

Efficiency and Sustainability of Farming Systems in Intermediate Zone of Jammu and Kashmir

Naseem Akhter Qammer
(2017-732-D)



**School of Agricultural Economics and
Horti-Business Management
Faculty of Horticulture
Sher-e-Kashmir University of Agricultural Sciences &
Technology of Kashmir**

2021

Efficiency and Sustainability of Farming Systems in Intermediate Zone of Jammu and Kashmir

Naseem Akhter Qammer
(2017-732-D)



Thesis

Submitted to

The Faculty of Horticulture

Sher-e-Kashmir

**University of Agricultural Sciences & Technology of Kashmir in
partial fulfilment of requirement for the award of the degree of**

**Doctor of Philosophy in
Agricultural Economics**

2021

DEDICATE MY THESIS TO
“MY BELOVED PARENTS”

“PARENTS”

Someone who holds us in arms as we enter this world

*Someone who encourages all our efforts and appreciate
us wholeheartedly*

Someone who helps us to smile instead shedding a tear

Someone who is our life-long friend

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir,
Faculty of Horticulture, School of Agricultural Economics and
Horti-Business Management

Certificate – I

This is to certify that the thesis entitled, **“Efficiency and Sustainability of Farming Systems in Intermediate Zone of Jammu and Kashmir”** submitted in partial fulfilment of the requirements for the award of the degree of **Doctor of Philosophy in Agricultural Economics**, to the **Faculty of Horticulture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir** is a record of bonafide research work carried out by **Ms. Naseem Akhter Qammer (Regd. No. 2017-732-D)** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

It is further certified that information received during the course of investigation has duly been acknowledged.

(Dr. F. A. Shaheen)
Chairman
Advisory Committee

Endorsed

Head,
School of Agricultural Economics and Horti-Business Management
FoH, SKUAST-Kashmir, Shalimar

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir,
Faculty of Horticulture, School of Agricultural Economics and
Horti-Business Management

Certificate – II

We, the members of the Advisory Committee of **Ms. Naseem Akhter Qammer (Regd. No. 2017-732-D)**, a candidate for the degree of **Doctor of Philosophy in Agricultural Economics** have gone through the manuscript of the thesis entitled, “**Efficiency and Sustainability of Farming Systems in Intermediate Zone of Jammu and Kashmir**” and recommend that it may be submitted by the student in partial fulfilment of the requirements for the award of the degree.

Advisory Committee

Chairman

Dr. F. A. Shaheen

Associate Professor, School of Agricultural
Economics and Horti-Business Management,
SKUAST-Kashmir

Members

Dr. S. A. Wani

Professor (Agricultural Economics),
Dean, Faculty of Horticulture,
SKUAST-Kashmir

Dr. Nageena Nazir

Associate Professor, Division of Agri-Statistics,
SKUAST-Kashmir

Dr. F. A. Lone

Professor, Division of Environmental Sciences,
SKUAST-Kashmir

Dean's Nominee

Dr. Shamim A. Simnani

Professor, Division of Fruit Science,
SKUAST-Kashmir

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir,
Faculty of Horticulture, School of Agricultural Economics and
Horti-Business Management

Certificate – III

This is to certify that the thesis entitled, **“Efficiency and Sustainability of Farming Systems in Intermediate Zone of Jammu and Kashmir”** submitted by **Ms. Naseem Akhter Qammer (Regd. No. 2017-732-D)** to the **Faculty of Horticulture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir** in partial fulfilment of the requirements for the award of the degree of **Doctor of Philosophy in Agricultural Economics** was examined and approved by the Advisory Committee and External Examiner on

Chairman
Advisory Committee

External Examiner

Head,
School of Agricultural Economics and Horti-Business Management

Dean,
Faculty of Horticulture,
SKUAST-Kashmir

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir,
Faculty of Horticulture, School of Agricultural Economics and
Horti-Business Management

Name of the student : **Naseem Akhter Qammer**

Registration No. : 2017-732-D

Major subject : Agricultural Economics

Minor subjects : Environmental Sciences/
Agricultural Engineering

Major advisor : **Dr. F. A. Shaheen**
Associate Professor,
School of Agricultural Economics and
Horti-Business Management,
SKUAST-Kashmir

Title of the Thesis : **“Efficiency and Sustainability of
Farming Systems in Intermediate Zone
of Jammu and Kashmir”**

ABSTRACT

Hill agriculture plays an important role in sustaining livelihoods of marginal and nomad communities. With the onslaught of liberalization and climate change, the mountain communities are at cross-roads. In order to sustain the livelihoods of mountain farmers, a better understanding of farming systems, efficiency, sustainability, equity and vulnerability issues are of paramount importance. Jammu and Kashmir being as a part of Himalayan ecosystem has four distinct agro-climatic zones out of which inter-mediate zone – transition between temperate and sub-tropical is lesser researched area with respect to present study. It was in this respect that a study on *efficiency and sustainability of farming systems in intermediate zone of Jammu & Kashmir* was undertaken in order (i) to analyze the livelihood platforms and their contribution to farm households (ii) estimate efficiency of farming systems and equity/access to resources and (iii) assess the sustainability and vulnerability.

The study was conducted during the period 2018-2020, covering two intermediate hill districts viz. Rajouri and Poonch. Data sources include both primary as well as secondary information. The primary data was collected from a sample

of 251 farm households representing 25 villages, 4 blocks and 2 districts. The selection of villages and farm households from the study area was carried from low, medium and high altitude areas ranging from 800 m amsl to 1500 m amsl. Primary data was collected by administering pre-tested questionnaire through personal interview method. The secondary data/information was collected from different sources/departments, websites etc. The primary data was tabulated and analysed using averages, ratios and percentages. Stochastic Frontier Production Function was used to estimate the efficiency of crops and farms. Inequality across the farm households was estimated by using Gini Concentration Ratio, weighted Gini-coefficient, Theil-Entropy and Theil-Bernoulli Index apart from drawing Lorenz Curve. Ordinal Logistic Regression Model was applied to analyse the livelihood strategies while as Household Vulnerability Index (HVI) was used to measure vulnerability of farm households.

Majority of the farmers (60%) were marginal with rest (40%) as small category farms. Major share (65%) of household income was from off-farm and only 34 percent from farming. The overall education attainment was poor across the sampled households, however, there was a positive sign with respect to female ratio and was observed even more favourable in younger generation. Sampled farm households had an average holding of 0.53 ha with cropping intensity of 191 per cent. Average holding size increases marginally as we move from lower to upper zone while as cropping intensity reduces, vice versa. Wheat emerged as major crop with 48 per cent of gross cropped area followed by maize+pulse (43%) as intercrop. Rice cultivation (only 7% of gross cropped area) was restricted to plains with assured irrigation systems. Wheat was found to give better net returns as compared to other crops despite of lower gross returns which can be mainly factored due to relatively lower cost structure as compared to other crops. Findings from Technical efficiency, Economic efficiency and Allocative efficiency indicate that the farmers are inefficient in the use of their resources and are not cost effective in their production process. So a lot of scope exists in improving farm efficiency, particularly of those farms who are operating below 70 per cent level, which can in turn bring farm financial stability as well as lead towards farm sustainability. Across all these three efficiency parameters, economic efficiency was more poor as majority of farms have dismal results. As almost 70 per cent of household income comes from off-farm, which may also be a reason that the households may not be doing their farming with dedication and zeal and ending with poor efficiency measures.

The factors which influenced livelihood strategies of farm household were broadly classified into human capital, natural capital, physical capital, financial capital and social capital and modelling results found that family size, number of workers, children, household education, house value, fixed asset value, and assistance for providing non-farm work had a negative relation with household livelihood strategies (dependence on agriculture). The equity measures show income inequality across the farm households which are relatively more

pronounced in Poonch district as compared to Rajouri district because of farther of Lorenz curve of former than latter from the diagonal line. The most obvious reason for the agriculture income inequality among farmers is due to varied farm structure, size, resources and other factors. Owing to marginal holdings, poor productivity, low household income and bigger family size, majority (61%) of farmers were found in high vulnerability class and 22 per cent in medium category which points to the fact that these tribal hill farmers are witnessing a higher vulnerability level which tantamount some serious interventions.

Hills and hill agriculture is important as they support the plains through provision of ecosystem services, besides taking care of themselves. To sustain the smallholder farming of tribal hill communities, there is a need of multi-pronged strategy at various levels. Government through development departments and research stations should make proper efforts in providing proper technical knowhow and latest farming methods and input technologies in order to boost the resource use efficiency and productivity which has remained confined to plains only. More focussed and targeted intervention is required with respect to basic infrastructure in terms education, health, roads, public amenities which can overall improve the living standard as well as withstand the shocks. As majority of the intermediate zone is a rainfed area, so more focus should be brought towards rainfed technologies with more emphasis on integrated watershed development programs in a holistic approach.

Key words: Production and profit efficiency, farm and off-farm income, Lorenz curve, vulnerability classes and factors, livelihood assets.

Signature of Student

Signature of Major Advisor

Dated : _____

Dated: _____

ACKNOWLEDGEMENT

First and foremost, I would like to thank Allah Subhana Wa ta'ala for giving me the strength and opportunity to finish this process and peace be upon his last messenger, Muhammad (Saw), who showed me how to be sincere, loyal and punctual in the work assigned to me.

My deep appreciation goes to my supervisor Dr. F. A. Shaheen, Associate Professor & Head, School of Agricultural Economics and Horti-Business Management whose valuable advice has enabled me to complete my doctoral research. His great patience and dedication, positive encouragement, critical comments and invaluable suggestions assisted me throughout this research.

I owe a special debt of gratitude to my co- advisor Dr. Shabir Ahmad Wani, Dean, Faculty of Horticulture. The completion of the doctoral work could not have been possible without flawless support and guidance by him.

I shall remain indebted and sincerely thankful to other members of my advisory committee, Dr. Nageena Nazir, Associate Professor, Division of Agricultural Statistics, Dr. F. A. Lone, Professor, Division of Environmental Sciences and Dr. Shamim A. Simnani, Professor, Division of Fruit Science (Dean PG Nominee) for their worthwhile guidance, generous help and pertinent suggestions throughout my journey of the doctoral research.

I feel immensely obliged to Dr. S.H. Baba, Associate Professor, Division of Social Sciences, Faculty of Fisheries, Rangil, SKUAST-K, Shalimar, for all moral support and advice at the tough time of my life.

I express my deep and sincere thanks to Dr. Kusumakar Gautam, Assistant Professor-cum-Junior Scientist, School of Agricultural Economics and Horti-Business Management, SKUAST-K, Shalimar for all moral support and valuable suggestions.

Special thanks to Dr. Ikhtlaq Mir and Dr. Fehim Jeelani Wani for their priceless help, support and assistance during my thesis work,

My sincere thanks to worthy Vice Chancellor, Director Education and Director Research, SKUAST-Kashmir for their kind patronage.

I am also thankful to all members of non-teaching staff of School of Agricultural Economics and Horti-Business Management, especially to Mrs.

Mehmooda, Mr. Sohail, and others for their help and cooperation during the research work.

I express my sincere thanks to the Head Central Library SKUAST-K and supporting staff for extending full cooperation in collecting the pertinent literature. The cooperation of ARIS and CAB staff is duly acknowledged.

With the grace of Almighty Allah I think I am so lucky to have cherished friends around me. Ms. Madinat-ul-Nisa, Ms. Saba mir, Ms. Divya Slathia, Ms. Masrat Maqbool, Ms. Misba, Ms. Rehana Javid, Mr. Yawar, Mr. Naik Zia-ud-din, Mr. Jahangir, Ms. Shazia, Ms Usma, Ms Farheen, Ms. Rigzen, Ms. Shabnum, Ms. Amreen, Ms. Ishrat, Ms. Irtiga, Ms Rakshanda, Ms. Saima for their support and understanding assisted me in many moments of difficulty and encouraged me to stay focused on my thesis. I greatly appreciate their friendship that helped me to adjust and experience a new life

I am colossally grateful to the unconditional love and support of my loving Sister Dr. Zeba, Nayeem Qammer, My Jiju Fazal Hussain, Showkat Mehmood, brother Shafqat Ahmad, Babhi Mrs. Shabnum, Ms. Naima, my loving nephew, my world Hasnain Ali and Naim Farooq Wani who have been the bless of my life. Their presence in my life has been a solace of my eyes bestowed on me by my Lord, Allah - the Almighty. My love increases for them with every passing day.

I would like to thanks to the most revered people in my life, my Parents, Mr Shabir Hussain & Mrs. Surya whose discipline and love gave me eyes to see grace, which gave me the right to dare to believe in myself. Whatever I have achieved today, would have been a dream, had it not been for their agglomerated attempts, unwavering ecstatic love, prudent persuasion, selfless sacrifices and prayers.

Last but not the least, I am thankful to Mr. Shahid Sultan of M/s Shahid Thesis Point, Shalimar for bringing this manuscript into present form, with patience and assiduity.

Naseem Akhter Qammer

Place : Shalimar, Srinagar

Dated :

CONTENTS

Chapter No.	Particulars	Page No.
1.	INTRODUCTION	1-5
2.	REVIEW OF LITERATURE	6-31
2. 1	Livelihood strategies	6
2. 2	Efficiency estimation	15
2. 3	Equity/ inequality among the farm household	20
2. 4	Vulnerability	22
2. 5	Concept of sustainability	28
3.	MATERIALS AND METHODS	32-47
3. 1	Selection of the study area	32
3. 2	Data collection	34
3. 3	Analytical framework	35
4.	RESULT AND DISCUSSION	48-103
4. 1	Land use and agricultural profile of the study area	48
4. 2	Cropping pattern	50
4. 3	Irrigation infrastructure	51
4. 4	Livestock	52
4. 5	Socio-economic profile	53
4. 6	Land holding and cropping pattern	58
4. 7	Cost and returns from crop enterprises	61
4. 8	Stochastic Frontier Production Function estimation	66

4. 9	Stochastic profit function	68
4.10	Distribution of farmers under different levels of efficiencies	69
4.11	Livelihoods	74
4.12	Agriculture income inequality among the farmer	83
4.13	Household vulnerability (Measurements and Determinants)	85
4.14	Livelihood constructions and capital formation	87
5.	SUMMARY AND CONCLUSION	104-112
	LITERATURE CITED	i-xxxii

LIST OF TABLES

Table No.	Particulars	Page No.
1	Details of villages selected in study area	33
2	Explanatory variables and their definitions	38
3	Factors affecting vulnerability across various vulnerability classes amongst households	45
4	Area and its classification in study district of Jammu division (000 ha)	49
5	Area sown under different food crops in study districts (000 ha)	50
6	Cropped area irrigated and irrigation efficiency in study districts	51
7	Livestock population in the study districts (No. in lakh)	52
8	Categorization of households on the basis of land holding	53
9	Family income per farm (₹/annum)	54
10	Age-wise categorization of the family heads	54
11	Education level of family heads	56
12	Average family size of sample respondents	56
13	Average number of family members up to 15 years among sample respondents	57
14	Average number of family members above 15 years among sample respondents	57
15	Distribution of farm households on the basis of primary source of income	58
16	Land holding and cropping pattern of sampled farm households	60
17	Cost of cultivation (₹/ha)	64

18	Net return from crop enterprises over various cost level (₹/ha)	65
19	Income & Employment Generation from Crop Production in Intermediate zone (₹/ha)	65
20	Estimation of stochastic frontier production function and technical efficiency	71
21	Estimation of stochastic frontier profit function	72
22	Frequency distribution of all three efficiencies of maize, rice and wheat crop	73
23	Livelihood strategies (LS) and income diversification table	76
24	Descriptive statistics for the independent variables	78
25	Ordinal logistic regression estimates for the agriculture dependence model	82
26	Measures of agriculture income inequality	84
27	Vulnerability status of the household	86
28	Factors affecting vulnerability across various vulnerability classes amongst household	87
29	Different zone and the villages of study area	88
30	Access to health facilities	90
31	Access to Agricultural/Animal Husbandry information	91
32	Natural capital and access to resources	92
33	Physical capital assets across the various zone	97
34	Financial capital (Stock and flows) across three zones	99
35	Indicator and rank of capital assets	102
36	Searching sustainability through understanding unsustainability dynamics	103

LIST OF FIGURES

Fig. No.	Particulars	After page No
1	Flow chart representing the sampling design followed in the study	32
2	Map of the study area	32
3	Lorenz curve distribution of agriculture income among farmers	83
4	Lorenz curve distribution of agriculture income among farmers in Rajouri and Poonch	83
5	Capital Asset Pentagons	100

LIST OF PLATE

Plate No.	Particulars	After page No.
1	Data collection from respondents	34

Chapter 1

INTRODUCTION

Mountains play a crucial role in sustaining about 10 per cent of the world population directly. The major mountain ranges in India are the Himalayas and the Western Ghats. Hill and mountainous areas in India are vastly distributed all over the country with larger area located in Himalayas, extending in 2500 km length and 250 to 400 km breadth. The Himalayan hill and mountain areas lying within India fall into two distinct geographical regions with wide variation in climate, land use and culture. These are North West Himalayan region comprising of Jammu and Kashmir, Himachal Pradesh, Uttarakhand and North East Himalayan region comprising of states of Assam, Arunachal Pradesh, Manipur, Mizoram, Meghalaya, Nagaland, Tripura, Sikkim, Siliguri and Darjeeling districts of West Bengal. North West Himalayan region covers more than one-eighth of the total land of the country and is located between 20° and 30° N latitude with elevations in the range of 300 to 8400 m masl.

The Union Territory of Jammu and Kashmir (UT of J&K) has mostly a mountainous area and occupies a central position in the Asian continent. Out of 3.5 million ha of mountainous area of India, nearly two-third i.e 2.3 million ha are found exclusively in Jammu and Kashmir (Anonymous, 2011). The UT of J&K lies in the extreme north of the Himalaya and constitutes about 67.5 per cent of the North West Himalayan region which extends between 32° and of 37° North parallels of latitude and 73° and 80° East of meridians of longitudes and 81° East of Greenwich. This geographical position, coupled with the varied physiography, provides the UT of J&K a wide climatic variation. The UT of J&K has been divided into three broad macro-climatic zones. These are subtropical Jammu region (up to 800 m masl), intermediate/semi temperate mid hills (800-1500 m masl) and temperate Kashmir valley (1500-2500 m masl) (Anonymous, 2011). Rajouri and Poonch are the two important mountainous districts which fall in

intermediate agro-climatic zone. Inter-mediate zone is transition between sub-tropical and temperate and comprises of the mid and high altitude areas of the Panjal trap. The zone is characterized by monsoon, concentration of precipitation, relatively wetter, cold winters and higher mean annual rainfall than subtropical zone. It encompasses all the areas above hills including district Doda, Poonch, parts of Rajouri and Udhampur. The zone varies in elevation from 800 to 1500 m masl. Rajouri and Poonch districts fall in Pir Panchal belt of Jammu division. The two districts have a total population of about 8.48 lakh and an area of 3.61 lakh ha with net sown area and gross sown area of 3.26 lakh ha and 6.07 lakh ha, respectively. The district Rajouri have a total forest area of about 94.85 thousand ha likewise, forest cover area in district Poonch is 34.05 thousand ha (Anonymous, 2017).

The Intermediate zone (study area) which is a sub component of the larger Hindu Kush Himalayan (HKH) mountains provide vast natural resources to support livelihoods needs - food, energy, shelter, medicine, cash and savings and feed for livestock and raw materials for industry (Rasul and Karki, 2007). Beside mountain agriculture largely depends on the interactions of crops, horticulture, livestock, rangelands and forest. There is also diversity in livelihoods of mountain communities at every level. Members of a household may work in different places engaging in various activities, either temporarily or permanently. Due to the increased importance of off-farm income in mountain communities livelihood diversification has generally occurred. Livelihood strategies consist of how people engage in and combine different income generating activities, how they use different resources and how much these resources influence household livelihood strategies.

In hilly areas of Jammu and Kashmir substantial progress has been made in the production of maize, paddy, wheat, milk and poultry but there is still a large untapped potential particularly with respect to niche areas, crops and commodities. Maize and wheat are the major crops grown in the hilly areas of

intermediate zone and are predominantly produced by small and marginal farmers under rain-fed conditions whereas, paddy is grown on some terraced slopes of the hilly areas where land is suitable for cultivation with assured irrigation facilities in the form of *nallahs* and *kuhls*. Low productivity in agriculture particularly in the crop sector has been observed over time. This has raised a concern about food insecurity among communities whose livelihoods are heavily dependent on agriculture. Therefore, increasing the technical efficiency levels of the farmers through enhancing support services, as well as facilitating easy access to basic inputs, would be among the best appropriate approaches to achieving increased productivity. These areas have lot of potential to accelerate agricultural growth through diversification from low to high value crops. Demand for attribute based products can be produced in hill agro-ecosystem which offers tremendous scope for enhancing farm income, addressing gender issues and creating job opportunities. However, this potential needs to be harnessed very carefully without disturbing the natural system and in harmony with socio-economic and cultural factors. Hill agriculture has several niche areas having comparative advantage for better exploitation of resources and for better trade. Organic farming still remains a viable option for export of specialised commodities especially fruits and vegetables. In recent years, role of horticultural crops including fruits and vegetables have been found significant to affect livelihood in the mountains. Livestock, particularly in rangeland areas provide additional opportunities to mountain households to generate cash income (Tulachan, 2001).

Also among the most marginalized sections in India, people are living in geographically fragile areas like the Himalayas, where conventional agricultural and industrial developments face severe constraints. Mountain communities are plagued with the problem of vulnerability which affects their livelihood. Sustainable livelihood includes the idea of coping with and recovering from stress and shocks and maintaining or enhancing existing capabilities and assets both now and in the future, while not undermining the natural resource base (Carney,

1998). The hilly areas always remained socially and economically backward. The important conditions characterizing mountain agriculture are inaccessibility, fragility, marginality, diversity and niche conditions that make agriculture in the hills and mountains areas suffer from inherent constraints of under pressure from natural and human-induced stresses which reduces the farm sustainability and also increases the level of vulnerability to various shocks, risks, trends etc. The rich environmental heritage of the Himalayan region is considering the poor scope for industrialisation in mountains and perspective of rural livelihood. Added to this, there are also some socioeconomic constraints that, primarily include small land holdings, poor productivity, poor production management, labour shortages, poor post-harvest management, poor market networks (lack of market development) and lack of entrepreneurship etc. All these factors have led to under utilization of available resource base leading to limited generation of surpluses. In view of its potential for economic growth and development of rural sector within the hill region and role of hills in providing life sustaining water and environmental services, hill agriculture has started receiving renewed attention of voluntary agencies and government. The hill agriculture has its own unique characteristics and that the growth potential of hill agriculture has remained under-exploited due to various mountain specificities like undulating topography, lack of system specific technologies, poor marketing and processing infrastructure and under developed supporting institutions.

The actual pressure on sloping hills and mountains on the agricultural land is much greater to support food security and livelihood of the mountain people (Pratap, 2001). The problem of shrinking agricultural land is getting compounded in that new human settlements, urbanization and industrialization and government infrastructure developments, which would threaten food security and livelihoods in the mountains (Gardner, 1996). Even though hill agriculture is constrained with numerous challenges but also offers opportunities that need to be harnessed for productive potential with respect to natural resource and agro-climatic diversities

as well as niche areas. Therefore, the above background makes it imperative to comprehensively analyze the sustainability, equity, vulnerability, farm efficiency and various other issues in intermediate agro-climatic zone of J&K. Accordingly, present study is a humble endeavour to analyze these aspects with following specific objectives:

- Analyze the livelihood platforms and their contribution to farm households.
- Estimate efficiency of farming systems and equity/ access to resources.
- Assess the sustainability and vulnerability of farming systems.

Limitations of the study

The study was based on sample survey of selected blocks in inter-mediate zone of Jammu and Kashmir. The information was collected by personal interview method based on respondent's remembrance, past experience and his involvement. Though maximum possible efforts were made to collect reliable information and cross checks were made at several points to confirm the correctness of data, yet there may be some launce in the information given by respondents.

- Owing to time and resource constraint for research scholars besides tough mountain geography of study area, a limited sample (251 farm households) was taken. A large sample with more geographical coverage would have definitely improved the reliability of findings.
- As the study area is a border valley, and also the respondents may not have understood the genuine purpose of the research study, they had the sense of fear to part with the exact information.
- The study was limited to intermediate zone of only two districts of Jammu region. More districts from the region that have certain areas under inter-mediate zone can be taken up by future researchers for broader perspective.

Chapter 2

REVIEW OF LITERATURE

2.1 Livelihood strategies

The livelihood strategy has been increasingly studied over the past years in the world and the significant progress has been made in classification of livelihood strategies. A popular definition of livelihoods is provided by Chambers and Conway (1992), wherein a livelihood comprises the capabilities, assets (including both material and social assets) and activities required for a means of living (Chambers and Conway, 1992). The term livelihood has been defined in a variety of ways by various authors. Considering the most common definition, a livelihood can be defined as people's capacity to maintain a living (Chambers and Conway, 1991). Therefore, livelihood strategies are the range and combination of activities and choices that people make in order to achieve their livelihood goals (DFID, 1999; FAO, 2005). These livelihood activities are subject to the endowment of livelihood capital because they determine the possibilities for rural household to achieve goals related to revenue, safety and welfare (Vanden Berg, 2010). In other words, livelihood strategies can also be understood as the means to cope with external disturbance and maintain livelihood capabilities (Chambers and Conway, 1991; Ellis, 1998 and 2000; Adato and Meinzen-Dick, 2002). The livelihood framework provides a comprehensive and complex approach to understand how people make a living. It can be used as a loose guide to a range of issues which are important for livelihoods or it can be rigorously investigated in all its aspects (Kanji *et al.*, 2005). It emphasizes understanding of the context within which people live, the assets available for them, livelihood strategies they follow in the face of existing policies and institutions and livelihood outcomes they intend to achieve (Scoones, 1998; DFID, 2000).

2.1.1 Poverty and livelihood strategies

It is increasingly accepted that poverty is understood as deficiency in individual's capabilities of obtaining materials necessities and social services (Coudouel *et al.*, 2002) and such deficiency is characterized by a lack of livelihood assets (Sen, 1993). Livelihoods analysis can serve a wide variety of applications, such as explanation of the root cause of rural poverty and development of effective methods for alleviating poverty. Consequently, the link between livelihood strategies and poverty is of fundamental importance to the long-term poverty reduction. Indeed, it is generally believed that non-farm activities play an enormous role in breaking the vicious cycle of poverty (Lanjouw and Feder, 2001; Hagglade *et al.*, 2002; De-Janvry *et al.*, 2005; World Bank, 2009; Hagglade *et al.*, 2010). Ansoms and McKay (2010) and Alemu (2012) have done a similar exercise in alleviating poverty although they did not explicitly refer to non-farm livelihood strategies. They founded that rural poverty could be alleviated by non-farm activities rather than local development in agriculture. Similarly, scholar such as Soltani *et al.* (2012) also claimed the positive correlation between off-farm livelihood strategies and poverty reduction. Van den Berg (2010) provided unique perspective on the relationship between natural disasters and household's income. He also addressed the necessity for the poor in rural areas to participate in non-farm strategies. On the contrary, studies (Reardon *et al.*, 2000; Shackleton *et al.*, 2007; Alary *et al.*, 2011; Christiaensen *et al.*, 2011; Soltani *et al.*, 2012; Hogarth *et al.*, 2013) also pointed to the important role of conventional farming strategies (e.g. agriculture, forestry and animal husbandry) in poverty reduction. They argued that the increasing area of farmland, developing high value-added farming products, adjusting the structure of agricultural production, improving productivity of land and fulfilling the basic requirements for agricultural activities, would produce less poverty. In addition to insights inherent in perceptual processes, the impacts of climate change are increasingly recognized as significant factors of livelihood strategies, particularly,

effective linkages to livelihood vulnerability, poverty alleviation (Fang *et al.*, 2012; Gentle and Maraseni, 2012; Fang, 2013b).

2.1.2 Livelihood assets

Due to spatial variations of capital assets in settlements and agro-climatic zones, the differential access to, or endowment of livelihood assets determines the choice of a household's livelihood strategies (Babulo *et al.*, 2008). It means that livelihood outcomes become critical to rational use and improve efficiency of livelihood capitals at the household level subject to the goal of maximizing these outcomes (Brown *et al.*, 2006). Livelihood assets are the resources on which people carry out their livelihood strategies (Chambers and Conway, 1992; Ellis and Allison, 2004). Livelihood assets are internal influential factors which have a crucial role in the mechanism of household decision-making to engage in livelihood strategies (Scoones, 1998; Fang *et al.*, 2014; Wu *et al.*, 2017). Barrett and Reardon (2000) define assets as stocks that produce cash or kind in returns. These assets are the bases for the household's ability to participate in activities to generate income. Productive assets are inputs used in the production process and therefore generate income indirectly via the activities. In contrast, non-productive assets generate income directly through transfers or capital gains. Reardon (1997) differentiate natural, human, on-farm physical capital, off-farm physical capital and community owned resources. Most commonly mentioned livelihood assets are human capital, physical capital, social capital, financial capital and natural capital. Human capital extends the notion of viewing human economic inputs not only as physical labour, but to include other human contributions to the economy such as the knowledge, skills and experiences required to carry out tasks (Johnson and Stallman, 1994). Human capital includes age, education, gender, health status, household size, dependency ratio and leadership potential (Bezemer and Lerman, 2002; Farrington *et al.*, 2002). Human assets are the most important household assets which enable individuals or households to pursue various livelihood strategies. It mainly denotes the amount of household labour and their qualities

including skills, knowledge, ability to work, good health, etc. (Scoones, 1998). Physical capital comprises the basic infrastructure and producer goods needed to support livelihoods; Physical capital is the stock of human made, material resources that can be used to produce a flow of future income (Lachmann, 1978). Ellis (2000) defined physical capital as the capital created by economic production processes. Social capital refers to social networks and connectedness of households. Social assets are defined as the resources available to individuals and groups through membership in a social network (Alvarez and Romani, 2017). Therefore, higher membership in social groups and institutions will result in higher social power and resources. Financial capital: there are two main sources of financial capital: (i) Available stocks-savings are the preferred type of financial capital because, they do not have liabilities attached and usually do not entail reliance on others. They can be held in several forms; cash, bank deposits or liquid assets such as livestock and jewellery. Financial resources can also be obtained through credit-providing institutions. (ii) Regular inflows of money: excluding earned income, the most common types of inflows are pensions or other transfers from the state and remittances. Smith *et al.* (2001) define natural capital as ‘those elements of the environment that yield resource materials and ecosystem services’.

2.1.3 Agriculture as a choice of livelihood strategies

Agriculture is considered the back bone of rural economies in most of the developing countries. The population of these economies depends on agriculture and its allied activities for their livelihood. But agriculture alone cannot provide livelihood to all the living population of rural areas. So they resort to other non-farm incomes that are available in their vicinity. According to the definition of a livelihood strategy, many scholars have conducted the classification study of livelihood strategies (Pichón, 1997; Browder *et al.*, 2004; Brown *et al.*, 2006; Alemu, 2012). For example, in Alemu’s (2012) study, livelihood strategies have been classified into four categories: only farm, farm and non-farm, only non-farm

and non-labour. Soltani *et al.* (2012) emphasized the classification of livelihood strategies and highlighted the dynamic natures of a livelihood strategy. Many other researchers have also used various approaches to classify livelihood strategies. For example, Fang *et al.* (2014) classified livelihood strategies into two types, farm and off-farm. Diniz *et al.* (2013) classified into three types, livestock-oriented, diversified-oriented and off-farm oriented. Household livelihood strategies can also be classified into less dependence, moderate dependence, high dependence and very high dependence on forest/livestock income (Xu. *et al.*, 2015).

Farm income includes income from crops, livestock, timber and pasture etc while non-farm income includes small scale businesses, public and private employment, overseas employment, pensions and income from property and hiring out transport to other people. Additional sources of non-farm income includes pensions, annuities, unemployment allowances, social security, veterans' benefits, other public retirement and public assistance programs and rental income from non-farm properties. Agriculture and livestock are key components of the livelihoods of the rural poor. The majority (almost 70%) of the world's poorest people are located in rural areas and engaged primarily in subsistence agriculture where agriculture remains a principal source of income for the majority of the population (ERS, 2000). Livestock make a substantial contribution to household's livelihood and food security and currently sustain the livelihoods of an estimated 700 million rural poor in developing countries. For many of these rural poor, livestock provide a source of income generation, improve household's food security and nutritional status and are often the only way of increasing assets and diversifying risks. The demand for livestock and livestock products in developing countries is predicted to double over the next 20 years due to human population growth, increasing urbanization and rising incomes (FAO, 2003). Non-farm sources are equally important for rural households. These sources contribute

significantly to the rural economies of developing countries. However its share varies from region to region and country to country.

2.1.4 Livelihood diversification strategies

Diversification in rural livelihoods is the subject of conceptual and policy-based research because income from farming has come under pressure due to population explosion (Davies, 1993; Ellis, 1998; Barrett *et al.*, 2001). It is being realized for some time that rural people no longer remain confined to crop production, fishing, forest management or livestock-rearing but combine a range of occupations to construct a diverse portfolio of activities (Krishnan and Dercon 1995; Unni, 1996; Ellis, 2000). Growth of agriculture and its diversification are crucial for the growth of non-agricultural sector as well as overall economy and also for reducing inter-regional economic disparities. Promotion of the livestock based integrated farming system and the efficient and effective self-help groups are the key initiatives to make farming a profitable and less risky venture, thus sustaining rural livelihoods and reducing regional inequalities (Kumar *et al.*, 2006). People diversify their income by adopting a range of activities. Thus, income sources may include farm income, non-farm income (non-agricultural income sources, such as non-farm wages and business income) and off-farm income (wages of exchange labour on other farms i.e. within agriculture, including payment in kind) (Ellis, 2000). Barrett *et al.* (2001) explained that exploiting these off-farm opportunities could offer a pathway out of poverty for the rural poor. The rural economy is not based mainly on agriculture but rather on a diversified array of livelihood activities and enterprises. Elsewhere, a common pattern for the very poor and comparatively well off to have the most diversified livelihood, while the middle ranges of income display less diversity (Ellis, 2000). In Kebeles of Dire Dawa administration out of the total sample, about 39 per cent of the total household income was derived from agriculture, 25 per cent from a combination of agriculture and non-farm, 17.5 per cent from a combination of agriculture, non-farm and off-farm and 10.5 per cent from a combination of

agriculture and off-farm activities (Abdissa, 2017). In Ethiopia, agriculture sector had a leading contribution to the total income of sample households (64%) followed by non-farm (22%) and off-farm income of 13 per cent (Eneyew and Bekele, 2012). Asfir (2016) in the Assosa district of BGRS, western Ethiopia pointed out that about 66 per cent of rural households combined on-farm activities with non-farm and/or off-farm activities, whereas about 33 per cent were relying only on on-farm activities to achieve their livelihood goals. Israr and Khan (2010) found that the main sources of livelihood were agriculture and its related activities and supplemented by off-farm activities in the rural areas of Northern Pakistan. Khatiwada *et al.* (2017) showed that the majority (61%) of the households diversified their income to non-farm sources, business/enterprise strategies adopted by 16 per cent of the households is the most remunerative strategy followed by commercial farming that includes 13 per cent of the sample and was more relevant to poverty reduction. Islam (1997) states that the shares of the non-farm sector in rural employment in developing countries vary from 20-50 per cent. Reardon (1997) found non-farm income shares in Africa ranging from 22-93 per cent. Davis *et al.* (2010) found that in most developing countries the greater contribution to total income comes from off-farm activities. John and Wobst (2006) showed that participation in rural non-farm activities is one of the livelihood strategies among rural poor households.

2.1.5 Factors affecting the choice of livelihood strategies

An increasing recognition that the ability to pursue different livelihood strategies is dependent on the basic material and social, tangible and intangible assets that people have in their possession (Scoones, 2009). For this reason, some recent studies give more emphasis to factors determining a livelihood strategy. These factors include the biodiversity protection (Salafsky and Wollenberg, 2000), soil fertility (Tittonell *et al.*, 2010), policies (Barrett *et al.*, 2001), market liberalization, agricultural intensification (Orr and Wmale, 2001), tourism (Wall and Methiesion, 2006; Tao and Wall, 2009; Iorio and Corsale, 2010; Mbaiwa,

2011), cropping, forestry and livestock products (Stoian, 2005; Babulo *et al.*, 2008; Kamanga *et al.*, 2009; Tesfaye *et al.*, 2011; Diniz *et al.*, 2013; Zenteno *et al.*, 2013) and natural capital (Fang, 2013a).

Family size, age of household head, sex and distance to the market were theoretically consistent and statistically significant effect to the likelihood choice of livelihood diversification, while livestock holding, farming systems and dependence ratio, were partially contrary to the expectation (Abdissa, 2017). Eneyew and Bekele (2012) in Ethiopia found that age, education, sex of household head, credit, land size, livestock and agro-ecology are the factors that reduced the likelihood of diversification; while, family size, dependency ratio, frequency of extension contact, membership to cooperatives, input use and remittance increased the likelihood of diversification. Asfir (2016) researched in the Assosa district of BGRS, western Ethiopia confirm that age of household head, settlement, family size, frequency of extension contact, livestock holding, access to credit, access to training, total annual cash income, membership in cooperatives and access to fertilizer have a statistically significant impact on the choice of livelihood diversification strategies. Khatiwada *et al.* (2017) made an attempt to assess livelihood strategies pursued by rural households and identified the factors that influence household's choice of better livelihood strategies in Nepal. The results showed that land holding, education, agriculture and skill training, access to credit and proximity to the road and market centre are the major influencing factors on the adoption of higher returning livelihood strategies. Therefore they led emphasis on stimulating poor households to follow market-oriented farm and non-farm activities by improving access to education, vocational training, rural credit and rural infrastructures for reducing poverty in the rural areas of central Nepal. Sultana and Lu (2017) studied household livelihood strategies in three selective districts of Bangladesh, the results indicated that, farm households were found to be depended on livelihood strategies choice and influenced by sex, age of household's head, educational level of household's

head, farm size, ownership of livestock, involvement in local leadership, annual cash income, access to credit, input use and training. Gebrul and Beyene (2012) studied rural household livelihood strategies in drought-prone areas in Gulomekeda district of Ethiopia indicated that there is positive role of education and productive family, access to credit and receiving regular remittance, membership to formal cooperatives, access to market and business oriented extension service are of poor farm households to diversify their livelihood income into off-farm and non-farm activities. Dinku (2018) studied the determinants of livelihood strategies in Borena district of southern Oromia, Ethiopia and found that different socio-economic characteristics of the household significantly influence the level of livelihood diversification and age of household head, farm input use, extension contact, market access, credit access and owned cattle size are the main factors. Saha and Bahal (2010) made a modest attempt to demonstrate that farm and off-farm activities are carried out significant proportion of adults and make an important contribution to livelihoods in West Bengal. It shows that there is a high involvement of farm households in different non-farm income sources along with agricultural income (76%). There was a high involvement of women (24%) also in different diversification activities. Okere and shittu (2012) observed that majority of the farm households were in their economically active years (below 50 years of age) and hence can actively involved in livelihood diversification. Based on the regression analysis, the relationship between livelihood strategies and consumption is already being observed (Alwang *et al.*, 2005). The impact of labour force and land on livelihood strategies is examined in the study conducted by Jansen *et al.* (2006) and Ulrich *et al.* (2012) described the causal relationship between livelihood strategies of rural families in Kenya and livelihood capitals portfolio, by employing welfare indexes as a means of quantifying analysis. They concluded that the portfolio of agricultural and husbandry production, stable non-farm activities and flexible and diversified livelihood capital, might become considerable importance to livelihood strategy. Adam *et al.* (2013) identified the key factors that influenced rural livelihood

strategies and quantified their effects on livelihood strategy. They argued that regulatory, technical and financial support related to non-timber forest products greatly improved the effect of a livelihood strategy. Similarly, the importance of viewing livelihood capitals as a driving force of livelihood strategy practices is emphasized in the paper prepared by Zenteno *et al.* (2013).

2.2 Efficiency estimation

Production is defined as the transformation of goods and services into finished products (that is input-output relationship) and this is also applied to every production process. Olayide and Heady (1982) define production process as one whereby some goods and services called inputs are transformed into other goods and services called output. Agriculture always remain a backbone of India, one of the basic thrusts of economics of agricultural production at the micro level is to assist individual farmers or a group of farmers to attain their objectives through efficient intra-farm allocation of resources at a particular time or over a period. The efficiency of a firm is its ability to produce the greatest amount of output possible from a fixed amount of inputs. Also an efficient firm is one that given a state of technical know-how, can produce a given quantity of goods by using the least possible quantity of inputs. The classical theory of production is based on the notion that firms are efficient and any actual output variation from the frontier is due to external shocks which is entirely beyond the control of the decision makers. According to neo-classical theory of production, different producers can produce different levels of output even if they use the same level of inputs and technology. The difference in observed outputs from the frontier among producers can be explained not only from external shocks but also through differences in efficiency of using the existing resources. Productive efficiency represents the optimal input mix to produce any given level of output that minimizes the cost of production (Forsund *et al.*, 1980). Efficiency is achieved either by maximizing output from given resources or by minimizing the resources required for producing a given output (Varian, 1992). In economic theory,

production efficiency comprises technical and allocative efficiencies, with technical efficiency reflecting the ability of a farm to maximize output for a given set of resource inputs while allocative (factor price) efficiency reflects the ability of the farm to use the inputs in optimal proportions given their respective prices and production technology (Farrell, 1957). The first analyses of efficiency measures were initiated by Debreu (1951), Koopmans (1951) and Farrell (1957). Farrell proposed a division of efficiency into two components: technical efficiency and allocative efficiency. According to Farrell, technical efficiency (TE) is associated with the ability of a firm to produce on the isoquant frontier while allocative efficiency (AE) refer to the ability of a firm to produce at a given level of output using the cost-minimizing input ratio. Thus, defining economic efficiency (EE) as the capacity of a firm to produce a predetermined quantity of output at a minimum cost for a given level of technology (Bravoureta *et al.*, 1997). Technical efficiency can either be output or input-oriented. An output-oriented technical efficiency occurs when the maximum amount of an output is produced for a given set of inputs while an input-oriented technical efficiency occurs when the minimum amount of inputs are required to produce a given output level (Farrell, 1957). According to Ellis (1988) technical efficiency is the extent to which the maximum possible output is produced from a given set of inputs and allocative efficiency is defined as the ability of a firm to use inputs in optimal proportions. Therefore, technical efficiencies are derived from production function or production possibility frontiers.

2.2.1 Methods of efficiency estimation

The existence of inefficiency in crop production comes from inefficient use of scarce resources. There exist two main competing methods for analyzing technical efficiency and its principal determinants:

2.2.1.1 The parametric frontier (stochastic frontier approach)

2.2.1.2 The non-parametric frontier (data envelopment analysis).

These approaches are qualified as bases or primary models in the analysis of technical efficiency (Coelli, 1996). Non-parametric frontier suffers from the criticism that it takes no account of the possible influence of random shocks like measurement errors and other noises in the data (Coelli, 1995). There are contradictions on the effect of using one or another method. For instance, Sharma *et al.* (1999) found almost similar results using DEA and SFA in efficiencies analysis in swine production in Hawaii. On the other hand, Theodoridis and Anwar (2011) have found weak correlation between the SFA and DEA results in their study comparing the two methods in farm households in Bangladesh.

2.2.2 Advantage of SFA over DEA

Data envelopment analysis is a deterministic frontier, meaning that all deviation from the frontier is attributed to inefficiency only. It is difficult to accept this assumption, given the inherent variability of agricultural production in developing countries due to a lot of exogenous factors like weather shocks, pests, diseases, etc (Coelli and Battese, 1996). Furthermore, because of the low level of education of farmers in developing countries, keeping accurate records is not a common practice. Thus, most available data on production are more likely to be subject to measurement errors. As a result of above argument, the stochastic frontier production function, which was independently proposed by Meeusen and Vanden-Broeck (1977), has been a significant contribution to the econometric modelling of production and the estimation of technical efficiency of firms. The parametric frontier uses econometric method to estimate the parameters of both stochastic frontier production function and inefficiency effect model. The biggest advantage of stochastic frontier approach is the introduction of stochastic random noises that are beyond the control of the farmers in addition to the inefficiency effects. The Stochastic Frontier Analysis (SFA) is based on econometric model

using functional forms such as Cobb-Douglas, Translog or the Zellner-Revankar generalised production function (Coelli, 1995). Cobb-Douglas is a special form of the translog production function where the coefficients of the squared and interaction terms of input variables of translog frontier are assumed to be zero. The Cobb-Douglas production function (in spite of its restrictive properties) is preferred because its coefficients directly represent the output elasticity of inputs and easy for interpretation and estimation than translog frontier (Coelli *et al.*, 1998; Seymoun *et al.*, 1998). According to Amaza *et al.* (2006), the stochastic frontier production function used in TE measurement differs from the production function in that the former has a composite error term while the latter has one. The composite disturbance term of a Stochastic Frontier Production Function is a sum of two error components, one representing the effects of errors which cannot be controlled by the production unit (weather, statistical errors, etc.) another accounting for the existence of technical inefficiency (i.e. errors that could be avoided by the producing unit). The stochastic frontier involved two random components, one associated with the presence of technical inefficiency and the other being a traditional random error. Prior to the introduction of this model, Aigner and Chu (1968), Timmer (1971), Afriat (1972) and Richmond (1974) considered the estimation of deterministic frontier models whose values were defined to be greater than or equal to observed values of production for different levels of inputs in the production process. Applications of frontier functions have involved both cross-sectional and panel data. These studies have made a number of distributional assumptions for the random variables involved and have considered various estimators for the parameters of these models. Survey papers on frontier functions have been presented by Fdr Sund *et al.* (1980), Schmidt (1986) and Battese and coelli (1988), the latter article giving particular attention to applications in agricultural economics. Ley (1990) and Beck (1991) have compiled extensive bibliographies on empirical applications of frontier functions and efficiency analysis. The concept of the technical efficiency of firms has been pivotal for the development and application of econometric models of frontier

functions. Although technical efficiency may be defined in different ways e.g Fare *et al.*, 1985, defined technical efficiency of a given firm (at a given time period) as the ratio of its mean production (conditional on its levels of factor inputs and firm effects) to the corresponding mean production if the firm utilized its levels of inputs most efficiently (Battese and Coelli 1988). Allocative and economic efficiencies have been investigated in a number of papers, including Schmidt and Lovell (1979); Kalirajan (1985); Kumbhakar (1988); Bailey *et al.* (1989) and Kumbhakar *et al.* (1989).

2.2.3 Factors effecting the efficiency level of farm household

In agriculture, the physical inputs which we use are: land, labor, capital and management. Pitt and Lee (1981) have estimated stochastic frontiers and predicted firm-level efficiencies using these estimated functions and then regressed the predicted efficiencies upon firm-specific variables such as managerial experience, ownership characteristics etc in an attempt to identify some of the reasons for differences in predicted efficiencies between firms in an industry. Although studies by Jha *et al.* (2005); Amos (2007) and Barnes (2008) found the relationship between land holding size and efficiency to be positive. On the other hand, influence of the number of plots on efficiency has been reported by Jha *et al.* (2005) to be negative. This implies land fragmentation (as measured by number of plots) have a negative impact on yields. Tchale and Sauer (2007) pointed out that, gender of the farmer has no significant influence on efficiency, other studies found that gender plays an important role. According to Skarstein (2005) and Msuya (2007), producer associations are very important in transforming the agricultural sector into one with high productivity and high quality output. While referring to Tanzania, Skarstein (2005) stress that if the agriculture sector is to be transformed, producer associations (in form of farmers' cooperatives) are needed first and foremost to give the smallholders bargaining power in the input, output and credit markets. Banik (1994) carried out a study on technical efficiency of irrigated farms in a village of Bangladesh and used a

stochastic production frontier. He used a Cobb-Douglas function with the Maximum Likelihood estimates (MLE) method to estimate the parameters of the stochastic frontier production function. The results showed that 88 out of 99 farms had a technical efficiency of 71 per cent or above. A very interesting finding was that ten out of thirteen most efficient farms belonged to the small category of farms. The study also revealed that owner-tenant farms were technically more efficient than owner farms. Panda (1996) used a frontier production function which he derived from Cobb-Douglas production function. Abedullah (2006) conducted a study on “Technical efficiency and its determinants in potato production in, Pakistan Punjab” using Cobb-Douglas stochastic production frontier approach. The results showed that potato farmers are 84 per cent technically efficient implying significant potential in potato production that can be developed. Obwona (2000) estimated a Translog production function to determine technical efficiency differentials between small- and medium-scale tobacco farmers in Uganda using a stochastic frontier approach. The estimated efficiencies were explained by socioeconomic and demographic factors. The results showed that, credit accessibility, extension services and farm assets contribute positively towards the improvement of efficiency. Chirwa (2007) using SFA one stage simultaneous estimate approach in estimating technical efficiency of smallholders farmers in southern Malawi found out that many households were technically inefficient with average of 46 per cent and as low as 8 per cent technical efficiency.

2.3 Equity/ inequality among the farm household

Kuznets theory (1955) is the pioneer of income inequality thought. He advocated that income inequality increases with economic development, then decreases and the course of this relationship resulted in an inverted-U shaped curve. After Kuznets, Williamson (1965) argued that like personal inequality, regional inequality also shows inverted-U shaped relationship. He pointed out that the most natural resources among the different regions of a country are unequally

distributed. In India among the most marginalized section of the society, people are living in geographically fragile areas like the Himalayas, where conventional agricultural and industrial developments face severe constraints. It is obvious that the income earning capability of a household is shaped by its demographic composition. Apart from these intrinsic characteristics of a household, its geographical location also determines its income earning capability. Theories of the urban bias (Lipton, 1977) have shown that urban areas get priority in the development process and this leads to income disparity between rural and urban areas. Thus households in a rural location will have lower income opportunities compared to urban households. Finally, for a hilly state, household incomes are also determined by altitude. The hilly regions of the state will provide less income earning opportunities than those in the foothills or the plains because of the difficulties of communication and the sparsity of population.

A few studies that have analyzed inter-household dispersion in income and poverty such as Panagariya *et al.* (2014) observed that inequality is lower in rural incomes than in urban incomes—broadly representing agriculture and non-agriculture incomes. Chakaraverty *et al.* (2016) analysed that income inequality in India's agricultural sector is very high (Gini- coefficient of around 0.6 during the period) and about half of the income inequality is explained by the household-level variance in income from cultivation which in turn depended primarily on variance in landownership, differences in the structures/patterns of income generation from agriculture and this is mainly due to the reason of the extreme fragmentation of agricultural land and which continues to grow more intense. Inequality in income in the mountainous area impose serious impediments to modern agriculture hindering irrigation and mechanization and presenting inimical conditions of soil fertility, slope and farm size (Gosh and Gupta, 2017). High inequality in rural incomes, at 0.76, based on the NSSO 70th (2012–13) round, attributes this finding to skewed ownership of both physical and financial assets (Rawal, 2013). Higher and pervasive income inequality was observed

among labouring households, without a consistent relationship to farm size (Meena *et al.*, 2017). Education, adoption of high yielding varieties and access to non-farm income opportunities were significant factors influencing income in the study region. Bathla *et al.* (2017) explored the differential effects of various public investments in addressing regional income inequalities.

2.3.1 Agriculture and inequality issue

Agriculture and farmers have always been a matter of great issue of concern in underdeveloped countries. If agriculture was to the sole source of income for the small holders, the majority of them would have remained poor (Chand *et al.*, 2017). Agriculture has diverse patterns of growth, because of varied climatic and production conditions, skewed land distribution and high poverty rates. A sub national analysis can help to evaluate how public policies may lessen income gaps within each state. A potent need for redesigning of agricultural policies and stepping up of public investments is suggested along with targeting of social benefits and appropriate institutions to enhance productivity (Kanbur *et al.*, 2014).

2.4 Vulnerability

A few decades ago, vulnerability studies tended to have a ‘single stressor, single outcome’ approach, focusing on the physical impact of a disaster and its negative outcomes (Eakin and Luers, 2006). The risk or hazard or biophysical approaches to vulnerability were concerned with the ‘likelihood of injury’ and damage caused as the core concern (Burton *et al.*, 1978). Subsequently, scholars posited that vulnerability is not confined to only the devastations caused by disaster to the physical environment, but also the impact on the social, economic and political environments (Morrow and Phillips, 1999). Moreover, the activities of people in view of their varying age, gender and ethnicity characteristics are equally significant (Juntunen, 2005). Later, the focus shifted to mitigation and control of disaster through coping measures (Turner *et al.*, 2003; Birkmann, 2006) and then to adaptation of resilience measures, which is considered the opposite

side of vulnerability (Timmerman, 1981; Holling, 1996). Finally, a comprehensive view of vulnerability, taking into account exposure, susceptibility, socio-economic conditions and resilience measures of households, was considered more appropriate in understanding disaster impact (Cardona, 1999; Birkmann, 2006). Vulnerability has gained considerable significance from the last three decades with the works of Jodha (1988) looking at the minority view of the poverty debate and that of Chambers (1995) on 'Voice of the Poor'. Chambers (2013) explored people's own words and concepts of well-being and ill-being, people's priorities, their experience of institutions and attitudes towards them as well as gender relations.

2.4.1 Vulnerability concepts

Vulnerability refers to the state of susceptibility to unprecedented risks arising out of multiple factors at play and has also been explained by the phrase 'living on the edge', it provides a graphic image of the livelihood scenario wherein a household is sustaining with the bare minimum in all aspects. Chambers (1989) explained that 'vulnerability means not lack or want but exposure and defencelessness'. This definition points to the external side of exposure to shocks, stress and risks and an internal side of defencelessness due to lack of means to cope with such exposures. Moser (1998) changed the focus and emphasis of Chamber's definition as he highlighted that 'analysing vulnerability involves identifying not only the threat but also the resilience or responsiveness in exploiting opportunities and in resisting or recovering from the negative effects of a changing environment. The means of resistance are the assets and entitlements that individuals, households, or communities can mobilise and manage in the face of hardships. Vulnerability is therefore closely linked to asset ownership. As per the World Bank, vulnerability refers to the relationship between poverty, risk and efforts to manage risks which therefore is cumulatively known as "Social Risk Management (SRM)". The SRM perspective addresses how vulnerable households are helped in better risk management and becoming less susceptible to

resultant welfare losses (Holzmann and Jorgansen, 1999). Furthermore, Clark *et al.* (2000) define vulnerability “as the risk of adverse outcomes to receptors or exposure units (human group, ecosystems and communities) in the face of relevant changes in climate, other environmental variables and social conditions”. Most recent definitions of vulnerability combine the impacts of internal and external defencelessness.

The Human Development Report argues that vulnerability is influenced considerably by the human capabilities, social background, fallacies in the policies and due to inadequate social institutions. The underlying causes of vulnerability are economic, demographic and political processes that affect the assignment and distribution of resources among different groups of people (Cardona, 2004). Vulnerability is correlated with the level of development and results from physical exposure, socioeconomic fragility and lack of resilience. By not thoroughly analysing the structural causes of vulnerability, the focus is shifted from the root causes of the problem. Thus, in order to deal with vulnerability better, it is important to place an increased emphasis on people’s endowment and link these to the causes of vulnerability. Also, policy makers and academicians share common view point regarding the fact that the dynamic nature of vulnerability needs special attention so that appropriate actions can be devised for mitigating the worst consequences.

2.4.2 Resilience towards vulnerability

Apart from vulnerability, the concept of resilience which is considered reciprocal of vulnerability, captures preparedness of the individuals for future by nurturing coping measures (Deleon and Carlos, 2006; Briguglio *et al.*, 2009). Birkmann *et al.* (2010) summarise resilience as ‘capability of a system to maintain its basic functions and structures in a time of shocks and perturbations’. However, the system may also entail an individual or a household. These sets of conditions have been explicitly related to individual characteristics which are determined by the interplay of socioeconomic, political and environmental circumstances as well

as the structures. Resistance is dependent upon the endowment levels of an individual, a household or a community. Resilience is the ability to cope with the shock. Uncertainty is determined by the types of risks to which households are exposed. Risk in this context can be defined as the expectation of future physical or economic losses (Alwang *et al.*, 2001; Heitzmann *et al.*, 2002; Cardonna, 2004). The existence of risks has different effects on populations with an adverse impact on their well-being. It not only results into the creation of additional risks and uncertainty, but also induces risk adverse behaviour among the entities forcing them to invest in low risk and low return activities. It is therefore vital to stress upon various internal and external risks to which a household is usually exposed. The seminal World Development Report (WDR) of 2000/2001 categorises these risks into natural, health, social, economic, political and environmental risks. To understand how risks converge and make a household vulnerable is hence important. Many studies have outlined the role of risk in designing and implementing social policy (Holzmann, 2001; Holzmann and Jorgensen, 2001; Heitzmann *et al.*, 2002). The nature and magnitude of risks and the extent of risk-management mechanisms adopted by a household in a given environment play central role in the analysis of vulnerability. Hence, vulnerability assessment is both desirable and necessary. There are three major arguments in favour of the need for assessing vulnerability. One, it helps in designing effective anti-poverty interventions by examining not only the currently poor groups but also those ones who are likely to be poor in future. Such a dynamic approach ensures that the poverty and hence vulnerability does not transmit from one generation to another. Two, exposure to some risks may bring significantly high reduction in incomes. In the absence of sufficient assets or insurance to smoothen consumption, such shocks may lead to irreversible losses, such as distress sale of productive assets, reduced nutrient intake, or interruption of education that, permanently reduces human capital, locking their victims in perpetual poverty (Jacoby and Skoufias, 1997). When people lack the means to smoothen consumption in the face of variable incomes, they are often trapped in poverty as

they are trapped in less productive and less remunerative attempts to ward-off the irreversible shocks (Morduch, 1994; Barrett, 1999). Third, vulnerability is an intrinsic aspect of wellbeing. That exposure to risk and uncertainty about the future adversely affects current wellbeing, is one of the central tenets of the basic economic theory of human behaviour, embodied in the assumption that individuals and households are risk averse. As the World Development Report 2000/2001 on attacking poverty documents, this presumption is echoed by findings from worldwide consultations that indicate that risk and uncertainty are a central preoccupation of the poor.

2.4.3 Methods of vulnerability assessment

The vulnerability is examined through the ownership of income and other welfare generating assets such as land, man-power, machinery, buildings, livestock, etc. The households with larger asset base are considered less vulnerable to welfare losses associated with risky events (Moser and Holland, 1997). Investments in the assets tend to reduce vulnerability by improving risk management and generating additional income from these assets. The advantage of asset-based is that it expands vulnerability even to those households who, despite not being consumption poor, are vulnerable due to their investment poverty as their asset base declines over time due to their inability to generate sufficient surpluses for future investments in assets (Reardon and Vosti, 1995). There are different methods to measure vulnerability. The econometric methods have focused largely on measurement of vulnerability as expected poverty (VEP), vulnerability as low expected utility (VEU) and vulnerability as uninsured exposure to risk (VER). While VEP and VEU measure the ex-ante probability of a household's future consumption of falling below a given minimum due to current or past shocks, VER measures ex-post welfare loss due to shocks (Vatta *et al.*, 2017). The most commonly cited shocks are climatic, economic, political, social, legal, crime and health conditions (Hoddinott and Quisumbing, 2003). The disadvantages of the VEP method is that estimates across

a single cross-section require an assumption that the cross-sectional variability captures temporal variability, whereas the weakness of the VEU method is that it is difficult to account for an individual's risk preference, given that individuals are ill informed about their preferences especially those related to uncertain events (Kanbur, 1987). The household vulnerability index (HVI) is a new method developed to measure vulnerability. The HVI helps in categorising a farm household by examining the external vulnerability that was due to different shocks faced by the farm household and internal vulnerability like how they withstand shocks, then, classifies the household as less, moderate, highly vulnerable class. The HVI is estimated with the data on a selected number of variables and a statistical score is calculated for each household indicating its level of vulnerability (Sibanda *et al.*, 2008). Endowment of the resource and their exposure to risk, these are the two factors on which vulnerability of an household depends. Davies (1996) defined structurally vulnerable households as those exhibiting underlying characteristics that make them vulnerable (such as headship, age, households with old and infirm members). Beside these there were various other methods have been developed to measure and understand the determinants of household vulnerability (Zhang, 2016). He developed a vulnerability index for an individual household and then used an ordered logistic regression model to identify the key determinants of vulnerability in Nigeria. Nizami *et al.* (2009); Chaudhary and Bawa (2011); Manandhar *et al.* (2011); Hussain *et al.* (2013); Asad *et al.* (2015); Piya *et al.* (2016) and Sujakhu *et al.* (2016) studied the impact of specific hazards on farmer's livelihoods in the Asian Highlands.

2.4.4 Factors affecting the vulnerability of a household

Physical, financial, social and natural capital determine the vulnerability and the adaptive capacity of people (Hahn *et al.*, 2009). Philip and Rayhan (2004) outlined various factors contributing to vulnerability such as low levels of education, gender inequality, fragile and hazardous location and lack of access to resources and services, lack of access to information and knowledge and

disintegration of social patterns. The factors such as land holding size, fertiliser use, access to non-farm income sources, household size, number of workers in the family, per capita income, adult literacy, livestock ownership, remittances, education of household head, skill and trainings were also identified as significant determinants of vulnerability (Omamao, 1998; Christiaensen and Subbarao, 2005; Inayatullah *et al.*, 2012; Nkondze *et al.*, 2013). Vatta *et al.* (2017) estimated the household vulnerability indices of 10 villages in Jharkhand and found that majority of the tribal rural households fall in medium to high vulnerability categories necessitating the urgency of income enhancement and livelihood improvement interventions in tribal areas. The ordered regression analysis revealed that education status of the household head, proportion of land under irrigation and share of non-agricultural income were highly significant ($p < 0.001$) to vulnerability. The education level of the household head is not only an important determinant of vulnerability in the Asian Highlands but also in the South African region. (Nkondze *et al.* (2013) found that livestock influences households to move from low vulnerability to moderate vulnerability or high vulnerability. Panthi *et al.* (2016) reported that the integration of livestock rearing with crops reduced the vulnerability of smallholder farmers in Dhading, Nepal. Edoumiekumo *et al.* (2013) used a logistic regression model to show that the major determinants of poverty in Nigeria were household size, per capita expenditure on education, health and food, in addition to female-headed household and engagement in agriculture activity only. Deressa *et al.* (2011) and Islam *et al.* (2013) indicated that the most vulnerable households and communities are poor with low income generating activities.

2.5 Concept of sustainability

Brundtland Commission's report in 1987 called 'Our Common Future' defined sustainability as a 'development which meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987). After that so many definitions on sustainability have been given

by different researchers across the globe (Pretty, 1995). IFAP (International Federation of Agricultural Producers) defined agricultural sustainability as not only economic sustainability but also environmental, social and ethical sustainability (Vorley, 2002). Bos *et al.* (2007) argued that agricultural sustainability can be measured from three perspectives: people, planet and profit. Pretty *et al.* (2008b) also support that agricultural sustainability should be accessed through economic growth, environmental protection and social progress. Different people have defined and interpreted sustainability based on their experience and local context. Kang *et al.* (1990) defined sustainability as the ability of a production system to produce stable yield of crops over a long period of time while minimizing soil degradation. Increased farm productivity and income are important factors for agricultural sustainability that can contribute to increased adoption of natural resource conservation measures to sustain upland production systems (Sajise and Ganapin, 1990; Vorley, 2002). Pretty *et al.* (2008a) further suggest that resilience and persistence, in addition to economic, social and environmental outcomes need to be considered with respect to sustainability of agriculture systems.

2.5.1 Sustainability indicators

There is a growing concern among research scientists and conservationists about the indicators to be used for measuring the sustainability of a farming system. ILEIA (1991) suggest indicators like productivity, security, continuity, adaptability and integrity to measure sustainability. Although large number of indicators have been developed by scientists and researchers to assess agriculture sustainability, they do not fully integrate ecological, economical, social and institutional indicators. The precise measurement of sustainability is difficult as it is site-specific and a dynamic concept (Ikerd, 1993). Therefore, the indicators applied in one area may not be applicable to another due to variation in biophysical and socio-economic conditions. For that reason, indicators should be

location-specific and considered within the context of the contemporary socio-economic situation (Dumanski and Pieri, 1996; Rasul and Thapa, 2003).

2.5.2 Agricultural sustainability

In the context of farming systems, sustainability can be examined through economic viability, sustainable use of resources, improved livelihoods of the local people and protection of ecosystems which are influenced by agricultural activities (Dalal *et al.*, 1999). Rapid changes in the social and economic environment together with the deterioration of the natural resource base threatens sustainability of farming systems in many areas of the world (Dogliotti *et al.*, 2004). They are especially acute in the densely populated, underdeveloped and ecologically fragile area of the Hindu Kush Himalayan (HKH) region (Rasul and Karki, 2007). Hilly areas of the India face rapid increase in population pressure as well as degradation of the environment and production resource base. There are emerging symptoms of unsustainability of current patterns of resource use and production practices. This situation is a cause of concern and a reason for evaluation of conventional development approaches to hilly areas. As a result of increasing population growth and less development of infrastructure in mountain areas, subsistence agriculture has been intensified to meet the increasing demand for food and income. Intensification, however, has been applied without suitable management of uplands, which has accelerated deforestation, soil erosion and environmental degradation. Such agricultural intensification with use of high yielding modern varieties and agrochemicals has many negative implications, particularly for the unique landscape of the mountains, where farmers are dependent on the local resources through locally developed technology (Sen *et al.*, 2002). Degradation directly and negatively impacts the lives of some 150 million people living in the HKH region and indirectly affects about 450 million more living downstream (Rasul and Karki, 2007), raising serious concerns about the sustainability of mountain agriculture. It is expected that change in cropping patterns in mountain areas is leading to noticeable change in environmental and

socioeconomic consequences (Seddon and Adhikari, 2003). The sustainability context for agricultural systems picked up momentum as discourses on conservation, ecosystem services, food security, nutrient security, resilience and climate adaptation pitched up in the global agenda (Rao and Rogers, 2006). Additionally, sustainability of agricultural systems was regarded as critical in the context of its multi-functionality, changing knowledge paradigm and social aspirations and influence from drivers of change whose future intensity and impacts remain unpredictable. Sustainability, while it needs to consider current context of being more socio-culturally equitable, environmentally sound and economically viable (WCED, 1987). There have been concerns about sustainability assessments or sustainability oriented knowledge not adequately guiding farming communities and also manage their farms and other stakeholders should make relevant research, management and policy decisions.\

Various researchers/scientists gave different suggestions regarding different sustainability issues. According to Altieri (1995), farmers can improve the biological stability and resilience of the system by choosing more suitable crops, rotating them, growing a mixture of crops and irrigating, mulching and manuring land. According to Lynam and Herdt (1989), sustainability can be measured by examining the changes in yields and total factor productivity. Beus and Dunlop (1994) considered agricultural practices such as the use of pesticides and inorganic fertilizers and maintenance of diversity as measures of sustainability.

Chapter 3

MATERIAL AND METHODS

The reliability, precision and validity of the research findings of any investigation depend upon the selection of appropriate techniques. This section cogently elaborates the methodology that includes selection of study area, sampling design, data collection and analytical framework perused in the study. The present investigation entitled “efficiency and sustainability of farming systems in intermediate zone of Jammu and Kashmir” was conducted during 2018-2020.

3.1 Selection of the study area

The present study pertains to Jammu and Kashmir and intends to investigate the Sustainability, Equity, Farm efficiency, Vulnerability in the intermediate zone of J&K using both primary and secondary data. Since study is based on intermediate zone of Jammu and Kashmir, therefore, the primary survey was conducted from the farm households of this zone (Rajouri and Poonch districts).

3.1.1 Sampling design

Multistage stratified random sampling technique was employed for the selection of blocks, villages and farm households (Fig.1).

A. Selection of Districts

In the first stage of sampling, two district *viz.* Rajouri and Poonch were selected purposively as these two districts are representative areas of intermediate zone of the UT.

B. Selection of Blocks

In the second stage, four blocks, two from Rajouri and two from Poonch district were chosen randomly (Table 1).

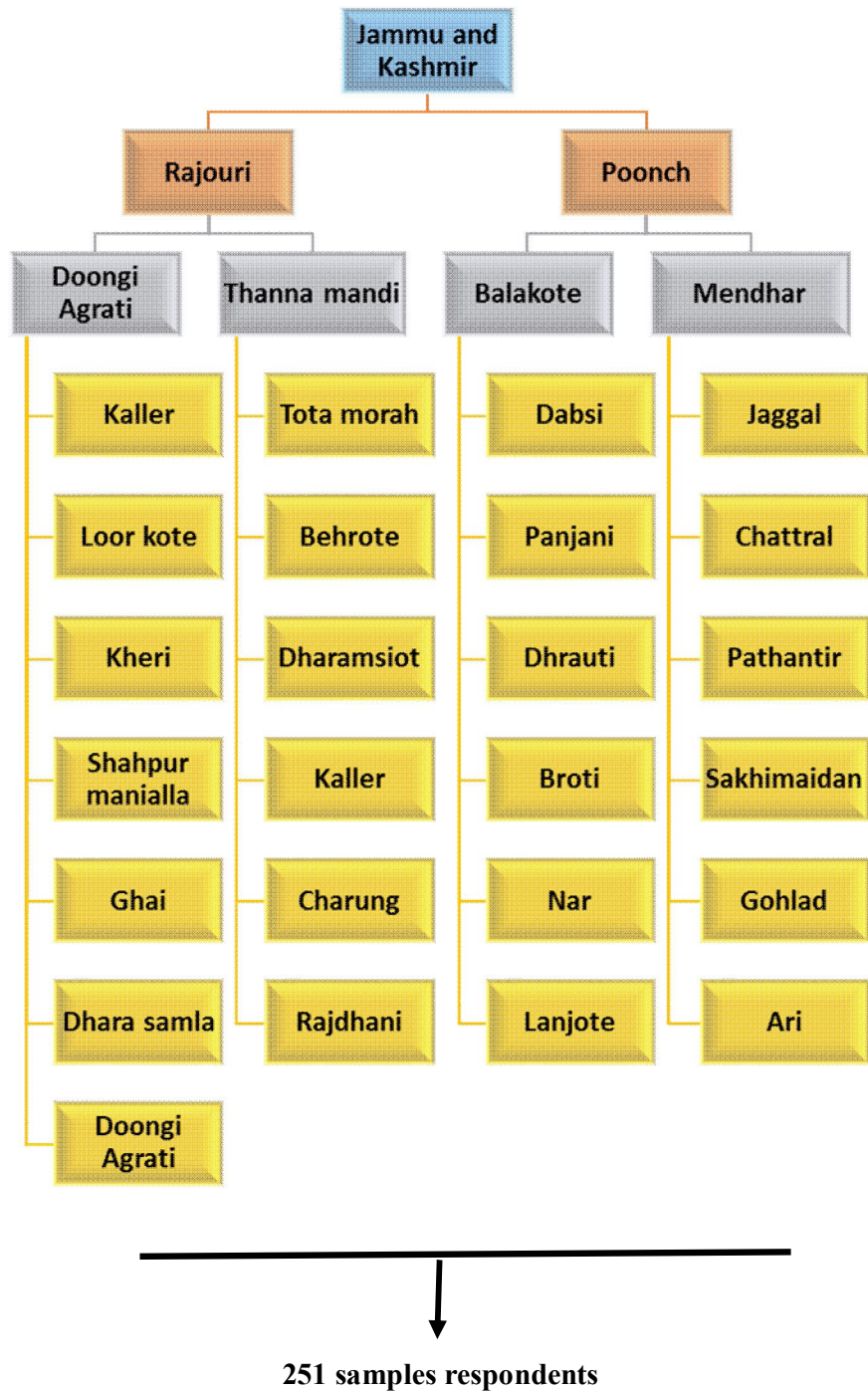


Fig. 1: Flow chart representing the sampling design followed in the study

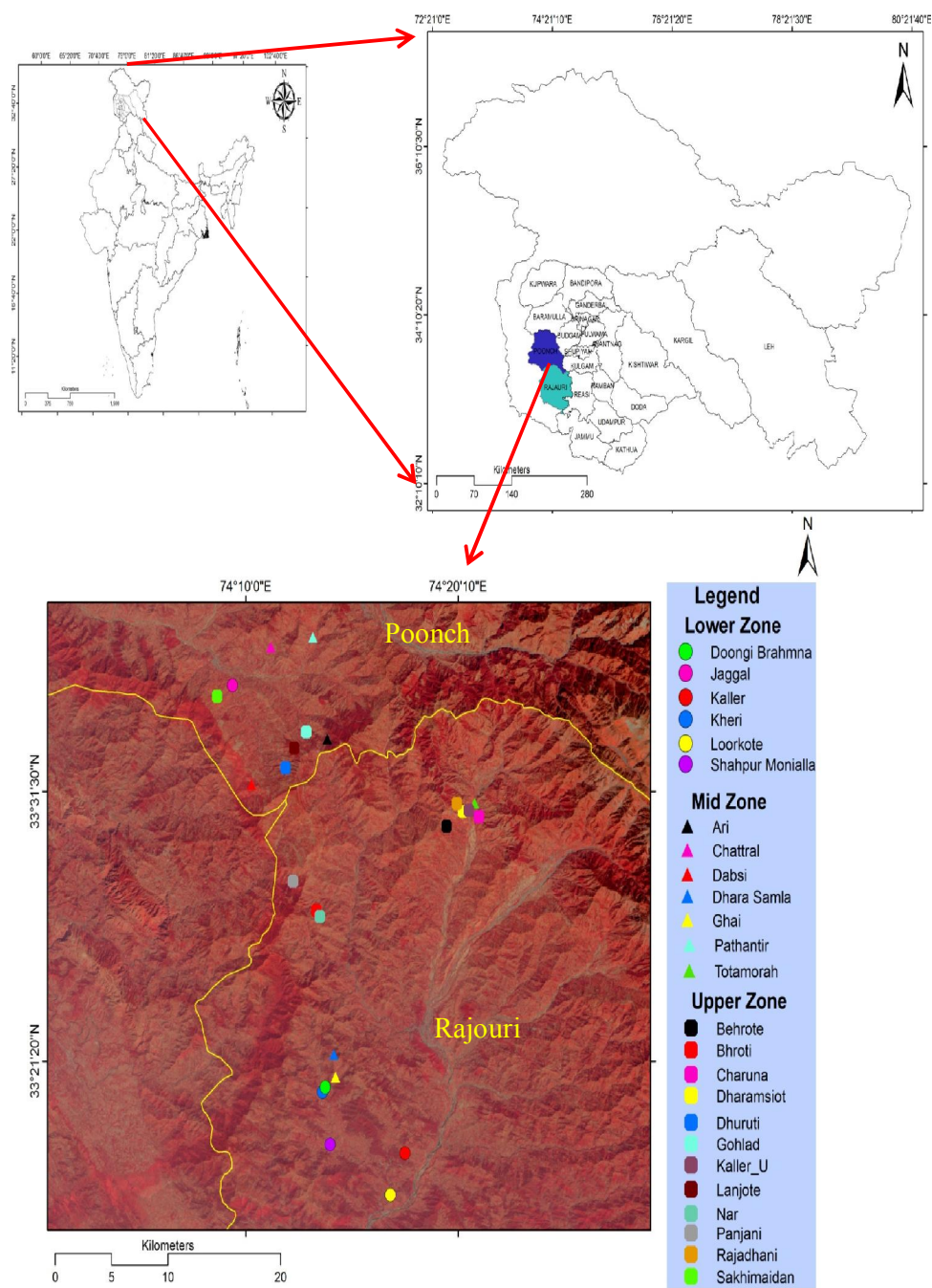


Fig. 2: Map of the study area

C. Selection of villages

In the third stage of sampling, 25 numbers of villages were selected by stratified simple random sampling and 251 farmers were identified from the selected villages for farm household survey data. The selection of villages from each block/district was carried out in such a way so as to get representative sample of villages from low, medium and high altitude habitations.

Table 1: Details of villages selected in study area

Agro-Climatic Zone	District	Block	Villages	Altitude (m masl)	Altitude Zone
INTERMEDIATE ZONE	Rajouri	DoongiAgrati	Kaller	859	Lower
			LoorKote	800	Lower
			Kheri	901	Lower
			Shahpur Manialla	998	Lower
			Ghai	1026	Middle
			DharaSamla	1171	Middle
			Doongi Brahma	972	Lower
		Thanna Mandi	TotaMorah	1297	Middle
			Behrote	1496	Upper
			Dharamsiot	1500	Upper
			Charung	1350	Upper
			Rajdhani	1300	Upper
			Kaller	1400	Upper
	Poonch	Balakote	Dabsi	1291	Middle
			Panjani	1476	Upper
			Dhrauti	1461	Upper
			Broti	1489	Upper
			Nar	1495	Upper
			Lanjote	1420	Upper
		Mendhar	Jaggal	992	Lower
			Chattral	1098	Middle
			Pathantir	1141	Middle
			Sakhimaidan	1350	Upper
			Gohlad	1369	Upper
			Ari	1220	Middle

3.2 Data collection

The study is based upon both primary and secondary data.

3.2.1 Primary data

The primary data were collected on the following broader variables from the sample respondents.

- Education of the sample respondents
- Household size
- Age of the sample respondents
- Land holding of sample respondents
- Livestock composition
- Input use and output from crops and livestock
- On-farm composition and marketable surplus
- Cropping pattern
- Farm income
- Off- farm income
- Resource endowments
- Natural Resource Harvesting
- Physical capital
- Financial capital etc.

The primary data were collected from sample respondents by employing well-designed and pre-tested questionnaire conducted through personal interview method (Plate I) for the agricultural year 2018-19.



Plate 1: Data collection from respondents

3.2.2 Secondary data

The secondary data was collected on the following variables pertaining to the study area.

- Demography
- Geography
- Climate
- Area and production of crops and livestock
- Rural infrastructure/amenities

The secondary data with respect to above information were collected from the published/unpublished records of Government of Jammu and Kashmir.

3.3 Analytical framework

In accordance with the objectives and data collected for the present study, following analytical tools were employed for analysis/interpretation of data.

3.3.1 Tabular analysis

Tabular analysis was employed to work out averages, ratios and percentages for the data related to various socio-economic indicators like cropping pattern, land utilization pattern, costs and returns etc.

3.3.2 Statistical tool

Following statistical/mathematical/econometric tools were employed for analysis of the data.

3.3.2.1 Ordinal logistic regression model

To determine the effect of independent variables on dependent variable, ordinal logistic regression analysis was used. The logistic regression techniques are powerful in analyzing livelihood choices and their determinants given their

suitability for modelling the categorical dependent variables (Babulo *et al.*, 2008; Mutenje *et al.*, 2010; Rahut and Micevska Scharf, 2012; Yenesew *et al.*, 2015; Walelign, 2016; Khatiwada *et al.*, 2017; Makate and Mango, 2017; Negeri and Demissie, 2017; Bealu, 2019; Shaheen, *et al.*, 2017).

For ordinal logistic regression analysis firstly we have to design dependent and independent variables

3.3.2.1.1 The Design of the Dependent Variable

A. Income Sources

Mainly there are two sources of farm household's income, 1. Farm income and 2. Off-farm income. For designing the dependent variable we calculate farm household's net income, agriculture net income and off-farm net income. (1) Agriculture net income was calculated by subtracting the cost of inputs used in the production process, such as seed and starter animals, fodder, fertilizer, pesticides, livestock medicine and so on from the gross income from crops, livestock, calculated by multiplying crop yields, livestock yields, by the unit price in the market in the investigation year. (2) Off-farm net income was calculated by adding family members' income from labour, including wages and business, employment, pensions and then by subtracting it by the total household expenditure.

B. Share of agriculture net income

The share of agriculture net income to total household net income was calculated for each household and used to group sample households into four groups according to the share of net income from agriculture and thus dependence on agriculture (dependent variable) interpreted in terms of livelihood strategies (LS): LS1, <20% = less dependent; LS2, 20%–40%, = moderately dependent; LS3, 40%–60%, = highly dependent; and LS4 >60%, = extremely dependent. The similar classification was followed by Xu *et al.*, 2015 in their study on

“Household livelihood strategy and dependence on agriculture in the mountainous settlements of three gorges reservoir area of China”.

3.3.2.1.2 The Design of the Independent Variable

Using the SLA framework as a base, the factors affecting farmer’s choices of livelihood strategies were divided into five types of capital: human, physical, natural, financial and social (Table 2). The different explanatory variables which we used are also used in previous studies as a determinants of livelihood strategies by various researcher such as (Abdulai and Crolerees, 2001; Escobal, 2001; De-Janvry and Sadoulet, 2001; Schwarze and Zeller, 2005; Croppenstedt, 2006; Rahut and Micevska Scharf, 2012; Yenesew *et al.*, 2015; Khatiwada *et al.*, 2017; Makate and Mango, 2017).

As described earlier since our dependent variable is categorical we used ordinal logistic regression model for our analysis as follows.

$$\text{logit}(Y) = \ln(p/(1 - p)) = b_0 + b_i \sum_{i=1}^{13} X + U$$

Where,

- Y = Livelihood strategies (LS1, LS2, LS3, LS4)
- p = probability of event
- 1 – p = probability of not happening the event and it ranges from 0 to 1
- b₀ = constant
- b_i = regression coefficient of the ith independent variable
- X₁₋₁₃ = 13 independent variables (Table 2) and
- U = random term.

Table 2: Explanatory variables and their definitions

Variable		Definition
Human capital		
X ₁	Family size	household size (No.)
X ₂	Worker	number of laborers in household (No.)
X ₃	Children	whether the household has children aged 5–15 years old (1 = yes; 0 = no)
X ₄	Householdage	age of household head in years
X ₅	Householdedu	years of education of household head
Physical capital		
X ₆	Asset val	current market value of all the fixed assets that a household possesses (₹)
X ₇	House val	current market value of the value of the house(s) that a household possesses (₹)
Natural capital		
X ₈	Area	household's per capita area of cultivated land (ha)
X ₉	SAU	Standard animal unit (Buffalo, Cow, Bull, Horse=1, Calf=.50, Sheep and goat=.20)
Financial capital		
X ₁₀	Loan	Whether the household loaned from financial channels(such as banks) in the past five year(1= yes, 0=no)
X ₁₁	Borrow	Whether the household borrowed from relatives and friends in the past five year(1= yes, 0=no)
Social capital		
X ₁₂	Socnetworkformoney	the social network of relatives and friends available for assistance when in urgent need of a lot of money (1 = none; 2 = underdeveloped; 3 = developed)
X ₁₃	Socialnetworkforwork	the social network of relatives and friends available for assistance when seeking non-farm work (1 = none; 2 = underdeveloped; 3 = developed)

3.3.2.2 Stochastic Frontier Approach

Stochastic frontier approach is most widely used for the efficiency estimation. This approach introduces stochastic random noises that are beyond the control of the farmers in addition to the inefficiency effects. There are many types of stochastic frontier functional forms such as Cobb-Douglas, Translog or the Zellner-Revankar generalised production function (Coelli, 1995). Among all these functional forms Cobb-Douglas stochastic frontier function (in spite of its restrictive properties) is mainly preferred because its coefficients directly represent the output elasticity of inputs, easy for interpretation and estimation than other forms of frontier moreover, it takes into account all the disturbance term, error and exogenous shocks that are beyond the human control and it also capture deviations from the frontier due to inefficiency. That is why the Cobb-Douglas stochastic frontier approach was chosen as more appropriate analytical tool for studying efficiency parameter (Coelli *et al.*, 1998 and Seyoum *et al.*, 1998) so, on the basis of above discussed facts, we have employed Cobb-Douglas stochastic frontier function in our present study for efficiency estimation due to its discreet advantages over the other methods of efficiency estimation. Aigner *et al.*, 1977; Ali and Flinn, 1989; Kalirajan and Shand, 1989; Sharma and Dutta, 1997; Rahman, 2003; Galawat and Yabe, 2012 have also used same analytical tool in their various fields of study. Allocative efficiencies were estimated by dividing economic efficiency with technical efficiency.

3.3.2.2.1 Cobb-Douglas stochastic frontier production function

The stochastic frontier production function that assumed Cobb-Douglas form is given as:

$$\ln Y_i = b_0 + b_1 \ln X_{i1} + b_2 \ln X_{i2} + b_3 \ln X_{i3} + b_4 \ln X_{i4} + b_5 \ln X_{i5} + V_i - U_i \dots \dots \dots (1)$$

Where

b_i = parameters denoted the coefficient of inputs to be estimated by maximum likelihood estimation method (MLE)

$\ln$	=	Natural logarithm
Y_i	=	Output (quintals/ha)
X_1	=	Quantity of seed (kg/ha)
X_2	=	Quantity of inorganic fertilizer (quintals/ha)
X_3	=	Quantity of organic fertilizer (quintals/ha)
X_4	=	Human labour (mandays/ha)
X_5	=	Machine labours (hrs/ha)
V_i	=	random variable assumed to be independently, identically and normally distributed
U_i	=	is a non-negative random variable and one-sided component that reflects technical efficiency relative to stochastic frontier

3.3.2.2.2 Technical Efficiency

The level of technical efficiency is estimated as:

$$TE_i = Y_i/Y_i^*$$

$$TE_i = f(X_i, b_i) \exp(U_i) / f(X_i, b_i) \exp(v_i)$$

$$TE_i = \exp(-U_i)$$

Where,

Y_i is the actual output while

Y_i^* is the frontier output or the maximum potential output.

In order to test whether technical inefficiency effect is absent, the conventional production function is more appropriate

For the inefficiency effect model, the household specific factors are assumed to linearly affect farm technical efficiency. Given the specification of

the stochastic frontier production function as defined by equation (1), the technical inefficiency effect of the i^{th} farmer is given as:

$$U_i = b_0 + b_1 \ln Z_1 + b_2 \ln Z_2 + b_3 \ln Z_3 + b_4 \ln Z_4 + b_5 \ln Z_5 + b_6 \ln Z_6 + W_i$$

Where,

b_i are parameters denoted the coefficient of technical efficiency effects

U_i	=	Technical inefficiency
Z_1	=	Number of females
Z_2	=	Education years of respondent
Z_3	=	Family size
Z_4	=	Cultivated area
Z_5	=	Age of respondents
Z_6	=	Number of Children
W_i	=	unobserved random error term
I	=	number of farmers.

3.3.2.2.3 Stochastic frontier profit function

The stochastic frontier profit function was used for the estimation of profit efficiency by employing following profit frontier model

$$\ln \Pi_i = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + V_i - U_i$$

Π_i	=	Restricted profit (Current revenue less current variable cost)
X_1	=	price of seed per kg normalized by output paddy (₹)
X_2	=	Price of inorganic fertilizer per quintal normalized by the output price of the i^{th} farm.
X_3	=	Price of organic fertilizer per quintal normalized by the output paddy of the i^{th} farm.

X_4 = Human labour wage rate per day normalized by output price of the i^{th} farm

X_5 = Machine labour wage rate per hour normalized by output price of the i^{th} farm

V_i = random variable

U_i = Farm –specific economic efficiency related variable

Normalised price is obtained by dividing the price of input with the output price.

3.3.2.2.4 The economic efficiency in relation to the stochastic profit frontier is given by:

$$EE_i = \exp(u_i)$$

3.3.2.2.5 Allocative efficiency was estimated by dividing economic efficiency with technically efficiency for each farm.

$$AE_i = EE_i/TE_i$$

3.3.2.3 The equity/ inequality measure

Agriculture income inequality has always been a matter of great issue of concern in underdeveloped countries. If agriculture were to the sole source of income for the small holders, the majority of them would have remained poor (Chand *et al.*, 2017). Agriculture has diverse patterns of growth, because of varied climatic and production conditions, skewed land distribution and high poverty rates. A sub national analysis can help to evaluate how public policies may lessen income gaps within each state. So, in order to understand agriculture income inequality and its level in our study area we have employed inequality measure like Gini concentration ratio and weighted Gini-coefficient. Beside these we also have used three other statistical measures to calculate income inequality order to control peculiarities in the data and are bottom sensitive means the sign will change if transfer will occur at the bottom of the income distribution.

The equity/inequality among the farmers were estimated by average agriculture income by employing various inequality measures like

- A. Gini Concentration Ratio(GCR)
- B. Weighted Gini Coefficient
- C. Theil Entropy Index
- D. Theil Bernoully Index
- E. Exponential Index

A. Gini Concentration Ratio (GCR)

Gini Concentration Ratio (GCR) was calculated to measure the inequality in the agriculture income among different farm classes using the following formula:

$$GCR = 1 - \sum_{i=1}^n P_i(Q_i + Q_{i-1})$$

Where,

- P_i = Proportion of number of farmers
- Q_i = Cumulative Proportion of income
- Q_{i-1} = Preceding Cumulative Proportion

B. The weighted Gini-coefficient is given as:

$$\text{Weighted Gini-coefficient} = \sum_{i=1}^j W_i (y_i / \mu)$$

and

$$W_i = p_i \left[\sum_{j=1}^j (2p_j - p_i - 1) \right]$$

Where,

- W_i = a weight associated with the proportion of the population in the i^{th} group
- p_i = the proportion of the population in the i^{th} income group
- p_j = the proportion of the population in the j^{th} income group

y_i = the average income in that group in ₹

μ = the overall mean income in ₹

C. Theil-Entropy Index

$$TE = \left[\frac{1}{N} \right] \sum_{i=1}^N \frac{y_i}{\mu} \ln \left[\frac{y_i}{\mu} \right]$$

D. Theil-Bernoulli Index

$$TB = \sum_{i=1}^j \ln(y_i / \mu)$$

E. Exponential Index

$$EXP = \sum_{i=1}^j p_i \exp(-y_i / \mu)$$

Where,

$\ln$ = natural logarithm

p_i = the proportion of the population in the i^{th} income group.

y_i = the average income in that group in ₹

μ = the overall mean income in ₹

N = number of income groups.

3.3.2.4 Vulnerability analysis

In this study Household Vulnerability Index (HVI) was used to measure vulnerability of farmers in study area, HVI act as a measure of overall risk from a hazard to which a household is exposed to and its capacity to mitigate the adverse effects. Vulnerability index was derived by combining the following six indicators which appeared to be the most relevant for assessing vulnerability in the study area. The details of the selected variables and their expected relationship with vulnerability are explained briefly in Table 3. The variables with positive expected relationship with vulnerability reflect that any increase in the value of the variable will lead to the increase in household vulnerability. A rise in the value of variable with negative sign will lead the reduction in household vulnerability.

Table 3: Factors affecting vulnerability across various vulnerability classes amongst households

Selected variables	Values	Expected relationship with vulnerability	Measurement
Household income	Rs/annum	(-)	It is obtained by adding income from all the farm and non-farm sources
Education of household head	Years	(-)	Total number of years spent by household head gaining education
Household size	Number	(+)	Total member of household
Worker participation ratio	Number	(-)	Ratio of workers to the household size. It varies between 0 and 1.
Operational area	Hectare	(-)	Area under crop cultivation
Livestock index	Number	(-)	$C*a+G*b+B*c+H*d$ (Where, C=cattle (Cow and buffalo), a=1, G= Goat and Sheep), b=.20, B=Bull, c= 1, H=Horse, d=1)

To ensure compatibility; all the variables were normalised/standardised. The standardisation was achieved by using equations (1) and (2), based on the selected variable and its hypothesised relationship with vulnerability. The equation used for this conversion is adapted from that used in the Human Development Index to calculate the life expectancy index, which is the ratio of difference between actual life expectancy and a pre-selected minimum and the range of pre-determined maximum and minimum life expectancy (UNDP, 2007).

Two types of functional relationship are possible between the indicators and vulnerability. Vulnerability increases with increase in the value of the indicator and vice-versa.

$$X_i = \frac{x - \min(x)}{\max(x) - \min(x)} \dots (1)$$

Where Min(x) and Max(x) are respectively the minima and maxima of (X_{i1}, X_{i2}, ... X_{in}). When the values of X_i will negatively related to the vulnerability, The standardization will be achieved by using equation (2).

$$X_i = \frac{\min(x) - x}{\max(x) - \min(x)} \dots (2)$$

From formulas above we will obtain normalized of y_{id} which may vary from zero to one. From the matrix of scaled values, Y=(X index) we constructed a measure of vulnerability for different household in the study area as follows:

$$\overline{y_d} = w_1 X_1 + w_2 X_2 + \dots + w_n X_n$$

Where the w's (0 < w < 1) and (w₁ + w₂ + ... , w_n = 1) are weights which reflects the relative importance of the individual indicators.

It is assumed that the weights vary inversely as the variation in the respective indicators of development. More, specifically, we assume:

$$W_i = \frac{k}{\sqrt{\text{var}(y_i)}}$$

Where $k = \left[\sum_{i=1}^m \frac{1}{\sqrt{\text{var}(y_i)}} \right]^{-1}$

The weights were obtained for overall vulnerability and were multiplied with the standardised values to obtain final index values.

Chapter 4

RESULTS AND DISCUSSION

The results from the present investigation on “*Efficiency and sustainability of farming systems in intermediate zone of Jammu and Kashmir*” are presented objective wise in this chapter through appropriate tables and figures under following headings.

4.1 Land use and agricultural profile of the study area

Large variations exist in the distribution and utilization of land resources which are mainly based on topographic, geographical, political and other factors in the study districts. As per land utilization statistics for the year 2016-17, the total reported area of district Rajouri is 253 thousand hectares and district Poonch as 115 thousand ha. To find the share in different land-use classes in these two study districts, percentages to total reported area in each class were estimated (Table 4). Net sown area accounts for about 54 thousand ha in Rajouri with a total cropped area of about 102 thousand ha whileas district Poonch accounts 27 thousand ha and 45 thousand ha areas, respectively, thus revealing cropping intensity of 189 per cent for district Rajouri and 164 per cent for district Poonch. Land in other classes includes area under forests (37% in Rajouri and 30% in Poonch), area not available for cultivation (27% and 23% in Rajouri and Poonch) and area under barren and cultivable land (14% in Rajouri and 16% in Poonch). It could be seen from the table that total uncultivated land contributes about 15 per cent in Rajouri and about 23 per cent in Poonch district. Ample scope exists in bringing more area under cultivation by trapping the unused potential of uncultivated land, including waste and fallow lands. In this direction, land use planners and government have a major role to play. Farmers should be provided training to use land on scientific lines. Incentives in the form of cheap credit, development subsidies, etc. may improve financial status of the poor farmers, enabling them to invest on land improvement and purchase of technologies and

critical inputs. In this way, they could shift unproductive land to productive use and transform agriculture towards commercialization. Soil and water conservation and other reclamation measures could help bring the untapped land under plough for productive uses.

**Table 4: Area and its classification in study district of Jammu division
(000 ha)**

Use Class	Rajouri		Poonch	
	Area	Percentage	Area	Percentage
Area according to village papers	253.341	100	115.007	100
Area under forest	94.853	37.44	34.05	29.61
Area not available for cultivation				
Land put to non-agricultural uses	32.665	12.89	8.864	7.71
Barren and uncultivable land	35.624	14.06	18.05	15.69
Total	68.289	26.96	26.914	23.40
Other uncultivated land				
Permanent pastures and other grazing land	20.41	8.06	18.578	16.15
Land under miscellaneous trees crops	1.006	0.40	0.002	0.00
Culturable waste land	14.757	5.82	7.779	6.76
Total	36.173	14.28	26.359	22.92
Fallow land				
Fallow land other than current fallow	0		0.092	0.08
Current fallow	0.394	0.16	0.256	0.22
Total	0.394	0.16	0.348	0.30
Net sown area	53.632	21.17	27.336	23.77
Total cropped area	101.543		44.728	
Cropping intensity (%)	189		164	

Source: Regional Digest of Statistics (2016-17), DE & S, Govt. of Jammu and Kashmir

4.2 Cropping pattern

Maize, wheat and paddy are three major crops grown in the study districts of Rajouri and Poonch. It is evident from the Table 5 that out of total cropped area, maximum acreage is under cereal crop in both districts among which major area is allocated towards maize (47%) and wheat (45%) in district Rajouri and 54 per cent and 33 per cent, respectively in district Poonch. Only small proportion of area is allocated to paddy and horticultural crops in the study districts. In Kharif season, paddy is grown on irrigated lands while as under rainfed condition wheat and maize crops are usually grown. Paddy cultivation is mostly concentrated on plain areas wherever assured network of irrigation canals is available. As district Rajouri and Poonch are mountainous districts, so maize and wheat are grown mostly on hilly areas. Rabi season is solely governed by wheat crop and is grown in these lands which are occupied by maize in kharif season.

Table 5: Area sown under different food crops in study districts (000 ha)

Crop	Rajouri		Poonch	
	Area	Percentage	Area	Percentage
Paddy	4.41	4.34	2.86	6.39
Bajra	0.56	0.55	0.00	0.00
Maize	47.48	46.75	24.20	54.11
Wheat	45.59	44.89	14.96	33.44
Barely	0.10	0.10	0.00	0.00
Pulses	0.31	0.30	0.03	0.06
Total Food-grains	98.44	96.94	42.04	94.00
Condiments & spices	0.45	0.44	0.29	0.65
Fruits & vegetables	0.21	0.21	0.12	0.26
Sugar + other food crops	0.02	0.02	0.00	0.00
Total food crops	0.67	0.66	0.41	0.91
Oil seeds	1.58	1.56	0.13	0.30
Fodder crops	0.85	0.84	1.79	4.00
Other non-food crops	0.00	0.00	0.36	0.80
Total non-food crop	2.43	2.40	2.28	5.09
Total area Sown	101.54	100.00	44.73	100.00
Net sown area	53.63		27.34	
Cropping intensity (%)	189		164	

Source: Regional Digest of Statistics (2016-17), DE & S, Govt. of Jammu and Kashmir

4.3 Irrigation infrastructure

Irrigation plays an important role in the agricultural economy of a region. In Jammu region, cultivation of crops throughout the year favour only when there will be sufficient rain and assured irrigation facility. For irrigation, farmers always depend mostly upon canals, river etc. Table 6 presents area under different crops which receive irrigation through various sources. The net area sown and net irrigated area in a year were taken as to calculate irrigation intensity. Although irrigation is a critical input in improving cropping pattern, but the agro-climatic constraints were found to hamper multiple cropping in the intermediate region of the study area. The net irrigated area in Rajouri is 4.77 thousand ha and 3.50 thousand ha in Poonch. Across the two districts, it could be seen from table that only 9 per cent of area i.e., of 54 thousand ha in Rajouri district and 13 per cent area (27 thousand ha) of net sown area is irrigated in Poonch districts. The main reason for very low irrigation intensity is because of the mountainous characteristics where it is impossible to irrigate crops through canal infrastructure and also due to the lack of government efforts and negligence towards hilly districts of Jammu and Kashmir.

Table 6: Cropped area irrigated and irrigation efficiency in study districts (000 ha)

Particulars	District	
	Rajouri	Poonch
Paddy/Paddy	4.4	2.9
Maize	0.2	0.6
Wheat	3.3	1.8
Other cereals	0.1	0.0
Fruits/veg	0.1	0.0
Spices	0.1	0.1
Oil seeds	0.1	0.0
Fodder	0.2	0.5
Total cropped area irrigated	8.5	5.9
Net sown area	53.63	27.33
Net irrigated area	4.77	3.50
Irrigation intensity (%)	8.89	12.80

Source: Regional Digest of Statistics (2016-17), DE & S, Govt. of Jammu and Kashmir

4.4 Livestock

Livestock sector plays a very important role in socio-economic upliftment and provides economic security at times of stress. Agriculture along with livestock is the only farming system which have been adopted by the people in hilly areas of district Rajouri and Poonch. Table 7 depicts that the population of buffalo comprises about 13 per cent and 23 per cent of total livestock population in the Rajouri and Poonch districts, respectively. Livestock composition clearly revealed that people have reared buffalo more than cow, for milk and meat purpose in the study area. Small ruminants comprising mainly of sheep and goat accounted major proportion (45% and 32%) in Rajouri and 31 per cent and 26 per cent in Poonch district to total livestock. Climatic condition, relief, soil, availability of pastures etc. create the major differences behind this type of differentiation. Chicken was the only poultry bird being reared for meat and egg purpose.

Table 7: Livestock population in the study districts (No. in lakh)

Particulars	Rajouri		Poonch	
	No. in lakh	Percentage	No. in lakh	Percentage
Cattle	1.05	8.51	0.92	18.44
Buffaloes	1.56	12.64	1.13	22.65
Sheep	5.53	44.81	1.54	30.86
Goats	3.97	32.17	1.3	26.05
Horse/ponies	0.16	1.30	0.09	1.80
Donkey/mule	0.07	0.57	0.01	0.20
Total livestock population	12.34	100	4.99	100.00
Hens	1.22		1.05	
Cocks	0.63		0.99	
Chickens	1.43		1.45	
Total poultry	3.28		3.49	

Source: Regional Digest of Statistics (2016-17), DE & S, Govt. of Jammu and Kashmir

4.5 Socio-economic profile

Farming efficiency and sustainability more or less depend on the resource availability, rational use of inputs and socio-economic background of a farm household. Keeping in view the above fact, the present section throws light on the socio-economic status of the households in the study area.

Land holdings of farm household are very important for raising crops, ensuring food security and livelihood. The Indian agriculture is home of small and marginal farmers. Therefore, the future of sustainable agricultural growth and food security depends on the performance of small and marginal farmers. As per the field survey in the study area, 61 per cent farmers belonged to marginal farm category, 39 per cent from small farm category (Table 8) and none was observed in medium and large class. The dominance of marginal farmer over small farm category in the study area emphasized upon their development. Owing to the fact of hills, holding size is very small as compared to plains like Punjab and Haryana.

Table 8: Categorization of households on the basis of land holding

S. No.	Farm category	No. of farmers	Percentage
1	Marginal (0 -.50 ha)	152	60.56
2	Small (>.50 ha)	99	39.44
Total		251	100.00

Income of a household determines financial resources at the hand of farmers which not only gives idea about his well-being, but also provide us an impression that farmers with better resources can invest more on technologies and improve their livelihood as well as living standard. It was observed that income from agriculture and livestock activities contribute about 34 per cent while as majority (66%) comes from off-farm sources (Table 9).

Table 9: Family income per farm (₹/annum)

S. No.	Source of family Income	(₹lakhs/annum)	Percentage
1.	Off -farm income	3.33	65.81
2.	Agricultural income	1.73	34.18
Total		5.06	100.00

Farmers in study area were found more engaged in off-farm employments like services (Govt. & Corporate), business etc. thereby signifying a dominant role of off-farm income. Results are in consistent with the study of De Janvry and Sadoulet, 2001; Haggblade *et al.*, 2007.

Age plays a prominent role in the farming activities as it determines the effectiveness and competence of labour availability. Young farmers have more risk bearing potential than that of old age farmers which encourage them to adopt technologies and farming practices on scientific lines. The figures documented in the Table 10 indicate that majority (59%) of family heads are less than 45 year of age. Another 27 per cent farm family heads belong above 55 year age and only 14per cent fall in age group of 45-55 years. It means that about 73 per cent of family head's are in productive stage and prove more active in their field in order to take up better and improved technologies to harvest untapped potential of their farms.

Table 10: Age-wise categorization of the family heads

S.No.	Age group	No. of family head	Percentage
1.	Up to 45 years	149	59.46
2.	45-55 years	35	13.95
3.	Above 55 years	67	26.69
Total		251	100.00

A central indicator of socio-economic status is the educational background of the household, which is measured by the level of education of the household head. The head of the households is of central importance in regard to resource management, strategic planning and decision making both at farm and at the household level. The education of family head is strongly correlated with economic wellbeing (Hunzai *et al.*, 2011). In addition, education is strongly linked to adaptive capacity because it improves the ability to understand, accept and properly utilise new agricultural (and non-agricultural) technologies and innovations (Asfaw and Admassie, 2004). Educational attainment is generally considered an important aspect of human assets. It plays a critical role in the betterment of socio-economic conditions, adoption of new technology, to get acquainted with various scientific technical know-how and provides a healthy environment for betterment of social and cultural life of the people, living in hilly regions. The findings as depicted in Table 11 reveal poor status of the household heads in education attainment. As high as 42.63 per cent of family heads were found illiterate in the study area which could lead to lack of awareness and adoption of improved technology in farming activities emphasized upon encouragement of both formal and informal education. These 42.63 per cent respondents are vulnerable section of the mountaineering society and are exposed to various types of shocks. About 39 per cent family heads have attained education up to 10th standard. However, data revealed that only 13.94 per cent had completed the higher secondary education in study area. This number is too nominal to uplift the community level. While looking about probable reasons for poor situation of educational status in the study area, it was revealed that the workloads, un-affordability, gender discrimination, family pressure and low income were the major causes of less educational attainment as they prefer to work to earn wages in order to support the family and meet daily expenses.

Table 11: Education level of family heads

S. No.	Education of the family head	No. of the family head	Percentage
1	Illiterate	107	42.63
2	Up to 5 th	55	22.00
3	5 th -10 th	44	17.53
4	10 th -12 th	10	3.98
5	Above 12 th	35	13.94
Total		251	100.00

The average family size in the study area was 5.22 members and female members have outnumbered their male counterparts, which resulted in favourable sex ratio (Table 12) The sex ratio in new generation (up to 15 age group) was 1547 implying that this region has more numbers of females compared to male members. The sex ratio in favour of female members is desirable in view of the fact that agriculture is becoming increasingly feminized as men are migrating to rural non-farm sector. Majority of farm activities like sowing, manuring and fertilization, weeding, transplanting and harvesting, animal husbandry/dairying, etc., are exclusively taken care-off by female member and accordingly their sizeable ratio in family structure has a great bearing on farming activities.

Table 12: Average family size of sample respondents

S. No.	Sex	No.	Percentage
1.	Male	2.46	47.13
2.	Female	2.76	52.87
Total		5.22	100.00

Sex ratio (No. of female/1000 male) = 1122

Table 13: Average number of family members up to 15 years among sample respondents

S. No.	Sex	No.	Percentage
1.	Male	0.17	40.48
2.	Female	0.25	59.52
Total		0.42	100.00

Sex ratio (No. of female/1000 male) = 1547

Table 14: Average number of family members above 15 years among sample respondents

S. No.	Sex	Average family size (No.)	Percentage
1.	Male	2.32	48.33
2.	Female	2.48	51.67
Total		4.80	100.00

Sex ratio (No. of female/1000 male) = 1051

Number of earners and their earnings depicts the economic status of a family. It also shows that how much a family is vulnerable to different types of shocks and how much capacity to withstand against such shocks. Due to lack of infrastructure in mountainous/hilly areas, farmers are more diverted to off-farm income sources. Table 15 indicates total number of workers and their percentage that are engaged in different off-farm activities in both districts and found that maximum number of farm household are labourers due to their less qualification, i.e about 62 per cent in Rajouri and 45 per cent in Poonch district of the study area, respectively.

Table 15: Distribution of farm households members on the basis of primary source of income

Source of income	Districts	
	Rajouri	Poonch
Business	23 (11.22)	21 (13.04)
Salaried employee	48 (23.41)	56 (34.78)
Labour	127 (61.95)	73 (45.34)
Pension	7 (3.41)	11 (6.83)
Total	205 (100)	161 (100)

Note: Figures in parenthesis represent % age to total

4.6 Land holding and cropping pattern

Crop production and livestock rearing are the two main agricultural enterprises adopted by the sampled households in hilly and mountainous areas. Major proportion of total cropped area was allocated towards cereals. Maize, wheat and paddy are the three main crops grown by the farm household in the study area. The holding size determines well-being and capacity to produce food for consumption as well as farm earnings. The farmers in the study area have an average holding of 0.53 ha in which majority (60%) of the farmers belongs to marginal farm category and rest to small farm category. The fragmented land patches of such a smaller holding size at several places further complicates the management and effective land use planning from farmers perspective resulting in further diseconomies of scale. On perusal of Table 16, it can be observed that the average holding size of marginal farmers is 0.34 ha while as small farm category is 0.81 ha. The holding size ranged from 0.06 ha to 1.65 ha across the surveyed farmers. The average holding size was found to increase as we move from plain to high altitude villages which may be due to the fact that upper zone villages/areas have lesser population pressure as well as joint family system. Across all the

farmers, a small portion of land adjacent to house is allocated for kitchen garden to fulfill the household needs. In Kharif season paddy is grown on irrigated lands while as the major portion (83%) of the net cultivated area fall under rainfed and is usually sown with maize+pulse as a mixed crop. Paddy cultivation is mostly concentrated on lower and middle zones wherever assured network of irrigation canals is available, while as, acreage under maize and pulse increases as we move from lower to upper zones.

Rabi season is solely governed by wheat crop and is grown as rainfed in these lands which are occupied by maize and pulse in kharif season. Because of low temperature as well as moisture availability during winter season, rabi crop in intermediate zone does not require supplemental irrigation. It is noteworthy to mention that wheat acreage increases as we move from lower to upper zone. The average cropping intensity in the study area was 194 per cent which declines from 218 per cent in lower zone to 179 per cent in upper zone.

Table 16: Land holding and cropping pattern of sampled farm households

Particulars			Marginal farmer (upto 0.50 ha)		Small farmer (0.51- 1.65 ha)		Lower zone (800- 1000masl)		Middle zone (1000- 1300)		Upper zone (1300- 1500masl)	
No. of farm respondents	251		157		99		61		70		120	
	Total Land (ha)	Avg. (ha)	Total Land (ha)	Avg. (ha)	Total Land (ha)	Avg. (ha)	Total Land (ha)	Avg. (ha)	Total Land (ha)	Avg. (ha)	Total Land (ha)	Avg. (ha)
Total Land Holding	132.22	0.53	51.97	0.34	80.25	0.81	28.18	0.46	35.47	0.51	68.58	0.57
Residential land	3.45	0.01	2.05	0.01	1.4	0.01	0.87	0.01	0.98	0.01	1.6	0.01
Pasture/Grass land	27.26	0.11	11.2	0.07	16.06	0.16	4.26	0.07	7.07	0.10	15.93	0.13
Kitchen garden	2.95	0.01	1.9	0.01	1.05	0.01	0.65	0.01	0.8	0.01	1.5	0.01
Kharif crop												
Paddy	14.2	0.06	2.25	0.01	11.95	0.12	6.2	0.04	6.15	0.09	1.85	0.02
Maize+Pulse	84.37	0.34	34.57	0.23	49.8	0.50	16.2	0.10	20.47	0.29	47.7	0.40
Rabi crop												
Wheat	92.73	0.37	36.62	0.24	56.11	0.57	26.51	0.43	27.08	0.39	39.14	0.33
Gross cropped area (GCA)	191.3	0.76	73.62	0.48	117.86	1.19	48.91	0.80	53.70	0.77	88.69	0.74
Operational holding	98.57	0.39	36.82	0.24	61.75	0.62	22.4	0.37	26.62	0.38	49.55	0.41
Cropping Intensity (%)	194		199		191		218		201		179	

4.7 Cost and returns from crop enterprises

Small-holder farmers in the study area operate a cereal based cropping system with maize, wheat and paddy as main crops. Maize along with pulse grown as an inter-crop on hilly areas in the district of Rajouri and Poonch. In almost all parts of Jammu and Kashmir, maize is grown as an inter-crop with pulse. The cost of cultivation of cereal crops were estimated considering the quantity of inputs, labour and their wages prevailing in the study area. The operational costs and returns along with production of three major crops grown by sample farm households are presented in Table 17.

Farmers incur both variable as well as fixed costs on the production of crops. Variable cost includes expenditure on part of ploughing, land preparation, seeds, fertilizers, manures, plant protection, cultural operations etc., while as, fixed cost component usually comprises of depreciation on part of farm machinery and buildings, interest on fixed capital and land rent. Table 17 depicts the cost structure of cereal grown in study area along with returns and profitability. Cultivation of paddy entails high cost (₹ 1,21,637/ha) followed by maize+pulse (₹ 1,07,704/ha) and least by wheat (₹ 82,685/ha). Variable costs constitute more than 75 per cent across all the crops. Expenditure on part of labour is the major cost component across all crops with almost 50 per cent share to variable cost component, which ranges from ₹ 26,000/ha in wheat to ₹47,000/ha in paddy and almost ₹ 50,000/ha in maize+pulse crop. However, almost 90 per cent of labour employed on farms is family labour which makes the reason that farmers continue with the farming.

Cost on part of manures and ploughing/land preparation with the help of tractor/bullocks are also major cost components of variable head. The manure is rarely purchased by the farm household and comes from their own livestock.

Average yield of main and by-product and returns obtained by the farmers from the cultivation of the major three crops is also depicted in Table 17. Average

yield from maize was 19.34 quintals per ha with 751 bundles of straw as by-product and 1.73 quintals of pulse which gave a total return of ₹ 87,045/ha. Similarly in wheat crop average yield obtained was 20 quintals/ha with 700 bundles of straw as by-product yielded gross return of ₹ 92,358/ha. In case of paddy, the average yield was 41 quintals with 719 bundles of by-product, yielding a gross return of ₹ 1,06,836/ha. Net return is found negative in maize+pulse and also in paddy crop however, it comes positive in wheat crop despite of lower gross returns which can be mainly factored due to relatively lower cost structure as compared to other crops.

The cost of cultivation for all the three crops depends verily on how farmer can efficiently utilize their available resources. However, it was found that variable cost forms the major proportion of total cost. One of the obvious reason was that farmers don't have adequate knowledge on how efficiently they can use seed, manure/fertilizer and other source of production for the cultivation of crops which ultimately lead to miss management of farm practices and raise the cost of production per hectare which deprived the farmers from obtaining the profit from their crop enterprises, also injudicious use of inputs like manure/fertilizer, seed rate etc are the reason for the low productivity of crops. For example in hilly areas of Jammu division the recommended dose of manure is 150 quintal per hectare in case of maize, paddy and wheat but in study area it was found that farmers applied a dose of 201 quintals in case of maize crop, 165 quintals in wheat and 193 quintals in case of paddy crop. Likewise seed rate is underutilized in case of wheat crop, the recommended seed rate in wheat crop is 112 kg/ha but farmers applied seed at the rate of 76 kg/ha which is too minimal than recommended seed rate. In case of paddy crop recommended seed rate is 40-45 kg/ha but farmers applied 130 kg of paddy seed per quintal. Recommended application of urea is 100 kg/ha in maize and wheat however, farmer used urea at the rate of 200 kg/ha almost double than that of recommended dose. Thus, it is evidently clear that farmer use the resource in an injudicious manner which ultimately is the reason of low

productivity and high value of variable cost/ha. Furthermore, the major share of costs (imputed value of owned family labour, manure, bullocks etc.) are farmers own assets and has not to pay for their services. That is why despite negative returns, farmers continue with these crops and facing systems as they don't take into account the imputed value of owned farm asset.

Table 18 showed the concept wise costs incurred on the production of maize wheat and paddy. The per hectare cost of cultivation towards cost A, cost B, cost C, respectively worked out to be ₹93,646, ₹1,07,704, ₹1,18,474 in case of maize+pulse. ₹63,085, ₹82,685 and ₹90,953 in wheat crop and ₹1,01,587, ₹1,21,637 and ₹13,3801 in paddy crop respectively. Net return over cost A, cost B, cost C, calculated as ₹ -6,601, ₹ -20,659 and ₹-31,429 in maize and pulse crop, ₹29,273, ₹9,673, ₹1,404 in wheat crop, ₹5,249, ₹-14,800 and ₹-26,965 in paddy crop respectively. However, the cost C was the overall average of total cost of production which included 10 per cent of cost B i.e value of management input. The major share of cost of cultivation goes towards cost B and cost C and this was due to total material cost like manure, fertilizer and family labour which constitute an important component of variable cost. Net return over cost A, B and C is positive in wheat crop however, it is highly negative in maize and paddy crop. Therefore rational use of input and economic efficiency maintenance is dire need for increasing the productivity and economic efficiency of cereal crop in study area.

Table 19 represent how much income and employment would be generated from the production of all these three major crop in Rajouri and Poonch districts of Jammu and Kashmir. The figures indicated the net income observed to be more for wheat crop (₹9,673) but it was found negative for paddy (₹-14,801) and maize + pulse (₹-20,659). Gross income was found to be highest in paddy (₹1,06,836) followed by wheat (₹92,358) and maize + pulse ₹87,045. Table 19 also reveal that number of mandays as well as income of family labour were more in paddy crop followed by maize+ pulse and wheat respectively.

Table 17: Cost of cultivation (₹/ha)

Particulars		Maize+Pulse		Wheat		Paddy	
		Qty.	Value (Rs)	Qty.	Value (Rs)	Qty.	Value (Rs)
Depreciation (buildings, farm equipments)			5372		6100		6500
Interest on fixed capital			2186		2500		2500
Land rent			6500		11000		11000
Total fixed cost			14058		19600		20050
Seed(kg)	36(M); 20(P)		3268(M); 2488(P)	76	2483	130	5115
Manure (qntl)	201		16038	165	13256	193	15406
fertilizers(qntl)	4		8561	3.31	7620	3.9	8776
Family labour	88		46113	50	24771	100	45393
Hired labour	6		3107	3	1606	2	1279
Bullock charge	3		8166	4	5750	5	8908
Tractor charge			4155		4915		8860
Plant protection chemicals			0		0	18	2802
Interest on working capital			2756		1928		3047
Miscellaneous			1750		756		2000
Total variable cost			93646		63085		101586
Gross cost			107704		82685		121637
Value of by-product			30400		27714		29463
Net cost (Gross cost-value of by-product)			77304		54971		92174
Yield	Main product (Qtls)	19.34(M); 1.73P		20		41	
	By-product (bundles)	751(M)		700		719	
Value of Main Product (₹)			38673(M) 17972(P)		61644		77373
Gross Returns (₹/ha)			87045		92358		106836
Cost of Cultivation (₹/ha)			107704		82685		121637
Net Returns (₹/ha)			-20659		9673		-14801
Cost of Production (₹/Qtl)			3997		2493		2248
(Net cost/Yield of main product)							

Table 18: Net return from crop enterprises over various cost level (₹/ha)

Particulars	Crops		
	Maize + pulse	Wheat	Paddy
Grain Yield (qtl/ha)	21.07	20	41
Fodder Yield (bundles)	751	700	719
Value of Main and by-product (₹/ha)	87045	92358	106836
Cost of cultivation (₹/ha)			
Cost A	93646	63085	101587
Cost B	107704	82685	121637
Cost C	118474	90953	133801
Net Returns (₹/ha)			
Over Cost A	-6601	29273	5249
Over Cost B	-20659	9673	-14801
Over Cost C	-31429	1404	-26965

Cost A: All actual expenses in cash and kind incurred in production by owner farmer including imputed value of family labour.

Cost B: Cost A + Interest on value of owned capital assets + Rental value of land+ depreciation on capital farm assets

Cost C: Cost B + 10% of Cost B on account of managerial functions performed by farmer.

Table 19: Income & Employment Generation from Crop Production in Intermediate zone (₹/ha)

Particulars/Crops	Maize+Pulse	Wheat	Paddy
Gross income(₹)	87045	92358	106837
Net income(₹)	-20659	9673	14801
Family labour income(₹)	46113	24771	45393
Employment (mandays)	88	50	100

4.8 Stochastic Frontier Production Function estimation

The maximum likelihood estimates of the parameters of the stochastic production frontier and inefficiency model are estimated using Frontier 4.1 computer programme to examine the parameter estimates of the production frontier and the factors that affect the efficiency of the farmers, Table 20 reveals that fertilizer and farm yard manure negatively affect the output level of maize, paddy and wheat crops. The magnitude of coefficient of labour indicated that output in crop production is highly elastic to change in the amount of labour used. One per cent increase in labour would induce an increase in output of 19 per cent in maize+pulse, 21 per cent in paddy and 25 per cent in wheat crop. Results are in conformity with Amaza *et al.* (2006) where they found that labour is the major factor that positively affects the output of food crops. Seed was being over utilized as evident from negative coefficient and significant. The value of sigma square is 0.032, 0.018, 0.029 in maize, paddy and wheat, respectively which indicate the existence of technical inefficiency among the farmers and also an indication of good fit and correctness of model. The estimated value of gamma was 0.74 for maize, 0.70 for paddy and 0.60 for wheat, which means that 74 per cent, 70 per cent and 60 per cent of inefficiencies for these crops respectively among farmers were due to factors which were under farmers control and 26 per cent, 20 per cent and 40 per cent were due to random factors beyond their control. The value of log likelihood function was significantly different from zero implies that inefficiencies exist in production of all the three crops.

4.8.1 Determinants of Technical inefficiency model

Technical efficiency relates to the degree to which a farmer produces the maximum feasible output from a given bundle of inputs. The main aim of this analysis was to provide an empirical evidence of inefficiency level among the farmers in the study area. The dependent variable of the model was farm inefficiency of the corresponding farm household and the independent variables are number of female, education years, family size, area (ha) and children. In this

analysis positive sign indicates that an increase in coefficient of explanatory variable increase the level of inefficiency among the farmer and vice-versa while negative sign indicates that as the value of estimated coefficient increase the inefficiency level of farmer decrease and vice-versa. Estimates of socio-economic factors like number of female, education years, family size, children were the most influential determinants of technical inefficiency. The focus of this analysis was to provide an empirical evidence of the determinants of productivity variability/inefficiency gaps among smallholder maize farmers in the study area. Results revealed that number of female, education years, family size and children decrease the technical inefficiency effect in maize, paddy and wheat crops signifying that these variables play a positive role in increasing the efficiency level of farm household (Table 20). The estimated coefficient of technical inefficiency revealed that women play a negative and significant role in increasing the technical inefficiency of crop growing farmer which indicate that as number of women/women participation increase in farm activities, their efficiency level increase and vice-versa. This finding is parallel with that of Rasheed, *et al.* (2020) where they found that women participation in agricultural activities reduced the inefficiency of farm by 47 per cent. As agriculture became more feminized in study area, it was found that women folk perform all on-farm activities except that of ploughing which ultimately increase the farm efficiency by devoting their maximum time in agriculture and allied activities. The cultivated area had a positive influence on increasing the inefficiency of all three crops which ultimately reduce the efficiency of farm households. Similar findings were observed by Bhatt and Bhat (2014) on negative effect of farm size on technical efficiency in Jammu and Kashmir. This is due to the reason that farmers with small farm use the land diligently which reduces the inefficiency level of farmers. When there will be small cultivated area, farmer use the resources in an efficient manner than the farmers with larger farm size. With increase in number of education years technical inefficiency of farm household decreases and is significant at 0.05 and 0.01 level of significance. Positive and significant impact

of education on technical efficiency verifies the importance of education in increasing the efficiency of a farm household. This is due to the fact that when farmer get more educated they get easily acquainted with new technology, proper knowledge about seed rate, application of required fertilizer dosage, using of high yielding varieties which ultimately increase farm efficiency level. As the age of respondents increases, technical efficiency increase, because the knowledge, experience and decision making capacity that the farmers gains over their farming years contribute in increasing technical efficiency. With the increase in family size more number of farm labour work force is available for farming activities thereby increasing the farm efficiency by fulfilling the shortage of labour at peak seasons like ploughing, sowing, weeding, harvesting etc. Analysis of technical efficiency of crop producing smallholder farmers in Tigray, Ethiopia by Shumet (2011) also revealed that an increase in age, education and family size increase the technical efficiency of farmers by increasing the farming experiences, decision making capacity and by availability of more labour to timely undertake the necessary farming activities.

4.9 Stochastic profit function

The maximum likelihood estimates of the parameter of stochastic frontier profit function presented in Table 21 revealed that the estimated coefficient of fertilizer, farm yard manure, labour and mechanization charge were negative for maize, wheat and paddy crop. However, cost of seed was found negative only in maize crop which reduce the profit of maize crop by 16 per cent. While in paddy crop, coefficients of all the concerned variables were negatively related with the profit except chemical cost and seed which was found to effect positively the profit of paddy farming. No chemical sprays for disease control is being used by the farmers in maize and wheat crop however, very few farmers used the plant protection chemical in paddy crop. These results are consistent with Samarpitha *et al.* (2016) where the coefficients of prices of seed, human labour and fertilizer showed a significant negative effect on the profits in paddy farms of Nalgonda

district of Telangana state and fertilizer cost and seed cost having negative effect on profits obtained from the cultivation of paddy in Liberia as reported by SAYSAY *et al.* (2016). The main reasons for poor profitability is due to high cost of input variables in hills, besides injudicious use, mountain characteristic of hilly area such as fragility, inaccessibility, etc. All these factors are the main reason for profit inefficiency which make the crop less profitable and lead the household vulnerability to shocks of poverty, uncertainty etc. The value of sigma square was found to be significant suggesting the presence of economic inefficiencies. Values of gamma were highly significant depicting the existence of profit/economic inefficiency to the level of 79 per cent for maize, 81 per cent for paddy and 89 per cent for wheat due to factors which are under farmers control and only 21 per cent, 19 per cent and 11 per cent of farmer inefficiency for these crops were due to random factors outside farmers control. Therefore to obtain optimal level of profit, inefficiency should be minimized. The value of log likelihood function gives a best fit to this stochastic frontier profit function.

4.10 Distribution of farmers under different levels of efficiencies

The technical efficiency ranges from 0-1, zero means perfect level of inefficiency and 1 indicated the perfect level of technical efficiency. The mean technical efficiency among the farmers was 86 per cent in wheat followed by paddy (80%) and maize (75%) which in turn implies scope for increasing production on an average by 14 per cent in wheat, 20 per cent in paddy and 24 per cent in maize by using existing resources and level of technology (Table 22). In maize+pulse, only 9 per cent of farmers cross technical efficiency level of 80 per cent followed by paddy where 34 per cent of farmers have TE greater than 80 per cent however, efficiency level seems to be better in wheat crop as more than 50 per cent of farmers cross technical efficiency level greater than 80 per cent. However, still there is presence of technical inefficiency effect in all the three crops as mean technical efficiency is worked out to be less than 1 indicating considerable amount of productivity loss due to inefficiency at farm level. This

variation in TE is an indication that most of the farmers in study area are using their resources inefficiently in the production process and opportunities exist for raising the productivity by improving the yield and enhance technical efficiency by following efficient management of crop practices without increasing the level of input resources. The economic efficiency was found 59 per cent, 68 per cent and 71 per cent in maize, paddy and wheat indicating that in the short run, farmers on an average can decrease input costs by 41 per cent in maize, 32 per cent in paddy and 15 per cent in wheat, respectively given the optimum level of output or in other words have the potential to further improve the economic efficiency by 41, 32 and 15 per cent in maize, paddy and wheat crops, respectively. Similarly, the mean allocative efficiency of crops in the study area was 66 per cent, 77 per cent and 83 per cent for maize, paddy and wheat, respectively which indicates that farmer could save upto 34 per cent, 23 per cent and 17 per cent of their current operational costs by behaving in a cost effective way. Results concluded that efficiency level of all the three types of efficiencies i.e TE, EE and AE found less than 1 in all the three crops however, it is observed more in wheat, followed by paddy and maize crop, respectively indicating that potential for increasing the level of all the three types of efficiencies is more in maize crop followed by paddy and wheat crop. Maize is the major crop grown in hilly areas so there is dire need of giving proper knowledge about scientific know-how to farmers to increase their efficiency level. Huge potential exists in producing the output of all crops in an efficient and profitable manner by following efficient crop planning and management practices.

Table 20: Estimation of stochastic frontier production function and technical efficiency

Crop	Maize		Paddy		Wheat	
Variables	Estimate	Std. Error	Estimate	Std. Error	Coefficient	Std. Error
Production factor						
Intercept	3.287	0.082**	2.495	0.519**	2.899	0.989**
Seed	0.182	0.019*	-0.235	0.095*	0.167	0.081*
Fertilizer	-0.246	0.011*	-0.423	0.019*	-0.519	0.097*
FYM	-0.045	0.010*	-0.081	0.028*	-0.460	0.043*
Labor	0.193	0.018*	0.213	0.010*	0.249	0.058*
Irrigation			0.537	0.115**		
Machine labour	0.230	0.022*	0.226	0.137	-0.067	0.960
Plant protection chemical			-0.036	0.029*		
Inefficiency factor						
Intercept	0.868	0.033**	0.910	0.015**	0.818	0.032**
No. of females	-0.503	0.007**	-0.034	0.004*	-0.050	0.007*
Edu. years	-0.271	0.001**	-0.771	0.006*	-0.314	0.007*
Family size	-0.486	0.005*	-0.237	0.002**	-0.035	0.005**
Area(ha)	0.657	0.029*	0.176	0.015*	0.072	0.028**
Age	-0.320	0.042*	-0.452	0.002**	-0.119	0.028*
Children	-0.091	0.012*	-0.598	0.006*	-0.337	0.011**
Diagnostic factor						
sigma square	0.032	0.002**	0.018	0.026*	0.029	0.075*
gamma	0.74	0.009**	0.703	0.117*	0.60	0.067*
Log likelihood value	32.77		44.770		43.235	

*and** denote significance at 0.05 and 0.01 level of significance

Table 21: Estimation of stochastic frontier profit function

Variables	Maize		Paddy		Wheat	
	Estimate	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Profit factor						
Intercept	10.358	0.460**	9.482	0.264**	11.340	0.398**
Seed cost	-0.162	0.017**	0.080	0.024**	-0.178	0.030*
Fertilizer cost	-0.161	0.026*	-0.196	0.061*	-0.267	0.021**
FYM cost	-0.289	0.027*	-0.229	0.077*	-0.413	0.031**
Labour charge	-0.444	0.020*	-0.149	0.070*	-0.187	0.019*
Mechanization charge	-0.267	0.026*	-0.408	0.075*	-0.079	0.027*
Chemical cost			0.022	0.007*		
Diagnostic factor						
sigma square	0.012	0.005*	0.084	0.009**	0.027	0.004**
gamma	0.79	0.050**	0.81	0.010**	0.89	0.064**
log likelihood value	28.07		30.784		19.40	

*and** denote significance at 0.05 and 0.01 level of significance

Table 22: Frequency distribution of all three efficiencies of maize, paddy and wheat crop

Maize			Paddy			Wheat		
Technical efficiency								
Efficiency percentage	No. of farmer	percentage	Efficiency percentage	No. of farmer	percentage	Efficiency percentage	No. of farmer	percentage
<40-50	4.00	1.59	<40-50	-	-	<40-50	12.00	4.78
50.01-60	25.00	9.96	50.01-60	-	-	50.01-60	20.00	7.97
60.01--70	63.00	25.09	60-70	13.00	21.31	60-70	12.00	4.78
70.01-80	137.00	54.58	70.01-80	27.00	44.26	70.01-80	70.00	27.89
80.01-90	13.00	5.18	80.01-90	10.00	16.39	80.01-90	117.00	46.61
>90	9.00	3.58	>90	11.00	18.03	>90	20.00	7.97
Total (No. of respondents)	251.00	100.00	Total (No. of respondents)	61.00	100.00	Total (No. of respondents)	251.00	100.00
Mean TE(%)	75.11		Mean TE(%)	80.00		Mean TE(%)	86.00	
Economic efficiency								
<40-50	66.00	26.29	<40-50	-	-	30-40	6.00	2.39
50.01-60	115.00	45.82	50.01-60	7.00	11.48	40.01-50	17.00	6.77
60.01--70	17.00	6.77	60.01--70	25.00	40.98	50.01-60	30.00	11.95
70.01-80	29.00	11.55	70.01-80	15.00	24.59	60.01--70	70.00	27.89
80.01-90	16.00	6.37	80.01-90	11.00	18.06	70.01-80	110.00	43.82
>90	8.00	3.19	>90	3.00	4.92	80.01-90	10.00	5.58
Total (No. of respondents)	251.00	100.00	Total (No. of respondents)	61.00	100.00	>90	80.00	3.98
Mean EE(%)	59.00		Mean EE(%)	68.00		Total (No. of respondents)	251.00	100.00
						Mean EE(%)	71.00	
Allocative efficiency								
<40-50	1.00	0.40	<40-50	-	-	30-40	5.00	1.99
50.01-60	67.00	43.82	50.01-60	2.00	3.29	<40-50	13.00	5.18
60.01--70	110.00	20.32	60.01--70	16.00	26.23	50.01-60	10.00	3.98
70.01-80	51.00	26.69	70.01-80	22.00	36.07	60.01--70	13.00	5.18
80.01-90	12.00	4.78	80.01-90	16.00	26.23	70.01-80	88.00	35.06
>90	10.00	3.98	>90	5.00	8.20	80.01-90	107.00	42.63
Total (No. of respondents)	251.00	100.00	Total (No. of respondents)	61.00	100.00	>90	20.00	7.97
Mean AE(%)	66.00		Mean AE(%)	77.02		Total (No. of respondents)	251.00	100.00
						Mean AE(%)	83.00	

4.11 Livelihoods

Livelihood can be defined as the capabilities, assets (tangible and intangible) and activities required to make a living (Chamber and Convoy, 1992). It will be sustainable and resilient when it can cope with and recover from shocks and stress and maintain or enhance its capabilities and assets, including the natural resource base both currently and in the future (DFID, 1999 and Chamber and Convoy, 1992). To comprehend whether mountain tribal farmers' life are sustainable or not, the Sustainable Livelihood Analysis Frameworks (SLF) have been proposed (Scoones, 1998 and DFID, 1999). Several studies related to rural livelihood have used SLF (Smith *et al.*, 2001; Liyama *et al.*, 2008; Ansoms and McKay, 2010; Xu *et al.*, 2015). It encompasses five interacting elements namely; livelihood strategy, mediating factors, outcomes that jointly create the livelihood of small holders, vulnerability context and capital asset pentagon (DFID, 1999). The livelihood framework of the farm households is discussed under following headings.

4.11.1 Household livelihood strategies and their dependence on agriculture

The present section discusses the patterns of livelihood diversification to explain the factors that influence to undertake diverse livelihood strategies; and outcomes of such strategies. The understanding of households' livelihood strategies requires analysis of levels of incomes from different sources which determine household's dependence on agriculture and its diversification strategy. This research seeks, within the sustainable livelihoods' framework, to contribute to understanding the specific factors and strategies that determine the livelihood pattern of the people living in inter-mediate hill agro-eco-zone.

The analysis revealed that farm households in the study area are more dependent on off-farm activities rather than on-farm activities and get their income from self-employed businesses, wage work and other non-agricultural activities to maintain their household livelihoods. Number of studies verified the

inability of agriculture to fully support livelihood security (Unni, 1996; Shylendra, 2002; Samal, 2006; Shukla and Shukla, 2007). The analysis of livelihood strategies revealed that on an average 31 per cent of farm household income come from agriculture activities and about 69 per cent come from off-farm sources (Table 23). Households were dependent on more than one source of income for their living. De-Janvry and Sadoulet (2001) had also found that off-farm activities generate on an average more than half of farm households' income in their study on "Income strategies among rural households in Mexico: the role of off-farm activities".

The study findings reveal that majority (56%) of households were less dependent on agriculture with income share less than 20 per cent and about 12 per cent were found to be extremely dependent on agriculture with income share greater than 60 per cent. About 23 per cent and 8 per cent of households were in the farm class of LS2 (moderately dependent) and LS3 (highly dependent) respectively. On an average, 69 per cent of income comprised of off-farm income and 31 per cent of agricultural income from total income. In LS1 farm class, 88 per cent of the share of household's total income came from off-farm source and rest 12 per cent from agriculture; where dependence on agriculture is very low. The proportion of off-farm income in total income in LS2 was as high as 71 per cent but agriculture still was an important source of income sharing about 29 per cent of the total income. Surprisingly, in LS3 half of the average share of income came from agriculture and half from off-farm sources. In LS4, more than half of farm household dependent on agriculture and rest (30%) on off-farm income (Table 23). The main reason for the diversification to off-farm livelihood strategies is due to very low income/profit obtained from farming in hilly areas which is not sufficient for a household to sustain their living. Thus the results are indication of a serious threat to agriculture sustainability in future.

Table 23: Livelihood strategies (LS) and income diversification table

LS Class	Agriculture income Share	Dependence on agriculture income	No. of household	Percentage	Average income share		Net household income from all source (₹)	
					Agriculture	Off -farm income	Mean	Range
1	below 20 %	Less dependent	142	56.57	0.12	0.88	48648	11314-150821
2	21-40%	Moderately dependent	58	23.11	0.29	0.71	28881	9060-64279
3	41-60%	Highly dependent	20	7.97	0.50	0.50	19936	7938-36514
4	above 60	Extremely dependent	31	12.35	0.70	0.30	16644	1056-35445
			251		0.31	0.69	114111.2	

4.11.2 Drivers of livelihood strategies

Several factors influence the livelihood strategies of farm household. They are broadly classified in five capital assets *viz*; (i) Human capital (ii) Natural capital (iii) Physical capital (iv) Financial capital and (v) Social capital. Table 24 indicates the mean and standard deviation of the five capital assets used in livelihood strategies model.

Human capital: Average family size was 5.22 person which ranged from 4.18 to 5.38 from the farm household livelihood strategies LS4 to LS1. Average number of workers in sampled farm households were found out to be 1.38 which increases with the family size. The burden on family head/elder member increase with increase in family size to earn more for their family means. Average number of children up to 15 years ranged in between from 0.25 to 0.43 from LS4 to LS1. Education years of the head of the household was found to be lower in LS4 and more in LS1. Average age of the household head shows increasing trend as we move from LS1 to LS4 indicating more dependence of older ones on agriculture activities than those who are young.

Natural capital: We have included two variables in natural capital (i) cultivated area and (ii) Standard Animal Unit (SAU), to determine the level of dependency of household on agriculture. The household who have more per capita area are more dependent on agriculture and vice-versa. Almost all of the households have livestock in hilly area of Jammu region. Majority of the people are rearing them for milk, curd, ghee, meat, wool etc. So the households with more land holding prefer to rear more livestock, because synergistic relationship of availability of fodder from crops for feed and in return farm yard manure (FYM) as livestock by-product for their crops. On the basis of descriptive analysis, the households who owned more livestock and having more holding were observed more dependent on agriculture for their livelihoods.

Table 24: Descriptive statistics for the independent variables

Variable	LS1		LS2		LS3		LS4		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Family size (No.)	5.38	1.28	5.32	1.17	4.90	1.19	4.18	1.10	5.22	1.18
Number of worker	1.63	0.25	1.58	0.20	1.29	0.05	1.18	0.06	1.38	0.64
Children (No.)	0.43	0.04	0.38	0.09	0.52	0.05	0.25	0.09	0.42	0.09
Hhedu (years)	7.96	1.06	7.41	1.17	6.95	1.31	5.94	0.57	7.60	1.95
HhAge (years)	43.77	10.42	45.93	10.21	55.01	11.99	52.01	11.55	44.75	10.85
Area (kanal)	1.39	0.87	1.64	0.46	1.89	0.95	2.00	0.96	1.52	0.17
SAU	2.45	1.44	2.72	1.43	2.96	2.25	3.01	2.41	2.91	2.19
Ln (house value) in ₹	1.97	0.78	1.92	0.78	1.55	0.67	1.20	0.59	1.89	0.78
Ln (fixed asset) in ₹	0.84	0.17	0.61	0.15	0.51	0.09	0.47	0.02	0.66	0.08
Loan (%)	0.20	0.08	0.17	0.06	0.16	0.05	0.03	0.01	0.07	0.03
Borrow (%)	0.56	0.01	0.68	0.09	0.48	0.05	0.70	0.09	0.59	0.09
Socialnetworkformoney	1.60	0.89	1.91	0.43	2.03	0.41	2.25	0.36	1.78	0.46
Socialnetworkforwork	2.58	0.99	2.13	1.9	2.14	1.12	1.83	1.15	2.02	1.09

Physical capital: Physical capital in present study majorly comprises of (i) value of house and (ii) household fixed assets which include agricultural implements, refrigerator, T.V, phone, bikes, car etc. These two variables were assessed by their market value. It could be seen from the results that households who are more dependent on agriculture have less valuable house and fixed assets and vice-versa.

Financial capital: Loans accrued from financial institutions and borrowing of money from relatives, friends etc were assessed and depicted in Table 24. Household heads who are educated and government employee were found to easily avail loan facilities than household heads who are less educated which were usually found to go for borrowing from friends, relatives etc.to meet their livelihoods such households were found more dependent on agriculture.

Social capital: It was assessed by households' social networks with friends, relatives, neighbours etc. Table 24 indicated that households with more social network or relations are mostly dependent on agriculture and seek help from friends and relatives when they are in urgent need of money and households who are less dependent on agriculture have social network to get help from in finding and providing work or other assistance.

4.11.3 Determinants of livelihood strategies

The present study attempts to identify how different factors affect the choice of livelihood strategies in hilly areas of the study region. It tries to explore the factors which are mainly responsible for households to determine their choice of livelihood. The analysis was done by using ordinal logistic regression model and the results are presented in Table 25. Results reveal that the value of wald χ^2 is 187.57 and probability greater than χ^2 which is equal to 0.0000. ($\text{prob} > \chi^2 = 0.000$) give best fit to model and also indicate that at least any one among independent variables chosen for analysis has a significant effect on dependent variable. In addition, the value of pseudo R^2 is 0.660 in this model which also shows the predictive strength of the model (Hu *et al.*, 2006). The results reveal

that with increase in family size and number of workers, dependence on agriculture reduces, in other words both these variables affects negatively the choice of livelihood strategy (dependence on agriculture) thus making them to lean more towards off-farm strategies in order to meet the basic needs of family like food, clothes, education, medical facilities etc. It is due to the fact that as the family size increases, the financial burden on household member increases, so majority of the households go for off-farm activities which provide them cash income for the survival. These findings are similar to that of Bezemer and Lerman (2002) which stated that larger households are more at risk of poverty and diversify more to off-farm sources of income. Household education was significant and found to affect negatively due to fact that with the attainment of education the dependence on agriculture reduces as they diversify toward off-farm sources. Household age was found significant and positively influence the livelihood strategies (dependence on agriculture) which indicated that as the farmer get older, their participation in off-farm activities start declining. This finding is similar to that of Asfir (2016) and Khatun and Roy (2012) where in they observed that age effect negatively to the decision to diversify livelihood strategies to off-farm source. The possible reason is that farmers who are relatively younger, leaving other factors constant, could be pushed to engage more in off-farm activities than agriculture. Moreover, younger generation is more attracted towards off-farm income activities for their livelihood besides being well accustomed and experienced in agricultural production; reluctant to new ideas and information, hence are more likely to continue with old age farming practices rather than venturing into new diversification activities. The per capita land owned by the household has a positive and significant relation with the dependent variable which indicates that households with more land are more oriented towards agriculture rather than diversifying their livelihood strategies towards off-farm activities. Standard Animal unit (SAU) was also found positive and significant relationship to dependent variable (dependence on agriculture). Jansen *et al.* (2006) and Barrett *et al.* (2005) had similar observations with households

owning more livestock are oriented more towards on-farm livelihood strategies than off-farm livelihoods. Likewise, Eneyew and Bekele (2012) in their study on “determinants of livelihood strategies in Wolaita” observed that likelihood of diversify livelihood into off-farm activities decrease by 1.9 per cent for household with more livestock number as they are interested more towards on-farm activities than off-farm source of income.

House value: Results reveal that as the value of house and other fixed assets increase, their dependence on agriculture reduces. More household assets value implies that they are more dependent on off-farm income and less on farm income. Houses have become a symbol of wealth for household in the society with more off-farm income as they possess enough financial resources for construction of attractive houses in order to maintain standard of living and societal status. Findings are similar with Xu *et al.* (2015). Their results showed that as the house value increases, household dependence on agriculture reduced by 1.7 times.

Financial capital: Loan was found to have a negative influence on livelihood strategies which is probably due to the reason that educated households with government jobs are availing more loan facilities from financial institutions and their dependence on agriculture is very low. On the other hand, households who are likely to borrow are more dependent on agriculture as it is difficult for them to avail loan from formal sources.

Social capital: Social network of relatives and friends available for assistance when in urgent need of money had a positive influence on livelihood strategies which means that households who are more dependent on agriculture have more strong network of relatives and friend when in urgent need of finances. Results are consistent with the findings of Xu *et al.* (2015) where they found that household with highly developed social network when in urgent need of money were 2.81 times more dependent on agriculture than those with no or very less social network. Social network of relatives and friends for assistance when seeking non-

farm work had negative and significant influence. Results are similar with the findings of Zhao *et al.* (2003) where they found that more than 75 per cent of the households were assisted by the relatives and friends in seeking non- farm work when they tend to diversify more towards off-farm source of income.

Table 25: Ordinal logistic regression estimates for the agriculture dependence model

Explanatory variable	Regression coefficient	Std. error
Family size	-0.424	0.173*
No. of worker	-3.462	0.545**
Children	-0.564	0.397
Hhedu	-0.340	0.050*
HhAge	0.036	0.018*
Area	0.711	0.019*
SAU	0.528	0.013*
ln(housevalue)	-0.019	0.002**
ln(fixedasset)	-0.103	0.005**
Loan	-0.831	0.011*
Borrow	0.576	0.0387*
Socialnetworkformoney	0.107	0.025*
Socialnetworkforwork	-1.253	0.353**

Note: No. of observation=251, Wald Chi²(14)=187.556; Prob> chi²=0.0000; Pseudo R² =.660,* and ** denote significance at 0.05 and 0.01 probability level.

4.12 Agriculture income inequality among the farmer

The Government of India always pays attention towards agriculture growth in production as well as productivity. There is a dire need to feed the growing population of India, to raise rural income, reduce the level of poverty and also to eliminate the various other issues which are sources for the prevalence of poverty in rural/hilly/mountainous parts of India. This is because, enhancing agriculture productivity encourage the farmers in realizing more remunerative price coupled with access to productive resource such as land, water, livestock and other inputs. However, the growth and development of sector/society is not inclusive and the welfare effects are usually observed iniquitous. So, in this regard inequality/equity concept is very important to understand the extent to which agriculture income is distributed among the farmers and how much it show equality/ inequality in agriculture income across the farm households in the study area. To measure the income inequality related to agriculture we used various statistical measures which are bottom sensitive as shown in Table 26 and also depicted through drawing the Lorenz curve. Gini-coefficient is the most commonly used measure of inequality as it meets the required axioms. The coefficient varies between 0- which reflects complete equality and 1- which indicates complete inequality (one person has all the income all others have none). Graphically, the Gini-coefficient can be easily represented by the area between the Lorenz curve and the line of equality. Inequality in agricultural income of farm household is measured by Gini-coefficient and it was found to 0.24 which indicated the presence of income inequality among farm household (Fig. 3). However, inequality is found to be more in Poonch district than Rajouri as in Rajouri Lorenz curve lies close to diagonal line (Fig. 4).

Beside this four other measures which were used to examine the pattern of income distribution, their coefficients and index are presented in Table 26. Aggregate ratio of all the other measures in these two districts shows the presence of agriculture income inequality among farmers and these values also support the

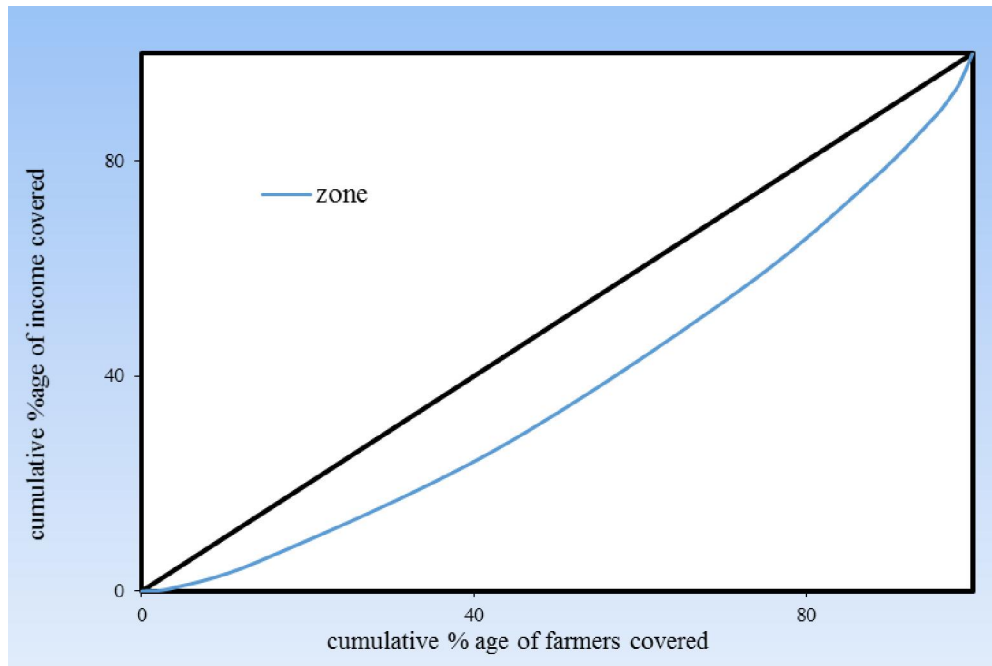


Fig. 3: Lorenz curve distribution of agriculture income among farmers

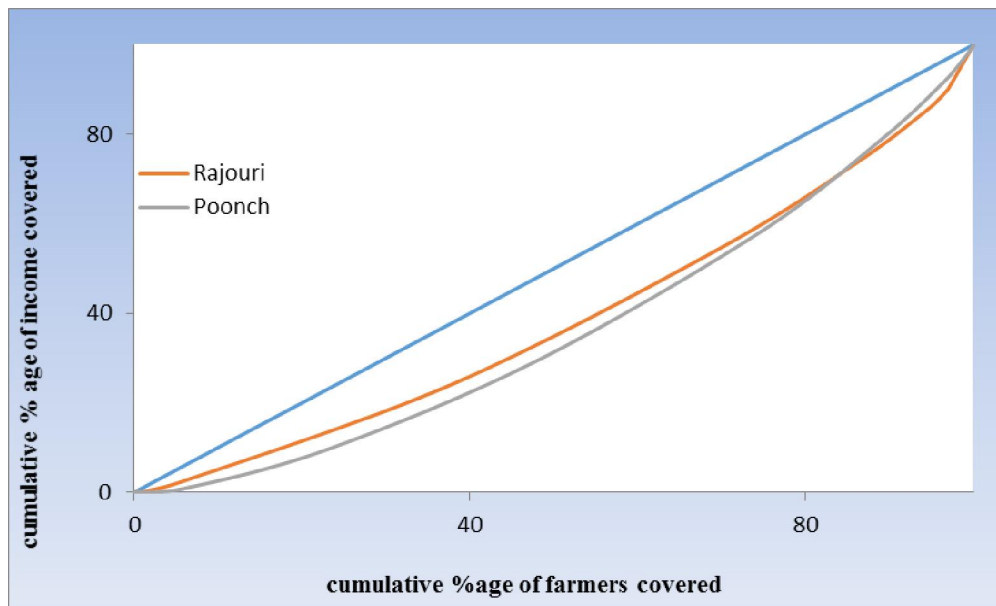


Fig. 4: Lorenz curve distribution of agriculture income among farmers in Rajouri and Poonch

Lorenz curve. The value of all index were observed more in Poonch districts than Rajouri, except the Exponential index, which shows around the same degree of inequality in both districts. Results are very much similar to the study done by Adams, 2001 and Davis *et al.*, 2010. Adams (2001) found that income from cultivation is the most important factor in income inequality and also per capita net receipts from cultivation contributed 50 per cent of income inequality of agricultural households. Davis *et al.* (2010) who undertook a cross country comparison of rural income generating activities, analysed data from 16 countries across four continents, viz. Asia, Africa, Eastern Europe and Latin America and found that the key drivers of income inequality varied across countries and observed that highest contributor to income inequality was income from crop cultivation. The most obvious reason for the agriculture income inequality among farmers is due to inequality in land and other resources. About 60 per cent of the household fall in marginal farm category having less than 0.50 ha of land and 40 per cent fall in the small farm category having farm size of greater than 0.50 ha. Also fragmentation of land due to increasing population pressure deprived them from attaining income equality because of the reason that household who have small land holding give more stress to off-farm source which make them less interested to make agriculture a remunerative sector as discussed earlier.

Table 26: Measures of agriculture income inequality

Inequality measure	Rajouri	Poonch	Overall zone
Gini concentration ratio (GCR)	0.219	0.259	0.240
Weighted Gini-coefficient	0.219	0.259	0.241
Theil-Entropy index	0.3940	0.515	0.883
Theil-Bernoulli index	0.090	0.150	0.120
Exponential index	0.401	0.408	0.405

4.13 Household vulnerability (Measurements and Determinants)

As the Rajouri and Poonch are the hilly districts of Jammu and Kashmir which are mostly inhabited by the tribal people and mostly deprived from all the sustainable livelihood facilities due to inaccessibility, fragility and mountainous characteristics of area. Therefore, the present study aimed to assess the vulnerability of tribal households by developing a household level vulnerability index and classifying the households into different levels of vulnerability. The study has attempted to integrate asset-based approach to look at the current levels of vulnerability and expected outcomes of development interventions in reducing household vulnerability of farm households.

The households in study area were found with multiple sources of income, particularly, working as skilled and unskilled labourers as their income from agriculture accounted for only 31 per cent of the total household income. Due to low farm income, these households relied more on off-farm source of income. Relatively high work participation ratio of 0.41 amongst sampled households might be an indication of distress owing to lower incomes, compelling more family members to work to supplement their income. All the above factors interact with each other to determine the overall vulnerability of these households. The vulnerability index for 251 households was estimated and these households were then classified into low, medium and high vulnerability households. The vulnerability classification under the above three categories was carried out by examining the average vulnerability and the distribution of values of vulnerability index for the sampled households. The three classes were determined by using the confidence intervals at 95 per cent level of confidence mean $\pm$ (2 standard deviations). The households with low vulnerability indicated their ability to cope with future shocks. Those with medium level of vulnerability were assumed to be suffering with relatively poor situation of socio-economic indicators and needed some urgent assistance to move out of such situation. Households showing high levels of vulnerability are perhaps not able to recover unless benefited with the

best possible interventions of income enhancement and socio-economic upliftment. Owing to small land holdings, low productivity, low household income and larger family size, about 61 per cent of the households were found in high vulnerability and 22 per cent in medium vulnerability category (Table 27) which points to the fact that more than 83 per cent of the tribal rural households were witnessing such levels of vulnerability that there is an urgent need for serious interventions to improve their livelihood.

Table 27: Vulnerability status of the household

Vulnerability status	Value of vulnerability index	Number of households
Low	Below 0.427	43(17.13)
Moderate	0.427-0.677	55(22.00)
High	0.677 and above	153(61.10)
Total		251(100)

Note: Figures in the parenthesis are %age

The result presented in Table 28 revealed that average annual income of household varies from high vulnerable to low vulnerable class i.e from ₹ 32,245 to ₹ 61,037. Operational area (ha) of the household who are less vulnerable was found to be relatively more than household who are more vulnerable to various shocks. Inverse relationship of the operational area to the vulnerability was found. Similarly, the household heads having more number of education years are less vulnerable and vice-versa. Family size was found to have negative relationship with vulnerability. The work participation ratio is high among low vulnerable household and low among high vulnerable household. Data also indicate that household with more livestock assets are less vulnerable than having less number of asset. These above discussed result shows consistency with Nkondze *et al.* (2013) and Vatta *et al.* (2017)

Table 28: Factors affecting vulnerability across various vulnerability classes amongst household

Particulars	Low vulnerability	Moderate vulnerability	High Vulnerability
Annual household income (₹)	61037	41588	32245
Education of household head (years)	18.74	7.80	0.60
Family size (No.)	4.60	5.64	6.21
Work participation ratio	0.41	0.30	0.24
Operational area (ha)	0.56	0.33	0.24
Livestock index	3.69	2.77	2.53

The factors like income, education, family size etc. presented in Table 28 expose a household to shocks, risks and also hamper living standard. In this context poverty and vulnerability overlap with each other. Poverty, small holding size, unemployment, low education attained by the household member is a key to vulnerability and exposes to various kinds of economic and climatic shocks. Household living in hills of intermediate zone increasingly rely on wages from off-farm sources. Livestock rearing etc. and face several problems from politically, instability, border valley externalities, remoteness, steep and hilly terrain and lacking public and private infrastructural support system. There is an urgent need for taking up developmental efforts at ground level to enhance coping capacity against various shocks through different social welfare programs.

4.14 Livelihood constructions and capital formation

A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain its capabilities and assets both now and in the future, while not undermining the natural resource base.

The livelihoods framework is a tool to improve our understanding of livelihoods, particularly the livelihoods of the poor. The sustainable livelihoods framework presents the main factors that affect people's livelihoods and typical relationships between these. It can be used in both planning new development activities and assessing the contribution to livelihood sustainability made by existing activities.

Table 29 show details of the selected village and zone (lower, middle and upper) in which they fall. Among twenty villages six villages fall in lower zone having altitude range from 800-1000 masl, seven village fall in middle zone (1000-1300) and twelve villages fall in upper zone having altitude range from 1300-1500 masl.

The livelihood framework identifies five core asset categories also known as asset pentagon upon which livelihoods are built, these are (i) human capital (ii) social capital (iii) natural capital (iv) physical capital and (v) financial capital. The livelihood construction and capital formation among tribal mountain households of inter-mediate zone is discussed under this framework.

Table 29: Different zone and the villages of study area

Lower zone	Block	Middle zone	Block	Upper zone	Block
Kaller	DoongiAgrati	Ghai	DoongiAgrati	Rajdhani	ThannaMandi
Loorkote	DoongiAgrati	Dharasamla	DoongiAgrati	Charung	ThannaMandi
Kheri	DoongiAgrati	Totamurah	Thannamandi	Kaller	ThannaMandi
DoongiBrahmna	DoongiAgrati	Dabsi	Balakote	Dharamsiot	ThannaMandi
Shahpurmanialla	DoongiAgrati	Chattral	Mendhar	Behrote	ThannaMandi
Jaggal	Mendhar	Pathantir	Mendhar	Lanjote	Balakote
		Ari	Mendhar	Dharutti	Balakote
				Panjani	Balakote
				Bhroti	Balakote
				Nar	Balakote
				Sakhimaidan	Mendhar
				Gohlad	Mendhar

4.14.1 Human Capital

At the household level, human capital is a function of knowledge, health, the quality and quantity of available labour and livelihood relevant skills. The results obtained from the household survey are comparable with several human capital indicators; the percentage of respondents who had received at least primary education was 43 per cent. As many of the survey respondents finished their education a long time ago, the current level of 87 per cent enrolment in primary education is indicative of progress towards the second Millennium Development Goal (MDG), achievement of universal primary education.

Health facilities are one of the major factors for livelihood assets and which ultimately affects the livelihood of the people. Table 30 shows the level of accessibility to health facilities in different zones of the study area. Distance from settlement determines the context of vulnerability and level of risk that people had been suffering. All the sampled villages in lower zone fall in block Doongi Agrati of district Rajouri and only one sampled village from district Poonch i.e. Jaggal fall in lower zone. There is no any sub district hospital in block Doongi Agrati but there is sub district hospital in block Mendhar, Balakote of District Poonch and in Block Thanna Mandi of district Rajouri. Regarding Primary Health Centre (PHC), respondents who are living in upper zone have low accessibility and people of lower and middle zone having high accessibility. There is no sub centre/village dispensary in lower zone however, there is high accessibility of people living in upper and middle zones for sub centre/village dispensaries. About 74 per cent of people have high accessibility of private medical shops and small clinics in lower zones and 26 per cent of people have moderate accessibility. The people living in middle and lower zones have moderate accessibility towards medical shop. As far as private doctors are concerned there is low private practice in lower zone where as moderate accessibility of such service in middle and upper zone. The accessibility of district hospital is high in lower and middle zones and low in upper zone.

Extension of programs and technologies in agriculture and allied sectors has a great role in capital formation. Among the Agriculture extension office, Horticulture development office and Animal and sheep husbandry department, the latter one has high accessibility in lower and middle zones (Table 31) whereas all of the other agencies have low accessibility in upper zone. People have low accessibility to officials and extension workers of SKUAST-J/KVK and agriculture related programs in almost all zones. However, high accessibility of farmers was observed with other farmers and input supplier as later store the seeds and fertilizers in their respective shops and are the major suppliers of essential farm inputs to the famers. There is almost negligible role of Rajouri and Poonch district local media related to dissemination of agriculture/animal husbandry information.

Table 30: Access to health facilities

Health Care Sources	Lower zone	Middle zone	Upper zone
Sub District Hospital	*	***	**
Primary Health Centre	***	***	*
Sub centres/Village dispensary	—	***	***
Medical Shop	**	**	*
Private Doctor	*	**	**
District Hospital	***	***	*

Note: * Low accessibility, ** Moderate accessibility, *** High accessibility

Table 31: Access to Agricultural/Animal Husbandry information

Information Source/ Extension agency	Lower zone	Middle zone	Upper zone
Agricultural Extension Officer	**	*	*
Horticulture Development Officer	**	**	*
Animal and Sheep Husbandry Deptt.	**	***	*
SKUAST-J/KVK	*	*	*
Other farmers	***	***	***
Seed/Input suppliers	***	***	***
Media	*	*	-

Note: * Low accessibility, ** Moderate accessibility, *** High accessibility

4.14.2 Natural capital

Natural capital is the term used for the natural resource stocks from which resource flows and services (e.g. nutrient cycling, erosion protection, watershed services, biodiversity etc) useful for livelihoods are derived. There is a wide variation in the resources that make up natural capital, from intangible public goods such as the atmosphere and biodiversity to divisible assets used directly for production (trees, land, water, pastures, NTFPs etc). Natural capital was found an important component of livelihood asset basket among the residents of intermediate zone, particularly the dependence on this asset set was found of high degree among the pastoralist group living at higher altitudes. Table 32 depicts the natural capital assets of households expressed in absolute metric units as well as in relative terms. On an average the land holding in lower zone is 0.46 ha followed by 0.51 ha in middle and highest in upper zone of study area i.e 0.57 ha. Livestock forms an important component in this asset basket and as important livelihood option. Hence, they are an integral part of household economy. Household living in hilly areas have their own livestock in the form of buffalo, cow, calf, bullock, sheep and goats, horses etc. Average number of cow per household was low across all the three zones than buffalo. Average number of bullocks were observed relatively high in upper zone as they are reared for

ploughing purpose on difficult terrains while tractorization is impossible or out of reach. Likewise, rearing and domestication of small ruminants (sheep and goat) is more among high altitude households as they majorly belong to pastoralist communities.

The use of natural resources from common lands as well as forest fringes in form of collection of fuel wood, grass for livestock and other NTFPs was of higher order in upper zone villages than that of lower zone areas. However, lower zone villages were found to have better water supply due to piped water supply schemes in those areas as compared to people living in upper zones who were found restricted with scanty water sources of natural springs which are also now drying up due to climate change as reported by the people living in such areas.

Table 32: Natural capital and access to resources

Natural Capital	Lower zone	Middle/central zone	Upper zone
1. Land(ha)	0.46	0.51	0.57
2. Livestock			
Buffalo	1.52	1.95	2.24
Cow	0.18	0.06	0.05
Calf	0.34	0.6	0.47
Bullock	0.10	0.08	0.19
Sheep and goats	1.85	1.92	3.45
Horses	0.04	0.14	0.11
3. Water resources(availability)	**	*	*
4. Natural Resource Collection			
Fuel wood	*	**	***
Grass	*	**	**
NTFPs	*	**	***

Note: * Low accessibility, ** Moderate accessibility, *** High accessibility

4.14.3 Physical capital

Physical capital consists of the basic infrastructure and producer goods needed to support livelihoods. Infrastructure components such as road and affordable transport network, secure shelter and buildings, adequate water supply and sanitation, clean and affordable energy and access to information (telecommunication network) etc are essential for sustainable livelihoods. Infrastructure is commonly a public good that is used without direct payment. Exceptions include shelter, which is often privately owned and some other infrastructure that is accessed for a fee related to usage (e.g. toll roads and energy supplies). Producer goods may be owned on an individual or group basis or accessed through rental or ‘fee for service’ markets, the latter being common with more sophisticated equipment.

Physical capital is a function of the existing infrastructure, which may be freely or nominally accessible to households in the location and the implements available for assistance with livelihood construction. It is therefore necessary to consider both the existing infrastructure and the generation and variation of household physical capital and how this varies by a range of factors. Infrastructure that is generally accessible to all the population in the study area includes the road and transport network. Resources that may necessitate payment for usage include water, telecommunication services, machinery to assist agricultural production, particular forms of energy consumption and educational establishments.

Present study has presumed that insufficient or inappropriate production of physical goods and services can constrain people’s productive capacity. In this study physical assets were housing materials, housing goods and other gadgets of the houses that are essential for the community to live their daily lives. Physical assets include basic infrastructures and producer goods which are essential to support livelihood such as access to road, electricity, water supply and access to communication facility among the tribal hill farmers. Like other assets, there are several common assets which affect the livelihoods of households. These assets

are road, water facility, electricity, communication and other services and their availability as well as accessibility for people living in these areas. Infrastructure plays a very important role in analysing the economic condition of households.

The physical capital as well as its accessibility and usage were determined through qualitative information on the variables across the three zones which is summarised under Table 33. The information reveals varied degrees of physical asset either under public or private domain along with their usage and accessibility. The physical assets apart from own private capital assets also comprises of public infrastructure goods and services which creates efficiency and effectiveness in production process as well as livelihoods and overall living standard. These are discussed under following sub-headings.

4.14.3.1 Road and transport facility in study area

Road and transport facility is an important determinant in development and welfare of a given region. Lower zones were observed with moderate road network while as middle and upper zones had poor road infrastructure. Availability of transport was of average order in lower and middle zones where as poor transport facility was found in upper zone. The internal road network leading to villages are not macadamized and are usually gravelled with major portions damaged. Transport is very scanty which ends up in long waits and wastage of time. In middle and upper zones, number of villages are still not connected properly with roads. Therefore, the transportation connectivity is lacking in such areas. In nut-shell, the high altitude areas lag behind in mobility and connectivity with no public transportation system. Due to this, they are not able to take the advantage of road networks which ultimately limits their livelihood strategies and make a household more vulnerable especially during sickness, expecting mothers, etc., as they cannot reach hospital on time and can pose a severe threat to the life.

4.14.3.2 Building Infrastructure

Availability of wood logs and stone in the upper reaches of hilly areas

makes these materials cheaper than other house-making materials. So, majority of houses are log-wood houses with stone as basal material. The poor housing asset of the respondents had different implications to the livelihood strategies and assets. It largely affected their livelihood security and social prestige in the society. About 73 per cent of respondents living in upper area have houses made up of mud and stone with roof stand on log-wood and soil and only 10 per cent of respondents have houses made up of cement and stone where leftover 10 per cent of respondents have pacca houses. In lower zone 50 per cent of respondents have houses made up of mud and stone, 18 per cent have pacca houses and 32 per cent have houses made up of stone and cement. In middle zone only 10 per cent of respondents have pacca houses, 70 per cent have houses made up of stone and mud and 20 per cent have houses made up of cement and stone.

4.14.3.3 Water supply and sanitation

The sanitation and access to proper toilets is the basic condition to live and is one of the major components of physical asset. The availability of natural water resource which includes stream, spring, in the community has started to recede during last couple of years and such resources are far from their houses which takes a lot of time of women folk to collect it from its natural source. There is poor availability of piped drinking water, quality of water and sanitation in upper and middle zones (Table 33). However, there is average facility of piped drinking water for short periods in lower zone of the study area. It can be observed that higher proportion of respondents of higher altitude areas were not satisfied with the current situation of drinking water facility. The results presented in Table 33 shows that most of the households (72 %) had built their toilets in lower zone while as its proportion in middle and upper zones was abysmally very poor and majority are still acquainted with open sanitation in such areas.

4.14.3.4 Energy source and access

The electricity is a basic infrastructure as a source of energy which has

both direct and indirect contributions to livelihood and quality of life. Time as well as quality of electricity supply is very poor in upper zone, however, average in lower and middle zones as reported by the respondents. When they were asked the “purpose of using electricity”, almost the households answered that they used for lighting because the quality of light was very poor and cannot be used for cooking purpose. Wood is used for cooking purpose through traditional means known as *Chulas*. Almost every household has cooking gas and cylinder after the launch of Pradhan Mantri Ujjwala Yojna Scheme 2016 under which government provided free LPG connections to women of below poverty line families and also priorities to household belonging to SC and ST category. The subsidized amount is credited in the saving bank accounts of the women who applied for this on refilling of the cylinder, but beside this women folk are still using wood as fuel.

4.14.3.5 Telecommunication network

The communication asset of the upper region of hilly area was found poor in comparison to other zones. The study revealed that 99 per cent of the total household have mobile phone access, however all of them don't have smart phones. Radio service abundantly used by people living in upper and middle zone, however its usability is low in lower zone of study area. It could also be possible that due to the hilly and mountainous geographic location which cause difficulty in providing good network facilities as main reason for poor connectivity. Television affordability was seen moderate in lower zone however, it is very low or minimal in middle and upper zones.

Table 33: Physical capital assets across the various zone

Particulars	Lower zone	Middle/ central zone	Upper zone
Road and transport			
Road network connection	Moderately	Poorly	Poorly
Quality of roads	Average	Very poor	very poor
Availability/Affordability of transport service	average	low	low
Building Infrastructure			
Mud and stone house	50%	70%	73%
Stone with concrete	32%	20%	17%
Brick with concrete	18%	10%	10%
Water Supply and Sanitation			
Piped drinking water	Good	Poor	Poor
Availability of water	Average	Poor	Poor
Quality of water	Average	Poor	Poor
Timeliness of water	Average	Poor	Poor
Sanitation	Average	Poor	Poor
Toilet facility available to	72 %	20 %	8%
Energy Source and Access			
Cooking gas	***	**	*
Wood	**	**	***
Manure cakes	—	—	—
Electricity	**	**	*
Telecommunication Network			
Cell phone	***	***	***
TV	**	*	*
Radio service	*	***	***

Note: * Low accessibility, ** Moderate accessibility, *** High accessibility

4.14.4 Financial capital

Financial assets denote income flows from various sources that people use to achieve their livelihoods. These assets comprise of the availability of cash or equivalent that enables people to adopt different livelihood strategies. Assets/stock in rupees possessed by respondents across all three zones is depicted in Table 34. Deposits in banks were lower in upper zone and significantly high in lower and middle zones. People living in lower zones have better opportunities for livelihood options and jobs as compared to middle and upper zone. The value of luxurious items was high in lower zone whileas value of implements used in farming was high in upper zone than other two zones.

Livelihood strategies denote wide range of activities that households adopt in order to meet their livelihood needs. The sources of income of household found in study area were majorly classified into (i) agriculture and allied activities and (ii) off-farm income. The most common livelihood strategy of the respondents found as a manual labour in off-farm activities. Average household income from agriculture crop production system was lower in upper zone (0.70 lakh rupees) relative to lower zone (0.81 lakh rupees). Income from livestock products in upper zone was 0.74 lakh rupees while as 0.61 lakh rupees in middle zone and 0.52 lakh rupees in lower zone. Forest products contribute an average income of 0.46 lakh rupees per household in upper zone followed by 0.31 lakh rupees in middle and lower zone. On the other hand, income from public and private employment contributed about 0.91 lakh rupees of total income in upper zone and 1.44 lakh rupees in lower zone. Income earned from business activities was high in lower zone due to more opportunities for commerce activities in relation to high altitude areas. Average income earned by doing labour work was 1.82 lakh rupees in upper zone followed by 1.29 lakh rupees in middle zone and 1.50 lakh in lower zone. Financial capital was found to be more concentrated in lower zone villages because of wide options for livelihoods and capital formation in relation to middle and upper zones.

Table 34: Financial capital (Stock and flows) across three zones

Particulars	Lower zone	%age	Middle zone	%age	Upper zone	%age
Stocks (₹ in lakh)						
Deposits in banks	0.94	6.52	0.83	6.50	0.1	0.85
House	10.13	70.30	8.07	63.19	7.75	66.24
Jewellery	0.80	5.55	1.1	7.42	0.50	4.27
Livestock	2.48	17.21	2.68	20.99	3.23	27.61
Tools and Implements	0.06	0.42	0.09	0.70	0.12	1.03
Sub total	14.41	100.00	12.77	100.00	11.70	100.00
Income flows from						
Agriculture	0.81	14.89	0.89	19.35	0.7	14.34
Livestock	0.52	9.56	0.61	13.26	0.74	15.16
Forest product	0.32	5.88	0.31	6.74	0.46	9.43
Sub total (lakh)	1.65	30.33	1.81	39.35	1.90	38.93
Off -farm income						
Employment(Public/Private)	1.44	26.47	1.29	28.04	0.91	18.65
Business	0.85	15.63	0.21	4.57	0.25	5.12
labour	1.50	27.57	1.29	28.04	1.82	37.30
Sub total	3.79	69.67	2.79	60.65	2.98	61.07
Annual income (lakh)	5.44	100.00	4.60	100.00	4.88	100.00

4.14.5 Social capital

The networks of relationships among people who live and work in a particular society, enabling that society to function effectively. In other words, social resources which people use in pursuit of their livelihood are commonly recognized as social capital. They are in form of networks and connectedness, membership of formal groups and reciprocity. A few number of people were found to be affiliated with political parties in lower and middle zones; however no such kind of membership with any political party or NGO was observed in upper zone. However there is high connectivity of people across all three zones with panchayats.

4.14.6 Capital Asset Pentagon

The livelihood asset pentagon is perceived as a ‘multidimensional process’ which measures the socio-economic situation, as well as livelihood asset status with respect to study area. In general, livelihood asset pentagon measures the socio-economic situation and it includes scores generated from livelihood assets. As the livelihood asset pentagon has multi dimensional aspects, it includes financial asset, natural asset, social asset, human asset and physical asset. So that it is important to select true and representative parameters of sustainability of livelihood. Also it explains how much hilly people living in respective geographical location are privileged in owning the livelihood assets aggregating the inequities in the distribution and allocation.

In this study, five major components considered are (i) human asset (ii) social asset (iii) natural asset (iv) financial asset and (v) physical asset. Each major component has several sub-components as mentioned earlier and shown in Table 35 which actually determine the livelihoods of individual and how these influence the person in society. Asset pentagon is based on the score obtained by each indicator (component) of the capital asset. The figure 5 of asset pentagon depicts that household lying in innermost pentagon represent the minimum level

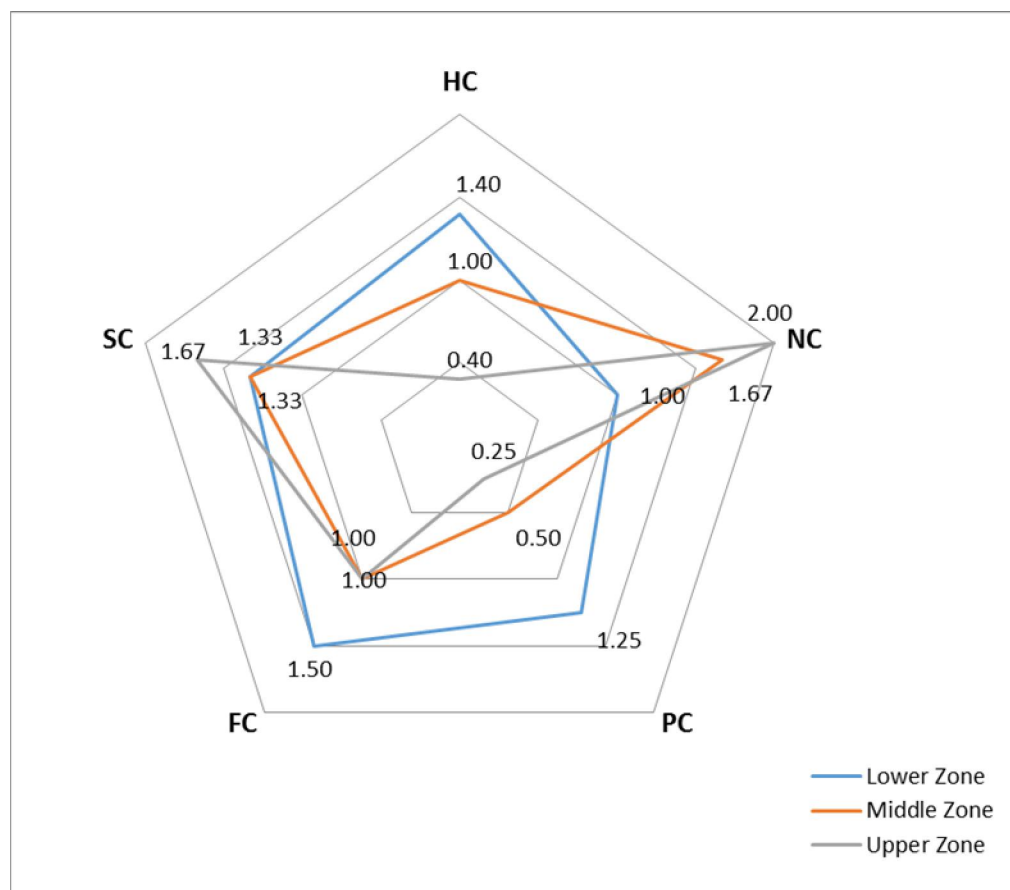


Fig. 5: Capital Asset Pentagons

of asset or in other words we can say that household improve as we move away from the innermost pentagon. Based on score gained by the each capital it was observed that lower zone has higher score for financial capital (1.50) followed by human capital (1.40), social capital (1.33), physical capital (1.25) and natural capital (1.00). Middle zone received maximum scores in natural (1.67), social (1.33) and financial capital. As expected, upper zone got maximum scores in natural capital i.e 2.00 followed by social capital (1.67) and minimum in physical capital and human capital. The figure revealed that lower zone is more skewed towards financial capital and less towards social and natural capital. On the other hand, middle zone is more skewed towards natural and social capital. However, Upper zone was found to be more skewed towards natural and social capital than other capital assets. Thus on the basis of above observation it can be concluded that household who are living in upper and middle reaches of study area are found to be more vulnerable to economic shocks and health issue and poverty shocks and thus more prone to various unsustainable livelihood issue thus it could be seen that is clear bias with the household living in upper and middle reaches of mountainous area. The household living in upper zone having high score for natural capital indicated that some effort should be taken to for proper management and preventing of natural resource *viz.*, forests, pastures, grasslands and other natural resources from being over exploited.

The present study has identified and analysed indicators of unsustainability, their underlying processes and the focused efforts to reverse the same to restore sustainability. This framework has been conceptualised based on the past work in similar field by Jodha (1992) and Shrestha (1992) and same has been summarised under in Table 36.

Table 35: Indicator and rank of capital assets

S. No.	Indicator	Score given		
		LZ	MZ	UZ
1.	Human Capital			
(i)	HC1: % of respondents with at least primary education	2	1	1
(ii)	HC2: % of respondents with at least secondary education	2	1	0
(iii)	HC3: % of respondents with access to healthcare	1	2	1
(iv)	HC4: % respondents with access to extension services	1	0	0
(v)	HC5: Awareness of education, health and extension programmes	1	1	0
2.	Natural Capital			
(i)	NC1: Average size of holding	1	1	2
(ii)	NC2: Level of dependence on natural resource for livelihood	1	2	2
(iii)	NC3: Reliance on fuel wood for energy	1	2	2
3.	Physical Capital			
(i)	PC1: Quality of roads in the area	1	0	0
(ii)	PC2: Access to piped water	1	0	0
(iii)	PC3: Quality of housing	2	1	1
(iv)	PC4: Usage of electricity/solar light	1	1	0
4.	Financial capital			
(i)	FC1: Average annual income	2	1	1
(ii)	FC1: Possession of livestock	1	1	2
(iii)	FC1: Possession of valuable household items (jewellery, household asset, automobile)	1	1	0
(iv)	FC5: Importance of off -farm income	2	1	1
5.	Social capital			
(i)	SC1: Social network of relatives and friends available for assistance when seeking non-farm work	1	2	1
(ii)	SC2: Social network of relatives and friends available for assistance when in urgent need of a lot of money	2	1	2
(iii)	SC3: Reliance and connectedness with panchayat/village groups	1	1	2

Note: LZ= lower zone; MZ=middle zone; UZ=Upper zone

Table 36: Searching sustainability through understanding unsustainability dynamics

Indicator	Effects	Causes /promotional activities
Resource Base	Less availability of per capita and fragmented land	Pressure of population on land
	Vast area of land not fit for cultivation	Presence of Rock and very steep land
	Spring/ water resource are disappearing water flow getting reduced and also some water resource are completely dried	Raising temperature, unevenly rainfall
	Increased land slide	Due to fragility of soil in hilly areas
Production flows	Low potential for crop diversification	As the hilly areas are agrarian in nature. Farmers not diversify their land for horticultural land beside the hilly areas are suitable for horticultural crops like walnut, peach, plump, pear etc.
	There are presence of some medicinal herbs and plants but have less scope for their harnessing,	They are getting far from their
	Low level of yield in agricultural crops	Unevenly rainfall distribution, injudicious use of FYM and fertilizer
	No soil testing, disease control, soil fertility management	Unaware d lack of facilities
	Lack of rain water harvesting measure	Lack of infrastructure and facilities
	Interest towards off -farm income	No profitable crop production
Resource management	Same type of crop rotation on same piece of land	Only grow two crops Kharif and Rabi.
	Low income from agriculture and allied activities	Promote livestock product and by product
	Less availability of money. Misery condition of people living in hilly areas.	Improve credit, extension and insurance facilities for agriculture and livestock at ground level in hilly areas
	Horticultural crops like walnut, peach, apricot, pear and vegetables are not commercially in hilly areas	As the people living in hilly areas are traditionally grow agricultural crops. Therefore various institutions have to Enhance support and encourage for horticultural crops.
	Almost all the farmers kept their produce for personal consumption	Lack of remunerative price and market infrastructure for their produce.

Chapter 5

SUMMARY AND CONCLUSION

Jammu and Kashmir is a mountainous union territory and occupies a central position in the continent of Asia. Out of 3.5 million ha of mountainous area of India, nearly two-third i.e, 2.3 million ha are found exclusively in Jammu and Kashmir. The UT of J&K has been divided into three broad macro-climatic zones. These are sub tropical Jammu region (up to 800 m masl), intermediate/semi temperate mid hills (800-1500 m masl) and temperate Kashmir valley (1500-2500 m masl). Rajouri and Poonch are the two important mountainous districts which fall in intermediate agro-climatic zone. Inter-mediate zone is transition between sub-tropical and temperate comprises of the mid and high altitude areas of the Panjal trap having altitude range from 800-1500 m masl. Agriculture is substantially more important to households living on mountains than the people living in urban areas. Although, hilly areas always remained socially and economically backward mainly because of the inaccessibility, fragility, marginality, diversity and niche conditions due to this reason agriculture in the hills and mountains areas suffer from inherent constraints of under pressure from natural and human-induced stresses which reduces the farm sustainability, low/negative net returns from crop enterprises and also increases the level of vulnerability to various shocks, risks, trends etc. which force the farm households to diversify more towards off-farm source of income. Even though hill agriculture is constrained with numerous challenges but also offers opportunities that need to be harnessed for productive potential with respect to natural resource and agro-climatic diversities as well as niche areas. Therefore, the above background makes it imperative to comprehensively analyze the sustainability, equity, vulnerability, farm efficiency and various other issues in intermediate agro-climatic zone of J&K. Accordingly, present study is a humble endeavour to analyze these aspects with following specific objectives:

- Analyze the livelihood platforms and their contribution to farm households.
- Estimate efficiency of farming systems and equity/ access to resources.
- Assess the sustainability and vulnerability of farming systems.

Since study is based on intermediate zone of Jammu and Kashmir therefore, the primary survey was conducted from the farm households of Rajouri and Poonch districts falling under this zone. Multistage stratified random sampling technique was employed for the selection of blocks, villages and farm households. In the first stage of sampling, two district *viz.* Rajouri and Poonch were selected purposively as these two districts are representative areas of intermediate zone of the UT. In the second stage, four blocks, two from Rajouri and two from Poonch district were chosen randomly. In the third stage of sampling, 25 numbers of villages were selected by stratified simple random sampling and 251 farmers were identified from the selected villages for farm household survey data. The selection of villages from each block/district was carried out in such a way so as to get representative sample of villages from low, medium and high altitude habitations.

Based on formulated objectives, various analytical procedures were employed, besides tabular analysis such as, averages, ratios and percentages for the data related to various socio-economic indicators like cropping pattern, land utilization pattern, costs and returns from agricultural enterprises etc. Since agriculture is the mainstay for the people living in mountains, so in order to understand about sources of income and their dependence on agriculture along with the factors that influence to undertake diverse livelihood strategies, we applied Ordinal Logistic Regression Model. For the purpose of estimation of farm households' efficiency regarding their farm activities, Cobb-Douglas form of stochastic frontier function was employed owing to its simplicity and also because of the easily interpretation of the variables. In order to understand the extent to

which agriculture income is distributed among the farmers and how much it show equality/ inequality across the farm households in the study area, inequality measure like Gini concentration ratio and weighted Gini-coefficient were used beside other statistical measures like Theil Entropy Index, Theil Bernoulli Index and Exponential Index to calculate income inequality. The reason for using three other statistical measures for inequality analysis is to control peculiarities in the data. As the area comprises of hills mostly inhabited by the tribal people with meagre livelihood options due to mountain characteristics of the area, present study aims to assess the vulnerability of tribal farm households by developing vulnerability index and classifying the households into different levels of vulnerability. In this study, Household Vulnerability Index (HVI) was used to measure vulnerability of farmers in study area, HVI act as a measure of overall risk from a hazard to which a household is exposed to and its capacity to mitigate the adverse effects. To measures the socio-economic situation, as well as livelihood asset status with respect to study area, we used livelihood asset pentagon which is perceived as a ‘multidimensional process.’ In general, livelihood asset pentagon measures the socio-economic situation and it includes scores generated from livelihood assets. As the livelihood asset pentagon has multidimensional aspects, it includes financial asset, natural asset, social asset, human asset and physical asset. Therefore, it is important to select true and representative parameters of sustainability of livelihood in order to explain how much people living in respective geographical locations are privileged in owning the livelihood assets aggregating the inequities in the distribution and allocation.

Based on tabular analysis of the collected primary information from farm household survey, it was found that 61 per cent farmers belonged to marginal and 39 per cent to small farm category with none in medium and large class farm category. Income from agriculture and livestock activities contribute about 34 per cent while as majority (66%) comes from off-farm sources. Majority (59%) of family heads have less than 45 years age, 27 per cent farm family heads belong

above 55 year age and only 14 per cent fall in age group of 45-55 years. It means that about 73 per cent of family heads are in productive stage and prove more active in their field in order to take up better and improved technologies to harvest untapped potential of their farms. About 39.53 per cent family heads have attained education up to 10th standard. As high as 42.63 per cent of family heads were found illiterate in the study area which could lead to lack of awareness. The average family size in the study area was 5.22 members and female members have outnumbered their male counterparts, which resulted in favourable sex ratio.

Crop production and livestock rearing are the two main agricultural enterprises adopted by the sampled households in hilly areas. Major proportion of total cropped area was allocated towards cereals. Maize, wheat and paddy are the three main crops grown by the farm household in the study area. The holding size determines well-being and capacity to produce food for consumption as well as farm earnings. The farmers in the study area have an average holding of 0.53 ha in which majority (60%) of the farmers belongs to marginal farm category and rest to small farm category. It was observed that the average holding size of marginal farmers is 0.34 ha while as small farm category have 0.81 ha. The holding size ranged from 0.06 ha to 1.65 ha across the surveyed farmers. In Kharif season, paddy is grown on irrigated lands while as the major portion (83%) of the net cultivated area fall under rainfed and is usually sown with maize+pulse as a mixed crop. The average cropping intensity in the study area was 194 per cent which declines from 218 per cent in lower zone to 179 per cent in upper zone. The cost of cultivation for all the three crops depends verily on how farmer can efficiently utilize their available source. However, it was found that variable cost forms the major proportion of total cost. The cost C was the overall average of total cost of production which included 10 per cent of cost B i.e. value of management input. The major share of cost of cultivation goes towards cost B and cost C and this was due to total material cost like manure, fertilizer and family labour which constitute

an important components of variable cost. Net return over cost A, B and C is positive in wheat crop however, it is highly negative in maize and paddy crop.

The maximum likelihood estimates of the parameters of the stochastic production frontier reveal that fertilizer and farm yard manure negatively affect the output level of maize, paddy and wheat crops. The magnitude of coefficient of labour indicated that output in crop production is highly elastic to change in the amount of labour used. One per cent increase in labour would induce an increase in output of 19 per cent in maize+pulse, 21 per cent in paddy and 25 per cent in wheat crop. Seed was being over utilized in paddy as evident from negative and significant coefficient. The value of sigma square of 0.032, 0.018, 0.029 in maize, paddy and wheat, respectively indicate the existence of technical inefficiency among the farmers. Estimates of socio-economic factors reveal that number of female, education years, family size and children decrease the technical inefficiency effect in maize, paddy and wheat crops signifying that these variables play a positive role in increasing the efficiency level of farm household. Cultivated area had a positive influence on increasing the inefficiency of all the three crops which ultimately reduce the efficiency of farm households. With increase in number of education years technical inefficiency of farm household decreases and is significant at 0.05 and 0.01 level of significance. As the age of respondents increases, technical efficiency increases. The maximum likelihood estimates of the parameter of stochastic frontier profit function reveal that the estimated coefficient of fertilizer, farm yard manure, labour and mechanization charge were negative for maize, wheat and paddy crop. However, cost of seed was found negative only in maize crop which reduce the profit of maize crop by 16 per cent. While in paddy crop, coefficients of all the concerned variables were negatively related with the profit except chemical and seed costs which was found to effect positively the profit of paddy farming. Value of gamma were highly significant depicting the existence of profit/economic inefficiency to the level of 79 per cent for maize, 81 per cent for paddy and 89 per cent for wheat due to

factors which are under farmers control and only 21 per cent, 19 per cent and 11 per cent of farmer inefficiency for these crops were due to random factors outside the farmers control. Efficiency levels, i.e., TE, EE and AE were observed less than 1 in all the three crops however, it is was more in wheat, followed by paddy and maize crops, indicating potential for increasing efficiencies is more in maize crop followed by paddy and wheat crop.

Livelihood strategies adopted by the household in the study area may be broadly categorized into (i) income generated from crops and livestock activities and (ii) off-farm income where households are dependent on private small scale businesses, public/private sector services, daily wage labourers, skilled and semi-skilled work etc. The average income of the households was found to be ₹1,14,111 per annum out of which contribution of off-farm was about 69 per cent and rest (31%) was from the farming activities. About 57 per cent of households fall in category of less dependent on agriculture, moderately dependent (23%), extremely dependent (12%) and highly dependent (8%) on agriculture for their livelihood. The study concludes that agriculture merely is not an enough source of income for the household livelihoods of inter-mediate hill zone so family members go for off-farm activities for their survival.

Inequality in agricultural income of farm household was measured by Gini-coefficient, the estimate of 0.24 indicate the presence of income inequality among farm household. Aggregate ratio of all the other measures in these two districts shows the presence of agriculture income inequality among farmers and these values also support the Lorenz curve. The value of all index were observed more in Poonch districts than Rajouri, except the Exponential index, which shows around the same degree of inequality in both districts. The result revealed that average annual income of household varies from ₹32,245 in high vulnerable to ₹61,037 in low vulnerable class. Operational area (ha) was relatively more in case of less vulnerable households than more vulnerable to various shocks. Inverse relationship of the operational area to the vulnerability was found. Similarly, the

household heads having more number of education years are less vulnerable and vice-versa. Family size was found to have negative relationship with vulnerability. The work participation ratio is high among low vulnerable household and low among high vulnerable household. Data also indicate that household with more livestock assets are less vulnerable than having less number of asset. In this study, five major components considered are (i) human asset (ii) social asset (iii) natural asset (iv) financial asset and (v) physical asset. Each major component has several sub-components as Asset pentagon is based on the score obtained by each indicator (component) of the capital asset. Asset pentagon depicts that household lying in innermost pentagon represent the minimum level of asset or in other words we can say that household improve as we move away from the innermost pentagon. Based on score gained by the each capital, it was observed that lower zone has higher score for financial capital (1.50) followed by human capital (1.40), social capital (1.33), physical capital (1.25) and natural capital (1.00). Middle zone received maximum scores in natural (1.67), social (1.33) and financial capital. As expected, upper zone got maximum scores in natural capital i.e 2.00 followed by social capital (1.67) and minimum in physical capital and human capital. The figure revealed that lower zone is more skewed towards financial capital and less towards social and natural capital. On the other hand, middle zone is more skewed towards natural and social capital. However, Upper zone was found to be more skewed towards natural and social capital than other capital assets. Thus on the basis of above observation it can be concluded that household who are living in upper and middle reaches of study area are found to be more vulnerable to economic shocks and health issue and poverty shocks and thus more prone to various unsustainable livelihood issues.

Policy suggestions/recommendation

- Majority of the household heads are young which should be target for innovative agriculture activities and future development planning in the area and emphasis on various skill development training programme and

non-formal education system may be provided to illiterate and less educated individuals across gender and age groups so that it could help them to improve their productive efficiency in different income augmenting activities.

- Government through development departments and research stations should make proper efforts in providing proper technical knowhow and latest farming methods and input technologies in order to boost the resource use efficiency and productivity which has remained confined to plains only.
- There is huge potential for the horticultural crops in study area indicating that farmers/households should be encouraged by the concerned development departments to diversify their livelihood option to horticulture sector, particularly towards high value horticultural crops for better market returns.
- As majority of the intermediate zone is a rainfed area, so more focus should be brought towards rainfed technologies with more emphasis on integrated watershed development programs in a holistic approach.
- More focussed and targeted intervention is required with respect to basic infrastructure in terms education, health, roads and public amenities, which will go in a long way in improving the living standard as well as to cushion the shocks.
- More emphasis and incentive on agri-horti-silvi–pastoral system in the zone for enhanced income and diversified livelihood opportunities.
- To overcome vulnerability more stress should be given to enhance adaptive capacity through skill development programs.
- Need of robust and effective extension outreach by R&D institutes, KVKs and development departments in the study area.

- Household living in upper zone having high score for natural capital, suggest that concerted efforts should be taken for community management of natural resource viz., forests, pastures, grasslands and other natural resources from being over exploited.
- Beautiful landscape with snow covered mountains and streams provide huge potential towards the establishment of tourism industry. Government should undertake various promotional activities related to tourism like transportation, resorts, hotels and restaurants etc. across inter-mediate hill zone and historical Mughal road which can attract the tourists and by this way generate source of employment and income for the peoples of the region.

LITERATURE CITED

- Abdissa, N. 2017. Determinants of rural livelihood strategies: The case of rural kebelas of Dire Dawa administration. *Journal of Finance and Accounting* **8**(15): 37.
- Abdulai, A. and Crole Rees, A. 2001. Determinants of income diversification amongst rural households in Southern Mali. *Food Policy* **26**(4): 437-452.
- Abedullah, B. K. and Ahmad, B. 2006. Technical efficiency and its determinants in potato production, evidence from Punjab, Pakistan. *The Lahore Journal of Economics* **11**(2): 1-22.
- Adam, Y. O., Pretzsch, J. and Pettenella, D. 2013. Contribution of non-timber products livelihood strategies to rural development in drylands of Sudan: potentials and failures. *Agricultural Systems* **117**: 90-97.
- Adams, R. H. 2001. Non-farm income, inequality and poverty in rural Egypt and Jordan. Policy Research Working Paper 2572. World Bank, Washington, D. C.
- Adato, M. and Meinzen-Dick, R. 2002. Assessing the impact of agricultural research on poverty using the sustainable livelihoods framework. EPDT discussion paper 89/ FCND discussion paper 128. International Food Policy Research Institute Washington, D. C.
- Afriat, S. N. 1972. Efficiency estimation of production functions. *International Economic Review* **13**: 568-598.
- Aigner, D. J. and Chu, S. F. 1968. On estimating the industry production function. *American Economic Review* **58**: 826-839.

- Aigner, D. J., Lovell, C. A. K. and Schmidt, P. 1977. Formulation and estimation of stochastic frontier production functions models. *Journal of Econometrics* **6**(1): 21-37.
- Alary, V., Corniaux, C. and Denis, G. D. 2011. Livestock's contribution to poverty alleviation: How to measure it? *World Development* **39**: 1638–1648.
- Alemu, Z. G. 2012. Livelihood strategies in rural South Africa: implications for poverty reduction. in 2012 Conference, International Association of Agricultural Economists. August 18–24, Brazil.
- Ali, M. and Flinn, J. C. 1989. Profit efficiency among Basmati paddy producers in Pakistan's Punjab. *Indian Journal of Agricultural Economics* **71**(2): 303-310.
- Altieri, M. A. 1995. The science of sustainable agriculture. Agroecology. Boulder, Westview Press.
- Alvarez, E. C. and Romani, J. R. 2017. Measuring social capital: further insights. *Gaceta Sanitaria* **31**(1): 57–61.
- Alwang, J., Jansen, H. G. P., Siegel, P. B. and Pichon, F. 2005. Geographic space, assets, livelihoods and well-being in rural Central America: Empirical evidence from Guatemala, Honduras and Nicaragua. DSGD discussion paper 26. IFPRI, Washington, D. C.
- Alwang, J., Siegel, P. B. and Jorgensen, S. L. 2001. Vulnerability: A view from different disciplines, Social Protection Unit, Human Development Network, The World Bank, Washington, D. C., U. S. A.
- Amaza, P. S., Bila, Y. and Iheanacho, A. C. 2006. Identification of factors that influence technical efficiency of food crop production in west Africa,

- empirical evidence from Borno state Nigeria. *Journal of Agriculture and Rural Development in the Tropics and Subtropics* **107**(2): 139-147.
- Amos, T. T. 2007. An analysis of productivity and technical efficiency of smallholder cocoa farmers in Nigeria. *Journal of Social Science* **15**(2): 127-133.
- Anonymous, 2011. Available in <[http:// www.jkapd.nic.in/overview](http://www.jkapd.nic.in/overview) of Jammu and Kashmir.
- Anonymous, 2017. Regional Digest of Statistics, Government of Jammu and Kashmir. Directorate of Economics and Statistics J&K pp. 58.
- Ansoms, A. and Mckay, A. 2010. A quantitative analysis of poverty and livelihood pro-files: the case of rural Rwanda. *Food Policy* **35**: 584-598.
- Asad, M., Wali, S., Hassan, S., Salim, M. A. and Ara, R. 2015. Hazards and coping strategies: A case study from Chitral Valley Pakistan. Peshawar, Pakistan: Inter cooperation Pakistan.
- Asfaw, A. and Admassie, A. 2004. The role of education on the adoption of chemical fertilizer under different socioeconomic environments in Ethiopia. *Agricultural Economics* **30**(3): 215–228.
- Asfir, S. S. 2016. Determinants of rural households' livelihood strategies: Evidence from Western Ethiopia. *Journal of Economics and Sustainable Development* **7**(15): 103.
- Babulo, B., Muys, B., Nega, F., Tollens, E., Nyssen, J., Deckers, J. and Mathijs, E. 2008. Household livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia. *Agricultural System* **98**(2): 147-155.

- Bailey, D. V., Biswas, B., Kumbhakar, S. C. and Schulthies, B. K. 1989. Analysis of technical, allocative and scale inefficiency: The case of Ecuadorian dairy farms. *Western Journal of Agricultural Economics* **14**(1): 30-37.
- Banik, A. 1994. Technical efficiency of irrigated farms in a village of Bangladesh. *Indian Journal of Agricultural Economics* **49**: 70-78.
- Barnes, A. 2008. Technical efficiency estimates of Scottish agriculture. *Journal of Agricultural Economics* **59**(2): 370-376.
- Barrett, C. 1999. On vulnerability, asset poverty and subsidiarity. Comments to the Ford/Rockefeller Foundations Seminar Series. Managing vulnerability and shocks within the Agro Food System, New York, May 26.
- Barrett, C. B. and Reardon, T. 2000. Asset, activity and income diversification among African agriculturalist: Some practical issues, project report to USAID BASIS CRSP, March 2000.
- Barrett, C. B., Clark, M. B., Clay, D. C. and Reardon, T. 2005. Heterogeneous constraints, incentives and income diversification strategies in rural Africa. *Quarterly Journal of International Agriculture* **44**: 37-60.
- Barrett, C. B., Reardon, T. and Webb, P. 2001. Non-farm income diversification and households livelihood strategies in rural Africa: Concepts, dynamics and policy implications. *Food Policy* **26**(4): 315-331.
- Bathla, S., Joshi, P. K. and Kumar, A. 2017. Revisiting investments and subsidies to accelerate agricultural income and alleviate rural poverty in India, ” IFPRI Discussion Paper, 01701, Washington, D. C.
- Battese, G. E. and Coelli, T. J. 1988. Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. *Journal of Econometrics* **38**(3): 387-399.

- Bealu, T. 2019. Analysis of livelihood diversification practice to promote rural households food security: The case of Hawassa Zuria District of Sidama Zone, Ethiopia. *Journal of Development and Agricultural Economics* **11**(1): 1-8.
- Beck, M. 1991. Empirical applications of frontier functions: a bibliography. Mimeo, Joachim-Ringelnatz-Str. 20, W-6200 Wiesbaden, Germany.
- Beus, C. E and Dunlop, R. E. 1994. Agricultural paradigm and the practice of agriculture. *Rural Sociology* **59**(4): 620-635.
- Bezemer, D. J. and Lerman, Z. 2002. Rural livelihoods in Armenia. The Centre for Agricultural Economic Research, the Department of Agricultural Economics and Management Discussion Paper No. 403.
- Bhatt, M. S. and Bhat, S. A. 2014. Technical efficiency and farm size productivity-micro level evidence from Jammu and Kashmir. *International Journal of Food and Agricultural Economics* **2**(4): 27-49.
- Birkmann, J. 2006. Measuring vulnerability to promote disaster-resilient societies: conceptual frameworks and definitions. In measuring vulnerability to natural hazards: towards disaster resilient societies. Shibuya-ku, Tokyo: United Nations University Press. 1st edition. 9–54.
- Birkmann, J., Buckle, P., Jaeger, J., Pelling, M., Setiadi, N., Garshagen, M., Fernando, N. and Kropp, J. 2010. Extreme events and disasters: A window of opportunity for change. Analysis of organisational, institutional and political change, formal and informal responses after mega-disasters. *Natural Hazards* **3**(55): 637-655.

- Bos, M. G., Bosch, H. D., Diemont, H., Keulen, H. V., Lahr, J., Meijerink, G. and Verhagen, A. 2007. Quantifying the sustainability of agriculture. *Irrigation Drainage System* **21**(1): 1–15.
- Bravoureta, B. E. and Pinheiro, A. E. 1997. Technical, economic and allocative efficiency in peasant farming: Evidence from the Dominican Republic. *The Developing Economies* **30**(1): 48–67.
- Briguglio, L., Cordina, G., Farrugia, N. and Vella, S. 2009. Economic vulnerability and resilience: Concepts and Measurements. *Oxford Development Studies* **37**(3): 229-247.
- Browder, J., Pedlowski, M. and Summers, P. 2004. Land use patterns in the Brazilian Amazon: Comparative farm-level evidence from Rondonia. *Human Ecology* **32**(2): 197-224.
- Brown, D. R., Stephens, E. C., Ouma, J. O., Murithi, F. M. and Barrett, C. B. 2006. Livelihood strategies in the rural Kenyan highlands. *Journal of Agricultural Resource Economic* **1**(1): 21–36.
- Burton, I., Kates, R. W. and White, G. F. 1980. The environment as hazard. Oxford University Press, Oxford. capacity of farmer-managed irrigation systems: Learnings from Nepal. *Current Opinion in Environmental Sustainability* **70**(2): 306-311.
- Cardona, O. D. 1999. Environmental management and disaster prevention: Holistic risk assessment and management. Natural Disaster Management, Tudor Rose, London.
- Cardona, O. D. 2004. The need for rethinking the concepts of vulnerability and risk from a holistic perspective: A necessary review and criticism for

effective risk management Mapping Vulnerability: Disasters, Development and People pp. 17.

Carney, D. 1998. Implementing the sustainable rural livelihoods approach, Chapter, Sustainable rural livelihood: What contribute can we make? Department of international Development, London U. K.

Chakravorty, S. Chandrasekhar, S. and Naraparaju, K. 2016. Income generation and inequality in India's agricultural sector: The consequences of land fragmentation Indira Gandhi Institute of Development Research (IGIDR), Vaidya Marg Goregaon (E), Mumbai.

Chambers, R. 1989. Editorial introduction: Vulnerability, Coping and Policy. *IDS Bulletin* **20**(2): 1-7.

Chambers, R. 1995. Poverty and Livelihoods: Whose Reality Counts?’, *Environment and Urbanisation* **7**(1): 173-204.

Chambers, R. 2013. Voices of the poor and beyond: Lessons from the past, agenda for the future, lecture delivered on 11 October 2012 on the Occasion of the 60th Dies Natali of the International Institute of Social Studies, The Hague, Netherlands.

Chambers, R. and Conway, G. 1991. Sustainable rural livelihoods: practical concepts for the 21st century. Institute of Development Studies discussion paper, 296. London.

Chambers, R. and Conway, G. 1992. Sustainable rural livelihoods: practical concepts for 21st century. Institute of Development Studies discussion papers, 296. Cambridge.

- Chand, R. S., Srivastava, K. and Singh, J. 2017. Changes in rural economy of India, 1971 to 2012: Lessons for Job-led Growth. *Economic & Political Weekly* **52**(52): 64-71.
- Chaudhary, P. and Bawa, K. S. 2011. Local perceptions of climate change validated by scientific evidence in the Himalayas. *Biology Letters* **7**(5): 767-770.
- Chirwa, W. E. 2007. Sources of technical efficiency among smallholder maize farmers in Southern Malawi. AERC Research Paper 172, African Economic Research Consortium, Nairobi.
- Christiaensen, L. and Subbarao, K. 2005. Toward an understanding of household vulnerability in rural Kenya. *Journal of African Economies* **14**(4): 520-558.
- Christiaensen, L., Demery, L. and Kuhl, J. 2011. The evolving role of agriculture in poverty reduction, a n empirical perspective. *Journal of Development Economics* **96**(2): 239-254.
- Clark, W. C., Jager, J. R., Corell, R., Kaspersen, J. J., Mc Carthy, D. C. and Guston, D. H. 2000. Assessing vulnerability to global environmental risks. Report of the workshop on vulnerability to global environmental change: Challenges for Research, assessment and decision making, Chicago Press, Chicago.
- Coelli, T. and G. Battese. 1996. Identification of factors which influence the technical inefficiency of Indian farmers. *Australian Journal of Agricultural Economics* **40**(2): 103-28.

- Coelli, T. J. 1995. Recent developments in frontier modelling and efficiency measurement. *Australian Journal of Agricultural Economics* **39**(3): 219-245.
- Coelli, T. J. 1996. A guide to FRONTIER version 4. 1: A computer program for stochastic frontier production and cost function estimation". Center for Efficiency and Productivity Analysis (CEPA) Working Paper 96/07. University of New England, Armidale, Australia.
- Coelli, T., Prasada, R. and G. Battese. 1998. An introduction to efficiency and productivity analysis. Boston: Kluwer Academic Press.
- Coudouel, A., Hentschel, J. and Wodon, Q. 2002. Poverty measurement and analysis. In: Klugman, J. (Ed.), A Source Book for Poverty Reduction Strategies. World Bank, Washington, D. C.
- Croppenstedt, A. 2006. Household income structure and determinants in rural Egypt, ESA Working Paper No. 06-02 from Agricultural and Development Economics, Division of the Food and Agricultural Organization of the United Nations (FAO-ESA).
- Dalal, R. C., Lawrence, P., Doughton, J. A., Walker, J., Shaw, R. J., Lawrence, G., Yule, D., Bourne, A., Duivenvoorden, L., Choy, S., Moloney, D., Turner, L., King, C. and Dale, A. 1999. A framework to monitor sustainability in the grains industries. *Australian Journal of Experimental Agriculture* **39**(3): 605-620.
- Davies, A. P. 1996. Targetting the vulnerable in emergence situation: Who is vulnerable? *Lancet* **348**(9031): 868-871.
- Davies, S. 1993. Are coping strategies a cop out, IDS bulletin **24**(4): 60-72.

- Davis, B., Paul W., Gero, C., Katia, C., Esteban, J., Quiñones, A. Z., Kostas, S., Carlo, A., and Stefania, D. G. 2010. A cross-country Comparison of Rural Income Generating Activities. *World Development* **38**(1): 48-63.
- De Janvry, A. and Sadoulet, E. 2001. Income strategies among rural households in Mexico: The role of off-farm activities. *World Development* **92** (3): 467-480.
- Debreu, G. 1951. The coefficient of resource utilisation. *Econometrica* **19**: 273–92.
- De-Janvry, A., Sadoulet, E. and Zhu, N. 2005. The role of non-farm incomes in reducing rural poverty and inequality in China. CUDARE working paper 1001. Department of Agricultural and Resource Economics, UCB.
- Deleón, V. and Carlos, J. 2006. Vulnerability: A conceptional and methodological review, UNUEHS.
- Deressa, T., Hassan, R. and Ringler, C. 2011. Perception and adaption to climate change by farmers in the Nile basin of Ethiopia. *The Journal of Agricultural Science* **149**(1): 23-31.
- DFID, 1999. Sustainable Livelihoods Guidance Sheets. DFID, London.
- DFID, 2000. Sustainable Livelihoods Guidance Sheets. DFID, London.
- Diniz, F. H., Hoogstra-Klein, M. A., Kok, K. and Arts, B. 2013. Livelihood strategies in settlement projects in the Brazilian Amazon: determining drivers and factors within the Agrarian Reform Program. *Journal of Rural Studies* **32**: 196-207.

- Dinku, A. M. 2018. Determinants of livelihood diversification strategies in Borena pastoralist communities of Oromia regional state, Ethiopia. *Agricultural and Food Security* **7**: 41.
- Dogliotti, S., Rossing, W. A. H. and Vanittersum, M. K. 2004. Systematic design and evaluation of crop rotations enhancing soil conservation, soil fertility and farm income: a case study for vegetable farms in South Uruguay. *Agricultural Systems* **80**(3): 277-302.
- Dumanski, J. and Pieri, C. 1996. Application of the pressure-state-response framework for the land quality indicator (LQI) program. Land quality indicators and their use in sustainable agriculture and rural development Rome: Land and Water Development Division, FAO.
- Eakin, H. and Luers, A. L. 2006. Assessing the vulnerability of social environmental systems. *Annual Review Environment Resource* **31**: 365-389.
- Economic Research Services (ERS)/USD. 2000. Composition of farm households' income and wealth.
- Edoumiekumo, S., Tombofa, S. and Moses, T. 2013. Multidimensional energy poverty in the South-South Geopolitical zone of Nigeria. *Journal of Economics and Sustainable development* **4**(20): 96-103.
- Ellis, F. 1998. Household strategies and rural livelihood diversification. *Journal of Developing Studies* **35**(1): 1-38.
- Ellis, F. 2000. Rural livelihoods and diversification in developing countries. Oxford University Press, Oxford.

- Ellis, F. and Allison, E. 2004. Livelihood diversification and natural resource access. Overseas development group, working paper 9. University of East Anglia UK.
- Eneyew, A. and Bekele, W. 2012. Determinants of livelihood strategies in Wolaita, Southern Ethiopia. *Agricultural Research Review* **1**(5): 153-161.
- Escobal, J. 2001. The determinants of nonfarm income diversification in rural Peru. *World Development* **29**(3): 497-508.
- Fang, Y. P. 2013a. The effects of natural capital protection on pastoralist's livelihood and management implication in the source region of the Yellow River, China. *Journal Mountain Science* **10**(5): 885-897.
- Fang, Y. P. 2013b. Managing the three-rivers headwater region, China: From ecological engineering to social engineering. *Ambio* **42**: 566-576.
- Fang, Y. P., Fan, J., Shen, M. Y. and Song, M. Q. 2012. Gradient effect on farmers' income in the mountain areas and its implication for poverty alleviation strategies: Empirical analysis from the upper reach of Minjiang River. *Journal of Mountain Science* **9**: 869-878.
- Fang, Y. P., Fan, J., Shen, M. Y. and Song, M. Q. 2014. Sensitivity of livelihood strategy to livelihood capital in mountain areas: empirical analysis based on different settlements in the upper reaches of the Minjiang River, China. *Ecological Indicator* **38**: 225-235.
- Fare, R., Grosskopf, S. and Lovell, C. A. K. 1985. The measurement of efficiency of production. Dordrecht: Kluwer –Nijhoff. Boston.
- Farrell, M. J. 1957. Measurement of productive efficiency. *Journal of the Royal Statistical Society Series* **120**(3): 253-290.

- Farrington, J., Ramasut, T. and Walker, J. 2002. Sustainable Livelihoods Approaches in Urban Areas: General Lessons, with Illustrations from Indian Cases, ODI, London, UK.
- Fdrund, F. R., Lovell, C. A. K. and Peter, S. 1980. A survey of frontier production functions and of their relationship to efficiency measurement. *Journal of Econometrics* **13**(1): 5-25.
- Food and Agriculture Organization (FAO), 2003. PPLPI Documentation, Retrieved Dec. 12, 2009.
- Food and Agriculture Organization FAO, 2005. Global forest resources assessment-progress towards sustainable forest management, FAO forestry paper no. 147. Rome.
- Galawat, F. and Yabe, M. 2012. Profit efficiency in paddy production in Brunei Darussalam: A stochastic frontier approach. *Journal of International Society for Southeast Asian Agricultural Sciences* **18**(1): 100-112.
- Gardner, G. 1996. Shrinking fields: Crop land loss in a world of eight billion, world watch paper 161, world watch institute Washington D. C.
- Gebru1, G. W. and Beyene, F. 2012. Rural household livelihood strategies in drought-prone areas: A case of Gulomekeda district, eastern zone of Tigray, National Regional State, Ethiopia. *Journal of Development and Agricultural Economics* **4**(6): 158-168.
- Gentle, P. and Maraseni, T. N. 2012. Climate change, poverty and livelihoods: adaptation practices by rural mountain communities in Nepal. *Environment Science Policy* **21**: 24-34.
- Ghosh, P. P. and Gupta, C. D. 2017. Uneven Growth in India: Inter-and Intra-state disparities, New Delhi: Manak Publications.

- Haggblade, S., Hazell, P. and Reardon, T. 2002. Strategies for stimulating poverty-alleviating growth in the rural nonfarm economy in developing countries. EPTD discussion paper 92. World Bank, Washington, D. C.
- Haggblade, S., Hazell, P. and Reardon, T. 2007. Transforming the rural non-farm economy. John Hopkins University Press Baltimore.
- Haggblade, S., Hazell, P. and Reardon, T. 2010. The rural non-farm economy: Prospects for growth and poverty reduction. *World Development* **38**(10): 1429-1441.
- Hahn, M. B., Riederer, A. M. and Foster, S. O. 2009. The livelihood vulnerability index: A `pragmatic approach to assessing risks from climate variability and change-a case study in Mozambique. *Global Environmental Change* **19**(1): 74-88.
- Heitzmann, K., Canagarajah, R. S. and Siegel, P. B. 2002. Guidelines for assessing the sources of risk and vulnerability, social protection discussion paper 0218, Social protection unit, human development network, The World Bank, Washington, D. C., U. S. A.
- Hoddinott, J. and Quismbing, A. 2003. Methods for micro econometric risk and vulnerability assessments, social protection discussion paper series No. 324, social protection unit, human development network, The World Bank, Washington, D. C., U. S. A.
- Hogarth, N. J., Belcher, B., Campbell, B. and Stacey, N. 2013. The role of forest-related income in household economies and rural livelihoods in the border-region of Southern China. *World Development* **43**: 111-123.
- Holling, C. S. 1996. Surprise for science resilience for ecosysytems and incentives for people. *Ecological Application* **6**(3): 733-735.

- Holzmann, R. 2001. Risk and vulnerability: The forward looking role of social protection in a globalizing world. Paper prepared for the Asia and Pacific forum on poverty policy and institutional reforms for poverty reduction, asian development bank, manila, February 5-9.
- Holzmann, R. and Jorgensen, S. 1999. Social Protection as social risk management: conceptual underpinnings for social protection sector strategy paper, Social protection discussion paper no. 9904, the World Bank, Washington, D. C., U. S. A.
- Holzmann, R. and Jorgensen, S. 2001. Social risk management: A conceptual framework for social protection and beyond, social protection, discussion paper no. 0006, The World Bank, Washington, D. C., U. S. A.
- Hu, B., Shao, J. and Palta, M. 2006. Pseudo- R^2 in logostic regression model. *Statistical Sinica* **16**: 847-860.
- Hunzai, K., Gerlitz, J. Y. and Hoermann, B. 2011. Understanding mountain poverty in the Hindu Kush-Himalayas: Regional report for Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan. Kathmandu: ICIMOD.
- Hussain, S. S., Hussain, S. and Hanif, M. 2013. Climate change scenarios and possible adaptation measures-districts chitral and DI Khan-Khyber Pakhtunkhwa. Peshawar, China: Inter cooperation Pakistan.
- Ikerd, J. E. 1993. The need for a system approach to sustainable agriculture *Agriculture Ecosystems and Environment* **46**: 147–160.
- ILEIA. 1991. Criteria for assessment. ILEIA (Institute for Low External Input Agriculture) Newsletter **7**(3).
- Inayatullah, J., Munir, K. K., Khan, M. A., Shakeel, H. and Tariq, R. 2012.

- Factors affecting rural livelihood choices in Northwest Pakistan. *Sarhad Journal of Agriculture* **28**(4): 681-688.
- Iorio, M. and Corsale, A. 2010. Rural tourism and livelihood strategies in Romania. *Journal Rural Studies* **26**(2): 152-162.
- Islam, N. 1997. The non-farm sector and rural development: Review of issues and evidence, 2020 vision. Discussion paper No. 22. International Food policy research institute.
- Islam, N., Deb, U. K., Alamin, M., Jahan, N. Ahmad, I., Tabassun, S., Ahmad, M. G, Nabi, A., Singh, N. P., Byjesh, K. and Bantian, C. 2013. Vulnerability to climate change: Adaption strategies and layers of resilience-quantifying vulnerability to climate change in Bangladesh. Patancheru 502 324 andhra Pradesh, India: *International crops research institute for the semi arid Tropics* pp. 36.
- Israr, M. and khan, H. 2010. An analysis of livelihood sources in hilly areas of northern Pakistan. *Journal of Agriculture* **26**(4): 665-672.
- Jacoby, H. and Skoufias, E. 1997. Risk, financial markets and human capital in a developing country. *Review of Economic Studies* **64**(3): 311-335.
- Jansen, H. G., Pender, J., Damon, A., Wielemaker, W. and Schipper, R. 2006. Policies for sustainable development in the hill side areas of Honduras: A quantitative livelihoods approach. *Agricultural Economics* **34**(2): 141-153.
- Jha, R., Nagarajan, H. K. and Prasanna, S. 2005. Land fragmentation and technical efficiency *Journal of Indian Agriculture* **34**(12): 23-64.
- Jodha, N. S. 1988. Poverty debate in India: A minority view. *Economic and Political Weekly* **22**(45-47): 2421-2428.

- Jodha, N. S. 1992. Mountain perspective and sustainability: A framework for development strategies. In *sustainable Mountain Agriculture*, op cit.
- John, K. M. and Wobst, P. 2006. Determinants of rural labor market participation in Tanzania. Center for Development Research (ZEF), University of Bonn 1-30. Retrieved Oct. 19, 2009.
- Johnson, T. G. and Stallman, J. I. 1994. Human capital investment in resource dominated economies. *Society and natural resources* **7**(3): 221-233.
- Juntunen, L. 2005. Addressing social vulnerability to hazards. *Disaster safety review* **4**(2): 3-10.
- Kalirajan, K. P. 1985. On measuring absolute technical and allocative efficiencies. *Indian Journal of Statistics* **47**(3): 385-400.
- Kalirajan, K. P. and Shand, R. T. 1989. A generalized measure of technical efficiency. *Applied Economics* **21**(1): 25-34.
- Kamanga, P., Vedeld, P. and Sjaastad, E. 2009. Forest incomes and rural livelihoods in Chiradzulu district. Malawi. *Ecological Economics* **68**(3): 613–624.
- Kanbur, R. C., Rhee and Zhuang, J. 2014. Inequality in Asia and the Pacific: Trends, drivers, and policy implications, London: Asian Development Bank and Routledge.
- Kanbur, S. M. R. 1987. Measurement and alleviation of poverty. *International Monetary Fund* **34**(1): 60-85.
- Kang, B. T., Reynolds, L. and Atta-Krah, A. N. 1990. Alley farming. *Advance in Agronomy* **43**: 15–359.

- Kanji, N., Macgregor, J. and Tacoli, C. 2005. Understanding market-based livelihoods in a globalising world: Combining approaches and methods. International Institute for Environment and Development (IIED).
- Khatriwada, S. P., Deng, W., Paudel, B., Khatriwada, J. R., Zhang, J. and Su, Y. 2017. Household livelihood strategies and implication for poverty reduction in rural areas of central Nepal. *Sustainability* **9**(4): 1–20.
- Khatun, D. and Roy, B. C. 2012. Rural livelihood diversification in West Bengal: Determinants and constraints. *Agricultural Economics Research Review* **25**(1): 115-124.
- Koopmans, T. C. 1951. An analysis of production as an efficient combination of activities. Cowles Commission for Research in Economics, Monograph No. 13. New York: Wiley.
- Krishnan, P. and Dercon, S. 1995. Income portfolios in rural Ethiopia and Tanzania: choices and constraints 12, CSAE working paper series, centre for the study of African Economies, University of Oxford.
- Kumar, P., Singh, N. P. and Mathur, V. C. 2006. Sustainable agriculture and rural livelihoods: A symthesis. *Agricultural Economics Research Review* **19**: 1-22.
- Kumbhakar, S. C. 1988. On the estimation of technical and allocative inefficiency using stochastic frontier functions. *International Economic Review* **29**: 727-743.
- Kumbhakar, S. C., Biswas, B. and Bailey D. V. 1989. A study of economic efficiency and Utah diary farms: A system Approach. *The Review of Economics and Statistics* **71**(4): 595-604.

- Kuznets, S. 1955. Economic growth and income inequality. *American Economic Review* **45**(1): 1-28.
- Lanjouw, P. and Feder, G. 2001. Rural non-farm activities and rural development: from experience towards strategy. In: Rural development strategy background paper 4. World Bank, Washington, DC
- Lchmann, L. M. 1978. An Austrian stocktaking: unsettled question and talkative answer. In L. Spardo Ed. New direction in Austrian economics pp; 1-18, Kansas city: Sheed.
- Ley, E. 1990. A bibliography on production and efficiency. Mimeo department of economics, university of Michigan annarbour, MI 48109: 32.
- Lipton, M. 1977. Why Poor People Stay Poor: Urban Bias in World Development', Cambridge: Harvard University Press.
- Liyama, M., Kariuki, P., Kristjanson, P., Kaitibie, S. 2008. Livelihood diversification strategies, incomes and soil management strategies: A case study from KERIO valley Kenya. *Journal of International Development* **20**(3): 380-397.
- Lynam, J. K. and Herdt, R. W. 1989. Sense and sustainability: Sustainability as an objective in international agricultural research. *Agriculture Economics* **3**(4): 381-398.
- Makate, C. and Mango, N. 2017. Diversity amongst farm households and achievements from multi-stakeholder innovation platform approach: Lessons from Balaka Malawi. *Agriculture and Food Security* **6**(1): 1–15.
- Manandhar, S., Vogt, D. S., Perret, S. R. and Kazama, F. 2011. Adapting cropping systems to climate change in Nepal: A cross-regional study of farmers' perception and practices. *Regional Environmental Change* **11**(2): 335-348.

- Mbaiwa, J. E. 2011. Changes on traditional livelihood activities and lifestyles caused by tourism development in the Okavango Delta. Botswana. *Tour. Manage.* **32**(2): 1050-1060.
- Meena, M. S., Singh, K. M., Singh, R. K., Kumar, A., Kumar, A. and Chahal, V. P. 2017. Inequality and determinants of income among rural households in tribal dominated areas of Jharkhand. *Indian Journal of Agricultural Sciences* **87**(1): 92-96.
- Meeusen, W. and Vanden-Broeck. 1977. Efficiency estimation from Cobb-Douglas production function with composed error. *International Economic Review* **18**(2): 435-441.
- Morduch, J. 1994. Poverty and vulnerability. *The American Economic Review* **84**(2): 221-225.
- Morrow, B. H. and Phillips, B. 1999. What's gender got to do with it. *International Journal of Mass Emergencies and Disasters* **17**(1): 5-11.
- Moser, C. 1998. The Asset vulnerability framework: Reassessing urban poverty reduction, Strategies. *World Development* **26**(1): 1-19.
- Moser, C. and Holland, J. 1997. Household responses to poverty and vulnerability, volume 4: Confronting crisis in Kawama, Lusaka, Zambia. Urban management programme, policy paper. UMPP No. 24, The World Bank, Washington D. C., U. S. A.
- Msuya, E. 2007. The impact of foreign direct investment on agricultural productivity and poverty reduction in Tanzania. Kyoto University, Kyoto. MPRA paper no 3671.

- Mutenje, M. J., Ortmann, G. F., Ferrer, S. R. D. and Darroch, M. A. G. 2010. Rural livelihood diversity to manage economic shocks: Evidence from south-east Zimbabwe. *Agrekon* **49**(3): 338-350.
- Negeri, B. and Demissie, G. 2017. Livelihood Diversification: Strategies, determinants and challenges for pastoral and agro-pastoral communities of Bale Zone, Ethiopia. *American Journal of Environmental and Geoscience* **1**(1): 19-28.
- Nizami, A., Fakhruddin, S. H. M. and Policarpio, R. R. 2009. Climate risk management (CRM)–Synthesis report Pakistan. Pakistan: Inter cooperation under Livelihoods Programme.
- Nkondze, M. S., Masuku, M. B. and Manyatsi, A. M. 2013. The impact of climate change on livestock production in Swaziland: The case of Polonjeni area development programme. *Journal of Agricultural Studies* **2**(1): 108–122.
- Obwona, M. 2000. Determinants of technical efficiency differentials amongst small and medium scale farmers in Uganda: A case of tobacco growers. Final report presented at the AERC biannual workshop, Nairobi, Kenya.
- Okere, C. P. and Shittu, A. M. 2012. Patterns and determinants of livelihood diversification among farm households in odeda local government area, ogun state, nigeria. paper presented at the nigerian association of agricultural economist conference held at obafemi awolowo university, Theme: Agriculture in the National Transformation Agenda: The Policy Mix.
- Olayide, S. O and Heady, E. O. 1982. Introduction to agricultural production economics. Ibadan university Press. University of Ibadan. Nigeria.

- Omamao, S. W. 1998. Transport costs and small holder cropping choices: An application to Siaya District, Kenya. *American Journal of agricultural Economics* **80**(1): 116-123.
- Orr, A. and Wmale, B. 2001. Adapting to adjustment: smallholder livelihood strategies in Southern Malawi. *World Development* **29**(8): 1325–1343.
- Panagariya, A., Chakraborty, P. and Rao, M. G. 2014. State level reforms, growth and development in Indian states: Studies in Indian Economic Policies, New Delhi: Oxford University Press.
- Panda, R. C. 1996. Efficiency and productivity. The case of silculture in Tamilnadu. *Indian Journal of Agricultural Economics* **5**(3): 13.
- Panthi, J., Arya, S., Dahal, P., Bhandari, P., Krakauer, N. Y. and Panday, V. P. 2016. Livelihood vulnerability approach to assessing climate change impacts on mixed agro-livestock smallholders around the Gandaki River basin in Nepal. *Regional Environment Change* **16**(4): 1121-1132.
- Philip, D. and Rahyan, M. I. 2004. Vulnerability and poverty; What are the causes and how they are related? Term paper for interdisciplinary courses, International Doctoral studies. Program at ZEF, Bonn.
- Pichon, F. J. 1996. Settler households and land-use patterns in the Amazon frontier: farm-level evidence from Ecuador. *Human Organization* **55**(4):416-424
- Pitt, M. M. and Lee, L. F. 1981. Measurement and sources of technical inefficiency in the Indonesian weaving industry. *Journal of Development Economics* **9**(1): 43-64.

- Piya, L., Joshi, N. P and Maharjan, K. L. 2016. Vulnerability of Chepang households to climate change and extremes in the mid-hills of Nepal. *Climatic Change* **135**(3-4): 521-537.
- Pratap, T. 2001. Mountain agriculture, marginal lands and sustainable livelihood: challenges and opportunities, international symposium on mountain agriculture in HKH region, 21-24 May, ICIMOD, Kathmandu, Nepal.
- Pretty, J. N. 1995. Regenerating agriculture: policies and practice for sustainability and self Reliance. London: Eartscan Publication pp: 131-163.
- Pretty, J., Smith, G., Goulding, K. W. T., Groves, S. J., Henderson, I., Hine, R. E., King, V., Oostrum, J. V., Pendlington, D. J., Vis, J. K. and Walter, C. 2008a. Multi-year assessment of Unilever's progress towards agricultural sustainability I: Indicators, methodology and pilot farm results. *International Journal of Agricultural Sustainability* **6**(1): 37–62.
- Pretty, J., Smith, G., Goulding, K. W. T., Groves, S. J., Henderson, I., Hine, R. E., King, V., Oostrum, J. V., Pendlington, D. J., Vis, J. K. and Walter, C. 2008b. Multi-year assessment of Unilever's progress towards agricultural sustainability II: outcomes for peas (UK), spinach (Germany, Italy), tomatoes (Australia, Brazil, Greece, USA), tea (Kenya, Tanzania, India) and oil palm (Ghana). *International Journal of Agricultural Sustainability* **6**(1): 63–88.
- Rahman, S. 2003. Profit efficiency among Bangladeshi paddy farmers. *Food Policy* **28**(5): 487-503.
- Rahut, D. B. and Micevska-Scharf, M. 2012. Livelihood diversification strategies in the Himalayas. *Australian Journal of Agricultural and Resource Economics* **56**(4): 558–582.

- Rao, N. H. and Rogers, P. P. 2006. Assessment of agricultural sustainability. *Current Science* **91**(4): 439-447.
- Rasheed, A., Mwalupaso, G. E., Abbas, Q., Tian, X. and Waseem, R. 2020. Women Participation: A Productivity Strategy in Paddy Production. *Sustainability* **12**(2870): 1-15.
- Rasul, G. and Karki, M. 2007. A pro-poor policy agenda for sustainable agricultural development in the Hindu-Kush Himalyan region. International Centre for Integrated Mountain Development (ICIMOD). *Journal of Economics and Sustainable Development* **4**(20): 96–103.
- Rasul, G. and Thapa, G. 2003. Sustainability analysis of ecological and conventional agricultural system in Bangladesh. *World Development* **31**(10): 1721–1741.
- Rawal, V. 2013. Changes in the distribution of operational land holdings in India: A Study of national sample survey data. *Review of Agrarian Studies* **2**(3): 73–104.
- Reardon, T. 1997. Using evidence of household income diversification to inform Study of the rural non-farm labour market in Africa. *World Development* **25**(5): 735-747.
- Reardon, T. and Vosti, S. 1995. Links between rural poverty and the environment in developing countries: asset categories and investment poverty. *World Development* **23**(9): 1495-1506.
- Reardon, T., Taylor, J. E., Stamoulis, K., Lanjouw, P. and Balisacan, A. 2000. Effects of non-farm employment on rural income inequality in developing countries: an investment perspective. *Journal of Agricultural Economics* **51**(2): 266–288.

- Richmond, J. 1974. Estimating the efficiency of production. *International Economic Review* **15**(2): 515-521.
- Saha, B. and Bahal, R. 2010. Livelihood diversification pursued by farmers by farmers in West Bengal. *Indian Journal of Extension Education* **10**(2): 1-9.
- Sajise, P. E. and Ganapin, D. J. 1990. An overview of upland development in the Philippines. Technologies for sustainable agriculture on marginal uplands in Southeast Asia. Proceedings of a Workshop, Ternate, Cavite, Philippines, ACIAR Proceedings No. 33, Canberra pp. 31–44.
- Salafsky, N. and Wollenberg, E. 2000. Linking livelihoods and conservation: a conceptual framework and scale for assessing the integration of human needs and biodiversity. *World Development* **28**(8): 1421–1438.
- Samal, C. K. 2006. Remittances and sustainable livelihoods in semiarid areas. *Sia-Pacific Development Journal* **13**(2): 73-92.
- Samarpitha, A., Vasudev, N. and Sushasini, K. 2016. Technical, economic and allocative efficiencies of paddy farms in Nalgonda district of Telangana state. *Economic Affair* **61**(13): 365-374.
- Saysay, J. L., Gabagambi, D. M. and Mlay, G. I. 2016. Profit efficiency among small holder paddy farmers in central Liberia. *Journal of Economics and sustainable Development* **7**(14): 94-103.
- Schmidt, P. 1986. Frontier production function. *Economic reviews* **4**: 289-328.
- Schmidt, P. and Lovell, C. A. K. 1979. Estimating technical and allocative inefficiency relative to stochastic production and cost frontiers. *Journal of Econometrics* **9**(3): 343-366.

- Schwarze, S. and Zeller, M. 2005. Income diversification of rural households in Central Sulawesi, Indonesia. *Quarterly Journal of International Agriculture* **44**(1): 61–73.
- Scoones, I. 1998. Sustainable livelihoods, a framework for analysis, IDS working paper number 72, Brighton.
- Scoones, I. 2009. Livelihoods perspectives and rural development. *Journal of Peasant Studies* **36**(1): 171–196.
- Seddon, D. and Adhikari, J. 2003. A conflict and food security in Nepal: A preliminary analysis. Rural Reconstruction Nepal (RRN) report series-1. Kathmandu, Nepal.
- Sen, A. 1993. Capability and well-being. The quality of life. Clarendon Press, Oxford pp. 30–53.
- Sen, K. K., Semwal, R. L., Rana, U., Nautiyal, S., Maikhuri, R. K., Rao, K. S. and Saxena, K. G. 2002. Patterns and implications for land use/cover change: A case study in Pranmati Watershed (Garhwal Himalaya, India). *Mountain Research and Development* **22**(34): 56– 62.
- Seyoum, E. T., Battese, G. E. and Fleming, E. M. 1998. Technical efficiency and productivity of maize producers in Eastern Ethiopia: A study of farmers within and outside the Sasakawa Global 2000 Project. *Agricultural Economics* **19**(3): 341–48.
- Shackleton, C. M., Shackleton, S. E., Buiten, E. and Bird, N. 2007. The importance of dry wood lands and forests in rural livelihoods and poverty alleviation in South Africa. *Forest Policy Economics* **9**(5): 558–577.
- Shaheen, F. A., Wani, S. A., Baba, S. H. and Naqash, F. 2017. Disadvantaged mountain farmers of Gurez valley in Kashmir: Issues of livelihood,

- vulnerability, externality and sustainability. *Indian Journal of Agricultural Economics* **72**(3): 456-474.
- Sharma, K. R., Leung, P., Zaleski, H. M. 1999. Technical, allocative and economic efficiencies in swine production in Hawaii: A comparison of parametric and nonparametric approaches. *Agricultural Economics* **20**(1): 23-35.
- Sharma, V. P. and Datta, K. K. 1997. Technical efficiency in wheat production on reclaimed alkali soils. *Productivity* **38**(2): 334.
- Shreshtha, S. 1992. Mountain agriculture: Indicators of unsustainability and options for reversal. MFS discussion paper no 32. Kathamdu; ICIMOD.
- Shukla, N. D. and Shukla, K. C. 2007. Scope and limitations of crop diversification in Indian agriculture. *Agricultural Situation in India* **64**(8): 357-365.
- Shumet, A. 2011. Analysis of technical efficiency of crop producing smallholder farmers in Tigray. MPRA Paper No. 40461. Ethiopia.
- Shylendra, H. S. 2002. Environmental rehabilitation and livelihood impact: Emerging trends from Ethiopia and Gujarat. *Economic and Political Weekly* **37**(31): 3286-3292.
- Sibanda, L. M., Kureya, T. and Chipfupa, U. 2008. The household vulnerability index framework.
- Skarstein, R. 2005. Economic liberalization and smallholder productivity in Tanzania. From promised success to real failure, 1985-1998. *Journal of Agrarian Change* **5**(3) 334-362.

- Smith, D. R., Gordon, A., Meadows, K. and Zwick, K. 2001. Livelihood diversification in Uganda: Patterns and determinants of change across two rural districts. *Food Policy* **26**(4): 421–435.
- Soltani, A., Angelsen, A., Eid, T., Naieni, M. S. N. and Shamekhi, T. 2012. Poverty, sustainability and household livelihood strategies in Zagros, Iran. *Ecological Economics* **79**: 60–70.
- Stoian, D. 2005. Making the best of two worlds: rural and peri-urban livelihood options sustained by non timber forest products from the Bolivian Amazon. *World Development* **33**(9): 1473-1490.
- Sujakhu, N. M., Ranjitkar, S., Niraula, R. R., Pokharel, B. K., Schmidt, V. D. and Xu, J. 2016. Farmer's perceptions of and adaptations to changing climate in the Melamchi Valley of Nepal. *Mountain Research and Development* **36**(1): 15–30.
- Sultana, N. and Lu, Q. 2017. Household livelihood strategies choice and the impact of livestock rearing on the sustainable rural livelihoods of indigenous people in three selective districts of Bangladesh. *International Research Journal of Social Science* **6**(8): 9-22.
- Tao, T. C. H. and Wall, G. 2009. Tourism as a sustainable livelihood strategy. *Tour Management* **30**(1): 90–98.
- Tchale, H. and Saurer, J. 2007. The efficiency of maize farming in Malawi: A bootstrapped translog frontier, *Cashiers d' Economie et Sociologie Rurales* editions **82**: 34-56.
- Tesfaye, Y., Roos, A., Campbell, B. M. and Bohlin, F. 2011. Livelihood strategies and the role of forest income in participatory-managed forests of Dodola

area in the bale highlands, southern Ethiopia. *Forest Policy Economics* **13**(4): 258–265.

Theodiridis, A. and Anwar, M. 2011. A comparison of DEA and SFA methods: A case study of farm household in Bangladesh. *The Journal of Developing Areas* **45**(1): 95-110.

Timmer, C. P. 1971. Using a probabilistic frontier production function to measure technical efficiency. *Journal of Political Economy* **79**(4): 776-794.

Timmerman, P. 1981. Vulnerability resilience and the collapse of society a review of models and possible climatic application. Institute for Environmental Studies, University of Toronto, Canada.

Tittonell, P., Muriuki, A., Shepherd, K. D., Mugendi, D., Kaizzi, K. C., Okeyo, J., Ver-chot, L., Coe, R. and Vanlauwe, B. 2010. The diversity of rural livelihoods and their influence on soil fertility in agricultural systems of East Africa—a typology of smallholder farms. *Agricultural System* **103**(2): 83–97.

Tulachan, P. M. 2001. Mountain agriculture in the Hindu Kush-Himalaya: A regional comparative analysis in Kathmandu: ICMOD. *Mountain Research and Development* **21**(3): 260-267.

Turner, B. L., Kaperson, R. E., Matson, P. A., McCarthy, J. J. and Corell, R. W. 2003. A frame work for vulnerability analysis in sustainable science. *National Academy Science* **100**(14): 8074-8079.

Ulrich, A., Speranza, C. I., Roden, P., Kiteme, B. and Wiesmann, U. 2012. Small-scale farm-ing in semi-arid areas: livelihood dynamics between 1997 and 2010 in Laikipia, Kenya. *Journal of Rural Studies* **28**(3): 241–251.

- UNDP, 2007. Human Development Reports, <http://hdr.undp.org/en/> (accessed 25 December 2007).
- Unni, J. 1996. Diversification of economic activities and non-agricultural employment in rural Gujarat. *Economic and Political Weekly* **31**(33): 2243-2251.
- Vanden-Berg, M. 2010. Household income strategies and natural disasters: dynamic livelihoods in rural Nicaragua. *Ecological Economics* **69**(3): 592–602
- Varian, R. H. 1992. *Microeconomic Analysis*. 3rd edition. New York.
- Vatta, K., Budhiraja, P. and Dixit, S. 2017. Vulnerability of tribal rural households in India: measuring the current status, risks of climate shocks and impact of potential interventions for improving rural livelihoods. *Indian Journal of Agriculture Economics* **72**(3): 341-361.
- Vorley, B. 2002. Sustaining agriculture: policy, governance and the future of family based farming Birmingham: DFID/Sida. pp 23.
- Walelign, S. Z. 2016. Livelihood strategies, environmental dependency and rural poverty: the case of two villages in rural Mozambique. *Environment, Development and Sustainability* **18**(2): 593–613.
- Wall, G. and Mathieson, A. 2006. Tourism: Changes, Impacts and Opportunities. Pearson Prentice Hall, New York.
- WCED, 1987. Our Common Future. Oxford and New York: Oxford University Press.

- Williamson, J. G. 1965. Regional inequality and the process of national development: A Description of the patterns. *Economic Development and Cultural Change* **13**(4): 1-84.
- World Bank, 2009. From poor areas to poor people. China's evolving poverty reduction agenda: An assessment of poverty and inequality in China. Poverty reduction and economic management department, World Bank, Washington, D. C.
- World Development Report 2000/2001: Attacking Poverty, Washington, D. C., USA.
- Wu, Z., Li, B. and Hou, Y. 2017. Adaptive choice of livelihood patterns in rural households in a farm-pastoral zone: a case study in Jungar. Inner Mongolia. *Land Use Policy* **62**: 361-375.
- Xu, D., Zhang, J., Rasul, G., Liu, S., Xie, F., Cao, M. and Liu, E. 2015. Household livelihood strategies and dependence on agriculture in the mountainous settlements in the three Gorges reservoir area, China. *Sustainability* **7**(5): 4850-4869.
- Yenesew, S. Y., Eric, N. O. and Fekadu, B. 2015. Determinants of livelihood diversification strategies: The case of smallholder rural farm households in Debre Elias Woreda, East Gojjam Zone, Ethiopia. *African Journal of Agricultural Research* **10**(19): 1998–2013.
- Zenteno, M., Ziudema, P. A., De-Jong, W. and Boot, R. G. A. 2013. Livelihood strategies and forest dependence: new insights from Bolivian forest communities. *Forest Policy Economics* **26**: 12–21.

- Zhang, H. 2016. Household vulnerability and economic status during disaster recovery and its determinants: A case study after the Wenchuan earthquake. *Natural Hazards* **83**(3) 1505–1526.
- Zhao, Y. 2003. The role of migrant networks in labour migration: The case of China. *Contemporary Economic Policy* **21**(4): 500–511.

Sher-e-Kashmir
University of Agricultural Sciences & Technology of Kashmir,
Faculty of Horticulture, School of Agricultural Economics and
Horti-Business Management

CERTIFICATE

Certified that all the corrections/amendments as suggested by External Examiner Dr. Sudhakar Dwivedi, Associate Professor, Division of Agricultural Economics & ABM, SKUAST-Jammu during Viva-Voce examination held on 12-07-2021 have been incorporated in the manuscript entitled **“Efficiency and Sustainability of Farming Systems in Intermediate Zone of Jammu and Kashmir”** submitted by **Ms. Naseem Akhter Qammer (Regd. No. 2017-732-D)**.

(Dr. F. A. Shaheen)
Chairman
Advisory Committee