

Assessment of Livelihoods of Smallholder Rice Farmers in Aurangabad District, Bihar, India



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Dedication

This report is dedicated to my parents, daughter Anushka Singh, son Ayush Kumar and wife Priyanka Singh who supported me thick and thin throughout my life.

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Acronyms

ATMA	:	Agricultural Technology Management Agency
CABI	:	Centre for Bioscience International
CLL	:	Community Living Lab
DFID	:	Department for International Development
FAO	:	Food and Agriculture Organization of the United Nations
FGD	:	Focus Group Discussion
GDP	:	Gross Domestic Product
GOB	:	Government of Bihar
GOI	:	Government of India
HDI	:	Human Development Index
ILRI	:	International Livestock Research Institute
KVK	:	Krishi Vigyan Kendra
MT	:	Metric Tonne
PACS	:	Primary Agricultural Co-operative Societies
RQ	:	Research Questions
SDG	:	Sustainable Development Goals
SIRDI	:	Sustainable and Inclusive Rural Development Institute
SLF	:	Sustainable Livelihood Framework
SQ	:	Sub-question
USA	:	United States of America
VHL	:	Van Hall Larenstein University of Applied Sciences

Abstract

Smallholder rice farming has an important role to secure a sustainable livelihood, food and nutrition security in Bihar, India. Despite being a staple food and main source of income of smallholder rice farmers, productivity is comparatively very low. The intended objective of this study was to examine various factors affecting smallholder farmers' livelihood in Aurangabad district of Bihar, India to recommend the Sustainable and Inclusive Rural Development Institute (SIRDI) to adapt or change its policy and how to intervene for improving the livelihood of smallholder rice farmers in the district.

The research applied a case study as a strategy to address the research objective. Primary and secondary data were used for the study. Qualitative primary data was collected through semi-structured interviews with 27 individual farmers using a checklist in the Aurangabad district of Bihar, India. Two Focused Group Discussions (FGD), first with young farmers and second with aged farmers, and 3 key informants' interview was organised to validate the findings.

Results and discussion of this study indicate that collaboration and coordination among stakeholders have a serious stake in improving the livelihood of smallholder rice farmers in the district. The study found that vulnerability context has a negative impact on smallholder rice farming and it needs to be minimized. The asset portfolio has a positive impact on smallholder rice farming and it requires to maximize particularly human, natural, physical and financial assets. Off-farm income should be maximised and farmer needs on-farm or off-farm work during the lean period.

On the basis of findings, the study recommends the SIRDI to develop an Innovation Platform to bring together all stakeholders of smallholder rice farming in the district. Further, considering the features of Living Labs which provide complex multi-stakeholder constellations where a multitude of activities take place, could be a better option to enhance livelihood options and improve the productivity of smallholder rice farming in the district.

Chapter 1: Introduction

This chapter sets the scene about the study, starts with background for the study on rice production in India (section 1.1) and followed by research problem and objective (section 1.2), research question (section 1.3) and finally ends with the organisation of thesis (section 1.4).

1.1: Background

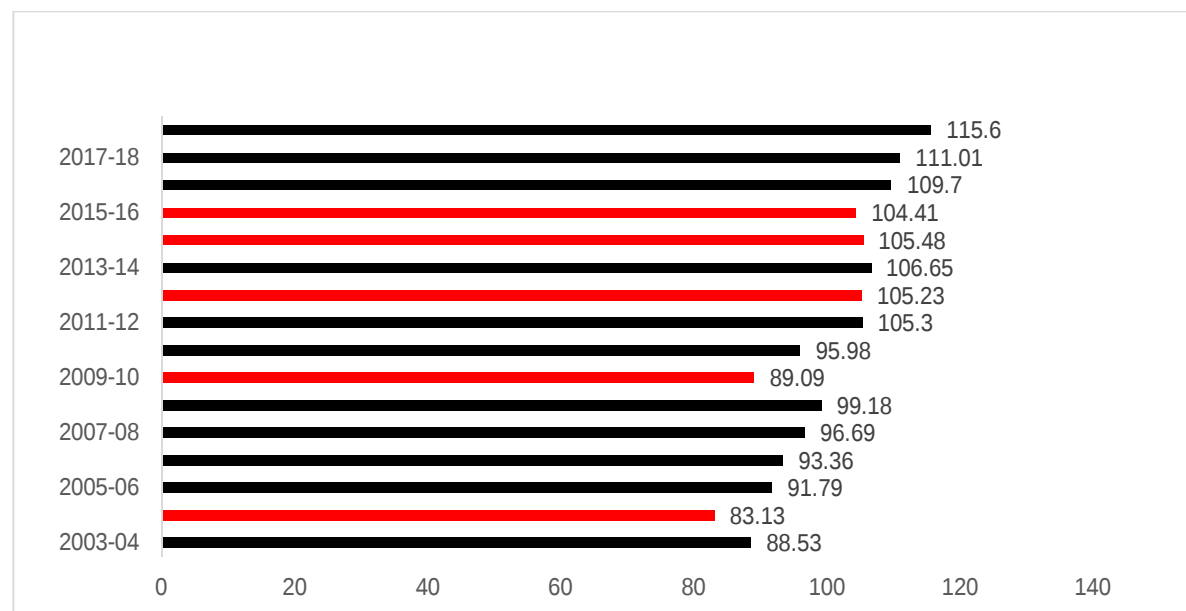
Rice¹ is the most prominent crop of India, as it is the staple food for most of the people of the country (Mahajan, et al., 2017; Pathak, et al., 2018). Despite its importance for millions of people as staple food and source of income, overall rice productivity in India is relatively low just 2.56 t/ha in comparison to other rice-growing countries (FAO Stat, 2016). In Australia, Egypt and USA rice productivity is 6.68 t/ha, 6.37 t/ha and 5.66 t/ha, respectively. The past trends reveal that India has been marginally surplus in rice production and has been even exporting rice in small volumes. However, the demand-supply projection study by Kumar et al., (2016) indicates that India is not likely to remain a rice surplus and may even become a deficit in rice production (Table 1). The yearly rice production data (Fig 1) indicates that 6 out of 15 years (shown in red) since 2003-04 to 2017-18 production has decreased from previous years caused by several biotic and abiotic challenges (Pathak, et al., 2018).

Table 1: Demand-supply gap of rice in India (in million tonnes)

Year	Supply Projected	Demand Projected	Demand Supply gap
2020	108.1	111.8	-3.7
2030	122.1	122.4	-0.3

Source: Kumar et al., (2016)

Figure 1: Year wise production of rice in India



Source: GOI 2018-19, Annual Report

With a large population (over 104 million), Bihar is one of the poorest and most food-insecure states in India. About 80% of Bihar's population depends on agriculture, which contributes 60% to the state's

¹ In this study term Rice is used for Paddy (with husk)

Gross Domestic Product (GDP) (Thakur, et al., 2000). Rice is the staple crop and is grown over a large area in Bihar and for the majority of smallholder farming households, it is the main source of income and livelihood. However, rice productivity in the state is among the lowest in India (Najmuddin, et al., 2018).

The state has an about 3.31-million-hectare area under rice cultivation, with a production of 8.93 million tonnes during 2017-18, the state's average productivity is about 2.2 tonnes/ha (Directorate of Economics and Statistics, 2019). In terms of vulnerability context, flood and droughts along with climate-related weather shocks are the more frequent and severe challenge of smallholder rice farming in the state (Kishore, et al., 2014).

The key challenge before agricultural planners in Bihar is how to increase rice productivity so that more food can be produced and provided to a large food insecure population. However, in order to design effective policies for increasing rice productivity, it is first necessary to understand the factors that influence present levels of productivity.

1.2: Research Problem and objective

Rice farming system dominated by smallholder farmers in Bihar, faces serious biotic and abiotic challenges (Pathak, et al., 2018), which ultimately leads to low productivity. Though several initiatives have been adopted by Indian as well as state Governments to enhance the productivity in the rice farming system. However, partial success has been achieved after the 'Green Revolution' phase but still a long way to go. In order to meet future food needs and to foster economic development among the rural poor in India, there is a growing consensus that development efforts must prioritize agriculture, particularly rice farming Pathak, et al., (2018) where current productivity is low but sufficient scope for improvement exists. As of today, Sustainable and Inclusive Rural Development Institute (SIRDI)² lacks knowledge on the reasons why the rice productivity is less than anticipated to provide sustainable livelihood to all in Aurangabad district in Bihar and explores factors that could influence to enhance the rice productivity. This study examines the vulnerability context, livelihood asset, livelihood strategies and livelihood outcomes of smallholder rice farmers in Aurangabad district, Bihar and factors that influence rice productivity of smallholders.

The objective of this study is to examine various factors affecting rice productivity and to recommend the Sustainable and Inclusive Rural Development (SIRDI) to adapt/change its policy and how to intervene for improving the livelihood of smallholder rice farmers in the district.

1.3: Research Question:

What are the factors affecting rice production for securing livelihoods of smallholder rice farmers in Aurangabad, Bihar?

Sub-question:

1. What is the vulnerability context faced by smallholder rice farmers?
2. Which livelihood assets are currently available to smallholder rice farmers?
3. What are the livelihood strategies adopted by smallholder rice farmers?
4. How are organisations involved in smallholder rice farming?
5. How smallholder rice farming affects households' food availability?

² A non-governmental organisation entails sustained effort to raise smallholder farmers livelihood and food security in Bihar, India

1.4: Organisation of Thesis

The study consists of six chapters. Chapter one sets the scene with background followed by research problem, research objective, research question and organisation of the thesis. Next chapter two reviews relevant literature which involves, theoretical explanations of the topic, and conceptual framework, which puts the current research into perspective. Further, chapter three focuses on the research methodology and explains about the study area, research design, sampling procedure, data collection process, data triangulation activity plan, and ethical issues. Chapter four dealt with research findings and interpretation. While chapter five discusses the findings, chapter six is made up of drawn conclusions with recommendations in the light of factors affecting smallholder rice farming in Aurangabad district, Bihar, India.

Chapter 2: Literature Review

This chapter focuses on literature related to rice farming to understand the factors affecting the livelihood of smallholder rice farmers in Aurangabad district, Bihar, India. The chapter starts with general description about rice farming in India (section 2.1), followed by vulnerability context (section 2.2), livelihood asset (section 2.3), policies, institution and processes (section 2.4), livelihood strategies (section 2.5), food availability and smallholder rice farming (section 2.6) and finally ends with conceptual framework of the study (section 2.7).

2.1: Rice Farming in India

Rice plays a major role in diet, economy, and employment in India. It is a staple food for more than 65% Indian population contributing approximately 40% of the total food grain production, thereby, occupying a pivotal role in the food and livelihood security of people (Pathak, et al., 2018). The country

Table 2: Area, production, and productivity-wise top five rice producing countries (2016)

Country	Area (Mha)	Country	Production (Mt)	Country	Productivity (t/ha)
India	43.67	China	137.64	Australia	6.68
China	30.67	India	105.79	Egypt	6.37
Indonesia	13.69	Indonesia	46.93	USA	5.66
Bangladesh	11.67	Bangladesh	34.27	Spain	5.14
Thailand	11.49	Vietnam	29.5	Turkey	5.11

Source: FAO STAT, 2016 & Pathak et. al., 2018

has the world's largest area under rice cultivation i.e., about 43.67 million hectares and second highest production i.e., about 105.79 Mt at the productivity of 2.56 t/ha (Table 2).

Bihar is one of the most climate-sensitive states

in India due to its geographical setting, hydro-meteorological uncertainties, dense rural population and high level of poverty (GOB, 2016). Smallholder rice farming plays an important role in the economic development of the state and as a prime source of livelihood for about 90% of the population (GOB, 2016). Smallholder rice farmers are highly dependent upon the natural environment. The climate change and environmental degradation pose a critical challenge to a sustainable livelihood, income and food security of smallholder rice farmers. Changing weather patterns and increased risk of vulnerabilities are complicating the livelihoods of farmers and it might worsen in the future. The rainy season upon which many farmers rely will become increasingly unpredictable (Tingem, et al., 2008). In addition, according to Gosh (2004), decreasing soil fertility due to over-cropping and unsustainable use of chemical inputs is adding to the vulnerability of smallholder rice farmers. At present, land degradation and population growth in combination with climate change pose a serious challenge for sustainable livelihoods and food security for smallholder farmers in developing countries (Tingem, et al., 2008).

The yield gap, the difference between attainable yield at the farm and actual yield is a serious concern for the Indian rice farming system. According to Mondal, et al., (2018) India's yield gap is very high as compared to China. The yield gap in China is only 3.38% however in India it's 27.78%. In absolute terms, China has just 0.2 t/ha but India has 1 t/ha.

The factors causing the yield gap in smallholder rice farming can be classified as: vulnerability context (Pathak et. al. 2018; Najmuddin, et al., 2018; Easterling et al. 2007;) impact of assets on livelihood (Mumuni and Oladele, 2018; Yang et. al. 2018); policies institution and processes (Shenggen, et al., (1999); Khan & Akram, (2012); Gulati, et al., 2018); Livelihood strategies (Thorpe et. al., 2007; Deshingkar, et al., 2006). The next sections of this chapter explain these factors in detail.

2.2: Vulnerability Context Impact on Smallholder Rice Farming

The vulnerability context in the smallholder rice farming alludes to the seasonality, trends, and shocks that affect smallholder rice farmers' livelihood. According to [DFID \(1999, 2.2\)](#) "The Vulnerability Context frames the external environment in which people exist. People's livelihoods and the wider availability of assets are fundamentally affected by critical trends as well as by shocks and seasonality – over which they have limited or no control."

Climate change in rice farming is expected to lopsidedly influence smallholder farmers by further intensifying the risks that farmers face in rice farming. Recent studies using regional and global simulation models, for instance, demonstrate that even moderate increments in temperatures will negatively affect rice, maize, and wheat, which are the primary grain yields of smallholder farmers ([Morton, 2007](#)). Climate change is also expected to alter pest and disease flare-ups, increment the recurrence and severity of droughts and floods, and increase the likelihood of poor yields, crop failure and livestock mortality ([Morton, 2007](#); [Kishor et al., 2014](#)). All these biotic and abiotic challenges have a high impact on the rice farming system in India ([Pathak, et al., 2018](#))

Global warming due to climate change is likely to further increase agricultural water requirement. A study conducted in Bihar by ([Najmuddin, et al., 2018](#)) highlights that climate change is likely to further increase agricultural water requirement and Improving agricultural water productivity remains one of the biggest issues in food production and ensuring sustainable livelihoods. [Alauddin & Sharma, \(2013\)](#) conducted study in Bangladesh recommends that rice productivity can be improved by increasing irrigation facilities in the dry season would lead towards the sustainable livelihood of farmers during the lean period. In a pan-India study conducted by [Sharma et. al., \(2018\)](#) concludes that considering the water scarcity as a serious threat, re-aligning cropping pattern with available water resources endowment across states is required in India.

A study conducted in Madagascar by [Harvey, et al., \(2014\)](#) concludes that farmers are especially vulnerable against any shocks to their agricultural system attributable to their high reliance on agriculture for their livelihoods, chronic food insecurity, physical isolation and lack of access to formal safety nets. Rice farmers are vulnerable against pest and disease outbreaks and extreme weather events, which cause critical crop and income losses and exacerbate livelihood and food insecurity ([Pathak, et al., 2018](#)).

According to [Easterling et al. \(2007: p277\)](#) "The inter-annual, monthly and daily distribution of climate variables (e.g., temperature, radiation, precipitation, the water vapor pressure in the air and wind speed) affects a number of physical, chemical and biological processes that drive the productivity of agriculture". The climate variability impacts agriculture particularly rice farming in Bihar, have been generally harmful to smallholder rice farmers. For example, intermittent impacts such as droughts and floods threaten the livelihood of rural people who are dependent on agriculture ([Ranganathan et al., 2010](#)).

Smallholder rice production is influenced by natural changes, for example, environmental change and its environmental change have risen as the key concern for environmentally and economically vulnerable countries ([Sarker, et al., 2012](#)). According to [Nasir and Makmom \(2009\)](#), the immediate effect of climatic vulnerability to rice farming can be characterized in: (i) decreasing the agricultural productivity (ii) increasing of food insecurity, and (iii) affecting the supply chain of production. [Chamhuri & Quasem, \(2009\)](#) looked into that production and yield changes might be because of the decrease in the water availability for irrigation, the risk of weeds, insects, and diseases could increase.

Vulnerability is a function of how a smallholder rice farming household's livelihood would be influenced by a specific hazard and how it can adapt to its impact (Ellis, 2003). Many studies indicate that the vulnerability context has a serious impact on the livelihood of farmers (Deshingkar, et al., 2006) Chetan, (2017) Tsujita & Hisaya, (2012). All these studies conducted in Bihar exemplify that the occurrence of out-migration from rural Bihar is most likely more noteworthy than anywhere else in India. A blend of conditions, natural and societal, has created a situation in the state where sending a relative out to earn was the main method for remaining alive.

2.3: Livelihood Assets Impact on Smallholder Rice Farming

The smallholder rice farmers' livelihood portfolio is comprised of various livelihood strategies attempted to create a certain livelihood; yet the strategies themselves are derived from combining and managing the capital assets to which people have access (Scoones, 1998: 7).

Mumuni & Oladele, (2016) conducted a study in the Ashanti and northern region of Ghana to examine rice farmers' access to livelihood capital (human, social, natural, financial and physical) and relationship and propensity for entrepreneurship among rice farmers. The study reveals that farmers' access to strong livelihood capitals improve locus of control, improve their farming management capabilities and boost their agricultural entrepreneurial capability which ultimately provides them options to improve livelihood.

The human asset in the smallholder rice farming system is presumably the most significant asset because, in addition to its own intrinsic value, it is necessary in order to make use of the other four assets. Human asset describes the availability of skills, knowledge, ability to utilize their capability to understand their livelihood options. According to Ellis (2012), the human asset comprises of education level and health status of individuals and populations. In addition, a human capital asset is the collective sum of the attributes, life experience, knowledge, inventiveness, energy, and enthusiasm that its people choose to invest in their work. Robinson-Pant, (2016) highlights that high quality and profitable knowledge could stimulate production in farming systems. Keshwan and Swaminathan, (2008) emphasise the need for an evergreen revolution in India. They suggest that blending of frontier technology with traditional knowledge would lead to sustainable agriculture.

Natural assets in smallholder rice farming play a critical part in the asset pentagon in rural areas, where most people engage in some kind of agricultural activity. According to Ellis (2012), Natural asset refers to the natural resources base (land, water, trees) that yields products utilized by human populations for their survival. A large number of poor people in the world are negatively affected because the natural assets on which they depend for their livelihoods are degraded and unproductive (Coward, et al., 1999, p.6). Moreover, natural capital is the planet's stock of renewable and non-renewable natural resources (forests, minerals, oil, plant and animal species), ecological assets (environment, water) and land (Molnar, 2011). The natural assets are basically correlated with infrastructure and particularly with irrigation facilities. In the same line, according to Najmuddin, et al., (2018) water productivity plays a key role in increasing productivity and improving the livelihood of smallholder rice farmers.

The physical asset in smallholder rice farming is one of the important assets to sustain the livelihood. As indicated by (Coward, et al., 1999) there is no particular asset that could be successful without utilizing physical assets. The physical asset for smallholder rice farmer is mainly the infrastructure such as transport, shelter, water, energy and communications, and the production equipment and means which enable people to pursue their livelihoods (Ellis, 2012). The physical assets brought into existence by economic production processes, for example, tools, machinery, and land improvements like ter-

races or irrigation canals (Ellis, 2012). Access to irrigation facilities, roads, storage, and markets facilitates the strength of farmer's physical capital and improves the livelihood outcomes of smallholder rice farmers. A study conducted by Shekhar & Bhat, (2014) in eastern states finds that mechanization play important role in improving the livelihood of farmers and the percentage of farmers using the machine in Bihar is low compared to other states.

In smallholder rice farming financial asset refers to the financial resources that farmers use to achieve their livelihood objectives and includes flows and stocks that can contribute to production and consumption. This includes cash or equivalent that enables people to adopt different livelihood strategies, cash income through wage labour, self-employment and/or salaried employment, flows or stocks of capital, e.g. cereal stocks, livestock holdings as well as access to loans or credit. According to (DFID, 1999), financial capital is probably the most versatile of the five categories of assets. This is because it can be converted, depending upon Transforming Structures and Processes, into other types of capital. What is sure, nonetheless, is that for most smallholder rice farmers, access to financial assets might be the most difficult to obtain. According to then-Deputy Governor-General of Reserve Bank of India (Mohan, 2004) "Agricultural finance and credit have played a vital role in supporting the Green Revolution by greater use of inputs like fertilizers, seeds, and other inputs, increased credit requirements which were provided by the agricultural financial institutions". A study on micro-credit in India (Rao & Priyadarshini, 2013) augmented rural sector employment, the efficiency of the non-agribusiness sector, strengthening of women in socioeconomic aspects to improve livelihood security in rural areas.

Social assets in smallholder rice farming allude to the social resources that individuals can get help from so as to accomplish their livelihoods – this could be through networking, membership of formalized groups or mere trust between people that make them help one another. The social networks and associations where individuals participate, and from which they can infer support that adds to their livelihoods (Ellis, 2012). The social capitals of smallholder rice farmers include family, friends, trust, norms, communality, gatherings, and networks of farmer associations and other actors like agro-inputs dealers, landowners and agricultural extension officers. In developing countries such as India, the agriculture extension system plays an important role in promoting economic growth, alleviating poverty and improving livelihood, food, and nutrition security (Gulati, et al., 2018). A study by (Hoang, et al., 2006), advocates a similar need for the social asset for the efficient delivery of extension services and research and development interventions at the micro-level.

2.4: Policies, Institution and Processes Impact on Smallholder Rice Farming

The significance of policies, institutions, and processes on smallholder rice farming can't be overemphasized, in light of the fact that they work at all levels, from the family unit to the international arena, and in all circles, from the most private to the most public. Policies, institutions, and processes have an immediate effect on whether people can accomplish a feeling of inclusion and well-being. Since culture is incorporated into this area they also count for other 'unexplained' differences in the 'way things are done' in different societies (DFID, 2000). Institutions and processes can decide access to resources and impact decision making processes.

According to North (1990: 3), institutions are formal rules conventions and informal codes of behavior, that comprise constraints on human interaction. Examples of institutions are laws, land tenure arrangements and the way market work in practice (the market as an institution). The role of the institution is to reduce uncertainty by establishing a stable structure of human interaction. Organizations, as distinguished from institutions, are a group of individuals bound by some common purpose to achieve objectives (North, 1990: 5). Examples of organisations are government agencies (e.g. Ministry

of Agriculture, livestock department), administrative bodies, (e.g. local government) NGOs, associations (e.g. farmer association), and private companies (firms). For this study, the only organisation who has a stake in rice farming is considered.

[Khan & Akram, \(2012\)](#) showed that the effectiveness of extension services is affected by farmers' contact with extension personnel. Farmers' satisfaction depends on perceived economic return, regular extension contacts, family size, and off-farm income. The finding suggests that there is a need to develop a demand-driven extension instead of a supply-driven one.

In developing countries such as India, the agriculture extension system plays an important role in promoting economic growth, alleviating poverty and improving food and nutrition security ([Gulati, et al., 2018](#)) among smallholder farmers. According to [Shenggen, et al., \(1999\)](#) the "Green Revolution" in India during the 1960s was largely successful due to systemic change in structure and process particularly extension system.

2.5: Livelihood Strategies Impact on Smallholder Rice Farming

Smallholder rice farmers rely on several activities to diversify household income (farm production, off-farm activities, migration, etc.), resulting in outcomes such as food or income security. According to Ellis ([2012, p. 15](#)), livelihood diversification is 'the process by which rural families construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standard of living'.

According to [Thorpe et. al., \(2007\)](#) crop-livestock interaction provides better livelihood opportunities for smallholder farmers in Bihar. The share of crop-livestock income was high that other sources. The findings of a study conducted in Nepal by [Kathiwada, et al., \(2017\)](#) shows that income diversification to non-farm activities has turned into the dominant livelihood strategy since the majority (about 61%) of households have diversified their livelihood to non-farm related strategies (includes remittance and non-farm wages).

[Nathan and Mohamad \(2014\)](#) conducted a study to find out the importance of non-farm employment to paddy growing farming community in Northern Selanger, Malaysia. The results from multinomial logistic regression showed that the size of cultivated land was a significant factor for a livelihood strategy. The average education of working members, the share of other non-farm income and the availability of credit were also the significant determinants of a diversified livelihood strategy.

Remittances have an important role in smallholder rice farming households ([Deshingkar, et al., 2006](#)), [Chetan, \(2017\)](#), ([Tsujita & Hisaya, 2012](#)) in Bihar economy. All these studies highlighted that remittances play a positive role in livelihood diversification. Migrant households have higher incomes than non-migrant households.

2.6: Food Availability and Smallholder Rice Farming

Rice is an important source of smallholder rice farmers' food availability. A study on self-sufficiency in rice and food security conducted by [Ghose et al., \(2013\)](#) indicates that domestic production plays an important role in self-sufficiency. A regional rice strategy for sustainable food security in Asia and the Pacific report by [FAO\(2014\)](#) highlights that rice farming plays an important role in food security among smallholder farmers and poor consumers. According to this report, rice production is an important source of livelihood for around 140 million rice-farming households and for millions of rural poor who work on rice farms as hired labour.

Food availability is an important pillar of food security. The physical availability of food addresses the "supply-side" of food security and is determined by the level of food production, stock levels, and net

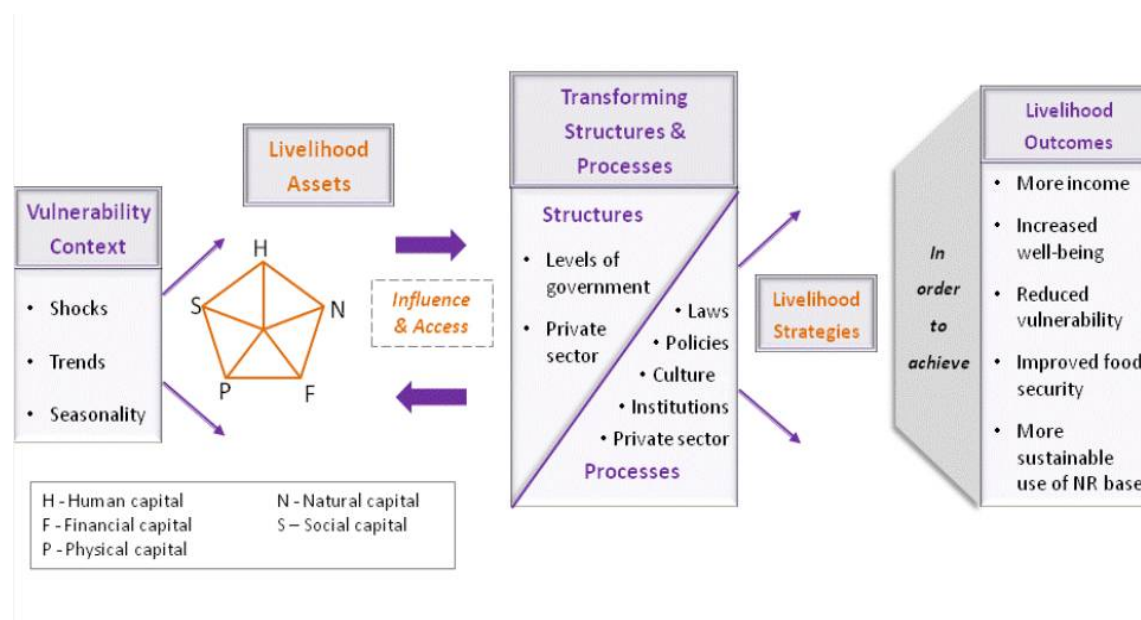
trade. "Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996)."

A study conducted in Uganda by Winchurn, et al., (2017) found that "consumption of crop products on-farm contributed most of the availability for households. Off-farm and market-oriented on-farm activities were more important for household food availability." Frelet, et al., (2016) saw that household food availability improved with expanding reliance on off-farm activities and recommends diverse strategies among rural households.

2.7: Conceptual Framework for this Study

The Sustainable Livelihood Framework [SLF] (Fig 2) has been used to answer the research questions. According to (DFID, 1999), the livelihoods framework is a tool to improve our understanding of livelihoods, particularly the livelihoods of the poor. The SLF presents the main factors that affect peoples' 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. In particular, the framework provides a checklist of important issues and sketches out the way these link to each other; draws attention to core influences and processes; and emphasizes the multiple interactions between the various factors which affect livelihoods. The framework is centered on people. It does not work in a linear manner and does not try to present a model of reality. Its aim is to help stakeholders with different perspectives to engage in structured and coherent debate about the many factors that affect livelihoods, their relative importance and the way in which they interact. This, in turn, should help in the identification of appropriate entry points for support of livelihoods (DFID, 1999).

Figure 2: Sustainable Livelihood Framework



Source: DFID (1999), p.1.

Chapter 3: Research Methodology

This chapter focuses on research methodologies and strategies. The chapter starts with selection of research location (section 3.1) followed by research framework (section 3.2), research strategy and approaches (section 3.3), sources of the data for research (section 3.4), data collection tools (section 3.5), sampling procedure and sample size (section 3.6), data triangulation (section 3.7), data analysis (section 3.8) ethical consideration (section 3.9) and finally ends with limitation of research and reliability of data (3.10).

3.1: Selection of Research Location

Aurangabad districts (fig 3) under Bihar state were selected for this study, has an area of 3,305 km² including 3,244.13 Km² rural and 60.87 Km² urban area. The district has a population of 2,540,075 people and 391,898 households. For their livelihood, people mainly depend on agriculture. The soil of the district is highly suitable for rice, wheat, and sugarcane; however, rice is the prominent crop grown in the rainy season.

Figure 3: Map of the selected village for the study

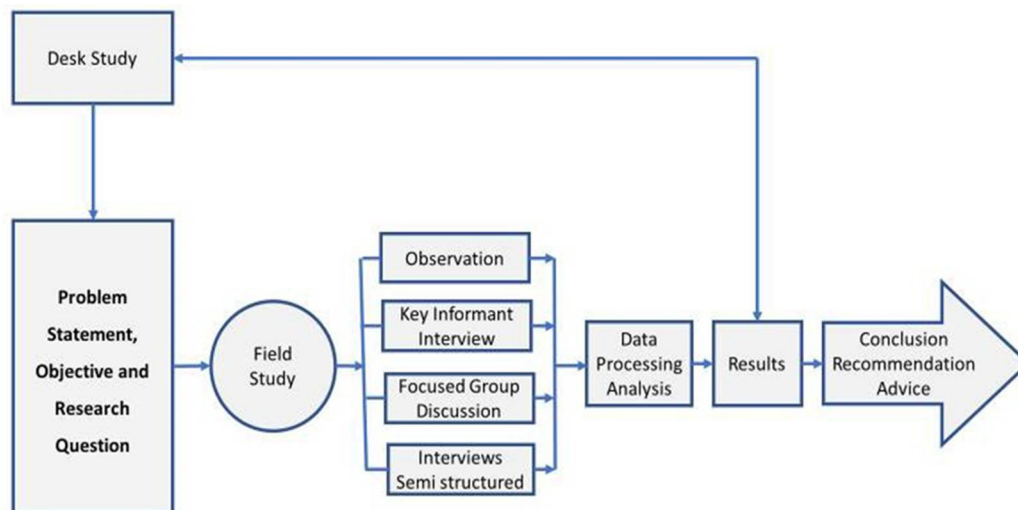


Source: Road division Map, Bihar

3.2: Research Framework

The research frame illustrated below in figure 4 shows the flow chart of the study. The research started with defining the research problem, research objectives and research questions. Further, literature was reviewed to establish a foundation and other evidence to support the study. Later on, data collection, analysis, and interpretation formed the bases for which conclusions and recommendations were drawn.

Figure 4: A Research Framework



Source: Prepared by the author

3.3: Research Strategy and Approaches

The research adopted two strategies: desk study and case study. The desk study helped in reviewing theories, views of different authors, information on the subject matter and key concepts. The case study used qualitative methods of research to conduct this study. The case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not evident; and in which multiple sources of evidence are used (Yin, 1984). The case study strategy was employed to enable the researcher to go in-depth and to get a holistic view of the situation.

3.4: Sources of Data for the Research

Data were collected from secondary and primary sources for the study. Secondary data in the form of the literature review was collected from the second week of May to the first week of August 2019. Primary data was collected from the first week of July to the first week of August 2019.

3.4.1: Secondary Data

A desk study was conducted to collect secondary data through the review of literature from books, academic periodicals, research journals, publications by development organisation, past dissertation, annual reports, and internet source. Desk study helped in reviewing existing theories, views of different authors, information on the subject matter and key concepts such as livelihood and rice farming, and vulnerability context, livelihood assets, livelihood strategies, and livelihood outcomes. Operationalizing and defining the key concepts used in the study was done through the literature review. Oliver (2012) pointed out that, reviewing the literature and collecting secondary data was to help the re-

searcher create research in academic areas, which are of relevance to the subject of study. Using secondary data is necessary because it points out different opinions and experiences from sources of relevance.

3.4.2: Primary Data Collection

The data from the rice farming community on the mentioned variables were collected through face-to-face interviews with respondents, key informants' interviews, focus group discussion (FGDs), and personal observation. Further data collected were coded, triangulated and analysed.

3.4.2.1: Individual Interviews

Face to face, semi-structured interviews were conducted using the topic list. Respondents were selected from the rice farming community (procedure for selection is captured in 3.6). Individual private interviews were conducted to get in-depth data from respondents. This approach was used to help grant confidentiality and afford the researcher the opportunity to ask the question, which is sensitive to individuals, and questions, it could not be asked at Focus Group Discussions (FGDs).

Photo 1: Interview with individual farmer



selected from the rice farming community (procedure for selection is captured in 3.6). Individual private interviews were conducted to get in-depth data from respondents. This approach was used to help grant confidentiality and afford the researcher the opportunity to ask the question, which is sensitive to individuals, and questions, it could not be asked at Focus Group Discussions (FGDs).

3.4.2.2: Key Informant Interview

The key informant selection was based on a discussion with the village political representative (Sarpanch). The selection was made on the basis of informants' experience, knowledge in smallholder rice farming. Experts from the government department, farmers' leader and the experienced farmer were selected as key informants. Semi-structured interviews were carried out with selected key informants in local Hindi language to understand the vulnerability context, asset portfolio status, organisations role, livelihood strategies, livelihood outcomes in rice farming.

3.4.2.3: Focus Group Discussions

A focus group discussion was conducted with two groups of rice farmers in the community. First FGD was conducted with young rice farmers (less than or equal to 35 years of age) to find out their impression on livelihood indicators and rice farming. Another FGD was conducted with 35+ age farmers. By conducting discussions with two different focus groups, the researcher's objective was to elicit views from different groups in the rice farming. It is considered that young farmers are more open to new ideas and innovations. FGDs also afforded the researcher an opportunity to get information from households, which were not represented in the

Photo 2: FGD with experienced and aged farmers



individual face-to-face interviews so that their views were also included. Due to the traditional barriers, the only male was invited for FGDs.

Furthermore, FGDs offered the researcher an opportunity to validate the data collected from individuals' face-to-face interviews. It also inspired the researcher to collect more data as possible allowing the fair and equal contribution of members.

3.4.2.4 Observation

Another method of data collection employed by the researcher was observation. Personal observation was employed to identify the effects or performance of the indicators in relation to the objective of the research. This personal observation was done alongside the face to face interviews with individuals and the FGDs. The researcher observed activity in relation to various rice farming activities. The walking in the village gave an opportunity to find out the status of natural, physical and financial assets. However, during a discussion with farmers, the researcher tried to observe social and cultural behavior and values in the smallholder rice farming society. Unfortunately, the field study was conducted in the lean season so, I couldn't see the rice crop in the field. To get a deeper understanding of the social and cultural values of the smallholder rice farmers', the researcher stayed one night in the village.

3.5: Data Collection Tools

Three sets of data collection tools were used in this study. Check-list for individual interviews of rice farming households, key informant guide and FGD guide for selected rice farmers were used for the data collection. A checklist was used to conduct semi-structured interviews for an individual because it offered the researcher the opportunity to interact with the respondents and to make adjustments to the checklist during interviews whenever the need arose. It also offered the researcher the opportunity to ask probing questions.

3.6: Sampling Procedure and Sample Size

The random sampling procedure was employed during the research. At the first stage, the district and village were selected because of rice as the main crop in the district. In the community, snow-ball random sampling method was used. In this regard, twenty-seven [n= 27] respondents were selected and interviewed using a checklist.

3.6.1: Village and Sample Selection

The sample was made by the researcher randomly. In the first step, on the basis of literature review and secondary data, Bihar was selected as a study region. Further, in the next step, the researcher had an appointment with a Key Informant who worked as a senior NGO professional in Bihar. Based on his suggestion, a rice-growing district Aurangabad district had been selected. And following his suggestion, a rice-growing village (Jaihind Tendua) had been randomly selected for a detailed field study (Fig 5). The selected village was 25 Km far from district headquarter. Agriculture, particularly rice farming was the main source of livelihood in the village.

For sample selection in the village, the researcher had a meeting with the village head (political representative). The researcher formally introduced himself and hand in his introductory letter given by VHL. Further, the objective of researchers' study and what research questions intended to find out were mentioned. The village representative authorised the ward members to extend support during the entire period of data collection.

3.6.2: Pre-test of the Questionnaire

The pre-testing with a topic list with a farmer was also done in all the intended settings to appreciate their cultural norms and farming practices, and this allowed the researcher to make changes to some of the interviewed questions where there were duplication and repetition. Indeed, two questions were altered to be able to get clear information it required as they failed in the beginning.

3.7: Data Triangulation

The data obtained from various methods has been triangulated to strengthen the quality of findings. The information gathered from key informant interviews [n=3] was cross-examined during an individual interview and FGDs. Simultaneously, data and information gathered from individual interviews were cross-checked with FGDs. According to [Miller & Brewer \(2003\)](#) triangulation is the combination of different methods used in a social science perspective. In the study, different methods have to be used during the data gathering process. They complement or challenge the data obtained through interviews, observations and Focus Group Discussions. Using these arrays of qualitative methods or techniques has enabled to answer the research question(s).

3.8: Data Analysis

Data checking and cleaning were done alongside data collection. Data were then sorted after which data was coded and finally analysed. Both qualitative and quantitative data were analyzed by the use of narrative form and results were interpreted with the help of descriptive statistics to answer research questions. Results were further presented in tables and figures with the help of Microsoft excel. To ensure the credibility of data, triangulation was employed.

3.9: Ethical Considerations

Privacy and confidentiality at all times had been maintained in this research. The findings of this research depict the high level of confidentiality as no identifiable information of participants was documented in this study. Codes were assigned to interviewees and responses were only identified by the codes. The human rights of respondents with regard to the choice of participation were respected.

3.10: Limitation of Research and Reliability of data

The research engaged a relatively smaller size of the households and therefore, findings may not be a total representation of the situation but would provide valuable insight into what are the factors impacting the rice farming in Bihar, India. While it was a random sampling that might have left the potential respondents, who might have different views to share. The result may have influence due to a smaller sampling size (27 individual rice farmers). As stated by [Bryman, \(2016\)](#), a small sampling size has a greater chance of sampling error, while increased sample size would also increase the precision of a sample and thereby reduce the chance for sampling error. However, after 25th interview, the same information and data were repeating so only 27 interviews were conducted.

During the data collection, checking and cleaning, none of the responses provided by the respondents was rejected. This put the response rate at 100%. This is in line with [Punch \(2003\)](#) who stated that a response rate for a face-to-face interview between 80% - 85% is rated good and 86% and above is very good. This is a very good score of response rate thus bias is minimal. This is in line with a study [Massey & Tourangeau \(2013\)](#) found that a high level of response rate reduces bias and therefore findings of this study are highly acceptable. To avoid the caste base biases in information, respondents were taken from all farming caste. And during the interview, the researcher remained neutral so it couldn't influence the interview information and results.

Chapter 4: Results

This chapter deals with the main findings from the respondents who participated in the interviews and focus group discussions. Results or findings are presented as per research questions. The chapter starts with General descriptions of interviewed households (section 4.1) followed by vulnerability context in smallholder rice farming (section 4.2), livelihood asset impact on smallholder rice farmers livelihood (section 4.3), organisation involvement in smallholder rice farming (section 4.4), livelihood strategy of smallholder rice farmers (section 4.5), and finally ends with smallholder rice farming impact on food availability.

4.1: General Description of Smallholder Rice Farming Households

In order to understand in detail about rice farming, all respondents comprise of smallholder rice farmers who were at the same time the head of their households³. Respondents were 25 men and 2 women. 8 farmers belonged to young age⁴ and 19 were aged smallholder rice farmers. The average size of the family members was 6.4 persons. However, working-age members were just 4 people per household. Which was slightly less for young age farmers. The dependency ratio was 1.75 in interviewed households.

Across the sample, the age group of the participants ranged from 28 years – 78 years. Furthermore, the average age of the rice farmers was 47.3 years and 73.7 % of farmers had more than 35 years of age. It is found that most of the respondents were aged and young farmers are reluctant to adopt farming as a profession (FGD 1).

Table 3 indicates that all household heads were literate. 10% of household heads had elementary schooling while about 46% attended high school. Remaining 13% completed higher secondary and 7% completed graduation level of education. Overall, the average years spent in school was 8.3 years.

Table 3: General characteristics of rice farmers

Indicators	Young farmer	Aged Farmer	Overall
interviewed respondents [no]	8	19	27
female-headed respondents [%]	0.0	10.6	7.4
the average age of respondents [in years]	27.0	53.7	47.3
number of members in a family [average]	6.0	6.4	6.3
per family average workers	3.4	4.2	4.0
average education of respondents [in years]	8.6	7.5	8.3
average holdings of respondents [in acres]	1.9	2.3	2.2
average area under rice farming	1.7	2.1	2.0
cropping intensity	170	170	170

Source: Farmers interview, 2019

The households, on average owned 2.2 acres of land which was slightly less for young age farmers. and around 92% area was used for rice farming which was grown in the rainy season (mid-July to mid-November. Rice was the main crop and productivity was 0.9 tonnes/acre (2.2 tonnes/ha). Further, the

³Those that sleep under the same roof and take meals together at least four days a week' Coates et. al., (2007) FANTAProject

⁴ Less than or equal to 35 years of age

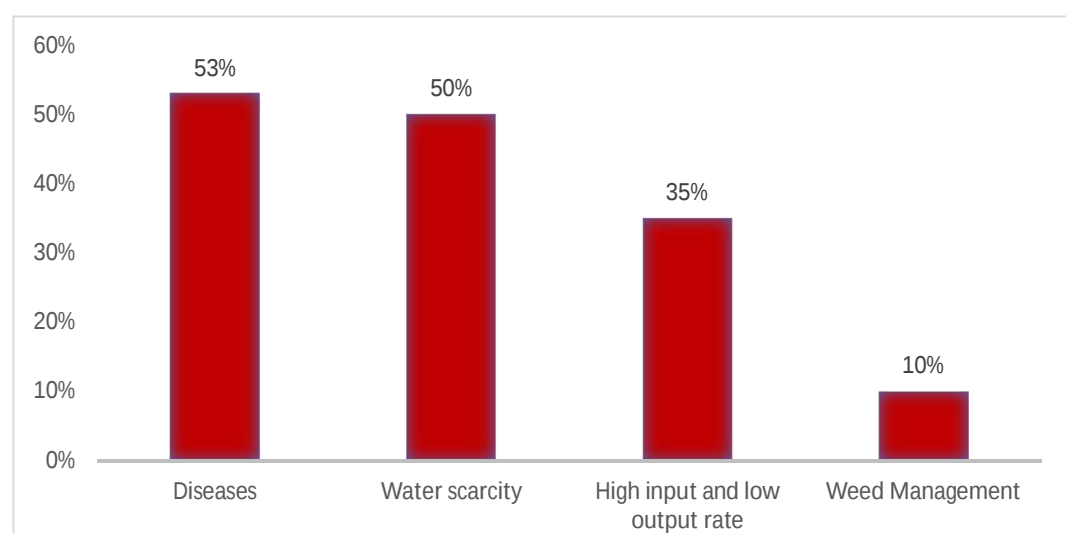
dominant cropping pattern was rice-wheat and rice – pulses. Rice was mainly grown in the Kharif season and wheat and pulses were grown in Rabi season. And cropping intensity was 170⁵. The brief profile of the respondents is presented in (Table 3).

4.2: Vulnerability Context in Smallholder Rice Farming

In this section of the report, results are presented for the first research sub-question; *What are the vulnerability context faced by farmers?* Factors that have resulted in local vulnerability by the respondents are presented and discussed in detail. The vulnerability context was discussed in terms of shocks, trends, and seasonality facing the respondents.

The common vulnerability reported by respondents while the interview was rice diseases, lack of water availability, high input cost and low output rate, rodent attack and lack of weed problem (Fig 5) which hamper the food availability of farmers. Around 53% of farmers indicated bacterial and fungal diseases in rice farming. Rice Blast, Narrow Brown Spot, Bacterial Blight, and Whitetip are the common diseases that hamper rice productivity.

Figure 5: Vulnerability in rice farming



Source: Farmer interview, 2019

Rice is a water-intensive crop and production highly depends on proper management of water. 50% of respondents highlighted issues related to water scarcity and irrigation as a serious challenge caused by drought, fluctuating rainfall, lack of proper irrigation facility and lack of life-saving irrigation facilities.

Along with it, other issues that have been raised by 35% of the respondents were high input cost and low output rate.

During the focused group, discussion [FGD 2] all vulnerability: shocks, trends, and seasonality were discussed in detail (Box 1).

⁵ cropping intensity = gross cropped area/net sown area x 100

Shocks

The shock was the vulnerability context considered in this study. The shocks indicated by the respondents were naturally occurring shocks.

In the previous year, rice spike damage by insects, rodents attack and rice diseases had a serious impact on rice productivity. These shocks caused a 10 to 30% decline in productivity.

A respondent during FGD – 2; an experienced farmer explains about the impact of the shock on family and livelihood;

“When you invest all money on inputs like seed, fertilisers, pesticide, herbicide, etc along with your hard efforts with all family members over many months and suddenly you find that shocks like rodents destroy the field, rice spike damage by insects, and rice disease damages your production drastically. All these kinds of shocks ultimately stun you. You become hopeless and how you feed family becomes a serious question.”

Trends

The rising cost of inputs, increasing temperature, increasing labour cost, diminishing rainfall and land fragmentation are the issues raised by the group of farmers during focused group discussion (FGD – 2). The cost of inputs: particularly seeds, fertiliser, herbicide, the pesticide was the major challenge for farmers which increases year by year. In comparison to input cost, the output (rice) rate doesn't increase simultaneously which minimises the profitability of farmers. At the same time, the farmer faces labour scarcity during the season. Most of the farmers were dependent on outside labour that comes from the neighboring districts and Jharkhand state.

Box 1: Livelihood features emerging from focused group discussion

Vulnerability Context

Shocks

Rice spike damage by insects
Rodents attack
Rice Diseases

Trends

The rising cost of inputs (seed, fertilisers, herbicide, pesticide)
Increasing temperature
Increasing labour cost
Diminishing rainfall
Land fragmentation

Seasonality

Decreasing the price of rice in the harvest season
High transportation rate
Lack of irrigation
Availability of food

Source: FGD -2

Seasonality

One significant seasonality factor acting as a vulnerability was the rate of rice during harvest season declines and at the same time transportation cost increases. Along with it, lack of irrigation and availability of food during the lean season are the severe challenges reported by farmers during FGD -2. In the study region, rice marketing is dominated by local rice traders. During harvests season the rate of rice decreases and farmers are forced to sell at a low rate. At the same time transporter increases the rate of transportation which is ultimately bearded by farmers. When irrigation is required more, the availability of water decreases. The summer season (April -June) is the lean season for farmer and farming household faces food scarcity during this period.

"In my lifetime, observed that more than 50% of rice farmers left farming and either migrated or changed profession. Because the input rate is increasing day by day but output (rice) rate is not increasing at the same pace. A new generation is reluctant to adopt the farming profession due to high vulnerability and lack of sustainable income."

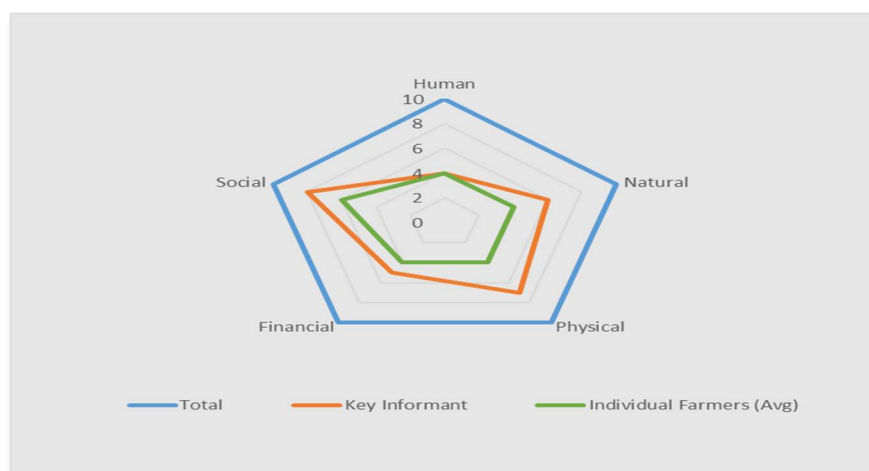
Respondent [RF I 21], age 78 years

Findings show that the above-mentioned shocks, trends, and seasonality negatively influences the rice farmers' livelihood. During focused group discussion [FGD-2] farmers agreed that vulnerability reduces productivity which ultimately hampers farmers' livelihood. However, the decline in productivity depends on the type of vulnerability farmer faces. Generally, it reduces 20-40% of rice productivity but sometimes drought caused 100% of productivity loss (FGD-2). It has been observed that the vulnerability context is one of the serious causes of outmigration in the study region. It is found during the interview that 90% of households' family members are working in town or city and these families receive remittances.

4.3: Assets Impact on Smallholder Rice Farming

This section focuses on findings based on livelihood assets accessed by rice farmers and how does it influence farmers' livelihood.

Figure 6: Asset Pentagon in rice farming



Source: FGD and Farmers Interview

The livelihood assets are classified as human, natural, physical, financial and social capital. The study, therefore, attempts to describe how the assets influence livelihood among rice farming households.

In the case of surveyed rice farming, the human, natural, physical and financial assets are comparatively low compared to the social asset. Fig 6 indicates the asset composition in the rice farming system which has been calculated on the basis of one key informant and all individual farmers' responses. During the interview, farmers were asked to scale all kinds of assets between 1 to 10. In scale 1 represents the minimum and 10 denotes maximum. Finally, the individual farmer's score was averaged to create the asset pentagon. The same exercise was done with a key informant to triangulate the result.

The Asset pentagon indicates that human and financial capital is low compare to physical, social and natural capital. For the financial capital, the key informant and farmers' opinion was different. The key informant had a higher score than individual farmers. It might be due to the helicopter view of key informant who was not able to know the exact reality at the grass-root level.

4.3.1: Human Asset

Most of the farming households rely on agri-farm labour for most of their farm activities such as rice transplanting, weeding, harvesting, and threshing. 100% of transplanting, weeding, and application of fertiliser, herbicide, a pesticide is done manually, however, tillage practices were entirely practiced by tractor [FGD 1] (Table 4). Contrary to it, 40% of harvesting and 20% of threshing was performed by manual labour, whereas, remaining 60% of harvesting and 80% of threshing was performed with the use of the machine in the rice farming system. Despite traditional farming methods that they have practiced over the years, they still lack modern and scientific methods of farming techniques and strategies because of the lack of explicit (scientific) knowledge and lack of financial resources. Farmers in the study region use indigenous knowledge for crop selection. The literacy rate was moderate among the rice farmers but women farmers were comparatively less educated than counterpart male farmers. The availability of government middle and high school in the village provides an opportunity for the farmers for basic education.

Table 4: Type of farming practices

farming practices	manual	machine
tillage	--	100%
transplanting	100%	--
weeding	100%	--
fertiliser/herbicide/pesticide application	100%	--
harvesting	40%	60%
threshing	20%	80%

Source: Focussed Group Discussion [FGD 1]

Most of the interviewed respondents heavily depend on tacit knowledge for rice farming. 80% of farmers agreed that they mostly rely on tacit knowledge which has been transferred by their forefathers and gained from generations. 20% of respondents agreed that they mostly rely on explicit knowledge for farming practice. While the interview, an interesting trend has been observed that the aged respondents mostly rely on tacit knowledge, however, the young age respondents were innovative and curious to adopt new scientific knowledge. According to a farmer during [FGD 1]:

“Days are gone when farmers were only dependent on indigenous knowledge. When I was young, I learned and observed everything from my father who taught me how and when to perform the farming activities in rice farming. Nowadays, without scientific

knowledge, you can't survive or you will have low productivity. Education has an important role to play for rice farming. If farmers are educated then they can learn easily how to use and select good seed, fertiliser, herbicide, and pesticides"

Respondent [RFI 15], Age 56

During FGD-1 another interesting facet emerged that the use of knowledge in rice farming mostly depends on activities being performed. While local seed selection, tillage practices, transplantation of rice, manure use, water management/irrigation, harvesting, and post-harvest management farmers mostly rely on tacit knowledge (Table 5). On the other hand, HYV seed selection mostly depends on explicit knowledge and it becomes the preferred method while herbicide and pesticide selection, disease control and harvesting. Contrary to it, farmers use both tacit and explicit knowledge for disease control, fertiliser use and water management.

Rice farming requires various kinds of tacit and explicit knowledge. While focus group discussion, respondents agreed that tacit knowledge they inherited from forefathers. Another source of this knowledge was neighboring farmers and relatives of the farmers.

Table 5: Knowledge use in rice farming

farmling practices	tacit	explicit	both
local seed selection	+++	+	--
HYV seed selection	--	+++	--
tillage practices	+++	--	--
rice transplantation	+++	--	+
fertiliser use	++	+	++
manure use	+++	--	--
water management/irrigation	+++	+	++
herbicide selection	+	++	+
pesticide selection	+	++	+
diseases control	+	++	+++
harvesting	+++	++	+
post-harvest management	++	++	--

Source: Focused Group Discussion [FGD 2], +++ indicates the most common practice and – not at all.

4.3.2: Natural Asset

The cultivable land belonged to only 40% of households who were mostly from upper and backward casts. Remaining 60% of households were dependent on-farm and non-farm labour for their livelihood. 85% of the respondents had their own land. Some rice farming respondents [n=5] had buffalo, cows, and goats. Few respondents [n=2] were leasing out their land because it was not manageable for them. Only one farmer was leasing in land for rice farming. The average landholding was just 2.24 acres (table 6) and highly fragmented. Only 8.27% of land remains fallow during rainy season. For irrigation, the farmers in the village were mostly dependent on seasonal rainfall and the seasonal river was the main

Photo 3: Fallow land during summer



source of irrigation. Due to lack of irrigation during the summer season, 80% of land remains fallow which could be utilised for summer rice. Since colonial era a check dam was built on river for irrigation and storage facility (ahar) had been created to store the water. During focused group discussion farmers unanimously agreed that rainfall is declining and water table going down. According to a rice farmer (RFI 2):

“In our village, the soil is suitable for rice farming and we are cultivating for long. Our main problem is fluctuating rainfall and dependency on it. Since long, we were storing rainfall and river water for the distress period. The area of this storage was spread of around 100 acres of land which was locally called Ahar. The entire farming community was concerned about water storage and stored water was carefully and rationally used for lifesaving irrigation during the distress period. But nowadays people don’t care about storage because everyone has a small patch of land to cultivate for. In this case, no one wants to remain his land fallow.”

Another farmer (RFI 28) raised the issue of fallow land. According to him:

“Our maximum land remains fallow during the summer season due to lack of irrigation facility. Nearly 80% - 90% land remains fallow. So, if we get a better irrigation facility then we can produce more and have more income and food availability.”

Table 6: Landholding size of farmers [n=27]

landholding	% of Farmer	average holding (acre)
less than 1.5	33	1.42
1.6 to 3	67	2.32
Overall		2.24

Source: farmers’ interview

4.3.3: Physical Asset

In terms of a physical asset, most of the farmers had small farm machinery like a hoe, spade, axe, etc. A few years ago, the oxen were used for cultivation and traction but now modern tractors have replaced. Among the interviewed respondents, 7% had a tractor and remaining were hiring on rent. In the village, there was one tank which was used during the summer season for irrigation. 4 respondents had well and 25% respondent had diesel pump for irrigation. 20% of respondents had motorbike and only one respondent had car. Few respondents [n=2] had grocery shop, by-cycle repairing shop, and electric shop.

An aged farmer (RFI 24) explains the change of technology in rice farming systems. According to him:

“New technology has transformed the system, approximately 10 years ago we were using oxen for ploughing the rice field and threshing the rice, but now everyone uses the tractor for tillage and threshing. Even very small farmer hires the tractor which saves time and effort. The fast process of mechanisation is changing the rice farming system.”

4.3.4: Financial Asset

The financial asset was the least among the other assets in the rice farming community as compared to the other four assets. Since rice farming is the leading economic activity in the community, farmers seasonally require money for cultivating crops. It is found during FGD-1 that though due to the national governments' scheme, recently all farmers opened a bank account, around 40% of respondents accessed micro-credit for farming and the remaining 60% of respondents were still relying on an informal source of credit i.e. money lenders, family friends or other social networks. In distress situations, most of the respondents agreed that they sold their livestock or other tangible assets to make up the shortfall which in the long run, reduces their resilience to come back from severe shock in cases of severe disaster. Because of their high vulnerability status, it has made very difficult for them to have access to credit from a financial institution because of their low collateral status. In this village, people's main source of finance is saving, the loan from money lenders and loans from banks. During interview respondent [RFI 14] explains that;

“We all have opened bank account but only 50% of farmers have Kishan Credit Card (KCC). Sometimes, banks are reluctant to open a KCC account. KCC is a great help for a smallholder farmer to get microcredit for farming inputs”

4.3.5: Social Assets

Social assets were however much stronger as compared to other capitals (Fig 6). Concerning social capital, network among the villagers was deep particularly among the family relatives and the same caste farmers. They mostly rely on relatives or neighboring farmers for information and financial needs. It is found that around 80% of respondents were members of cooperatives which have been formed by the government, though the female-headed households were not members. When probed with farmers during a focused group discussion that why remaining 20% are not members of the cooperative? The respondents had no clear answer however they speculated that these farmers were reluctant because they feel that it's not economically beneficial. In this village, farmers were not a member of any unions and other farmer-based non-governmental organisations.

4.4: Organisations Involvement in Smallholder Rice Farming

It is found that the District and Block Agriculture Department was the only governmental agency in the district working to improve agriculture in the village. Though the Krishi Vigyan Kendra (KVK) and Agriculture Technology Management Agency (ATMA) offices were just 25 km from district headquarter the presence of these organisations has not been reported by farmers during FGD-2. The other non-governmental organisations working to improve the welfare of the people were local NGOs. Chetna and Nehru Yuva Kendra. Both NGOs were managed by the board of trustees and mandate was not focused around agriculture only. Though they are found working to improve the wellbeing of the people in the village, their operations are yet to be felt by the people. 80% of farmers were the member of Primary Agricultural Co-operative Societies (PACS) which has the mandate to provide agricultural credits, strategic inputs to overcome the constraints of agricultural development.

While interview only 40% of respondents reported that they have access to microcredit or loans from a formal institution. However, 100% of respondents have a bank account in local nationalise banks.

Respondents unanimously replied that not one organization contacted them in the last five years. Only 10% of respondents agreed that they himself approached the government agriculture department officials at block headquarter and received subsidies. They also received HYV seeds from the department.

The respondents don't know much about ATMA and KVKs, even though the offices of these institutions are based at district headquarter. This is a supporting agency to Government Agriculture Department that supports technology dissemination at the district level.

50% of the respondents were satisfied with the performance of Cooperatives. Only 20% of respondents felt that information or support provided by the government department is sufficient remaining 80% of respondents told that it is insufficient (Table 7). On the other hand, 80% of respondents felt that local traders provide sufficient information related to rice farming. Other very important stakeholders like KVK, local NGOs, international NGOs, Agricultural Universities and private companies were out of the scene.

Now a question arises on how farmers are using HYV seeds, fertiliser, pesticide, herbicide, etc. in rice farming? The reply to this question was as follows;

“Gradually farmers have learned how to use this information related to HYV seeds, fertiliser, pesticide, herbicide, etc. either from fellow farmers, relatives or local trader. The traders have hidden interest to sell the seeds as well as build trust with farmers.”

Respondent [RFI 23], age 35

Table 7: Farmers' Interaction with organisations involved in rice farming [n=27]

Organisations/stakeholders	sufficient	insufficient
Government Agriculture Department	20%	80%
Krishi Vigyan Kendra (Agriculture Science Centre)	--	100%
Local NGOs	--	100%
National NGOs	--	100%
International NGOs	--	100%
Agricultural University	--	100%
Private companies	--	100%
Local traders	80%	20%
Cooperaives	50%	50%

Source: Farmers' interview

While focused group discussion, a sad and annoyed farmer made a heart-touching comment. Which is as follows in the box.

"Just like an abandoned child, no one cares for our wellbeing. The system uses us as a fodder. We are at the mercy of God. Though the new government had announced to double the income of farmers, however, nothing changed at the grass-root level. We are unaware of the government's new policies and programs."

A sad farmer, while focus group discussion

The result of the above-mentioned question was highly surprising so triangulation had been made while focused group discussion [FGD-1]. Farmers were asked how often they or organisations contact each other. Again, the same pattern emerged, only around 20% of farmers were in contact with the agriculture department seasonally or yearly, however, traders were mostly in touch with farmers. They contacted them monthly, seasonally and yearly. On the other hand, KVK, local NGOs, international NGOs, Agricultural Universities and private companies never contacted with the rice farmers (Table 8).

Table 8: how often rice farmer and organisations contact each other

Organisations/stakeholders	daily	weekly	monthly	seasonally	yearly	never
Government Agriculture Department	--	--	--	+	++	--
Krishi Vigyan Kendra (KVK)	--	--	--	--	--	+++
Local NGOs	--	--	--	--	--	+++
National NGOs	--	--	--	--	--	+++
International NGOs	--	--	--	--	--	+++
Agricultural University	--	--	--	--	--	+++
Private companies	--	--	--	--	++	--
Local traders	--	--	+	+++	+++	--

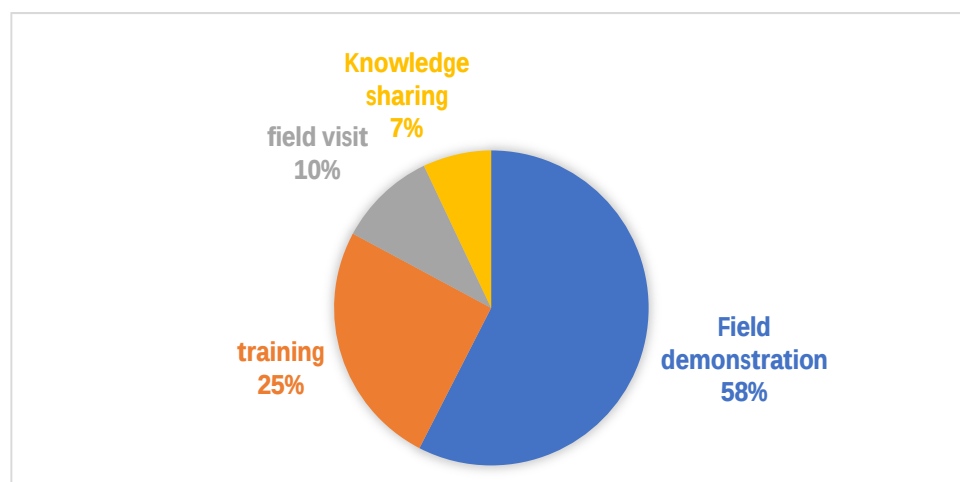
Source: Focused Group Discussion [FGD 1], +++ indicates the most common practice and – not at all.

4.4.1: Farmer's Perception of Organisations Involvement

For understanding the preferences of respondents, the question was raised during the interviews: what kind of stakeholder's assistance farmers require? Field demonstrations of information, knowledge, and technologies were the first choice of farmers, followed by training, field visit and knowledge sharing.

57% of respondents prefer field demonstrations of new seed, insecticide, herbicide, fertilisers, etc in the village by stakeholders. Furthermore, the other 25% of respondents choice was training on various rice farming issues that need to be conducted by the stakeholders. Along with it, a few respondents advocated for field visits and knowledge sharing by print and electronic media which was 10% and 7% respectively (Fig 7).

Figure 7: Desired assistance from stakeholders



Source: Farmer's interview

Table 9: Preferred mode of contact with stakeholders

Organisations/stakeholders	verbal communication	Demonstrations of techniques or technology	by mobile phone	individual contact
Government Agriculture Department	++	+++	++	++
Krishi Vigyan Kendra (KVK)	++	+++	+	--
Local NGOs	+	+++	++	--
National NGOs	++	+++	++	--
International NGOs	++	+++	++	--
Agricultural University	++	+++	++	--
Private companies	++	++	++	--
Local traders	++	--	+	+++

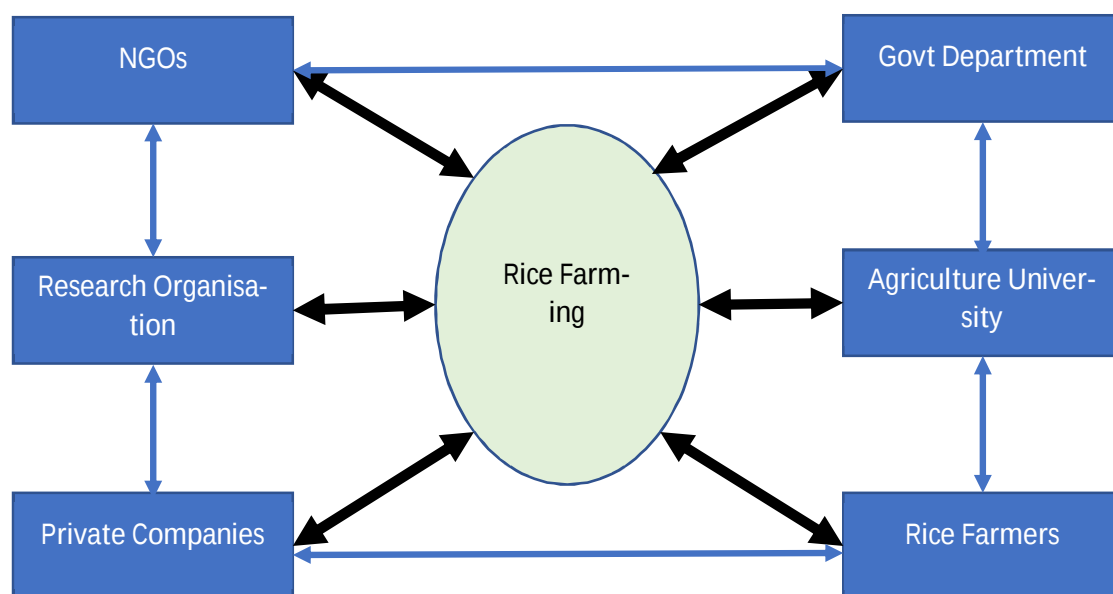
Source: Focused Group Discussion [FGD 1], +++ indicates the most preferred practice, -- not at all preferred

The coordination and collaboration among the stakeholder were a serious challenge. Unanimously, while the interview, all respondents were agreed that lack of collaboration among various organisations, and implementation agencies are a serious concern to percolate down information, knowledge, and technology in the rice farming system.

Another hypothetical question discussed with the respondents' group was: what would be the best mode of contact with stakeholders? The field demonstration of techniques/technologies was the most preferred method followed by verbal communication and information by mobile (table 9).

Later on, during focused group discussions, respondents were asked: whom they perceive as a potential stakeholder to improve the efficiency of the smallholder rice farming system? The concerned government departments, Agricultural University, NGOs, Research organisations (Agricultural Universities, KVKs, and ATMA) and private companies were identified as a potential partner (Fig 8). Along with it, respondents indicated that coordination and collaboration among the stakeholder is a serious concern so independent facilitators must be included for enabling coordination and introducing new appropriate and smart technologies in farming. Farmers identified themselves as a potential stakeholder and knowledge source. When contradicted, why they want to be included as a stakeholder? Then reply to the farmers was notable: "we have indigenous knowledge along with several years of experience, so how can you ignore us".

Figure 8: Farmers preferred stakeholder



Finally, regarding the transformation of the agriculture sector, an enthusiastic young farmers' stated. According to him during [FGD-1],

The extension mechanism has totally collapsed and doesn't reach to the poor grass-root level small-holder farmers. Gradually, the staffs of these institutions have become highly inefficient or reluctant to work with farmers in remote areas. The government is just taming "White Elephant" whose intake is very high but in comparison output is nothing. My suggestion (respondent) is just handover these organisations to the private sector. They know "how to milk the cow" and definitely, you will see the visible impact just like the Telecom sector in India which was totally inefficient in the 1990s. The Government-owned BSNL was the only player and had monopoly over the market. But when private players entered the market, now impact is visible even to a common man. Nowadays, even in villages teledensity is more than 80% and at least every household has one mobile in remote village as well. And we can say this is transformation. And lastly, he concluded with; "To transform the agriculture sector, a harsh decision needs to be taken. Dare to throw away rotten part of the system"

An enthusiastic young farmer (FGD 1)

4.5: Livelihood Strategy of Smallholder Rice Farmers

Rice farming was the main source of livelihood for all respondents. Remittances, non-farm work and on-farm other than crops were livelihood diversification strategies. During individual interviews, 47% of respondents reported that they are dependent on remittances followed by non-farm work in the village 27% and on-farm other than crop 10% for income diversification. Only 16% of rice farming households were solely dependent on rice farming. These respondents (16%) had no other option to diversify the income. A second major source of income comes from seasonal and permanent migration to nearby towns or metropolitan cities like Delhi and Kolkata. The next major strategy to diversify the income of rice farming households was grocery shop, by-cycle repairing shop, and electric shop. Along with it, some rice farming households had buffalo and cows to sell milk and some were rearing goats to gain extra income (Table 10).

Table 10: % of farming households dependent on other than rice farming income [n=27].

source	% of hh	means of income
Remittances	47%	The family member sends money from another town or city.
Non-farm work	27%	Income from a small grocery shop, by-cycle repairing, electric shop
On-farm other than crop	10%	Dairy, goat rearing
None	16%	No other mean

Source: Individual farmers Interview

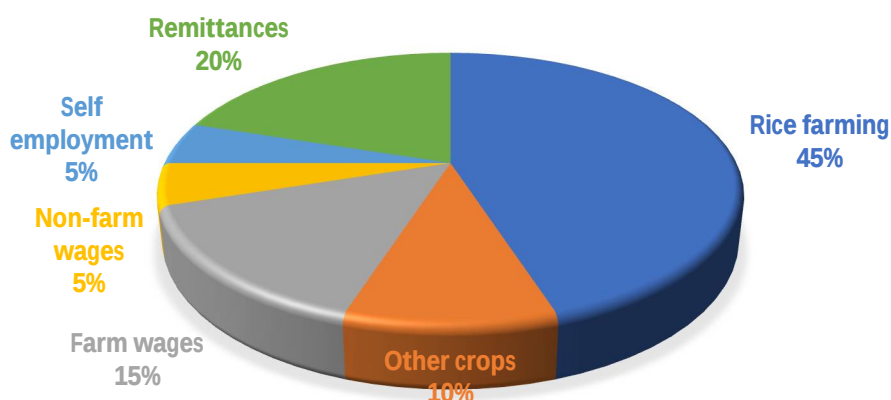
Respondents who were rearing poultry and livestock do sell some of their animals to make extra income to meet household demands. While interview one respondent had a remark on livelihood strategies of farmers is as follows in below box;

"Rice farming alone can't provide sustainable income and even both end meals for the entire year. Without supportive alternative livelihood activities, farming is not possible at all for smallholder farmers. Many families left farming because they had no other income sources."

Respondent RFI 12

While focused group discussion [FGD-2], respondents were asked for income composition. Though, the main source of income of farmers was rice farming which contributes 45% of total income, followed by other crops 10%, farm wages 15%, non-farm wages 5%, self-employment 5% and remittances 20% (fig 9). Other than rice, the farmer grows wheat, pulses, and vegetables.

Figure 9: Farmers source of income



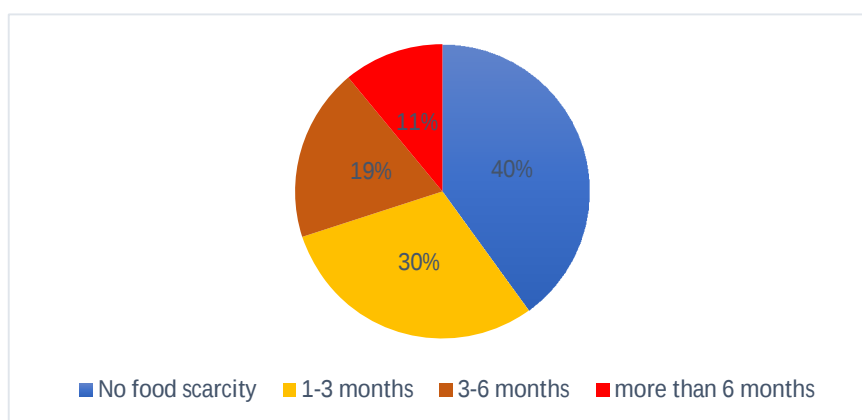
Source: FGD with farmers [FGD 2], 2019

4.6: Rice Farming Impact on Food Availability

Rice is the staple food of all respondents. For cereal (rice), respondents were mostly dependent on domestic production. The respondents were asked how many months they faced rice scarcity last year? 40% of respondents had no scarcity of rice throughout the year, however, 11% of respondents were facing acute scarcity of more than 6 months. 19% of respondents were facing moderate kinds of a scarcity of 3-6 months in a year and 30% of the respondents had 1-3 months scarcity of food (Fig 10). A respondent [RFI 15] highlights what's the importance of rice farming for smallholder households;

"Rice is a lifeline for us. Our household economy is mostly dependent upon rice production. We eat rice and every chore starts and ends with rice. Even our children's future depends on rice production."

Figure 10: Smallholder farmers' food availability



Source: Rice farmers' interview, 2019

When analysed who were the households confronting intense rice scarcity? The pattern emerged that these are the farmers who just rely on rice cultivating. All households who had no shortage had an alternative source of off-farm income. They were generally dependent upon either remittances or other alternative incomes.

The rice availability calendar (Table 11) elucidates that smallholder rice farmers don't face food scarcity after the harvesting period (Dec-Jan). On the other hand, they face a severe shortage of rice from June to December which is a lean period. However, water scarcity starts in January but it becomes severe during May and June. During severe water scarcity period, farmers don't get an opportunity for on-farm income so after 3-4 months lean period smallholder rice farmer faces severe food scarcity. While discussing on food and water availability, a farmer explains as follows;

“The water scarcity which starts from May to mid-June, we (rice farmers) face scarcity of food availability because of 3-4 months farmers don't have any income opportunity. In the event that we will get water for irrigation in these lean seasons, at that point we can mitigate food availability issues.”

Table 11: Calendar of rice and water⁶ availability

	January	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Rice	-	-	+	+	++	++	+++	+++	+++	+++	+++	+++
Water	++	++	++	++	+++	+++	++	+	+	+	+	+

+++ indicates severe scarcity, ++ moderate scarcity, + low scarcity, and – no scarcity.

Source: FGD 2

⁶ Refers to water for irrigation

Chapter 5: Discussion

This chapter describes the discussions on the findings from chapter four. The chapter starts with vulnerability context impact on smallholder rice farmer livelihood (section 5.1) followed by assets impact on smallholder rice farmer livelihood (section 5.2), organizations impact on smallholder rice farmer livelihood (section 5.3), livelihood strategies impact on smallholder rice farmer livelihood (section 5.4), food availability impact on smallholder farmers livelihood (section 5.5) and finally ends with the critical reflection as a researcher (section 5.6). The findings have been compared with other researchers and conclusions are drawn eventually.

5.1: Vulnerability Context Impact on Smallholder Rice Farmer Livelihood

The findings section 4.2 highlights that the vulnerability context has a significant impact on the rice farming system. The analysis of the result emphasized that the smallholder rice farmer faces several shocks, trends, and seasonality. In the studied farming community, smallholder rice farmer lives in precarious conditions and they are intrinsically vulnerable to various shocks trends and seasonality. Rice diseases, spike damage by insects and rodents attack were the shocks that declined 10 to 30% productivity. These vulnerability context issues are in line with [Pathak, et al., \(2018\)](#) emphasizes several biotic and abiotic challenges in the rice farming system in India. In the same line, a study conducted by [\(Harvey, et al., 2014\)](#) concludes that Malagasy farmers are especially vulnerable against any shocks to their agricultural system attributable to their high reliance on agriculture for their livelihoods, chronic food insecurity, physical isolation and lack of access to formal safety nets. Farmers are every now and again faces pest and disease outbreaks and extreme weather events, which cause critical crop and income losses and exacerbate food insecurity. The prevalence of such kind to shocks is self-evident that farmers are not getting the proper information from knowledge institutions to mitigate the challenges to improve productivity. The structure and process are not aligned with the farmers' needs.

Another finding of this study indicated in section 4.2 water scarcity is one of the major challenges raised by 50% of interviewed farmers which impacts the livelihood of farmers. Similar findings of a study conducted in Bihar by [\(Najmuddin, et al., 2018\)](#) depicts that irrigation facilities and irrigation quality need to be improved so that farmers can increase the area under rice during the Garma (dry) season when there is no flood risk and the growing conditions for rice are better. In this study, it has been found that 80% of land remains fallow during the summer season which entails that if irrigation facility would be improved then the farmer can grow another crop which will lead towards better food availability and nutrition security for rice farming households. Similar line experiences from Bangladesh recommend that rice productivity can be improved by increasing irrigation facilities in the dry season [\(Alauddin & Sharma, 2013\)](#). Apart from surface water irrigation, efforts could be made to enhance groundwater irrigation facilities for the timely and adequate supply of water for irrigation. At present, only 46% of available groundwater is being utilized in Bihar. Where electricity is not available, the solar-powered irrigation system could be arranged [\(Najmuddin, et al., 2018\)](#). Improved groundwater irrigation will also help in coping with drought spells. Concerning the water/irrigation as a serious concern, recently [Sharma et. al., \(2018\)](#) a pan-India study attempts to develop first-of-its-kind map and chart for water productivity covering the relevant production, climate and water data from all 640 districts with detailed analysis concludes that re-aligning cropping pattern with available water resources endowment across states is required in India.

Based on the result of section 4.2, vulnerability in rice farming is one of the central causes of outmigration in the study region. The farmers are forced to leave farming due to vulnerability and less profitability in rice farming. The finding correlates with the study conducted by [\(Deshingkar, et al., 2006\)](#). According to this study, the occurrence of out-migration from rural Bihar is most likely more noteworthy than anyplace else in India. A blend of conditions, natural and societal, has created a situation in

the state where sending a relative out to earn was the main method for remaining alive. Due to the vulnerability context which creates a trap of a vicious circle, smallholder farmers are forced to migrate to urban areas. Further, the landowner becomes an unskilled worker in urban areas. In short-run, it is a highly painful process for households. They lose their traditional jobs but at the same time, it opens the window for new opportunities as well because they were relying on uneconomical farms. Chetan, (2017) has slightly different findings on the impact of migration on households. A study conducted by him in 10 villages of Siwan district of Bihar, India concludes that outmigration increases the food security of households and their purchasing power increases which enables them to invest more in agriculture. Another study conducted by Tsujita & Hisaya, (2012) in five districts of Bihar, India indicates that the probability of migration is high among the landless and smallholder farmers but it decreases as the size of landholding increases. These studies contradict the results of migration impact which shows that it has negative impact on livelihood and income security but secondary literature shows that remittances have a positive impact.

5.2: Assets Impact on Smallholder Rice Farmer Livelihood

As a human resource knowledge plays an important role in rice farming. As indicated by section 4.3.1, farmers are mostly dependent upon tacit knowledge for rice farming. 80% of respondents agreed that they mostly rely on tacit knowledge which has been transferred by their forefathers and gained from generations. Most of the farming practices, for example, local seed selection, tillage, transplanting, and manure use has been performed by using tacit knowledge. Though rice farmers are highly dependent on it for various farming practices, however, there are limits of tacit knowledge in responding to the current challenges of globalized economies, new forms of communication, climate change and environmental degradation. Furthermore, for improving agricultural productivity in the rice farming system, access to explicit knowledge is crucial. Keswan & Swaminathan (2008), advocate that the pathway for evergreen revolution prerequisites blending of frontier technologies with traditional wisdom. Another study (Robinson-Pant, 2016) also confirms that learning knowledge and skill are highly correlated with agricultural productivity, livelihood, and food security.

From section 4.3.2, natural asset land remains fallow and mainly during the summer season which is generally considered a lean period when farmer faces food and livelihood scarcity. It's basically correlated with infrastructure and particularly with irrigation facilities. In the same line, according to Najmuddin, et al., (2018) increasing water productivity in Bihar is a key challenge before agricultural planners. The increased water productivity would provide more food security as well as an employment opportunity for smallholder farmers.

As indicated in section 4.3.3, and table 4 highlights that farm mechanization is taking place in the study area and ploughing (100%), harvesting (60%) and threshing (80%) done by machines. During the interview, the respondent explains that 10 years ago most of the activity was performed manually. This finding concurs to the study conducted in eastern states of India which includes Bihar along with other states, by Shekhar & Bhat, (2014) founds that eastern states have very low mechanization. The Orissa and Bihar are way below the national average. The percentage of farmers using the machine in Bihar ranges from 21% to 100% for different types of machinery whereas the percentage of farmers owning such machinery ranges from 7% to 50%. The low rate of mechanization in the state might be due to the fragmentation of land which is not suitable for mechanization. Similar result has been found in study conducted in China by Suhao, (2005) finds that land fragmentation has negative effect on farming and proposes for consolidation of small, fragmented plots into fewer bigger plots situated at little separations to the residence (1) reduces production costs, (2) causes a shift from labour-intensive methods towards the use of modern technologies, (3) diminishes technical efficiency and increases input use efficiency, (4) contributes to soil quality improvement, and (5) increases the availability of the two major yield-limiting factors in rice production in the research area.

The result in section 4.3.4 shows that financial capital was least among others in asset pentagon. More or less all respondents have a bank account but access to micro-credit was limited to only 40% of the respondents which indicates that the remaining 60% of respondents are bound to access credit from money lenders or other information sources on the high-interest rate. Since long ago, agricultural credit has been considered one of the options to enhance the income and livelihood of farmers. According to then-Deputy Governor-General of Reserve Bank of India (Mohan, 2004) “Agricultural credit has played a vital role in supporting agricultural production in India. The Green Revolution characterized by greater use of inputs like fertilizers, seeds, and other inputs, increased credit requirements which were provided by the agricultural financial institutions”. Highlighting the importance of micro-credit in India (Rao & Priyadarshini, 2013) indicates that well managed and regulated microfinance programs augmented rural sector employment, the efficiency of the non-agribusiness sector, strengthening of women in socioeconomic aspects, it upgrades health and educational facilities. Another significant effect of the microfinance program is that a decrease in income and consumption disparities, especially vulnerable sections of the society will get the advantages from collateral or guarantee free access to finance.

As reflected in section 4.3.5, the social asset is much stronger as compared to other capital. The bond among the farmers is stronger in the study area. This asset could be materialized for knowledge and skill dissemination among the farmers. A case study in the northern mountains of Vietnam by (Hoang, et al., 2006), provides evidence to the need for the social asset for the efficient delivery of extension services and research and development interventions at the micro-level. Village communities are not homogeneous entities but rather a mix of complex systems of social connections. Numerous components, for example, ethnicity, sexual orientation, socio-economic status, and power relations decide one's access to information and resources.

5.3: Organisations Impact on Smallholder Rice Farmer livelihood

The finding of section 4.5 indicates that farmers are unanimously unsatisfied with the performance related to input and information sharing of the organizations and informal marketing dominance. Which ultimately elucidates that the performance of institutions and organisations doesn't meet the expectation related to rice farming of the respondents. Most of the respondents were not satisfied with the performance of public and private sector organisations. Even after, the central and state government strong policies and programs towards doubling the income of farmers, the impact and influence are not percolating at the grass-root level. It can be said that policies and programs are not aligned with the expectation of farmers. This finding is like the study done in Ethiopia by (Elias, et al., 2015) reported that the empirical results perceived that economic return, frequency of extension contact, off-farm income and family size increase the probability of farmers' overall satisfaction with the agricultural extension service. As the perceived monetary return is the most significant driving variable for satisfaction, the extension service needs to concentrate on diversified farm technologies that suit with specific needs of farmers.

As reflected in the findings (table 8) of this study, the bond among stakeholders and rice farmers was very weak in the study region. The knowledge institutions/organisations that have mandate and stake for the diffusion of information, knowledge and technologies at the grass-root level were not at all in contact with farmers in the last five years. The Krishi Vigyan Kendra, Agricultural University, ATMA, and private companies had no presence among rice farmers. A study conducted in Pakistan by (Khan & Akram, 2012) showed that the effectiveness of extension services is affected by farmers' contact with extension personnel. The extension methods used by extension personnel for the dissemination of knowledge and information among the farming community were also not effective. In the ranking, the farm/home visit was found as the best method for delivering agricultural information.

Results of section 4.4.1 indicate that farmers preferred field demonstration (58%) in the village followed by training (25%). It elucidates that the farmer prefers “*learning by doing and believing by seeing*” method. The current extension mechanism is not efficient and effective at all for rice farmers. Farmers were not getting any support from these organisations. According to farmers, “gradually the staffs of these institutions have become highly inefficient or reluctant to work with farmers in remote areas.” Due to that farmers were in the opinion that Government is just taming “White Elephant” whose intake is very high but in comparison output is nothing. The extension mechanism is the core for intervention, adoption, and facilitation of change. In the same line [Gulati, et al., \(2018\)](#), [Shenggen, et al., \(1999\)](#) and [Bhatt et. al \(2016\)](#) also agreed that “Green Revolution” in India during the 1960s was largely successful due to systemic change in structure and process particularly extension system needs to be strengthened.

As reflected in section 4.4.1 farmers perceive that there is no need to include other stakeholders for rice farming, the present stakeholders mentioned in [Fig 8](#) are sufficient, however, for efficient coordination and collaboration among stakeholders, monitoring by independent or external organizations would be a key to success. In the same line [Schut, et al., \(2016\)](#) opined that by facilitating interaction, negotiation and collective action between farmers, researchers and other stakeholders, IPs can contribute to more integrated, systemic innovation that is essential for achieving agricultural development impacts. However, successful implementation of IPs requires institutional change within AR4D establishments

5.4: Livelihood Strategies Impact on Smallholder Rice Farmer Livelihood

In section 4.5 result indicates that rice farming households combine a diverse set of income-generating activities and construct a portfolio of livelihood activities to enhance better livelihood outcomes. The study result shows that the majority of households (84%) diversified their income other than rice farming ([fig 9](#)). Farmers' major source of income comes from farming (70%) followed by remittances (20%), non-farm wage (5%) and self-employment (5%). It indicates that crop-livestock remains the main source of income followed by remittances and non-farm income.

The findings were harmonizing with [\(Kathiwada, et al., 2017\)](#) study conducted in Nepal, the result shows that income diversification to non-farm activities has turned into the dominant livelihood strategy since the majority (about 61%) of households have diversified their livelihood to non-farm related strategies (includes remittance and non-farm wages). This result appears to be sensible in light of the fact that developing outmigration to urban cities and abroad incited by restricted employment opportunities and low profit from subsistence farming in the rural areas has been increasing the households receiving non-farm wages including settlement and non-farm wages.

In the same line, a scoping study conducted in three districts of Bihar by [\(Thorpe, et al., 2007\)](#) found that livelihood strategies predominantly revolved around the crop-livestock system and land remains a central asset for livelihood. The intention of the study was not to provide any recommendations but to flag the issues for further research on crop-livestock interactions. One of the main issues raised by the study was to improve the productivity of staple crops (rice) which is highly correlated with the production of livestock.

Many studies have raised the importance of remittances [\(Deshingkar, et al., 2006\)](#), [Chetan, \(2017\)](#), [\(Tsujita & Hisaya, 2012\)](#) in Bihar economy. In a similar line with this study, all these studies highlighted that remittances play a positive role in livelihood diversification. Migrant households have higher incomes than non-migrant households. Beyond the immediate impact of remittances in providing cash to rural households to meet their food needs, the evidence in these studies suggests that remittance

income enabled several households to invest in land and agriculture at their places of origin. Along these lines, the relationship between migration and landholding was mutually reinforcing.

5.5: Food Availability Impact on Smallholder Rice Farmer Livelihood

Section 4.6 elucidates that domestic production of rice is the main source of household food availability. The respondents highlighted that rice is not only the main source of food but its' lifeline for smallholder rice farming communities. Smallholder rice farmers' all socio-economic and cultural activities revolve around rice farming. In the same line [Ghose et. al., \(2013\)](#) highlights that domestic rice production plays an important role in household food availability. According to him "rice provides around 60 to 70% of calories and 50 to 55% of protein intake in the South Asian population." The Indian subcontinent has a custom that is indistinguishably blended with rice, is more than mere livelihood and has shaped the history, culture, art, and way of life of its population in many ways. It is viewed as an indication of fortune and prosperity in numerous South Asian societies. At weddings, occasional celebrations, and ceremonies, rice has an inescapable impact.

Another finding of section 4.6 demonstrates that household food availability is highly correlated with off-farm income. The diversity of income sources plays an important role in household food availability. The households that were solely dependent on rice farming were confronting the severe scarcity of food availability. The study carried out in Uganda by [Winchern, et al., \(2017\)](#) found that off-farm and market-oriented on-farm activities were more important for household food availability.

The food and water calendar presented in ([table 11](#)) ascribed that water scarcity is highly correlated with food availability in smallholder rice farming. The same line study conducted in Bihar by ([Najmuddin, et al., 2018](#)) indicates that water is highly correlated with the productivity of rice as well as availability. Aside from surface water irrigation, endeavors could be made to improve groundwater water irrigation facilities. For rational utilization of water, policy-level interventions are required in Bihar. Since the northern part of Bihar faces floods every year and same time southern part faces dry spells. So appropriate management to divert the excessive water in scarcity zones could be a boon for the smallholder rice farmers in Bihar.

5.6: The critical reflection as a researcher

As part of the requirement for the award of a Master of Science degree by Van Hall Larenstein University of Applied Sciences students need to conduct research on a problem within their field of work or their organization, which is related to student's specialization. I chose to conduct a study for the interest to understand the problem and prospect of the rice farming community in Bihar, India.

Despite the fact that I saw it as an opportunity, I knew it was going to be challenging when especially I was going to undertake qualitative research which is not very familiar to me. Prior to this study, I had worked on fodder and milk vale chain in Bihar but not in the area of rice farming through the lens of food and nutrition security. I have also not conducted a study on the subject matter. It was, therefore, a revelation and a challenging assignment to formulate problem statement, objectives, and the research questions. However, at the same time, I remain neutral, acted impartial and independent and collected the data from a community where I never worked.

During the desk study, it was not very easy for me to get information, which is relevant and current on the subject matter. Although I had volumes of information from books, journals, and other published sources on how to judge which of them were relevant and credible to the study. From the research design module lecture, I was able to sort out the relevant information looking at the methodologies that were applied in their data collection. Although I know there was a problem, which I have to research, it was not easy to formulate a problem statement, which will be relevant to the study and

understandable by readers. The research questions were not easy to formulate. This was because they have to be researchable and clear enough for readers to know what is expected of the work at the end. Using knowledge and experience from lectures during the management of the development module and the mini-research during the research design and implementation module, I was able to formulate my problem statement, main research question and the sub-questions.

It was my first time of unraveling the livelihood assessment of smallholder farmers. I learned and improved on how checklist for individual interviews and key informants are designed. In addition, I also got hands-on experience and knowledge on how to develop an FGD guide for various stakeholders. Through reading materials, I have now gained knowledge in areas I had little or no knowledge of. I hope my next research work will not be so challenging in terms of formulating problems statement, research main and sub-question.

During the data collection on the field, I spent 4 weeks instead of the 3 weeks I had an initial planned. This happens because I did not seek much information about the area during the time of the year the data was to be collected. I pre-tested the checklist with an NGO extension worker and thought it was well enough for the data collection. On getting to the field, I had to pre-test it again. After pre-testing the checklist on the field, I realized that there were some questions, which were not relevant and others that could not be answered. I, therefore, realized that it was important when preparing a checklist for research you have to pre-test it with people with similar characteristics as your respondents. I also had a more practical knowledge of collecting qualitative data and using both the right and left side of the brain.

This research work has offered me the opportunity to learn and apply some qualitative data analysis techniques. Although it was interesting using these techniques at the same time it was challenging as well. Interpreting the data and discussing it offers me an opportunity to know more about the rice farming systems, how it works and the various ways through which it contributes to household food and nutrition security.

Feedback from my supervisor was very critical and it confused me at times when he shared his neutral opinion, but it was realized that I was not thinking out of the box. Realising it, I took my own decision to adapt to the feedback as it helps me learn more dependently. There was fear at times whether am I doing in the right way. In fact, it helped to broaden my knowledge. His timely support has enabled to complete my report on time. There were times when supervisor was providing valuable feedbacks and upon incorporating the change, the paper set up got distorted. I felt it was extra work for me. But in the end, the changes were meaningful, and it strengthened the research quality.

The important limitation of this study could be explored in future research as my study focus only on factors affecting the livelihood of smallholder rice farmers. For a country like India with different geo-ecological conditions, further research is needed to identify the feasibility of innovation platforms to enhance the livelihood options for smallholder farmers.

Through this research, I have also realized that rice farming is actually contributing to food, nutrition and livelihood security which is essential for achieving Sustainable Development Goals (SDGs) at the grass-root level for 5Ps (people, planet, prosperity peace and partnership) in India.

Chapter 6: Conclusions and Recommendation

In this chapter, section 6.1 describes the conclusion from the study area on the factor affecting the livelihood of rice farmers in the Aurangabad district of Bihar, India. The conclusion answers the sub-main question. While section 6.2 suggest applied recommendations to the Sustainable and Inclusive Rural Development Institute (SIRDI) to adapt or change its policy and how to intervene for improving the livelihood of smallholder rice farmers in the district.

6.1: Conclusion

To answer the main question, "What are the main factors affecting the livelihoods of smallholder rice farmers in Aurangabad, Bihar? The following findings are summarised:

6.1.1. What is the vulnerability context faced by smallholder rice farmers?

The analysis of results and discussion indicate that rice farming is facing various shocks, trends, and seasonality which has a negative impact on livelihood. Farmers indicated (fig 5) bacterial and fungal diseases, water scarcity, high input, and low output rate, and weed management hampers rice productivity.

6.1.2: Which livelihood asset are currently available to smallholder rice farmers?

The asset pentagon (Fig 6) indicates that the human, natural, physical and financial assets are comparatively low compared to the social asset. The social asset is much stronger as compared to other capital. The bond among the farmers is stronger in the study area. This asset could be materialized for knowledge and skill dissemination among the farmers.

6.1.3: How organisations are involved in smallholder rice farming?

The collaboration and coordination among stakeholders were a serious concern of the rice farmers (table 7), (table 8). Respondents were unanimously unsatisfied with the performance of the organizations and informal marketing dominance. Which ultimately elucidates that the performance of institutions doesn't meet the expectation of farmers. Most of the farmers were not satisfied with the performance of public and private sector organisations.

6.1.4: What are the livelihood strategies adopted by smallholder rice farmers?

As indicated in section 4.6, agriculture, particularly rice farming was the main source of livelihood but remittances, non-farm work and on-farm other than crops were other livelihood diversification strategies adopted by rice farmers. The remittances were the second important source of income in the study area (fig 9), (table 10).

6.1.5: How smallholder rice farming affects households' food availability?

Rice is the staple food of all households and rice production is highly correlated with the food availability of smallholder rice farmers. The calendar of rice availability (table 11) indicates that after rice harvesting season household doesn't face scarcity. They face severe scarcity during lean periods.

Results and discussion of this study indicate that collaboration and coordination among stakeholders have a serious stake in improving the livelihood of smallholder rice farmers in the Aurangabad district of Bihar, India. Considering the main research question: What is the factors affecting rice production for securing livelihoods of smallholder rice farmers in Aurangabad, Bihar? It can be said after this study that vulnerability context has negative impact on smallholder rice farming and it needs to be minimized. The asset portfolio has positive impact on smallholder farming and it requires to maximize particularly human, natural, physical and financial assets. Off-farm income should be maximised and farmer needs on-farm or off-farm work during lean period.

6.2: Applied Recommendation

As per finding 4.5 and conclusion 6.1.4 of the study, collaboration and coordination among stakeholders with smallholder rice farmers to provide input and information were serious concerns to minimise the vulnerability, maximise the asset portfolio, and provide on-farm and off-farm options for better livelihood. Hence it is recommended to Sustainable and Inclusive Rural Development Institute (SIRDI) to trap the potential of rice farming, create a conducive environment to bring together all stakeholders in the rice farming at a single platform as follows;

1. The SIRDI is suggested to develop an innovation platform to bring together all stakeholders in rice farming. Further, considering the features of Living Labs which provide complex multi-stakeholder constellations where a multitude of activities take place, could be a better option to enhance livelihood options and improve the productivity of smallholder rice farming in the district.
2. Tacit knowledge is an important source of knowledge for various farming practices of a smallholder rice farmer, hence, during developing knowledge innovation platforms, tacit knowledge shouldn't be ignored and local farmers must be included as a stakeholder.

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Appendices

Annex 1: Interview Check list

Semi -structure interview for rice farmers

Name of respondent

Age of respondent

Education of respondent

Holding size

Area under rice

What kind of vulnerability did you face in past years particularly in rice farming?

(Shocks, Trends, Seasonality)

What kind of asset do you have for rice farming?

(Human; Natural; Physical; Financial; Social)

Activities performed: manually/machine

How family uses knowledge for rice cultivation?

(Tacit; Explicit)

Organisations and institutions involvement

Government, Private, laws/policies:

How does knowledge institutions interact and collaborate with you in rice farming?

In past 5 year who contacted you or you contacted them?

sufficient/insufficient;

if insufficient, how should they interact and collaborate?

What other strategies do you use?

Income sources

Status of food availability (monthly)

Please feel free, if you raise any other issues related to rice farming

Focused Group Discussion (FGD)

What is the status of vulnerability context for farmers in rice farming?

(Shocks, trends and seasonality)

What is the status of assets in rice farming?

(human, natural, physical, financial and social)

How knowledge is being used in rice farming?

(Tacit and explicit)

Which kind of machine farmer use for growing rice?

Livelihood strategies adopted by farmers

Share of income by different sources

Which kind of inputs farmers are using for rice farming?

What's the role of institutions and policies in rice farming?

(government/private; laws/policies)

Organisations and institutions involvement in rice farming

Status of food availability

Sources of income of rice farmers?

Activities involve in rice farming?

Knowledge farmer use for specific activity

Which activity you perform through tacit knowledge?

Which kind of activity you perform by using scientific knowledge?

Which kind of organizations are working in village?

Food availability status

Monthly food and water availability calendar

Please feel free, if you raise any other issues related to rice farming

Key Informant

What is the status of vulnerability context for farmers in rice farming?

Shocks, trends and seasonality

What is the status of assets in rice farming?

human, natural, physical, financial and social

How knowledge is being used in rice farming?

Tacit and explicit

Activities performed machine/manually

Which kind of machinery are being used in farming?

Which kind of input do you use?

What's the role of institutions and policies in rice farming?

(government/private; laws/policies)

Livelihood strategies of rice farmer

Source of farmers income

Status of food availability

How does knowledge institutions interact and collaborate in rice farming?

(sufficient/insufficient; if insufficient, how should they interact and collaborate?)

Please feel free, if you raise any other issues related to rice farming

Annex 2: Interviewed Farmers List

Farmer ID	Farmer AGE	Education (in years)	Total family members	Total land	Area under rice
RFI01	28	10	8	2.5	2.5
RFI02	42	10	4	1.5	1.5
RFI03	35	10	8	2	2
RFI04	58	12	5	2.5	2.5
RFI05	56	12	6	4	4
RFI06	46	5	6	2.5	2
RFI07	62	7	8	2.5	2.5
RFI08	45	10	8	3	2.5
RFI09	51	8	6	1.5	1.5
RFI10	38	10	7	1.3	1
RFI11	28	8	7	2	2
RFI12	43	9	6	2	2
RFI13	28	8	6	1.5	1.5
RFI14	76	4	7	2.4	2.4
RFI15	56	8	3	1.5	1.5
RFI16	30	10	6	1	1
RFI17	56	4	6	1	1
RFI18	38	8	5	1.5	1.5
RFI19	54	10	8	2	2
RFI20	55	8	6	2.5	2
RFI21	78	8	10	3	2.9
RFI22	30	15	6	2.5	2
RFI23	35	9	9	3	2.5
RFI24	30	9	6	3	2.5
RFI25	58	2	6	2.5	2
RFI26	59	5	5	2.5	2
RFI27	62	5	6	2	1.5

Source: Individual farmers interview, 2019 in Bihar, India

Annex 3: Research Activity Plan

Activity	Description	May 2019 (Weeks)				June 209 (Weeks)				July 2019 (Weeks)				Aug 2019 (Weeks)				Sep 2019 (Weeks)			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Planning Research																				
1.1	Literature review/Scoping																				
1.2	Developing a research plan																				
2	Data Collection																				
2.1	Desk study																				
2.2	Key Informant Interview																				
2.3	Focus Group Discussion																				
2.4	Interview with farmers																				
2.5	Observation																				
3	Data Analysis and Pro- cessing																				
4	Report Writing																				
5	Oral Assessment																				

Annex 4: Consent form

for inclusion and availability of graduation paper⁷ in a digital repository

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Date: **04 October, 2019**

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Theme/Study : **MOD – FNS**