Farming experience

It is the total number of years a farmer has cultivated crops either on his farm or leased in farm. A score of one was given to each year of experience in cultivation. Later the respondents were classified as less, medium and more experienced based on the mean  $\pm$  1/2 standard deviation.

| Category | Criteria                                  | Scores      |
|----------|---|-------------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<19.44$    |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 19.44-33.29 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>33.29$    |

Mean =26.37

SD=13.85

### 3.5.4 Family size

It was defined as the number of individuals living together in a single household with a common kitchen, sharing the same economic unit. It was measured as the absolute number of members in the household.

| Category | Criteria        |
|----------|-----------------|
| Small    | 3-5 members     |
| Medium   | 6-7 members     |
| Large    | Above 7 members |

### 3.5.5 Landholding

It refers to the number of acres of land possessed by the farmer using the criterion prescribed by the Karnataka Land Reforms Act 38 of 1966. According to this Act, one acre of irrigated or garden land was equated to 3 acres of dry land. Based on the responses of the respondents they were grouped into different categories.

| Category         | Criteria         |
|------------------|------------------|
| Marginal Farmers | < 2.5 acres      |
| Small Farmers    | 2.50 – 5.0 acres |
| Big Farmers      | > 5 acres        |

### 3.5.6 Level of aspiration

Level of aspiration was defined as the possible goal an individual sets himself in his performance.

Self-anchoring striving scale devised by Cantrill (1965) was adopted in this study to measure the level of aspiration. A figure of ‘ten step ladder’ was shown to the respondents and were asked to answer three questions regarding their status five years back, today and five years from now, considering the 10<sup>th</sup> step on the ladder as the best possible life and 1<sup>st</sup> step as the worst possible life. The summation of the ladder step numbers indicated by the farmer for the three questions was taken as the level of aspiration score. Theoretically, minimum possible score was 3 and the maximum was 30. Later the respondents were classified as having less, medium and more aspirations based on the mean  $\pm$  1/2 standard deviation.

| Category | Criteria            | Scores      |
|----------|---------------------|-------------|
| Low      | <(Mean - 1/2 SD)    | <16.12      |
| Medium   | (Mean $\pm$ 1/2 SD) | 16.12-18.83 |
| High     | >(Mean + 1/2 SD)    | >18.83      |

Mean = 17.48

SD=2.70

### 3.5.7 Economic motivation

It is defined as the extent to which an individual is oriented towards achievement of the maximum economic ends such as maximization of farm profit.

Economic motivation scale developed by Supe (1969) was used in this study. The responses were obtained on ‘Agree-Disagree’ dichotomous categories for each statement. The first four statements in the scale were positive and the last two were negative. ‘Agree’ response on a positive statement and ‘Disagree’ response on a negative statement attached one score each. Thus, the maximum and minimum possible scores were 0 to 6,

respectively. Based on the mean  $\pm$  1/2 standard deviation the respondents were classified into three categories.

| Category | Criteria                                  | Scores    |
|----------|---|-----------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<3.74$   |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 3.74-4.84 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>4.84$   |

Mean = 4.29

SD=1.10

### 3.5.8 Achievement motivation

It refers to striving to do a good work with a standard of excellence which may be task related, self-related. The achievement motivation was measured by using procedure followed by Gopala (2010). The scale consisted of seven statements to be rated on a five point continuum viz., strongly agree, agree, undecided, disagree and strongly disagree with the score of 5, 4, 3, 2 and 1, respectively. The possible score varied from 7 to 35. High score revealed higher achievement motivation of the respondents.

Based on the score obtained, the respondents were grouped into three categories using mean and standard deviation as a measure of check.

| Category | Criteria                                  | Scores      |
|----------|---|-------------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<25.65$    |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 25.65-28.55 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>28.55$    |

Mean = 27.10

SD=2.89

### 3.5.9 Management orientation

In the present study, the management orientation has been operationally defined as the degree to which a farmer is oriented towards scientific farm management, comprising of planning, production and marketing functions of farm. This variable was measured by adopting the scale developed by Samanta (1977). The scale consists of totally 18 statements, six statements for each of planning, production and marketing aspects. The management orientation scale has got two responses for each statement as 'agree' and 'disagree'. The orientation of scoring was conceptually unidirectional. The positive statements were given a score of one for 'agree' and zero for 'disagree'. The scoring was reversed in the case of negative statements. The range of scores for the scale were from 0 to 18.

Based on total scores obtained, the farmers were classified as low, medium and high using the mean and standard deviation.

| Category | Criteria                                  | Scores      |
|----------|---|-------------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<14.05$    |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 14.05-15.75 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>15.75$    |

Mean = 14.90

SD=1.69

### 3.5.10 Risk orientation

It is the degree to which a farmer is oriented towards risk and uncertainty in agriculture management and has the courage to face the various risks involved in agriculture.

Nagaraja (1989) developed a scale for measuring risk orientation of farmers. The scale contained six statements. The same scale was used in the present study with slight modifications. The fifth statement was negatively scored and all others were positively scored. In the case of positive statements, a score of one was assigned for the 'yes' response and zero score for 'no' response. This was reversed in the case of negative statement. The score ranged from 0 to 6.

The mean and standard deviation of risk orientation score of the respondents were considered for categorizing the respondents into low, medium and high.

| Category | Criteria                                  | Scores    |
|----------|---|-----------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<4.06$   |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 4.06-4.99 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>4.99$   |

Mean = 4.52

SD=0.935

### 3.5.11 Value orientation

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

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

| Category | Criteria                                  | Scores    |
|----------|---|-----------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<7.14$   |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 7.14-8.41 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>8.41$   |

Mean = 7.77

SD=1.26

### 3.5.12 Farming commitment

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

The farming commitment scale developed by Ramegowda (1991) was used with slight modifications to suit the present investigation. The responses were obtained on a five-point continuum of agreement ranging from 'strongly agree' to 'strongly disagree' for all the eight statements of the scale. The responses were quantified by giving score of 5, 4, 3, 2 and 1 for a positive statement and 1, 2, 3, 4 and 5 for a negative statement. The minimum and maximum possible farming commitment scores were 8 and 40, respectively.

The respondents were classified into low, medium and high, based on the mean and standard deviation.

| Category | Criteria                                  | Scores      |
|----------|---|-------------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<27.15$    |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 27.15-30.95 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>30.95$    |

Mean = 29.05

SD=3.79

### 3.5.13 Decision making pattern

Decision making pattern was operationalised as the nature of decision making (individual, joint or collective) that the farm family has resorted to, while performing farming activities.

The Decision making scale developed by Chandregowda (1996) was used with slight modifications to suit the present investigation. The scale had 14 decision making areas which were fitted on a four point continuum of decision making pattern viz., head of the family, parents, adult members and parents & adult members with a score of 0, 1, 2 and 3, respectively. Thus, the minimum and maximum possible scores were 0 and 42, respectively. Higher the score, more the collective decisions and lesser the score, more the individual decisions.

The respondents were classified into low, medium and high, based on the mean and standard deviation.

| Category | Criteria                      | Scores      |
|----------|-------------------------------|-------------|
| Low      | <(Mean - $\frac{1}{2}$ SD)    | <27.72      |
| Medium   | (Mean $\pm$ $\frac{1}{2}$ SD) | 27.72-40.04 |
| High     | >(Mean + $\frac{1}{2}$ SD)    | >40.04      |

Mean = 33.88

SD=12.32

### 3.5.14 Social participation

Social participation was operationalized as the degree of involvement of an individual from mere membership to organizational positions and their active participation in the activities of local formal organizations. This was quantified by using the method suggested by Trivedi (1963) with suitable changes in the items and weightage. The respondents were provided with a list of ten organisations and were asked to delineate their extent of participation in each of them. The scoring procedure for each of the organization was as follows,

| Membership/Office Bearer          | Scores |
|-----------------------------------|--------|
| Member in any organization        | 1      |
| Office bearer in any organization | 2      |

| Extent of Participation | Score |
|-------------------------|-------|
| Regular                 | 2     |
| Occasional              | 1     |
| Never                   | 0     |

Thus, the total possible score ranged from 0 to 40. By considering the total score obtained by each respondent they were divided into three groups as low, medium and high using mean and standard deviation as a measure of check.

| Category | Criteria                      | Scores      |
|----------|-------------------------------|-------------|
| Low      | <(Mean - $\frac{1}{2}$ SD)    | <10.04      |
| Medium   | (Mean $\pm$ $\frac{1}{2}$ SD) | 10.04-13.08 |
| High     | >(Mean + $\frac{1}{2}$ SD)    | >13.08      |

Mean = 11.56

SD=3.045

### 3.5.15 Cosmopolitaness

It is defined as the degree to which an individual is oriented to his immediate social system outside. The cosmopolite farmer is likely to be a unique individual in that he is motivated to look beyond his environment when most others are content to maintain

a legalistic frame of reference. The variable was measured using the scale developed by Desai (1981). Two dimensions of the variable were considered in this case.

- a. The frequency of visit to the nearest town.
- b. The purpose of visit to the town.

The items and scoring pattern followed in quantifying the frequency of visit and purpose of visit were as follows.

| No.  | a. Frequency of Visit       | Score | No.  | b. Purpose of Visit                 | Score |
|------|-----------------------------|-------|------|-------------------------------------|-------|
| i)   | Two or more times in a week | 5     | i)   | All visits relating to agriculture  | 5     |
| ii)  | Once in a week              | 4     | ii)  | Some visits relating to agriculture | 4     |
| iii) | Once in fifteen days        | 3     | iii) | Personal / Domestic                 | 3     |
| iv)  | Once in a month             | 2     | iv)  | Entertainment                       | 2     |
| v)   | Seldom                      | 1     | v)   | Others                              | 1     |
| vi)  | Never                       | 0     | vi)  | No response                         | 0     |

The cumulated maximum score obtainable was 10 and the minimum was 0. The mean and standard deviation of cosmopolitanism score of the respondents were considered for categorizing the respondents into low, medium and high.

| Category | Criteria                                  | Scores    |
|----------|---|-----------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<7.19$   |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 7.19-8.54 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>8.54$   |

Mean = 7.86

SD=1.35

### 3.5.16 Innovativeness

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

The innovativeness scale developed by Feaster (1968) was used with slight modification to suit the present study. Eight statements with first four positive and next four negative constituted the scale.

The responses were obtained on a three point continuum viz., 'yes', 'undecided' and 'no' with a scoring pattern of 2, 1 and 0, respectively for positive statements and 0, 1 and 2 for negative statements. The summated maximum score was 16 and minimum possible was 0. Maximum score would indicate low innovativeness. Based on the mean and standard deviation, the respondents were classified into three major categories.

| Category | Criteria                                  | Scores      |
|----------|---|-------------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<11.68$    |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 11.68-13.34 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>13.34$    |

Mean = 12.51

SD=1.66

### 3.5.17 Extension contact

Extension contact was operationally defined as the degree of contacts made by the respondent farmers with different extension workers in order to seek information on different aspects. The extension contact was measured by using the procedure followed by Byrareddy (1971). This variable was quantified as follows:

| Frequency of contact | Score |
|----------------------|-------|
| Once in a week       | 4     |
| Once in 15 days      | 3     |
| Once in a month      | 2     |
| Occasionally         | 1     |
| Never                | 0     |

Thus the maximum score that one could get was 40 and minimum being zero. Based on the score obtained, the respondents were classified into three categories using mean and standard deviation as a measure of check.

| Category | Criteria                                  | Scores      |
|----------|---|-------------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<19.64$    |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 19.64-26.28 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>26.28$    |

Mean = 22.96

SD=6.64

### 3.5.18 Extension participation

Extension participation was quantified by following procedure suggested by Dhaliwal (1963). List of extension activities was prepared and the respondents were asked to indicate extent of their participation in each one of them. The scoring procedure followed was as follows:

| <b>Frequency of Participation</b> | <b>Score</b> |
|-----------------------------------|--------------|
| Regular                           | 2            |
| Occasional                        | 1            |
| Never                             | 0            |

Thus the score that one could get was 20 and minimum being zero. Based on score obtained, the respondents were grouped into three categories using mean and standard deviation as a measure of check.

| <b>Category</b> | <b>Criteria</b>                           | <b>Scores</b> |
|-----------------|---|---------------|
| Low             | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<9.75$       |
| Medium          | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 9.75-13.57    |
| High            | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>13.57$      |

Mean = 11.66

SD=3.81

### 3.5.19 Mass media exposure

This refers to the frequency of reading newspaper, farm magazine and literatures relating to sustainable farming systems as well as viewing television and listening to radio broadcast on the subject cited above. The scale developed by Trivedi (1963) was adopted for measuring mass media use of the respondents. The scoring pattern followed was as follows,

| <b>Owner / Subscriber</b> | <b>Scores</b> |
|---------------------------|---------------|
| Yes                       | 1             |
| No                        | 0             |

| <b>Frequency of use</b> | <b>Score</b> |
|-------------------------|--------------|
| Regular                 | 2            |
| Occasional              | 1            |
| Never                   | 0            |

Thus, the total possible score ranged from 0 to 24. Based on the score obtained, the respondents were grouped into three categories using mean and standard deviation as a measure of check.

| Category | Criteria                                  | Scores      |
|----------|---|-------------|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  | $<10.02$    |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ | 10.02-13.24 |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  | $>13.24$    |

Mean = 11.66

SD=3.21

### 3.6 Constraints faced by the farmers in achieving sustainability of farming systems

To identify the probable constraints of farmers, the farmers were directly asked to indicate the constraints in farming in three different categories viz., lesser extent, moderate extent and large extent and a score of 1, 2 and 3 was given, respectively. According to the total score and percentage the constraints were ranked.

### 3.7 Suggestions by the farmers for achieving sustainability of farming systems

Suggestions are the hints or proposals or ideas or submissions offered by the individuals for further improvement of sustainability of farming systems. In the present study suggestions given by the farmers for achieving sustainability of farming systems were sought and expressed in terms of frequencies and percentage.

### 3.8 Development of interview schedule

Taking into consideration of the scope and objectives of the study, an interview schedule was prepared by including the items relating to the independent and dependent variables with all the relevant scales, schedule items, indices, etc., for measuring the variables included in the study. Pretesting of the schedule was made and suitable changes were incorporated in the formation of items, questions and their sequences. Adequate caution was exercised to make the schedules unambiguous, clear, complete, comprehensive and understandable. The final version of the interview schedule has been appended in the Appendix-VI.

### 3.9 Collection of data

The data were collected with the personal interview with the respondents. A preliminary visit along with local extension workers was undertaken to each village to get acquaintance with the local leaders and the farmers. During this visit, they were informed about the purpose of study. This helped in eliminating the suspicious attitude of the farmers.

The personal interview was conducted under in formal atmosphere. Each question was explained to the respondents and equal emphasis was given in explaining the questions to all the respondents. The onlooker's influence was avoided as far as possible throughout the data collection period.

### 3.10 Analysis of data

The data were scored as per the set standards and tabulated. Keeping in view the objectives of the study and amenability, the data were subjected to different statistical tests. These tests include mean, standard deviation, frequency and percentage grouping which are used in simple comparison of different categories. The other statistical tools like chi-square test ( $\chi^2$ ), student t-test, correlation coefficient, multiple regression, path analysis and principal component analysis were also used in analyzing the data. A brief description of these tools is given below.

#### 3.10.1 Mean

Mean is the sum of the observed values of a set divided by the number of observations in the set is called a mean or an average. The calculated mean was used for grouping the respondents.

#### 3.10.2 Standard Deviation

The positive square root of the variance is called standard deviation. It explains the average amount of variation on either side of the mean.

The mean and standard deviation were used to classify the farmers into three following categories.

| Category | Criteria                                  |
|----------|---|
| Low      | $<(\text{Mean} - \frac{1}{2} \text{SD})$  |
| Medium   | $(\text{Mean} \pm \frac{1}{2} \text{SD})$ |
| High     | $>(\text{Mean} + \frac{1}{2} \text{SD})$  |

#### 3.10.3 Relevancy analysis for index development

$$\text{Relevancy Percentage} = \frac{(\text{MR} \times 4) + (\text{R} \times 3) + (\text{SWR} \times 2) + (\text{NR} \times 1)}{\text{Maximum Possible score}} \times 100$$

$$\text{Relevancy Weightage} = \frac{(\text{MR} \times 4) + (\text{R} \times 3) + (\text{SWR} \times 2) + (\text{NR} \times 1)}{\text{Maximum Possible score}}$$

$$\text{Mean Relevancy Score} = \frac{(\text{MR} \times 4) + (\text{R} \times 3) + (\text{SWR} \times 2) + (\text{NR} \times 1)}{\text{Number of Judges responded}}$$

Where MR- Most relevant

R- Relevant

SWR- Somewhat relevant

NR- Not relevant

### 3.10.4 Frequencies

A frequency distribution was used to quantify the different personal, social, psychological and economical characteristics of the farmers. It was also used in the response analysis of knowledge and adoption statements.

### 3.10.5 Percentage

Percentage was used to make the simple comparison of different groups where ever needed.

### 3.10.6 Karl Pearson correlation coefficient/Half-test reliability ( $r_{1/2}$ )

This was used to calculate the degree of relationship between odd numbered scored judges and even numbered scored judges.

$$r = \frac{N(\sum XY) - (\sum X)(\sum Y)}{\sqrt{[N \cdot \sum X^2 - (\sum X)^2][N \cdot \sum Y^2 - (\sum Y)^2]}}$$

Where,

X = sum of the scores of odd numbered responses of respondents

Y = sum of the scores of even numbered responses of respondents

$\sum x$  = sum of the scores of all odd numbered responses of respondents

$\sum y$  = sum of the scores of all even numbered responses of respondents

$\sum x^2$  = sum of squares obtained from odd numbered responses of respondents

$\sum y^2$  = sum of squares obtained from even numbered responses of respondents

N = Total number of paired odd and even numbered responses of respondents

### 3.10.7 Spearman-Brown Formula ( $r_{11}$ )

This tool was used to determine the reliability co-efficient of scores obtained from odd and even numbered responses obtained from the respondents of the pilot study

$$r_{11} = \frac{2 \cdot r_{1/2}}{1 + r_{1/2}}$$

Where,

$r_{11}$  = whole-test reliability

$r_{1/2}$  = half-test reliability

### 3.10.8 Statistical Validity

$$v = \sqrt{r_{11}}$$

Where,  $r_{11}$  = whole-test reliability

### 3.10.9 Chi-square test ( $\chi^2$ )

The chi-square test was used to measure the association between dependent variables by categorizing into low, medium and high.

$$\chi^2 = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i}$$

Where O – Observed frequency  
 E – Expected frequency

### 3.10.10 Student ‘t’ Test

This test was used to know the comparison between characteristics of dependent variable under irrigated and rainfed systems, indicator wise comparison of sustainability of farming systems between irrigated and rainfed situations & the comparison between the farming systems of eastern and southern dry zone.

$$t = \frac{|\bar{x}_1 - \bar{x}_2|}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

where  $\bar{x}_1$  = mean of sample 1

$\bar{x}_2$  = mean of sample 2

$n_1$  = number of subjects in sample 1

$n_2$  = number of subjects in sample 2

$$s_1^2 = \text{variance of sample 1} = \frac{\sum(x_1 - \bar{x}_1)^2}{n_1}$$

$$s_2^2 = \text{variance of sample 2} = \frac{\sum(x_2 - \bar{x}_2)^2}{n_2}$$

### 3.10.11 Correlation Coefficient

This was used to find out the relationship between the independent and dependent variables as well as between the farmers practicing different farming systems and also between the farmers of different agro-climatic zones.

### 3.10.12 Multiple Regression Analysis

Multiple regression analysis was used mainly to find out the significant contributions made by the independent variables on the dependent variable. This was used for both overall respondents and among the farmers practicing irrigated and rainfed farming systems.

### 3.10.13 Path Analysis

In finding a quantitative interpretation of direct and indirect effects of factors (independent variables) on dependent variable, path analysis was employed.

The technique of path analysis is not a method for discovering causal laws but a procedure for giving quantitative interpretation of an assumed causal system as it operates within a given population. Path coefficients reflect the amount of direct contribution to a given variable on other variables when effects of other related variables

are taken into account. The direct path coefficients follow the order of magnitude of partial regression coefficients of the variable. The direct coefficients are comparable.

#### **3.10.14 Principal Component Analysis**

The principal component analysis was used to know the interdependent factors contributing as a component. The level at which inclusion of each variable contributes for the cumulative extent of variation. It also includes the proportion in which each component highlights its significance.

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

- 4.1 Profile characteristics of farmers of irrigated and rainfed farming systems.
- 4.2 Sustainability of farming systems and its dimensions/indicators.
- 4.3 Relationship between sustainability of farming systems and personal, socio-economic, psychological and communication characteristics of farmers.
- 4.4 Personal, socio-economic, psychological and communication factors contributing to the sustainability of farming systems.
- 4.5 Direct and indirect effects of independent variables on sustainability of farming systems.
- 4.6 Constraints faced by the farmers in achieving sustainability under irrigated and rainfed farming systems.
- 4.7 Suggestions by farmers to achieve sustainability in irrigated and rainfed farming systems.
- 4.8 Case studies of farming systems practiced in the two agro-climatic zones.

### **4.1 Profile characteristics of farmers of irrigated and rainfed farming systems**

It is necessary to analyze the profile of irrigated and rainfed farmers practicing different farming systems to have clear picture about their background. It helps to come out with appropriate suggestions based on conclusions arrived at from the study. Relevant information on the profile was collected and analyzed. The profile of irrigated and rainfed farmers are discussed separately in Table 4.1, Table 4.2 and Table 4.3.

#### **4.1.1 Personal and socio-economic characteristics of farmers under irrigated and rainfed farming systems**

The data provided in Table 4.1 represents the personal and socio-economic characteristics of the farmers under irrigated and rainfed farming systems.

##### **4.1.1.1 Age**

Age is an important factor as it reveals the maturity of an individual to take decisions for achieving his needs. Results in Table 4.1 highlights that 43.33 per cent of the irrigated farmers belonged to middle age category followed by old (40.00 %) and young age (16.67 %). In case of rainfed farmers, 40.00 per cent of respondents belonged to middle age followed by old (36.67 %) and young (23.33 %) age.

Overall, 41.67 per cent were found in middle age group followed by old (38.33 %) and young (20.00 %) age.

It was incidental that more number of farmers was in the middle age group. Moreover, middle aged farmers have more family responsibility, efficiency and sensibility. They may also work with a sense of commitment and involvement. The findings are in line with the findings of Chandra Naik (2002) and Lavanya (2010).

#### **4.1.1.2 Education**

Education is one of the important factors that influence the knowledge of individuals. It could be seen from Table 4.1 that 36.67 per cent and 43.33 per cent had high school education among irrigated and rainfed farmers, respectively. However, 35.00 per cent and only 21.67 per cent had PUC and above education, 20.00 per cent and 23.33 per cent had up to primary education and 8.33 per cent and 11.67 per cent had middle school education among irrigated and rainfed farmers, respectively.

In pooled situation, 40.00 per cent of farmers had high school education, 28.33 per cent had PUC and above, 21.67 per cent studied up to primary and only 10.00 per cent had middle school education.

It is universal fact that education plays a key role in moulding and bringing desirable changes among human beings. All the respondents were relatively educated, which could be the result of a common social environment. As the majority of the farmers were educated, they were able to gather knowledge on recent technologies on cultivation practices in the present scenario. The findings are in line with the findings of Chandra Naik (2002) and Mahatab Ali (2010).

#### **4.1.1.3 Family size**

From Table 4.1 it is observed that 66.67 per cent of irrigated and 60.00 per cent of rainfed farmers have small family followed by medium family (23.30 % and 16.67 %) and large family (10.00 % and 23.33 %), among irrigated and rainfed farming systems, respectively.

In pooled situation, 63.33 per cent of them belonged to small family, 20.00 per cent belonged to medium family and 16.67 per cent were having large family.

The present trend in the villages is also to have a small family for decision making for better economic progress and quality of life. This could be the possible reason for majority of the respondents to have relatively small family. The findings are in line with the findings of Ganeshprasad (2006), Mahatab Ali (2010), Raksha *et al.* (2012) and Rokonzaman (2013).

#### **4.1.1.4 Farming experience**

The results pertaining to farming experience of farmers under irrigated farming indicates that 45.00 per cent of respondents had medium level followed by 28.33 per cent high and 26.67 per cent low level of farming experience. The results pertaining to farming experience of farmers under rainfed farming reveals that one third (33.33 %) of

the respondents were found to be in the medium category whereas, 35.00 per cent of the respondents had low and 31.67 per cent of them had low level of farming experience.

In the pooled sample of farmers under irrigated and rainfed farming system, it was found that 39.17 per cent of them were having medium level of farming experience, 30.83 per cent belonged to low level and 30.00 per cent were having high level of farming experience.

Majority of the irrigated farming system had agriculture as their primary occupation got reflected in having medium level of farming experience. This might be due to the fact that as the farming experience of farmers is more, sustainability of farming systems will be more. Increased farming experience enhances their extension contact, contact with the progressive farmers and cosmopolitaness. The findings reported by Natikar (2001), Bheemappa (2001) and Maraddi (2006) support the above trend.

#### **4.1.1.5 Landholding**

From the Table 4.1 it could be seen that 41.67 per cent of farmers under irrigated farming system were small farmers followed by 33.33 per cent marginal farmers and 25.00 per cent big farmers. Table also reveals that 51.67 per cent of farmers under rainfed farming system were small followed by 33.33 per cent big and 15.00 per cent of them were marginal farmers.

In pooled data, 46.66 per cent of respondents were small farmers followed by 29.17 per cent big farmers and 24.17 per cent were marginal farmers.

The land holding distribution is matching with the general trends in the country that 80 per cent of the land holding in the country are small and medium size. The possible reason that could be attributed to this may be that agriculture was found to be the main occupation of the family who has inherited it from their ancestors and almost all depend on their land for living. Similar findings were reported by Lavanya (2010).

#### **4.1.1.6 Social participation**

From the study it was found that 40.00 per cent of farmers had medium level of social participation followed by 33.33 per cent of them had high and 26.67 per cent of them had low level of social participation. It was also found that 38.34 per cent of farmers under rainfed farming had medium level of participation followed by 33.33 per cent of them had low social participation and 28.33 per cent of them had high participation.

In combined situation, 39.17 per cent of farmers had medium level of social participation, 30.83 per cent had high level and 30.00 per cent had low level of social participation.

This finding can be explained on the basis of the fact that majority of the villages were having sufficient number of social organizations for the participation of the

respondents. The results of the present study are in line with the findings of Chandra Naik (2002) and Chandrani Saha (2008).

#### **4.1.2 Psychological characteristics of farmers under irrigated and rainfed farming systems**

##### **4.1.2.1 Level of aspiration**

Table 4.2 reveals the information on level of aspiration of farmers and indicated that more than one third (36.67 %) of farmers under irrigated farming system were having medium level of aspiration followed by 33.33 per cent belonged to high and 30.00 per cent had high aspiration level. Forty five per cent of farmers under rainfed farming system had medium level of aspiration followed by low (33.33 %) and high (21.67 %) level of aspiration.

Similar trend was observed with respect to pooled data wherein 40.83 per cent of the farmers had medium level of aspiration followed by low (31.67 %) and high (27.50 %) aspiration level. This may be due to the situational circumstances in both the farming systems. The findings are in line with the findings of Bheemappa (2001).

##### **4.1.2.2 Economic motivation**

Economic motivation of farmers under irrigated and rainfed farming systems was studied and the findings presented in the Table 4.2 reveals that 51.67 per cent of farmers under irrigated farming had medium level of economic motivation followed by low (30.00 %) and high (18.33 %). It also revealed that 61.67 per cent of farmers under rainfed farming had medium level of economic motivation followed by low (23.30 %) and high (15.00 %).

In combined situation, more than half (56.66 %) of the farmers had medium level of economic motivation followed by low (26.67 %) and high (16.67 %).

It could be due to aspiration for high returns from farming to have a high standard of living. The other reason might be that farmers are becoming more and more market oriented to have a more profit. The observation made by Bheemappa (2001), Chandra Naik (2002), Sandesh (2004) and Raksha (2012) were in line with the results of the present study.

##### **4.1.2.3 Achievement motivation**

A glance at the Table 4.2 reveals that nearly half (48.34 %) of the farmers under irrigated farming system had medium level of achievement motivation, 38.33 per cent of the farmers had high followed by low level of achievement motivation (13.33 %). In case of rainfed farming system, it was observed that 46.67 per cent of the farmers had medium level of achievement motivation while, one third (33.33 %) had low and 20.00 per cent had high level of achievement motivation.

In pooled data, nearly half of farmers (47.50 %) had medium level of achievement motivation followed by high (29.17 %) and low (23.33 %).

The reason is that achievement motivation is basic character which motivates and helps an individual to do anything. It is a psychologically internalized condition which drives an individual to aspire for higher level of earning and living. The findings are in line with the findings of Budihal (2001), Chandranaik (2002), Maraddi (2006) and Chandrani Saha (2008).

**Table 4.1: Personal and socio-economic characteristics of farmers**

| Characters           | Category         | Irrigated (n=60) |       | Rainfed (n=60) |       | Pooled (n=120) |       |
|----------------------|------------------|------------------|-------|----------------|-------|----------------|-------|
|                      |                  | No.              | %     | No.            | %     | No.            | %     |
| Age (years)          | Young (< 35)     | 10               | 16.67 | 14             | 23.33 | 24             | 20.00 |
|                      | Middle (35-50)   | 26               | 43.33 | 24             | 40.00 | 50             | 41.67 |
|                      | Old (50 & above) | 24               | 40.00 | 22             | 36.67 | 46             | 38.33 |
| Education            | Up to primary    | 12               | 20.00 | 14             | 23.33 | 26             | 21.67 |
|                      | Middle           | 5                | 08.33 | 7              | 11.67 | 12             | 10.00 |
|                      | High school      | 22               | 36.67 | 26             | 43.33 | 48             | 40.00 |
|                      | PUC & above      | 21               | 35.00 | 13             | 21.67 | 34             | 28.33 |
| Family Size          | Small family     | 40               | 66.67 | 36             | 60.00 | 76             | 63.33 |
|                      | Medium family    | 14               | 23.33 | 10             | 16.67 | 24             | 20.00 |
|                      | Large family     | 6                | 10.00 | 14             | 23.33 | 20             | 16.67 |
| Farming experience   | Low              | 16               | 26.67 | 21             | 35.00 | 37             | 30.83 |
|                      | Medium           | 27               | 45.00 | 20             | 33.33 | 47             | 39.17 |
|                      | High             | 17               | 28.33 | 19             | 31.67 | 36             | 30.00 |
| Land holding         | Marginal farmers | 20               | 33.33 | 9              | 15.00 | 29             | 24.17 |
|                      | Small farmers    | 25               | 41.67 | 31             | 51.67 | 56             | 46.66 |
|                      | Big farmers      | 15               | 25.00 | 20             | 33.33 | 35             | 29.17 |
| Social participation | Low              | 16               | 26.67 | 20             | 33.33 | 36             | 30.00 |
|                      | Medium           | 24               | 40.00 | 23             | 38.34 | 47             | 39.17 |
|                      | High             | 20               | 33.33 | 17             | 28.33 | 37             | 30.83 |

#### 4.1.2.4 Management orientation

From the Table 4.2, it is learnt that 76.67 per cent of the farmers in irrigated farming system and 46.67 per cent of farmers in rainfed farming system had medium level of management orientation followed by low (13.33 % and 30.00 %) and high (10.00 % and 23.33 %) level of management orientation among irrigated and rainfed farming systems respectively.

In combined situation, nearly two third of farmers (61.66 %) had medium level of economic motivation followed by low (21.67 %) and high (16.67 %).

**Table 4.2: Psychological characteristics of farmers**

| Characters              | Category | Irrigated (n=60) |       | Rainfed (n=60) |       | Pooled (n=120) |       |
|-------------------------|----------|------------------|-------|----------------|-------|----------------|-------|
|                         |          | No.              | %     | No.            | %     | No.            | %     |
| Level of aspiration     | Low      | 18               | 30.00 | 20             | 33.33 | 38             | 31.67 |
|                         | Medium   | 22               | 36.67 | 27             | 45.00 | 49             | 40.83 |
|                         | High     | 20               | 33.33 | 13             | 21.67 | 33             | 27.50 |
| Economic motivation     | Low      | 18               | 30.00 | 14             | 23.30 | 32             | 26.67 |
|                         | Medium   | 31               | 51.67 | 37             | 61.67 | 68             | 56.66 |
|                         | High     | 11               | 18.33 | 9              | 15.00 | 20             | 16.67 |
| Achievement motivation  | Low      | 8                | 13.33 | 20             | 33.33 | 28             | 23.33 |
|                         | Medium   | 29               | 48.34 | 28             | 46.67 | 57             | 47.50 |
|                         | High     | 23               | 38.33 | 12             | 20.00 | 35             | 29.17 |
| Management orientation  | Low      | 8                | 13.33 | 18             | 30.00 | 26             | 21.67 |
|                         | Medium   | 46               | 76.67 | 28             | 46.67 | 74             | 61.66 |
|                         | High     | 6                | 10.00 | 14             | 23.33 | 20             | 16.67 |
| Risk orientation        | Low      | 8                | 13.33 | 9              | 15.00 | 17             | 14.17 |
|                         | Medium   | 46               | 76.67 | 39             | 65.00 | 85             | 70.83 |
|                         | High     | 6                | 10.00 | 12             | 20.00 | 18             | 15.00 |
| Value orientation       | Low      | 13               | 21.67 | 6              | 10.00 | 19             | 15.83 |
|                         | Medium   | 32               | 53.33 | 48             | 80.00 | 80             | 66.67 |
|                         | High     | 15               | 25.00 | 6              | 10.00 | 21             | 17.50 |
| Farming commitment      | Low      | 15               | 25.00 | 16             | 26.67 | 31             | 25.83 |
|                         | Medium   | 21               | 35.00 | 27             | 45.00 | 48             | 40.00 |
|                         | High     | 24               | 40.00 | 17             | 28.33 | 41             | 34.17 |
| Decision making pattern | Low      | 25               | 41.67 | 21             | 35.00 | 46             | 38.33 |
|                         | Medium   | 10               | 16.66 | 14             | 23.33 | 24             | 20.00 |
|                         | High     | 25               | 41.67 | 25             | 41.67 | 50             | 41.67 |
| Innovativeness          | Low      | 11               | 18.33 | 19             | 31.67 | 30             | 25.00 |
|                         | Medium   | 22               | 36.67 | 27             | 45.00 | 49             | 40.83 |
|                         | High     | 27               | 45.00 | 14             | 23.33 | 41             | 34.17 |

The medium level of management orientation of farmers was substantiated by stating that farmers often face few complex situations with little resemblance to past or present situations in changing environment and changing nature of agriculture. A major role of farmers as managers is to manage the specific situations faced by them and hence the derived result. The findings are in line with the findings of Chandra Naik (2002), Maraddi (2006) and Lavanya (2010).

#### **4.1.2.5 Risk orientation**

Data pertaining to the risk orientation is presented in Table 4.2 and it indicated that 76.67 per cent of farmers under irrigated farming system were having medium level of risk orientation, followed by 13.33 per cent had low and 10.00 per cent belonged to low level of risk orientation. Whereas, 65.00 per cent of farmers under rainfed farming belonged to medium level of risk orientation, followed by 20.00 per cent low level and 15.00 per cent were having high level of risk orientation.

In pooled data, majority (70.83 %) of them had medium level of risk orientation followed by high (15.00 %) and low (14.17%) level of risk orientation.

The farmers in these categories might have made up their mind to take risk and have put efforts to adopt new agricultural technology for sustainability of their farming systems. It could be due to the fact that risk taking is a must for farmers to earn money to lead a better life. The results were supported by the findings of Chandra Naik (2002), Chandrani saha (2008) and Lavanya (2010) however, the results are contradictory to the findings of Raksha (2012).

#### **4.1.2.6 Value orientation**

The results pertaining to value orientation of farmers under irrigated farming indicates that more than half (53.33 %) of the farmers had medium level followed by 25.00 per cent high and 21.67 per cent low level of value orientation. In case of rainfed farming system, it was observed that majority (80.00 %) of the farmers had medium level of value orientation while, equal percentage (10.00 %) of them had low and high value orientation.

In pooled data, two third of them (66.67 %) had medium level of value orientation followed by high (17.50 %) and low (15.83 %) level of value orientation.

The probable reason could be the changing trends which are desirable, rural value systems need to be promoted on a wider ongoing developments and requirements of the present day. The findings are in line with the findings of Chandra Naik (2002) and Chandrani saha (2008).

#### **4.1.2.7 Farming commitment**

It was quite evident from the results that among irrigated farming system, more than one third (40.00 %) of the farmers belonged to high level of farming commitment followed by medium (35.00 %) and low (25.00 %) level of farming commitment. In case

of rainfed farming system 45.00 per cent of farmers belonged to medium level of farming commitment followed by high (28.33 %) and low (26.67 %).

In combined situation, more than one third of farmers (40.00 %) had medium level of farming commitment, followed by high (34.17 %) and low (25.83 %).

Farming commitment is a sort of dedication not only to earn a living but also to keep the resource base alive and to earn the living on a continuous basis. With all the temptation of intensive agricultural practices, which stress the use of agro-chemicals, the committed farmers have resorted to sustainable farming because of long term considerations. This is reflected in having high farming commitment. The findings are in line with the findings of Chandra Naik (2002).

#### **4.1.2.8 Decision making pattern**

From the Table 4.2, it is learnt that an equal percentage (41.67 %) of farmers under irrigated and rainfed farming systems belonged to high level of decision making followed by low (41.67 % and 35.00 %) and medium (16.66 % and 23.33 %) level category.

In pooled data, 41.67 per cent had high level of decision making followed by low (38.33 %) and medium (20.00 %) category.

The reason is that decision making is very important to make better returns from agriculture and allied activities. Farmers need to take decision according to the existing situation, available resources and to maintain the sustainability of farming systems. The findings are in line with the findings of Sidram (2008), but contradictory with the findings of Ravi (2007).

#### **4.1.2.9 Innovative proneness**

About 45.00 per cent of farmers under irrigated farming system had high level of innovative proneness followed by 36.67 per cent were medium and 18.33 per cent had low level of innovativeness. In case of rainfed farming system 45.00 per cent of farmers belonged to medium innovative proneness, followed by low (31.67 %) and high (23.33 %) level of innovative proneness.

In pooled situation, more than one third (40.83 %) had medium level of innovativeness followed by 34.17 per cent were having high innovativeness and 25.00 per cent had low innovativeness.

Innovativeness plays a greater role in the individuals' personality. The person with higher innovativeness can do things rapidly and more precisely than others. This also may be attributed to the fact that majority of the respondents had education up to high school and pre university/diploma. Generally, higher the formal education level, more the innovations. In such conditions, respondents try to seek more information and try out new ideas and technologies within their budget and limits and also farmers who

are prone to innovations will try to gather information regarding the new technology from various aspects, they wanted to learn new ways of farming, improved cultivation practices and adopt those technologies at faster rate with maximum accuracy. Similar findings were reported by Chandra Naik (2002), Chandrani Saha (2008), Lavanya (2010) and Raksha (2012).

#### **4.1.3 Communication characteristics of farmers under irrigated and rainfed farming systems**

##### **4.1.3.1 Cosmopolitaness**

Data pertaining to the cosmopolitaness presented in Table 4.3 indicates that nearly half (48.33 %) of the farmers under irrigated farming system had high degree of cosmopolitaness while, 36.67 per cent of them had medium level of cosmopolitaness and only 15.00 per cent had low level of cosmopolitaness. In case of rainfed farming system, 46.67 per cent of farmers had medium degree of cosmopolitaness while, 28.33 per cent had low degree of cosmopolitaness and 25.00 per cent had high Cosmopolitaness.

In pooled data, more than one third (41.66 %) of farmers had medium level of cosmopolitaness, 36.67 per cent had high level of cosmopolitaness and 21.67 per cent had low level of cosmopolitaness.

Farmers were actively involved in agricultural operations such as purchase of inputs, marketing and gaining additional knowledge on farming and nearness to town may be the reasons for irrigated farmers to have high level of cosmopolitaness. However, in case of rainfed farmers they had medium cosmopolitaness. The finding of this study was supported by the results of study conducted by Ganesh Prasad (2006), Lavanya (2010) and Mahatab Ali (2010).

##### **4.1.3.2 Extension contact**

It is accounted from Table 4.3 that 41.67 per cent of farmers under irrigated farming had medium level of extension contact which is followed by 30.00 per cent and 28.33 per cent belonged to high and low level of extension contact, respectively. From the study it is also confirmed that 45.00 per cent of farmers under rainfed farming system had medium level of extension contact followed by 28.33 per cent and 26.67 per cent had low and high level of extension contact, respectively.

In combined situation, 43.34 per cent of them had medium level of extension contact, whereas, equal percentage (28.33 %) had low and high extension contact.

Different sources of information influence the knowledge, attitude and perception of the individual towards any farming system. The medium extension contact of the both categories was due to the fact that extension contact results is a purposeful action to seek more information and to clarify the doubts pertaining to the current farming system from the officials of the development departments and other selected organizations. The findings of this study are in agreement with the findings of study conducted by Chandra Naik (2002), Gopala (2010), Mahatab Ali (2010) and Lavanya (2010).

**Table 4.3: Communication characteristics of farmers**

| Characters              | Category | Irrigated<br>(n=60) |       | Rainfed<br>(n=60) |       | Pooled<br>(n=120) |       |
|-------------------------|----------|---------------------|-------|-------------------|-------|-------------------|-------|
|                         |          | No.                 | %     | No.               | %     | No.               | %     |
| Cosmopolitaness         | Low      | 9                   | 15.00 | 17                | 28.33 | 26                | 21.67 |
|                         | Medium   | 22                  | 36.67 | 28                | 46.67 | 50                | 41.66 |
|                         | High     | 29                  | 48.33 | 15                | 25.00 | 44                | 36.67 |
| Extension contact       | Low      | 17                  | 28.33 | 17                | 28.33 | 34                | 28.33 |
|                         | Medium   | 25                  | 41.67 | 27                | 45.00 | 52                | 43.34 |
|                         | High     | 18                  | 30.00 | 16                | 26.67 | 34                | 28.33 |
| Extension participation | Low      | 12                  | 20.00 | 25                | 41.67 | 37                | 30.83 |
|                         | Medium   | 21                  | 35.00 | 17                | 28.33 | 38                | 31.67 |
|                         | High     | 27                  | 45.00 | 18                | 30.00 | 45                | 37.50 |
| Mass media use          | Low      | 9                   | 15.00 | 22                | 36.67 | 31                | 25.83 |
|                         | Medium   | 32                  | 53.33 | 26                | 43.33 | 58                | 48.34 |
|                         | High     | 19                  | 31.67 | 12                | 20.00 | 31                | 25.83 |

#### 4.1.3.3 Extension participation

The results on extension participation revealed that 45.00 per cent of farmers under irrigated farming system had high level of extension participation while 35.00 per cent of them had medium extension participation and 20.00 per cent had low extension participation. Regarding farmers under rainfed farming, 41.67 per cent had low participation followed by 30.00 per cent high and 28.33 per cent medium level of extension participation.

In pooled situation, more than one third (37.50 %) of farmers had high extension participation, 31.67 per cent belonged to medium and 30.83 per cent had low extension participation.

The probable reason for high level of extension participation among irrigated farmers might be due to the fact that majority of them had high level of education and frequently participated in the extension activities conducted by the agriculture department and agricultural university. The participation in the extension activities provides opportunities for contrived experiences and sources of improved agricultural practices prevailing in the region or locality. The results obtained may be due to eagerness of respondents in solving their problems with extension workers, also interest in extension activities to gather recent information and to learn about practical utility of the new technology from extension workers. In case of rainfed farmers, medium extension participation was observed the reason may be due to less opportunities to participate in the extension activities or the activities conducted by the development departments and

other organizations were less in rainfed situations. These results of the study are in conformity with that of Yeshwanth Kumar Naik (2008), Mahatab Ali (2010) and Lavanya (2010).

#### **4.1.3.4 Mass media use**

A glance at the Table 4.3 reveals that 53.33 per cent of the farmers under irrigated farming system had medium, 31.67 per cent had high followed by low mass media use (15.00 %). In case of rainfed farming system, it was observed that 43.33 per cent of the farmers had medium mass media use while, 36.67 per cent had low and 20.00 per cent were having high mass media use.

In pooled situation, nearly half of farmers (48.34 %) had medium level of mass media use followed by equal percentage (25.83 %) belonged low and high level.

Farmers in present days are having more access to the mass media such as television, radio, newspapers and farm magazines. They have the habit of reading newspaper and farm magazines, listening to radio programmes and watching television for agricultural programmes. Mass media are known for their accuracy, consistency, security, timeliness, completeness, reliability, accessibility, objectivity, relevancy, usability, understandability, reputation, usefulness, efficiency and value-addition. Majority of the farmers had medium participation in mass media which explains that they were very much dependent on mass media not only as a source of news and information, but also as a source of entertainment and leisure. In general, it increases the awareness levels of the farmers on the agriculture technology. They help to update latest developments which are a good sign and speak about the interest of respondents to view the things. Thus, their mass media exposure helps the farmers for upgrading agriculture knowledge. The findings are in line with Chandra Naik (2002), Nagadev and Venkataramaiah (2007) and Mahatab Ali (2010).

## **4.2 Sustainability of farming systems and its dimensions/indicators**

The sustainability index of the individual farmers was worked out and the respondents were grouped into three categories, according to sustainability level. The sustainability scores on each of the sub dimensions and indicators were also calculated for different farming systems. The results in this regard are presented in the subsequent headings.

### **4.2.1 Distribution of respondents according to sustainability level in irrigated and rainfed farming systems**

A glance of Table 4.4 and Figure 4.1 reveals that more than one third of the farmers in each system belonged to the medium level of sustainability, ranging from 40.00 per cent in the irrigated system to 46.67 per cent in the rainfed system. However, the distribution of respondents in rainfed system was skewed towards low level of sustainability with 43.33 per cent of farmers belonged to this category. In contrast to this, as high as 43.33 per cent of irrigated farming system farmers were observed in the high sustainability category.

The irrigated farming system has exhibited relatively higher sustainability, possibly because of its better ecological management of fields. There were increased considerations to organic manure, green leaf manure, mixing forest soil and crop residues which are all combined to make better nutrient management. The irrigated farming system was found to have regular water supply, less pest and disease endemics, less dependency on outside resources for inputs, following crop rotation. The irrigated system in the present study reflects unique farming situation having highest economic security, high profitability and lesser dependency on use of chemical insecticides as major factors for occupying medium to high position in sustainability level. The low sustainability level in the rainfed farming system could be attributed to lack of integrated farming system, poor farm management coupled with heavy dependency on purchased inputs, dependency on hired labour and not following crop rotation. The findings are supported by studies of Chandregowda (1996), Chandra Naik (2002) and Chandrani saha (2008).

#### **4.2.2 Distribution of respondents according to sustainability level in eastern and southern dry zones**

A glance of Table 4.5 and Figure 4.2 reveals that 46.67 per cent of the farmers of eastern dry zone under irrigated farming system belonged to the medium level of sustainability followed by high (33.33 %) and low (20.00 %), whereas, in southern dry zone 60.00 per cent of farmers were having medium level of sustainability followed by low (26.67 %) and high (13.33 %) level. The chi-square value which was non-significant indicated that there was no association between the two agro-climatic zones of irrigated farming system with respect to sustainability levels. The farmers under both the zones exhibit same level of sustainability.

The distribution of respondents in rainfed farming system of eastern dry zone belonged to medium (46.67 %) level of sustainability followed by high (43.33 %) and low (10.00 %) level, while in case of southern dry zone 43.33 per cent belonged to medium level, followed by low (40.00 %) and high (16.67 %). The chi-square value which was significant at 0.05 level indicated that there was an association between the two agro-climatic zones with respect to sustainability levels. The farmers under eastern dry zone exhibited a higher level of sustainability when compared to farmers under southern zone.

The irrigated farming system in both the zones has exhibited relatively same sustainability, possibly because of its better ecological management of fields in both the zones. The two zones were found to have regular water supply, less pest and disease endemics, less dependency on outside resources for inputs and reflects unique farming situation having highest economic security, high profitability and lesser dependency on use of chemical insecticides as major factors for occupying medium to high position in sustainability level. Whereas in the rainfed farming system in eastern and southern dry zones has exhibited different levels of sustainability. The low sustainability level in the southern dry zone of rainfed farming system could be attributed to lack of integrated approach in farming system, poor farm management coupled with heavy dependency on purchased inputs, dependency on hired labour.

**Table 4.4: Distribution of respondents according to sustainability level in irrigated and rainfed farming systems**

| Sl. No.      | Sustainability level | Farming system  |        |               |        |
|--------------|----------------------|-----------------|--------|---------------|--------|
|              |                      | Irrigated(n=60) |        | Rainfed(n=60) |        |
|              |                      | No.             | %      | No.           | %      |
| 1            | Low (<38.74)         | 10              | 16.67  | 26            | 43.33  |
| 2            | Medium (38.74-48.70) | 24              | 40.00  | 28            | 46.67  |
| 3            | High (>48.70)        | 26              | 43.33  | 6             | 10.00  |
| <b>Total</b> |                      | 60              | 100.00 | 60            | 100.00 |

**Table 4.5: Distribution of respondents according to sustainability level in eastern and southern dry zones**

| Sl. No. | Sustainability level | Farming system          |       |                          |       |                    |                         |       |                          |       |                |
|---------|----------------------|-------------------------|-------|--------------------------|-------|--------------------|-------------------------|-------|--------------------------|-------|----------------|
|         |                      | Irrigated (n=60)        |       |                          |       | Rainfed (n=60)     |                         |       |                          |       |                |
|         |                      | Eastern dry zone (n=30) |       | Southern dry zone (n=30) |       | $\chi^2$ Value     | Eastern dry zone (n=30) |       | Southern dry zone (n=30) |       | $\chi^2$ Value |
|         |                      | No.                     | %     | No.                      | %     |                    | No.                     | %     | No.                      | %     |                |
| 1       | Low                  | 6                       | 20.00 | 8                        | 26.67 | 3.36 <sup>NS</sup> | 3                       | 10.00 | 12                       | 40.00 | 8.99*          |
| 2       | Medium               | 14                      | 46.67 | 18                       | 60.00 |                    | 14                      | 46.67 | 13                       | 43.33 |                |
| 3       | High                 | 10                      | 33.33 | 4                        | 13.33 |                    | 13                      | 43.33 | 5                        | 16.67 |                |

\* Significant at 5% level, NS: Non-significant  $\chi^2$  (0.05, 2df) = 5.991

#### **4.2.3 Distribution of respondents according to ecological safety dimension in irrigated and rainfed farming systems**

It is evident from Table 4.6 and Figure 4.4 that 46.67 per cent of farmers in irrigated farming system belonged to medium level of ecological safety followed by high (41.67 %) and low (11.66 %) level. It was interesting to note in case of rainfed farming system 46.67 per cent of farmers had medium level of ecological safety followed by low (36.67 %) and high (16.66 %) level.

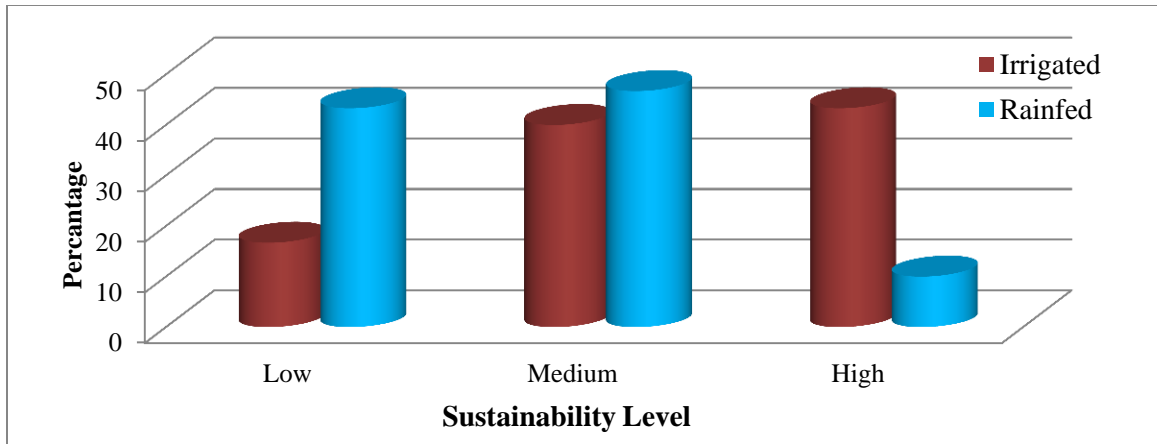
Between the two groups, farmers under irrigated system had better ecological safety. The plausible reasons for these results can be explained by the following factors. It was ascertained from the farmers that they were practicing sowing at right time to avoid pest and diseases in the off-season and to increase the yield considerably. Biological resources from plant, animal and microorganisms had shown favorable effects on preserving environmental capital intact. Increased consideration to biological resources and forest soil has all combined to make better effect in preserving environment in irrigated system.

#### **4.2.4 Distribution of respondents according to ecological safety dimension in eastern and southern dry zones**

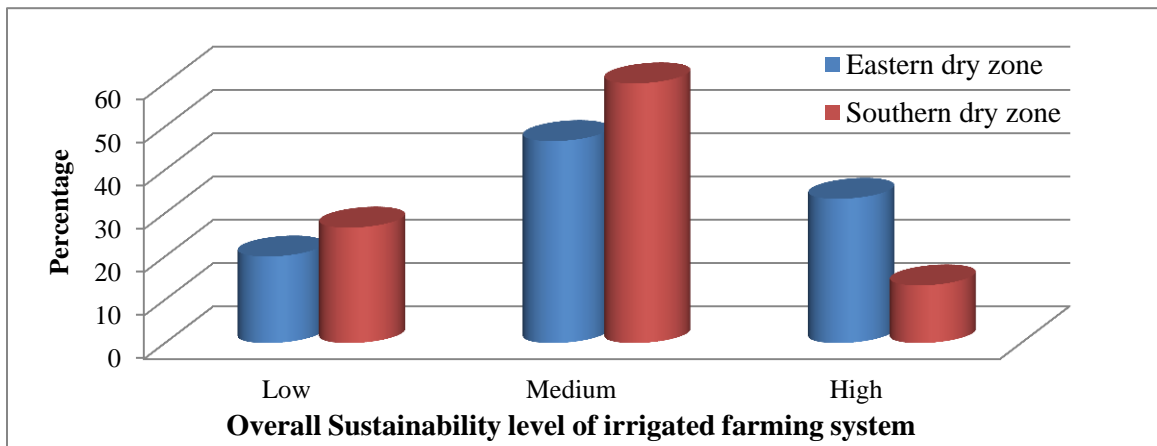
It is evident from Table 4.7 and Figure 4.5 that 43.33 per cent of farmers of eastern dry zone under irrigated farming system belonged to medium level of ecological safety followed by high (30.00 %) and low (26.67 %) level. It was interesting to note in case of southern dry zone of irrigated farming system 40.00 per cent of farmers had low level of ecological safety followed by high (33.33 %) and medium (26.67 %) level. The results of chi-square test applied on this set of data were statistically non-significant, which implied that there was no association between the levels of ecological safety and two zones of the irrigated farming systems.

Table 4.7 and Figure 4.6 also revealed that more than half (53.33 %) of farmers under eastern dry zone of rainfed farming system belonged to high level of ecological safety followed by medium (40.00 %) and low (6.67 %) level of ecological safety categories, with respect to southern dry zone of rainfed farming system, an higher percentage of respondents (60.00 %) belonged to low level of economic security followed by medium (33.33 %) and high (6.67 %). The chi-square value which was significant at 0.01 level indicated that there was an association between the two agro-climatic zones with respect to ecological safety levels.

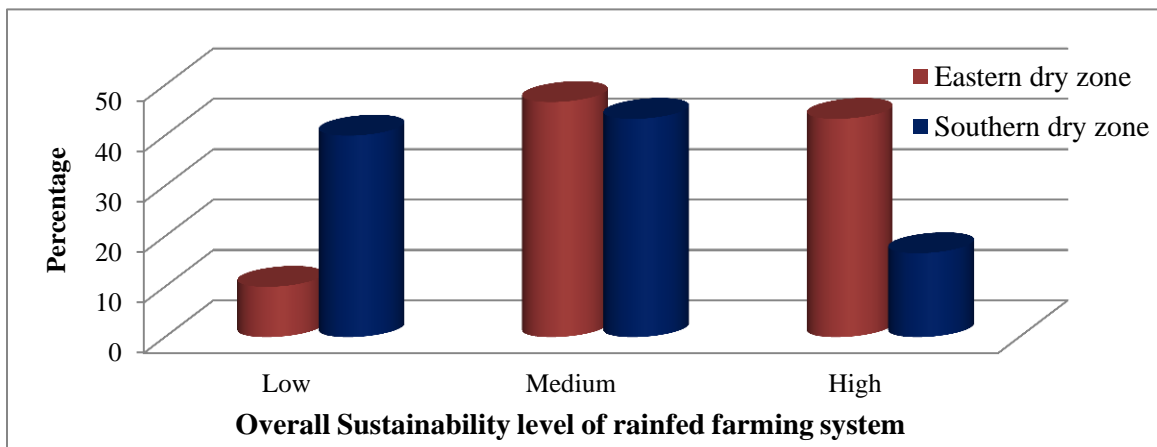
Two zones of farmers under irrigated farming system had better ecological safety. The plausible reasons for these results were due to the biological resources from plant, animal and microorganisms had shown favorable effects on preserving environmental capital intact. Increased consideration to biological resources and forest soil has all combined to make better effect in preserving environment in both the zones. Whereas, in rainfed farming system under eastern dry zone farmers were practicing good ecological management practices, applying more biological nutrients than southern dry zone so their farms are more sustainable. In southern dry zone farmers were having more reliance on



**Fig. 4.1: Distribution of respondents according to sustainability level in irrigated and rainfed farming systems**



**Fig. 4.2: Distribution of respondents according to sustainability level in eastern and southern dry zones of irrigated farming system**



**Fig. 4.3: Distribution of respondents according to sustainability level in eastern and southern dry zones of rainfed farming system**

**Table 4.6: Distribution of respondents according to ecological safety dimension in irrigated and rainfed farming systems**

| Sl. No.      | Ecological safety level | Farming system  |        |               |        |
|--------------|-------------------------|-----------------|--------|---------------|--------|
|              |                         | Irrigated(n=60) |        | Rainfed(n=60) |        |
|              |                         | No.             | %      | No.           | %      |
| 1            | Low (<40.27)            | 7               | 11.66  | 22            | 36.67  |
| 2            | Medium (40.27-53.92)    | 28              | 46.67  | 28            | 46.67  |
| 3            | High (>53.92)           | 25              | 41.67  | 10            | 16.66  |
| <b>Total</b> |                         | 60              | 100.00 | 60            | 100.00 |

**Table 4.7: Distribution of respondents according to ecological safety dimension in eastern and southern dry zones**

| Sl. No. | Ecological safety level | Farming system          |       |                          |       |                    |                         |       |                          |       |                     |
|---------|-------------------------|-------------------------|-------|--------------------------|-------|--------------------|-------------------------|-------|--------------------------|-------|---------------------|
|         |                         | Irrigated (n=60)        |       |                          |       | Rainfed (n=60)     |                         |       |                          |       |                     |
|         |                         | Eastern dry zone (n=30) |       | Southern dry zone (n=30) |       | $\chi^2$ Value     | Eastern dry zone (n=30) |       | Southern dry zone (n=30) |       | $\chi^2$ Value      |
|         |                         | No.                     | %     | No.                      | %     |                    | No.                     | %     | No.                      | %     |                     |
| 1       | Low                     | 8                       | 26.67 | 12                       | 40.00 | 2.04 <sup>NS</sup> | 2                       | 6.67  | 18                       | 60.00 | 23.87 <sup>**</sup> |
| 2       | Medium                  | 13                      | 43.33 | 8                        | 26.67 |                    | 12                      | 40.00 | 10                       | 33.33 |                     |
| 3       | High                    | 9                       | 30.00 | 10                       | 33.33 |                    | 16                      | 53.33 | 2                        | 6.67  |                     |

\*\* Significant at 1% level, NS: Non-significant,  $\chi^2$  (0.01, 2df) = 9.210

chemical inputs than biological nutrients which might have adversely affected the ecological sustainability of farming system.

#### **4.2.5 Distribution of respondents according to economic security dimension in irrigated and rainfed farming systems**

A perusal of data on the economic security level of respondents (Table 4.8 and Figure 4.7) revealed that 40.00 per cent of farmers under irrigated farming system belonged to medium level of economic security followed by high and low (38.33% and 21.67 %) level of economic security categories, with respect to rainfed farming system, an higher percentage of respondents (43.33 % and 31.67 %) belonged to low and medium levels of economic security. The irrigated farming system farmers showed higher level of economic security when compared to rainfed farmers.

The probable reasons for high economic security in irrigated farming system may be that the hybrid varieties they used to get higher return, more farm risk taken to maintain the production level of farm by staying always on farm, easy access to marketing of product, integrated approach of different components on the farm.

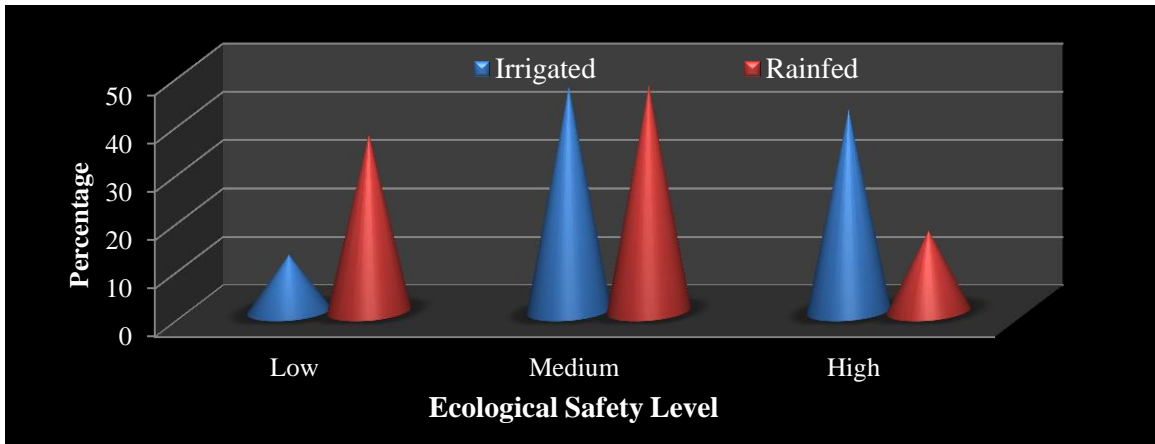
#### **4.2.6 Distribution of respondents according to economic security dimension in eastern and southern dry zones**

A perusal of data on the economic security level of respondents (Table 4.9 and Figure 4.8) revealed that 40.00 per cent of farmers under eastern dry zone of irrigated farming system belonged to medium level of economic security followed by same (30.00 %) in high and low level, with respect to southern dry zone of irrigated farming system, exactly half (50.00 %) of respondents belonged to medium level of economic security followed by low (26.67 %) and high (23.33 %).

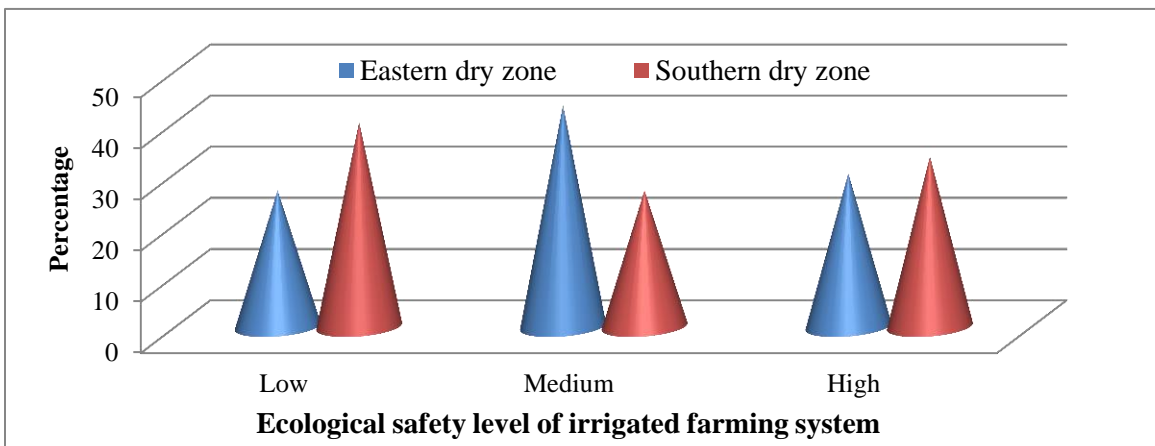
It is also evident from Table 4.9 and Figure 4.9 that 40.00 per cent of farmers of eastern dry zone under rainfed farming system belonged to low level of economic security followed by medium (36.67 %) and high (23.33 %) level. It was interesting to note in case of southern dry zone of rainfed farming system 40.00 per cent of farmers had medium level of economic security followed by high (36.67 %) and low (23.33 %) level.

The chi-square value showed non-significant association between the two zones of irrigated and rainfed farming systems and the level of economic security. Two zones of irrigated and rainfed farming systems exhibited same level of economic security.

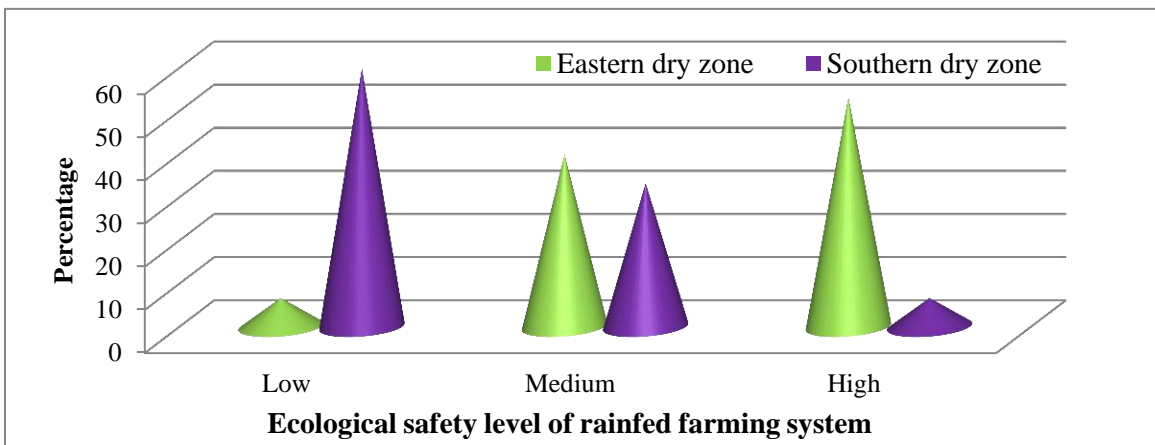
The probable reasons for non-significant association of economic security in both the zones of irrigated and rainfed farming systems may be that the hybrid varieties they used to get higher return, more farm risk taken to maintain the production level of farm by staying always on farm, easy access to marketing of product, integrated approach of different components on the farm.



**Fig. 4.4: Distribution of respondents according to ecological safety dimension in irrigated and rainfed farming systems**



**Fig. 4.5: Distribution of respondents according to ecological safety dimension in eastern and southern dry zones of irrigated farming system**



**Fig. 4.6: Distribution of respondents according to ecological safety dimension in eastern and southern dry zones of rainfed farming system**

**Table 4.8: Distribution of respondents according to economic security dimension in irrigated and rainfed farming systems**

| Sl. No.      | Economic security level | Farming system  |        |               |        |
|--------------|-------------------------|-----------------|--------|---------------|--------|
|              |                         | Irrigated(n=60) |        | Rainfed(n=60) |        |
|              |                         | No.             | %      | No.           | %      |
| 1            | Low (<35.15)            | 13              | 21.67  | 26            | 43.33  |
| 2            | Medium (35.15-49.44)    | 24              | 40.00  | 19            | 31.67  |
| 3            | High (>49.44)           | 23              | 38.33  | 15            | 25.00  |
| <b>Total</b> |                         | 60              | 100.00 | 60            | 100.00 |

**Table 4.9: Distribution of respondents according to economic security dimension in eastern and southern dry zones**

| Sl. No. | Economic security level | Farming system          |       |                          |       |                    |                         |       |                          |       |                    |
|---------|-------------------------|-------------------------|-------|--------------------------|-------|--------------------|-------------------------|-------|--------------------------|-------|--------------------|
|         |                         | Irrigated (n=60)        |       |                          |       | Rainfed (n=60)     |                         |       |                          |       |                    |
|         |                         | Eastern dry zone (n=30) |       | Southern dry zone (n=30) |       | $\chi^2$ Value     | Eastern dry zone (n=30) |       | Southern dry zone (n=30) |       | $\chi^2$ Value     |
|         |                         | No.                     | %     | No.                      | %     |                    | No.                     | %     | No.                      | %     |                    |
| 1       | Low                     | 9                       | 30.00 | 8                        | 26.67 | 0.64 <sup>NS</sup> | 12                      | 40.00 | 7                        | 23.33 | 2.24 <sup>NS</sup> |
| 2       | Medium                  | 12                      | 40.00 | 15                       | 50.00 |                    | 11                      | 36.67 | 12                       | 40.00 |                    |
| 3       | High                    | 9                       | 30.00 | 7                        | 23.33 |                    | 7                       | 23.33 | 11                       | 36.67 |                    |

NS: Non-significant

#### 4.2.7 Distribution of respondents according to their social stability levels in irrigated and rainfed farming systems

It is evident from Table 4.10 and Figure 4.10 that most (46.67 %) of the irrigated farmers had a high level of social stability followed by medium (28.33 %) and low (25.00 %), while in rainfed farming system 45.00 per cent belonged to medium level of social stability followed by low (38.33 %) and high (16.67 %). The farmers belonging to irrigated farming system had relatively high social stability than those coming under irrigated system.

The higher social stability of irrigated farming system could be attributed to less dependency on purchased inputs, have experienced repeated economic success over the years. As evident from the higher innovativeness of irrigated farmers, the information self reliancy also ought to be better and more employment is generated because of integrated approach, all these factors contributed for the better family food security and to lead a quality of life in irrigated farming system than rainfed system.

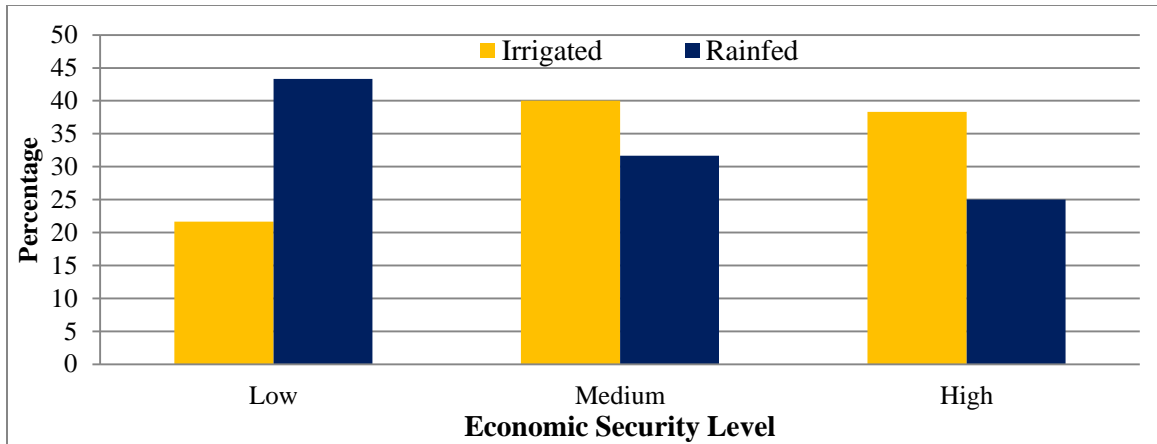
**Table 4.10: Distribution of respondents according to social stability dimension in irrigated and rainfed farming systems**

| Sl. No.      | Social stability level | Farming system  |        |               |        |
|--------------|------------------------|-----------------|--------|---------------|--------|
|              |                        | Irrigated(n=60) |        | Rainfed(n=60) |        |
|              |                        | No.             | %      | No.           | %      |
| 1            | Low (<32.26)           | 15              | 25.00  | 23            | 38.33  |
| 2            | Medium (32.26-43.16)   | 17              | 28.33  | 27            | 45.00  |
| 3            | High (>43.16)          | 28              | 46.67  | 10            | 16.67  |
| <b>Total</b> |                        | 60              | 100.00 | 60            | 100.00 |

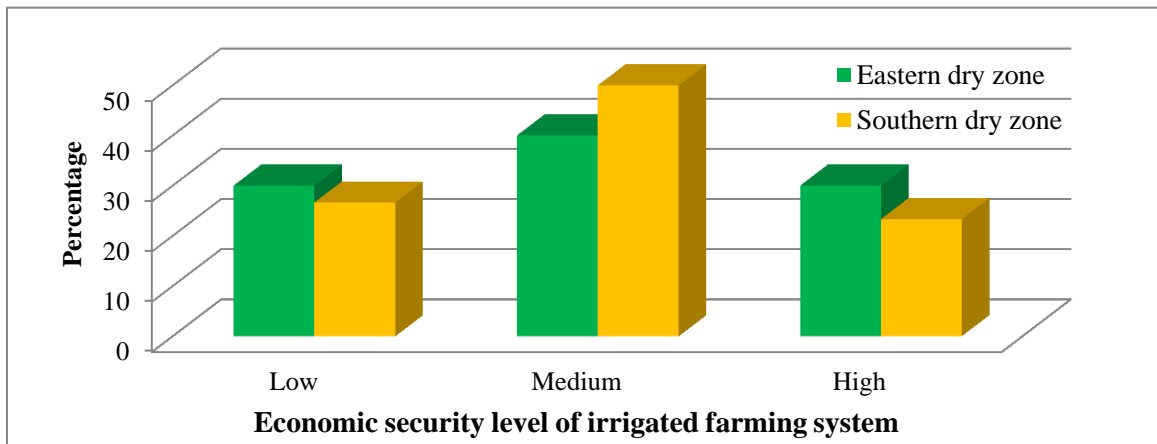
The above findings led to the acceptance of hypothesis No.3 which was stated that different dimensions of sustainability differ in irrigated and rainfed farming systems.

#### 4.2.8 Distribution of respondents according to social stability dimension in eastern and southern dry zones

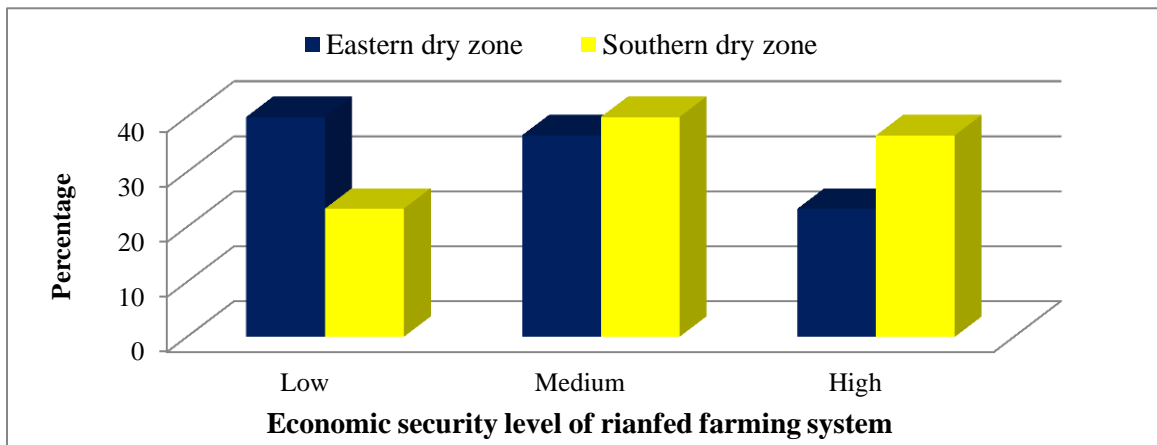
It is evident from Table 4.11 and Figure 4.11 that nearly half (46.67 %) of farmers under eastern dry zone of irrigated farming system had a high level of social stability followed by medium (40.00 %) and low (13.33 %) level, while in southern dry zone of irrigated farming system 43.33 per cent belonged to low level of social stability followed by medium (36.67 %) and high (20.00 %) level. The value of chi-square test applied in the irrigated farming system was statistically significant, which implied that there was an association between the levels of social stability and two zones of irrigated farming system. The farmers belonging to eastern dry zone of irrigated farming system had relatively high social stability than those coming under southern dry zone.



**Fig. 4.7: Distribution of respondents according to economic security dimension in irrigated and rainfed farming systems**



**Fig. 4.8: Distribution of respondents according to economic security dimension in eastern and southern dry zones of irrigated farming system**



**Fig. 4.9: Distribution of respondents according to economic security dimension in eastern and southern dry zones of rainfed farming system**

The high social stability of eastern dry zone of irrigated farming system could be attributed to less dependency for purchased inputs, the information self reliance also ought to be better more farm risk management, employment generation and more family food security than southern dry zone of irrigated farming system.

A glance of Table 4.11 and Figure 4.12 also reveals that exactly half (50.00 %) of the farmers of eastern dry zone under rainfed farming system belonged to high level of social stability followed by low (26.67 %) and medium (23.33 %), whereas, in southern dry zone 43.33 per cent of farmers were having medium level of social stability followed by low (30.00 %) and high (26.67 %) level. The chi-square value which was non-significant indicated that there was no association between two zones with respect to social stability level. The farmers under two zones of rainfed farming system exhibited same level of social stability.

As evident from the results eastern and southern dry zones of rainfed farming system were having non-significant difference in social stability level as both the zones having same level of information self reliance, farm risk management, family food security and quality of life.

#### **4.2.9 Comparison of different dimensions of sustainability between irrigated and rainfed farming systems**

The data in Table 4.12 and Figure 4.13 depicts the sustainability indices obtained by the farmers under the two farming systems. As it is evident that, the farmers under irrigated farming system had obtained a relatively higher mean ecological safety score of 52.70 while rainfed farming had a mean score of 41.49. In case of economic security index, the irrigated farmers had obtained a highest mean score of 45.65 followed by rainfed farmers who had scored only 38.94. And the irrigated farming had obtained a social stability mean score of 40.36 and rainfed farming had a mean score of 35.06. Further, the farmers under irrigated farming system had obtained a relatively higher overall sustainability index (48.00) than those under rainfed system (39.43).

Further, the t-value showed the significant difference at 0.01 per cent level of probability, pointing to significant difference in the sustainability indices between the two farming systems.

The present investigation revealed that irrigated system was relatively more stable in terms of water management, pest-disease management and yield per unit area and return per unit of input used. The ecological safety and economic security was found to be different among two systems. Irrigated system was found to be safer and secured than rainfed system. Ideally speaking the irrigated system is the most viable system considering its resources, well informed innovative managers and strong economic support in terms of information and input supply. Assured returns for investments have prompted these farmers to go in for the intensive management. Over the years, these farmers have been moulded and fine-tuned to accept and adopt anything that gives immediate returns. Above all, these farmers have not lagged behind in using costly

chemicals to save the crop from temporary pest incidences thus ensuring expected high yield levels. Hence, their level of sustainability was found to be high.

**Table 4.11: Distribution of respondents according to social stability dimension in eastern and southern dry zones**

| Sl. No. | Social stability level | Farming system          |       |                          |       |                |                         |       |                          |       |                    |
|---------|------------------------|-------------------------|-------|--------------------------|-------|----------------|-------------------------|-------|--------------------------|-------|--------------------|
|         |                        | Irrigated (n=60)        |       |                          |       |                | Rainfed (n=60)          |       |                          |       |                    |
|         |                        | Eastern dry zone (n=30) |       | Southern dry zone (n=30) |       | $\chi^2$ Value | Eastern dry zone (n=30) |       | Southern dry zone (n=30) |       | $\chi^2$ Value     |
|         |                        | No.                     | %     | No.                      | %     |                | No.                     | %     | No.                      | %     |                    |
| 1       | Low                    | 4                       | 13.33 | 13                       | 43.33 | 8.00*          | 8                       | 26.67 | 9                        | 30.00 | 3.99 <sup>NS</sup> |
| 2       | Medium                 | 12                      | 40.00 | 11                       | 36.67 |                | 7                       | 23.33 | 13                       | 43.33 |                    |
| 3       | High                   | 14                      | 46.67 | 6                        | 20.00 |                | 15                      | 50.00 | 8                        | 26.67 |                    |

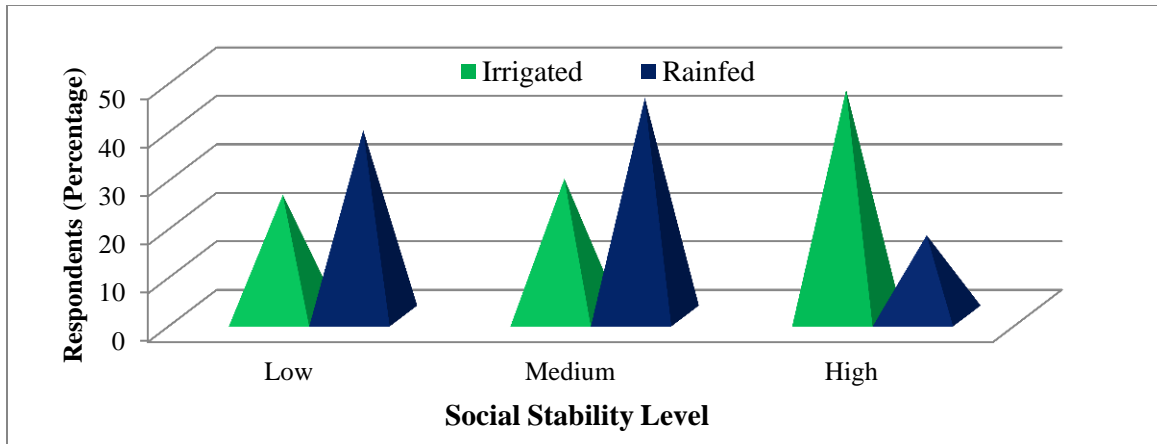
\* Significant at 5% level, NS: Non-significant,  $\chi^2 (0.05, 2df) = 5.991$

These findings led to the acceptance of hypotheses that “sustainability of irrigated farming system differed from that of rainfed farming system”.

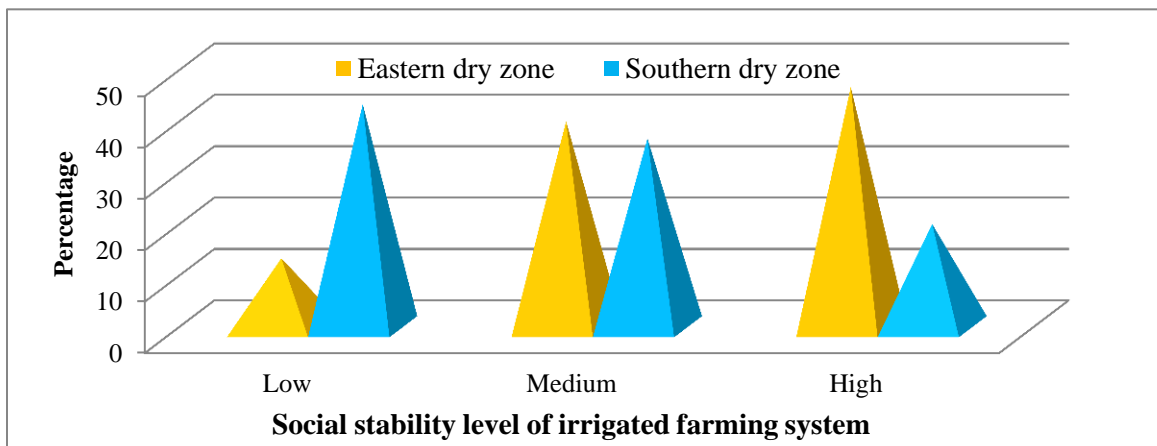
#### 4.2.10 Comparison of different dimensions of sustainability between eastern and southern dry zones

##### 4.2.10.1 Comparison of different dimensions of sustainability of irrigated farming system between eastern and southern dry zones

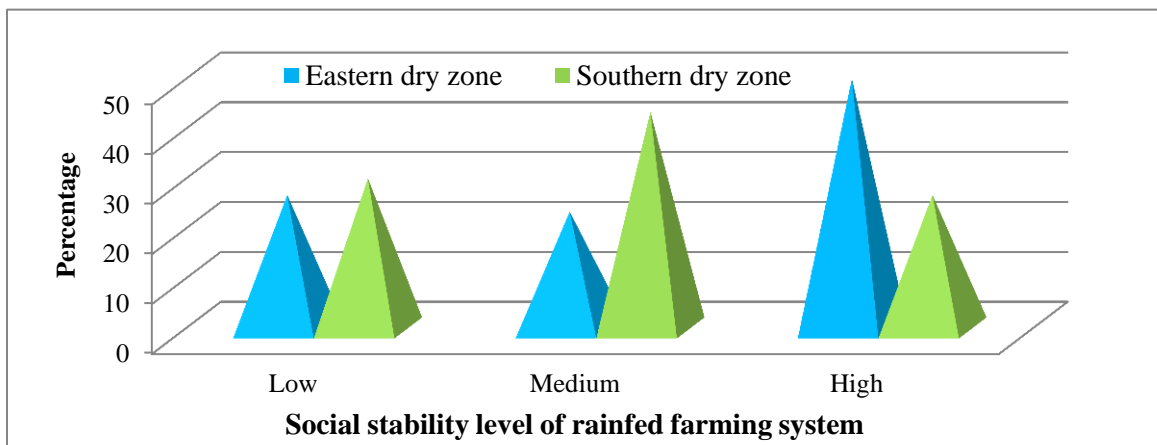
The data in Table 4.13 and Figure 4.14 depicts the sustainability indices obtained by the farmers under the two agro-climatic zones of irrigated farming system. As it is evident that, the famers under eastern dry zone and southern dry zone of irrigated farming system had obtained a same mean ecological safety score of 52.69 and the t-value showed the non-significant difference between two zones. In case of economic security index, irrigated farmers of eastern dry zone had obtained a mean score of 46.08 followed by southern dry zone farmers who had scored 45.23 and the t-value showed the non-significant difference between two zones. Whereas, the eastern dry zone of irrigated farming had obtained a social stability mean score of 45.06 and southern dry zone had a mean score of 35.66 and the t-value showed the significant difference at 0.01 per cent level of probability, pointing to significant difference in the social stability indices between the two zones of irrigated farming system. There is no significant difference between the famers under eastern dry zone (49.00) of irrigated farming system and that of farmers of southern dry zone (47.00) with respect to overall sustainability index (t-value showed the non-significant difference between two zones).



**Fig. 4.10: Distribution of respondents according to social stability dimension in irrigated and rainfed farming systems**



**Fig. 4.11: Distribution of respondents according to social stability dimension in eastern and southern dry zones of irrigated farming system**



**Fig. 4.12: Distribution of respondents according to social stability dimension in eastern and southern dry zones of rainfed farming system**

**Table 4.12: Comparison of different dimensions of sustainability between irrigated and rainfed farming systems**

| Sustainability dimensions | Mean index value                |                               | 't' value |
|---------------------------|---------------------------------|-------------------------------|-----------|
|                           | Irrigated farming system (n=60) | Rainfed farming system (n=60) |           |
| Ecological safety         | 52.7                            | 41.49                         | 4.91**    |
| Economic security         | 45.65                           | 38.94                         | 2.64**    |
| Social stability          | 40.36                           | 35.06                         | 2.74**    |
| Overall sustainability    | 48.00                           | 39.43                         | 5.20**    |

\*\* Significant at 1% level,  $t(0.01, 118df) = 2.58$

The ecological safety, economic security and overall sustainability has exhibited non-significant difference whereas, social stability has exhibited significant difference. The probable reasons for high social stability of eastern dry zone of irrigated farming system could be attributed to less dependency for purchased inputs, the information self reliance also ought to be better more farm risk management, employment generation and more family food security than southern dry zone of irrigated farming system.

#### **4.2.10.1 Comparison of different dimensions of sustainability of rainfed farming system between eastern and southern dry zones**

It is evident from Table 4.14 and Figure 4.15 that, the farmers under eastern dry zone of rainfed farming system had obtained a relatively higher mean ecological safety score of 49.57 while southern dry zone had a mean score of 33.42 and the t-value showed the significant difference at 0.01 per cent level of probability, pointing to significant difference in the ecological safety indices between the two zones of rainfed farming system. In case of economic security index, rainfed farming system of eastern dry zone had obtained a mean score of 35.84 while southern dry zone farmers had scored 42.03 and the t-value showed the non-significant difference between two zones. Whereas, the eastern dry zone of rainfed farming had obtained a social stability mean score of 36.91 and southern dry zone had a mean score of 33.20 and the t-value showed the non-significant difference between two zones. The farmers under eastern dry zone of rainfed farming system had obtained a relatively higher overall sustainability index (42.48) than those under southern dry zone (36.39) and the t-value showed the significant difference at 0.01 per cent level of probability, pointing to significant difference in the overall sustainability between the two zones of rainfed farming system.

In rainfed farming system the ecological safety and overall sustainability has exhibited significant difference but in case of economic security and social stability has exhibited non-significant difference. The probable reason for significant difference of ecological safety between eastern dry zone and southern dry zone might be due to the fact

that the farmers were practicing good ecological management practices, applying more biological nutrients than southern dry zone hence their farms were more sustainable. In southern dry zone farmers were having more reliance on chemical inputs than biological nutrients which adversely affected ecological sustainability of farming system. This intern might have affected the overall sustainability level of southern dry zone.

The above findings led to the acceptance of hypothesis (H<sub>3</sub>) which was stated that sustainability differs from eastern dry zone to southern dry zone.

**Table 4.13: Comparison of different dimensions of sustainability of irrigated farming system between eastern and southern dry zones**

| Sustainability dimensions | Mean index value        |                          |                     |
|---------------------------|-------------------------|--------------------------|---------------------|
|                           | Eastern dry zone (n=30) | Southern dry zone (n=30) | 't' Value           |
| Ecological safety         | 52.69                   | 52.70                    | 0.004 <sup>NS</sup> |
| Economic security         | 46.08                   | 45.23                    | 0.247 <sup>NS</sup> |
| Social stability          | 45.06                   | 35.66                    | 3.302 <sup>**</sup> |
| Overall sustainability    | 49.00                   | 47.00                    | 0.838 <sup>NS</sup> |

\*\* Significant at 1% level, NS: Non-significant, t (0.01, 58df) =2.58

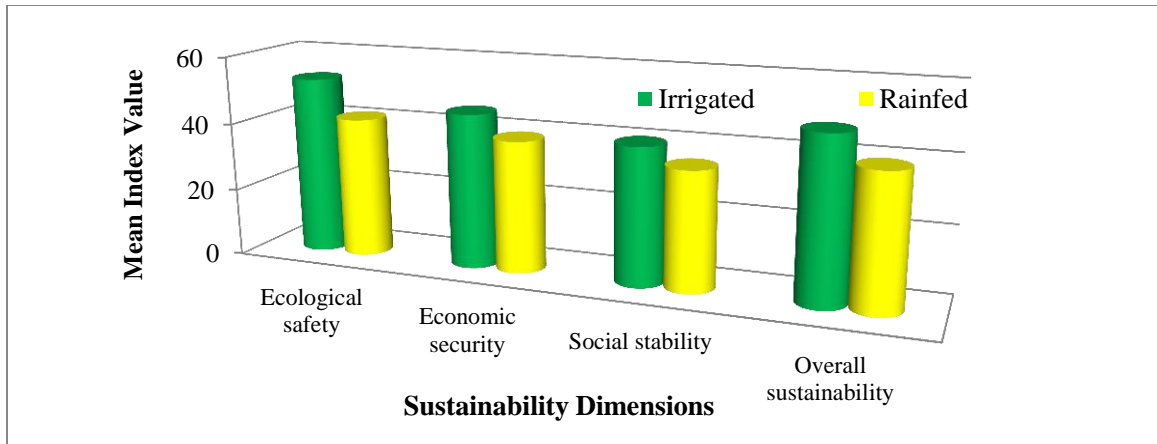
**Table 4.14: Comparison of different dimensions of sustainability of rainfed farming system between eastern and southern dry zones**

| Sustainability dimensions | Mean index value        |                          |                     |
|---------------------------|-------------------------|--------------------------|---------------------|
|                           | Eastern dry zone (n=30) | Southern dry zone (n=30) | 't' Value           |
| Ecological safety         | 49.57                   | 33.42                    | 6.115 <sup>**</sup> |
| Economic security         | 35.84                   | 42.03                    | 1.671 <sup>NS</sup> |
| Social stability          | 36.91                   | 33.20                    | 1.589 <sup>NS</sup> |
| Overall sustainability    | 42.48                   | 36.39                    | 2.829 <sup>**</sup> |

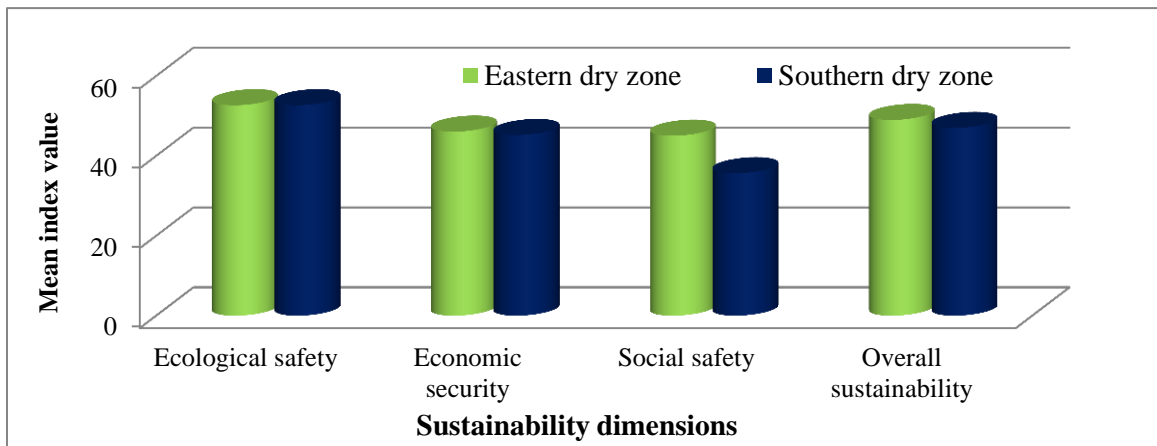
\*\* Significant at 1% level, NS: Non-significant, t (0.01, 58df) =2.58

#### **4.2.11 Comparison of indicators of sustainability between irrigated and rainfed farming systems**

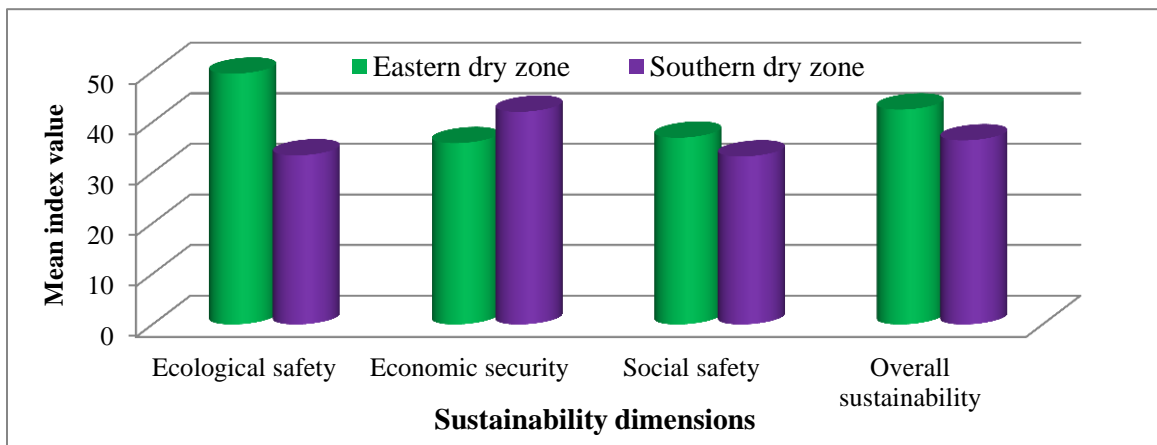
Table 4.15 and Figure 4.16 indicate the mean scores obtained by the respondents on the fifteen indicators of sustainability. A t-test was applied to know the significant difference if any, between the sustainability scores of irrigated and rainfed farming systems of the fifteen indicators. There was significant difference at 0.01 per cent level of



**Fig. 4.13: Comparison of different dimensions of sustainability and overall sustainability between irrigated and rainfed farming systems**



**Fig. 4.14: Comparison of different dimensions of sustainability of irrigated farming system eastern and southern dry zones**



**Fig. 4.15: Comparison of different dimensions of sustainability of rainfed farming system between eastern and southern dry zones**

probability in respect of eight indicators out of fifteen. These eight indicators were integrated pest management, water management, land productivity, profitability, farm level risk management, marketing, employment generation and quality of life. However, there was no significant difference in sustainability scores of the indicators like integrated nutrient management, cropping pattern, land use pattern, input output relationship (productivity), input self-sufficiency, information self-reliance and family food security.

The probable reasons for the results obtained for each of the indicator is discussed below:

**Integrated nutrient management:** This was found to be non-significant among irrigated and rainfed farming systems. This could be because of the reason that the farmers of both the farming system might have realized the benefits of integrated nutrient management practices. Higher level of extension contact of farmers in both the systems would have helped in exposing themselves to different sources of information. This would have been influenced in knowing the practices and adopting them without any hindrance.

**Integrated pest management:** This indicator showed significant difference with higher score for irrigated farming system. This might be due to the fact that heavy dependency and/or improper use of chemicals, ignoring the benefits of integrated approaches was witnessed in rainfed system. Unfortunately these chemicals were used even under unwarranted situations to add to the woes. Emphasis on preventive measures without giving equal attention to prophylactic measures was also lacking in the rainfed system.

**Water management:** This indicator showed significant difference between irrigated and rainfed farming system. This might be due to several reasons that the farmers in irrigated farming system could control water usage especially during before and after fertilizer application, they were able to provide accurate number of irrigation required for crop and hence they had obtained higher scores on water management. Whereas, water management in rainfed farming system had no control over the inflow of water and farmers experienced helplessness over runoff utilization. In this system, water management was purely at the mercy of rain God or nature and farmers exhibited least concern about its *in situ* retention.

**Cropping pattern:** There was a non-significant difference between irrigated and rainfed farming systems on this indicator. A vast majority of farmers were not practicing intercropping but practicing crop rotation. Farmers in both the irrigated and rainfed systems seem to have realized the benefits of crop rotation.

**Land use pattern:** This indicator showed non-significant difference between irrigated and rainfed farming systems. Most of the farmers under irrigated and rainfed systems were utilizing land judiciously for crop cultivation, forestry purpose and also for allied agriculture enterprises.

**Land productivity:** There was a significant difference between irrigated and rainfed farming systems. Farmers under irrigated system recorded more land productivity than

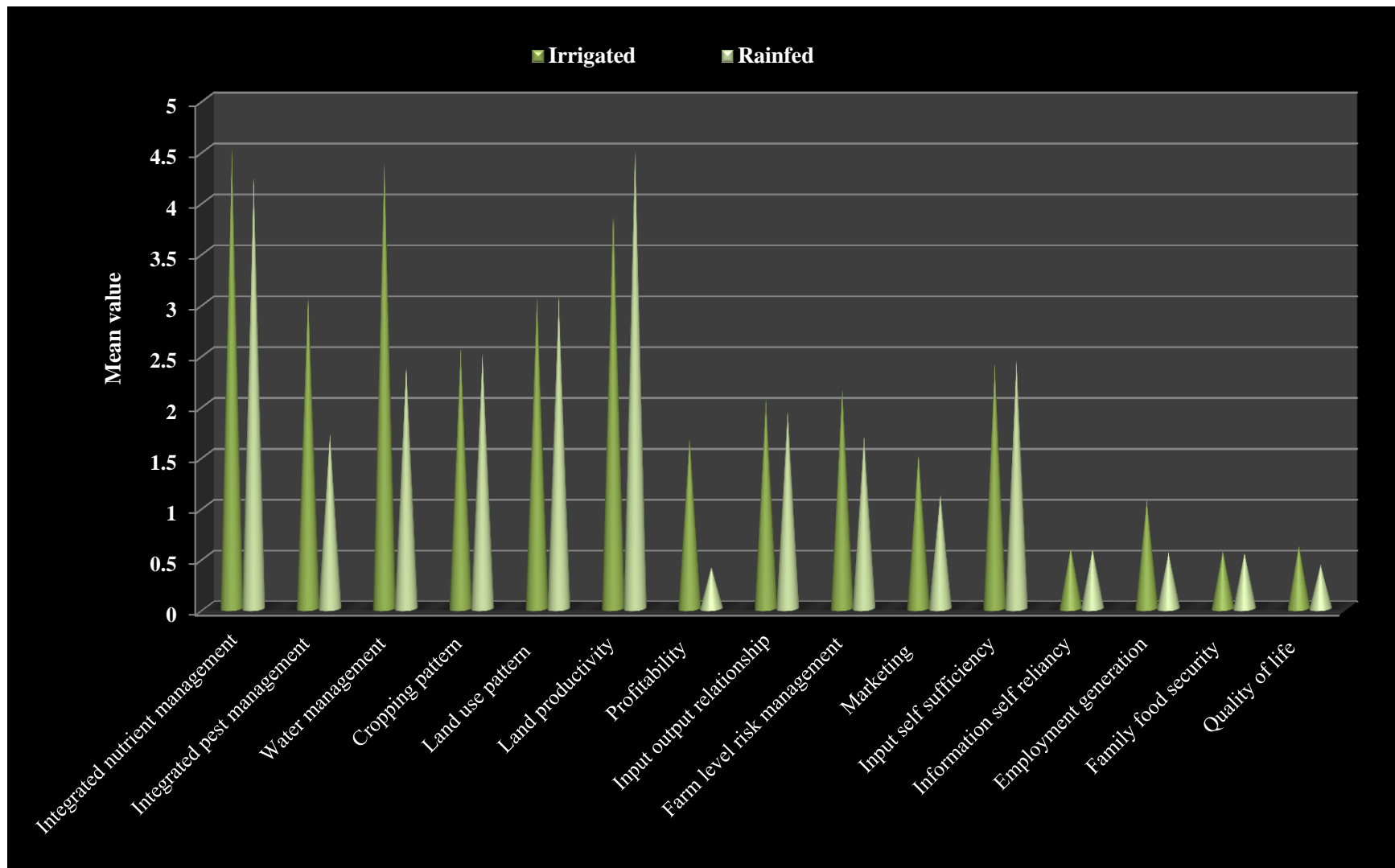
that of the rainfed system. Use of hybrids by innovative farmers under irrigated system might be the sole basis for their higher land productivity. Irrigated system's productivity showed a way for achieving the economic sustainability along with ecological sustainability.

**Profitability:** This indicator showed significant difference between irrigated farming system and rainfed farming system. This might be due to the fact that the rainfed farming system had one or other problems in getting the expected yield, owing to external threats that the farmers could not anticipate and failed to combat them. However, it is reassuring that the irrigated system with comparatively better yields and income security compared to rainfed system. However, the farmers from rainfed farming system faced the crop maturity problems, untimely rains and occasional floods. This finding reconfirms the ecologists view that an agricultural system may be highly productive but it is subjected to substantial risks as far as their sustainability is concerned (Nadakarni, 1993).

**Table 4.15: Comparison of different indicators of sustainability between irrigated and rainfed farming systems**

| Sl. No.    | Indicators of Sustainability             | Farming system   |      |                |      | 't' Value           |
|------------|--|------------------|------|----------------|------|---------------------|
|            |  | Irrigated (n=60) |      | Rainfed (n=60) |      |                     |
|            |  | Mean             | SD   | Mean           | SD   |                     |
| <b>I</b>   | <b>Ecological dimension</b>              |                  |      |                |      |                     |
| 1          | Integrated nutrient management           | 4.53             | 1.84 | 4.22           | 1.67 | 0.979 <sup>NS</sup> |
| 2          | Integrated pest management               | 3.12             | 1.14 | 1.73           | 0.98 | 7.175 <sup>**</sup> |
| 3          | Water management                         | 4.43             | 1.65 | 2.42           | 1.50 | 6.971 <sup>**</sup> |
| 4          | Cropping pattern                         | 2.55             | 1.08 | 2.52           | 1.44 | 0.115 <sup>NS</sup> |
| 5          | Land use pattern                         | 3.08             | 1.25 | 3.06           | 1.66 | 0.073 <sup>NS</sup> |
| <b>II</b>  | <b>Economic dimension</b>                |                  |      |                |      |                     |
| 6          | Land productivity                        | 4.55             | 2.02 | 3.95           | 1.57 | 2.980 <sup>**</sup> |
| 7          | Profitability                            | 1.68             | 1.03 | 0.41           | 0.29 | 9.169 <sup>**</sup> |
| 8          | Input output relationship (productivity) | 2.05             | 0.90 | 1.94           | 0.82 | 0.685 <sup>NS</sup> |
| 9          | Farm level risk management               | 2.18             | 1.06 | 1.69           | 1.19 | 2.378 <sup>**</sup> |
| 10         | Marketing                                | 1.54             | 0.98 | 1.13           | 0.70 | 2.650 <sup>**</sup> |
| <b>III</b> | <b>Social dimension</b>                  |                  |      |                |      |                     |
| 11         | Input self sufficiency                   | 2.40             | 1.06 | 2.45           | 0.85 | 0.254 <sup>NS</sup> |
| 12         | Information self reliancy                | 0.60             | 0.26 | 0.59           | 0.18 | 0.284 <sup>NS</sup> |
| 13         | Employment generation                    | 1.07             | 0.38 | 0.55           | 0.29 | 8.409 <sup>**</sup> |
| 14         | Family food security                     | 0.57             | 0.59 | 0.55           | 0.33 | 0.173 <sup>NS</sup> |
| 15         | Quality of life                          | 0.62             | 0.24 | 0.43           | 0.23 | 4.474 <sup>**</sup> |

\*\* Significant at 1% level,  $t(0.01, 118df) = 2.58$ , NS: Non-significant



**Fig. 4.16: Comparison of different indicators of sustainability between irrigated and rainfed farming systems**

**Input output relationship:** This indicator showed non-significant difference between irrigated and rainfed farming systems. Majority of the operations are being done by family labour, the work would have been done much more efficiently than the outside labour. When analyzed carefully, irrigated farmers had spent less money per unit produced; and they also depended more on owned inputs than purchased ones, thus showing more input productivity. In addition the land productivity of irrigated system was also found high.

**Farm level risk management:** This indicator showed significant difference between irrigated and rainfed farming systems. Farmers of irrigated system had adopted some of the strategies for farm risk management viz., diversification of source of income, crop diversification, inter cropping, sharing of crop, agricultural equipment, irrigation sources, contract farming, insurance of crop and livestock. All these factors had contributed for having higher level of farm risk management in irrigated system than rainfed system.

**Marketing:** This indicator showed significant difference between irrigated and rainfed farming systems. Farmers from irrigated farming system having more access to local markets, regulated markets and agricultural marketing co-operative societies for marketing of their produce, they also adopted contract farming, direct marketing and stored marketing as most of the farmers of irrigated system cultivated commercial and perennial crops hence they had better marketing than rainfed system.

**Input self-sufficiency:** There was no difference between irrigated and rainfed farming systems on this indicator. This would be because of the reason that dependency for purchased inputs was found to be prevalent among majority of farmers in both irrigated and rainfed systems. It was pathetic to note that some farmers owned not more than a pair of bullocks. In such cases it would be futile to talk of organic manuring and input sufficiency. Lesser input sufficiency was also because of larger holdings and more area under farming. It was natural for these farmers to depend on chemicals and fertilizers to get economic returns. Many farmers have also suffered due to labour crisis at critical junctures. Precisely, this is the reason why farmers are opting to shift to less labour intensive, long duration and more remunerative crops.

**Information self-reliance:** Information self-reliance was observed to be non-significant in both the systems. Farmers have the urge to aspire and achieve more and more has simultaneous influence on knowing more which is a precursor to do better. Also, the tested and trusted package of practice has enabled to acquire mastery over the routine operations other than the crisis situations. As evident from the higher extension contact of both the systems, the information self-reliance also ought to be better. Thus, the results of the present study pointed out higher information self-reliance in irrigated as well as in the rainfed farming systems.

**Employment generation:** This indicator showed significant difference between irrigated and rainfed farming systems. Farmers under irrigated system generated better employment. As the farmers of irrigated farming system were practicing integrated

approach, it was having more potential to generate more employment than rainfed farming system.

**Family food security:** There was no difference between irrigated and rainfed farming systems on this indicator. Both the systems were producing sufficient food to meet their family needs.

**Quality of life:** This indicator showed significant difference between irrigated and rainfed farming systems. This indicator was significantly having better quality of life under irrigated system than rainfed system. Farming under irrigated system had generated sufficient income to meet basic necessities and to lead healthy life to their family members, farming also offered an opportunity to live closely with the nature and kept them emotionally stable and they were accorded with a better status in the society, so irrigated system had better quality of life than the rainfed system.

#### **4.3 Relationship between personal, socio-economic, psychological, communication characteristics of farmers and sustainability of farming systems**

The personal, socio-economic, psychological, communication characteristics would account for the level of sustainability of farming systems. The correlation tests were employed to assess the relationship of personal, socio-economic, psychological, communication characteristics of farmers with level of sustainability. The correlation coefficient, which indicate the strength of relationship between the dependent and independent variables are hereunder projected below.

##### **Relationship between independent variables and sustainability of irrigated farming system**

As it could be seen from Table 4.16 and Figure 4.17, the characteristics of irrigated farmers like education, family size, level of aspiration, achievement motivation, management orientation, risk orientation, value orientation, farming commitment, social participation, innovative proneness, extension contact and extension participation had positive and significant relationship with sustainability of irrigated farming system, whereas farming experience had negative and significant relationship. Other six variables viz., age, landholdings, economic motivation, decision making pattern, cosmopolitaness and mass media use had non-significant relationship with sustainability of irrigated farming system.

##### **Relationship between independent variables and sustainability of rainfed farming system**

With regards to the results of rainfed farming system, the variables like education, family size, level of aspiration, economic motivation, achievement motivation, management orientation, farming commitment, decision making pattern, cosmopolitaness, extension contact and mass media use had positive and significant relationship, whereas farming experience had negative and significant relation with sustainability of rainfed farming system. Other seven variables viz., age, landholdings, risk orientation, value orientation, social participation, innovative proneness and

extension participation had non-significant relationship with sustainability of rainfed farming system.

**Age:** The value of correlation coefficient indicated that age was not significantly related to sustainability in both the systems. Reason for this finding may be that age is a chronological factor which does not hinder or promote learning. Hence, the respondents belonging to different age groups did not differ with sustainability of farming systems. These findings are in agreement with the studies conducted by Shashidhar (2006) but contradictory to the studies of Chandra Naik (2002), and Lavanya (2010).

**Education:** This variable showed significant relationship with sustainability in both the systems. Formal schooling has been valued as means of increasing knowledge about farm technology and marketing of produce. Education provides an opportunity for farmers to expose themselves to mass media which carry messages on production and marketing aspects of farming, thus motivating them to practice sustainable agriculture. These studies are contradictory to the findings of Chandra Naik (2002) but are in line with the studies of Tasneemasultana (2001) and Malthesh (2004).

**Farming experience:** This variable showed negative significant relationship with sustainability. As already said age shows non-significant relationship, if experience of the farming is more the farmers may adopt old technologies and they does not expose to sustainable practices as sustainable farming is new concept. These findings are contradictory with studies of Chandrani Saha (2008) and Chandra Naik (2002).

**Family size:** This variable showed highly significant relationship under irrigated and rainfed farming systems. As most of the farm families were having small family, so that all the members in family can actively involved in farming and make the farming more sustainable by jointly taking decision about agriculture and allied activities. The findings are supported by the studies of Jayale and Nachane (1995), Malthesh (2004), Chandrani Saha (2008) and Lavanya (2010)

**Landholdings:** This variable showed non-significant relationship with sustainability between irrigated and rainfed farming systems. The sustainability of farming systems does not depend on landholdings rather it depends on the practices which the farmers followed on farm. Hence, landholdings showed non-significant relationship. Present findings are contradictory to the studies of Malthesh (2004) and Shashidhar (2006).

**Level of aspiration:** This variable showed significant relationship with sustainability between irrigated and rainfed farming systems. It is possible that, the aspirations were generally the resultant of increased contact with urban areas, more mass media participation and comparing themselves with other people. Farmers aspired for the things which were within their reach. As a result, they belonged to medium aspiration category and hence, the results. The favorable factors like more income, easy reach of technology, high mass media use, extension participation, cosmopolitaness etc made the farmers to have significant relationship with sustainability. The findings are supported by the studies by Chandregowda and Jayaramaiah (1996) and Chandrani Saha (2008).

**Economic motivation:** This variable was significantly related to sustainability of rainfed system, while it was non-significant with respect to irrigated system. Hence, it may be argued that economic motivation has a role to play in case of rainfed system than irrigated system. From the general observations of the scientists and extension workers, it could be concluded that farmers have taken up farming under rainfed conditions mainly with economic consideration of getting higher profit. But economic motivation did not have any role in case of irrigated system as farmers were assured of higher economic returns. These studies are supported by the studies of Shailaja (1990), Chandregowda and Jayaramaiah (1996), Chandra Naik (2002) and Shashidhar (2006).

**Achievement motivation:** This factor was also showed highly significant relationship with sustainability under both the systems. It is likely that farmers under both the systems possess strong achievement motivation so as to play its role on the behavior of farmers. They exhibited varying levels of achievement motivation which manifested itself in reflecting the sustainability of farming systems. The findings are supported by studies of Shailaja (1990), Chandregowda (1996), Chandra Naik (2002) and Shashidhar (2006).

**Management orientation:** This variable was also significantly related to the sustainability in case of both categories of farmers. It is expected that a farmer with higher management orientation will be able to articulate new ideas and manage efficiently. Hence, this variable had played significant role in case of sustainability. These findings are in line with the studies of Lavanya (2010).

**Risk orientation:** This variable exhibited significant relation with sustainability in case of irrigated farming system but not so with rainfed farming system. These findings have amply demonstrated that risk orientation which is normally found in economically well being farmers is a prerequisite for moulding adoption of sustainable practices to achieve sustainability. The present finding was in conformity with the results of Shashidhar (2006), Chandrani Saha (2008) and Lavanya (2010).

**Value orientation:** This variable was significantly related to sustainability in case of irrigated system, while it was non-significant with respect to rainfed system. It is expected that an individual having a modern scientific value orientation will consider any new idea as a valuable proposition and adopted it if found suitable. Therefore, the results of present study are justified. These findings are supported by the studies of Chandregowda (1996) and Chandra Naik (2002).

**Farming commitment:** This variable showed highly significant relationship with sustainability among irrigated and rainfed farming systems. It is likely that the farmers under both the systems had more farming commitment in order to get more returns. These findings are contradictory with the findings of Chandra Naik (2002).

**Decision making pattern:** This variable showed non-significant relationship with sustainability regarding irrigated farming system but it was significant in case of rainfed farming system. Decision making is very important to make better returns from

agriculture and allied activities. Farmers need to take decision according to the existing situation, available resources and to maintain the sustainability of farming systems.

**Social participation:** This variable also showed significant relationship with sustainability of irrigated farming system, while it was non-significant in rainfed farming system. These findings bring into focus the predominant role played by social participation in fostering a sustainable farming in irrigated system. Social participation enables the individual to come in contact with different types of individuals and organizations which serve as source of new ideas. Therefore, an individual having higher social participation develops more favorable attitude, adopt more number of eco-friendly technologies and therefore attain higher level of sustainability. Whereas, in rainfed system most of the farmers having low social participation so it shows non-significant relationship. These findings are supported by the studies of Chandra Naik (2002) and Lavanya (2010).

**Cosmopolitaness:** This factor had non-significant relationship with sustainability among irrigated farming system, while it was significantly related in rainfed farming system. The findings are supported by the studies conducted by Shinde *et al.* (1999), Malthesh (2004), Shashidhar (2006) and Lavanya (2010).

**Innovativeness:** This factor was significantly related to sustainability in case of irrigated farming system but non-significant relationship with rainfed farming system. In case of irrigated farmers they were having high innovativeness and they try new ideas in farm to achieve sustainability. While in case of rainfed system, farmers were having less innovativeness so non-significant relationship was exhibited. Present findings are supported by the studies of Syamala (1988), Shailaja (1990), Subramanian (1992), Chandra Naik (2002), Malthesh (2004), Shashidhar (2006) and Lavanya (2010).

**Extension contact:** This variable was found to be significantly related to sustainability among irrigated and rainfed farming systems. It is likely that farmers under both the systems by virtue of their social contact and interaction with extension workers develop more favorable attitude and adopt sustainable practices to achieve higher level of sustainability. These findings are in conformity with studies of Shailaja (1990), Tasneemasultana (2001) and Chandra Naik (2002).

**Extension participation:** This variable was found to be significantly related to sustainability in case of irrigated farming system but non-significant with respect to rainfed farming system. Participation in extension activities such as, demonstrations, farmers field schools, field days, krishi melas, meetings etc would promote the acquisition and consequent adoption of farm technologies. Regular participation in extension activities has influenced the farmers to practice sustainable farming. Present findings are supported by the studies of Shailaja (1990), Narwal and Dixit (1991), Tasneemasultana (2001) and Shashidhar (2006).

**Mass media use:** This factor was not related to sustainability in case of irrigated farming system but highly related in case of rainfed farming system. Farmers in order to gather

information on scientific farming try to keep contact with extension functionaries since they have got long careers to achieve great things in life. Besides, the extent of exposure to mass media like radio, television, news paper, farm magazines etc, has helped the farmers to acquire knowledge about improved agriculture practices has influenced the sustainability of agriculture and allied activities. These findings are in conformity with studies of Tasneemasultana (2001) and Shashidhar (2006).

#### 4.4 Personal, socio-economic, psychological and communication factors contributing to sustainability of farming systems

The results pertaining to the contribution of the independent variables towards variation in the dependent variable has been presented in this section. The multiple regression analysis has been resorted to identify the prediction power of all the variables combinedly and of the variables independently.

**Table 4.16: Relationship between independent variables and sustainability of irrigated and rainfed farming systems**

| Sl. No.         | Independent Variables   | Correlation Coefficient (r) |                      |
|-----------------|-------------------------|-----------------------------|----------------------|
|                 |                         | Irrigated (n=60)            | Rainfed (n=60)       |
| X <sub>1</sub>  | Age                     | 0.018 <sup>NS</sup>         | -0.216 <sup>NS</sup> |
| X <sub>2</sub>  | Education               | 0.445 <sup>**</sup>         | 0.467 <sup>**</sup>  |
| X <sub>3</sub>  | Farming Experience      | -0.401 <sup>**</sup>        | -0.397 <sup>**</sup> |
| X <sub>4</sub>  | Family Size             | 0.354 <sup>**</sup>         | 0.386 <sup>**</sup>  |
| X <sub>5</sub>  | Landholdings            | 0.033 <sup>NS</sup>         | 0.215 <sup>NS</sup>  |
| X <sub>6</sub>  | Level of aspiration     | 0.296 <sup>*</sup>          | 0.307 <sup>*</sup>   |
| X <sub>7</sub>  | Economic Motivation     | 0.056 <sup>NS</sup>         | 0.357 <sup>**</sup>  |
| X <sub>8</sub>  | Achievement motivation  | 0.391 <sup>**</sup>         | 0.440 <sup>**</sup>  |
| X <sub>9</sub>  | Management orientation  | 0.301 <sup>*</sup>          | 0.322 <sup>*</sup>   |
| X <sub>10</sub> | Risk Orientation        | 0.280 <sup>*</sup>          | -0.023 <sup>NS</sup> |
| X <sub>11</sub> | Value orientation       | 0.267 <sup>*</sup>          | 0.112 <sup>NS</sup>  |
| X <sub>12</sub> | Farming commitment      | 0.428 <sup>**</sup>         | 0.400 <sup>**</sup>  |
| X <sub>13</sub> | Decision making pattern | -0.036 <sup>NS</sup>        | 0.385 <sup>**</sup>  |
| X <sub>14</sub> | Social Participation    | 0.266 <sup>*</sup>          | 0.223 <sup>NS</sup>  |
| X <sub>15</sub> | Cosmopolitaness         | 0.147 <sup>NS</sup>         | 0.296 <sup>*</sup>   |
| X <sub>16</sub> | Innovative Proneness    | 0.480 <sup>**</sup>         | 0.156 <sup>NS</sup>  |
| X <sub>17</sub> | Extension Contact       | 0.296 <sup>*</sup>          | 0.259 <sup>*</sup>   |
| X <sub>18</sub> | Extension Participation | 0.428 <sup>**</sup>         | 0.218 <sup>NS</sup>  |
| X <sub>19</sub> | Mass Media Use          | 0.231 <sup>NS</sup>         | 0.422 <sup>**</sup>  |

\*\* Significant at 1 % level, \* Significant at 5% level, NS: Non-significant

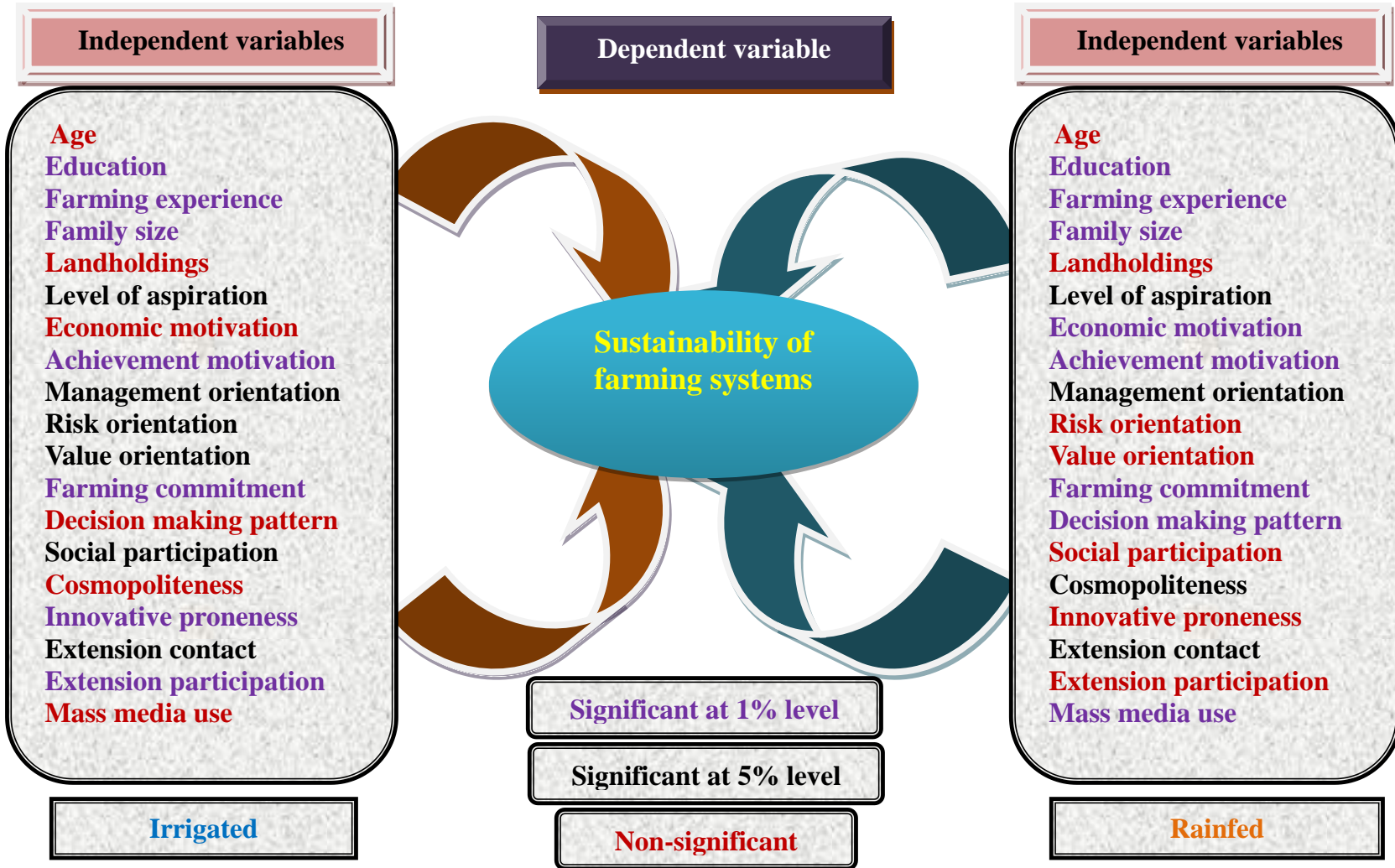


Fig. 4.17 : Empirical model of irrigated and rainfed farmers on Sustainability of farming systems

#### 4.4.1 Contribution of independent variables to the sustainability level under irrigated farming system

The results in Table 4.17 indicated that the total variation contributed by all the independent variables was found to be 71.30 per cent, as the  $R^2$  value was 0.7130. The 'F' value of the regression analysis, i.e. 4.12 was significant at 1 per cent level.

Among the nineteen variables included in the analysis, only four variables viz., education, farming experience, farming commitment and innovative proneness were significant at 1 per cent level and six variables viz., family size, achievement motivation, management orientation, risk orientation, value orientation and extension participation were significant at 5 per cent level. These ten variables together had significantly contributed to the variation in the sustainability level.

**Table 4.17: Multiple regression analysis of independent variables with sustainability of irrigated farming system**

(n=60)

| Sl. No.         | Independent Variables   | Regression coefficient | Standard error | 't' Value |
|-----------------|-------------------------|------------------------|----------------|-----------|
| X <sub>1</sub>  | Age                     | -0.1124 <sup>NS</sup>  | 0.1750         | 0.64      |
| X <sub>2</sub>  | Education               | 0.9529 <sup>**</sup>   | 0.3493         | 2.73      |
| X <sub>3</sub>  | Farming Experience      | 3.0900 <sup>**</sup>   | 1.1800         | 2.62      |
| X <sub>4</sub>  | Family Size             | 0.9490 <sup>*</sup>    | 0.4629         | 2.05      |
| X <sub>5</sub>  | Landholdings            | -0.4554 <sup>NS</sup>  | 0.2675         | 1.70      |
| X <sub>6</sub>  | Level of aspiration     | 0.0640 <sup>NS</sup>   | 0.5156         | 0.12      |
| X <sub>7</sub>  | Economic Motivation     | -1.3360 <sup>NS</sup>  | 1.0350         | 1.29      |
| X <sub>8</sub>  | Achievement motivation  | 1.0682 <sup>*</sup>    | 0.4430         | 2.41      |
| X <sub>9</sub>  | Management orientation  | 1.9012 <sup>*</sup>    | 0.8223         | 2.31      |
| X <sub>10</sub> | Risk Orientation        | 2.1285 <sup>*</sup>    | 1.075          | 1.98      |
| X <sub>11</sub> | Value orientation       | 1.6351 <sup>*</sup>    | 0.8015         | 2.04      |
| X <sub>12</sub> | Farming commitment      | 1.0541 <sup>**</sup>   | 0.3338         | 3.16      |
| X <sub>13</sub> | Decision making pattern | 0.0812 <sup>NS</sup>   | 0.0969         | 0.84      |
| X <sub>14</sub> | Social Participation    | -0.4526 <sup>NS</sup>  | 0.4061         | 1.11      |
| X <sub>15</sub> | Cosmopolitaness         | -0.5037 <sup>NS</sup>  | 0.8973         | 0.56      |
| X <sub>16</sub> | Innovative Proneness    | 2.4779 <sup>**</sup>   | 0.7490         | 3.31      |
| X <sub>17</sub> | Extension Contact       | -0.1058 <sup>NS</sup>  | 0.2440         | 0.43      |
| X <sub>18</sub> | Extension Participation | 0.7021 <sup>*</sup>    | 0.3493         | 2.01      |
| X <sub>19</sub> | Mass Media Use          | -0.7076 <sup>NS</sup>  | 0.5434         | 1.30      |

$R^2$  value= 0.713, F = 4.12<sup>\*\*</sup>

\*\* Significant at 1% level, \* Significant at 5% level, NS: Non-significant

#### **4.4.2 Contribution of independent variables to the sustainability level under rainfed farming system**

Table 4.18 shows the results of regression analysis between the independent variables and sustainability in rainfed farming system. As evident from the data, the regression coefficients of all the independent variables together contributed 73.2 per cent of variation. The 'F' value of the regression analysis, i.e. 2.82 was significant at 1 per cent level.

Among all variables studied, the variables such as education, farming experience, family size, economic motivation, achievement motivation, farming commitment, decision making pattern and mass media use were found significant at 1 per cent level and the three variables viz., level of aspiration, management orientation and cosmopolitaness had significant relation with sustainability at 5 per cent level. These eleven variables together had proved to be influencing variables on the sustainability of rainfed farming system. The plausible reasons might be that personal, socio-economic, psychological and communication factors were the deciding factors of sustainability of farming systems. Independent variables were having synergic effects to one other, helping each other to have a contribution to the sustainability of farming systems. Hence, the alternative hypothesis that there is significant contribution of independent variables on the sustainability of irrigated and rainfed farming systems was accepted.

#### **4.5 Direct and indirect effects of independent variables on sustainability of farming systems**

For establishing a quantitative interpretation of direct, indirect and largest effects of personal, socio-economic, psychological and communication factors on sustainability levels of farming systems and for developing the operational statistical models, the path analysis, which is an effective and appropriate technique, was employed. The findings of the analysis are presented under the following sub-headings.

##### **4.5.1 Direct and indirect effects of independent variables on sustainability of irrigated farming system**

The details of the analysis comprising direct effect, indirect effect and first, second and third largest indirect effects channeled through other variables on sustainability of irrigated farming system is presented in Table 4.19 and Figure 4.18.

A close observation of the Table 4.19 implies that out of 19 variables selected for path analysis, nine variables had positive direct effect and remaining 10 variables had negative and direct effect on sustainability of irrigated farming system.

Ranking variables based on their direct effect on levels of sustainability reveals that farming commitment ( $X_{12}$ ), innovative proneness ( $X_{16}$ ), extension participation ( $X_{18}$ ), risk orientation ( $X_{10}$ ) and education ( $X_2$ ) occupied first five ranks. Whereas, the variables viz., management orientation ( $X_9$ ), landholdings ( $X_5$ ), mass media use ( $X_{19}$ ), value orientation ( $X_{11}$ ) and achievement motivation ( $X_8$ ) secured last five ranks.

Regarding the total indirect effects, ranking of these effects indicated that mass media use (X<sub>19</sub>), social participation (X<sub>14</sub>), extension contact (X<sub>17</sub>), management orientation (X<sub>9</sub>) and level of aspiration (X<sub>6</sub>) obtained the first five ranks. Whereas, risk orientation (X<sub>10</sub>), farming commitment (X<sub>12</sub>), education (X<sub>2</sub>), decision making pattern (X<sub>13</sub>) and farming experience (X<sub>3</sub>) occupied last five ranks.

**Table 4.18: Multiple regression analysis of independent variables with sustainability of rainfed farming system**

(n=60)

| No.             | Independent Variables   | Regression coefficient | Standard error | 't' value |
|-----------------|-------------------------|------------------------|----------------|-----------|
| X <sub>1</sub>  | Age                     | 0.0031 <sup>NS</sup>   | 0.1492         | 0.02      |
| X <sub>2</sub>  | Education               | 0.7271 <sup>**</sup>   | 0.2416         | 3.01      |
| X <sub>3</sub>  | Farming Experience      | 0.2076 <sup>**</sup>   | 0.0786         | 2.64      |
| X <sub>4</sub>  | Family Size             | 1.0876 <sup>**</sup>   | 0.3984         | 2.73      |
| X <sub>5</sub>  | Landholdings            | -0.0869 <sup>NS</sup>  | 0.2726         | 0.32      |
| X <sub>6</sub>  | Level of aspiration     | 0.7371 <sup>*</sup>    | 0.3247         | 2.27      |
| X <sub>7</sub>  | Economic Motivation     | 3.1417 <sup>**</sup>   | 1.2130         | 2.59      |
| X <sub>8</sub>  | Achievement motivation  | 1.6363 <sup>**</sup>   | 0.4185         | 3.91      |
| X <sub>9</sub>  | Management orientation  | 1.6479 <sup>*</sup>    | 0.7134         | 2.31      |
| X <sub>10</sub> | Risk Orientation        | -0.9640 <sup>NS</sup>  | 1.1990         | 0.80      |
| X <sub>11</sub> | Value orientation       | -0.3313 <sup>NS</sup>  | 0.8218         | 0.40      |
| X <sub>12</sub> | Farming commitment      | 0.1062 <sup>**</sup>   | 0.0387         | 2.74      |
| X <sub>13</sub> | Decision making pattern | 0.1246 <sup>**</sup>   | 0.0465         | 2.68      |
| X <sub>14</sub> | Social Participation    | -0.1083 <sup>NS</sup>  | 0.4239         | 0.26      |
| X <sub>15</sub> | Cosmopolitaness         | 0.5013 <sup>*</sup>    | 0.2364         | 2.12      |
| X <sub>16</sub> | Innovative Proneness    | 0.4850 <sup>NS</sup>   | 0.6200         | 0.78      |
| X <sub>17</sub> | Extension Contact       | 0.1185 <sup>NS</sup>   | 0.2106         | 0.56      |
| X <sub>18</sub> | Extension Participation | -0.5995 <sup>NS</sup>  | 0.3686         | 1.63      |
| X <sub>19</sub> | Mass Media Use          | 1.4538 <sup>**</sup>   | 0.5101         | 2.85      |

R<sup>2</sup> value= 0.732, F = 2.82<sup>\*\*</sup>,

\*\* Significant at 1% level, \* Significant at 5% level, NS: Non-significant

The first largest indirect effect was channeled maximum through farming commitment (X<sub>12</sub>) in case of 8 variables, extension participation (X<sub>18</sub>) in six variables, farming experience (X<sub>3</sub>), mass media use (X<sub>19</sub>), management orientation (X<sub>9</sub>), innovative proneness (X<sub>16</sub>) and value orientation (X<sub>11</sub>) each in one variable. The second largest indirect effect was channeled through extension participation (X<sub>18</sub>) in six variables, farming commitment (X<sub>12</sub>) in four variables, innovative proneness (X<sub>16</sub>) and achievement motivation (X<sub>8</sub>) each in two variables, mass media use (X<sub>19</sub>), management orientation

(X<sub>9</sub>), education (X<sub>2</sub>), risk orientation (X<sub>10</sub>) and social participation (X<sub>14</sub>) each in one variable. Whereas, the third largest indirect effect was channeled through innovative proneness (X<sub>16</sub>) in six variables, risk orientation (X<sub>10</sub>) and education (X<sub>2</sub>) both in three variables, value orientation (X<sub>11</sub>) in two variables, management orientation (X<sub>9</sub>), landholdings (X<sub>5</sub>), achievement motivation (X<sub>8</sub>), mass media use (X<sub>19</sub>) and family size (X<sub>4</sub>) each in one variable. The residual effect was found to be 0.3008. The data are diagrammatically presented in Figure 4.18.

It could be observed from the Table 4.19 that farming commitment exerted a higher direct effect occupying first place on sustainability of irrigated farming system. In respect of indirect effect, mass media use emerged as most important variable occupying first place. This may be due to the more commitment of farmers towards farming to attain higher returns and exposure to mass media for getting information regarding available new technologies.

#### **4.5.2 Direct and indirect effects of independent variables on sustainability of rainfed farming system**

A close observation of Table 4.20 and Figure 4.19 revealed that out of 19 variables selected under personal, socio-economic, psychological and communication factors, 10 variables were found to have positive direct effect and remaining nine variables had negative and direct effect on sustainability of rainfed farming system.

Ranking of variables based on their direct effect on sustainability levels revealed that family size (X<sub>4</sub>), education (X<sub>2</sub>), decision making pattern (X<sub>13</sub>), farming commitment (X<sub>12</sub>) economic motivation (X<sub>7</sub>) and management orientation (X<sub>9</sub>) occupied first five ranks. Whereas, innovative proneness (X<sub>16</sub>), risk orientation (X<sub>10</sub>), level of aspiration (X<sub>6</sub>), farming experience (X<sub>3</sub>) and extension contact (X<sub>17</sub>) obtained last five ranks.

Further, perusal of the Table 4.20 reveals that ranking variables on the total indirect effect on sustainability of rainfed farming system, level of aspiration (X<sub>6</sub>), extension contact (X<sub>17</sub>), mass media use (X<sub>19</sub>), achievement motivation (X<sub>8</sub>) and cosmopolitaness (X<sub>15</sub>) gained first five ranks. Whereas, the variables viz., value orientation (X<sub>11</sub>), education (X<sub>2</sub>), family size (X<sub>4</sub>), farming experience (X<sub>3</sub>) and age (X<sub>1</sub>) secured last five ranks in the same order.

The first largest indirect effect was channeled through education (X<sub>2</sub>) in 12 variables, family size (X<sub>4</sub>) and extension contact (X<sub>17</sub>) each in three variables and farming experience in one variable. The second largest indirect effect was channeled through family size (X<sub>4</sub>) in case of eight variables, education (X<sub>2</sub>) and farming experience (X<sub>3</sub>) each in three variables, level of aspiration (X<sub>6</sub>) and decision making pattern (X<sub>13</sub>) each in two variables and management orientation in one variable. The third largest, indirect effect was channeled through farming experience (X<sub>3</sub>) in eight variables, family size (X<sub>4</sub>) and farming commitment (X<sub>12</sub>) each in three variables, decision making pattern (X<sub>13</sub>) in two variables, risk orientation (X<sub>10</sub>), management orientation (X<sub>9</sub>) and economic motivation (X<sub>7</sub>) each in one variable. The residual effect was found to be 0.3008. The data are diagrammatically presented in Figure 4.19.

**Table 4.19: Direct, indirect and largest indirect effects of independent variables on sustainability of irrigated farming system**

(n=60)

| Sl. No.         | Variable name           | Direct effect | Rank  | Indirect effect | Rank  | Three largest indirect effect channeled through                                     |
|-----------------|-------------------------|---------------|-------|-----------------|-------|---|
| X <sub>1</sub>  | Age                     | -0.1330       | XII   | 0.1510          | X     | 0.1436 (X <sub>3</sub> )<br>0.0861 (X <sub>19</sub> )<br>0.0684 (X <sub>9</sub> )   |
| X <sub>2</sub>  | Education               | 0.2450        | V     | -0.0827         | XVI   | 0.1504 (X <sub>12</sub> )<br>0.1051 (X <sub>18</sub> )<br>0.0744 (X <sub>16</sub> ) |
| X <sub>3</sub>  | Farming Experience      | 0.1800        | VII   | -0.2360         | XVIII | 0.1164 (X <sub>19</sub> )<br>0.0652 (X <sub>9</sub> )<br>0.0594 (X <sub>5</sub> )   |
| X <sub>4</sub>  | Family Size             | 0.2240        | VI    | 0.2560          | VI    | 0.0296 (X <sub>18</sub> )<br>0.0259 (X <sub>2</sub> )<br>0.0186 (X <sub>8</sub> )   |
| X <sub>5</sub>  | Landholdings            | -0.2230       | XVI   | 0.2560          | VI    | 0.1533 (X <sub>12</sub> )<br>0.0869 (X <sub>18</sub> )<br>0.0850 (X <sub>10</sub> ) |
| X <sub>6</sub>  | Level of aspiration     | 0.0210        | IX    | 0.2750          | V     | 0.2575 (X <sub>12</sub> )<br>0.1878 (X <sub>18</sub> )<br>0.1119 (X <sub>16</sub> ) |
| X <sub>7</sub>  | Economic Motivation     | -0.1700       | XIV   | 0.2270          | VII   | 0.1466 (X <sub>12</sub> )<br>0.1310 (X <sub>16</sub> )<br>0.436 (X <sub>2</sub> )   |
| X <sub>8</sub>  | Achievement motivation  | -0.2710       | XIX   | 0.1990          | IX    | 0.1772 (X <sub>12</sub> )<br>0.0574 (X <sub>10</sub> )<br>0.0463 (X <sub>2</sub> )  |
| X <sub>9</sub>  | Management orientation  | -0.2100       | XV    | 0.3420          | IV    | 0.1209 (X <sub>18</sub> )<br>0.1156 (X <sub>12</sub> )<br>0.0748 (X <sub>10</sub> ) |
| X <sub>10</sub> | Risk Orientation        | 0.3000        | IV    | -0.0196         | XIV   | 0.1062 (X <sub>12</sub> )<br>0.1018 (X <sub>18</sub> )<br>0.0788 (X <sub>16</sub> ) |
| X <sub>11</sub> | Value orientation       | -0.2550       | XVIII | -0.0116         | XIII  | 0.0345 (X <sub>9</sub> )<br>0.0331 (X <sub>14</sub> )<br>0.0314 (X <sub>19</sub> )  |
| X <sub>12</sub> | Farming commitment      | 0.4600        | I     | -0.0320         | XV    | 0.1486 (X <sub>16</sub> )<br>0.1434 (X <sub>18</sub> )<br>0.0801 (X <sub>2</sub> )  |
| X <sub>13</sub> | Decision making pattern | 0.1110        | VIII  | -0.1475         | XVII  | 0.0568 (X <sub>11</sub> )<br>0.0361 (X <sub>8</sub> )<br>0.0153 (X <sub>4</sub> )   |

|                 |                         |         |      |        |      |   |
|-----------------|-------------------------|---------|------|--------|------|---|
| X <sub>14</sub> | Social Participation    | -0.1560 | XIII | 0.4218 | II   | 0.2033 (X <sub>18</sub> )<br>0.1871 (X <sub>12</sub> )<br>0.1854 (X <sub>16</sub> ) |
| X <sub>15</sub> | Cosmopolitaness         | -0.0690 | X    | 0.2159 | VIII | 0.0827 (X <sub>18</sub> )<br>0.0476 (X <sub>8</sub> )<br>0.0448 (X <sub>11</sub> )  |
| X <sub>16</sub> | Innovative Proneness    | 0.4100  | II   | 0.0701 | XI   | 0.1668 (X <sub>12</sub> )<br>0.1087 (X <sub>18</sub> )<br>0.0601 (X <sub>11</sub> ) |
| X <sub>17</sub> | Extension Contact       | -0.0790 | XI   | 0.3748 | III  | 0.2463 (X <sub>18</sub> )<br>0.1688 (X <sub>12</sub> )<br>0.1352 (X <sub>16</sub> ) |
| X <sub>18</sub> | Extension Participation | 0.4000  | III  | 0.0276 | XII  | 0.1649 (X <sub>12</sub> )<br>0.1114 (X <sub>16</sub> )<br>0.0763 (X <sub>10</sub> ) |
| X <sub>19</sub> | Mass Media Use          | -0.2360 | XVII | 0.4668 | I    | 0.2183 (X <sub>18</sub> )<br>0.1868 (X <sub>12</sub> )<br>0.1526 (X <sub>16</sub> ) |

**Residual effect = 0.3008**

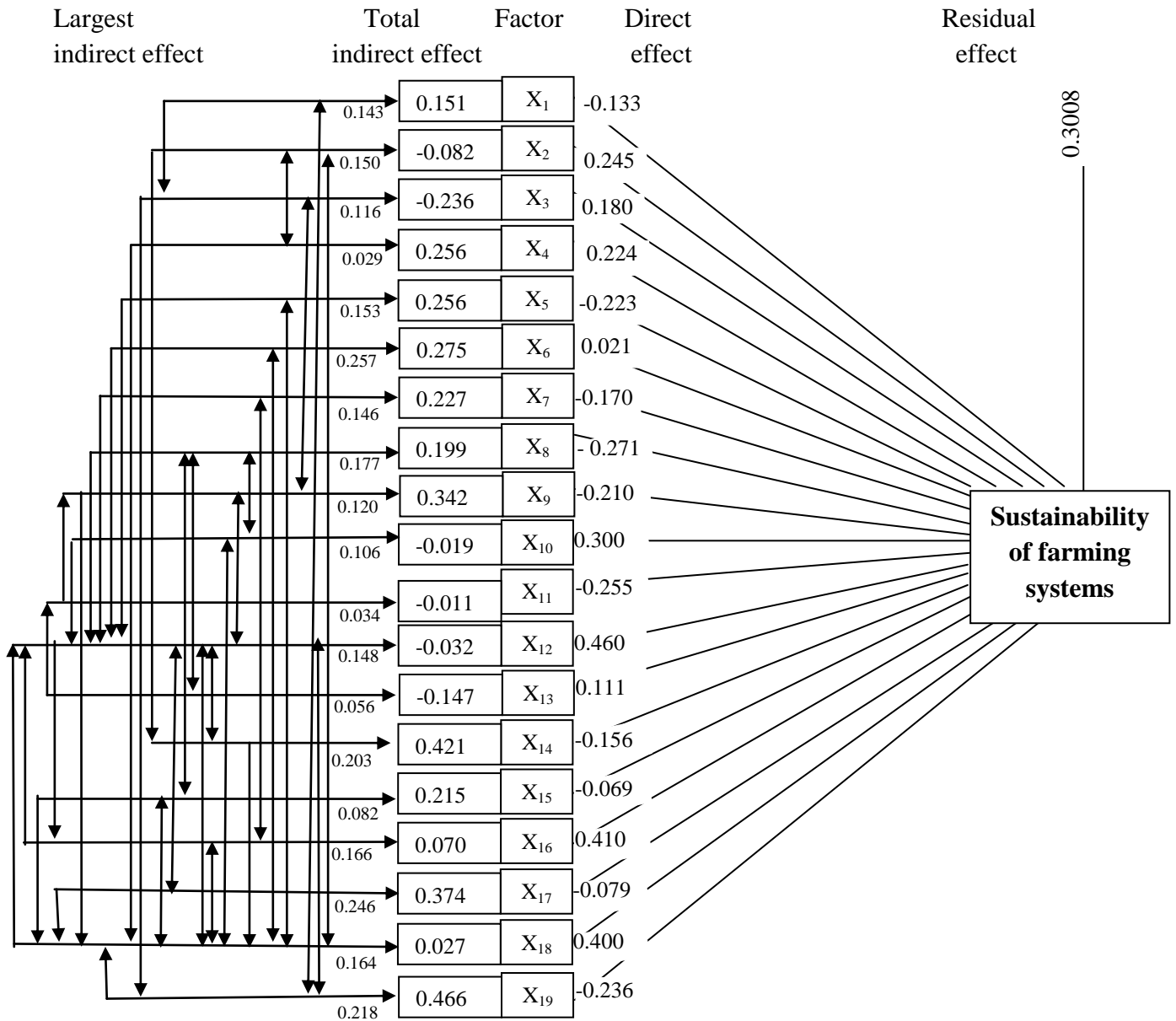
It could be observed from the Table 4.20 that family size exerted a higher direct effect occupying first place on sustainability. In respect of indirect effect, level of aspiration emerged as most important variable occupying first place. The probable reason might be that nearly two third of the farmers under rainfed farming system were having small family so that all the members jointly involved in decision making as well as better implementation of sustainable practices in farming to achieve sustainability.

#### **4.6 Constraints faced by the farmers in achieving sustainability under irrigated and rainfed farming systems**

##### **4.6.1 Constraints faced by the farmers in achieving sustainability under irrigated farming system**

The results in Table 4.21 represent the constraints faced by farmers practicing irrigated farming system. It could be observed that among all the constraints faced by them was high cost of inputs (Rank I), lack of knowledge regarding pest and diseases (Rank II) and non availability of inputs (Rank III) were the major production constraints. These might be due to the shortage of inputs or the fertilizer dealers which might have created artificial scarcity for earning more money in short period. These findings are in agreement with the findings of Govinda Reddy *et al.* (1997), Shivamurthy *et al.* (2008) and Lavanya (2010).

Lack of own resources like labour, seed materials; FYM was the major financial constraint. Lack of co-operation was major institutional constraint might be because of the lack of extension workers in the field situation further the extension worker to farmers ratio was high, so they might not be able to co-operate with all the farming families. Regarding situational constraints, distance from the location of land might be due to



**Fig. 4.18: Direct, indirect and largest indirect effects of independent variables on sustainability of irrigated farming system**

scattered land holdings in addition to highly inaccessible terrain, so they needed to walk more distance.

**Table 4.20: Direct, indirect and largest indirect effects of independent variables on sustainability of rainfed farming system**

(n=60)

| No.             | Variable name          | Direct effect | Rank | Indirect effect | Rank  | Three largest indirect effect channeled through                                    |
|-----------------|------------------------|---------------|------|-----------------|-------|--|
| X <sub>1</sub>  | Age                    | -0.0330       | XIII | -0.2539         | XIX   | 0.0831 (X <sub>17</sub> )<br>0.0648 (X <sub>6</sub> )<br>0.0139 (X <sub>4</sub> )  |
| X <sub>2</sub>  | Education              | 0.4200        | II   | 0.0778          | XVI   | 0.1353 (X <sub>3</sub> )<br>0.0765 (X <sub>13</sub> )<br>0.0709 (X <sub>12</sub> ) |
| X <sub>3</sub>  | Farming Experience     | -0.2630       | XVII | -0.1491         | XVIII | 0.1232 (X <sub>17</sub> )<br>0.0822 (X <sub>6</sub> )<br>0.0120 (X <sub>10</sub> ) |
| X <sub>4</sub>  | Family Size            | 0.4250        | I    | -0.0248         | XVII  | 0.0670 (X <sub>2</sub> )<br>0.0593 (X <sub>9</sub> )<br>0.0570 (X <sub>12</sub> )  |
| X <sub>5</sub>  | Landholdings           | -0.0180       | XII  | 0.2474          | VIII  | 0.1590 (X <sub>4</sub> )<br>0.1477 (X <sub>2</sub> )<br>0.0646 (X <sub>3</sub> )   |
| X <sub>6</sub>  | Level of aspiration    | -0.2520       | XVI  | 0.5764          | I     | 0.2000 (X <sub>2</sub> )<br>0.1586 (X <sub>4</sub> )<br>0.0857 (X <sub>3</sub> )   |
| X <sub>7</sub>  | Economic Motivation    | 0.1420        | V    | 0.2247          | IX    | 0.1123 (X <sub>4</sub> )<br>0.0717 (X <sub>13</sub> )<br>0.0609 (X <sub>3</sub> )  |
| X <sub>8</sub>  | Achievement motivation | 0.0950        | VI   | 0.3667          | IV    | 0.2176 (X <sub>2</sub> )<br>0.0686 (X <sub>3</sub> )<br>0.0664 (X <sub>4</sub> )   |
| X <sub>9</sub>  | Management orientation | 0.1420        | V    | 0.1865          | XII   | 0.1776 (X <sub>4</sub> )<br>0.0578 (X <sub>2</sub> )<br>0.0446 (X <sub>13</sub> )  |
| X <sub>10</sub> | Risk Orientation       | -0.1840       | XV   | 0.1585          | XIV   | 0.0766 (X <sub>17</sub> )<br>0.0660 (X <sub>2</sub> )<br>0.0389 (X <sub>12</sub> ) |
| X <sub>11</sub> | Value orientation      | 0.0230        | IX   | 0.0968          | XV    | 0.0642 (X <sub>2</sub> )<br>0.0517 (X <sub>4</sub> )<br>0.0254 (X <sub>9</sub> )   |
| X <sub>12</sub> | Farming commitment     | 0.1440        | IV   | 0.2747          | VI    | 0.2068 (X <sub>2</sub> )<br>0.1682 (X <sub>4</sub> )<br>0.0588 (X <sub>3</sub> )   |

|                 |                         |         |       |        |      |   |
|-----------------|-------------------------|---------|-------|--------|------|---|
| X <sub>13</sub> | Decision making pattern | 0.1870  | III   | 0.2121 | X    | 0.1717 (X <sub>2</sub> )<br>0.0569 (X <sub>3</sub> )<br>0.0544 (X <sub>7</sub> )  |
| X <sub>14</sub> | Social Participation    | 0.0400  | VII   | 0.1971 | XI   | 0.1164 (X <sub>2</sub> )<br>0.1097 (X <sub>3</sub> )<br>0.0999 (X <sub>4</sub> )  |
| X <sub>15</sub> | Cosmopolitaness         | 0.0250  | VIII  | 0.2789 | V    | 0.1130 (X <sub>2</sub> )<br>0.0919 (X <sub>4</sub> )<br>0.0715 (X <sub>3</sub> )  |
| X <sub>16</sub> | Innovative Proneness    | -0.1500 | XIV   | 0.1643 | XIII | 0.0944 (X <sub>2</sub> )<br>0.0547 (X <sub>4</sub> )<br>0.0353 (X <sub>13</sub> ) |
| X <sub>17</sub> | Extension Contact       | -0.4780 | XVIII | 0.5071 | II   | 0.1723 (X <sub>2</sub> )<br>0.1581 (X <sub>4</sub> )<br>0.0678 (X <sub>3</sub> )  |
| X <sub>18</sub> | Extension Participation | -0.0080 | X     | 0.2502 | VII  | 0.1649 (X <sub>2</sub> )<br>0.1090 (X <sub>4</sub> )<br>0.0782 (X <sub>3</sub> )  |
| X <sub>19</sub> | Mass Media Use          | -0.0090 | XI    | 0.4521 | III  | 0.2377 (X <sub>2</sub> )<br>0.1624 (X <sub>4</sub> )<br>0.1364 (X <sub>3</sub> )  |

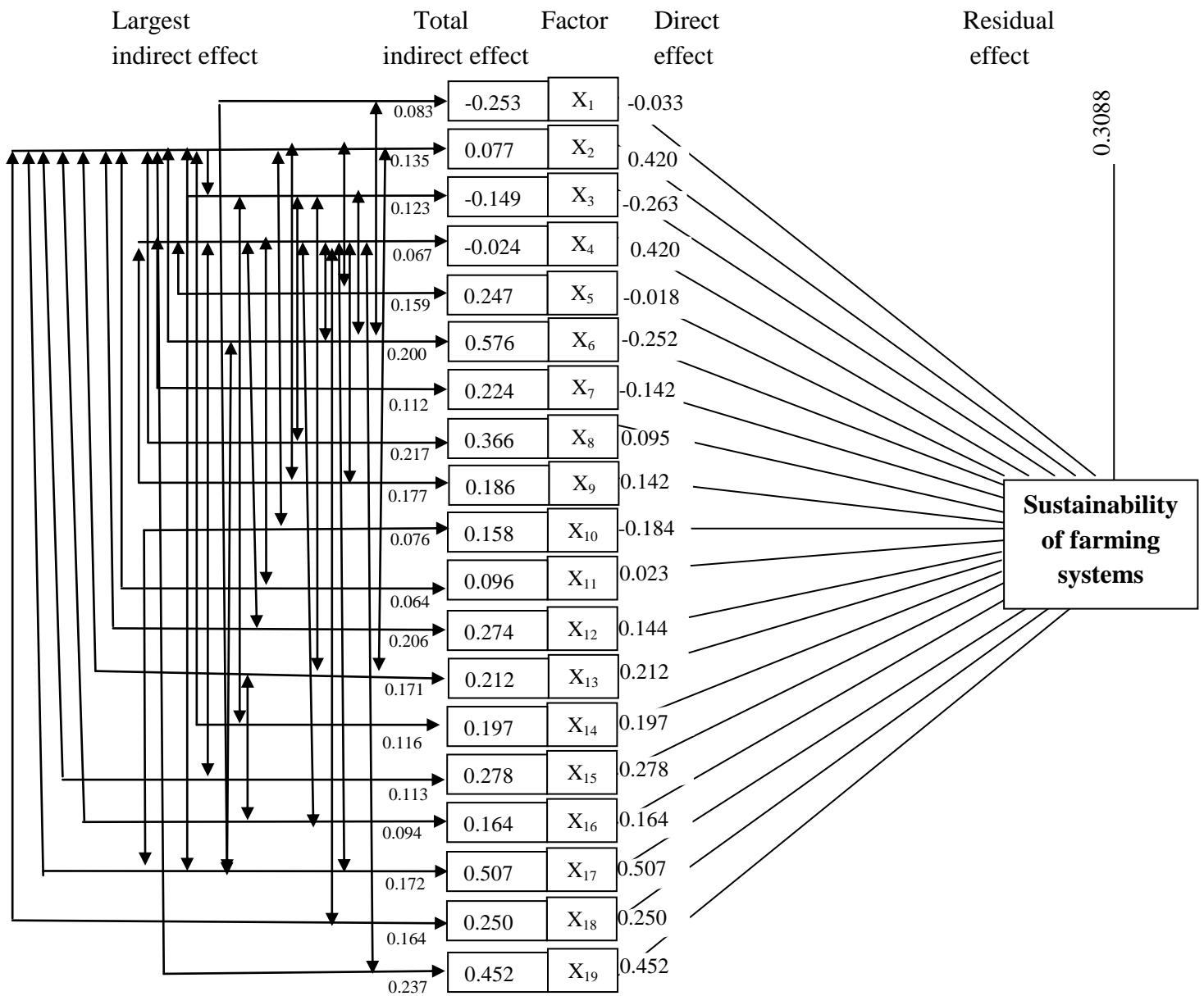
**Residual effect = 0.3088**

Lack of ICT facilities, cumbersome/ difficult procedure in seed production were major infrastructural and technical constraints experienced by farmers of irrigated farming system. These constraints held Rank I in their categories. The reason might be that most of the farmers were illiterate to use the ICT gadgets further; most of the villages were not having the facilities to use ICT gadgets.

#### **4.6.2 Constraints faced by the farmers in achieving sustainability under rainfed farming system**

An examination from Table 4.22 revealed that among all the constraints faced by rainfed farmers, lack of water for irrigation (Rank I), high cost of inputs (Rank II) and non availability of inputs (Rank III) were the major production constraints faced by farmers. These might be due to the scarcity of water for agricultural purpose in rainfed situation and the shortage of inputs or lack of cost effective inputs. These findings are supported by the findings of Radhakrishnan *et al.* (1999) and Lavanya (2010).

Regarding financial constraints, lack of own resources like labour, seed materials and FYM (Rank I), inadequate credit (Rank II) and inadequate subsidy (Rank III) were the major constraints experienced by farmers of rainfed farming system. The reasons might be due to the practice of different components in the rainfed farming system required lot of financial investments, which might not be possible to invest by the farmers. Further, the financial institutions procedures for lending money might be cumbersome and time consuming. The rate of interest might have act as a barrier for the



**Fig. 4.19: Direct, indirect and largest indirect effects of independent variables on sustainability of rainfed farming system**

farmers to avail credit from non institutional sources in the absence of institutional finance.

**Table 4.21: Constraints faced by the farmers in achieving sustainability under irrigated farming system**

(n=60)

| Sl. No.     | Constraints   | %    | Rank |
|-------------|---|------|------|
| <b>I.</b>   | <b>Production constraints</b>                               |      |      |
| 1           | High cost of inputs   | 83.9 | I    |
| 2           | Non availability of quality seed material/plant material    | 70.6 | IV   |
| 3           | Non availability of inputs                                  | 73.9 | III  |
| 4           | Lack of knowledge regarding pest and diseases               | 80.6 | II   |
| 5           | Lack of water for irrigation                                | 45.6 | VI   |
| 6           | Lack of knowledge on balanced fertilizer application        | 66.1 | V    |
| <b>II.</b>  | <b>Financial constraints</b>                                |      |      |
| 7           | Inadequate credit   | 75.6 | III  |
| 8           | Inadequate subsidy  | 76.1 | II   |
| 9           | High interest rate  | 61.6 | V    |
| 10          | Insufficient repayment time                                 | 64.4 | IV   |
| 11          | Lack of own resources like labour, seed materials, FYM etc. | 81.7 | I    |
| <b>III.</b> | <b>Institutional constraints</b>                            |      |      |
| 12          | Lack of co-operation  | 55.0 | I    |
| 13          | Lack of support from developmental departments              | 48.3 | II   |
| <b>IV.</b>  | <b>Situational constraints</b>                              |      |      |
| 14          | Distance from the location of market                        | 55.6 | III  |
| 15          | Distance from the location of land                          | 61.7 | I    |
| 16          | Poor transport facilities                                   | 60.0 | II   |
| 17          | Lack of knowledge about sustainable farming practices       | 55.0 | IV   |
| <b>V.</b>   | <b>Infrastructural constraints</b>                          |      |      |
| 18          | Lack of established structures for livestock                | 65.6 | II   |
| 19          | Lack of ICT facilities                                      | 80.0 | I    |
| <b>VI.</b>  | <b>Technical constraints</b>                                |      |      |
| 20          | Erratic supply of electricity                               | 56.7 | IV   |
| 21          | Lack of mechanization of farm                               | 68.3 | II   |
| 22          | Unavailability of new technologies                          | 57.2 | III  |
| 23          | Cumbersome/difficult procedure in seed production           | 73.9 | I    |

Lack of support from developmental departments, distance from the location of land, lack of ICT facilities, unavailability of new technologies were major institutional, situational, infrastructural and technical constraints experienced by farmers of rainfed farming system. These constraints held Rank I in their categories. The probable reason might be that the developmental departments concentrated more on farmers of irrigated farming system, scattered land holdings in highly inaccessible terrain of rainfed lands, lack of knowledge and awareness about ICT gadgets usage by the farmers.

**Table 4.22: Constraints faced by the farmers in achieving sustainability under rainfed farming system**

(n=60)

| Sl. No.     | Constraints   | %    | Rank |
|-------------|---|------|------|
| <b>I.</b>   | <b>Production constraints</b>                               |      |      |
| 1           | High cost of inputs   | 85.6 | II   |
| 2           | Non availability of quality seed material/plant material    | 76.7 | VI   |
| 3           | Non availability of inputs                                  | 82.8 | III  |
| 4           | Lack of knowledge regarding pest and diseases               | 77.8 | V    |
| 5           | Lack of water for irrigation                                | 87.2 | I    |
| 6           | Lack of knowledge on balanced fertilizer application        | 81.7 | IV   |
| <b>II.</b>  | <b>Financial constraints</b>                                |      |      |
| 7           | Inadequate credit   | 70.0 | II   |
| 8           | Inadequate subsidy  | 68.3 | III  |
| 9           | High interest rate  | 63.9 | IV   |
| 10          | Insufficient repayment time                                 | 55.6 | V    |
| 11          | Lack of own resources like labour, seed materials, FYM etc. | 87.8 | I    |
| <b>III.</b> | <b>Institutional constraints</b>                            |      |      |
| 12          | Lack of co-operation  | 55.6 | II   |
| 13          | Lack of support from developmental departments              | 81.1 | I    |
| <b>IV.</b>  | <b>Situational constraints</b>                              |      |      |
| 14          | Distance from the location of market                        | 67.2 | II   |
| 15          | Distance from the location of land                          | 56.1 | IV   |
| 16          | Poor transport facilities                                   | 66.1 | III  |
| 17          | Lack of knowledge about sustainable farming practices       | 87.8 | I    |
| <b>V.</b>   | <b>Infrastructural constraints</b>                          |      |      |
| 18          | Lack of established structures for livestock                | 68.9 | II   |
| 19          | Lack of ICT facilities                                      | 85.0 | I    |
| <b>VI.</b>  | <b>Technical constraints</b>                                |      |      |
| 20          | Erratic supply of electricity                               | 56.1 | IV   |
| 21          | Lack of mechanization of farm                               | 86.7 | II   |
| 22          | Unavailability of new technologies                          | 90.6 | I    |
| 23          | Cumbersome/difficult procedure in seed production           | 85.0 | III  |

#### 4.7 Suggestions by farmers to achieve sustainability in irrigated and rainfed farming systems

The suggestions given by irrigated and rainfed farming farmers are presented in Table 4.23 and Table 4.24.

##### 4.7.1 Suggestions by farmers to achieve sustainability in irrigated farming system

The suggestions given by the irrigated farmers are as follows. Dependency on hired labour is more so government should give importance for farm mechanization (90.00 %), Proper marketing and transportation facilities should be provided (86.67 %), More knowledge should be given on sustainable farming practices (85.00 %), Adequate supply of organic manure from development departments (83.33 %), Development departments should be co-operative and supportive & More and more ICT facilities should be provided (80.00 %), Adequate information should provide on balanced use of inorganic fertilizers (78.33 %), Provide more quality of agricultural inputs (75.00 %), Adequate credit and subsidy should be given (66.67 %), Adequate knowledge regarding pest and diseases (58.33), Proper water management guidelines prior, during and/or after fertilizer application (41.67 %) and Arranging irrigation facilities for cultivation (30.00 %).

**Table 4.23: Suggestions by farmers to achieve sustainability in irrigated farming system**

(n=60)

| Sl. No. | Suggestions  | %     | Rank |
|---------|--|-------|------|
| 1       | Adequate supply of organic manure from development departments                                 | 83.33 | IV   |
| 2       | Adequate information should provide on balanced use of inorganic fertilizers                   | 78.33 | VI   |
| 3       | Proper water management guidelines prior, during and/or after fertilizer application           | 41.67 | X    |
| 4       | Provide more quality of agricultural inputs  | 75.00 | VII  |
| 5       | Dependency on hired labour is more so government should give importance for farm mechanization | 90.00 | I    |
| 6       | Arranging irrigation facilities for cultivation  | 30.00 | XI   |
| 7       | Adequate knowledge regarding pest and diseases   | 58.33 | IX   |
| 8       | Adequate credit and subsidy should be given  | 66.67 | VIII |
| 9       | Development departments should be co-operative and supportive                                  | 80.00 | V    |
| 10      | Proper marketing and transportation facilities should be provided                              | 86.67 | II   |
| 11      | More knowledge should be given on sustainable farming practices                                | 85.00 | III  |
| 12      | More and More ICT facilities should be provided  | 80.00 | V    |

#### 4.7.2 Suggestions by farmers to achieve sustainability in rainfed farming system

Arranging irrigation facilities for cultivation (90.00 %), More knowledge should be given on sustainable farming practices & Adequate information should provide on balanced use of inorganic fertilizers (88.33 %), Development departments should be co-operative and supportive (70.00 %), Adequate supply of organic manure from development departments & Adequate knowledge regarding pest and diseases (66.67 %), More and more ICT facilities should be provided (65.00 %), Provide more quality of agricultural inputs (58.33 %), Proper water management guidelines prior, during and/or after fertilizer application (50.00 %), Proper marketing and transportation facilities should be provided (40.00 %), Adequate credit and subsidy should be given (38.33 %), Dependency on hired labour is more so government should give importance for farm mechanization (33.33 %) were the major suggestions given by the rainfed farmers.

**Table 4.24: Suggestions by farmers to achieve sustainability in rainfed farming system**

(n=60)

| Sl. No. | Suggestions  | %     | Rank |
|---------|--|-------|------|
| 1       | Adequate supply of organic manure from development departments                                 | 66.67 | IV   |
| 2       | Adequate information should provide on balanced use of inorganic fertilizers                   | 88.33 | II   |
| 3       | Proper water management guidelines prior, during and/or after fertilizer application           | 50.00 | VII  |
| 4       | Provide more quality of agricultural inputs  | 58.33 | VI   |
| 5       | Dependency on hired labour is more so government should give importance for farm mechanization | 33.33 | X    |
| 6       | Arranging irrigation facilities for cultivation  | 90.00 | I    |
| 7       | Adequate knowledge regarding pest and diseases   | 66.67 | IV   |
| 8       | Adequate credit and subsidy should be given  | 38.33 | IX   |
| 9       | Development departments should be co-operative and supportive                                  | 70.00 | III  |
| 10      | Proper marketing and transportation facilities should be provided                              | 40.00 | VIII |
| 11      | More knowledge should be given on sustainable farming practices                                | 88.33 | II   |
| 12      | More and More ICT facilities should be provided  | 65.00 | V    |

#### 4.8 Case studies of farming systems practiced in eastern and southern dry zones

Four case studies were identified based on the research results and findings. Two highest sustainable farming systems and two lowest sustainable farming systems were documented as case studies for the study.

##### Case study – 1

##### **Sri Chikkaboregowda: High sustainable farming system under irrigated situation in southern dry zone**

Mr. Chikkaboregowda aged about 58 years is staying in Sathnur village, Sathnur hobli of Mandya Taluk in Mandya district of Karnataka state. He studied up to 10<sup>th</sup> standard and having farming experience of 35 years. He is having land of 3 acres and 20 guntas. The family consists of wife and one son who are residing on the farm.

He has one bore well for permanent irrigation source and cultivating sugarcane in an area of 2.5 acres, varieties are M-1, CO-62175. The special feature of this farmer is he uses one eye bud for planting, wider spacing for mulching and practicing intercropping with crops like soya bean, bean, tomato and green leaf manure crops. He is cultivating paddy and ragi in an area of 0.5 acre each in kharif. Accordingly, he planted many perennial plantation trees like coconut and arecanut around the border. He also planted some tree fodders like Agase, subabul and timber species like Teak, Silver Oak.

Along with this dairy as another subsidiary agricultural enterprise, he is maintaining 2 HFcows, one buffalo and 2 local cows. Small portion of the farm land is converted as poultry farm in an area of 80 x14 ft (Giriraja, Swarnadhara -1000 birds/batch), rearing goats (15 No., local breed), water storage tank is being profitably used for fish rearing (Catla – 250 No.). He constructed 2 composting tanks with 15 x 6 ft dimension, he is using *Nadep* method of composting; it yields 4 tonnes of compost in 4 months. Fertigation tank has been installed for judicious usage of fertilizers and also to save labour. For judicious use of available water entire farm is drip irrigated thereby he saves labour and also weeds are under control. Integration of different agriculturally related enterprises with crops provided ways to recycle products. Cost of production is reduced by using by-products of one component as input of another linked component. Thus the total income of the farm is raised. Multiple land use through integration of crops, livestock, poultry, fishery and goat rearing has given the best and optimum production from unit land area.

**Indicator wise sustainability scores of Mr. Chikkaboregowda and average sustainability scores of respondents in irrigated farming system**

| Sl. No. | Indicators                     | Sustainability Score of respondent | Average sustainability scores |
|---------|--------------------------------|------------------------------------|-------------------------------|
| 1       | Integrated nutrient management | 88.69                              | 75.82                         |
| 2       | Integrated pest management     | 72.92                              | 70.76                         |
| 3       | Water management               | 100.00                             | 75.24                         |
| 4       | Land use pattern               | 113.89                             | 94.70                         |
| 5       | Cropping pattern               | 100.00                             | 90.37                         |
| 6       | Land productivity              | 92.33                              | 46.68                         |
| 7       | Profitability                  | 104.78                             | 71.20                         |
| 8       | Input output relationship      | 141.10                             | 97.58                         |
| 9       | Farm level risk management     | 85.71                              | 60.48                         |
| 10      | Marketing                      | 85.71                              | 77.30                         |
| 11      | Input self sufficiency         | 53.15                              | 47.87                         |
| 12      | Information self reliance      | 91.67                              | 69.07                         |
| 13      | Employment generation          | 15.90                              | 10.37                         |
| 14      | Family food security           | 51.67                              | 42.83                         |
| 15      | Quality of life                | 91.40                              | 71.90                         |

The details of net income generated:

| Enterprise   | Area                             | Cost of Production (Rs.) | Gross Income (Rs.) | Net Income (Rs.) |
|--------------|----------------------------------|--------------------------|--------------------|------------------|
| Sugarcane    | 2.5 acres                        | 1,02,664                 | 3,52,000           | 2,49,336         |
| Paddy        | 0.5 acres                        | 9,047                    | 18,362             | 9,315            |
| Ragi         | 0.5 acres                        | 6,078                    | 10,500             | 4,422            |
| Coconut      | 72 Nos.                          | 10,000                   | 55,000             | 45,000           |
| Arecanut     | 20 Nos.                          | 2,000                    | 9,000              | 7,000            |
| Cows         | 2 HF & 1 Buffalo                 | 52,000                   | 1,15,200           | 63,200           |
| Goat         | 15 No.                           | -                        | -                  | -                |
| Poultry      | 1000 birds/batch- 4 batches/year | 55,000                   | 1,26,000           | 71,000           |
| <b>Total</b> |                                  | <b>2,36,789</b>          | <b>6,86,062</b>    | <b>4,49,273</b>  |
| <b>C:B</b>   |                                  | <b>1:2.90</b>            |                    |                  |



**Plate 1: Sheep rearing**



**Plate 2: Poultry farm**



**Plate 3: Compost preparation tank**



**Plate 4: Bore well for irrigation**



**Plate 5: Fertigation tank**



**Plate 6: Mulching in sugarcane**



**Plate 7: Livestock**



**Plate 8: Water storage tank with**

In view of well-balanced optimum combination of enterprises the annual income generation from seasonal, annual, perennial crops, livestock and poultry enterprises is very encouraging and motivating to many farmers. His advice for others is to adopt combination of planned cropping pattern, organic soil mulching besides he has adopted drip-irrigation for effective water use efficiency, labour management and to minimize expenditure.

### **Social Impact on Family**

- Due to increased income he has renovated his house
- Daughter married to an educated person
- Investing on farm improvements
- Many approach him for his knowledge and experience
- Local leader and role model for the contemporary farmers
- Has a contact with local Agricultural, Horticultural, Forest department officials, KVK Scientists, NGOs, Marketing and financial institutions.
- President of VSS

### **Recognitions and awards**

1. ‘Raita Theerpu’ 2009 from Deccan Development Society, Hyderabad.
2. Appreciated from Indian Council of Agricultural Research on November 2010, is an encouragement for reshaping the farmer oriented farm technologies across the country during national farm innovators meet 2010 held at JSS Krishi Vigyan Kendra, Suttur, Mysore.
3. Award for natural farming in 2007 from Mandya district rural development organization, Sathnur hobli, Mandya taluk.
4. Awarded “Innovative Farmer” in 2011 from Directorate of Rice Research, Rajendranagar, Hyderabad.
5. “S. D. Jayaram Samudaya Seva Prashasti” in 2011 from S. D. Jayaram Samagra grameena abhivruddi samste.

The integrated farming system approach has helped Mr. Chikkaboregowda to get stable returns from the entire farm. Hence, it is high time for the scientists, administrators and planners to provide adequate facilities and encouragement to the farmers to adopt integrated farming system all over the country. Since the integrated farming system is by itself self-employment oriented, these improved technologies would definitely provide lots of employment opportunities to the farmer. It also helps in maintaining livelihood security of the farmers in turn it reduces hunger and poverty of the society. Thus the integrated farming system would improve the capabilities, assets and activities required for living means of the farmers.

### **Strengths for high sustainability**

- Family resides on the farm, saving time in transportation and enabling timely activities
- Consolidated land holding
- Interlinking of different components on the farm
- Recycling of farm and animal waste for manure
- Less dependency on external inputs & labour
- Effective utilization of available water through drip irrigation
- Having good contacts with experts/Scientists from University, Developmental department, Research Institutions and marketing agencies.
- Generating sufficient organic matter on farm which is helpful in maintaining soil fertility and reduction in use of chemical fertilizers
- Innovativeness and interest in updating knowledge and technology

### **Case study-2**

#### **Sri Jaishankar: Low sustainable farming system under irrigated situation in southern dry zone**

Mr. P. Jaishankar aged about 42 years is staying in Umdahalli village, Sathnur hobli of Mandya Taluk in Mandya district of Karnataka state. He studied up to 10<sup>th</sup> standard and having farming experience of 28 years. He is having land of 4 acres and 10 guntas. The family consists of father, mother and wife who are residing on the farm, son is studying college.

He also having one bore well for irrigation and also use canal water for irrigation purpose. He is cultivating sugarcane in an area of 3 acres and variety is CO-62175, he is not practicing mulching and intercropping. Paddy is cultivating in 1 acre during kharif and summer season. He planted only coconut around the border.

He is maintaining one HF cow, 2 local cows, one sheep and one goat. He is not practicing different components on the farm, he is not preparing compost, instead he using more chemical fertilizers than on farm inputs. Cost of production is not reduced by using by-products of one component as input of another linked component. Thus the total income of the farm is reduced.



**Plate 9: Paddy field**



**Plate 10: Sugarcane field**



**Plate 11: Sheep and goat rearing**



**Plate 12: Local cows**

**Indicator wise sustainability scores of Mr. Jaishankar and average sustainability scores of respondents in irrigated farming system**

| Sl. No. | Indicators                     | Sustainability Score of respondent | Average sustainability scores |
|---------|--------------------------------|------------------------------------|-------------------------------|
| 1       | Integrated nutrient management | 61.31                              | 75.82                         |
| 2       | Integrated pest management     | 62.50                              | 70.76                         |
| 3       | Water management               | 60.00                              | 75.24                         |
| 4       | Land use pattern               | 95.45                              | 94.70                         |
| 5       | Cropping pattern               | 95.45                              | 90.37                         |
| 6       | Land productivity              | 56.57                              | 46.68                         |
| 7       | Profitability                  | 21.89                              | 71.20                         |
| 8       | Input output relationship      | 55.85                              | 97.58                         |
| 9       | Farm level risk management     | 42.86                              | 60.48                         |
| 10      | Marketing                      | 71.43                              | 77.30                         |
| 11      | Input self sufficiency         | 18.00                              | 47.87                         |
| 12      | Information self reliance      | 33.33                              | 69.07                         |
| 13      | Employment generation          | 6.89                               | 10.37                         |
| 14      | Family food security           | 31.75                              | 42.83                         |
| 15      | Quality of life                | 54.29                              | 71.90                         |

The details of net income generated:

| Enterprise   | Area             | Cost of Production (Rs.) | Gross Income (Rs.) | Net Income (Rs.) |
|--------------|------------------|--------------------------|--------------------|------------------|
| Sugarcane    | 3 acres          | 1,51,000                 | 3,30,000           | 1,79,000         |
| Paddy        | 2 acres          | 30,595                   | 55,400             | 24,805           |
| Coconut      | 30 Nos.          | 4,500                    | 22,000             | 17,500           |
| Cows         | 1 HF             | 17,000                   | 34,400             | 17,400           |
| Sheep & Goat | 1 sheep & 1 goat | -                        | -                  | -                |
| <b>Total</b> |                  | <b>2,03,095</b>          | <b>4,41,800</b>    | <b>2,38,705</b>  |
| <b>C:B</b>   |                  |                          | <b>1:2.18</b>      |                  |

**Weakness's for low sustainability**

- Not practicing different components on the farm
- Not recycling farm and animal waste for fuel and manure
- More dependency on external inputs
- Less mechanization
- Not have much expert contacts
- Less innovativeness

### **Case study-3**

#### **Sri Krishnareddy: High sustainable farming system under rainfed situation in eastern dry zone**

Mr. Krishnareddy, M. B. aged about 52 years is staying in Paccharamakalahalli village, Nelavanki hobli of Srinivaspura Taluk in Kolar district of Karnataka state. He studied up to 10<sup>th</sup> standard and having farming experience of 30 years. He is having land of 10 acres. The family consists of 12 members.

He is having sufficient water for irrigation; he has 4 bore wells and having fragmented land. He is cultivating mango in an area of 4.5 acres and intercropping of cotton, ragi, field bean, red gram and coriander. Cultivating tomato in an area of 2 acres, mulberry in 2 acres of land and eucalyptus in an area of 2 acres. Accordingly, he planted many perennial trees like tamarind around the border. He also planted some tree fodders like subabul and timber species.

Along with this dairy as another subsidiary agricultural enterprise, he is maintaining 2 HF cows and 4 buffalo. Rearing sheep and goat (50 sheep and 30 goats), water storage tank has been constructed for storage and judicious use of water. He constructed 3 composting tanks with 18 x 8 ft dimension; it yields 5 tonnes of compost in 3 months. Fertigation tank has been installed in field for judicious and approximate usage of fertilizers and also to save labour. For judicious use of available water entire farm is drip irrigated thereby he saves labour and also weeds are under control. Integration of different agriculturally related enterprises with crops provided ways to recycle products. Cost of production is reduced by using by-products of one component as input of another linked component. Thus the total income of the farm is raised. Multiple land use through integration of crops, livestock, sheep & goat rearing has given the best and optimum production from unit land area.

#### **Indicator wise sustainability scores of Mr. Krishnareddy and average sustainability scores of respondents in rainfed farming system**

| <b>Sl. No.</b> | <b>Indicators</b>              | <b>Sustainability Score of respondent</b> | <b>Overall average sustainability scores</b> |
|----------------|--------------------------------|---|--|
| 1              | Integrated nutrient management | 78.33                                     | 74.03  |
| 2              | Integrated pest management     | 72.92                                     | 63.37  |
| 3              | Water management               | 70.00                                     | 50.17  |
| 4              | Land use pattern               | 166.70                                    | 94.35  |
| 5              | Cropping pattern               | 166.70                                    | 89.74  |
| 6              | Land productivity              | 13.33                                     | 11.46  |
| 7              | Profitability                  | 55.87                                     | 21.00  |
| 8              | Input output relationship      | 36.75                                     | 23.83  |
| 9              | Farm level risk management     | 71.43                                     | 53.33  |
| 10             | Marketing                      | 77.78                                     | 71.90  |
| 11             | Input self sufficiency         | 52.25                                     | 48.56  |



**Plate 13: Agricultural implements**



**Plate 14: Mango + cotton intercrop**



**Plate 15: Mulberry garden**



**Plate 16: Eucalyptus**



**Plate 17: Goat rearing**



**Plate 18: Mango + coriander**



**Plate 19: Tomato crop**



**Plate 20: Drip irrigation**

|    |                           |       |       |
|----|---------------------------|-------|-------|
| 12 | Information self reliance | 97.22 | 68.33 |
| 13 | Employment generation     | 9.91  | 6.80  |
| 14 | Family food security      | 26.82 | 30.34 |
| 15 | Quality of life           | 77.14 | 63.81 |

The details of net income generated:

| Enterprise   | Area                       | Cost of Production (Rs.) | Gross Income (Rs.) | Net Income (Rs.) |
|--------------|----------------------------|--------------------------|--------------------|------------------|
| Mango        | 4.5 acres                  | 1,58,872                 | 4,60,000           | 3,01,128         |
| Cotton       | 2 acres                    | 82,576                   | 2,70,000           | 1,87,424         |
| Ragi         | 2 acres                    | 23,000                   | 40,000             | 17,000           |
| Red gram     | 1 acre                     | 5,000                    | 12,000             | 7,000            |
| Avre         | 0.5 acre                   | 2,000                    | 5,200              | 3,200            |
| Coriander    | 0.5 acre                   | 5,600                    | 10,000             | 4,400            |
| Tomato       | 2 acres                    | 1,48,782                 | 3,22,450           | 1,73,668         |
| Mulberry     | 2 acres                    | -                        | -                  | -                |
| Eucalyptus   | 2 acres                    | -                        | -                  | -                |
| Tamarind     | 20 No.                     | 4,500                    | 20,000             | 15,500           |
| Cows         | 2 HF & 4 Buffalo           | 60,000                   | 1,30,200           | 70,200           |
| Sheep & Goat | Sheep 50 No. & Goat 30 No. | 15,000                   | 60,000             | 45,000           |
| <b>Total</b> |                            | <b>5,05,330</b>          | <b>13, 29,850</b>  | <b>8,24,520</b>  |
| <b>C:B</b>   |                            | <b>1:2.63</b>            |                    |                  |

In view of well-balanced optimum combination of enterprises the annual income generation from seasonal, annual, perennial, livestock, sheep and goat rearing enterprises is very encouraging and motivating to many farmers. His advice for others is to adopt combination of planned cropping pattern besides he has adopted drip-irrigation for effective water use efficiency, labour management and to minimize expenditure.

### Social Impact on Family

- Due to increased income he has renovated his house
- He is investing more on farm for improvements
- Many people are approaching him for his knowledge & experience
- Local leader and role model for the contemporary farmers
- He has built up close rapport with local Agricultural, Horticultural, Forest department officials, KVK Scientists, NGOs, Marketing and financial institutions.

### **Strengths for high sustainability**

- Interlinking of different components on the farm
- Recycling of farm and animal waste for manure
- Less dependency on external inputs & labour
- Effective utilization of available water through drip irrigation
- Having good contacts with experts/Scientists from University, Developmental department, Research Institutions and marketing agencies.
- Generating sufficient organic matter on farm which is helpful in maintaining soil fertility and reduction in use of chemical fertilizers
- Innovativeness and interest in updating knowledge and technology

### **Case study-4**

#### **Sri Narayanaswamy: Low sustainable farming system under rainfed situation in eastern dry zone**

Mr. P. G. Narayanaswamy aged about 41 years is staying in Paccharamakalahalli village, Nelavanki hobli of Srinivaspur Taluk in Kolar district of Karnataka state. He is illiterate and having farming experience of 20 years. He is having land of 4 acres. The family consists of wife she is residing on the farm, daughter and son is going for school.

He doesn't have bore well and depends on rain for irrigation. He is cultivating mango in an area of 2 acres, ragi + Red gram + Avre in an area of 1acre. He is not practicing intercropping and 2 acres of land is barren. He is maintaining only one sheep and two goats. He is not practicing different components on the farm, he is not preparing his own compost, instead he using more chemical fertilizers than on-farm inputs. Cost of production is not reduced by using by-products of one component as input of another linked component. Thus the total income of the farm is reduced.

#### **Indicator wise sustainability scores of Mr. Narayanaswamy and average sustainability scores of respondents in rainfed farming system**

| <b>Sl. No.</b> | <b>Indicators</b>              | <b>Sustainability Score of respondent</b> | <b>Overall average sustainability scores</b> |
|----------------|--------------------------------|---|--|
| 1              | Integrated nutrient management | 63.33                                     | 74.03  |
| 2              | Integrated pest management     | 56.25                                     | 63.37  |
| 3              | Water management               | 30.00                                     | 50.17  |
| 4              | Land use pattern               | 73.33                                     | 94.35  |
| 5              | Cropping pattern               | 60.00                                     | 89.74  |
| 6              | Land productivity              | 10.67                                     | 11.46  |
| 7              | Profitability                  | 17.61                                     | 21.00  |
| 8              | Input output relationship      | 24.87                                     | 23.83  |

|    |                            |       |       |
|----|----------------------------|-------|-------|
| 9  | Farm level risk management | 28.57 | 53.33 |
| 10 | Marketing                  | 77.78 | 71.90 |
| 11 | Input self sufficiency     | 81.16 | 48.56 |
| 12 | Information self reliance  | 55.56 | 68.33 |
| 13 | Employment generation      | 9.24  | 6.80  |
| 14 | Family food security       | 16.93 | 30.34 |
| 15 | Quality of life            | 57.14 | 63.81 |

The details of net income generated:

| Enterprise             | Area             | Cost of Production (Rs.) | Gross Income (Rs.) | Net Income (Rs.) |
|------------------------|------------------|--------------------------|--------------------|------------------|
| Mango                  | 2 acres          | 80,000                   | 1,98,000           | 1,18,000         |
| Ragi + Red gram + Avre | 1 acre           | 11,500                   | 28,500             | 17,000           |
| Sheep & Goat           | 1 sheep & 2 goat | -                        | -                  | -                |
| <b>Total</b>           |                  | <b>91,500</b>            | <b>2,26,500</b>    | <b>1,35,000</b>  |
| <b>C:B</b>             |                  | <b>1:2.47</b>            |                    |                  |

#### Weakness's for low sustainability

- Not practicing different components on the farm
- Not recycling farm and animal waste for fuel and manure
- More dependency on external inputs
- Less mechanization
- Not have much expert contacts
- Less innovativeness



**Plate 21: Sheep rearing**



**Plate 22: Mango farm**



**Plate 23: Pits for mango planting**



**Plate 24: Water storage tank**

The average holding of a farm in India has been declining and 83.9 per cent of operational holdings are small. There is no scope for increasing the farm size. In addition, there is shrinkage of cultivated land due to industrialization and urbanization. In this context integrated farming system become inevitable for the sustainable agriculture production and to help the farmers to increase their income. In any farming system greater importance should be given for effective and efficient management of farm resources to enhance the farm productivity and to reduce environmental degradation, which facilitates maintaining the sustainability. The sustainable farming systems ensure higher productivity to meet the present and future needs of the farmers without jeopardizing economic viability and ecological compatibility. Hence, such of the farming systems are to be developed for specific agricultural region. The slow growth of agricultural sector is mainly due to stagnation in productivity which is a great concern for policy makers and planners. The key challenge to Indian agriculture lies in designing, developing and managing farming systems that enable the farming to be profitable.

There is a need to quantify sustainability of farming systems and to make the concept operational duly incorporating its economic viability, environmental sustainability and social equity. Many individuals and organizations have attempted to identify certain indicators and then to work out an index for measuring sustainability at macro level (Anon., 1990 and 1991). Chandregowda (1996) made an in-depth farm level analysis of rice farming sustainability, Naghbushanam (1997) analyzed the sustainability of agriculture in watershed environment and Chandra Naik (2002) studied the sustainability of cotton farming systems. However, such micro level studies on sustainability for different agricultural crops are very few. The felt need of the day is increasing and stabilizing the productivity level of farming systems and this could be achieved by generating appropriate low cost and sustainable technologies. Sustainability level in any farming system is influenced by the technologies available.

Hence, the present study was aimed to find out the sustainability of farming systems with the following specific objectives:

1. To develop sustainability index for measuring sustainability of farming systems practiced by farmers.
2. To study the sustainability of irrigated and rainfed farming systems in selected agro-climatic zones.
3. To study the relationship between profile of farmers and sustainability level of irrigated and rainfed farming systems.
4. To document the constraints of farmers in achieving sustainability of farming systems and to know their suggestions.
5. To document few case studies of farming systems practiced in the selected agro-climatic zones.

## Methodology

The study was conducted in two agro-climatic zones of Karnataka namely eastern and southern dry zones. Based on the highest irrigated and highest rainfed area in each agro-climatic zone, taluks were finalized. Gubbi taluk in Tumkur district, Mandya taluk in Mandya district having highest irrigation and Srinivasapura taluk in Kolar district and Gundlupet taluk in Chamarajnagar district having highest rainfed were purposively selected. Kasaba and Kadaba hoblies in Gubbi taluk, Kasaba and Kottathi hoblies in Mandya taluk having highest irrigation & Ronuru and Nelavanki hoblies in Srinivasapura taluk & Terkanambi and Hangla hoblies in Gundlupet taluk having highest rainfed were thus, selected. Three villages were randomly selected for the study from each of the selected hoblies. Five farmers from each village were randomly selected as sample and thus the data were gathered from a total sample of 120 respondents. An index was developed by using standard procedures like identifying indicators, working out scale values and then combining them to arrive at the final index. This index was used to measure sustainability of farming systems. Data were collected through personal interview method. The collected data were scored, tabulated and analyzed keeping in view the objectives of the study. Important findings are summarized below.

## Salient findings of the study

The important findings of the study are as follows

1. With respect to personal and economic characteristics of farmers in irrigated farming system, it was found that 83.33 per cent of farmers were middle to old age, had high school to PUC education (71.67 %), belonged to small family (66.67 %), had medium farming experience (45.00 %) and belonged to small farmers (41.67 %). In rainfed farming system, most (76.67 %) of them belonged to middle to old age, 43.33 per cent had high school education, 60.00 per cent belonged to small family, 35.00 per cent were having low farming experience and 51.67 per cent were small farmers.
2. It was observed that among psychological characteristics of irrigated farming system, about one third (36.67 %) had medium level of aspiration, about half of them had medium level of economic motivation (51.67 %), achievement motivation (48.34 %) and value orientation (53.33 %), majority had medium level of management orientation (76.67 %), risk orientation (76.67 %), 40.00 per cent had high level of farming commitment, 41.67 per cent belonged to high level of decision making pattern and 45.00 per cent were having high level of innovativeness. In rainfed farming system 45.00 per cent of farmers had medium level of aspiration, 61.67 per cent had medium level of economic motivation, 46.67 per cent had medium level of achievement motivation, 46.67 per cent had medium level of management orientation, 65.00 per cent had medium level of risk orientation, 80.00 per cent had medium level of value orientation, 45.00 per cent of farmers had medium level of farming commitment & innovativeness and 41.67 per cent had high level of decision making pattern.
3. It could be observed from the result that among the social and communication characteristics of the farmers in irrigated farming system, 40.00 per cent had medium

social participation, 48.33 per cent had high cosmopolitanness, 41.67 per cent had medium level of extension contact, 45.00 per cent had high level of extension participation and 53.33 per cent had medium level of mass media use. While in rainfed farming system, 38.34 per cent of them had medium level of social participation, 46.67 per cent had medium level of cosmopolitanness, 45.00 per cent had medium level of extension contact, 41.67 per cent had low extension participation and 43.33 per cent had medium level of mass media use.

4. Sustainability level of irrigated and rainfed farming systems revealed that most of the farmers in each system belonged to the medium level of sustainability, ranging from 40.00 per cent in irrigated situation to 46.67 per cent in the rainfed situation. The farmers under irrigated farming system exhibited a higher level of sustainability when compared to farmers under rainfed farming system.
5. About 46.67 per cent of eastern dry zone farmers and 60.00 per cent of southern dry zone farmers in irrigated farming system belonged to the medium level of sustainability. The chi-square value which was non-significant indicated that there was no association between the two agro-climatic zones of irrigated farming system with respect to sustainability levels. The farmers under both the zones exhibit same level of sustainability.
6. In rainfed farming system 46.67 per cent of farmers in eastern dry zone and 43.33 per cent of farmers in southern dry zone had medium level of sustainability. The chi-square value which was significant at 0.05 level indicated that there was an association between the two agro-climatic zones with respect to sustainability levels. The farmers under eastern dry zone exhibited a higher level of sustainability when compared to farmers under southern zone.
7. About 46.67 per cent of both the irrigated and rainfed farmers belonged to medium level of economic security level.
8. More than one third (43.33%) of eastern dry zone farmers under irrigated farming system belonged to medium level of ecological safety whereas, in case of southern dry zone 40.00 per cent of farmers had low level of ecological safety. The results of chi-square test applied on this set of data were statistically non-significant, which implied that there was no association between the levels of ecological safety and two zones of the irrigated farming systems.
9. More than half (53.33 %) of eastern dry zone farmers in rainfed farming system belonged to high level of ecological safety, with respect to southern dry zone of rainfed farming system, an higher percentage of respondents (60.00%) belonged to low level of economic security. The chi-square value which was significant at 0.01 level indicated that there was an association between the two agro-climatic zones with respect to ecological safety levels.
10. More than seventy five (78.33 %) per cent of the farmers practicing irrigated farming system belonged to medium to high level of economic security, whereas in rainfed farming system, a higher percentage of respondents (75.00 %) belonged to low to medium level of economic security.

11. A data on the economic security level of respondents revealed that 40.00 per cent of farmers under eastern dry zone of irrigated farming system belonged to medium level of economic security, with respect to southern dry zone exactly half (50.00 %) of respondents belonged to medium level.
12. Forty per cent of eastern dry zone farmers under rainfed farming system belonged to low level of economic security. It was interesting to note in case of southern dry zone 40.00 per cent of farmers had medium level of economic security.
13. About half (46.67 %) of the farmers practicing irrigated farming system had a high level of social stability, in case of rainfed farming system 45.00 per cent belonged to medium level.
14. Nearly half (46.67 %) of eastern dry zone farmers under irrigated farming system had a high level of social stability, while in southern dry zone 43.33 per cent belonged to low level. The value of chi-square test applied in the irrigated farming system was statistically significant, which implied that there was an association between the levels of social stability and two zones of irrigated farming system. The farmers belonging to eastern dry zone of irrigated farming system had relatively high social stability than those coming under southern dry zone.
15. Exactly half (50.00 %) of eastern dry zone farmers under rainfed farming system belonged to high level of social stability, whereas, in southern dry zone 43.33 per cent of farmers were having medium level of social stability. The chi-square value which was non-significant indicated that there was no association between two zones with respect to social stability level. The farmers under two zones of rainfed farming system exhibited same level of social stability.
16. With regard to mean scores, the famers under irrigated farming system had a relatively higher mean ecological safety score of 52.70, while farmers under rainfed farming had a mean score of 41.49. In case of economic security index, the irrigated farming had obtained a highest mean score of 45.65, followed by rainfed farmers who had scored only 38.94. Whereas, the irrigated farming had obtained a social stability mean score of 40.36 and rainfed farming had a mean score of 35.06. However, the famers under irrigated farming system had obtained a relatively higher overall sustainability index (48.00) than those under rainfed system (39.43). Further, the t- value showed the significant difference at 0.01 per cent level of probability, pointing to significant difference in the sustainability indices between the two farming systems.
17. The famers under eastern dry zone and southern dry zone of irrigated farming system had obtained a same mean ecological safety score of 52.70 and the t-value showed the non-significant difference between two zones. In case of economic security index, irrigated farmers of eastern dry zone had obtained a mean score of 46.08 followed by southern dry zone farmers who had scored 45.23 and the t-value showed the non-significant difference between two zones. Whereas, the eastern dry zone of irrigated farming had obtained a social stability mean score of 45.06 and southern dry zone had a mean score of 35.66 and the t-value showed the significant difference at 0.01 per cent level of probability, pointing to significant difference in the social stability indices between the two zones of irrigated farming system. There is no

significant difference between the farmers under eastern dry zone (49.00) of irrigated farming system and that of farmers of southern dry zone (47.00) with respect to overall sustainability index (t-value showed the non-significant difference between two zones).

18. The farmers under eastern dry zone of rainfed farming system had obtained a relatively higher mean ecological safety score of 49.57 while southern dry zone had a mean score of 33.42 and the t-value showed the significant difference at 0.01 per cent level of probability, pointing to significant difference in the ecological safety indices between the two zones of rainfed farming system. In case of economic security index, rainfed farming system of eastern dry zone had obtained a mean score of 35.84 while southern dry zone farmers had scored 42.03 and the t-value showed the non-significant difference between two zones. Whereas, the eastern dry zone of rainfed farming had obtained a social stability mean score of 36.91 and southern dry zone had a mean score of 33.20 and the t-value showed the non-significant difference between two zones. The farmers under eastern dry zone of rainfed farming system had obtained a relatively higher overall sustainability index (42.48) than those under southern dry zone (36.69) and the t-value showed the significant difference at 0.01 per cent level of probability, pointing to significant difference in the overall sustainability between the two zones of rainfed farming system.
19. The t-test was applied to know the significant difference if any, between the sustainability mean scores of irrigated and rainfed farming systems under the fifteen sub indicators. There was significant difference at 0.01 per cent level of probability with respect to integrated pest management and water management, profitability, farm level risk management, marketing, employment generation and quality of life. However, there was no significant difference in sustainability scores of the indicators like integrated nutrient management, cropping pattern and land use pattern, land productivity, input output relationship, input self-sufficiency, information self-reliance and family food security.
20. The Correlation analysis indicated a positive and significant relationship between education, family size, level of aspiration, achievement motivation, management orientation, risk orientation, value orientation, farming commitment, social participation, innovative proneness, extension contact, extension participation and sustainability of irrigated farming system, whereas farming experience had negative and significant relationship.
21. The results of the study revealed that the variables such as education, family size, level of aspiration, economic motivation, achievement motivation, management orientation, farming commitment, decision making pattern, cosmopolitanism, extension contact and mass media use had positive and significant relationship, whereas farming experience had negative but significant relation with sustainability of rainfed farming system.
22. The multiple linear regression analysis of independent variables with sustainability level of irrigated farming systems indicated that only four variables viz., education, farming experience, farming commitment and innovative proneness were significant at 1 per cent level, whereas six variables like family size, achievement motivation,

management orientation, risk orientation, value orientation and extension participation were significant at 5 per cent level. The  $R^2$  value indicated that all the 19 independent variables contributed to the tune of 71.30 per cent of variation in sustainability of irrigated farming system.

23. Multiple Regression analysis of independent variables with sustainability level of rainfed farming systems indicated that the variables like education, farming experience, family size, economic motivation, achievement motivation, farming commitment, decision making pattern and mass media use were found significant at 1 per cent level and the three variables viz., level of aspiration, management orientation and cosmopolitaness had significant relation with sustainability at 5 per cent level. The  $R^2$  value indicated that all the 19 independent variables had contributed to the tune of 73.20 per cent of variation in sustainability of rainfed farming system.
24. Path analysis was applied to know the direct and indirect effects of independent variables on sustainability of irrigated farming system. As regards to the direct effects on sustainability is concerned, farming commitment stood first followed by innovative proneness and extension participation. Further, ranking of variables based on their total indirect effects on sustainability revealed that mass media use, social participation and extension contact had highest indirect effect. The residual effect was found to be 0.3008.
25. With respect to direct and indirect effects of independent variables on sustainability of rainfed farming system, highest direct effect was recorded by family size, followed by education and decision making pattern. Further, the data show that high total indirect effect on sustainability was recorded by level of aspiration, extension contact and mass media use. The residual effect was found to be 0.3088.
26. Major constraints faced by farmers of irrigated farming system were high cost of inputs, lack of knowledge regarding pest and diseases, non-availability of inputs, lack of own resources, lack of co-operation, lack of ICT facilities and cumbersome/difficult procedure in seed production.
27. Major constraints faced by farmers of rainfed farming system were lack of water for irrigation, high cost of inputs, non-availability of inputs, lack of own resources, lack of support from developmental departments, lack of ICT facilities, unavailability of new technologies.
28. The major suggestions given by the farmers of irrigated farming system were dependency on hired labour is more, so development departments should give importance for farm mechanization (90.00 %), followed by providing proper marketing and transportation facilities (86.67 %) and providing more information on sustainable farming practices (85.00 %).
29. Arranging irrigation facilities for cultivation (90.00 %), providing more information on sustainable farming practices & adequate information should provide on balanced use of inorganic fertilizers (88.33 %) were the major suggestions given by the farmers of rainfed farming system.

### **Implications of the study**

1. The index developed for measuring sustainability of farming systems practiced by farmers was found reliable, valid and internally consistent. Hence, the index could be used to measure the sustainability of farming systems in any situation.
2. The study has conclusively demonstrated that the farming systems under irrigated situation is more sustainable than rainfed situation. Hence, the development departments should focus in promoting sustainable practices under rainfed situation.
3. The results showed some of the economic indicators of rainfed farmers contribute less for sustainability level. Hence, the scientists should develop more of non-cash and low cost technologies for better economic condition.
4. The results on influence of independent variables viz., management orientation, level of aspiration, achievement motivation and farming commitment played a significant role in enhancing the sustainability level of farming systems among both irrigated and rainfed farming systems. Hence, these variables have to be considered in promoting them among the farming community in the long run.
5. The extension workers need to give sufficient attention to provide low cost technologies, educate farmers in improving their knowledge regarding pest and diseases and should also create awareness on ICT facilities, as these were found to be some of the major constraints for better sustainability.

### **Suggestions for future research**

1. The evolved sustainability index has to be made use better for different 'crop based' or 'enterprise based' farming systems.
2. The dimensions and indicators of sustainability of farming systems need to be verified for different purposes and the suitable modifications in terms of addition, replacement or deletion of dimensions/indicators is to be done without reducing the validity of such an index.
3. The present study was conducted in only two selected agro-climatic zones of Karnataka viz., eastern dry zone and southern dry zone. Similar attempts be made in other agro-climatic zones of Karnataka and the findings confirmed.
4. The present study had the limitation of the time and resource of single investigator and the size of the sample were only 120. Hence, a comprehensive study with a large size sample including more number of farmers may be taken up for in depth proving and for wider application of results.
5. Also the study was confined to farmers in general under irrigated and rainfed farming systems. It is worthwhile to conduct study on comparison of marginal, small and big farmers within irrigated and rainfed farming systems. This helps to compare differences in sustainability of farming systems among diverse sections classes of people.

## CHAPTER IV

---

### REFERENCES

- ANONYMOUS, 1986, Project Preparation and Monitoring Cell, Govt. of Kerala. *Project for development of small farm mechanization system in Kerala-report-1986*. PPM Cell, Govt. of Kerala, Trivandrum: 13.
- ANONYMOUS, 1987, "Our Common Future." World Commission on Environment and Development, Oxford University Press.
- ANONYMOUS, 1989a, Towards the 21<sup>st</sup> Century: Strategic issues and operational strategies, Consultative Group on International Agricultural Research, Mexico City.
- ANONYMOUS, 1989b, Decision reached on sustainable agriculture. *Agronomy News*, January 15.
- ANONYMOUS, 1990, Putting sustainability into context, sustainable farming and the role of farmers' organization (Seminar for Developing Country). *Farm Leader*, Adelaide, Australia.
- ANONYMOUS, 1991a, Sustainable agriculture and rural development in Asia and Pacific Regional document No. 2, Netherlands conference on agriculture and environment, Food and Agriculture Organization, The Netherlands, 15-19.
- ANONYMOUS, 1991b, Criteria for assessment, Workshop proceedings, ILEIA (Institute for Low External Input Agriculture). *ILEIA Newsletter*, 7 (3): 21-23.
- ANONYMOUS, 1992a, Towards sustainability, Document Com (92) 23-II Final.Cat.No.CB-CO-92-150-EN-C of the Commission of European Committee, in Brussels.
- ANONYMOUS, 1992b, Sustainable food production in Sub-Saharan, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.
- ANONYMOUS, 1993, Non-Governmental Organization sustainable agriculture treaty, June 11, 1992; principles of an alternative approach. *WSAA News Letter*, 2 (6): 4-5.
- ANONYMOUS, 1996, Overseas development project. Implications of environmental and sustainable issues for the organization and practice of agricultural extension. Univ. Agric. Sci., Bangalore in collaboration with department of agricultural extension and rural development, Reading University, U.K., 20:24.

- ANONYMOUS, 2004, Agriculture and the Environment: Lessons learned from a decade of OECD work.
- ABROL, I. P. AND KATYAL, J. C., 1990, Managing soil fertility for sustainable agriculture. Indian Society of Agronomy, International Symposium, Feb. 6-10, 236.
- AINSWORTH, E., 1989, Farmers have called you. *Farm Journal*, **113** (February): 1.
- ALEXANDER, K. C., 1982, Agricultural development and social transformation. A study in Ganganagar, Rajasthan. *Journal of Rural Development*, **1** (1): 1-71.
- ALLEN, P., VAN D'USEN, D., LUNDY, L. AND GLIESSMAN, S., 1991, Integrating social, environmental and economic issues in sustainable agriculture. *American J. Alternative Agriculture*, **6**: 34-39.
- AMUDHASURABI AND VASANTHAKUMAR, J., 2001, Sustainable agriculture development. *Kisan World*, **28**(1): 18-19.
- ANIL KUMAR AND ARORA, V. P. S., 1999, Post-harvest management of vegetables in Uttar Pradesh hills. *Indian Journal of Agricultural Marketing*, **13**(2): 6-14.
- ANITHA, 2004, Entrepreneurial behavior and market participation of farm women in Bangalore rural district of Karnataka. *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- ASHA DEVI, P., 2006, Marketing behaviour and profitability of different farm enterprises among various categories of farmers in Kolar District. *M.Sc. (Agri.) Thesis*, (Unpub.), Tamil Nadu Agric. Univ., Coimbatore.
- BHANU, V. L., 2006, Study on aspirations of rural youth and their attitude towards rural development activities in Dharwad district of Karnataka state. *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. of Agric. Sci., Dharwad.
- BHEEMAPPA, A., 2001, A comparative analysis of knowledge and technological gap in adoption of Paddy and Cotton cultivation practices between migrant and non-migrant farmers of TBP command area in Karnataka. *Ph. D. Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad (India).
- BONNY, P. B., 1996, Constraints in commercial production of vegetables. *Journal of Tropical Agriculture*, **34**(2): 159-160.
- BUDIHAL, R. A., 2001, Utilization pattern of Cotton production technology by farmers of northern Karnataka. *Ph. D. Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad (India).

- BUNCH, R., 1990, The meaning and benefits of partnership in agricultural research: Past successes-future potentials. *Am. J. Alternative Agric.*, **5**(4): 147-150.
- BUTTEL, F. H., 1993, The sociology of agricultural sustainability: some observations on the future of sustainable agriculture. *Agriculture, Ecosystems and Environment*.**46**: 175-186.
- BYRAREDDY, H.N., 1971, A study on differential characteristics of adopters and non-adopters of fertilizers of rainfed ragi in Bangalore North Taluk, *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- CACERES, D. M., 1996, Tecnologia, participacion y Desarrollo Rural. A forthcoming edition of *Estudios*.
- CANTRILL, H., 1965, *The Pattern of Human Concerns*. Rutgers University, New Brunswick.
- CHANDRA CHARAN, 2003, A profile of Sujala watershed project beneficiary farmers in Dharwad district. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad, Karnataka (India).
- CHANDRA NAIK. S., 2002, An analysis of sustainability of cotton farming systems. *Ph.D. Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- CHANDRANI SAHA, 2008, A study on sustainability of farming system and livelihood security among rural households in Tripura. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- CHANDRASHEKARA, P., REDDY, A. G. S. AND SURESHKUMAR, V. B., 1996, Occupation pattern, interest, training needs and problems of Wayanad coffee growers. *Indian Coffee*, **LX** (8): 3-7.
- CHANDREGOWDA, M. J. AND JAYARAMAIAH, M., 1996, Integrated nutrient management in rice farming under four rice ecosystem. Organic farming and sustainable agriculture. *Proceedings of National Seminar*, Oct 9-11, Organized by the Univ. Agric. Sci., Bangalore.
- CHANDREGOWDA, M. J., 1996, Sustainability of rice farming in different rice ecosystem. *Ph.D. Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- CHAUDHARI, R.R., 2006, A study on entrepreneurial behaviour of dairy farmers. *Ph. D.Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad (India).
- CONWAY, G. AND BARBIER, E., 1988, *After the green revolution: sustainable agriculture for rural development*. Earthscan Publications Ltd., London, pp.205.

- CONWAY, G.R., 1985, Agroecosystem analysis. *Agricultural Administration*, **20**: 31-55.
- CONWAY, R. O., DOERING, R., NEHRING AND FRERICHS, S., 1991, A perspective on sustainable agriculture. Draft Manuscript.
- DALLY, H. E. AND COBB, J. B., Jr., 1989, For the common good: Redirecting the economy toward community, the environment and a sustainable future, Boston, beacon press.
- DE JAGER, A. AND ONDURU, D., VAN WIJK, VLAMING, J., GACHINI, G.N., 2001, Assessing sustainability of low-external-input farm management systems with the nutrient monitoring approach: a case study in Kenya. *Agric. Systems*, **69**:99–118.
- DESAI, G. R., 1981, A Critical Analysis of the Contribution of Education and Extension Guidance to Economic Performance of Cotton Farmers of Karnataka State. *Ph.D. Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- DHALIWAL, 1963, Cited Research in Extension of Accelerating Development Process ed. by SINGAL, K.N, RAO, C.S.S, AND SAY,B.N., 1970, *Indian Society of Extension Education*, IARI, New Delhi.
- DIXIT SREENATH, 1992, Block level planning and execution of integrated rural development programme and its impact on beneficiaries – a study in selected blocks of Karnataka. *Ph.D. Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- DOUGLAS, G. K., 1984, The meanings of agricultural sustainability, In: *Agricultural sustainability in changing world order*. (Eds) G. DOUGLAS, West view press, Boulder, Colorado.
- DUNLOP, R. E., BEUS, C. E., NOWELL, R. E. AND WAND, J., 1992, What is sustainable agriculture? An empirical examination faculty and farmer definitions. *J. Sustainable Agriculture*, **3**(1): 5-39.
- EDWARDS, C.A., 1987, The concept of integrated systems in lower input/sustainable agriculture. *American J. Alternative Agriculture*, **2**: 148-152.
- EMMA J. DILLON, THIA HENNESSY AND STEPHEN HYNES, 2009, Towards measurement of farm sustainability – an Irish case study. Contributed Paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China, August 16-22.
- FEASTER, J.Y., 1968, Measurement and determinants of innovativeness among primitive agriculturists. *Rural Sociology*, **33**: 339-348.

- FRANCIS, C. AND YOUNGBERG, G., 1990, What is Sustainable Agriculture?, Common Misconception about Sustainable Agriculture and Historical Developments Relevant to the Concept of Sustainable Agriculture. *Sustainable Agriculture in Temperate Zones*: 3-15. Edited by C. FRANCIS, C. FLORA AND L. KING, New York: Wiley.
- FRESCO, L. O. AND KROONENBERG, S. B., 1992, Time and spatial scales in ecological sustainability. *Land Use Policy*, **9**(3):155-168.
- GALE, R. P. AND CORDRAY, S. M., 1994, Making sense of sustainability; Nine answers to what should be sustained?. *Rural Sociology*, **59**(2): 311-332.
- GANESH PRASAD, T.S., 2006, An analysis of adoption, marketing and constraints of turmeric growers in chamarajanagar district. *M.Sc. (Agri) Thesis (Unpub)*, University of Agricultural Sciences., Bangalore.
- GIRASE, C. P., KALANTRI, L. B. AND TEKALE, V. S., 2004, Constraints faced by the farmers in the adoption of recommended package of practices of cotton. *Asian J. Extn. Edu.*, **23**: 157-160.
- GOLAM RASUL AND GOPAL B. THAPA, 2004, Sustainability of ecological and conventional agricultural systems in Bangladesh: an assessment based on environmental, economic and social perspectives. *Agricultural Systems*, **79**: 327–351.
- GOODLAND, R., 1995, The concept of environmental sustainability. *Annu. Rev. Ecol. Syst.*, **26**: 1-24.
- GOPALA, Y. M., 2010, Knowledge and Adoption of participant and non-participant maize growers of FFSs in Chickaballapur district of Karnataka. *M.Sc. (Agri.) Thesis, (Unpub.)*, Univ. Agric. Sci., Bangalore.
- GOVINDA REDDY, D.M., SRINIVAS GOWDA, M.V., SRINIVAS REDDY, M.V. AND PRASANNA KUMAR, G.T., 1997, Constraints in production and marketing of mangoes: A case study in Srinivaspur region, *The Bihar Journal of Agricultural Marketing*, **5** (2): 234-237.
- GUILFORD, J.P., 1954, *Psychometric Methods*. McGraw Hill Book, New York.
- HADAGALI VISHWANATH., 2013, A study on aspirations and participation of rural youth practicing agriculture and allied activities. *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. of Agric. Sci., Bangalore.
- HAILU, J. C., 1988, Moisture conservation-fundamental to rainfed agriculture, *ILEIA News Letter*, **4**(4):15-17.

- HANSEN, J. W. AND JONES, J. W., 1996, A systems framework for characterizing farm sustainability. *Agricultural Systems*, **5**: 185-201.
- HARWOOD, R. R., 1990, The history of sustainable agriculture. In *Sustainable Farming Systems*, (Eds) C. A. EDWARDS, P. MADDEN, R. MILLAR AND G. HOUSE, Soil and Water Conservation Society, Iowa, pp. 3-19.
- HAYO M.G. VAN DER WERF AND JEAN PETIT, 2002, Evaluation of the environmental impact of agriculture at the farm level: a comparison and analysis of 12 indicator-based methods. *Agriculture, Ecosystems and Environment*, **93**: 131-145.
- HEGDE, N. G., 2000, Sustainable agriculture for food security. *Indian Farming*, **11**(3): 5-7.
- HEMAKUMARI, V., 1992, Production and marketing of chrysanthemum flower in East Godavari district of Andhra Pradesh: An economic analysis. *Agricultural Economic Research Review*, **9**: 111-112.
- HENNING, J., BAKER, L. AND THOMASSIN, P. 1991, Economic issues in organic agriculture. *Canadian J. Agril. Econ.*, **39**: 877-889.
- HIREMATH, G. M., 1993, Economics of production and marketing of Lime in Bijapur district, Karnataka. *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad, Karnataka.
- IKERD, J., 1993, Two related but distinctly different concepts: organic farming and sustainable agriculture. *Small Farm Today*, **10** (1): 30±31.
- IZAC, A. M. N., SWIFT, M. J. AND DEVERAK, K. A., 1992, Unpublished paper, CGIAR Social Sciences Meet, ISNAR, The Hague, August.
- JAYALE, P. S. AND NACHANE, M. N., 1995, Orchard sustainability and socio-personal characteristics of mango and citrus growers. *Maharashtra J. Extn. Edu.*, **14**: 21-23.
- JODHA, K. S., 1991, Sustainable agriculture in fragile resources zones: technological imperatives. *Econ. & Pol. Weekly*, **26** (13): 15-26.
- KAINE, G.W. AND TOZER, P.R., 2005, Stability, resilience and sustainability in pasture-based grazing systems. *Agricultural Systems*, **83**: 27-48.
- KARPAGAM, C., 2000, A study on knowledge and adoption behaviour of Turmeric growers in Erode district of Tamil Nadu. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad (India).

- KEENAY, D. R., 1989, Toward a sustainable agriculture: need for clarification of concepts and terminology. *American J. Alternative Agriculture*, 4(3&4): 101-105.
- KERLINGER, E.N., 1978, *Foundations of Behavioural Research*, New York: Holt, Rine Hart and Winston.
- KESHVAMURTHY, N. N., 2005, A study on contract farming in Gherkin production. *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad, Karnataka.
- KHOSLA, A., 1987, Alternative strategies for achieving sustainable development. Conservation with equity – strategies for sustainable development, Ottawa, Canada.
- KRISHNA, K. S. AND NARAYANASWAMY, B. K., 1996, Projects of sustainable agriculture in Karnataka: Research, extension, education and training needs. Organic farming and sustainable agriculture *Abstracts*. National Seminar, October 9-11, organized by Univ. Agric. Sci., Bangalore.
- KRISHNA, K. S., 1995, Practice of sustainable agriculture in Karnataka. Conference on informatics for sustainable agriculture development *Abstracts*. Organized by National Informatics Centre Planning Commission, Ministry of Agriculture, Vigyan Bhavan, New Delhi, May 24-25: 100.
- KUMARSWAMY, P., 2001, Towards sustainable agriculture. *Kisan World*, 28(6): 9-10.
- KUTTY, J.K., 1996, Analysis of the management of sustainable agriculture by the farmers of Kerala. *Ph.D. thesis (Unpub.)*, Kerala Agric. Univ. Vellanikkara, Thrissur.
- LAKSHMINARAYAN, M. T., 1997, Adoption of sustainable sugarcane farming practices – An analysis. *Ph. D. Thesis (Unpub.)*, University of Agricultural Sciences, Bangalore.
- LAL, R. AND MILLER, I. P., 1990, Sustainable farming systems for the Tropics. Sustainable agriculture: issues, perspectives and prospects in Semi-Arid Tropics, New Delhi, 6-10.
- LAMPKIN, N. AND MEASURES, M., 1995, *Organic Farm Management Handbook*. University of Wales Elm, Farm Research Centre, Aberystwyth.
- LAVANYA, S., 2010, Assessment of farming systems efficiency in Theni district of Tamil Nadu. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.

- 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.
- LOKHANDAE, V. D. AND WANGIKAR, S. D., 1991, Constraints in the adoption of selected scientific grape technology. *Maharashtra J. Extn. Edu.*, **10**(2): 138-139.
- LYNAM, J. K. AND HERDT, R.W., 1989, Sense and sustainability: sustainability as an objective in international agricultural research. *Agricultural Economics*, **3**:381–398.
- MACCORMACK, H., 1995, Sustainable agriculture versus organic farming. In: Bird, Bultena, Gardner (Eds.), ‘What is Sustainable Agriculture?’ Planting the Future: Developing an Agriculture that Sustains Land and Community. Iowa State University Press, (Chapter 3), pp. 60±61.
- MAHATAB ALI, K. M., 2010, A study on Knowledge and Adoption of aerobic rice growers in eastern dry zone of Karnataka state. *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- MAJI, C. C., 1991, Farming systems approach to research. *Indian Journal of Agricultural Economics*, **46**(3): 403-411.
- MALATHESH, G. B. SHIVMURTHY, M., LAKSHMAN REDDY, B. S. AND RAMKRISHNA RAO, L., 2009, Employment generation under selected farming systems in eastern dry zone of Karnataka. *Karnataka J Agric. Sci.*, **22**(2): 368-372.
- MALTHESH, G. B., 2004, An analysis of selected farming systems in Eastern dry zone of Karnataka. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- MAMATHALAKSHMI, N., 2013, An analysis of livelihood security among agricultural labourers in Karnataka. *Ph.D. Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- MARADDI, G. N., 2006, An analysis of sustainable cultivation practices followed by Sugarcane growers in Karnataka. *Ph. D. Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad (India).
- MARADDI, G. N., 2008, Constraints perceived and suggestions expressed by sugarcane growers in adoption of sustainable cultivation practices. *Mysore J. Agric. Sci.*, **48**(3): 522-525.
- MASKEY, R. K., 1995, Sustainable agriculture and resource poor farmers in less developed countries. *J. Rural Development*, **14** (2): 167-185.

- MEHTA, K., 1995, Sustainable agriculture, *Kissan World*, **32** (1): 57-59.
- MENDOZA, T. C., 1994, Incorporating sustainability in National Food Production and Agricultural Extension Programmes in the Philippines. *Farm Management Notes No. 17*: 32-43.
- MOULASAB, I., 2004, A study on knowledge and adoption of improved cultivation practices by Mango growers of North Karnataka. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).
- NADAKARNI, M. V., 1993, Sustainable development: Concept and issues with special reference to agriculture. *Indian J. Agric. Econ.*, **48**(3): 516-525.
- NAGADEV, B AND VENKATARAMAIAH, P., 2007, Characteristics of integrated pestmanagement (IPM) trained dry paddy farmers. *The Andhra Agric. J.*, **54**(3&4): 240-242
- NAGARAJ, N. AND CHANDRASHEKAR, H., 2000, Designing methodologies for evaluation of economic and environmental implications of groundwater depletion and quality degradation effects – A study in Karnataka Peninsular India. *Water Institutions and Sustainable Use, Environmental Economics Research Committee Working Paper Series: WIS-4*.
- NAGARAJA, N., 1989, A study on management efficiency and economic performance of sericulture in Karnataka. *Ph.D. Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- NAGESH, 2006, Study on entrepreneurial behavior of pomegranate growers in Bagalkote district of Karnataka. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad, Karnataka.
- NAGESH, P.N., 2005, Study on entrepreneurial behaviour of vegetable seed producing farmers of Haveri district. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad (India).
- NAGHBUSHANAM, K., 1997, Sustainability of agriculture in watershed environment – an analysis. *Ph.D. Thesis (Unpub.)*, TNAU, Coimbatore.
- NARENDRAN, K., 2000, Occupational aspirations of rural youth in Kolar district of Karnataka state. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- NARWAL, R. S. AND DIXIT, V. N., 1991, Farmer's attitude and knowledge about feeding practices of buffaloes. *Indian Journal of Dairy Sciences*, **44**(8): 469-473.

- NATARAJU, S. AND VENKATARANGANAIIKA, K., 1995, Technological options of farmers for sustainable agricultural development. Conference on informatics for sustainable agriculture development *Abstracts*. Organized by National Informatics Centre Planning Commission, Ministry of Agriculture, Vigyan Bhavan, New Delhi, May 24-25: 123.
- NATIKAR, K. V., 2001, Attitude and use of farm journal by the subscribers farmers and their profile: A critical analysis. *Ph. D. Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad (India).
- NEHER, D., 1992, Ecological sustainability in agricultural systems: Definitions and measurement. *J. Sustainable Agriculture*, **2** (3): 51-61.
- NIRMALA, B. AND MUTHURAMAN, P., 2009, Economic and constraint analysis of rice cultivation in Kaithal district of Haryana. *Indian Res. J. Extn. Edc.*, **9**(1), January 2009.
- NITHYASHREE, D. A., 1992, A study on yield gap and adoption of improved practices of coffee in Chickmagalur district of Karnataka. *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- NORMAN, D. W., 1978, Farming systems research to improve the livelihood of small farmers. *American Journal of Agricultural Economics*, **60**: 813-818.
- PARODA, R. S., 1995, Sustainable agriculture and development. *Haryana Farming*, **25**(2): 1-2.
- PATEL, G. N., PATEL, R. M., PATEL, H. A., KHATRA, R. G. AND GONDALIA, V. K., 1997, Marketing efficiency – A case of Anand vegetable market. *Indian Journal of Agricultural Marketing*, **11**(1-2): 87-88.
- PATIL, N., 2005, A study on knowledge, extent of participation and benefits derived by participant farmers of the watershed development programme. *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad (India).
- POTTAPPA, K., 2008, Knowledge and adoption of potato growers in Chikkaballapur district- a study, *M.Sc. (Agri.) Thesis, (Unpub.)*, Univ. Agric. Sci., Bangalore.
- PRETTY, J., 1996, *Sustainable agriculture: impacts on food production and challenges for food security*. IIED Gatekeeper Series No. SA60.
- RADHAKRISHNAN, T., MATHAIYA, K. AND RAVICHANDRAN, V., 1999, Constraints experienced by mango growers. *J. Extn. Edu.*, **10**: 2520-2522.

- RAGHUNANDAN, H. C., 2004, A study on knowledge and adoption level of soil and water conservation practices by farmers in Northern Karnataka. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad (India).
- RAKSHA, RITA GOEL. AND LALI YADAV., 2012, Constraints faced by rural women in procurement and utilization of credit facilities in Hisar district. *J. of Research, ANGRAU*, **40**(4): 29-35.
- RAMANNA, K. N. AND CHANDRAKANDAN, K., 2001, Essential components of sustainable agriculture. *Kisan World*, **28**(1): 20.
- RAMEGOWDA, B.L., 1991, Crisis Management by Farmers – An Analysis. *Ph.D. Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- RANGASWAMY, A., 1999, Integrated farming systems for sustainable crop Production. pp.1-20. In : Lecture notes of summer short course on *Farming Systems for Sustainable Production*, University of Agricultural Sciences, Dharwad, 24th May to 2nd June, 1999.
- RAVI, G. K., 2007, A study on entrepreneurial behavioural characteristics of SC and ST farmers of Gulbarga district. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad (India).
- RAVISHANKAR, R. L. AND KATTEPPA, Y., 2000, Constraints analysis of potato farmers. *J. Extn. Edu.*, **11**: 2714-2715.
- RAY, R. W., 1990, Defining and using the concept of sustainable agriculture. *J. Agron. Edu.*, **19** (2): 126-130.
- REDDY PRASAD, T. S, 2003, Differential innovation decision and attitude of rice growing farmers towards eco-friendly technologies in Andhra Pradesh -A critical analysis. *Ph.D. Thesis* Acharya N.G. Ranga Agric. Uni., Hyderabad.
- REDDY, V. S. V., 2006, Knowledge and adoption of integrated pest management practices among vegetable growers of Gadag district in northern Karnataka. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).
- REIJNTJES, HAVERHORK, B. AND BAYER, A.W., 1992, Farming of the future, An introduction to Low-External-Input and sustainable agriculture. The Mac Millan Press Ltd., London.
- RODALE, R., 1990, Sustainability: An opportunity for leadership, *sustainable agricultural systems*. Ed. C. A. EDWARDS, New York, John Wiley & Sons.
- ROKONUZZAMAN, M., 2013, Training needs of tribal people regarding income generating activities. *Indian Res. J. Extn. Edn.*, **13**(2): 10-16.

- SADAPHAL, S. S., SAWANT, P. A. AND KELASKAR, A. J., 2001, Constraints experienced by the white onion growers from Raigad district of Maharashtra state. *Maharashtra J. Extn. Edu.*, **20**: 69-73.
- SAMANTA, R.K., 1977, Some agro-economic, socio-psychological and communication variables associated with repayment behaviour of agricultural credit users of national bank. *Ph.D. Thesis (Unpub.)*, Bidhan Chandria Krishi Viswavidhyalaya, Kalyani, West Bengal.
- SANDESH, H. M., 2004, A profile study of Kannada farm magazine readers in Karnataka. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).
- SHAILAJA, S., 1990, Role of women in mixed farming productivity. *Ph. D. Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- SHANNER, W.E., PHILIPP. P.F. AND SCHMEHL, W. P., 1982, Farming system research and development: a guideline for developing countries. *West view press*, Colorado, U. S. A.
- SHASHIDHAR, D. N, 2004, A study on influencing factors and constraints in drip irrigation by horticulture farmers of Bijapur district of Karnataka. *M. Sc. (Agri.) Thesis*, University of Agricultural Sciences, Dharwad.
- SHASHIDHAR, K. K., 2006, Study on management of eco-friendly practices by vegetable growers of North Karnataka. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad, Karnataka.
- SHINDE, P. S., BHOPLI, P. P. AND CHIKHALE, N. J., 1999, Multivariate analysis of adoption of animal husbandry management practices by dairy farmers. *Maharashtra J. Extn. Edu.*, **18**: 111-113.
- SHIVAMURTHY, M., RAMAKRISHNA, RAO, L., SHAILAJA HITTALAMANI AND LAKSHMINARAYANA, M.T., 2008, Constraints of farmers cultivating rainfed paddy in Eastern Dry Zone of Karnataka. *Mysore J. Agric. Sci.*, **42**(1): 163-165.
- SHIVAPRASAD, M. V., 1982, An analysis of farming system with reference to cropping pattern, profitability and behavioural characteristics of farmers of the southern dry zone of Karnataka state. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- SHRIVASTAVA, K. K., PATIL, H. L. AND BARETH, L. S., 1998, Constraints in adoption of recommended ability production technology. *Maharashtra J. Extn. Edu.*, **27**: 390-393.
- SIDRAM, 2008, Analysis of organic farming practices in Pigeonpea in Gulbarga district of Karnataka state. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).

- SINGH, K. K., PATRA, M. L. AND SHARMA, H. C., 2000, Environmental protection and sustainable agriculture. *Environment and People*, **6**(9): 5-9.
- SINGH, S. P. AND RAJENDRA, 1990, A study on adoption of improved sugarcane technology. *Indian J. Extn. Edu.*, **26** (1&2): 110-112.
- SMITH, C.S. AND MCDONALD, G.T., 1998, Assessing the sustainability of agriculture at the planning stage. *J. Environ. Management*, **52**: 15-37.
- SMYTH, A.J. AND DUMANSKI, J., 1993, An international framework for evaluating sustainable land management (FESLM). FAO World Soil Resource Report No. 73, 74. FAO, Rome.
- SOPHIA SATHYAVATHI, 2001, A study on knowledge and adoption of sustainable cultivation practices of sugarcane and cotton by farmers of Cuddalore district of Tamil Nadu. *M.Sc. (Agri.) Thesis*, (Unpub.), Univ. Agric. Sci., Dharwad.
- SOWMYA, T. M., 2009, Entrepreneurial behavior of rural women in Mandya district of Karnataka. *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- SRINIVASREDDY, M. V., 1995, A study on knowledge and adoption of recommended mango cultivation practices among farmers of Kolar district. *M.Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- SUBBARAO, I. V., 1999, Soil and environment pollution threat to agriculture. *Journal of the Indian Society of Soil Science*, **47**(4): 611-633.
- SUBRAMANIAN, K. P., 1992, A critical analysis of national demonstration on sunflower crop in Chitradurga district, Karnataka state. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- SUNIL KUMAR, G.M., 2004, A study on farmers' knowledge and adoption of production and post harvest technology in tomato crop of Belgaum district in Karnataka. *M.Sc. (Agri.) Thesis*, (Unpub.), Univ. Agric. Sci., Dharwad.
- SUPE, S.V., 1969, Factors related to different degrees of rationality in decision-making among farmers. Doctoral Dissertation in Agriculture Extension. Indian Agricultural Research Institute, New Delhi, India.
- SURESH, 2004, Entrepreneurial behaviour of milk producers in Chittoor district of Andhra Pradesh – A critical study. *M. V. Sc. Thesis*, Acharya N.G. Ranga Agric. Univ., Hyderabad (India).
- SWAMINATHAN, M.S., 1989, Ensuring ecological security. *The Hindu Survey of Indian Agric.*, 18.

- SWAMINATHAN, M.S., 1991, Agriculture for the 21<sup>st</sup> Century, *Kissan World*, 1-12.
- SWAMINATHAN, M.S., 1996, Integrated intensive farming systems. *Indian Farming*, **46**(7):59-60.
- SYAMALA, K. S., 1988, An analysis of the effectiveness of national demonstration conducted by the Kerala Agricultural University. *M. Sc. (Agri.) Thesis (Unpub.)*, College of Agriculture, Vellayani, Trivandrum, Kerala.
- TARDE, V. J., PHARATE, D. N. AND THORAT, D. R., 2006, Constraints faced by the vegetable growers in adoption of improved technologies of vegetable cultivation. *Maharashtra J. Extn. Edu.*, **22**: 223-225.
- TASNEEMASULTANA, 2001, Impact of selected nongovernmental organization on rural women. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- TELLARINI, V. AND CAPORALI, F., 2000, An input/output methodology to evaluate farms as sustainable agro-ecosystems: an application of indicators to farms in central Italy. *Agric. Ecosyst. Environ.*, **77**:111-123.
- THIPPESWAMY, R., 2007, A study on knowledge and adoption of plant protection measures in coconut cultivation of farmers of Chitradurga district. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad, Karnataka.
- TRIVEDI, G., 1963, Measurement and analysis of socio-economic status of rural families. *Ph.D. Thesis (Unpub.)*, Indian Agricultural Research Institute, New Delhi, India.
- VAN DEN BAN, A. W., 1993, Communication and sustainable agriculture, paper presented at the international conference on Integrated Resource Management for sustainable agriculture, Beijing, Peoples Republic of China, September, 5-13.
- VANI, M., 2005, A study on farming system approach: Socio-psychological and economic dimensions of farming system approach in Chitradurga district of Karnataka state. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Bangalore.
- VARADARAJU, G.M., RANGANATH MANGALVEDKAR AND CHANDRE GOWDA, K.N., 2009, Adoption of production technologies by tomato growers: An Analysis, *J. Extn. Edu.*, **21**(3): 4256-4260.
- VEDAMURTHY, H. S., 2002, A study of management of arecanut gardens and marketing pattern preferred by the arecanut farmers of Shimoga district of Karnataka. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).

- VENKATA SHIVA REDDY, V., 2006, Knowledge and adoption of integrated nutrient management practices among vegetable growers of Gadag district in North Karnataka. *M. Sc. (Agri.) Thesis (Unpub.)*, Univ. Agric. Sci., Dharwad, Karnataka.
- VIJAYKUMAR, P. K., 2000, A study on knowledge and adoption behaviour of sugarcane growers in Belgaum district of Karnataka. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad, Karnataka (India).
- VINAY KUMAR, R., 2005, Study on knowledge and adoption of Rose growing farmers in Karnataka. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).
- WAMAN, G. K. AND PATIL, P. S., 2000, Production, storage and marketing constraints faced by onion growers. *Maharashtra J. Extn. Edu.*, **19**: 104-108.
- WHITBY, M. AND ADGAR, W. N., 1996, Natural and reproductive capital and the sustainability of land use in the UK. *J. Agril. Econ.*, **47**(1), 50-56.
- YESHWANTH KUMAR NAIK, L. G., (2008), A study on Knowledge and Adoption of Integrated Crop Management Practices by the Participants of FFS in Bellary district. *M.Sc. (Agri.) Thesis*, (Unpub.), Univ. Agric. Sci., Dharwad.
- YOUNGBERG, G. AND HARWOOD, R., 1989, Sustainable farming systems: needs and opportunities. *American Journal of Alternative Agriculture*, **4**(3&4): 100.
- YUNLONG, C. AND SMITH, B., 1994, Sustainability in agriculture: a general review. *Agric. Ecosyst. Environ.*, **49**:299-307.
- ZHEN, L. AND ROUTRAY, J. K., 2003, Operational indicators for measuring agricultural sustainability in developing countries. *Environ. Manage*, **32**(1):34-46.

## APPENDIX – I

### THE UNIVERSITY OF AGRICULTURAL SCIENCES, ANGALORE

**Dr. D. NANJAPPA**

Professor and Former Head of the Department  
Department of Agricultural Extension  
UAS, GKVK, Bangalore-560065

Date: 26/02/2014

Dear sir/madam,

I am glad to inform that Miss Sunitha, A. B., Ph.D. scholar in Agricultural Extension is pursuing a research study entitled **Sustainability of farming systems in selected agro-climatic zones of Karnataka** under my guidance. As a part of the study, the student is trying to develop an index to measure sustainability of farming system.

In this connection, some dimensions of sustainability and indicators of sustainability of farming system have been enlisted based on review of literature and discussion with few experts. Considering your high academic qualifications and rich experience, we are pleased to seek your valuable judgment on the relevancy of these dimensions and indicators. The definition/operational definition of each of these indicators are also provided to facilitate your judgment.

Please make specific judgment on the relevancy of these indicators on four point continuum, by ticking (√) in the appropriate column. You are also requested to suggest any other pertinent item(s) that you consider as relevant to sustainability of farming systems, under each of the dimensions.

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

With kind regards,

Yours sincerely,

(D. NANJAPPA)

## **Sustainability of farming systems in selected agro-climatic zones of Karnataka**

Sustainability of farming system is operationally defined as a process by which production process is optimized through efficient utilization of inputs without infringing on the quality of environment with which it interacts on one hand and attempt to meet the national goals on the other.

Please give your rating/judgment related to relevancy of the components presented under different dimensions.

Following are the dimensions identified by the researcher to measure sustainability of farming

### **1. Ecological dimensions, 2. Economic dimensions and 3. Social dimensions**

Considering the above dimensions as relevant to sustainability of farming system, the researcher has identified several components under each dimensions, the definition/operational definition of each are given below

| <b>Sl. No.</b> | <b>The definition/operational definition of each of the identified components</b>  |
|----------------|--|
| <b>I</b>       | <b>Ecological dimensions</b>   |
| 1              | <b>Integrated Nutrient Management</b><br>Involves efficient and judicious supply, use or management of all the major components of plant nutrient sources: chemical fertilizers in conjunction with animal manures, compost, green manures, legumes in cropping system, bio-fertilizers, crop residues, or recyclable waste and other locally available nutrient sources for sustaining soil fertility, health and productivity. |
| 2              | <b>Integrated Pest Management</b><br>Use of simpler and economically safer measures for the pest [insects, diseases, nematodes and weeds] control in reducing environmental pollution and other problems caused by excessive and indiscriminate use of pesticide.  |
| 3              | <b>Water Management</b><br>Management of water, including rainfall and irrigation water, such that it is judiciously utilized for enhancing crop production on a sustainable basis and does not degrade land resource due to its misuse.   |
| 4              | <b>Land-use Pattern</b><br>Details of land, including net area sown, forestry component, land put to non-agricultural uses, barren and uncultivable land, permanent pastures and other grazing lands, cultivable waste and fallow land.  |
| 5              | <b>Cropping Pattern</b><br>The yearly sequence and spatial arrangement of crops and fallow on a given area   |
| 6              | <b>Activities/ practices to mitigate changing climatic conditions</b><br>Any practice or technologies followed in crop/livestock production by farmers to overcome adverse effects of climate change   |

|            |   |
|------------|---|
| <b>II</b>  | <b>Economic dimensions</b>  |
| 1          | <b>Land or Production Efficiency</b><br>This is to know whether land is efficiently used or not, which can be known by studying cropping intensity, yield per hectare and crop yield index.   |
| 2          | <b>Profitability or Profit Efficiency</b><br>Profitability or profit efficiency of a farm refers to net farm income (net cash income + change in inventory), farm earnings (net farm income + value of farm produce used in home), family labour earnings (farm earnings + interest charged on farm capital) and returns to management (family labour earnings – imputed value of family labour). |
| 3          | <b>Input – Output Relationship</b><br>It refers to the technical relationship i. e. the levels of output at various levels of inputs such as seed rate, labour use, fertilizers, pesticides, power, feed, irrigation etc. and the prices of the inputs and product prices   |
| 4          | <b>Farm Level Risk Management</b><br>Risk refers variability or outcomes which are measurable in a quantitative manner, including yield risk, risk of fall in price of products and risk of increase of input prices.   |
| 5          | <b>Farm Level Uncertainty Management</b><br>It is the measures taken by farmer to manage the uncertainties that arise out of imperfect knowledge about the market conditions, yield and other factors that affect farming.  |
| 6          | <b>Efficient Marketing Strategy</b><br>Plan and utilize the available facilities viz. regulated markets, agricultural marketing co-operative societies, storage facilities, transportation facilities, with adequate information, less intermediaries, good quality of produce and staying power.   |
| <b>III</b> | <b>Social Dimension</b>   |
| 1          | <b>Input self-sufficiency</b><br>Extent to which farmer meets input requirement of farming from own/farm generated resources than purchased/outside inputs.   |
| 2          | <b>Information self-sufficiency</b><br>Ability of the farmer and his family to possess information related to planning and practicing farm activities and to rely upon that at the time of decision making for successful farming.  |
| 3          | <b>Employment generation</b><br>Extent of employment generated (man days per year) for family members as well as hired labour by taking into consideration all activities of the farm.  |
| 4          | <b>Family Foodsecurity</b><br>It is the extent of physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.   |

|   |  |
|---|--|
| 5 | <p><b>Decision making pattern of family</b></p> <p>Decision making is the process of <a href="#">making choices</a> among possible alternatives at the time of choice of crops arrangements for inputs, activities related to production, post production and investment of farm income.</p> |
| 6 | <p><b>Compatibility to the community needs and requirements</b></p> <p>Extent to which practices of farming system are compatible to community members.</p>  |
| 7 | <p><b>System/ institutional support</b></p> <p>Extent to which supports received by the farmers as a result of policies of government like subsidies to inputs, minimum support prices, crop insurance etc.</p>  |
| 8 | <p><b>Resources possessed</b></p> <p>Extent to which the quantity of farming inputs availability like FYM, number of family labours and training received by the farmer and his family.</p>  |
| 9 | <p><b>Quality of life</b></p> <p>Extent to which farmer in content with nutritional requirement and other living habits.</p>   |

You are requested to rate the relevancy of the dimensions. Please indicate the relevancy by ticking (√) in the appropriate column

| Sl. No.    | Components under each dimension of sustainability of farming system | Very much relevant | Relevant | Somewhat relevant | Not relevant |
|------------|---|--------------------|----------|-------------------|--------------|
| <b>I</b>   | <b>ECOLOGICAL DIMENSION</b>   |                    |          |                   |              |
| 1          | Integrated Nutrient Management                                      |                    |          |                   |              |
| 2          | Integrated Pest Management  |                    |          |                   |              |
| 3          | Water Management  |                    |          |                   |              |
| 4          | Land-use Pattern  |                    |          |                   |              |
| 5          | Cropping Pattern  |                    |          |                   |              |
| 6          | Activities/ practices to mitigate changing climatic conditions      |                    |          |                   |              |
|            | Any other, please specify   |                    |          |                   |              |
| 7(i)       |   |                    |          |                   |              |
| (ii)       |   |                    |          |                   |              |
| <b>II</b>  | <b>ECONOMIC DIMENSION</b>   |                    |          |                   |              |
| 1          | Land Productivity Efficiency  |                    |          |                   |              |
| 2          | Profitability or Profit Efficiency                                  |                    |          |                   |              |
| 3          | Input – Output Relationship   |                    |          |                   |              |
| 4          | Farm Level Risk Management  |                    |          |                   |              |
| 5          | Farm Level Uncertainty Management                                   |                    |          |                   |              |
| 6          | Efficient Marketing Strategy  |                    |          |                   |              |
|            | Any other, please specify   |                    |          |                   |              |
| 7(i)       |   |                    |          |                   |              |
| (ii)       |   |                    |          |                   |              |
| <b>III</b> | <b>SOCIAL DIMENSION</b>   |                    |          |                   |              |
| 1          | Input self-sufficiency  |                    |          |                   |              |
| 2          | Information self- reliance  |                    |          |                   |              |
| 3          | Employment generation   |                    |          |                   |              |
| 4          | Family FoodSecurity   |                    |          |                   |              |
| 5          | Decision making pattern in the family                               |                    |          |                   |              |
| 6          | Compatibility to the community needs and requirements               |                    |          |                   |              |
| 7          | System/ institutional support                                       |                    |          |                   |              |
| 8          | Resources possessed   |                    |          |                   |              |
| 9          | Quality of life   |                    |          |                   |              |
| 10(i)      |   |                    |          |                   |              |
| (ii)       |   |                    |          |                   |              |

Name & Address:

Signature

## APPENDIX – II

### THE UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE

**Dr. D. NANJAPPA**

Date: 27/06/2014

Professor and Former Head of the Department  
Department of Agricultural Extension  
UAS, GKVK, Bangalore-560065

Dear sir/madam,

Ms. Sunitha, A. B., Ph.D. scholar in Agricultural Extension is pursuing a research study entitled **Sustainability of farming systems in selected agro-climatic zones of Karnataka** under my guidance. As a part of the study, the student is trying to develop an index to measure sustainability of farming system. Fifty judges have identified the following fifteen indicators of sustainability of farming systems. Now, you are requested to rate these indicators for their importance in measuring sustainability on a fifteen-point rating scale. Your rating is required to assign relative weightages to each indicator. Please give the appropriate rank number. First rank indicates highest importance and the fifteenth rank indicates least importance.

Please devote a little bit of your valuable time in helping the researcher to proceed further.

With kind regards,

Yours sincerely,  
(D. NANJAPPA)

| No. | Indicators of sustainability of farming system | Rank |
|-----|--|------|
| 1   | Integrated Nutrient Management                 |      |
| 2   | Land Productivity                              |      |
| 3   | Input self-sufficiency                         |      |
| 4   | Land-use Pattern                               |      |
| 5   | Input – Output Relationship (Productivity)     |      |
| 6   | FoodSecurity                                   |      |
| 7   | Profitability                                  |      |
| 8   | Water Management                               |      |
| 9   | Information self- reliency                     |      |
| 10  | Marketing Strategy                             |      |
| 11  | Integrated Pest Management                     |      |
| 12  | Farm Level Risk Management                     |      |
| 13  | Employment generation                          |      |
| 14  | Cropping Pattern                               |      |
| 15  | Quality of life                                |      |

## APPENDIX – III

### THE UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE

**Dr. D. NANJAPPA**

Date: 11/09/2014

Professor and Former Head of the Department  
Department of Agricultural Extension  
UAS, GKVK, Bangalore-560065

Dear sir/madam,

I am glad to inform that Ms. Sunitha, A. B., a Ph.D. student of Agricultural Extension is pursuing a research study entitled **Sustainability of farming systems in selected agro-climatic zones of Karnataka** under my guidance. As a part of the study, the student is trying to develop scale on quality of life of farmer, is one of the indicator under social dimension to measure sustainability of farming system in irrigated and rainfed situations.

In this connection, some items of quality of life have been enlisted based on review of literature and discussion with few experts. Considering your high academic qualifications and rich experience, we are pleased to seek your valuable judgment on the relevancy of these items.

Please make specific judgment on the relevancy of these items on four point continuum, by ticking (√) in the appropriate column. You are also requested to suggest any other pertinent item(s) that you consider as relevant to quality of life of farmer.

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

With kind regards,

Yours sincerely,

(D. NANJAPPA)

| <b>Sl. No.</b> | <b>Statements</b>  | <b>Very much relevant</b> | <b>Relevant</b> | <b>Somewhat relevant</b> | <b>Not relevant</b> |
|----------------|--|---------------------------|-----------------|--------------------------|---------------------|
| 1              | Basic necessities of my family are achieved from the existing combination of farm components         |                           |                 |                          |                     |
| 2              | Farming is a thankless profession and has made my life miserable                                     |                           |                 |                          |                     |
| 3              | Farming offers an opportunity to live closely with the nature and thus keeps me emotionally stable   |                           |                 |                          |                     |
| 4              | Income generated from my farm is sufficient to meet my family needs                                  |                           |                 |                          |                     |
| 5              | Vagaries of monsoon have made my life stressful  |                           |                 |                          |                     |
| 6              | I am able to balance farming and personal life without any problem                                   |                           |                 |                          |                     |
| 7              | My farming system supports my family to lead a healthy life  |                           |                 |                          |                     |
| 8              | Prevailing farming system doesn't provide enough employment to my family members                     |                           |                 |                          |                     |
| 9              | In the prevailing farming system I get enough time to participate in family and community activities |                           |                 |                          |                     |
| 10             | Status accorded to a farmer in the society is demoralizing me  |                           |                 |                          |                     |
| 11             | I am able to give quality time to my family  |                           |                 |                          |                     |
| 12             | There is no pride being a farmer   |                           |                 |                          |                     |
| 13             | If any other specify   |                           |                 |                          |                     |

## APPENDIX -IV

| ri              | Ri | c <sub>1</sub> | c <sub>2</sub> | c <sub>3</sub> | c <sub>4</sub> | c <sub>5</sub> | c <sub>6</sub> | c <sub>7</sub> | c <sub>8</sub> | c <sub>9</sub> | c <sub>10</sub> | c <sub>11</sub> | c <sub>12</sub> | c <sub>13</sub> | c <sub>14</sub> | c <sub>15</sub> |      |    | P    | C |
|-----------------|----|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------|----|------|---|
| 1               | 15 | 8              | 8              | 1              | 3              | 1              | 1              | 3              | 2              | 0              | 0               | 0               | 1               | 0               | 0               | 2               |      | 30 | 96.7 | 9 |
| 2               | 14 | 2              | 2              | 3              | 7              | 1              | 2              | 1              | 3              | 0              | 1               | 3               | 0               | 1               | 3               | 1               |      | 30 | 90   | 8 |
| 3               | 13 | 4              | 3              | 2              | 1              | 4              | 1              | 1              | 4              | 0              | 1               | 2               | 2               | 1               | 4               | 0               |      | 30 | 83.3 | 7 |
| 4               | 12 | 0              | 3              | 4              | 1              | 1              | 2              | 3              | 1              | 0              | 3               | 4               | 2               | 2               | 2               | 2               |      | 30 | 76.7 | 6 |
| 5               | 11 | 5              | 3              | 1              | 4              | 0              | 2              | 1              | 3              | 1              | 2               | 2               | 1               | 0               | 4               | 1               |      | 30 | 70   | 6 |
| 6               | 10 | 3              | 4              | 4              | 1              | 5              | 1              | 0              | 4              | 0              | 1               | 2               | 3               | 1               | 1               | 0               |      | 30 | 63.3 | 6 |
| 7               | 9  | 3              | 1              | 2              | 2              | 3              | 2              | 3              | 3              | 0              | 1               | 4               | 1               | 2               | 3               | 0               |      | 30 | 56.7 | 5 |
| 8               | 8  | 1              | 1              | 2              | 3              | 3              | 1              | 2              | 1              | 2              | 2               | 4               | 4               | 2               | 1               | 1               |      | 30 | 50   | 5 |
| 9               | 7  | 1              | 0              | 0              | 1              | 4              | 2              | 2              | 1              | 2              | 2               | 5               | 1               | 3               | 5               | 1               |      | 30 | 43.3 | 5 |
| 10              | 6  | 3              | 0              | 2              | 2              | 1              | 1              | 4              | 1              | 1              | 1               | 0               | 6               | 2               | 2               | 4               |      | 30 | 36.7 | 4 |
| 11              | 5  | 0              | 1              | 4              | 0              | 4              | 3              | 1              | 5              | 1              | 4               | 0               | 2               | 2               | 3               | 0               |      | 30 | 30   | 4 |
| 12              | 4  | 0              | 3              | 2              | 2              | 0              | 4              | 1              | 0              | 7              | 4               | 1               | 1               | 2               | 0               | 3               |      | 30 | 23.3 | 4 |
| 13              | 3  | 0              | 0              | 1              | 2              | 2              | 1              | 3              | 1              | 11             | 3               | 0               | 3               | 3               | 0               | 0               |      | 30 | 16.7 | 3 |
| 14              | 2  | 0              | 0              | 2              | 1              | 1              | 4              | 0              | 0              | 3              | 5               | 1               | 2               | 3               | 2               | 6               |      | 30 | 10   | 2 |
| 15              | 1  | 0              | 1              | 0              | 0              | 0              | 3              | 5              | 1              | 2              | 0               | 2               | 1               | 6               | 0               | 9               |      | 30 | 3.3  | 1 |
|                 |    |                |                |                |                |                |                |                |                |                |                 |                 |                 |                 |                 |                 |      |    |      |   |
| $\sum f_{ij}$   |    | 30             | 30             | 30             | 30             | 30             | 30             | 30             | 30             | 30             | 30              | 30              | 30              | 30              | 30              | 30              | 450  |    |      |   |
| $\sum f_{ij} C$ |    | 201            | 196            | 160            | 180            | 159            | 133            | 139            | 171            | 103            | 131             | 159             | 139             | 113             | 163             | 103             | 2250 |    |      |   |
| $M_c=R_j$       |    | 6.7            | 6.53           | 5.33           | 6.0            | 5.3            | 4.43           | 4.63           | 5.7            | 3.43           | 4.37            | 5.3             | 4.63            | 3.77            | 5.43            | 3.43            | 75   |    |      |   |
| $R_c^*$         |    | 8.78           | 8.39           | 5.56           | 7.13           | 5.48           | 3.44           | 3.91           | 6.42           | 1.08           | 3.28            | 5.48            | 3.91            | 1.87            | 5.8             | 1.08            | 71.6 |    |      |   |

Where ri = Ranks given by judges to fifteen indicators

Ri = Rank values

Rc = 2.357 Rj - 7.01

Rj =  $\sum f_{ij} c_j / \sum f_{ij}$

P = Centile position

C = Values determined to each centile value

## APPENDIX-V

### Total cropped area, irrigated and rainfed area of eastern and southern dry zones

| Zones/Taluks             | Total cropped area (ha) | Irrigated area (ha) | Rainfed area (ha) | No. of canals | No. of wells | No. of tanks |
|--------------------------|-------------------------|---------------------|-------------------|---------------|--------------|--------------|
| <b>Eastern Dry Zone</b>  |                         |                     |                   |               |              |              |
| <b>Bangalore Rural</b>   |                         |                     |                   |               |              |              |
| Devanahalli              | 24173                   | 8446                | 15727             | -             | 10132        | 114          |
| Doddabalapur             | 39847                   | 5851                | 33996             | -             | 8619         | 168          |
| Hosakote                 | 32797                   | 5878                | 26919             | -             | 8491         | 209          |
| Nelmangala               | 26143                   | 3956                | 22187             | -             | 4605         | 263          |
| <b>Ramanagar</b>         |                         |                     |                   |               |              |              |
| Channapatna              | 25753                   | 10509               | 15244             | 2             | 11420        | 115          |
| Kankapura                | 52001                   | 14564               | 37437             | 1             | 12374        | 239          |
| Magadi                   | 40808                   | 7946                | 32862             | 1             | 7486         | 348          |
| Ramanagar                | 29460                   | 7112                | 22348             | 3             | 6779         | 106          |
| <b>Kolar</b>             |                         |                     |                   |               |              |              |
| Bangarpet                | 33470                   | 5426                | 28044             | -             | 17823        | 367          |
| Kolar                    | 36354                   | 8600                | 27754             | -             | 21458        | 271          |
| Malur                    | 28132                   | 6309                | 21823             | -             | 15119        | 341          |
| Mulbagal                 | 46759                   | 8881                | 37878             | -             | 14661        | 732          |
| Srinivasapura            | 43119                   | 3979                | 39140             | -             | 12771        | 344          |
| <b>Chikkaballpur</b>     |                         |                     |                   |               |              |              |
| Bagepalli                | 36965                   | 7842                | 29123             | -             | 4345         | 515          |
| Chikkabalapur            | 32563                   | 12595               | 19968             | -             | 5884         | 156          |
| Chintamani               | 53636                   | 11366               | 42270             | -             | 5955         | 648          |
| Gowribidanur             | 50184                   | 17663               | 32521             | -             | 6205         | 244          |
| Gudibanda                | 14464                   | 3061                | 11403             | -             | 1302         | 91           |
| Sidalaghatta             | 30261                   | 9171                | 21090             | -             | 5304         | 327          |
| <b>Tumkur</b>            |                         |                     |                   |               |              |              |
| Gubbi                    | 69049                   | 31585               | 37464             | 0             | 21749        | 195          |
| Tumkur                   | 58366                   | 23658               | 34708             | 0             | 17778        | 346          |
| <b>Southern Dry Zone</b> |                         |                     |                   |               |              |              |
| <b>Mysore</b>            |                         |                     |                   |               |              |              |
| K.R.Nagar                | 48868                   | 25286               | 23582             | 4             | 2398         | 158          |
| T.Narasipur              | 52074                   | 36971               | 15103             | 10            | 4522         | 35           |
| Mysore                   | 32907                   | 14444               | 18463             | 4             | 3462         | 103          |
| Nanjangud                | 90025                   | 26206               | 63819             | 5             | 4635         | 34           |

| <b>Chamarajnar</b> |       |       |       |    |       |      |
|--------------------|-------|-------|-------|----|-------|------|
| Chamarajanagar     | 75947 | 21124 | 54823 | 4  | 9720  | 53   |
| Gundlupet          | 76155 | 13503 | 62652 | 2  | 7276  | 75   |
| Kollegal           | 69144 | 27960 | 41184 | 1  | 4632  | 16   |
| Yelandur           | 11040 | 7102  | 3938  | 1  | 1221  | 11   |
| <b>Mandya</b>      |       |       |       |    |       |      |
| K.R.Pet            | 43751 | 26658 | 17093 | 10 | 310   | 142  |
| Nagamangala        | 42118 | 9628  | 32490 | 1  | 355   | 136  |
| Pandavapura        | 34813 | 21238 | 13575 | 3  | 45    | 48   |
| Srirangapatna      | 17734 | 10799 | 6935  | 4  | 800   | 19   |
| Mandya             | 32463 | 26009 | 6454  | 1  | 1290  | 95   |
| Maddur             | 36142 | 25606 | 10536 | 0  | 142   | 143  |
| Malavalli          | 35344 | 20410 | 14934 | 1  | 3591  | 47   |
| <b>Tumkur</b>      |       |       |       |    |       |      |
| Kunigal            | 49205 | 14564 | 34641 | 3  | 9940  | 227  |
| Turuvekere         | 57080 | 15600 | 41480 | 0  | 13053 | 74   |
| <b>Hassan</b>      |       |       |       |    |       |      |
| Channarayapatna    | 68955 | 23108 | 45847 | 0  | 13751 | 242  |
| Hassan             | 54633 | 14835 | 39798 | 1  | 7323  | 1063 |

#### **Major farming systems in eastern dry zone**

- Crop production farming system
- Crop+dairy farming system
- Crop+dairy+sericulture farming system
- Crop+sericulture farming system

#### **Major farming systems in eastern dry zone**

- FS-I (crop production and poultry enterprises),
- FS-II (crop production and sericulture enterprises)
- FS-III (crop production and dairy enterprises) and
- FS-VI (only crop production enterprises)

## APPENDIX-VI



UNIVERSITY OF AGRICULTURAL SCIENCES  
DEPARTMENT OF AGRICULTURAL EXTENSION  
GKVK, BANGALORE-560 065

### INTERVIEW SCHEDULE

#### Sustainability of Farming Systems in selected Agro Climatic Zones of Karnataka

Respondent No: \_\_\_\_\_

#### PART-I

##### I. General Information about the respondent

1. Name of the Farmer : \_\_\_\_\_
2. Village : \_\_\_\_\_
3. Taluk : \_\_\_\_\_
4. District : \_\_\_\_\_

##### II. Personal information

1. Age : -----Years
2. Education :  
a. Illiterate b. Can read and write c. Primary education  
d. Middle school education e. High school education f. PUC g. Graduation h. PG
3. Farming experience: ----- years

##### 4. Family size (No. of members)

| Sl. No. |          | Male | Female |
|---------|----------|------|--------|
| 1.      | Adult    |      |        |
| 2.      | Children |      |        |
| 3.      | Total    |      |        |

##### 5. Land holdings:

| Land holding(acres) |          |             | Total |
|---------------------|----------|-------------|-------|
| Dry land            | Wet land | Garden land |       |
|                     |          |             |       |

### Agriculture Related Infrastructure/ Resources

| Infrastructure/ resources        | Year of purchase/construction/creation | Approximate cost (Rs.) |
|----------------------------------|--|------------------------|
| <b>Equipments</b>                |  |                        |
| 1                                |  |                        |
| 2                                |  |                        |
| 3                                |  |                        |
| 4                                |  |                        |
| <b>Irrigation infrastructure</b> |  |                        |
| Bore well/s                      |  |                        |
| Drip irrigation                  |  |                        |
| Sprinkler irrigation             |  |                        |
| Tanks (water storage)            |  |                        |
| Animal shed                      |  |                        |
| Silkworm rearing house           |  |                        |
| Cold storage                     |  |                        |
| Godowns                          |  |                        |
| Threshing yard                   |  |                        |
| Transportation facilities        |  |                        |

### Land Use Pattern and Cropping Pattern

Farm activity details of 2014

| Plot No. | Crops/activity | Area under cultivation (Ac/Qty/Size) |        |        | Total (ha) |
|----------|----------------|--------------------------------------|--------|--------|------------|
|          |                | Rabi                                 | Summer | Kharif |            |
| 1        |                |                                      |        |        |            |
| 2        |                |                                      |        |        |            |
| 3        |                |                                      |        |        |            |
| 4        |                |                                      |        |        |            |
| 5        |                |                                      |        |        |            |
| 6        |                |                                      |        |        |            |
| 7        |                |                                      |        |        |            |
| 8        |                |                                      |        |        |            |

### Crop Production:

Name of the crop..... Area..... Season.....

| Inputs                            | Own source |       | Purchased |       |
|-----------------------------------|------------|-------|-----------|-------|
|                                   | Qty        | Value | Qty       | Value |
| Seeds/plant materials             |            |       |           |       |
| <b>Organic manures</b>            |            |       |           |       |
| Green manuring/ green leaf manure |            |       |           |       |
| FYM                               |            |       |           |       |
| Biofertilizers                    |            |       |           |       |
| <b>Inorganic fertilizers</b>      |            |       |           |       |

|                                   |                     |              |                 |              |
|-----------------------------------|---------------------|--------------|-----------------|--------------|
| a)                                |                     |              |                 |              |
| b)                                |                     |              |                 |              |
| c)                                |                     |              |                 |              |
| <b>Growth regulators</b>          |                     |              |                 |              |
| a)                                |                     |              |                 |              |
| b)                                |                     |              |                 |              |
| <b>Plant protection chemicals</b> |                     |              |                 |              |
| Mechanical measures               |                     |              |                 |              |
| a)                                |                     |              |                 |              |
| b)                                |                     |              |                 |              |
| c)                                |                     |              |                 |              |
| Biological measures               |                     |              |                 |              |
| a)                                |                     |              |                 |              |
| b)                                |                     |              |                 |              |
| c)                                |                     |              |                 |              |
| Chemical measures                 |                     |              |                 |              |
| a)                                |                     |              |                 |              |
| b)                                |                     |              |                 |              |
| c)                                |                     |              |                 |              |
| <b>Weed control</b>               |                     |              |                 |              |
| Mechanical measures               |                     |              |                 |              |
| a)                                |                     |              |                 |              |
| b)                                |                     |              |                 |              |
| Biological measures               |                     |              |                 |              |
| a)                                |                     |              |                 |              |
| b)                                |                     |              |                 |              |
| Chemical measures                 |                     |              |                 |              |
| a)                                |                     |              |                 |              |
| b)                                |                     |              |                 |              |
| <b>Irrigation</b>                 |                     |              |                 |              |
| Irrigated area                    |                     |              |                 |              |
| Frequency of irrigation           |                     |              |                 |              |
| Method of irrigation              |                     |              |                 |              |
| <b>Labour</b>                     |                     |              |                 |              |
| Male                              |                     |              |                 |              |
| Female                            |                     |              |                 |              |
| Bullock pair                      |                     |              |                 |              |
| Tractor                           |                     |              |                 |              |
| If any other specify              |                     |              |                 |              |
| <b>Quantity produced</b>          | <b>Qty consumed</b> | <b>Value</b> | <b>Qty sold</b> | <b>Value</b> |
| Main product                      |                     |              |                 |              |
| By-product                        |                     |              |                 |              |

### Land Productivity

Could you please recall the total quantity of yield produced on your farm during 2013 and 2012

| Crop | 2013 |              |            | 2012 |              |            |
|------|------|--------------|------------|------|--------------|------------|
|      | Area | Production   |            | Area | Production   |            |
|      |      | Main product | By product |      | Main product | By product |
| 1    |      |              |            |      |              |            |
| 2    |      |              |            |      |              |            |
| 3    |      |              |            |      |              |            |
| 4    |      |              |            |      |              |            |

### Water Saving Measures

| Sl. No. | Measure                                       | Adopted (area) |  |
|---------|---|----------------|--|
| 1       | Deep ploughing                                |                |  |
| 2       | Mulching                                      |                |  |
| 3       | Contour Bunding                               |                |  |
| 4       | Land leveling                                 |                |  |
| 5       | Contour cultivation                           |                |  |
| 6       | Roof top collection                           |                |  |
| 7       | Dug out ponds/storage tanks                   |                |  |
| 8       | Gully control structures/ check dams/barriers |                |  |
| 9       | If any other specify                          |                |  |

### Livestock Production

| Sl. No. | No. of Cows/Bufaloes | Breed | Age | No. of Calf/ calves | Age |
|---------|----------------------|-------|-----|---------------------|-----|
| 1       |                      |       |     |                     |     |
| 2       |                      |       |     |                     |     |
| 3       |                      |       |     |                     |     |
| 4       |                      |       |     |                     |     |

| Sl. No.  | Inputs           | Own source |       | Purchased |       |
|----------|------------------|------------|-------|-----------|-------|
|          |                  | Qty        | Value | Qty       | Value |
| <b>I</b> | <b>Dairy</b>     |            |       |           |       |
| 1        | Ground nut cake  |            |       |           |       |
| 2        | Rice bran        |            |       |           |       |
| 3        | Feed mix         |            |       |           |       |
| 4        | Dry fodder       |            |       |           |       |
| 5        | Green fodder     |            |       |           |       |
| 6        | Medicines        |            |       |           |       |
| 7        | Labour           |            |       |           |       |
| 8        | Others (specify) |            |       |           |       |

No. of birds ..... Breed..... No. of Batches per year.....

| <b>II</b> | <b>Poultry</b>   |  |  |  |  |
|-----------|------------------|--|--|--|--|
| 1         | Starter feed     |  |  |  |  |
| 2         | Finisher feed    |  |  |  |  |
| 3         | Medicines        |  |  |  |  |
| 4         | Labour           |  |  |  |  |
| 5         | Others (specify) |  |  |  |  |

No. of sheep ..... Breed..... No. of goat ..... Breed.....

| <b>III</b> | <b>Sheep/ goat</b> |  |  |  |  |
|------------|--------------------|--|--|--|--|
| 1.         | Mineral mixtures   |  |  |  |  |
| 2          | Medicines          |  |  |  |  |
| 3          | Green fodder       |  |  |  |  |
| 4          | Labour             |  |  |  |  |
| 5          | Others (specify)   |  |  |  |  |

No. of Fishes ..... Variety.....

| <b>IV</b> | <b>Fisheries</b>           |  |  |  |  |
|-----------|----------------------------|--|--|--|--|
| 1         | Manuring / mahuva oil cake |  |  |  |  |
| 2         | Feeding / fertilization    |  |  |  |  |
| 3         | Labour                     |  |  |  |  |
| 4         | Others (specify)           |  |  |  |  |

No. of Pigs ..... Breed.....

| <b>V</b> | <b>Piggery</b>   |  |  |  |  |
|----------|------------------|--|--|--|--|
| 1        | Roughages        |  |  |  |  |
| 2        | Concentrates     |  |  |  |  |
| 3        | Medicines        |  |  |  |  |
| 4        | Labour           |  |  |  |  |
| 5        | Others (specify) |  |  |  |  |

### B. Gross income from livestock

| <b>Sl. No.</b> | <b>Particulars</b>  | <b>Quantity per month</b> | <b>Price per unit</b> | <b>Qty consumed</b> | <b>Qty sold</b> | <b>Total amount (Rs.)</b> |
|----------------|---------------------|---------------------------|-----------------------|---------------------|-----------------|---------------------------|
| 1              | Yield               |                           |                       |                     |                 |                           |
|                | Milk (liter)        |                           |                       |                     |                 |                           |
|                | Broiler chicken(kg) |                           |                       |                     |                 |                           |
|                | Eggs (No.)          |                           |                       |                     |                 |                           |
|                | Pork (kg.)          |                           |                       |                     |                 |                           |
|                | Fish (kg.)          |                           |                       |                     |                 |                           |
|                | Mutton (kg.)        |                           |                       |                     |                 |                           |
| 2              | Manure (cart loads) |                           |                       |                     |                 |                           |

|   |   |  |  |  |  |  |
|---|---|--|--|--|--|--|
| 3 | Sale of male calves/ culled birds/fingerlings/piglets |  |  |  |  |  |
| 4 | Sale of animals                                       |  |  |  |  |  |
|   | <b>Total</b>  |  |  |  |  |  |

### Cost of Silkworm Rearing

**Variety:** Cross breed / Bivoltine

**No. of DFLs**.....

**Method of rearing:** shoot/ leaf rearing

**Frequency of feeding**.....

| Sl. No.                          | Item  | Unit | Quantity | Amount (Rs.) |
|----------------------------------|---|------|----------|--------------|
| 1                                | Rearing plates  |      |          |              |
| 2                                | Chandrikas  |      |          |              |
| 3                                | Stand   |      |          |              |
| 4                                | Uzy fly net   |      |          |              |
| 5                                | Wax paper   |      |          |              |
| 6                                | Sponge rubber   |      |          |              |
| 7                                | Gunny clothes   |      |          |              |
| 8                                | Sprayer   |      |          |              |
| <b>Total fixed cost</b>          |   |      |          |              |
| <b>Rearing expenditure</b>       |   |      |          |              |
| 1                                | Cost of DFLs  |      |          |              |
| 2                                | Materials (bleaching powder, formalin, Chlorine dioxide, bed disinfectant etc.) |      |          |              |
| 3                                | Labour wages  |      |          |              |
| <b>Total rearing expenditure</b> |   |      |          |              |
| <b>Yield and returns</b>         |   |      |          |              |
| 1                                | Main product(cocoon)  |      |          |              |
| 2                                | By product<br>a. Crop waste<br>b. Manure (tons)                                 |      |          |              |
| <b>Gross returns (Rs.)</b>       |   |      |          |              |

### Farm Level Risk Management

Please indicate the risks as you perceived in your farm activities

| Sl. No. | Risk factors experienced  | Strategies adopted   | Yes | No |
|---------|---|--|-----|----|
| 1       | Problem with the income   | Diversification of source of income                              |     |    |
| 2       | Mono cropping   | Crop diversification and inter cropping                          |     |    |
| 3       | Lack of own resources like land, labour, FYM, water, equipments etc.    | Sharing of crop, agricultural equipment, irrigation sources etc. |     |    |
| 4       | Problem with the marketing facilities, storage and transport facilities | Contract marketing, futures contracts                            |     |    |

|   |                                  |   |  |  |
|---|----------------------------------|---|--|--|
| 5 | Failure of crop/death of animals | Insurance: crop insurance, livestock insurance. Crop loan |  |  |
| 6 | High cost of inputs              | Adoption of organic farming                               |  |  |
| 7 | Inadequate finance               | Loan from banks   |  |  |
| 8 | Any other specify                |   |  |  |
| 9 |                                  |   |  |  |

## Marketing

Please indicate the source and facilities available for marketing of the produces

| Method of Marketing                              | Adequate   | Moderate  | Inadequate |
|--|------------|-----------|------------|
| <b>1. Source of utilization</b>                  |            |           |            |
| a) Local Markets                                 |            |           |            |
| b) Regulated markets                             |            |           |            |
| c) Agricultural marketing co-operative societies |            |           |            |
| <b>2. Facility Available</b>                     |            |           |            |
| a) Storage                                       |            |           |            |
| b) Transportation                                |            |           |            |
| <b>Marketing Strategies</b>                      | <b>Yes</b> | <b>No</b> |            |
| Pre harvest                                      |            |           |            |
| Contract farming                                 |            |           |            |
| Direct marketing                                 |            |           |            |
| Stored marketing                                 |            |           |            |

## Information Self Reliancy

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

### Crop production:

| Information areas         | Source of information |               |        |
|---------------------------|-----------------------|---------------|--------|
|                           | Self                  | Partly others | Others |
| 1. Seeds / plant material |                       |               |        |
| 2. FYM/compost            |                       |               |        |
| 3. Green manure           |                       |               |        |
| 4. Fertilizer             |                       |               |        |
| 5. Chemicals              |                       |               |        |
| 6. Pesticides             |                       |               |        |
| 7. Herbicides             |                       |               |        |
| 8. Equipments             |                       |               |        |
| 9. Storage                |                       |               |        |
| 10. Marketing             |                       |               |        |
| 11. Others, if any        |                       |               |        |
| 12.                       |                       |               |        |

### Livestock Production:

| Information areas         | Source of information |               |        |
|---------------------------|-----------------------|---------------|--------|
|                           | Self                  | Partly others | Others |
| 1. Breed/s                |                       |               |        |
| 2. Feed                   |                       |               |        |
| 3. Feeding method         |                       |               |        |
| 4. Green fodder varieties |                       |               |        |
| 5. Fertilization          |                       |               |        |
| 6. Medicines              |                       |               |        |
| 7. Equipments             |                       |               |        |
| 8. Marketing              |                       |               |        |
| 9. Others, if any         |                       |               |        |
| 10.                       |                       |               |        |

### Family Food Security

Please give details of the farm produce and consumed by your family members for the year

| Particulars       | Qty produced | Qty Consumed | Qty purchased |
|-------------------|--------------|--------------|---------------|
| Cereals & Millets |              |              |               |
| Pulses            |              |              |               |
| Oilseeds          |              |              |               |

### Quality of life:

Opinion of the farmers regarding the perception of quality of life experienced by him

| Sl. No. | Statements  | SA | A | UD | DA | SDA |
|---------|---|----|---|----|----|-----|
| 1       | Basic necessities of my family are achieved from the existing combination of farm components  |    |   |    |    |     |
| 2       | Farming is a thankless profession and has made my life miserable                              |    |   |    |    |     |
| 3       | Farming offers an opportunity to live closely with the nature and keeps me emotionally stable |    |   |    |    |     |
| 4       | Income generated from farm is sufficient to meet my family needs                              |    |   |    |    |     |
| 5       | Vagaries of monsoon have made my life stressful   |    |   |    |    |     |
| 6       | Farming system supports my family to lead a healthy life                                      |    |   |    |    |     |
| 7       | Status accorded to a farmer in the society is demoralizing                                    |    |   |    |    |     |

## PART II

Please indicate the constraints faced in farming and its extent

| Constraints   | Large extent | Moderate extent | Lesser extent |
|---|--------------|-----------------|---------------|
| <b>I. Production constraints</b>                                |              |                 |               |
| 1.High cost of inputs   |              |                 |               |
| 2. Non availability of quality seed material/plant material     |              |                 |               |
| 3. Non availability of inputs                                   |              |                 |               |
| 4. Lack of knowledge regarding pest and diseases                |              |                 |               |
| 5. Lack of water for irrigation                                 |              |                 |               |
| 6. Lack of knowledge on balanced fertilizer application         |              |                 |               |
| 7.Others  |              |                 |               |
| <b>II. Financial constraints</b>                                |              |                 |               |
| 8. Inadequate credit  |              |                 |               |
| 9. Inadequate subsidy   |              |                 |               |
| 10.High interest rate   |              |                 |               |
| 11. Insufficient repayment time                                 |              |                 |               |
| 12. Lack of own resources like labour, seed materials, FYM etc. |              |                 |               |
| 13. Others  |              |                 |               |
| <b>III. Institutional constraints</b>                           |              |                 |               |
| 14. Lack of co-operation  |              |                 |               |
| 15. Lack of support from developmental departments              |              |                 |               |
| 16.Others   |              |                 |               |
| <b>IV. Situational constraints</b>                              |              |                 |               |
| 17. Distance from the location of market                        |              |                 |               |
| 18. Distance from the location of land                          |              |                 |               |
| 19. Poor transport facilities                                   |              |                 |               |
| 20. Lack of knowledge about sustainable farming practices       |              |                 |               |
| 21. Others  |              |                 |               |
| <b>V. Infrastructural constraints</b>                           |              |                 |               |
| 22. Lack of established structures for livestock                |              |                 |               |
| 23. Lack of ICT facilities                                      |              |                 |               |
| 24.Others   |              |                 |               |
| <b>VI. Technical constraints</b>                                |              |                 |               |
| 25. Erratic supply of electricity                               |              |                 |               |
| 26. Lack of mechanization of farm                               |              |                 |               |
| 27. Unavailability of new technologies                          |              |                 |               |
| 28. cumbersome/difficult procedure in seed production           |              |                 |               |
| 29. Others  |              |                 |               |

### **Suggestions to achieve sustainability in farming system**

- 1.
- 2.
- 3.
- 4.
- 5.

### Part III

#### 1. Level of Aspiration

You please see the picture of ladder with 10 steps, suppose we say that top of the ladder represents the best possible life of you and bottom represents the worst possible life of you.

|   |                            |         |
|---|----------------------------|---------|
| 1. Where do you stand at present?<br>Step No. ---                 | <b>Best possible life</b>  | --10--  |
| 2. Where did you feel stand five years ago<br>Step No. ---        |                            | --9---  |
| 3. Where will you stand after five years from now?<br>Step No. -- |                            | --8---  |
|   |                            | ---7--- |
|   |                            | ---6--- |
|   |                            | ---5--- |
|   |                            | ---4--- |
|   |                            | ---3--- |
|   |                            | ---2--- |
|   | <b>Worst possible life</b> | ---1--- |

#### 2. Economic motivation

Please give your degree of agreement on the following statements

| Sl. No. | Statements   | Response |          |
|---------|--|----------|----------|
|         |  | Agree    | Disagree |
| 1.      | A farmer should work toward high yields and economic profits   |          |          |
| 2.      | The most successful farmer is one who makes most profit  |          |          |
| 3.      | A farmer should try any new farming techniques which may earn him more money   |          |          |
| 4.      | A farmer should practice all enterprises in farming to increase the monetary profit in comparison to growing crops alone |          |          |
| 5.      | It is difficult for farmers' children to make good start, unless he provides him with economic assistance                |          |          |
| 6.      | A farmer must earn his living but the most important thing cannot be defined in economic terms                           |          |          |

SA – strongly agree, A – Agree, UD – Undecided, DA – disagree, SDA – strongly disagree

### 3. Achievement motivation

Please indicate the degree of response for the following statements

| No. | Statements   | SA | A | UD | DA | SDA |
|-----|--|----|---|----|----|-----|
| 1   | One should enjoy work as much as a play  |    |   |    |    |     |
| 2   | One should work like a servant at everything he undertakes until he is satisfied with the results                              |    |   |    |    |     |
| 3   | One should succeed in his occupation even if one has been neglectful to his family   |    |   |    |    |     |
| 4   | One should have determination and deriving ambition to achieve certain things in life (even this qualities make one unpopular) |    |   |    |    |     |
| 5   | Work should come first even if one cannot take rest  |    |   |    |    |     |
| 6   | Even when one's interest is in danger, he should concentrate on his job and forget his obligations to others                   |    |   |    |    |     |
| 7   | One should set difficult goals for oneself and try to accomplish them  |    |   |    |    |     |

SA – strongly agree, A – Agree, UD – Undecided, DA – disagree, SDA – strongly disagree

### 4. Management Orientation

Please indicate whether you agree or disagree with the following statements

| Sl. No. | Statement   | Response |          |
|---------|---|----------|----------|
|         |   | Agree    | Disagree |
|         | <b>I. Planning orientation</b>  |          |          |
| 1.      | Every year one should think about the Enterprise to be taken up during that year                      |          |          |
| 2.      | It is not necessary to make prior decisions about the type of enterprise to be taken up by the family |          |          |
| 3.      | Selecting enterprises does not depend upon the availability of resources                              |          |          |
| 4.      | The amount of input required for the enterprise should be assessed before starting the work           |          |          |
| 5.      | It is necessary to think of cost before taking up an enterprise                                       |          |          |
| 6.      | It is possible to increase the output through production plan of enterprise                           |          |          |
|         | <b>II. Production Orientation</b>   |          |          |
| 1.      | Timely planning of enterprise ensures higher production   |          |          |
| 2.      | One should use resources as much as it is required  |          |          |
| 3.      | Knowing the capacity of resources, saves money on inputs.   |          |          |
| 4.      | Inputs must be used as recommended by specialists.  |          |          |
| 5.      | Regular precautionary measures necessary irrespective of happenings.                                  |          |          |
| 6.      | It is necessary to consult specialist during production process.                                      |          |          |

| <b>III. Market Orientation</b> |  |  |  |
|--------------------------------|--|--|--|
| 1.                             | Market news is useful to the enterprise.                                     |  |  |
| 2.                             | An enterprise will get more income by grading the produce.                   |  |  |
| 3.                             | Proper storage facilities can help to get good price for produce.            |  |  |
| 4.                             | One should sell the produce in the nearest market irrespective of the price. |  |  |
| 5.                             | One should go for such enterprise, which has more market demand.             |  |  |
| 6.                             | It is not profitable to sell to a middleman locally.                         |  |  |

### 5. Risk orientation

Please give your response to the following statements by putting (√) mark in the appropriate column

| Sl. No. | Statements  | Response |          |
|---------|---|----------|----------|
|         |   | Agree    | Disagree |
| 1.      | A farmer should grow many crops to avoid greater risks involved in growing only one crop                              |          |          |
| 2.      | A farmer should take more of chance in making a big profit than to be content with a smaller but less risky profit    |          |          |
| 3.      | A farmer who is willing to take greater risk than average farmer, usually does better financially                     |          |          |
| 4.      | It is good for a farmer to take risk when he/she knows his/her chance of success is fairly high                       |          |          |
| 5.      | It is better for a farmer not to try new farming methods unless most others in the locality have used it with success |          |          |
| 6.      | Trying entirely a new method in farming by a farmer involves risk, but it is worth trying                             |          |          |

### 6. Value orientation

Please indicate whether you agree or disagree with the following statements

| Sl. No. | Statements   | Response |          |
|---------|--|----------|----------|
|         |  | Agree    | Disagree |
| 1.      | God's blessing is the most important condition necessary for a good crop.  |          |          |
| 2.      | A farmer should not be sentimental in selling away old cattle  |          |          |
| 3.      | It is below the dignity of a person of good social standing to engage in activities such as poultry farming even though it is profitable |          |          |
| 4.      | It is below the status of a farmer belonging to a respectable family to work as laborer in others field.                                 |          |          |
| 5.      | As pig is a dirty animal and person belonging to upper caste should not rear it.   |          |          |

|     |   |  |  |
|-----|---|--|--|
| 6.  | In cultivating different crops, ones attempt should be to meet the requirement of one's family.           |  |  |
| 7.  | Only those people whose occupation by tradition is keeping dairy animals would succeed in that endeavour. |  |  |
| 8.  | It is below the dignity of an educated farmer to plough field   |  |  |
| 9.  | One should try to start important agricultural works during auspicious period                             |  |  |
| 10. | It is due to the displeasure of god on human beings due to bad deeds that it does not rain regularly.     |  |  |

## 7. Farming commitment

Please choose any one among five alternatives given for each statement

| Sl. No. | Statements   | Response category |   |    |    |     |
|---------|--|-------------------|---|----|----|-----|
|         |  | SA                | A | UD | DA | SDA |
| 1       | If I were to be given a job in city, I will quit farming   |                   |   |    |    |     |
| 2       | I feel that people simply talk of farming problems; they forget that everything depends on how they manage it. |                   |   |    |    |     |
| 3       | I am willing to take a great deal of effort to develop my farm.  |                   |   |    |    |     |
| 4       | I am prepared to face any problem to stay permanently in farming.  |                   |   |    |    |     |
| 5       | I wish my children to be Government employees rather than farmers like me.                                     |                   |   |    |    |     |
| 6       | There is not much to be gained by sticking on to farming permanently.  |                   |   |    |    |     |
| 7       | For me farming is the best occupation when compared to other occupations.                                      |                   |   |    |    |     |
| 8       | I believe that cultivation pays in the long run  |                   |   |    |    |     |

SA – strongly agree, A – Agree, UD – Undecided, DA – disagree, SDA – strongly disagree

## 8. Decision making pattern

Please indicate who takes decision with respect to the following activities

| Sl. No. | Decision making areas    | Decision taken by        |         |               |                           |
|---------|--------------------------|--------------------------|---------|---------------|---------------------------|
|         |                          | Head of the family alone | Parents | Adult members | Parents and adult members |
| 1       | Area to be cultivated    |                          |         |               |                           |
| 2       | Selection of crop/s      |                          |         |               |                           |
| 3       | Selection of variety/ies |                          |         |               |                           |
| 4       | Seed rate                |                          |         |               |                           |
| 5       | Seed treatment           |                          |         |               |                           |

|    |                                    |  |  |  |  |
|----|------------------------------------|--|--|--|--|
| 6  | Quantity and nature of manure      |  |  |  |  |
| 7  | Quantity and nature of fertilizers |  |  |  |  |
| 8  | Method of fertilizer application   |  |  |  |  |
| 9  | Water management                   |  |  |  |  |
| 10 | Weed management                    |  |  |  |  |
| 11 | Disease and insect management      |  |  |  |  |
| 12 | Hiring laborers                    |  |  |  |  |
| 13 | Marketing place                    |  |  |  |  |
| 14 | Marketable quantity                |  |  |  |  |

### 9. Social Participation:

Please indicate your participation in the social organizations either as member or office bearer

| Sl. No. | Organisation                            | Position |               | Extent of Participation |              |       |
|---------|---|----------|---------------|-------------------------|--------------|-------|
|         |   | Member   | Office bearer | Regularly               | Occasionally | Never |
| 1.      | Gram Panchayat                          |          |               |                         |              |       |
| 2.      | Taluk Panchayat                         |          |               |                         |              |       |
| 3.      | Zilla Panchayat                         |          |               |                         |              |       |
| 4.      | Co-operative society                    |          |               |                         |              |       |
| 5.      | MPCS                                    |          |               |                         |              |       |
| 6.      | Youth club                              |          |               |                         |              |       |
| 7.      | Mahila mandal                           |          |               |                         |              |       |
| 8.      | Raitha Sangha<br>(Farmers Organization) |          |               |                         |              |       |
| 9.      | Self Help Group                         |          |               |                         |              |       |
| 10.     | Any others                              |          |               |                         |              |       |
| 11.     |   |          |               |                         |              |       |

### 10. Cosmopolitaness

#### a. Please indicate the frequency of your visit to the nearest town

1. Two or more times in a week
2. Once in a week
3. Once in a fortnight
4. Once in a month
5. Seldom
6. Never

**b. What generally would be the main purpose of your visit?**

1. All visits are related to agriculture.
2. Some visits are related to agriculture.
3. Personal/ domestic.
4. Entertainment.
5. Others
6. No Response

**11. Innovativeness**

Please give your response to the following statements by putting (√) mark in the appropriate column

| Sl. No. | Statements  | Response |           |    |
|---------|---|----------|-----------|----|
|         |   | Yes      | Undecided | No |
| 1.      | Do you want to learn new ways on farming  |          |           |    |
| 2.      | If an agricultural extension worker gives a talk on improved cultivation practices, would you attend? |          |           |    |
| 3.      | If the government would help you establish a farm elsewhere, would you move?                          |          |           |    |
| 4.      | Do you want to change your way of life?   |          |           |    |
| 5.      | A farmer should try to farm the way his parents did.  |          |           |    |
| 6.      | Do you want your son to be farmers?   |          |           |    |
| 7.      | It is better to enjoy today and let tomorrow takes care of itself.                                    |          |           |    |
| 8.      | A man's fortune is in the hands of God.   |          |           |    |

**12. Extension contact**

Please indicate the extent of contact you had with the following extension personnel

| Sl. No. | Extension personnel                | Once in a week | Once in 15 days | Once in a month | Occasionally | Never |
|---------|------------------------------------|----------------|-----------------|-----------------|--------------|-------|
| 1       | Agricultural Assistant             |                |                 |                 |              |       |
| 2       | Assistant Agricultural Officer     |                |                 |                 |              |       |
| 3       | Agricultural Officer               |                |                 |                 |              |       |
| 4       | Assistant Director of Agriculture  |                |                 |                 |              |       |
| 5       | Assistant Director of Horticulture |                |                 |                 |              |       |
| 6       | KVK – SMS                          |                |                 |                 |              |       |
| 7       | University Scientists              |                |                 |                 |              |       |
| 8       | Veterinary Officer                 |                |                 |                 |              |       |
| 9       | Sericulture Officer                |                |                 |                 |              |       |
| 10      | Others (specify)                   |                |                 |                 |              |       |

### 13. Extension participation

Please indicate the extent of participation in the following extension methods

| Sl. No. | Activities            | Participation |              |       |
|---------|-----------------------|---------------|--------------|-------|
|         |                       | Regularly     | Occasionally | Never |
| 1       | Training              |               |              |       |
| 2       | Discussions/ meetings |               |              |       |
| 3       | Result demonstration  |               |              |       |
| 4       | Method demonstration  |               |              |       |
| 5       | Field Days            |               |              |       |
| 6       | Field visits          |               |              |       |
| 7       | Krishimela            |               |              |       |
| 8       | Exhibitions           |               |              |       |
| 9       | Educational tours     |               |              |       |
| 10      | Any others (specify)  |               |              |       |

### 14. Mass media Exposure

Please indicate ownership or subscription and frequency of use

| Sl. No. | Media               | Owner/<br>subscriber | Frequency of use |            |       |
|---------|---------------------|----------------------|------------------|------------|-------|
|         |                     |                      | Regular          | Occasional | Never |
| 1.      | Newspaper           |                      |                  |            |       |
| 2.      | Farm Magazine       |                      |                  |            |       |
| 3.      | Extension folder    |                      |                  |            |       |
| 4.      | Radio               |                      |                  |            |       |
| 5.      | Television          |                      |                  |            |       |
| 6.      | Internet            |                      |                  |            |       |
| 7.      | Mobile              |                      |                  |            |       |
| 8.      | Any other (specify) |                      |                  |            |       |

## Development of an Index to Measure Sustainability of Farming Systems

A. B. SUNITHA AND D. NANJAPPA

Department of Agricultural Extension, College of Agriculture, UAS, GKVK, Bengaluru - 560 065

### ABSTRACT

An index of sustainability of farming systems was developed in this research study. Based on the review of literature and discussion with the experts, 21 indicators were enlisted. The relevancy rating was obtained from 50 judges in the concerned area. All those dimensions / indicators with the relevancy coefficient of 0.75 and mean relevancy score of 2.25 and above were selected for the inclusion in the sustainability index. Fifteen indicators passed the above criteria. To compute the scale values for each of the identified indicators, their relative importance in the sustainable farming system was worked out by adopting normalized ranking method recommended by Guilford (1954) and the total scale value was 71.6. The index developed was reliable (0.9180) and valid with respect to content validity.

THE average holding of a farm in India has been declining and 83.9 per cent of operational holdings are small. There is no scope for increasing the farm size. Further, there is shrinkage of cultivated land due to industrialization and urbanization. Hence, there is a scope for integrated farming system to increase the income of the farmer. The farming systems, therefore assume greater importance for effective and efficient management of farm resources to enhance the farm productivity and to reduce environmental degradation thus facilitates to maintain the sustainability. The sustainable farming systems, economically viable and ecologically compatible encompassed with higher productivity to meet the present and future needs without jeopardizing the potential, are to be developed for specific agricultural region. The slow growth of agricultural sector is mainly due to stagnation in productivity which is a great concern for policy makers and planners. The key challenge to Indian agriculture lies in designing, developing and managing farming systems that enable the farmers to be profitable.

There is a need to quantify sustainability of farming systems and to make the concept operational duly incorporating its economic viability, environmental sustainability and social equity. Many individuals and organizations have attempted to identify certain indicators and then to work out an index for measuring sustainability at macro level (Anon., 1990 and 1991).

Chandregowda (1996) made an in-depth farm level analysis of rice farming sustainability and Naghabushanam (1997) analyzed the sustainability of agriculture in watershed environment. However, such micro level studies on sustainability for different agricultural crops are very few. The felt need of the day is increasing and stabilizing the productivity level of farming systems and this could be achieved by generating appropriate low cost and sustainable technologies. Sustainability level in any system is influenced by the technologies available. Sustainability of farming systems is a complex concept and there is no common viewpoint among scholars about its dimensions. Nonetheless various parameters for measuring agricultural sustainability have been proposed. A large number of indicators have been developed but they do not cover all dimensions and levels. Therefore, indicators used for agricultural sustainability should be location specific. They should be constructed within the context of the contemporary socio-economic and ecological situation. Hence, the present study is taken up with the specific objective to develop and standardize an index to measure the sustainability of farming system.

Sustainability of farming systems is operationalised as the extent to which farmer manages soil and water resources, relying on farm and other additional inputs to maintain or enhance the

productivity without affecting the production environment of his farm.

Composite of three dimensions *viz.*, ecological, economic and social. Many authors have indicated that the components that have been identified were based on secondary data and were also not further operationalised. Hence, the researcher's thrust was to identify components that truly reflect farm level sustainability. An attempt has been made to develop an index to measure the sustainability of farming systems.

Based on the review of literature as well as discussion with the experts in the field, 21 indicators were enlisted in accordance with the situation existed in farming system. These items were mainly concerned with consequences by using the cultivation practices covering widely from environmental effects to the social aspects. The final list of indicators was subjected to relevancy rating of 50 judges in the concerned area. The judges were belongs to the cadre of Assistant Professors and above in the area of Agricultural Extension; Agricultural Economics; Agricultural Marketing, Co-operation and Business Management; Agricultural Statistics, Applied Mathematics and Computer Science; Agronomy; Agricultural Entomology; Plant Pathology; Soil Science and Horticulture in the University, KVKs and other ICAR institutes. The experts were requested to indicate whether each of the components sent to them were relevant and suitable for inclusion in the scale to measure the sustainability index of farmers on a four point relevancy continuum, *viz.*, Most Relevant, Relevant, Somewhat Relevant and Not Relevant with 4, 3, 2 and 1 scores, respectively. They were also requested to add new indicators, which tend to measure the sustainability, if any, they consider relevant. The responses had from the judges were scored and the relevancy coefficient of indicator (RC) was worked out using the following formula:

$$RC_i = \frac{\text{Total score of all the judges on 'i'th indicator}}{\text{Maximum score on the continuum} \times \text{Total number of judges}} \times 100$$

All those components with the relevancy coefficient of 0.75 and mean relevancy score of 2.25

and above were selected for the inclusion in the sustainability index. Fifteen indicators selected are listed in Table I.

TABLE I  
*Indicator wise relevancy score under different dimensions of sustainable farming systems (n=50)*

| Indicators                     | Relevancy coefficient (RC) | Mean relevancy score |
|--------------------------------|----------------------------|----------------------|
| <b>I. Ecological dimension</b> |                            |                      |
| Integrated nutrient management | 0.953                      | 2.86                 |
| Integrated pest management     | 0.933                      | 2.80                 |
| Water management               | 0.920                      | 2.76                 |
| Land-use pattern               | 0.847                      | 2.54                 |
| Cropping pattern               | 0.867                      | 2.60                 |
| <b>II. Economic dimension</b>  |                            |                      |
| Land productivity              | 0.887                      | 2.66                 |
| Profitability                  | 0.893                      | 2.68                 |
| Input – output relationship    | 0.860                      | 2.58                 |
| Farm level risk management     | 0.787                      | 2.36                 |
| Marketing                      | 0.860                      | 2.58                 |
| <b>III. Social dimension</b>   |                            |                      |
| Input self-sufficiency         | 0.813                      | 2.44                 |
| Information self- sufficiency  | 0.753                      | 2.26                 |
| Employment generation          | 0.800                      | 2.40                 |
| Family food security           | 0.880                      | 2.64                 |
| Quality of life                | 0.760                      | 2.28                 |

In order to compute the scale values for each of the identified indicators, their relative importance in the sustainable farming system was worked out by adopting normalized ranking method recommended by Guilford (1954). A list of 30 experts working in relevant field in the University of Agricultural Sciences, Bangalore was prepared and considered for seeking opinion. The judges were requested to give rank order based on the relative importance of the indicators to the 15 selected indicators of sustainability. After receiving ratings from the judges, they were used in calculation of scale values. Ranking the components based on their relative importance - Ranks were converted to rank values using the formula:

$$R_i = (n - r_i + 1)$$

Where,  $R_i$  = Rank values

$n$  = Number of indicators

$r_i$  = Ranks given by judges to fifteen indicators

The calculation of scale values consisted of working out the centile position ‘p’ based on the formula recommended by Guilford (1954), working out ‘c’ scale values, calculating ‘R<sub>j</sub>’ value and finally determining the scale of (R<sub>c</sub>) (Appendix-1) :

$$P = \frac{(R_i - 0.5) 100}{n}$$

$$R_c = 2.357 \times R_j - 7.01$$

Where, P= Centile position

C= Values determined to each centile value

R<sub>i</sub>= Rank value

n = Number of indicators

TABLE II  
Scale values for fifteen indicators under different dimensions of sustainability of farming systems (n=30)

| Indicators                     | Scale value  |
|--------------------------------|--------------|
| <b>I. Cological dimension</b>  |              |
| Integrated nutrient management | 8.78         |
| Land-use pattern               | 7.13         |
| Water management               | 6.42         |
| Cropping pattern               | 5.80         |
| Integrated pest management     | 5.48         |
| <b>II. Economic dimension</b>  |              |
| Land productivity              | 8.39         |
| 2Input – output relationship   | 5.48         |
| Profitability                  | 3.91         |
| Farm level risk management     | 3.91         |
| Marketing                      | 3.28         |
| <b>III Social dimension</b>    |              |
| Input self-sufficiency         | 5.56         |
| Family food security           | 3.44         |
| Employment generation          | 1.87         |
| Information self- sufficiency  | 1.08         |
| Quality of life                | 1.08         |
| <b>Total Scale value</b>       | <b>71.60</b> |

The scale values were used to arrive at sustainability index for each farmer.

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

$$U_{ij} = \frac{Y_{ij} - \text{Min } Y_j}{\text{Max } Y_j - \text{Min } Y_j}$$

Where,

U<sub>ij</sub> = Unit standard score of the i<sup>th</sup> respondent on j<sup>th</sup> component

Min Y<sub>j</sub> = Minimum score on the j<sup>th</sup> component

Max Y<sub>j</sub> = Maximum score on the j<sup>th</sup> component

Y<sub>ij</sub> = Score of the i<sup>th</sup> respondent on j<sup>th</sup> component

These unit values ranged from 0 to 1, when Y<sub>ij</sub> is minimum, unit value is ‘0’ and when Y<sub>ij</sub> is maximum unit value is 1.

Then, these unit values of each respondent could be multiplied by respective component scale values, summed up, divided by total scale value and multiplied by 100 to get sustainability index for each respondent.

$$S_i = \frac{\sum U_{ij} \times S_j}{\text{Total scale value}} \times 100$$

Where,

S<sub>i</sub> = Sustainability index of i<sup>th</sup> respondent

U<sub>ij</sub> = Unit standard scores of the i<sup>th</sup> respondent on j<sup>th</sup> component

S<sub>j</sub> = Scale value of j<sup>th</sup> component

Total scale value = 71.6

i = 1,....., 120

j = 1,....., 15

An instrument has to be reliable and valid to prove its value as well its accuracy. This is more so when a composite index is obtained by combining several components. Reliability refers to precision of the instrument constructed for any purpose. It is otherwise called the extent to which repeated measurement produces the same result. Any newly constructed

APPENDIX-1

| ni                             | Ri | c <sub>1</sub> | c <sub>2</sub> | c <sub>3</sub> | c <sub>4</sub> | c <sub>5</sub> | c <sub>6</sub> | c <sub>7</sub> | c <sub>8</sub> | c <sub>9</sub> | c <sub>10</sub> | c <sub>11</sub> | c <sub>12</sub> | c <sub>13</sub> | c <sub>14</sub> | c <sub>15</sub> | P  | C    |   |
|--------------------------------|----|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----|------|---|
| 1                              | 15 | 8              | 8              | 1              | 3              | 1              | 1              | 3              | 2              | 0              | 0               | 0               | 1               | 0               | 0               | 2               | 30 | 96.7 | 9 |
| 2                              | 14 | 2              | 2              | 3              | 7              | 1              | 2              | 1              | 3              | 0              | 1               | 3               | 0               | 1               | 3               | 1               | 30 | 90   | 8 |
| 3                              | 13 | 4              | 3              | 2              | 1              | 4              | 1              | 1              | 4              | 0              | 1               | 2               | 2               | 1               | 4               | 0               | 30 | 83.3 | 7 |
| 4                              | 12 | 0              | 3              | 4              | 1              | 1              | 2              | 3              | 1              | 0              | 3               | 4               | 2               | 2               | 2               | 2               | 30 | 76.7 | 6 |
| 5                              | 11 | 5              | 3              | 1              | 4              | 0              | 2              | 1              | 3              | 1              | 2               | 2               | 1               | 0               | 4               | 1               | 30 | 70   | 6 |
| 6                              | 10 | 3              | 4              | 4              | 1              | 5              | 1              | 0              | 4              | 0              | 1               | 2               | 3               | 1               | 1               | 0               | 30 | 63.3 | 6 |
| 7                              | 9  | 3              | 1              | 2              | 2              | 3              | 2              | 3              | 3              | 0              | 1               | 4               | 1               | 2               | 3               | 0               | 30 | 56.7 | 5 |
| 8                              | 8  | 1              | 1              | 2              | 3              | 3              | 1              | 2              | 1              | 2              | 2               | 4               | 4               | 2               | 1               | 1               | 30 | 50   | 5 |
| 9                              | 7  | 1              | 0              | 0              | 1              | 4              | 2              | 2              | 1              | 2              | 2               | 5               | 1               | 3               | 5               | 1               | 30 | 43.3 | 5 |
| 10                             | 6  | 3              | 0              | 2              | 2              | 1              | 1              | 4              | 1              | 1              | 1               | 0               | 6               | 2               | 2               | 4               | 30 | 36.7 | 4 |
| 11                             | 5  | 0              | 1              | 4              | 0              | 4              | 3              | 1              | 5              | 1              | 4               | 0               | 2               | 2               | 3               | 0               | 30 | 30   | 4 |
| 12                             | 4  | 0              | 3              | 2              | 2              | 0              | 4              | 1              | 0              | 7              | 4               | 1               | 1               | 2               | 0               | 3               | 30 | 23.3 | 4 |
| 13                             | 3  | 0              | 0              | 1              | 2              | 2              | 1              | 3              | 1              | 11             | 3               | 0               | 3               | 3               | 0               | 0               | 30 | 16.7 | 3 |
| 14                             | 2  | 0              | 0              | 2              | 1              | 1              | 4              | 0              | 0              | 3              | 5               | 1               | 2               | 3               | 2               | 6               | 30 | 10   | 2 |
| 15                             | 1  | 0              | 1              | 0              | 0              | 0              | 3              | 5              | 1              | 2              | 0               | 2               | 1               | 6               | 0               | 9               | 30 | 3.3  | 1 |
| f <sub>ni</sub>                |    | 30             | 30             | 30             | 30             | 30             | 30             | 30             | 30             | 30             | 30              | 30              | 30              | 30              | 30              | 30              |    |      |   |
| f <sub>pc</sub>                |    | 201            | 196            | 160            | 180            | 159            | 133            | 139            | 171            | 103            | 131             | 159             | 139             | 113             | 163             | 103             |    |      |   |
| M <sub>c</sub> =R <sub>j</sub> |    | 6.7            | 6.53           | 5.33           | 6.0            | 5.3            | 4.43           | 4.63           | 5.7            | 3.43           | 4.37            | 5.3             | 4.63            | 3.77            | 5.43            | 3.43            |    |      |   |
| R <sub>c</sub> *               |    | 8.78           | 8.39           | 5.56           | 7.13           | 5.48           | 3.44           | 3.91           | 6.42           | 1.08           | 3.28            | 5.48            | 3.91            | 1.87            | 5.8             | 1.08            |    |      |   |

Where, ni = Ranks given by judges to fifteen indicators

Ri = Rank values

Rc = 2.357 Rj - 7.01

Rj = "fjic" / "fji"

P = Centile position

C = Values determined to each centile value

index has to be tested for its reliability before it is used. In the present study, the reliability of sustainability index was determined by split-half method. In order to find out the reliability, the sustainability index was divided into two halves, based on odd and even numbered questions and administered to 30 respondents. The two sets of scores of same respondents were correlated. The coefficient of correlation was found to be 0.9180, which was found to be significant at 1 per cent level of probability, indicating high reliability of scale. It was concluded that the sustainability index constructed was reliable.

The true value of the sustainability index is reflected by its validity. Also, the usefulness of the index must be evaluated by determining its validity. An index is said to be valid if it stands for one's reasoning. Validity could be established through the following way.

According to Kerlinger (1973) content validity is the representativeness or the sampling adequacy of the contents, the substance, the matter and the topics of a measuring instrument. He further stated that, content validation consists essentially in judgment. Content validity in the current study was established in two ways. First, the items selected for inclusion in sustainability index were based on extensive review

of literature. Secondly, the opinion of the panel of judges was obtained to find out whether the items suggested were relevant for inclusion in the index or not. Hence, it was concluded that the index was valid owing to the judgment given by the majority of the judges regarding content validity.

#### REFERENCES

- ANONYMOUS, 1990, Putting sustainability into context, sustainable farming and the role of Farmers' Organisation (Seminar for Developing Country). *Farm Leader*, Adelaide, Australia.
- ANONYMOUS, 1991, Criteria for assessment ILEIA workshop proceeding, *ILEIA News Letter*, 7(3): 21-23.
- CHANDREGOWDA, M. J., 1996, Sustainability of rice farming in different rice ecosystem. *Ph.D. Thesis* (Unpub.), Univ. Agric. Sci., Bangalore.
- GUILFORD, J. P., 1954, Psychometric Methods. McGraw Hill Book, New York.
- KERLINGER, E. N., 1978, Foundations of Behavioural Research, New York: Holt, Rine Hart and Winston.
- NAGHABUSHANAM, K., 1997, Sustainability of agriculture in watershed environment – an analysis. *Ph.D. Thesis* (Unpub.), TNAU, Coimbatore.

## **A Study on Socio-Economic Characteristics of Farmers Practicing Different Farming Systems**

A. B. SUNITHA\* AND D. NANJAPPA

*Department of Agricultural Extension, University of Agricultural Sciences, GKVK, Bangalore-560065*  
*email : \*sunithareddyuas@gmail.com*

### **ABSTRACT**

The present study was conducted in Eastern and Southern Dry Zones of Karnataka to assess the socio-economic characteristics of farmers practicing different farming systems with the total sample size of 120 respondents (60 from irrigated eco-system and 60 from rainfed eco-system). The results indicated that 43.33 per cent and 40.00 per cent of the irrigated and rainfed eco-system farmers belonged to middle age, respectively. It was observed that irrigated (36.67%) and rainfed (43.33%) ecosystem farmers had high school education. More than half of the irrigated (66.67 %) and rainfed (60.00 %) eco-system farmers had 3-5 family members, nearly half of the irrigated eco-system farmers (45.00 %) had medium farming experience, in contrast to low farming experience of 35.00 per cent of rainfed farmers, irrigated (41.67%) and rainfed (51.67%) eco-system farmers were having small holdings. It could be seen that more than one third (36.67% and 45.00%) had medium level of aspiration, majority (51.67% and 61.67%) had medium level of economic motivation, medium level of achievement motivation (48.34% and 46.67%), medium (71.67% and 51.67%) level of management orientation, majority (76.67% and 65.00%) possessed medium risk orientation, majority (53.33% and 80.00%) possessed medium value orientation among irrigated and rainfed eco-system farmers, respectively. An equal percentage (41.67%) of both categories belonged to high level of decision making pattern, about 45.00 per cent of the irrigated eco-system farmers had high innovative proneness whereas, 45.00 per cent of rainfed eco-system farmers' medium innovative proneness. A majority (40.00% and 38.34%) medium social participation category, almost an equal percentage (41.67% and 45.00%) had medium extension contact, medium mass media use (43.33% and 53.33%) among irrigated and rainfed eco-system farmers.

**Keywords** *Social characteristics, Economic characteristics, Irrigated eco-system, Rainfed eco-system, Farming systems*

The average holding of a farm in India has been declining and about 83.9 per cent of operational holdings are small. There is no scope for increasing the farm size, because of steady increase in population with shrinkage of cultivated land due to industrialization and urbanization. Only vertical expansion is possible by integrating appropriate farming components requiring lesser space and time ensuring periodic income to the farmer. The integrated farming systems, therefore assumes greater importance for sound management of farm resources to enhance the farm productivity, to reduce environmental degradation to maintain the sustainability in farming systems. Hence, the farming systems, economically viable and ecologically compatible encompassed with higher productivity to meet the present and future needs without jeopardizing the potential, are to be optimized for specific agricultural domain. The slow growth of agricultural sector is mainly due to stagnation in productivity growth which is great concern for policy makers and planners. The key challenge to Indian agriculture lie in designing, developing and managing farming systems that enable the farmers to be efficient, equitable and sustainable in the bio economic, bio-physical and socio cultural environment. With this brief background the present study was conducted on socio-economic profile of the farmers practicing different farming systems.

### **METHODOLOGY**

The present investigation was carried out in Eastern and Southern dry zones of Karnataka state during 2014-15. From each of the selected zone, one taluk representing highest irrigated and one taluk representing highest rainfed area were identified. Gubbi taluk and Srinivasapura taluk in Eastern dry zone and Mandya taluk and Gundlupet taluk in Southern dry zone. Two hoblies representing highest irrigated and two hoblies representing highest rainfed area in each selected taluk were

**Table 1. Personal and economic characteristics of farmers**

| Characters         | Category      | Irrigated (60) |       | Rainfed (60) |       | Total (120) |       |
|--------------------|---------------|----------------|-------|--------------|-------|-------------|-------|
|                    |               | No.            | %     | No.          | %     | No.         | %     |
| Age                | < 35          | 10             | 16.67 | 14           | 23.33 | 24          | 20.00 |
|                    | 35-50         | 26             | 43.33 | 24           | 40.00 | 50          | 41.67 |
|                    | 50 & above    | 24             | 40.00 | 22           | 36.67 | 46          | 38.33 |
| Education          | Up to primary | 12             | 20.00 | 14           | 23.33 | 26          | 21.67 |
|                    | Middle        | 5              | 8.33  | 7            | 11.67 | 12          | 10.00 |
|                    | High school   | 22             | 36.67 | 26           | 43.33 | 48          | 40.00 |
|                    | PUC & above   | 21             | 35.00 | 13           | 21.67 | 34          | 28.33 |
| Family Size        | 3-5 members   | 40             | 66.67 | 36           | 60.00 | 76          | 63.33 |
|                    | 6-7 members   | 14             | 23.33 | 10           | 16.67 | 24          | 20.00 |
|                    | 8 & above     | 6              | 10.00 | 14           | 23.33 | 20          | 16.67 |
| Farming experience | Low           | 16             | 26.67 | 21           | 35.00 | 37          | 30.83 |
|                    | Medium        | 27             | 45.00 | 20           | 33.33 | 47          | 39.17 |
|                    | High          | 17             | 28.33 | 19           | 31.67 | 36          | 30.00 |
| Land holding       | <2.5 acres    | 20             | 33.33 | 9            | 15.00 | 29          | 24.17 |
|                    | 2.5-5 acres   | 25             | 41.67 | 31           | 51.67 | 56          | 46.66 |
|                    | >5 acres      | 15             | 25.00 | 20           | 33.33 | 35          | 29.17 |

identified again. Kasaba and Kadaba in Gubbi taluk, Kasaba and Kottathi in Mandya taluk having highest irrigation & Ronuru and Nelavanki in Srinivasapura taluk & Terkanambi and Hangla in Gundlupet taluk having highest rainfed were thus, selected. Three villages were randomly selected for the study from each of the selected hobbies based on the highest irrigated and rainfed area. From each of the selected 24 villages, 5 farmers were selected using random sampling method. Ex-post-facto research design was employed for conducting study. Data was collected by using a detailed interview schedule employing personal interview method. The responses were scored, quantified, categorized and tabulated using percentage, mean, standard deviation.

## RESULTS AND DISCUSSION

### Personal and economic characteristics of the farmers practicing different farming systems

The data in Table-1 reveal that 43.33 per cent of the irrigated eco-system farmers belonged to middle age category, followed by old age (40.00%) and young age (16.67%) category. In case of rainfed eco-system, 40.00 per cent of respondents belonged to middle age category, followed by old (36.67%) and young (23.33%) age categories. The

probable reasons might be that, the farmers of middle age are enthusiastic and have more work efficiency. Moreover, middle aged farmers have more family responsibility, efficiency and sensibility. They also work with a sense of commitment and involvement. The findings are in line with the findings of Chandranaik, 2002 and Lavanya, 2010.

It was observed that 36.67 per cent and 43.33 per cent had high school level of education among irrigated and rainfed ecosystem farmers respectively. However, 35.00 per cent of the irrigated and only 21.67 per cent of rainfed ecosystem farmers had PUC and above level of education. It is universal fact that education plays a key role in moulding and bringing desirable changes among human beings. All the respondents were relatively educated, which could be the result of a common social environment. As the majority of the farmers were educated, they were able to gather knowledge on recent technologies on cultivation practices. In the present scenario, almost everybody is anticipating to be literate due to the awareness brought by the government on the importance of education and the efforts of the government and non – governmental agencies. The findings are in line with the findings of Chandranaik, 2002.

More than half of the irrigated (66.67 %) and

rained (60.00 %) eco-system farmers had 3-5 members. The present trend in the village is to have a small family for agricultural operations and decision making for better economic progress and quality life. This could be the possible reason for majority of the respondents to have relatively small family. The findings are in line with the findings of Mahatab Ali, 2010.

Nearly half of the irrigated eco-system farmers (45.00 %) had medium farming experience, in contrast to low farming experience of 35.00 per cent of rainfed farmers. Majority of the irrigated eco-system farmers had agriculture as their primary occupation got reflected in having medium farming experience. The possible reason could be that for a women has grown up in farm family and got married with a farmer, age is an appropriate indicator which shows her level of experience in agriculture and subsidiary enterprises, because she usually start working in the farm at an early age or since time of childhood and adolescence. The findings are in conformity with Anitha, 2004.

It could be seen that 41.67 per cent of the irrigated and 51.67 per cent of rainfed eco-system farmers were small farmers followed by marginal and big farmers. The findings are in conformity with the findings of Gopala, 2010 and Mahatab Ali, 2010.

### **Psychological characteristics of farmers practicing different farming systems**

The results in Table-2 showed that 36.67 per cent of irrigated and 45.00 per cent of rainfed eco-system farmers had medium level of aspiration. This may be due to the situational circumstances in both the eco-systems. The findings are in line with the findings of Chandranaik, 2002 and Chandrani Saha, 2008.

A majority of the respondents under both the categories had medium (51.67% and 61.67%) level of economic motivation, followed by low (30.00% and 23.30%) and high (18.33% and 15.00%) levels of economic motivation. It could be due to aspiration for high returns from farming to have a high standard of living. The other reason might be that farmers are becoming more and more market oriented to have a more profit. The findings are similar with the findings of Lavanya, 2010.

Comparatively higher percentage (48.34% and 46.67%) of irrigated and rainfed eco-system farmers belonged to medium achievement

motivation category, while 38.33 per cent of irrigated eco-system farmers belonged to high category and 33.33 per cent of rainfed eco-system farmers were observed under low achievement category. The reason is that achievement motivation is basic character which motivates and helps an individual to do anything. It is a psychologically internalized condition which drives an individual to aspire for higher level of earning and living. The reason for medium level of achievement motivation may be due to religious customs of that village which does not allow the farmers to come forward. The findings are in line with the findings of Chandranaik, 2002 and Chandrani Saha, 2008.

From the Table-2, it is learnt that majority of the respondents under both the categories had medium (71.67% and 51.67%) level of management orientation, followed by low (18.33% and 25.00%) and high (10.00% and 23.33%) level of management orientation. The medium level of management orientation of farmers can be substantiated stating that farmers often face new and complex situations, with little resemblance to past or present situations because of the ever changing environment and changing nature of agriculture. A major role of farmers as managers is to manage the specific situations faced by them and hence the derived result. The findings are in line with the findings of Chandranaik, 2002 and Lavanya, 2010.

The results showed that majority (76.67% and 65.00%) of irrigated and rainfed eco-system farmers possessed medium risk orientation. The possible reason for the above trend might be farmers medium level of education and majority of them had medium to low degree of cosmopolitanism.

A majority (53.33% and 80.00%) of irrigated and rainfed eco-system farmers possessed medium value orientation. The probable reason could be the changing trends are desirable, rural value systems need to be promoted on a wider ongoing developments and requirements of the present day. The findings are in line with the findings of Chandranaik, 2002 and Chandrani Saha, 2008.

It was quite evident from the results that among irrigated eco-system farmers, most (40.00%) of the respondents belonged to high level of farming commitment. In case of rainfed eco-system farmers 45.00 per cent belonged to medium level of farming commitment category. The findings are in line with the findings of Chandranaik, 2002.

From the Table-2, it is learnt that an equal

**Table 2. Psychological characteristics of Farmers**

| Characters              | Category | Irrigated (60) |       | Rainfed (60) |       | Total (120) |       |
|-------------------------|----------|----------------|-------|--------------|-------|-------------|-------|
|                         |          | No.            | %     | No.          | %     | No.         | %     |
| Level of aspiration     | Low      | 18             | 30.00 | 20           | 33.33 | 38          | 31.67 |
|                         | Medium   | 22             | 36.67 | 27           | 45.00 | 49          | 40.83 |
|                         | High     | 20             | 33.33 | 13           | 21.67 | 33          | 27.50 |
| Economic motivation     | Low      | 18             | 30.00 | 14           | 23.30 | 32          | 26.67 |
|                         | Medium   | 31             | 51.67 | 37           | 61.67 | 68          | 56.67 |
|                         | High     | 11             | 18.33 | 9            | 15.00 | 20          | 16.67 |
| Achievement motivation  | Low      | 8              | 13.33 | 20           | 33.33 | 28          | 23.33 |
|                         | Medium   | 29             | 48.34 | 28           | 46.67 | 57          | 47.50 |
|                         | High     | 23             | 38.33 | 12           | 20.00 | 35          | 29.17 |
| Management orientation  | Low      | 11             | 18.33 | 15           | 25.00 | 26          | 21.67 |
|                         | Medium   | 43             | 71.67 | 31           | 51.67 | 74          | 61.67 |
|                         | High     | 6              | 10.00 | 14           | 23.33 | 20          | 16.67 |
| Risk orientation        | Low      | 8              | 13.33 | 9            | 15.00 | 17          | 14.17 |
|                         | Medium   | 46             | 76.67 | 39           | 65.00 | 85          | 70.83 |
|                         | High     | 6              | 10.00 | 12           | 20.00 | 18          | 15.00 |
| Value orientation       | Low      | 13             | 21.67 | 6            | 10.00 | 19          | 15.83 |
|                         | Medium   | 32             | 53.33 | 48           | 80.00 | 80          | 66.67 |
|                         | High     | 15             | 25.00 | 6            | 10.00 | 21          | 17.50 |
| Farming commitment      | Low      | 15             | 25.00 | 16           | 26.67 | 31          | 25.83 |
|                         | Medium   | 21             | 35.00 | 27           | 45.00 | 48          | 40.00 |
|                         | High     | 24             | 40.00 | 17           | 28.33 | 41          | 34.17 |
| Decision making pattern | Low      | 25             | 41.67 | 21           | 35.00 | 46          | 38.33 |
|                         | Medium   | 10             | 16.66 | 14           | 23.33 | 24          | 20.00 |
|                         | High     | 25             | 41.67 | 25           | 41.67 | 50          | 41.67 |
| Innovativeness          | Low      | 11             | 18.33 | 19           | 31.67 | 30          | 25.00 |
|                         | Medium   | 22             | 36.67 | 27           | 45.00 | 49          | 40.83 |
|                         | High     | 27             | 45.00 | 14           | 23.33 | 41          | 34.17 |

percentage (41.67%) of irrigated and rainfed eco-system farmers belonged to high level of decision making pattern, followed by low (41.67% and 35.00%) and medium (16.66% and 23.33%) level category. The findings are in line with the findings of Chandregowda, 1996.

About 45.00 per cent of the irrigated eco-system farmers had high innovative proneness whereas, 45.00 per cent of rainfed eco-system farmers' medium innovative proneness. This could be attributed to the medium level of education of the respondents which helped them to try new technologies on their fields. Further, because of dry land farming, they might be interested to try new innovations to increase their income. The

findings are in line with the findings of Chandranaik, 2002.

### **Social and Communication characteristics of farmers practicing different farming systems**

It could be seen from Table-3 that a majority of irrigated and rainfed eco-system farmers belonged to medium social participation category (40.00% and 38.34%). All the respondents were educated and they had medium to low levels of extension participation and mass media participation. All these characteristics would naturally enable the respondents to have medium level social participation. The findings are in line with the findings of Mahatab Ali, 2010.

**Table 3. Social and Communication characteristics of farmers**

| Characters              | Category | Irrigated (60) |       | Rainfed (60) |       | Total (120) |       |
|-------------------------|----------|----------------|-------|--------------|-------|-------------|-------|
|                         |          | No.            | %     | No.          | %     | No.         | %     |
| Social participation    | Low      | 16             | 26.67 | 20           | 33.33 | 36          | 30.00 |
|                         | Medium   | 24             | 40.00 | 23           | 38.34 | 47          | 39.17 |
|                         | High     | 20             | 33.33 | 17           | 28.33 | 37          | 30.83 |
| Cosmopolitaness         | Low      | 13             | 21.67 | 13           | 21.67 | 26          | 21.67 |
|                         | Medium   | 22             | 36.67 | 28           | 46.67 | 50          | 41.66 |
|                         | High     | 25             | 41.67 | 19           | 31.67 | 44          | 36.67 |
| Extension contact       | Low      | 17             | 28.33 | 17           | 28.33 | 34          | 28.33 |
|                         | Medium   | 25             | 41.67 | 27           | 45.00 | 52          | 43.34 |
|                         | High     | 18             | 30.00 | 16           | 26.67 | 34          | 28.33 |
| Extension participation | Low      | 16             | 26.67 | 21           | 35.00 | 37          | 30.83 |
|                         | Medium   | 17             | 28.33 | 21           | 35.00 | 38          | 31.67 |
|                         | High     | 27             | 45.00 | 18           | 30.00 | 45          | 37.50 |
| Mass media use          | Low      | 15             | 25.00 | 16           | 26.67 | 31          | 25.83 |
|                         | Medium   | 26             | 43.33 | 32           | 53.33 | 58          | 48.34 |
|                         | High     | 19             | 31.67 | 12           | 20.00 | 31          | 25.83 |

In case of irrigated eco-system farmers 41.67 per cent had high degree of cosmopolitaness as compared to 46.67 per cent of rainfed eco-system farmers who possessed medium degree of cosmopolitaness. Farmers were actively involved in agricultural operations such as purchase of inputs, marketing, and gaining additional knowledge on farming and nearness to town may be the reasons for irrigated eco-system farmers to have high level of cosmopolitaness. In case of rainfed eco-system farmers their medium cosmopolitaness was due to lack of interest on agricultural innovativeness. This might be due to their concentration on purchase of locally available inputs and marketing within the region. This is in line with the findings of Gopala, 2010 and Mahatab Ali, 2010.

It was observed from Table-3 that almost an equal percentage (41.67% and 45.00%) the irrigated and rainfed eco-system farmers had medium extension contact. The medium extension contact of the both categories was due to the fact that extension contact results in purposeful actions which is largely contingent upon an individual's belief in his/her ability to perform that action correctly and/or effectively and thus he/she frequently contacts various departmental officials to seek more information and to clarify the doubts pertaining to the current cropping system. The findings are in line with Sophiasathyavathi, 2001.

The results on extension participation revealed that 45.00 per cent of the irrigated eco-system farmers had high extension participation as compared to 35.00 per cent of rainfed eco-system farmers who had equal medium and low extension participation. The probable reason for high level of extension participation among irrigated eco-system farmers might be due to the fact that majority of them had high level of education and frequently participated in the extension activities conducted by the agriculture department and agricultural university. In case of rainfed eco-system farmers, medium extension participation was observed which the reason may be due to lack of proper guidelines and ineffective implications. These results of the study are in conformity with that of Mahatab Ali, 2010 and Lavanya, 2010.

With respect to mass media exposure, it was observed from findings that both the categories belonged to medium mass media use (43.33% and 53.33%). Mass media are known for their accuracy, consistency, security, timeliness, completeness, conciseness, reliability, accessibility, objectivity, relevancy, usability, understandability, reputation, usefulness, efficiency and value-addition. Majority of the farmers had medium participation in mass media which explains that they were very much dependent on mass media not only as a source of news and information, but also as a source

of entertainment and leisure. In general, it increases the awareness levels of the farmers on the agriculture technology. They help to update latest developments which are a good sign and speak about the interest of respondents to view the things. Thus, their mass media possess the enormous potential to the farmers for upgrading agriculture knowledge. The findings are in line with Gopala, 2010, Mahatab Ali, 2010 and Lavanya, 2010.

#### LITERATURE CITED

- Anitha, 2004, A study on entrepreneurial behaviour and market participation of farm women in Bangalore rural district of Karnataka. *M.Sc. (Agri.) Thesis*, Univ. Agric. Sci., Bangalore.
- Chandranaiik. S., 2002, An Analysis of Sustainability of Cotton Farming Systems. *Ph.D. Thesis*, Univ. Agric. Sci., Bangalore.
- Chandrani Saha, 2008, A study on sustainability of farming system and livelihood security among rural households in Tripura. *M. Sc. (Agri.) Thesis* Univ. Agric. Sci., Bangalore.
- Chandregowda, M. J., 1996, Sustainability of Rice Farming in Different Rice Ecosystem. *Ph.D. Thesis*, Univ. Agric. Sci., Bangalore.
- Gopala, Y. M., 2010, Knowledge and Adoption of participant and non-participant maize growers of FFSS in Chickaballapur district of Karnataka. *M.Sc. (Agri.) Thesis*, , Univ. Agric. Sci., Bangalore.
- Lavanya, S., 2010, Assessment of farming systems efficiency in Theni district of Tamil Nadu. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Bangalore.
- Mahatab Ali, K. M., 2010, A study on Knowledge and Adoption of aerobic rice growers in estern dry zone of Karnataka state. *M.Sc. (Agri.) Thesis*, Univ. Agric. Sci., Bangalore.
- Sophiasathyavathi, 2001, A study on knowledge and adoption of sustainable cultivation practices of sugarcane and cotton by farmers of Cuddalore district of Tamil Nadu. *M.Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad.

Received on 14-03-2015

Accepted on 18-03-2015