Rethinking financial instruments: The case study of floods in Nepal

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Abstract

Index-based insurance is often discussed in the literature as one of the innovative financial instruments for micro-insurance. Ongoing research has shown that concerns remain about the demand for index insurance in low and middle-income countries. In Nepal, recent literature has demonstrated that the demand for crops is low, that index-based insurance products for specific crops should be piloted and that farmers' willingness to participate should be assessed.

This thesis explores the factors that affect smallholder farmers' demand for hypothetical index-based flood insurance (IBFI) for crops in Nepal. The study employs a mixed-methods approach including an index-based insurance game and brings empirical quantitative and qualitative evidence from flood exposed areas in the lowlands of the Karnali River basin.

Three common factors were identified and are most likely to influence farmers' decisions for potential IBFI; i) the basis risk ii) education and iii) recent weather conditions. However, non-common factors identified by the qualitative approach indicated that practical implementations (such as distance to insurance provider) should also be taken into consideration when piloting future activities for potential index-based

insurance products to minimise the risks and increase participation. Employing a mixed-methods approach was proved to be valuable to expand the research around application of IBFI but also to provide a foundation for potential policy and practical implementation.

Declaration

I, Eleftheria Vavadaki, hereby declare that this is entirely my own work unless referenced to the contrary in the text. No part of this thesis has previously been submitted elsewhere for any other degree or qualification in this or any other university.

To my beloved parents.

My father that was always inspiring me with his hard work and supporting my choices. My mother for taking care of us and being the foundation of our family.

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Nomenclature

Symbol	Description
ARC	African Risk Capacity
CCA	Climate Change Adaptation
CDMC	Community Disaster Management Committee
CRRA	Constant Relative Risk Aversion
CSDR	Centre for Social Development and Research
DHM	Department of Hydrology and Meteorology
DRF	Disaster Risk Finance
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EWS	Early Warning System
FGD	Focus Group Discussion
FRM	Flood Risk Management
GoN	Government of Nepal
HDI	Human Development Index
HH	Household
HRA	Highly Risk Averse
IBFI	Index-Based Flood Insurance
ILW	Industry Loss Warranty
INGO	International Non Governmental Organisation
KI	Key Informant
KII	Key Informant Interview
mMPL	modified Multiple Price List
MPL	Multiple Price List
MRA	Moderate Risk Averse
NEOC	National Emergency Operations Centre
NRA	Negative Risk Averse
NPR	Nepali Rupee
OLS	Ordered Lottery Selection
PCRAFI	Pacific Catastrophe Risk Assessment and Financing Initiative
r	Latent risk coefficient
StN	Slight to Neutral
TCIP	Turkish Catastrophe Insurance Pool
UNFCCC	United Nations Framework Convention on Climate Change
WTP	Willingness To Pay

Chapter 1

Introduction

1.1 Background

Climate-related disaster losses have been growing recently [Herweijer et al., 2009]. One route for climate adaptation is to achieve financial resilience [Jarzabkowski et al., 2019], which according to the Sendai Framework of the UNISDR [2015] can be facilitated by employing insurance and risk transfer schemes.

One of the innovative financial instruments for risk transfer is index-based micro-insurance. Micro-insurance is designed mostly for low income individuals [Hochrainer et al., 2009; Warner et al., 2009] and is usually offered for risks related to weather and agriculture [Herweijer et al., 2009]. However, previous research relevant to the demand of farmers in low and middle income countries for weather index insurance has many unanswered questions [Norton et al., 2014].

Nepal is exposed to a variety of disasters [GoN, Ministry of Home Affairs, 2019] and to various climate change related risks [Guo and Bohara, 2015]. Farming is the main source of income for a large portion of the population of Nepal

[Ghimire and Kumar, 2014], and the number of farmers vulnerable to natural hazards is growing [Wehrhahn et al., 2019]. In 2013 crop and livestock agricultural insurance, with the purpose to increase resilience of farmers to disasters began to be promoted [Wehrhahn et al., 2019]. However, recent research shows that the demand for crops insurance is lower compared to livestock [Ghimire et al., 2016b] and literature argues that the Government of Nepal (GoN) explores whether index-based insurance could improve the current multi-peril insurance scheme [Ghimire et al., 2020b].

Therefore, this study attempted to better understand the demand for index-based insurance by exploring the factors affecting the demand for hypothetical Index-Based Flood Insurance (IBFI) for crops, bringing empirical evidence from the lowlands of the Karnali River basin in Nepal, contributing to knowledge on the role of microinsurance in Flood Risk Management (FRM).

1.2 Research Approach

The study employed a mixed-methods quantitative-qualitative approach to collect empirical data from the fieldwork sites. The main research instruments were a large quantitative survey using a structured questionnaire and a qualitative approach using open-ended questions, combined with an innovative index-based insurance game. My methodology is derived from research frameworks from business and management, finance, economics, disaster risk reduction and human geography.

1.3 Research Questions and Objectives

The thesis main research question aims to answer:

Which are the factors affecting the demand for potential IBFI in the study area?

The research question is approached through three separate research sub-questions :

1. Is the degree of farmers' risk aversion in the study area the same when employing and comparing the two risk aversion methods employed in this study?

2. Which are the factors affecting farmers' Willingness To Pay (WTP) for hypothetical IBFI for crops in the study area that can be identified by a quantitative survey?

3. Which are the factors affecting the demand for potential IBFI for crops in the study area that can be identified by qualitative approaches and an index-based insurance game?

The objectives addressed in this thesis aim to answer the three research sub-questions (objectives 1-3) and the main research question (objective 4):

1. To examine the degree of farmers' risk aversion by assessing their risk preferences by using and comparing two methods often used in low and middle income countries.

2. To quantitatively explore the factors affecting farmers' Willingness To Pay (WTP) for hypothetical IBFI for crops in the study area.

3. To explore the factors affecting the demand for potential IBFI for crops in the study area using qualitative approaches and an index-based insurance game.

4. To understand the factors affecting the demand for potential IBFI through an integrated quantitative and qualitative research approach.

A diagram with the objectives of the thesis is graphically presented in Figure 1.1.

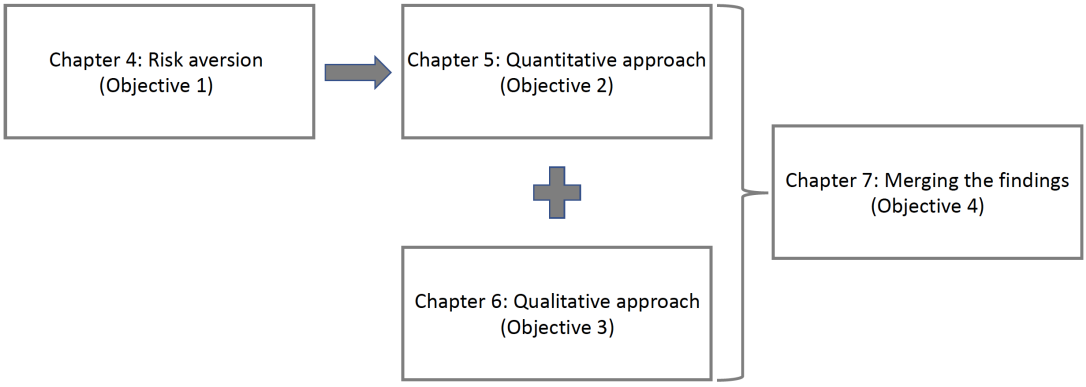


Figure 1.1: Objectives diagram

1.4 Thesis Structure

The remainder of the thesis is organised as follows: Chapter 2 presents the literature review introducing disasters and climate change losses and introduces the financial instruments for disasters focusing on index-based micro-insurance. The chapter continues with literature related to Nepal. Finally, the chapter connects the identified gaps with this research study. Chapter 3 presents the research framework of the study. The chapter gives an overview of the methods utilised, the research in practice, the study area, the preparation and overview of the main

fieldwork, the research instruments for data collection and collected data, the research methods, participants' consent and my positionality followed by some of the challenges.

Chapters 4 to 6 are the empirical chapters. Chapters 4 and 5 utilised quantitative methods and Chapter 6 qualitative methods and an index-based insurance game. Chapter 4 employs and compares together, two commonly used separately risk preference methods. Chapter 5 explores the factors affecting the interest in flood insurance and the WTP for IBFI in the study area. Chapter 6, explores factors affecting the demand for IBFI through an index-based insurance game and qualitative approaches.

The findings of the empirical Chapters 4 to 6 are summarised and discussed in Chapter 7. Chapter 8 provides a summary and the contributions of the thesis, followed by the limitations of the research and proposed future work.

Chapter 2

Literature review and institutional background

This chapter reviews the relevant literature for the thesis. Sections 2.1 to 2.3 describe the significance of insurance, present the existing financial instruments for DRR, introduce index-based microinsurance and Nepal as a study area. Having introduced the previous topics, Section 2.4 presents the research gaps found in the literature and the main research question of the study.

The remainder of the chapter is organised as follows: Section 2.1 outlines the impacts of climate change in disaster losses, introduces Disaster Risk Finance (DRF) for Climate Change Adaptation (CCA) and reviews the existing financial instruments for DRR. Section 2.2 provides a particular focus on index-based insurance and index-based microinsurance for agriculture, emphasising insurance for floods. Section 2.3 reviews the impact of climate change in Nepal, the floods in the study area, and provides a review of agricultural insurance in Nepal. Section 2.4 identifies the potential fields for further research. The chapter concludes

with a summary in Section 2.5.

2.1 Disasters, Climate Change, Disaster Risk Finance and Financial Instruments for Disaster Risk Reduction

Disasters are defined as:

"*A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts.*"[UNDRR, 2016, p.13]

"*[...] a situation involving a natural hazard which has consequences in terms of damage, livelihoods/economic disruption and/or casualties that are too great for the affected area and people to deal with properly on their own.*" [Wisner et al., 2012, p.30].

Other definitions are related to catastrophes, which are defined as extreme events usually resulting in considerable economic shocks [Zeckhauser, 1996]. In developing countries[1], catastrophes are typically defined as events that cause substantial injuries and fatalities [Jaffee and Russell, 2006]. In contrast, the insurance industry in developed countries refers to catastrophes as the events that generate considerable insured losses (ibid.). A significant number of catastro-

[1]The term *developing countries* is inherited from the prior literature I build on. However, there is substantial discussion in the practitioner community on it's use, see the following discussion piece from the World Bank here: https://blogs.worldbank.org/opendata/should-we-continue-use-term-developing-world, last accessed 12 May 2021. Following this approach I make no specific judgement on the development status of any country as my studies are community specific.

phes are caused by nature combined with human activity [Zeckhauser, 1996]. For instance, an earthquake is generated by nature (ibid.). However, when the earthquake is combined with humans living in risky locations, inadequate construction and infrastructure the result might lead to a significant disaster (ibid.). Due to their natural or human origins, catastrophes have three main components that differentiate them from other risks which cause losses related to property and casualty; the unpredictability of the events, the infrequency of the events and the high amount of losses they provoke [Dong et al., 1996]. The most significant environmental issue at present is climate change [Zeckhauser, 1996].

In combination with mitigation strategies, adaptation is one potential route to climate change risk reduction [IPCC, 2014]. The following subsections, Section 2.1.1 to Section 2.1.3 introduce disasters, climate change and their impact in losses, analyse DRF for CCA and present the financial instruments for disasters identified in this literature review.

2.1.1 Climate change and disaster losses

The changes in the temperature globally have raised during the past decades while the intensity and frequency of extreme weather events is also increasing [Kahn et al., 2019]. During June 2021 parts of U.S and Canada recorded increased temperature levels that had never been experienced before, due to human-caused climate change, according to the study of the World Weather Attribution[2]. The previous example provides one of the most recent evidence regarding the effects of climate change, while scientists repeatedly warn about the future of climate

[2]Data retrieved from https://www.worldweatherattribution.org, last accessed August 5, 2021.

change. For instance, "*Global warming is likely to reach* $1.5°C$ *between 2030 and 2052 if it continues to increase at the current rate (high confidence)*" [IPCC, 2018, p.6]. Climate model simulations under various global warming scenarios show substantial differences between the current and projected climate, such as an increase in mean temperatures in land and oceans, extreme hot events in many inhabited locations, intense precipitation in a few locations as well as droughts and lack of precipitation in some areas [IPCC, 2018]. However, it is uncertain how the changes in climate will impact locally [Ranger and Garbett-Shiels, 2011]. For instance, one location may experience a decrease in frequency and intensity of a specific hazard but may experience an increase in frequency and intensity of a different hazard, or locations could be exposed to hazards that historically seldomly occurred (ibid.).

Climate change impacts the increase of the disaster losses [Andersen, 2002; Herweijer et al., 2009; Linnerooth-Bayer et al., 2009]. Climate-related disaster losses have been increasing during the past decades [Hochrainer-Stigler et al., 2014], while extreme weather can have long term economic impacts [Bouwer, 2019]. Therefore, climate change is often described as the most environmentally and economically threat of our era [Hornsey and Fielding, 2020]. The increase of the exposure of assets and people living in hazardous areas also contributes to enhanced losses [Andersen, 2002; Warner et al., 2009]. Due to the uncertainty in estimating the impact of climate change locally, the amount of future losses is difficult to quantify [Herweijer et al., 2009]. This uncertainty in predicting future climate conditions hinders the development of adaptation and mitigation strategies for governments, and challenges the preparation for future losses to companies and individuals [Botzen and van den Bergh, 2009].

Climate change threatens the insurance industry too [Herweijer et al., 2009; Warner et al., 2009]. Historically the insurance industry based their calculations of risk on past events [Herweijer et al., 2009]. As most of the catastrophes occur infrequently, historical data is limited [Dong et al., 1996]. Additionally, as new events differ from the past ones, this methodology is no longer adequate [Herweijer et al., 2009]. As a result, the pricing and diversification of risks across an organisation are challenged, which might risk the organisation's economic stability (ibid.).

"*Managing the risks from climate change requires urgent action [...] to adapt to changes in climate at a local level to minimise risks and maximise potential opportunities*" [Herweijer et al., 2009, p.360]. As noted in Ranger and Garbett-Shiels [2011] developing and least developed countries are expected to be affected the most by the changes in climate; hence risk reduction and risk compensation mechanisms need to evolve. In developing countries, the consequences of disasters can be catastrophic, especially for the most vulnerable [Hochrainer-Stigler et al., 2014; Mechler et al., 2010]. As a result, there is a great need for adaptation, especially for the most vulnerable [Warner et al., 2009].

2.1.2 Disaster risk finance for climate change adaptation

Disaster risk is defined as: "*The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity.*"[UNDRR, 2016, p.14]. The Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change

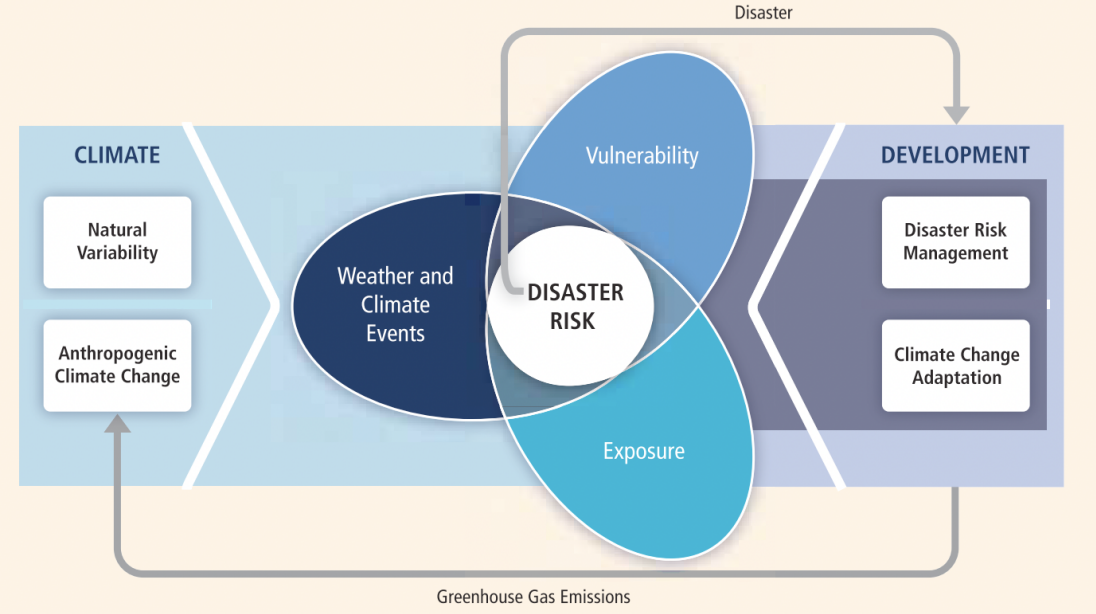


Figure 2.1: Core concepts of SREX, taken from Lavell et al. [2012, p.31]

Adaptation (SREX) assesses how Disaster Risk Management (DRM) and CCA can be integrated [Lavell et al., 2012]. The main concepts of SREX are illustrated in Figure 2.1.

Climate adaptation demands both physical (e.g. reducing the vulnerability to hazard) and financial resilience [Jarzabkowski et al., 2019]. Linnerooth-Bayer and Hochrainer-Stigler [2015] extend the SREX report by exploring the equilibrium between DRR and DRF for CCA and argue that well-planned DRF instruments can contribute to loss and damage reduction.

In the same vein, the Sendai Framework of UNISDR [2015] illustrates that one of the measures to achieve resilience in DRR is the need for promotion of insurance, risk transfer, and risk-sharing mechanisms. Furthermore, one of the three pillars of catastrophe risk financing framework is the "*promotion of risk transfer to competitive insurance markets*" [Cummins and Mahul, 2008, p.21].

Even using the best and most successful risk management approaches for risk reduction, there is always space for protection from natural hazards with financial instruments [Andersen, 2002].

The role of financial instruments in CCA is limited to the redistribution of loss and damage [Linnerooth-Bayer and Hochrainer-Stigler, 2015]. Even though financial instruments do not reduce the physical impact of the catastrophes, they assure the existence of cash flow for recovery and diminish the economic effects after the event [Hochrainer and Pflug, 2009]. In this way, financial instruments contribute to the countries' preparation and resilience to climate change [Mahul and Signer, 2014].

2.1.3 Traditional and non-traditional financial instruments for disasters

The literature divides the financial instruments for disasters[3] into traditional and innovative (non-traditional instruments) (e.g. the literature found in Linnerooth-Bayer and Hochrainer-Stigler [2015]; Linnerooth-Bayer et al. [2012]). Linnerooth-Bayer et al. [2012] and Linnerooth-Bayer and Hochrainer-Stigler [2015] categorise the traditional disaster risk financing mechanisms into four types; solidarity, savings and credit, informal risk-sharing and insurance mechanisms (Table 2.1). A focus is given to the risks that are challenging the insurance industry (Table 2.2), and the approaches that the insurance industry utilises to estimate disasters' loss (Table 2.3).

[3]This is not a review of all the financial instruments but rather the most commonly found in this literature review.

Table 2.1: Traditional financial instruments

Instrument	Explanation
Solidarity	Activated usually at high impact events when the affected populations rely on governments or international aid for relief [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012].
Savings and credit	Savings are considered an ex-ante measure and credit an ex-post [Linnerooth-Bayer and Hochrainer-Stigler, 2015]. At the community level savings can take the form of food, seeds etc., which can be used to stabilise the consumption after crisis [Linnerooth-Bayer et al., 2012]. Governments also save in case disaster strikes (ibid.). On the other hand, credit usually follows a disaster through small debts (micro-finance) and at a governmental level when there are not available sources within the government's budget [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012].
Informal risk sharing	Economic agreements that include mutual exchange, family ties, or help within the community [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012]. Informal risk sharing usually is effective for low or medium-level risks [Linnerooth-Bayer and Hochrainer-Stigler, 2015], informal risk-sharing involves participation in informal risk protection schemes and can also take the form of remittances received from migrants [Linnerooth-Bayer et al., 2012].
Insurance & Re-insurance	**Insurance:** The insurance industry plays a substantial role among the risk reduction strategies [Herweijer et al., 2009]. Insurance is defined as a contract where one party pays a premium in exchange for financial coverage from the other party in case of a loss [Warner et al., 2009]. According to Cummins and Mahul [2008] the best conditions for the insurance industry are frequent but low-severity events, which are statistically independent and relatively stationary in time. The diversification of risk is the central role of the insurer [Cummins and Mahul, 2008]. The insurers diversify the risk by pooling many statistically independent risks, and their losses occur randomly [Cummins and Mahul, 2008; OECD, 2016]. This principle allows the uncertainty of financial loss to be reduced by diversifying it between many policyholders [Surminski, 2014]. **Re-insurance:** Insurance companies often concentrate on risks that are too large for a particular geographic region or a specific policy [Andersen, 2002]. Catastrophes are usually infrequent events, which affect many assets lying at the same location simultaneously, resulting in a tremendous amount of losses and disrupting the main principles that insurance is based on; the independence of the events and thus diversification of risk [Andersen, 2002; Cummins and Mahul, 2008]. However, the locally dependent risks might be independent on a global scale, which generates the reinsurance companies that insure the primary insurance companies [Cummins and Mahul, 2008]. The insurance companies usually transfer part of their risks to the reinsurance industry to diversify the exposure of their risks and reduce potential losses [Andersen, 2002; Cummins and Mahul, 2008]. The transaction is usually done through a reinsurance broker, whose role is to find the best price and terms on behalf of the insurance company [Cummins and Mahul, 2008], (Figure 2.2). Transferring part of the risks globally is also beneficial for the national economies, as part of the compensation payments are usually absorbed by the international markets and relief of the local economies [OECD, 2016].

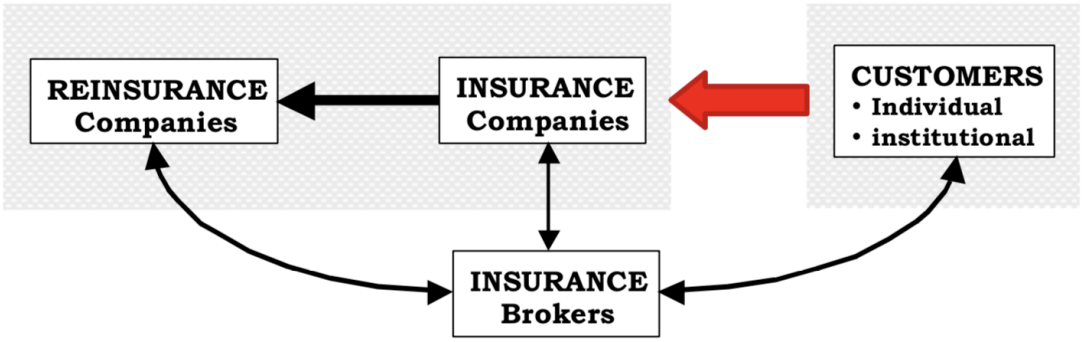


Figure 2.2: Overview of the insurance market, taken from Andersen [2002, p.16]

Table 2.2: Risks challenging the insurance industry

Moral Hazard	The risk that the policyholders might not take preventive measures to minimise potential losses once they are insured [Andersen, 2002; Miller and Keipi, 2005]. Usually occurs when the insurer cannot control the behaviour of the policyholder [Cummins and Mahul, 2008].
Adverse selection	The risk that the policyholder might have more information regarding the risk exposure and might try to achieve more favourable conditions from the insurance company, which provides the contract [Andersen, 2002]. The insurer might charge the premiums accordingly to be protected from this type of uncertainty (ibid).
Basis risk	The risk of a significant difference between the compensation provided and the actual damages occurred [Andersen, 2002].

Table 2.3: Insurance industry disasters loss estimation approaches

Individual loss adjustment	A certified loss adjuster is sent by the insurance company to assess the loss of the policyholder (indemnity-based) [Clarke and Dercon, 2016; Mahul and Signer, 2014].
Index-based	The payouts are triggered according to a predetermined index (e.g. rainfall level, wind speed etc.), which is correlated with the losses [Clarke and Dercon, 2016; Clement et al., 2018; Mahul and Signer, 2014].
Area average index	The losses over a specific region are calculated on average by the insurer, and the payout is the same for everyone [Clarke and Dercon, 2016].

Developing countries have a lower financial capacity to adapt to climate change challenges [Herweijer et al., 2009] and usually depend on international support, charities and donors when a catastrophe occurs [Andersen, 2002; Gurenko, 2004]. A substantial number of developing countries might not take sufficient pre-

cautions to reduce the impacts of disasters [Andersen, 2002], while the amount of premiums that insurers often provide is unaffordable for some developing countries [Gurenko, 2004]. Furthermore, a substantial number of the population in developing countries do not have the means to insure for weather-related hazards or risk mitigation [Herweijer et al., 2009]. The people in developing countries are the most vulnerable to climate risks today and consequently to climate change consequences in the future (ibid.).

In developing countries many households have an absence of access to insurance [Panda et al., 2020]. The insured direct losses from natural hazards in low and middle-income countries are less than 5% and less than 10%, respectively, compared to more than 40 % in developed countries [Cummins and Mahul, 2008]. Specifically, in low and low-middle income countries, the insurance density reaches 1-2% [Linnerooth-Bayer et al., 2009].

There is an increasing interest in re-insurance companies to allocate capital to middle and low-income countries to diversify their portfolios [Cummins and Mahul, 2008]. Insurance already plays a growing role in some locations of developing countries [Herweijer et al., 2009]. Not only do developing countries present an opportunity for the insurance industry to expand their market and generate innovative products, but the insurance industry can also additionally benefit from the management of weather-related risks in disaster-prone countries (ibid.).

As weather-related risks and climate change pose increasing challenges for a viability of international insurance schemes, it is essential that the participating countries engage in reducing their exposure and vulnerability to disasters [Warner et al., 2009]. Similarly, the private sector needs to act in combination with a climate adaptation strategy to generate suitable products for the most vulnerable

[Linnerooth-Bayer et al., 2009]. A successful adaptation will benefit the existing and future insurance market and the long-term maintenance of it, by reducing insurance companies' risk and increasing opportunities for the industry [Herweijer et al., 2009].

Despite the insurance industry's opportunities in developing countries [Herweijer et al., 2009], developing countries present a challenging market for insurance [Herweijer et al., 2009; Linnerooth-Bayer et al., 2009]. Due to the limited and insufficient experience of insurance in developing countries, it is not clear if the benefits of insurance programmes reach the most vulnerable [Warner et al., 2009].

Even though the conventional risk finance instruments are handy tools, they have some limitations when a major disaster happens, as they seem insufficient to absorb high-level shocks [Linnerooth-Bayer and Hochrainer-Stigler, 2015]. The reinsurance market was the unique risk transfer mechanism for disasters until the mid-1990s when the exploration for alternative financial instruments began to transfer catastrophe risk to global markets [Andersen, 2002].

The innovative financial instruments for disasters identified in this literature review are presented in Table 2.4. Linnerooth-Bayer and Hochrainer-Stigler [2015] analyse a series of benefits and challenges that the innovative financial instruments provide to governments and individuals. For instance, micro-insurance for individuals can contribute to the recovery process's accelerations by providing liquidity and resulting in resilience [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012]. For governments, sovereign risk financing, and insurance instruments, provide ex-post liquidity, assessing governments to support the most vulnerable and to invest in recovery and reconstruction [Linnerooth-

Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012].

However, many challenges might lead to the financial instruments becoming more costly than the expected losses [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012, 2009]. For instance, insurance might end up expensive to reach the clients due to high transaction costs [Linnerooth-Bayer and Hochrainer-Stigler, 2015]. Therefore, the benefits should be assessed regarding the costs [Linnerooth-Bayer et al., 2012]. Other limitations of the non-traditional financial instruments are, for instance, the moral hazard, adverse selection, basis risk, trust, institutional stability and climate change [Linnerooth-Bayer and Hochrainer-Stigler, 2015].

Table 2.4: Non traditional financial instruments

Instrument	**Example**
Micro-insurance: Known for their low premiums, these products are designed mainly for low-income individuals [Hochrainer et al., 2009; Warner et al., 2009]. They are mostly offered for weather-related risks (e.g. agricultural) and not for properties [Herweijer et al., 2009]. Micro-insurance products are offered whether as indemnity based or index-based ones [Linnerooth-Bayer and Hochrainer-Stigler, 2015], with demand for index-based micro insurance to be increasing [Herweijer et al., 2009].	E.g. the Swiss Re collaborated with a micro-finance institution and a local insurer to develop microinsurance for smallholder farmers in India [Herweijer et al., 2009].
National insurance: There are cases when private insurers are unwilling to provide products in specific regions or nationally because these locations might accumulate high levels of risks for particular hazards [Linnerooth-Bayer and Hochrainer-Stigler, 2015]. The public-private partnerships overcome this problem by generating mandatory policies of affordable insurance premiums for individuals, which the government and donors secure [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012].	E.g. the Turkish Catastrophe Insurance Pool (TCIP) consists the first public-private partnership in a middle income developing country, which is designed for protection of urban properties exposed to earthquake risks [Cummins and Mahul, 2008; Gurenko, 2004; Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012].

Continued.

Instrument	Example
Regional catastrophe insurance pools: This is a multi-country insurance pool usually designed between small developing countries, which contribute to a pool and achieve better premium terms from the international insurance industry [Cummins and Mahul, 2008].	E.g. the African Risk Capacity (ARC), the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) [OECD, 2016].
Public sector risk transfer: When governments cannot absorb the costs of catastrophe events or cannot provide ex-post relief to private companies or humanitarian assistance, the indirect costs might end up greater than the direct damages arising after a hazardous event [Linnerooth-Bayer et al., 2012]. For instance, governments might choose to insure in global markets their public assets or to ensure adequate post-disaster liquidity (ibid.).	E.g. the Gross Domestic Product of Honduras (GDP) after Hurricane Mitch in 1998 was 6% below predisaster conditions five years after the hurricane (Mechler [2004] as cited in Linnerooth-Bayer et al. [2012]). The government faced difficulties repairing public infrastructure and helping the private sector recover after the hurricane [Linnerooth-Bayer et al., 2012].
Secure donors that support governments: After numerous catastrophes, donors might also face a shortage of liquidity [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012]. In this case, they might proceed to insurance or support governments to arrange to insure themselves [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012].	E.g. the World Food Programme set up an insurance programme that would provide cash to Ethiopia in case of extreme drought (Wiseman and Hess [2007] as cited in Linnerooth-Bayer and Hochrainer-Stigler [2015]).
Catastrophe bonds: CAT-bonds is an alternative to commercial reinsurance instrument [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012]. The insurance market is avoided by transferring the risks directly to the financial markets [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Miller and Keipi, 2005]. CAT-bonds or event-linked bonds [Cummins and Mahul, 2008], are related to a specific event, where the payments are activated in case the event occurs [Cummins and Mahul, 2008; Goldfinch et al., 2020; Warner et al., 2009]. The criterion for the payments to be triggered can be the amount of loss or another parameter depending on the contract [Warner et al., 2009]. The profit for the investors come from the high returns the investors receive in case the event does not take place the specific time, but the investors share the risk of the insurer or government by giving up part of the interest after the event [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012; Mechler et al., 2010].	E.g. Mexico issued a three year CAT-bond (Cat-Mex) in 2006 to transfer earthquake risk to investors [Cummins and Mahul, 2008].

Continued.

Instrument	Example
Weather derivatives: These type of instruments are used to protect the private market, whose profit might get influenced by weather events (e.g. changes in temperature, rainfall, wind speed etc.) [Miller and Keipi, 2005]. Weather derivatives can form a supplement to insurance for disasters or CAT-bonds, as they are usually used for low-impact, high-probability events (ibid.).	E.g. Malawi's government bought weather derivatives in 2008-2009, 2009-2010, 2010-2011 to transfer part of the risk to a severe drought to the international markets and receive funds within days if the event occurs [Abousleiman and Mahul, 2012].
Contingent credit: Governments pay a fee, to secure the option of potentially taking a loan with predetermined conditions after an event occurs in the future [Linnerooth-Bayer and Hochrainer-Stigler, 2015; Linnerooth-Bayer et al., 2012; Mechler et al., 2010]. In other words, governments assure the availability of funds for a disaster beforehand [Mahul and Signer, 2014]. When the event occurs, and the country announces a state of emergency, the funds start to be paid out [Cummins and Mahul, 2008]. This kind of loans assure the liquidity after the event and are usually cheaper than insurance (ibid.). A disadvantage of this instrument is that in some countries these loans sharpen the country's credit limits [Linnerooth-Bayer et al., 2012].	E.g. Columbia secured a contingent loan of US $150 million from World Bank in case a major disaster would hit the country [Cummins and Mahul, 2008].
Industry Loss Warranties (ILWs): This type of contract is a reinsurance contract triggered by two factors [Cummins and Mahul, 2008]. One factor is the *retention trigger*, which is the losses that happened to the insurer (ibid.). The other factor is the *warranty trigger*, which is the number of losses of the whole industry (ibid.). ILW can be triggered *binary* when both factors happen simultaneously or *pro rata triggers* when the payoff is done depending on how much the loss exceeds the warranty (ibid.).	
Catastrophe risk swaps: This financial instrument is performed between two companies, which agree to swap their exposure to different types of risks [Cummins and Mahul, 2008].	E.g. in Figure 2.3 the reinsurer A with earthquake risk exposure in California swaps the risk with reinsurer B with earthquake risk exposure in Japan [Cummins and Mahul, 2008].

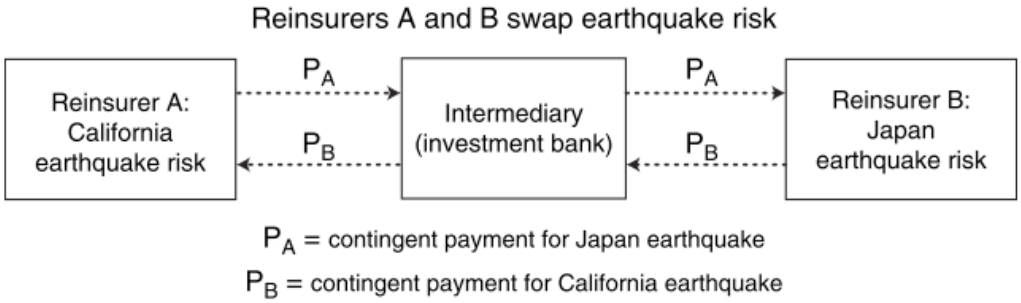


Figure 2.3: Catastrophe risk swap example, taken from Cummins and Mahul [2008, p.220]

This research focuses on index-based microinsurance, which is one of the innovative financial instruments that were identified in the literature review applicable for agriculture in a developing country context. Therefore, index-based microinsurance is analysed extensively in the following sections.

2.2 Index-Based Microinsurance

Agriculture has always been a risky business threatened by various hazards that affect the production and consequently livelihoods [Yanuarti et al., 2019]. The agricultural shocks as a consequence of natural hazards such as floods and droughts depress the investments and risk-taking [Hill et al., 2013]. Additionally, climate change will likely have a significant effect on households in rural areas, specifically on their income, assets and other activities [Tiwari et al., 2014]. The yields in developing countries, particularly in South Asia, are expected to be negatively affected by climate change [Nelson et al., 2009].

Insurance provides a capital flow when disasters occur, supporting the societies financially for recovery [Jarzabkowski et al., 2019]. Agricultural insurance

is a tool to manage the risks threatening agrarian production in developing countries [Gehrke, 2014] and can enable farmers to sustain a better living [Ghimire et al., 2016b]. For instance, agricultural insurance contributes to the smallholder farmers' financial security against extreme shocks and encourages credit and investments [Morsink et al., 2016]. Furthermore, climate risk management might contribute to improving farmers' livelihoods in "unfavourable years" and taking risks that will improve their production in the "favourable" years [see Norton et al., 2014, p.630]. Hence, crop insurance as a means for climate change adaptation supports rural economies by stabilising the income and consequently, the livelihoods of communities and individuals [Afroz et al., 2017].

Microfinance has gained increasing attention since the United Nations International Year of Microcredit in 2005, established to ease poverty in developing countries [Hochrainer-Stigler et al., 2012]. Table 2.4 shows that one of the innovative financial instruments is micro-insurance. Microinsurance is considered a promising tool for agricultural risk management in developing countries [Gehrke, 2014], however the demand for microinsurance continues to be relatively low [Panda et al., 2020]. As already mentioned, micro-insurance can be offered as indemnity- or index-based [Linnerooth-Bayer and Hochrainer-Stigler, 2015], with an increasing demand for index-based [Herweijer et al., 2009]. The Global Index Insurance Facility (GIIF), a multi-donor fund, invests in the index-based insurance in developing countries to progress the related regulatory framework for microinsurance [Jensen and Barrett, 2017].

This study deals with index-based microinsurance for agriculture in Nepal. Index-based insurance is a tool which supports smallholder farmers in climate risk management, empowering investments and development in the field of agriculture

[Greatrex et al., 2015]. Weather index-based crop insurance, for instance, is considered a promising and ambitious tool for agriculture risk management [Fonta et al., 2018].

The following subsections, Section 2.2.1 to Section 2.2.4 introduce index-based insurance, give a particular focus in basis risk and index-based flood insurance for agriculture and review the demand for index-based insurance for agriculture in developing countries.

2.2.1 Introduction to index-based insurance

Index-based insurance originated from the US in 1948 when the first area-yield index insurance approach was developed [Barnett et al., 2005]. Index-based insurance correlates the losses to an index that is triggered when a threshold is exceeded, independently of the actual damages [Carter et al., 2014; Jarzabkowski et al., 2019]. "*Index-based insurance is against events that cause loss, not against the loss itself*" [Hochrainer et al., 2009, p.235].

Index-based insurance was developed to confront the moral hazard, adverse selection, high transaction and loss adjustment costs from traditional indemnity-based insurance [Castellani and Viganò, 2017]. The traditional indemnity-based insurance is not considered to function very efficiently for disasters as it takes time to confirm the claims [Clarke and Dercon, 2016]. Furthermore, there is the risk of moral hazard, such as the possibility of the policyholders' risk-taking behaviour, leading the insurer to increase the number of prerequisites in the insurance contract (ibid.). Some of the benefits of index-based insurance contracts are the reduced moral hazard and adverse selection [Mahul and Signer, 2014], the

fact that an adjuster is not required to go to the location to assess the loss when a disaster occurs [Clarke and Dercon, 2016], the faster payments [Clarke and Dercon, 2016; Mahul and Signer, 2014] and reduced administrative costs [Barnett et al., 2008; Mahul and Signer, 2014]. According to Figure 2.4, which presents an illustrative comparison of the costs between traditional and index-based insurance products, the absence of loss adjustment, moral hazard and adverse selection reduce the total cost of index-based insurance compared to traditional insurance [Burke et al., 2010].

Index-based insurance exists at the individual, institutional, regional or national level [Carter et al., 2014]. There are different types of index-based insurance. For instance, weather index-based insurance relates the index with weather data collected from meteorological stations [Carter et al., 2014]. Some examples of weather indicator insurance are the precipitation level, the temperature, the wind speed, and the vegetation indicators [Castellani and Viganò, 2017]. Satellite information also relates indexes to external parameters [Clement et al., 2018]. Additional types of index-based insurance are related to the average of the area yield or mortality levels of livestock over a pre-determined area usually controlled by remote sensing technologies [Carter et al., 2014].

Index-based instruments are mainly used for agricultural and livestock insurance purposes related to natural hazards and are attractive to developing countries [Clement et al., 2018]. The main advantage of this type of insurance, especially for developing countries, is the substantial reduction in the transaction costs [Hochrainer et al., 2009]. Additionally, the fast payout of weather index crop insurance protects the policyholders from selling valuable assets until the compensation or food aid rises [Fonta et al., 2018]. The major disadvantage of

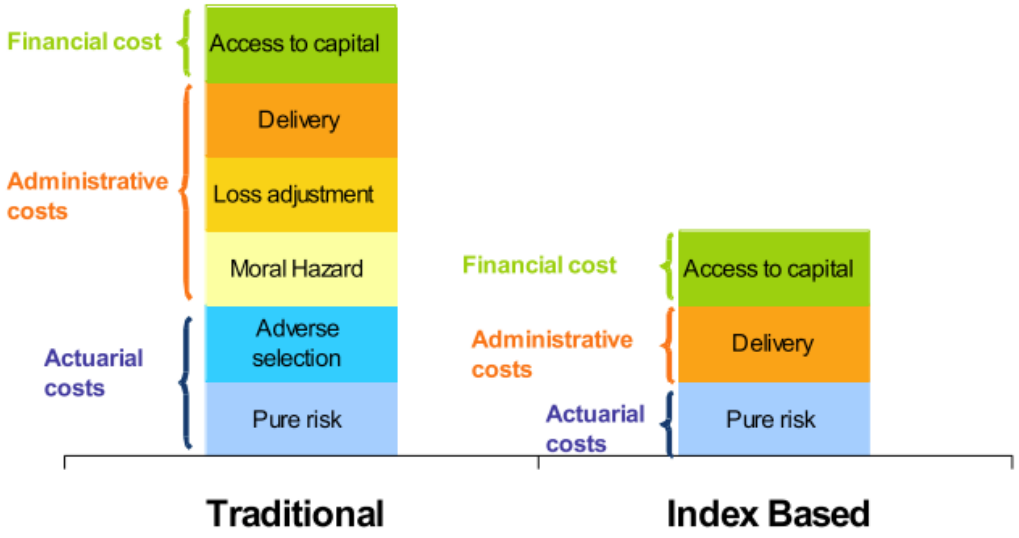


Figure 2.4: Comparison of traditional and index based costs, taken from Burke et al. [2010, p.18]

index-based insurance is basis risk [Hochrainer et al., 2009].

2.2.2 Basis risk

The risk of a significant difference between the index-losses and the actual-damages is called basis risk [Andersen, 2002; Mahul and Signer, 2014]. In other words, basis risk is the imperfect correlation between the trigger values and the actual damages [Hochrainer et al., 2009; Morsink et al., 2016]. The payments can be lower or higher than the losses occurred [Castellani and Viganò, 2017; Morsink et al., 2016]. For instance, a policyholder might not get compensation for the occurred losses if the index did not get triggered [Mahul and Signer, 2014]. However, a policyholder might get compensation without damages having occurred (ibid.).

The first scenario is named downside basis risk and the second upside basis risk [Morsink et al., 2016]. Both situations will negatively affect farmers with low

income in developing countries [Morsink et al., 2016]. Facing downside basis risk, the farmers will end up in a worse situation compared with not having bought insurance in the first place (ibid.). On the other hand, upside basis risk will increase the insurance costs and consequently, the insurance premium without the farmers purchasing further risk protection (ibid.).

As basis risk is related to the uptake of index-insurance [Clement et al., 2018; Jensen et al., 2018; Marr et al., 2016], it might make the product appear unreliable when failing to protect farmers with low earnings [Morsink et al., 2016]. In terms of index-based insurance assessment, "*[...] too little attention has been paid to evaluating and improving index insurance product quality and the underlying market structure.*" [Jensen and Barrett, 2017, p.201]. The scarce assessment of index insurance might affect the reputation of the product and consequently, its reliability and demand [Morsink et al., 2016]. A basis risk reliability assessment based on two indicators for the micro-scale and for low-income farmers is proposed by Morsink et al. [2016]. The first proposed indicator is the probability of catastrophic basis risk, which is the probability that the farmer will not receive payment in case of loss (ibid.). The second indicator is the catastrophic performance ratio, which is the amount that the farmer receives back on average in the case of loss in relation to the premium that the farmer paid (ibid.).

Basis risk is an important topic to be included in future studies to understand its effect on demand for insurance [Cole et al., 2013]. Understanding the relation of downside basis risk and demand might contribute to estimating the sustainability of an index insurance market [Hill et al., 2013]. My study attempts to evaluate farmers' sensitivity towards basis risk and the effect of basis risk on farmers WTP, as explained in Chapter 5. Furthermore, my study incorporates

basis risk in the index-based insurance game, as explained in Chapter 6.

2.2.3 Index-based flood insurance for crops

Lotsch et al. [2010] divide crop insurance into traditional and index-based, each of which consists of two categories (Table 2.5). The majority of index-based insurance is related to weather losses [Jensen and Barrett, 2017]. An index for floods is more complicated to generate (compared to, e.g. rainfall, temperature) as usually one parameter (water level, extent etc.) is not enough to define the event [Lotsch et al., 2010].

Table 2.5: Agricultural insurance products for crops

Traditional	
Damage-based	The compensation an individual farmer receives is according to the occurred damage in the field, having first assessed the damage soon after the loss takes place [Lotsch et al., 2010].
Yield-based	Based on historical data the farmer insures a percentage of the expected yield [Lotsch et al., 2010]. If the insured yield is not reached then the farmer gets compensation for the difference between actual and insured yield (ibid.).
Index	
Area-yield	The payments for the insured farmers are triggered if the whole areas' yield (e.g. district) falls below a predetermined threshold independently of the actual loss of the individual farm [Lotsch et al., 2010]. Historical yield data of the whole area are necessary (ibid.).
Weather-index	The insurance is bought for weather hazards [Lotsch et al., 2010]. One parameter is usually used to create a table, which determines the values under or over which the payments are triggered (ibid.). These values represent the values that losses are expected, which means the index is correlated with the expected losses (ibid.).

Index-based flood insurance for crops adds some further challenges [Lotsch et al., 2010]. For instance, every crop is defined by different growing stages (ibid). The same flood event will not have the same impact on losses at different crop cycle stages (ibid.). Furthermore, not only the growing stages of the crops affect the damages but also the variety of the crops (ibid.). Therefore, having

first identified the flood parameters, flood insurance needs to define the index level that triggers the payouts and the method to measure the index (ibid.).

Despite the challenges, the feasibility for the future development of flood index insurance programmes in micro-scale (i.e. clients are individual farmers) is promising [Lotsch et al., 2010]. For instance, simplified scales of one parameter, binary payouts (all or nothing) etc. could be some options (ibid.). Simultaneously, pilot-testing of agricultural flood insurance is suggested to be combined with other activities and measures for DRR such as planning, structural measures etc. (ibid.).

In South and Southeast Asia, ways to cope with seasonal flooding have been developed, although extreme flood events still threaten people in flood-prone areas, including the farmers and the agricultural production [Lotsch et al., 2010]. Despite the limited flood insurance in developing countries, the demand for efficient flood risk instruments is increasing (ibid.).

2.2.4 Demand for index-based insurance

Despite the ongoing research in developing countries for index-based insurance, there is still no definite conclusion regarding its demand [Castellani and Viganò, 2017]. Additionally, the degree to which index-based insurance might benefit the households in rural areas in developing countries remains unclear [Jensen and Barrett, 2017]. For instance, Norton et al. [2014] conducted experimental games with smallholder farmers in Ethiopia regarding the demand for weather index insurance. The results showed a preference for index insurance as participants chose index-based insurance over some other risk management options provided

to them (e.g. community risk pool) (ibid.). Weather index insurance is addressed in Lin et al. [2015] that focused on factors affecting the farmers' willingness to pay for such insurance products; concluding that farmers in Hainan Province of China have a positive attitude towards weather index insurance for managing their risks. Further evidence can be seen in Guo and Bohara [2015] for Nepal, where households found index-based insurance to be the best tool for protection against weather events.

However, the demand in developing countries is usually low [Jensen and Barrett, 2017]. A global review of the impact of basis risk on demand of index insurance is produced by Clement et al. [2018], explaining that the low demand is due to basis risk and the imperfect correlation to the actual damages and the deviation of the clients' expectations of the payments. Basis risk has a negative relation to demand, driving to the lower purchase of the product [Marr et al., 2016]. Actual demand for index-based insurance ranges between 2 to maximum 50 % with many research studies revealing a less than 25 % take-up (ibid.). Additional studies, for instance, Cole et al. [2013] mention that despite the benefits of rainfall insurance and the fact that the demand is at an increasing rate, the demand remains low. Finally, Binswanger-Mkhize [2012] states that index-based pilot programmes have shown low demand and present a paradox for semi-arid tropics of India; the poor farmers who need and could benefit the most from the insurance cannot afford it, while the wealthier farmers are usually self-insured via informal mechanisms. Therefore, the main problem remains for small and poor farmers (ibid.).

In summary, despite empirical studies showing a preference and a positive attitude of farmers towards index-based insurance, previous studies show that

demand generally remains low. Even though index-based insurance is considered a promising tool, index-based insurance has shown limited uptake [Elabed and Carter, 2015], with open questions regarding the demand of weather index insurance for farmers in developing countries [Norton et al., 2014].

This study brings further empirical evidence on the topic of index-based microinsurance for agriculture. The specific research gaps are summarised and discussed in Section 2.4 having previously introduced why Nepal was a suitable for the topic research area in Section 2.3.

2.3 Why Nepal ?

"*An estimated 31.2 percent of the population live close to the poverty line (earning between US $1.90 a day and US $3.20 a day) and are at high risk of falling into extreme poverty.*" [World Bank, 2020, p.25-26]. Nepal's Human Development Index (HDI) in 2019 was 0.602, which is categorised in the medium human development group [UNDP, 2020]. While India and Bangladesh were also categorised at the medium human development group in the same UNDP [2020] report, India and Bangladesh were ranked higher than Nepal, with the HDI values of India and Bangladesh in the UNDP [2020] reported to be 0.645 and 0.632, respectively.

The following subsections, Section 2.3.1 to Section 2.3.5, introduce disasters and the climate change effect in Nepal, the catchments and floods in Nepal with a focus on the Karnali River, give an introduction to agriculture in Nepal and the existing agricultural insurance scheme in Nepal. The literature review for Nepal in the following sections, shows that Nepal is prone to disasters and climate change (Section 2.3.1), while the literature for the Karnali river basin shows that

the river is frequently flooded (Sections 2.3.2 and 2.3.3). Moreover, the literature for Nepal presents the agricultural dependence (Section 2.3.4) and the existing agricultural insurance scheme in Nepal shedding light on the first results and some of the challenges of the scheme (Section 2.3.5), which presents that there is a space for further research on the topic of agricultural insurance in Nepal, that additionally justifies the selection of the study area.

2.3.1 Disasters and climate change in Nepal

Nepal is prone to a broad range of disasters due to the country's topology, climate and hilly landscape that varies between 59 to 8 848 meters in less than 200 kilometres distance [GoN, Ministry of Home Affairs, 2019]. Additionally, a variety of geological and hydro-meteorological hazards (e.g. landslides, floods etc.) lead to frequent disasters too, while the country is equally prone to earthquakes due to the tectonic activity (ibid.).

In the past thirty years, Nepal has been exposed to different kinds of climate change related risks [Guo and Bohara, 2015], as Nepal is vulnerable to climate change, due to the country's location, the low development and complicated topography [Ghimire et al., 2016a; Joshi et al., 2017]. In combination with climate change and environmental degradation, the disasters' reoccurrence has demonstrated an increasing trend in the country [GoN, Ministry of Home Affairs, 2019]. In particular, Nepal is ranked in the climate risk index among the ten most affected countries over the period 2000–2019 and twelfth for the year 2019 [Eckstein et al., 2021].

In Nepal, 6 381 disasters occurred in 2017 and 2018, see National Emergency

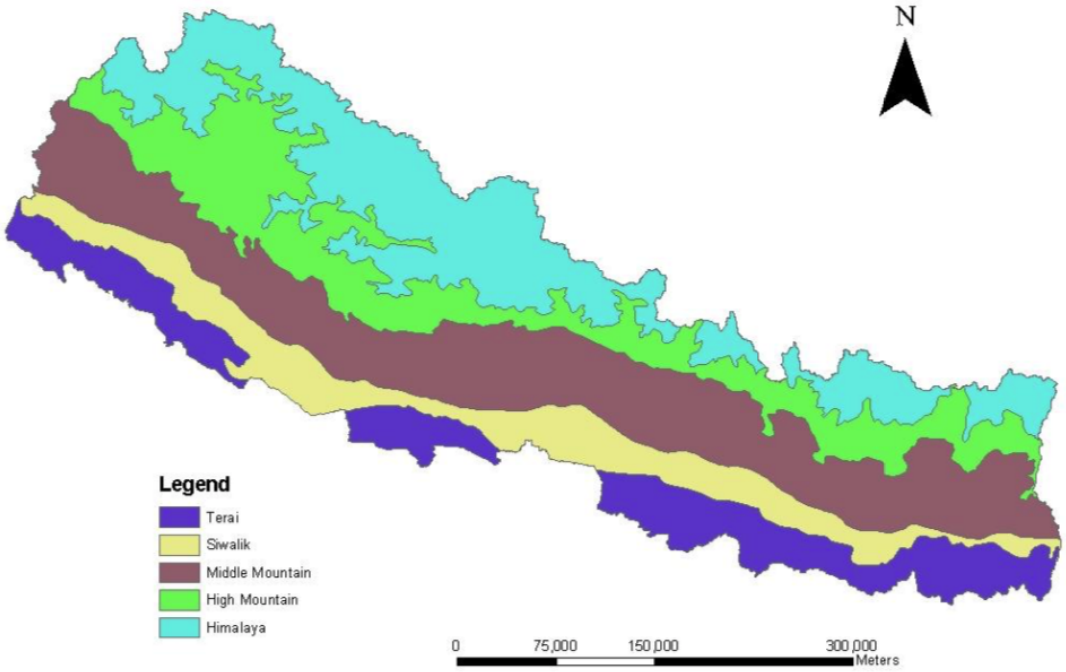
Operations Centre (NEOC) as cited in GoN, Ministry of Home Affairs [2019] for further discussion. In terms of economic loss these disasters totalled 6.84 billion NRP [GoN, Ministry of Home Affairs, 2019]. Other disasters, such as the earthquake of 2015 led to economic loss that amounted to one third of the GDP (ibid.). Additionally, climate change and extreme weather events generate annual losses between $1.5 - 2\%$ of the country's GDP, which is expected to increase to $2 - 3\%$ by 2050 [Chhetri, 2016].

Nepal approved the United Nations Framework Convention on Climate Change (UNFCCC) to take measures for climate change [Maharjan et al., 2011] and has also signed the Paris Climate Agreement[4]. Nepal needs immediate adaptation strategies to cope with climate change [Chhetri, 2016]. The financial resources for that cost must be searched internally and externally in the country (ibid.).

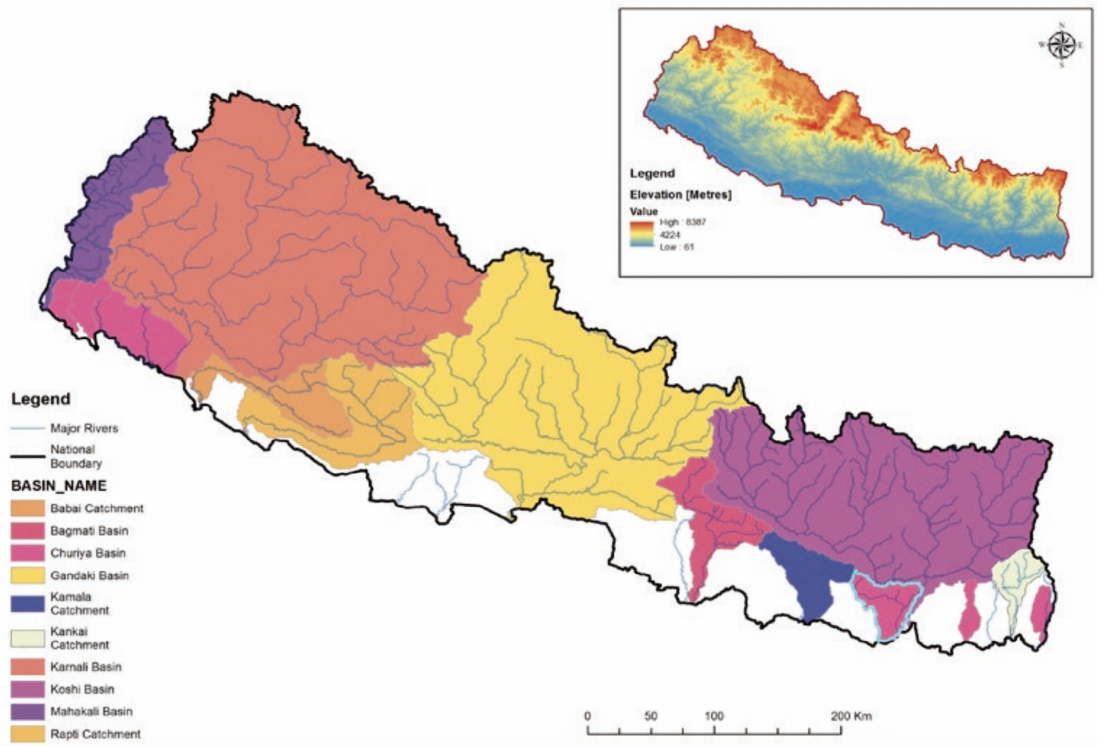
2.3.2 Nepal's rivers: Introducing the Karnali River

Nepal's rivers are categorised into three main types depending on their origins [Bhandari et al., 2018]. The first and second type are perennial rivers with roots in the Himalayas mountains and Nepal's middle mountains, respectively (ibid.). The third type has its origins within the Chure and Siwalik hills, which are the hills located in the south (ibid.). These are relatively small rivers, which flow during the rainy season (June to September) being responsible for flash floods, bringing debris and increasing the river bed (ibid.). In Figure 2.5a, the physiographic regions of Nepal are presented, the lowest of which is named Terai, while the catchments of Nepal's rivers are shown in Figure 2.5b.

[4]Data retrieved from https://www.un.org/sustainabledevelopment/blog/2016/04/parisagreementsingatures/, last accessed April 20, 2021.



(a) Physiographic regions, taken from Yogacharya and Gautam [2008, p.4]



(b) Main river basins, taken from Bhandari et al. [2018, p.5]

Figure 2.5: Physiographic regions and river catchments in Nepal

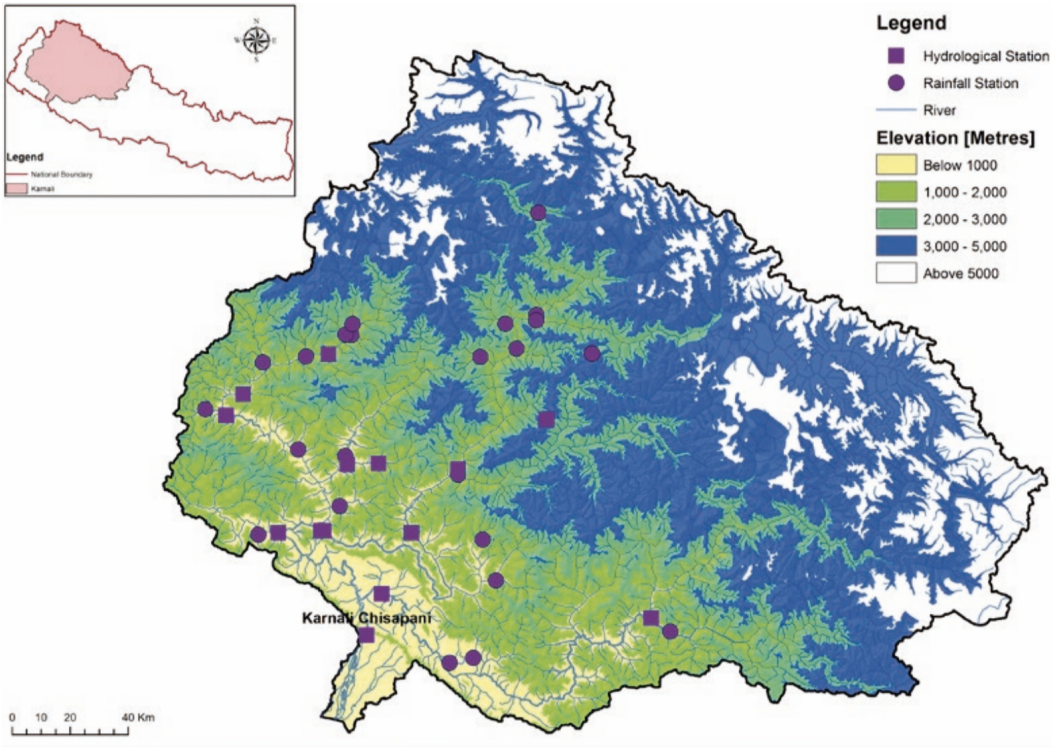


Figure 2.6: Karnali River basin, taken from Bhandari et al. [2018, p.10]

One of the three large river systems in Nepal with numerous branches is the Karnali River [Rai et al., 2020]. The other two rivers are the Kosi and Narayani (ibid.). The Karnali is the longest river in Nepal [Khatiwada et al., 2016]. The basin has a total catchment area of approximately 49 000 km^2 [Bhandari et al., 2018], which is presented in Figure 2.6. The Karnali River is a perennial river flowing also during the dry period [Bhandari et al., 2018]. The Karnali River discharges reach their peaks between June to September, while 80% of the total flow occurs in the monsoon period (ibid.).

Before outflowing to India, the Karnali River flows through a very narrow gorge, named Chisapani, where the river divides into two smaller streams [Bhandari et al., 2018]. The eastern stream is called Geruwa, and the western is called

Karnali [Paudel et al., 2015]. The two rivers meet again downstream in India, creating an inland delta [Bhandari et al., 2018] (Figure 2.7). Chisapani forms the boundary between the upstream mountainous and hilly areas of the catchment, and the downstream floodplain, which is the lower catchment which belongs to the Terai [Smith et al., 2017].

The Karnali River basin contains seven hydrological and 25 rainfall stations which are automated, with a combined one at Chisapani [Smith et al., 2017] (Figure 2.6). Local staff maintain the river gauges in Nepal by recording the water levels of the river.

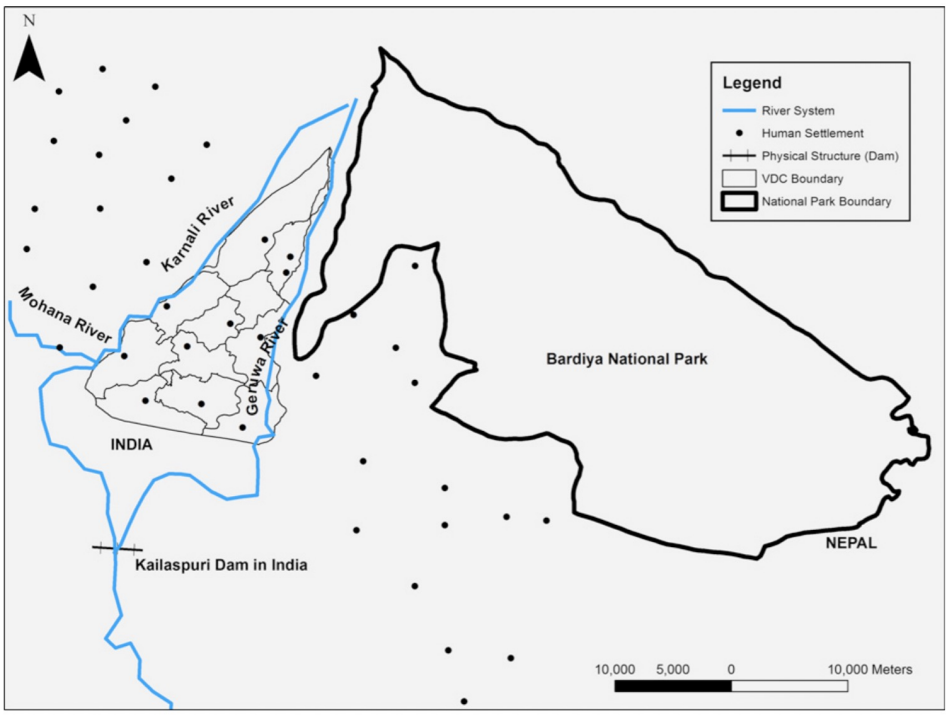


Figure 2.7: Inland delta of Karnali River downstream of Chisapani gorge, taken from Paudel et al. [2015, p.710]

2.3.3 Floods in Nepal: A focus on Karnali

Among other natural hazards, floods affect smallholder farmers' livelihoods in South Asia [Aheeyar et al., 2019]. During the last 40 years, floods were calculated to account for approximately 50% of the total number of disasters (ibid.). Floods, among other hazards in Nepal, threaten the population [Budimir et al., 2020]. Nepal was ranked 30^{th} among 200 countries for its vulnerability to floods [Dangal, 2011].

Floods are classified into three severity categories based on their reoccurrence interval [Yogacharya and Gautam, 2008]. The floods can be large (reoccurrence less than 20 years), very large (reoccurrence interval between 20 and 100 years) and extreme (reoccurrence exceeding the 100 years) (ibid.). The causes of flooding are natural or anthropogenic (ibid.). The natural reasons are climate conditions, topographical, and geological conditions in Nepal's rivers or even seismic activities (ibid.). The anthropogenic causes are activities related to the development and infrastructure of the country (roads, urbanisation, etc.), changes of the population (socio-economic changes), land-use changes, deforestation, or similar causes (ibid.).

The Chisapani station in the Karnali River has a flood forecasting station for the prediction of downstream flooding [Bhandari et al., 2018]. The Chisapani station was integrated as an Early Warning System (EWS) from Practical Action and the Department of Hydrology and Meteorology (DHM) in 2010 [Smith et al., 2017]. Chisapani station gives a warning level at 10 m and a danger level at 10.8 m [Bhandari et al., 2018]. These warning and danger levels are correlated with the river height in the communities downstream [Smith et al., 2017].

The warning level represents the water reaching the riverbanks' maximum height downstream, while the danger level represents the situation when the water overflows the river banks (ibid.). The duration for the floodwater from Chisapani to reach the downstream communities is approximately $2-3$ hours (ibid.).

The communities in the lower parts of the Karnali River basin in Kailali and Bardiya districts, which lie below Chisapani, are exposed to frequent flood events with recent examples being the floods of 2014 and 2017 [Rai et al., 2020]. In the Karnali River's flood history (Figure 2.8), it is observed that until 2014 recent significant flood events took place in the years 2009, 2013 and 2014 with a previous comparable flood event taking place in 1983 [MacClune et al., 2015].

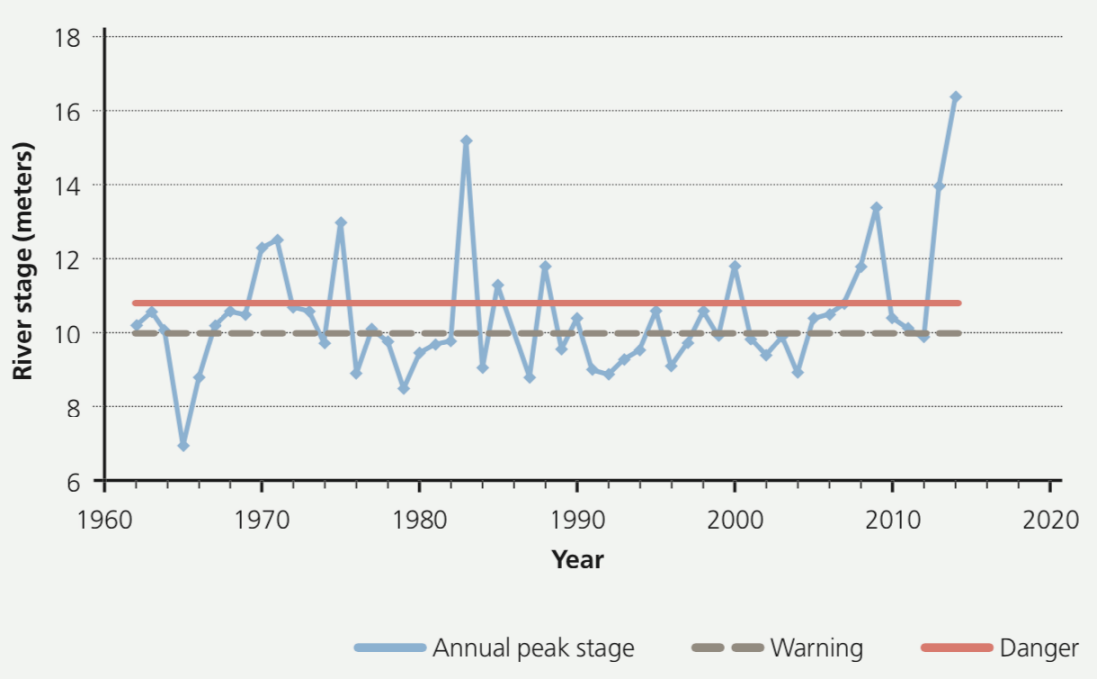


Figure 2.8: Flood history in the Karnali River, taken from MacClune et al. [2015, p.10]

The small rivers originating from the Chure and Siwalik hills are responsible for increasing the height of the river bed [Bhandari et al., 2018]. The Karnali

is a dynamic river, therefore changes in the river bed affect the extent of the floodplain, which on some occasions diverges from the existing flood maps [Sinclair et al., 2017]. The Karnali River, which flows in the western branch, carries around 80% of the flow apart from the monsoon period when it accounts for 50% of the flow (ibid.). There is a substantial seasonal change in the discharge and water level between summer and winter due to the intense rainfall, which can reach from 500 to 10,000 $m^3 s^{-1}$ discharge [Smith et al., 2017].

2.3.4 Agricultural dependence in Nepal

Nepal's economy is based on agriculture as it is the primary source of income for two-thirds of the population [Ghimire, 2014; Ghimire and Kumar, 2014] and approximately one-third of the gross domestic product comes from the agricultural sector [Chhetri, 2016; Joshi et al., 2017], out of which one-third comes from livestock activities [GoN, National Planning Commission, 2017]. The cultivated area reaches 4.2 million hectares, while the lowlands, named Terai, is a more productive location than the hilly areas, named Hill [Ghimire, 2014]. In respect to ownership, approximately 75% own less than 1 hectare of land, while 24% own between 1 to 5 hectares and more than 5 hectares are owned by around 1% (ibid.).

There is a potential market for crop insurance in Nepal as more than 3.7 million households are related to farming or livestock activities and their livelihood depends on agriculture [Ghimire and Kumar, 2014]. Farmers anticipate an insurance product for a long time and progressively raise their financial engagements with cooperatives, NGOs, or other types of micro-finance associations (ibid.).

Climate change has a significant impact on the agriculture related communities in rural regions [Tiwari et al., 2014]. Highly agriculture dependent countries like Nepal will likely have an intense effect on income, assets and activities of households in rural areas (ibid.). As the number of Nepali farmers who are vulnerable to natural hazards risks is increasing, insurance should be considered a solution towards these risks and consequently promoted [Wehrhahn et al., 2019].

2.3.5 Existing crops and livestock insurance scheme in Nepal

Although agricultural insurance is available in more than 100 countries globally, two-thirds of developing countries have not developed such insurance programmes [Ghimire et al., 2016a]. Comparing Nepal to other Asian countries, the insurance penetration and density has the lowest levels [Ghimire and Kumar, 2014]. Specifically, the penetration of Nepal for the year 2009/10 was 1.1 % compared to India and China that was 4.9 and 2.6 %, respectively [Ghimire, 2014; Ghimire and Kumar, 2014]. The insurance density of Nepal, was $7.9 compared to India and China that was $ 52.2 and 93.6, respectively [Ghimire, 2014; Ghimire and Kumar, 2014].

Disasters have always threatened agriculture in Nepal [Ghimire et al., 2016b]. Additionally, given the impacts of climate change, there has been an increasing interest in agricultural insurance in Nepal over the last decade [Ghimire et al., 2016a], with agricultural insurance being one of the country's strategies to confront its agricultural risks [Ghimire et al., 2020a]. Agricultural insurance can potentially increase the productivity, which is decreasing in Nepal, but also re-

duce the climate change impacts [Ghimire, 2014].

Therefore, in 2013 the GoN introduced directives and guidelines for non-life insurance companies to develop appropriate products for crops and livestock [Budhathoki et al., 2019; Ghimire, 2014; Ghimire et al., 2016a,b; Timsina et al., 2018; Wehrhahn et al., 2019], with the goal to make farmers more resilient to disasters, among other agriculture related risks [Wehrhahn et al., 2019]. Seventeen companies have offered agricultural insurance [Ghimire et al., 2016b]. Each company has been committed to three to five districts for the 77 districts of the whole country to be covered [Ghimire et al., 2016a; Timsina et al., 2018]. More than 70 non-life insurance products for crops and livestock had been developed by 2018 [Timsina et al., 2018].

The existing insurance scheme is damaged based, covers all crops and the compensation is based on the production cost and not related to yield estimation [Budhathoki et al., 2019]. The minimum area for a crop to be insured is one anna (approximately 254 square meters) in hilly areas and one kattha (339 square meters) in the Terai [Wehrhahn et al., 2019]. The first results demonstrate that livestock insurance is taken out to a much higher degree than crop insurance [Ghimire et al., 2016b]. The total sum insured shows an increasing rate reaching 22 095 million NPR in 2019, out of which 95% is bought for livestock and only 5% for crop insurance [MEFIN, 2020], as presented in Figure 2.9.

In Nepal, agricultural insurance is considered as a social and not commercial business [Ghimire and Kumar, 2014], promoted among poor farmers [Wehrhahn et al., 2019]. The existing insurance scheme being promoted was subsidised at 50% at the beginning of 2013 [Ghimire et al., 2016a]. To increase the participants, the subsidy was increased to 75% in the fiscal year 2014-2015 (ibid.). The

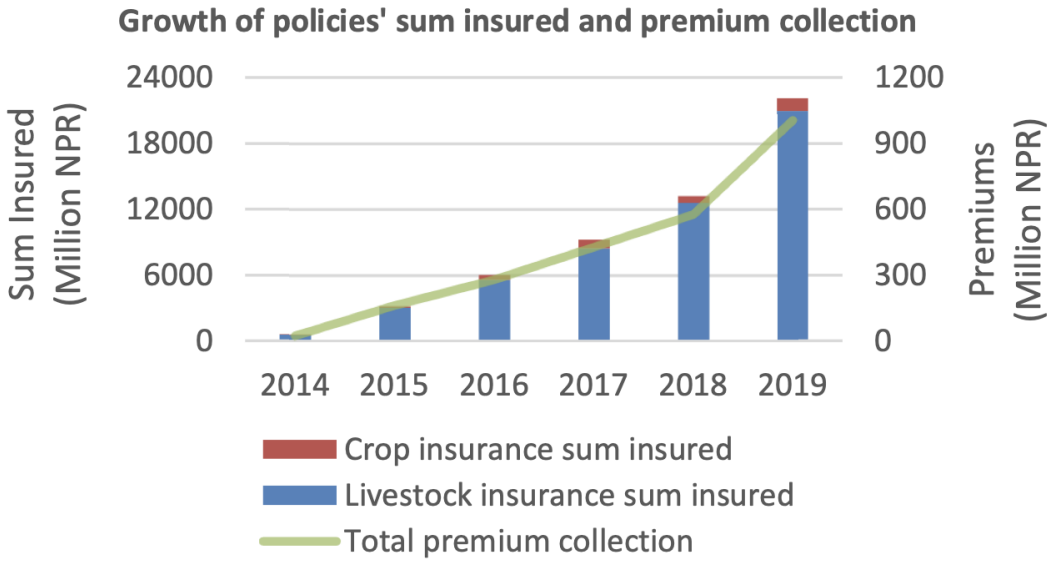


Figure 2.9: Crop and livestock insured insurance, taken from MEFIN [2020, p.2]

farmer pays 25% of the premium, and 75% is funded by the government to the insurance company [Wehrhahn et al., 2019]. At the beginning of the programme, a substantial number of farmers needed to be motivated to take part, which can be achieved mainly by subsidising the insurance premium [Ghimire and Kumar, 2014]. The subsidies alone are a useful tool to increase the number of policyholders only when they are in a substantial percentage [Jensen and Barrett, 2017]. However, the GoN is unlikely to be able to continue providing this high subsidy [Budhathoki et al., 2019].

Some of the main challenges of micro-insurance programs are the limited experience with agricultural insurance, while a substantial number of farmers have a low level of education and income less than 1$ per day [Ghimire and Kumar, 2014]. The challenges are categorised in institutional (e.g. not framed regulations, lack of insurance experts etc.), local (e.g. increased administrative costs due to remote areas etc.) and operational level (e.g. farmers inexperience of operation

and advantage of being insured etc.) [Ghimire, 2014; Ghimire and Kumar, 2014].

Although the insurance industry is expanding rapidly in Nepal, it is still not wholly developed [Wehrhahn et al., 2019]. For non-life insurance, for instance, the inadequate know-how for the underwriting of the claims is often a problem for the insurers (ibid.). From the farmers' point of view, the first results show that farmers are unsatisfied with the compensation, which is based on the investment cost and not on the cost of the expected production as the farmers would prefer (ibid.). Additionally, there are cases where farmers might not be willing to purchase insurance because if a hazardous event does not occur, they do not get back their premium or farmers found the current premium to be expensive [Ghimire et al., 2016a]. However, Budhathoki et al. [2019] found that the price is probably not the reason for the low take-up of paddy rice and wheat.

As the literature review in Section 2.3 presented, Nepal is a low income country that is prone to disaster and climate change losses, which will likely affect the population related to agricultural activities. The country showed an interest in agricultural insurance introducing the current crop and livestock agricultural insurance scheme in 2013. However, recent studies (i.e MEFIN [2020]) show that crop insurance uptake remains low. Therefore, the following Section 2.4 sheds light on the research gaps of the general literature on index-based microinsurance and that of agricultural insurance specifically in Nepal to demonstrate the contributions of this study and connect them with the empirical chapters.

2.4 Research Gaps

Despite the increasing number of studies during the past years, further empirical research is needed to understand index-based insurance and the extent to which index-based insurance is beneficial for smallholder farmers [Marr et al., 2016]. The difference between the high expectations for index-based insurance products for smallholders and the low uptake demonstrates a clear research gap to understand further this type of insurance [Burke et al., 2010].

The first results for the existing agricultural insurance in Nepal are positive [Wehrhahn et al., 2019]; however, with a varying level of success for livestock and crop insurance. While livestock insurance seems more attractive to farmers, the uptake of crop insurance is minimal [Wehrhahn et al., 2019]. Therefore, Nepal's government is interested in increasing the uptake of crop insurance [Timsina et al., 2018].

Research has proposed that insurance should be promoted to reduce the risks of natural hazards that are currently faced by the Nepali farmers and those that they are likely to face in the future (e.g. Wehrhahn et al. [2019]). Specifically in Nepal, "*Agriculture insurance should evolve from a pure indemnity product involving farm-level loss assessment to an index-based product.*" [Wehrhahn et al., 2019, p.55]. Moreover, it is suggested to pilot[5] "*[...] selected DRF instruments and agriculture insurance products that can be readily demonstrated and scaled up, e.g., parametric insurance.*" [Wehrhahn et al., 2019, p.21].

In this context, Nepal's government explores whether index-based insurance would be more beneficial than the existing multi-peril insurance [Ghimire et al.,

[5]Parametric insurance is a synonym for index-based insurance.

2020b]. Similarly, it is being suggested to pilot weather index insurance products for specific crops and locations in Nepal (ibid.). Additionally, one of the activities for piloting weather index-based insurance, which is recommended, is to assess farmers' willingness to participate in weather index insurance [Ghimire et al., 2016c].

Summarising the research gaps, the general literature highlights the need for further research on the topic of index-based microinsurance, while the studies related to Nepal promote the piloting of index-based insurance products in the country. Therefore, this study deals with the topic of demand for hypothetical index-based microinsurance taking as case study a rural flood prone area in Nepal, with the goal to create new empirical knowledge in the field of index-based agricultural insurance. This study will approach the topic through answering to the main research question:

Which are the factors affecting the demand for potential IBFI in the study area?

in Chapter 7, where the findings of the empirical Chapters 4 to 6 are merged.

Further relevant prior research on farmers' risk preferences (Chapter 4), the factors affecting the willingness to pay for insurance in developing countries (Chapter 5) and insurance simulation games (Chapter 6) are briefly discussed in the subsequent empirical chapter, and/or a brief introduction to the specific literature of the above-mentioned topics that shape the research sub-questions is also presented in the following Sections 2.4.1 to 2.4.3.

2.4.1 Literature review on risk aversion

Prior research argues that understanding the risk behaviour of farmers in rural areas in developing countries contributes to the design and adoption of the right policies, programmes and strategies to support farmers to face risks and to adapt to climate change. In recent years, there has been a growing interest of research on extracting risk attitudes in developed and developing countries, with an increasing body of literature focusing on how smallholder farmers' decisions in rural areas in developing countries are influenced by the challenges they deal with.

Empirical studies such as Dave et al. [2010]; Yesuf and Bluffstone [2007] and Ihli et al. [2016] seek to determine the degree of risk aversion in rural agricultural areas in developing countries. A recent innovation by Ihli et al. [2016] employs multiple methods to extract risk preferences in a developing country. Similar work by Dave et al. [2010] has addressed the developed countries context. Chapter 4 contributes to the literature by estimating the risk aversion of the participants of this empirical research study, based on two commonly used separately methods, the Ordered Lottery Selection (OLS) by Binswanger [1980] and the modified Multiple Price List (mMPL) based on Holt and Laury [2002] as modified by Brick et al. [2012] (explanation follows in Chapter 4), with the purpose to compare them and answer to the research sub-question 1:

Is the degree of farmers' risk aversion in the study area the same when employing and comparing the two risk aversion methods employed in this study?

2.4.2 Literature review on WTP

Despite the ongoing research on index-based insurance and studies showing a preference for index-based insurance, among other options, a significant number of studies reveal that the uptake remains low. For example, Norton et al. [2014] and Guo and Bohara [2015] demonstrate that index insurance should dominate other alternative risk management products. However, Cole et al. [2013] finds that the uptake remains low. Furthermore, a review of Marr et al. [2016] reveals that even though stated WTP studies have shown high levels of demand for index-based insurance, actual demand studies have lower percentages.

Despite the fact that they do not represent real situations, stated willingness to pay (WTP) studies are a useful tool to provide valuable information, especially when a particular product market does not yet exist [Hill et al., 2013]. A considerable number of empirical studies assess the farmers' WTP for crop insurance by employing stated preferences methods. For instance, List et al. [2019] examined the role of index-based insurance for floods among other mitigation preferences to assess farmers' WTP in Amazonia; Hill et al. [2013] used WTP to estimate which farmers would be early adopters of weather index-based insurance products in rural Ethiopia; Afroz et al. [2017] used a logistic regression model to examine the factors affecting farmers WTP for crop insurance for flood risk in Malaysia.

Chapter 5 examines the factors affecting the farmers' WTP for IBFI to answer the research sub-question 2:

Which are the factors affecting farmers' WTP for hypothetical IBFI for crops in the study area that can be identified by a quantitative survey?

2.4.3 Literature review on games

Simulations, games and other instructional methods consist of rules and players, and imitate a real-life activity or event [Rusca et al., 2012], while changing the traditional way of "learning by listening" to "learning by doing" [see Garris et al., 2002, p.441]. However, what every player learns from the game is related to the player's personality and the environment in which the game took place [Wagner and Wernbacher, 2013]. Games usually have a reduced complexity; therefore, their development does not demand a high level of accuracy [Wagner and Wernbacher, 2013]. A game cannot include all the complexities of the real world; therefore, some components of reality might be highlighted, and some others might be omitted [De Suarez et al., 2012].

Games can be found in various disciplines. For instance, in the water sector, Craven et al. [2017] developed a computer simulation game to communicate the complex relationships in river basins by enabling communication between policy-makers and scientists in the context of the Magdalena-Cauca basin in Columbia. Games can be used for different types of activities and take various forms. For instance, Mochizuki [2016] reviews games' applications in humanitarian operations and DRM and argues that games can be potentially used for experimental observations, decision-making and other aspects of social interactions, while games, among other concepts, can take the form of policy exercises, role-playing and simulations games. Finally, games can reach various audiences from stakeholders to vulnerable groups (e.g. communities exposed to hazards) as revealed by the review of games for DRM by Solinska-Nowak et al. [2018]. For instance, a serious game presented by Delima et al. [2021] was used as a tool among different DRR

actors for disaster governance to co-create knowledge.

There has been a growing body of literature where games have been developed for index-based insurance. For instance, Carter et al. [2008] developed games to explain crop yield index-based insurance to farmers; Pablo Suarez and Anthony Patt, unpublished research for WRMF, as cited in Hazell et al. [2010], used role-playing games to understand farmers' demand for index insurance in Ethiopia and Malawi; McPeak et al. [2010] explained index-based livestock insurance to pastoralists in northern Kenya through an experimental game; Norton et al. [2014] used experimental games in Ethiopia where one of the risk management options offered was index-based insurance; [Patt et al., 2009] researched the role of field games in establishing and creating a trust for the insurance product for the participating organisations and trust in farmers' own decisions.

A limited number of games include basis risk, especially in a developing country context. For instance, Helgeson [2015] developed a complex dice game for basis risk to explore farmers' attitudes and responses towards basis risk in Uganda. Therefore, my game adds to the literature by being one of the first games which incorporates basis risk in the game structure and analyses the effect of basis risk in demand of the game quantitatively and qualitatively. Chapter 6 analyses the qualitative components of the research with the purpose to understand the demand for IBFI by answering to the research sub-question 3:

Which are the factors affecting the demand for potential IBFI for crops in the study area that can be identified by qualitative approaches and an index-based insurance game?

2.5 Chapter Summary

The literature indicates that disastrous events are likely to be more frequent and intense in the future due to climate change. The consequences of disasters in developing countries and on the most vulnerable people will probably be adverse [Hochrainer-Stigler et al., 2014; Mechler et al., 2010].

Insurance and risk transfer mechanisms are promoted as one of the adaptation strategies for DRR, and their importance towards CCA has been highlighted throughout the literature review. Index-based insurance is one of the most prominent innovative insurance products in microfinance. Despite the increasing research into index-based insurance in developing countries, there are still calls for further empirical research as the benefits of index-based insurance to smallholder farmers remain unclear [Marr et al., 2016]. Index-based insurance has shown a low uptake [Elabed and Carter, 2015], with open questions regarding its demand [Castellani and Viganò, 2017]. Recent literature (e.g. Aheeyar et al. [2019]; Budhathoki et al. [2019]; List et al. [2019] demonstrates the ongoing research on the topic of index-based insurance for farmers in developing countries.

A substantial number of the Nepali population is involved in agriculture-related activities [Joshi et al., 2017]. The first results of the existing agricultural insurance scheme in Nepal show a low uptake in crop-related insurance [Wehrhahn et al., 2019]. Therefore, previous research suggested to pilot index-based insurance in specific crops and locations of the country [Ghimire et al., 2020b]. Furthermore, Ghimire et al. [2016c] argue that farmers' willingness to participate in weather index-insurance in Nepal should be assessed. However, previous research on farmer's willingness to pay for index-based insurance for smallholder farmers

in Nepal is limited. Therefore, it is clear that there is a need to understand further the demand for index-based insurance.

To address this gap, this study brings empirical evidence on farmers' demand for hypothetical index-based flood insurance from the lowlands of the Karnali River basin, which is highly flood-prone. A quantitative-qualitative mixed-methods approach was employed combined with a serious game, which is analysed in the following chapter.

Chapter 3

Research framework

This chapter presents the overall methodological framework used to explore the thesis objectives. Section 3.1 presents the selection of mixed-methods approach and Section 3.2 presents the research in practice; including the research partners, the gatekeepers and the selection of research assistants and enumerators and the sampling. The study consists of a scoping trip followed by one main data collection period. Section 3.3 presents an overview of the scoping trip and the study area identification process. Section 3.4 includes the preparation for the main fieldwork activities before reaching Nepal. Section 3.5 gives an overview of main fieldwork and its data collection activities. Section 3.6 presents the research instruments for data collection and the collected data. Section 3.7 presents the research methods followed in the empirical chapters, Section 3.8 the participants' consent and my positionality, while Section 3.9 presents some of the challenges that arose during data collection. The chapter concludes with a chapter summary in Section 3.10.

3.1 Selection of Mixed-Methods Approach

This study employed a mixed-methods approach (i.e. quantitative-qualitative). More specifically, a sequential mixed methods design consisting of two phases was employed. According to Saunders et al. [2016, p.171], "*Sequential mixed methods research involves more than one phase of data collection and analysis*". This approach is schematically presented in Figure 3.1. Phase 1 consists of the scoping trip in April 2019. Phase 2 is divided into 2a and 2b and consists of the primary data collection fieldwork, which took place from mid-October 2019 to early December 2019.

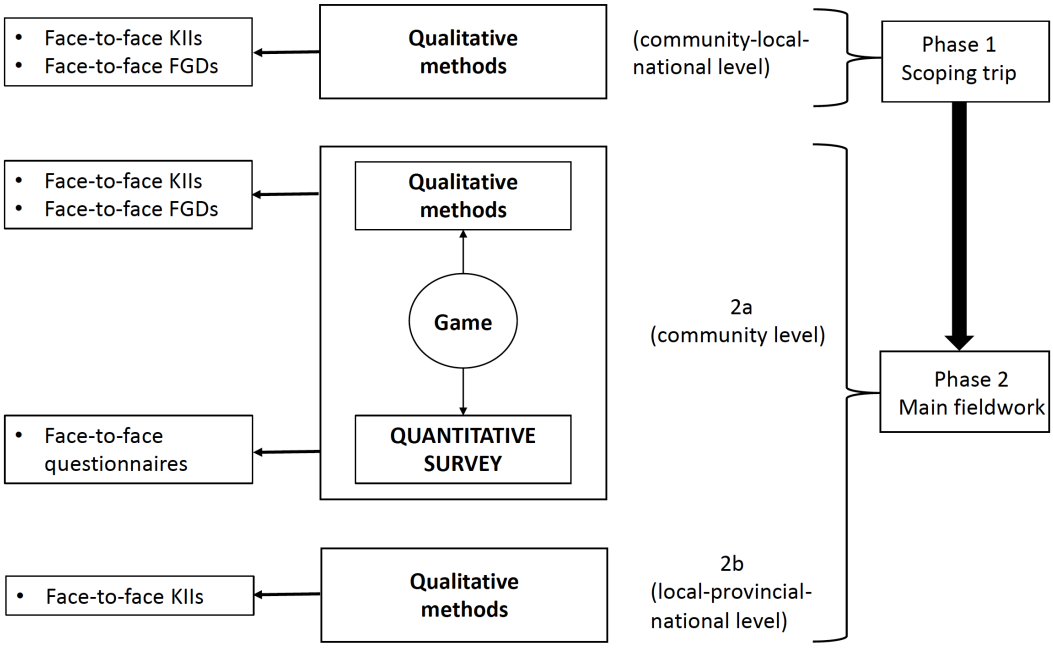


Figure 3.1: Mixed-methods approach

Phase 1: The scoping trip took place over ten days in April 2019 and was spent between the study area and the national level. The scoping trip's goal was to provide a contextual understanding of the study area and establish initial contacts

to facilitate the main fieldwork. Data collection activities during the scoping trip were based on face-to-face qualitative methods, which included exploratory discussions at the community, local and national level, through Focus Group Discussions (FGDs) or Key Informant Interviews (KIIs) (explanation follows in Section 3.3.1). Furthermore, the scoping trip aimed to prepare the ground for and inform the second phase, the main fieldwork.

Phase 2: The second fieldtrip was the main fieldwork, which lasted approximately eight weeks. Collecting data from the community[1] and local level lasted approximately seven weeks. The last period of the fieldtrip was spent between the provincial and national level and lasted nearly one week.

2a: In a mixed methods approach, one of the methods might be enclosed within the other using one tool for data collection (e.g. using a structured questionnaire that involves open-ended questions), this is called a concurrent embedded design [Saunders et al., 2016]. "*Alternatively, a single-phase research design may use both quantitative and qualitative methods concurrently but collect these separately, one of which will be used to support the other*"[Saunders et al., 2016, p.172]. This study employed an embedded mixed-methods approach for the data collection at the community level, where the collection of data was done concurrently but collecting them using separate tools.

The quantitative survey included an extensive face-to-face questionnaire survey with local communities, which was a primary source of data for this thesis's findings. The qualitative components of the mixed-methods approach consist of

[1]In the remainder of this thesis, the definition of *community* is used according to Victoria [2003, p.271] "*A community is a group of individuals and households living in the same location and having the same hazard exposure, who can share the same objectives and goals in disaster risk reduction.*"

FGDs and KIIs at the community level. During the scoping trip, I found it challenging to communicate IBFI to research participants. It was clear to me that there is a need for developing research instruments appropriate for the local context and aims of the study. Therefore, a game was created after the scoping trip, which was used during the main data collection at the community level as a tool to introduce IBFI to farmers. The game had multiple purposes in quantitative survey and qualitative method approaches, explained in Section 3.4.

When using mixed methods, the weight might be unequally shared by one method playing the leading role and the other the supplementary role [Saunders et al., 2016]. The dominant part of the main data collection phase was a large quantitative survey, which presented a core data set for this research. In contrast, the qualitative data collection was used to obtain further in-depth information and complement the quantitative study with contextual understanding and in-depth explanations.

2b: The qualitative components of the research additionally consisted of face-to-face KIIs in the local, provincial and national level (Phase 2b in Figure 3.1). The provincial and national level interviews took place after completing the study area's data collection. In contrast, the local level interviews were conducted during the same period as the community level data collection.

In this thesis, the quantitative data are analysed in Chapters 4 and 5, while the data collected during the game sessions and qualitative methods are analysed in Chapter 6, as presented in Figure 3.2.

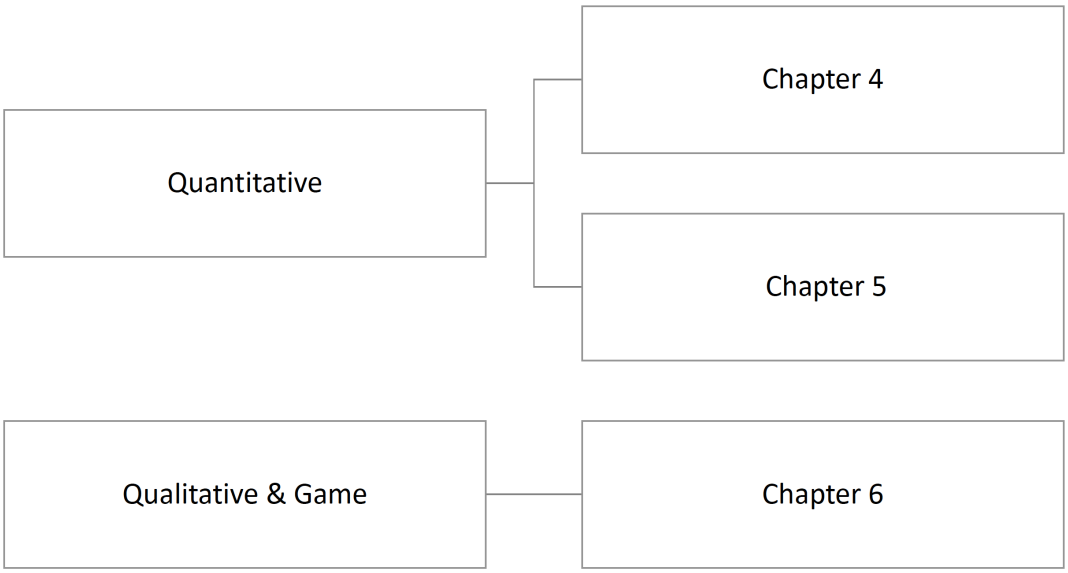


Figure 3.2: Framework of data analysis

3.2 Research in Practice and Sampling Methods

The following subsections Section 3.2.1 to Section 3.2.3 introduce the research partners, the administrative structure in Nepal, the gatekeepers, the selection of research assistants, enumerators and the sampling methods.

3.2.1 Research partners

This research study was conducted in partnership with Practical Action, an INGO with a local presence in the study area. Practical Action in the United Kingdom and Practical Action in Nepal and their local partner, the Centre for Social Development and Research (CSDR), were essential partners in facilitating the research "in" and "outside" the fieldwork sites. In the remainder of the thesis, Practical Action's local partner stands for CSDR.

Practical Action UK, Practical Action Nepal and Practical Action's local part-

ner supported the research team and me at all fieldwork stages, from preparation to data collection. Without them, the research would have been challenging. The fieldtrips and activities were organised to a high degree before reaching the fieldwork sites through ongoing online calls and meetings with Practical Action before I flew to Nepal. Practical Action and their local partner guided the decision making before the fieldtrip and in the fieldwork sites when I needed guidance. For instance, after the scoping trip when I identified the municipality where the research would take place, Practical Action and Practical Action's local partner indicated some of the most highly exposed communities for the study (detailed explanation follows in Sections 3.3.1 and 3.5).

Most of the study area communities from which the data are collected are part of the Zurich Flood Resilience Alliance project. The project is a partnership of various sectors such as humanitarian, NGO, research and private sector, focusing on supporting communities to increase their resilience to flood risk[2]. The project was launched in 2013, extended in 2018 for five years and in 2020 for four years. Practical Action is one of the partners implementing the project in the area.

3.2.2 Background information of administrative structure in Nepal, gate keepers, selection of research assistants and enumerators

The Federal Government of Nepal was established in 2015 by Nepal's Constitution to create strong local governments [Acharya, 2018; Adhikari et al., 2017]. The Federal Government of Nepal consists of seven provincial and 753 local govern-

[2]Data retrieved from https://floodresilience.net/zurich-flood-resilience-alliance/ last accessed March 10, 2021.

ments [Acharya, 2018]. The seven provinces consist of 77 districts, which function as coordination committees located above the local governments (ibid.), as presented schematically in Figure 3.3. The local governments are either municipal (293) or village (460) governments, named urban or rural municipalities, respectively [Acharya, 2018; Adhikari et al., 2017; Chaudhary, 2019]. There are three types of urban governments: the metropolitan cities (6), the sub-metropolitan cities (11) and the municipalities (276) [Chaudhary, 2019]. Local governments consist of wards that are physically the closest to the citizens [Acharya, 2018].

The gatekeepers support the research process by providing entry to the participants [Clark, 2011]. Supporting the research process might take the role of allowing researchers to enter a specific environment or even provide means to gain access in terms of supporting the research project (ibid.). Not only they solve the problem of gaining access to contact the respondents but additionally to acquire more efficient and productive research (ibid.).

The role of Practical Action and Practical Action's local partner as gatekeepers was priceless and instrumental in facilitating access in the fieldwork sites by reaching out and establishing contact with local stakeholders and communities. For instance, during the scoping trip and the main fieldwork, I was introduced by Practical Action Nepal to the local authorities and the purpose of the research was briefly explained. Practical Action and Practical Action's local partner are implementing the Zurich Flood Resilience Alliance in most of the visited communities, indicating an ongoing relationship and trust between Practical Action-Practical Action's local partner and these communities, which facilitated my study. For instance, Practical Action's local partner was communicating with groups of farmers about participating in the game session, usually the day be-

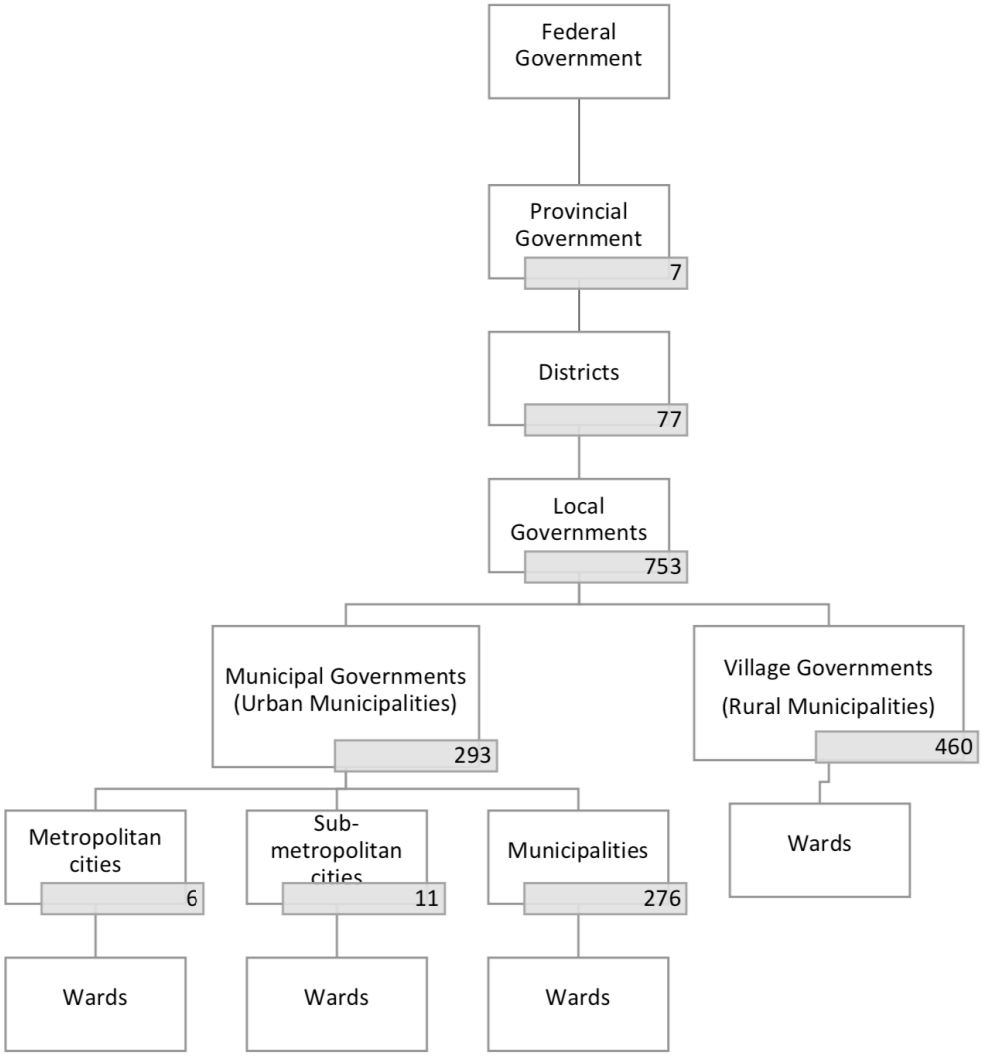


Figure 3.3: Administrative structure in Nepal, summarised as a flowchart from the following sources Acharya [2018]; Adhikari et al. [2017]; Chaudhary [2019]

fore, and the location and time for conducting the game were arranged. At times, the senior research assistant and I were accompanied by a member of Practical Action's local partner to the game sessions.

One senior and one junior research assistant were employed during the main fieldwork. The senior research assistant had extensive research and fieldwork ex-

perience. Additionally, the senior research assistant had experience with Durham University's regulations and previous collaboration with Durham University's researchers, who also conducted fieldwork in Nepal. Therefore, the assistant was highly recommended, and indeed, his reflections on the interviews, questionnaires, games and assistance during all stages of the fieldwork were very useful. The junior research assistant, a graduate with studies in the field of DRR, was recommended by Practical Action Nepal. The junior research assistant accompanied me during part of the scoping trip and he also provided support during the main fieldwork trip.

The enumerators for the data collection were selected following the advice of local partners. Six enumerators (four women and two men) were employed for the whole community level data collection period of the main fieldwork. Most of the enumerators had previous experience with conducting surveys, and some of them were familar with the villages where the research was conducted, hence they were aware of the local customs.

3.2.3 Sampling

The research employed two sampling methods; purposive and snowball.

Purposive sampling includes the selection of the participants purposefully [Oakshott, 2016], which means participants who could give information related to the research aim and objectives [Saunders et al., 2016]. The research took place at some of the most flood exposed communities of the two municipalities, residents of which are mainly farmers. To start an interview for quantitative survey questionnaire, the five following criteria had to be fulfilled:

- **Head of the household:** The quantitative interview would be conducted with the head of household who makes the financial decisions. If the head was not available, the interview would be conducted with a family member who knew about the financial decisions. The reason was that the research question was the willingness to pay for index-based flood insurance.

- **Farming experience:** Due to the research focus on crop insurance, the participant was asked if they had experience with farming for more than five years for the interview to start.

- **Experience with flooding and experience with agricultural losses.**

- **Living in the area for a minimum of five years**. To ensure that the participants have knowledge and experience with flood events and agricultural losses in the area.

- **Age about 25 years old or older:** To ensure that the participants is active on the household's financial decision-making and simultaneously support the criteria mentioned above (farming experience, experienced flooding, agricultural losses etc.).

The second method used during data collection was snowballing. In the snowballing method, the researcher asked the participants or initial contacts, who were initially chosen from another sampling method [Oakshott, 2016], to name new participants who might have valuable information on the research topic [Oakshott, 2016; Saunders et al., 2016]. For instance, at the community level, an additional effort to increase the number of farmers who had bought the existing agricultural insurance in quantitative and qualitative methods was made. A va-

riety of ways was employed to identify and approach some of those farmers. For instance, during the purposive sampling with Key Informants (KIs) from insurance local officers, some of the farmers who had bought agricultural insurance in the wards that the research was taking place were recommended. Apart from the local insurance offices, the snowballing method was adopted during interviews with experienced agricultural insurance KIs. In some cases, the KIs who had bought insurance could give contacts and recommendations regarding possible participants experienced with agricultural insurance farmers.

3.3 Study Area

The research was conducted in the Karnali River basin's lowlands in the Terai plains.[3] The following subsections, Section 3.3.1 to Section 3.3.2, provide an overview of the scoping trip and the study area identification process.

3.3.1 Overview of the scoping trip

The scoping trip took place in April 2019. The scoping trip was crucial to choosing the study area, preparing for the main fieldwork, and establishing contacts at the local and national level.

Three municipalities were visited during the scoping trip in the lower Karnali River basin downstream of the Chisapani gorge, profoundly affected by reoccurring floods. During the scoping trip, FGDs took place with farmers, and KIIs took place with local government officials. After interacting with local stakeholders in-

[3]As this study does not represent all agricultural zones or inundation types of the country, the data collected are not representative of Nepal or other developing-countries context.

cluding local government officials and gaining information regarding the existing crop and livestock insurance scheme, the main fieldwork's specific study area was chosen. The process for selecting the study area is presented in Section 3.3.2.

Additionally, the scoping trip contributed to the development of the questionnaires for the main data collection. For instance, during the scoping trip, information regarding the existence of the local financial schemes (or saving groups) was obtained from FGDs with the farmers, e.g. CDMC[4]. Hence, questions regarding the participation in local schemes were incorporated in the questionnaires for the main data collection (e.g. how many groups the farmer participates in, if the farmer participates in the CDMC).

The scoping trip also contributed to the modification of the research methods for the main data collection. Having interacted with farmers, I found it challenging to communicate and start discussions regarding agricultural insurance in general and IBFI. As a result, having summarised the research conducted during the scoping trip, a game was developed, as has already been mentioned. Also, simplified colourful water level tables were created to explain IBFI during the quantitative or qualitative interviews with the farmers (see section Section 3.9).

The fieldtrip was completed by establishing and gaining information from the national level regarding the agricultural insurance scheme (information regarding the conducted interviews is presented in Section 3.6.2). At the national level, KIIs took place with government officials (e.g. Ministry of Finance), INGOs, multilateral and bilateral organisations.

[4]One task of the Community Disaster Management Committee (CDMC) is fundraising for DRM by K. Shrestha from 2020 found at https://floodresilience.net/blogs/bangaun-community-sets-a-good-example-in-managing-mixed-vulnerability, last accessed 5 January 2021.

3.3.2 Study area identification process

Before flying to Nepal for the scoping trip, communication with Practical Action UK and Practical Action Nepal led to the research focus on the lower Karnali River in Nepal. Upon arriving in Nepal, a team from Practical Action Nepal accompanied me to the lower Karnali River basin. The three visited municipalities were the municipality of Tikapur in province Sudurpashchim (Prov. 7) in district Kailali, the municipality of Rajapur and the rural municipality of Geruwa, both in Province Lumbini (Prov. 5) in Bardiya district. The visited municipalities are presented in Figure 3.4.

Experience with agricultural insurance was a key parameter to choose the study area in addition to the problematic natural hazard portofolio. It was crucial to include data of experienced farmers in the research. The municipality of Tikapur was selected to be the primary selected case study area as it had the highest number of farmers with experience of agricultural insurance (crop and livestock) in comparison to the other municipalities, according to information gained during the scoping trip from local stakeholders. However, during the main fieldtrip, the research was extended to the municipality of Rajapur, for two reasons. First, the identification of experienced farmers was too challenging and a sufficient number were not recruited for interview. Secondly, the time and resources to extend the research were available. This functioned as an additional benefit for the study by extending the geographic coverage of the research. Schematically, the process for identifying the specific study area is presented in Figure 3.5.

The population of Tikapur reached 56 983 people and 11 639 Households [Census, 2011]. Tikapur is one of the municipalities of Kailali District located in its

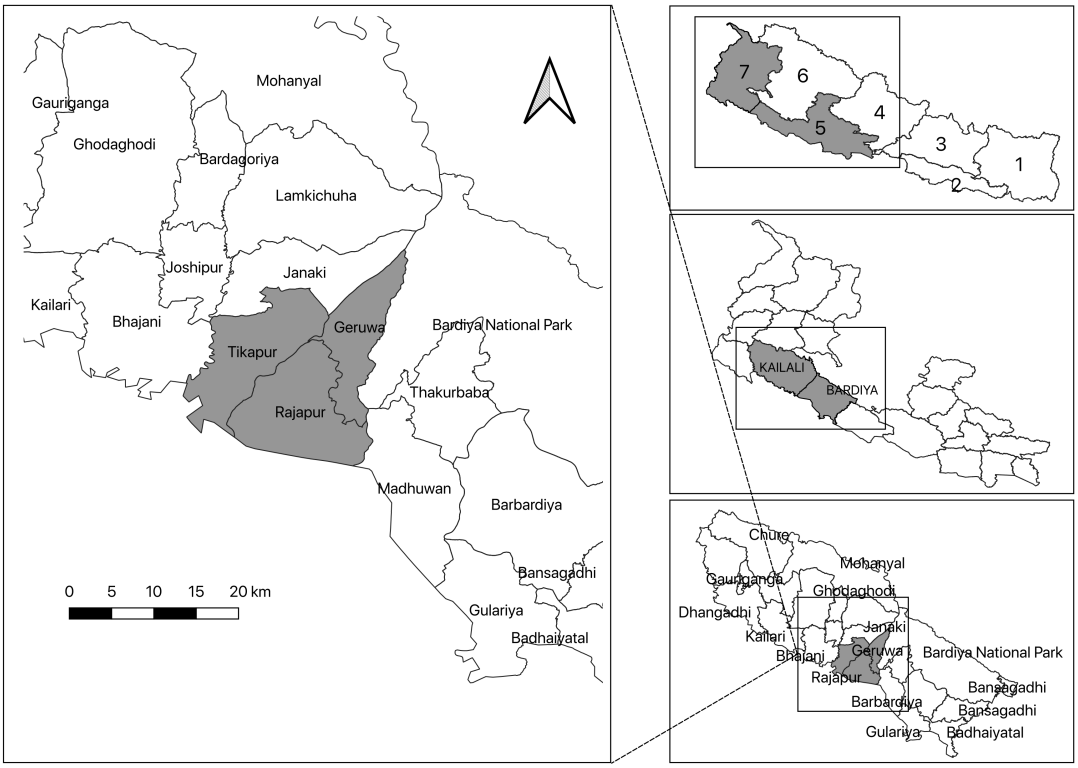


Figure 3.4: Visited municipalities during scoping trip, source for GIS data retrieved from Government of Nepal, Ministry of Land Management, Cooperatives and Poverty Alleviation, Survey Department, see link for information at http://dos.gov.np/nepal-map last accessed December 30, 2020

southeastern part. Located in the western part of Nepal, province Sudurpashchim (Province 7) consists of nine districts[5] and Kailali district is one of them (Figure 3.6).

The population of Rajapur is 59 559[6]. Rajapur is one of the municipalities of Bardiya, located opposite the municipality of Tikapur. Bardiya district is one of the 12 districts of Province Lumbini[7] (Province 5) (Figure 3.6).

[5]Data retrieved from http://lgcdp.gov.np/dhangadhi, last accessed February 12, 2021.
[6]Data retrieved from https://rajapurmun.gov.np/en/node/60 last accessed April 7, 2021.
[7]Data retrieved from http://lgcdp.gov.np/nepalgunj, last accessed February 12, 2021.

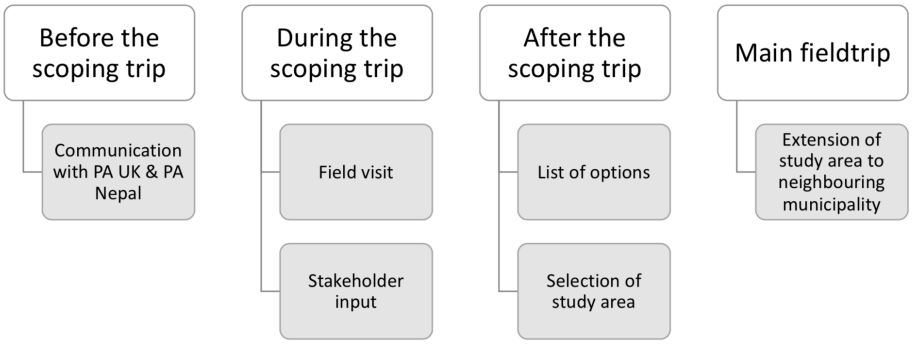


Figure 3.5: Process for the specific study area selection

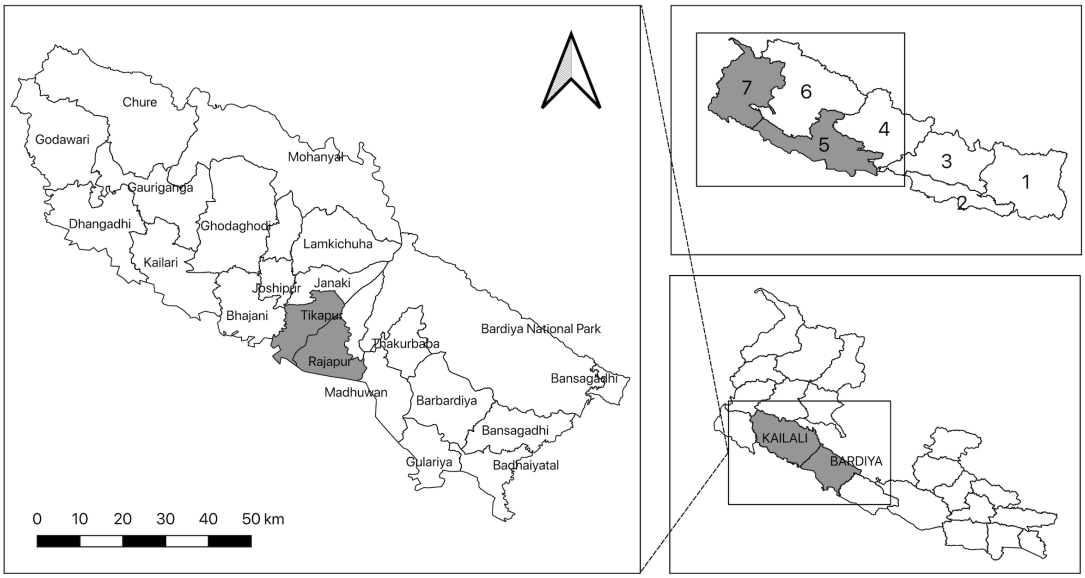


Figure 3.6: Study area, source for GIS data retrieved from Government of Nepal, Ministry of Land Management, Cooperatives and Poverty Alleviation, Survey Department, see link for information at http://dos.gov.np/nepal-map last accessed December 30, 2020

3.4 Preparation for the Main Fieldwork

This section describes the activities that took place after the scoping trip and are related to steps for the preparation of the main fieldwork period.

Questionnaires design and testing: After developing the questionnaires, I discussed them with various researchers from Durham University. For instance, the quantitative questionnaire was tested with researchers from Durham University who had previously conducted research in developing countries or Nepali scholars who conducted research in Nepal (e.g. to ensure local context, identify how long the interview lasts etc.). The questionnaire was updated according to their reflections, insights, comments or other considerations I observed (e.g. formulation of a question).

Game development and testing: The lack of experience with insurance might be one of the reasons why farmers usually have difficulty in understanding them (Pablo Suarez and Anthony Patt, unpublished research for WRMF as cited in Hazell et al. [2010].). A game for index-based insurance piloted in Ethiopia and Malawi in 2008, among other findings, revealed that games could support education purposes (ibid.). During the scoping trip, I observed that a substantial number of farmers in the visited areas had a lack of experience with agricultural insurance. The game was developed after the scoping trip to introduce basic terms of IBFI and consequently to:

- **Initiate FGDs:** Index-based insurance is a new and relatively complicated topic to be explained. Additional challenges are added when this product does not exist in the area and the farmers are not familiar with it. Therefore, the game was a way to introduce the concept of IBFI, familiarise the farmers with IBFI, and initiate discussions in the researched communities during and after the game (during FGDs) with the purpose to gain in-depth opinions and insights about the topic.

- **Introduce basis risk:** The game was a tool to introduce upside and downside basis risk. It was explained to the players that the losses are correlated to the payments. However, there could be the possibility of a mismatch of payments and losses both positively and negatively. During and after the game (during the FGD), the farmers' discussed their perspectives on basis risk.

- **Introduce IBFI:** A substantial number of the farmers who took part in the game also took part in the quantitative survey. The enumerator would skip the step of introducing IBFI during the quantitative interview as it was assumed that IBFI was already introduced during the game.

The game was tested during the development process by playing with UK based scholars and senior researchers, the insights of whom were beneficial for improving the game. Presenting the game to researchers, some of whom had used other participatory tools in developing countries (e.g. computer simulation water resources games), was an excellent opportunity for further reflections and improvement. The simulation procedure helped me understand the game's different aspects, challenges, and how the players perceived it. For instance, adding some trial rounds without insurance before the game begins to highlight that insurance is a product that is being purchased, the amount of insurance premium etc. Furthermore, I gained familiarity and improved how to explain specific terms in simple language and practised by playing the game with participants who were not familiar with IBFI. Finally, the game simulations contributed to the preparation of the fieldwork activities. For instance, it was a way to understand the game's duration, which had an essential value in incorporating the game into the

fieldwork's planned activities.

Finalising and sending documents for translation: Approximately one month before conducting the main fieldwork, the research documents were sent for translation to the senior Nepali research assistant. I was in frequent communication with the senior research assistant for clarifications when necessary.

Planning of activities and resources needed: Having selected the municipality of Tikapur after the scoping trip, I met with Practical Action UK and Practical Action in Nepal to identify some of the most flood vulnerable communities. Having discussed the scope of the research and the data needed for the survey, Practical Action Nepal and their local partner shared a list of 13 communities that belong to four wards (wards 5, 6, 7 and 8) in the municipality of Tikapur and have in total 823 households, which are shown in Table 3.1. The researched communities in Rajapur, which were suggested to me during the fieldwork, belong to three wards (wards 1, 3 and 4) and consisted of 837 households, presented in Table 3.1.

The preparation period was completed by organising the activities in agreement with Practical Action and Practical Action Nepal, bringing me in contact with the enumerators who were suggested by Practical Action Nepal and other logistical issues (e.g. discussing the dates for the fieldwork).

Table 3.1: Total households number of visited communities in Tikapur and Rajapur, data provided from Practical Action and Practical Action's local partner in 2019

Incr. No.	District	Municipality	Ward	Community	No. HHs
1	Kailali	Tikapur	5	Karmidanda	67
2	”	”	5	Dakshina Shahipur	35
3	”	”	5	Simreni	40
4	”	”	6	Simreni	101
5	”	”	7	Baidi	125
6	”	”	7	Ram Janaki Tole	35
7	”	”	7	Dhami Tole	45
8	”	”	7	Mahadev Tole	60
9	”	”	8	Bangau	68
10	”	”	8	Arnawa	142
11	”	”	8	Phata	35
12	”	”	8	Ramdada	40
13	”	”	8	Banjariya	30
				Sum	823
14	Bardiya	Rajapur	4	Sangharsanagar	636
15	”	”	1	Murgahuwa	103
16	”	”	3	Chakkhapur	98
				Sum	837

3.5 Overview of the Main Fieldwork

The main data collection lasted approximately eight weeks between mid-October 2019 to the beginning of December 2019. The following subsections, Section 3.5.1 to Section 3.5.2, describe the activities that took place during the preparatory period and the data collection phase in the study area.

3.5.1 Preparatory period

This phase consisted of a series of activities such as training the enumerators and testing the questionnaire, which lasted almost one week.

Training the enumerators for the questionnaires: The first days were spent training the enumerators. With the support of the research assistants, I explained the questionnaire to the enumerators. The enumerators in groups of two, tested the questionnaires for training and gaining familiarity. Insights and comments from the enumerators were welcomed for final adjustments of some questions. For instance, in question 24 of the questionnaire in Appendix A the options "*adia*" (shared cropping) and "*contract*" (rented with a pre-agreeed condition how much the farmer will pay afterwards to the owner) rephrased the initial options of land ownership. The enumerator who was de-coding the questionnaires into excel was also trained during the preparatory period. Finally, the game was played with the enumerators as it was part of the methodology. It was of significant value to the enumerators to have familiarity with the game context and get further insights on IBFI. Playing the game with the enumerators also functioned as training for the senior research assistant, who accompanied me during the games (e.g. translating, keeping notes etc.).

Testing the questionnaire: During the last days of the preparatory week, the questionnaires were tested in the fieldwork sites for the enumerators to gain further confidence and familiarity with them. Testing in the fieldwork sites enabled further final adjustments, such as rephrasing some questions or adjusting them to the local context.

3.5.2 Data collection period

Contacting the communities for interviews: Contacting the communities did not appear challenging as most of the communities were part of Practical

Action's and/or Practical Action's local partner project areas. Hence, the respondents had previous experience in participating in surveys.

Almost daily meetings with enumerators and work update: The senior research assistant and I would almost daily meet the enumerators and when we needed discuss challenges or issues that arose. I was checking regularly the completed questionnaires and was giving feedback when deemed necessary.

Reporting, documentation and distribution of activities within the research team: Due to the high amount of data being generated and various activities being undertaken, keeping a record of the data was of high importance. Therefore, each questionnaire had a specific coding number assigned to each enumerator (e.g. E1Q5 stands for Enumerator 1-Questionnaire 5). This allowed for any follow up from the researcher. The de-coded to excel questionnaires were then sent for scanning and, when received back post-processed, saved and backed-up with the same coding number.

The recordings of the semi-structured interviews and the game sessions were mainly transcribed by the junior research assistant. Some semi-structured interviews were transcribed jointly by the senior research assistant and myself. The interviews conducted in English were transcribed by myself. Schematically, the activities distribution is presented in Figure 3.7.

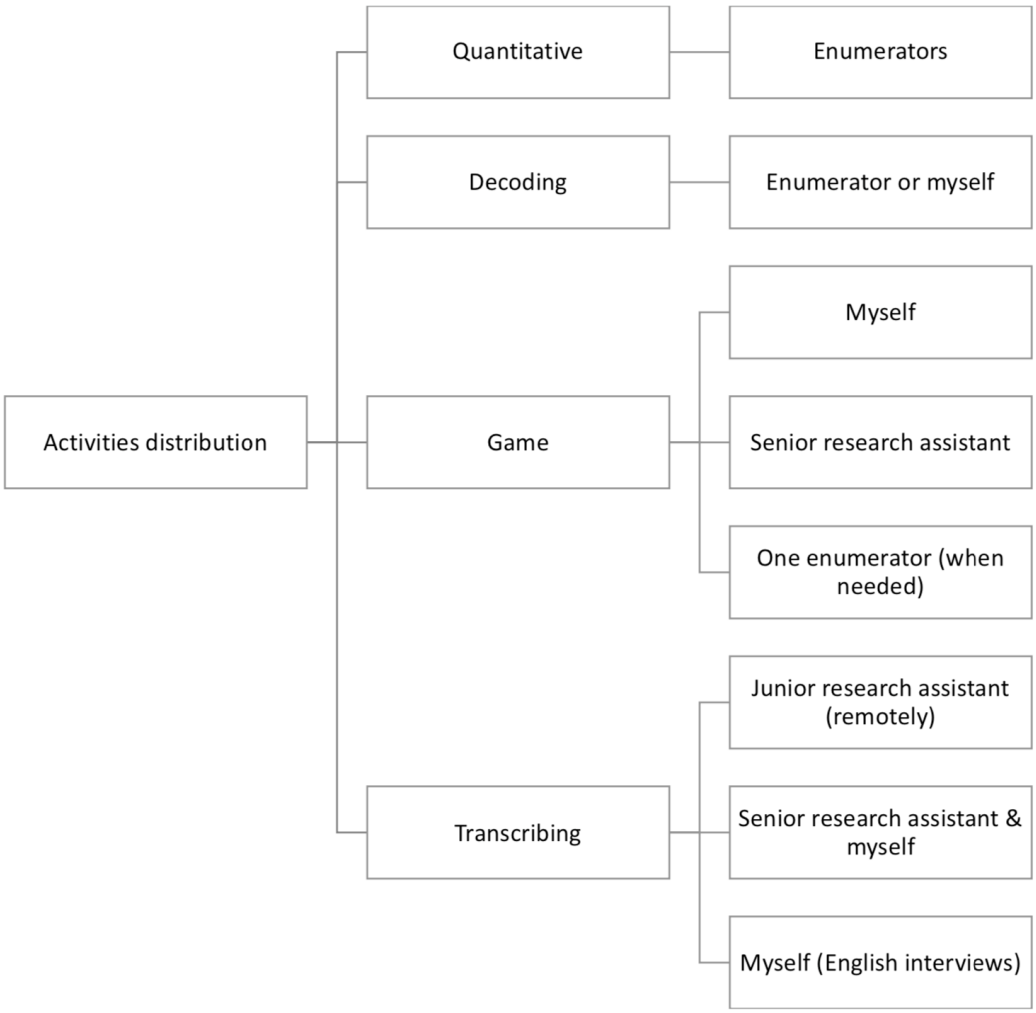


Figure 3.7: Activities distribution during fieldwork

3.6 Research Instruments for Data Collection and Collected Data

The following subsections, Section 3.6.1 to Section 3.6.3, discuss the data collected during the the quantitative survey, the qualitative component of the research and

the index-based insurance game.

3.6.1 Quantitative survey

The structured interviews involve a series of predetermined questions and allow a number of responses that allows to quantify the findings [Qu and Dumay, 2011]. Therefore, the answers cannot deviate a lot from each other as all interviewees are asked the same questions from the same list (ibid.). Data collected from the quantitative component of the research consist the analysis of Chapter 5 that identifies possible factors affecting the interest in flood insurance and for IBFI for crops. The quantitative survey questionnaire consisted of eight sections (Figure 3.8) that included 129 questions[8] (see Appendix A).

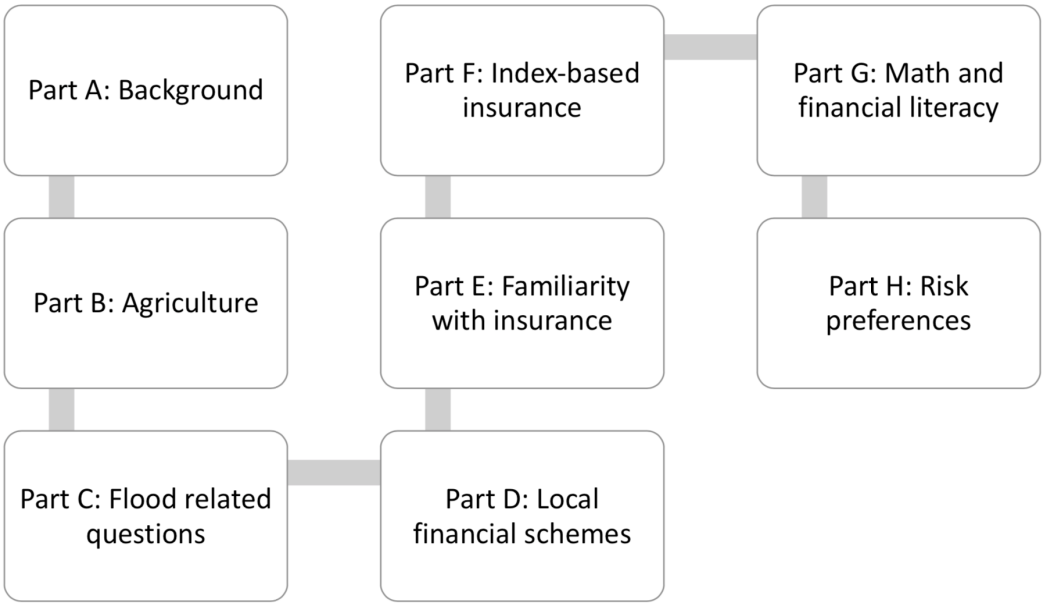


Figure 3.8: Quantitative questionnaire structure

Part A consisted of background (i.e. demographic, income levels) questions.

[8]The question 84 was removed during the last adjustments before starting the survey therefore the questionnaire is consisted of 128 questions in total not 129.

Part B was related to agriculture and agricultural experience questions (i.e. years of agricultural experience, cultivated land size). Part C was related to flood questions (i.e. flooding experience). Part D consisted of the questions related to local saving groups (e.g. saving schemes, cooperatives) and loans. Part E explored familiarity with insurance and agricultural insurance specifically. Part F included the explanation of IBFI and consisted of questions related to WTP[9], understanding of IBFI and maximum WTP. The enumerator introduced IBFI briefly to the participants by the use of an explanation flyer guide (Appendix A) and the colourful water level table, which is presented in Figure 3.14. In case the farmer had, however, participated in the game[10] the explanation flyer was avoided as the game had already covered this part. Part G consisted of four sections related to mathematics, probability, ambiguity aversion and financial literacy. Part H explored farmers' risk preferences by employing two methods to identify the degree of risk aversion. The two methods used to identify the degree of risk aversion in Part H are compared and analysed in Chapter 4.

The visited communities are presented in Figure 3.9, where each colour represents that the communities belong to the same ward. On the right side of the river, the three communities of Rajapur are shown, and on the left, the 13 visited communities of Tikapur. In total, 705 questionnaires were collected from the visited communities in the municipalities of Tikapur and Rajapur, as presented in Table 3.2.

Ten out of 705 questionnaires were collected from interviews with farmers who belonged to the same wards in which the research took place, but outside of the

[9]Note that the instruction 38 in the beginning of Part F includes an error as the hint had the intention the next two questions to be asked and not to be definitely answered.

[10]The same water level table was used during the game and the IBFI explanation flyer.

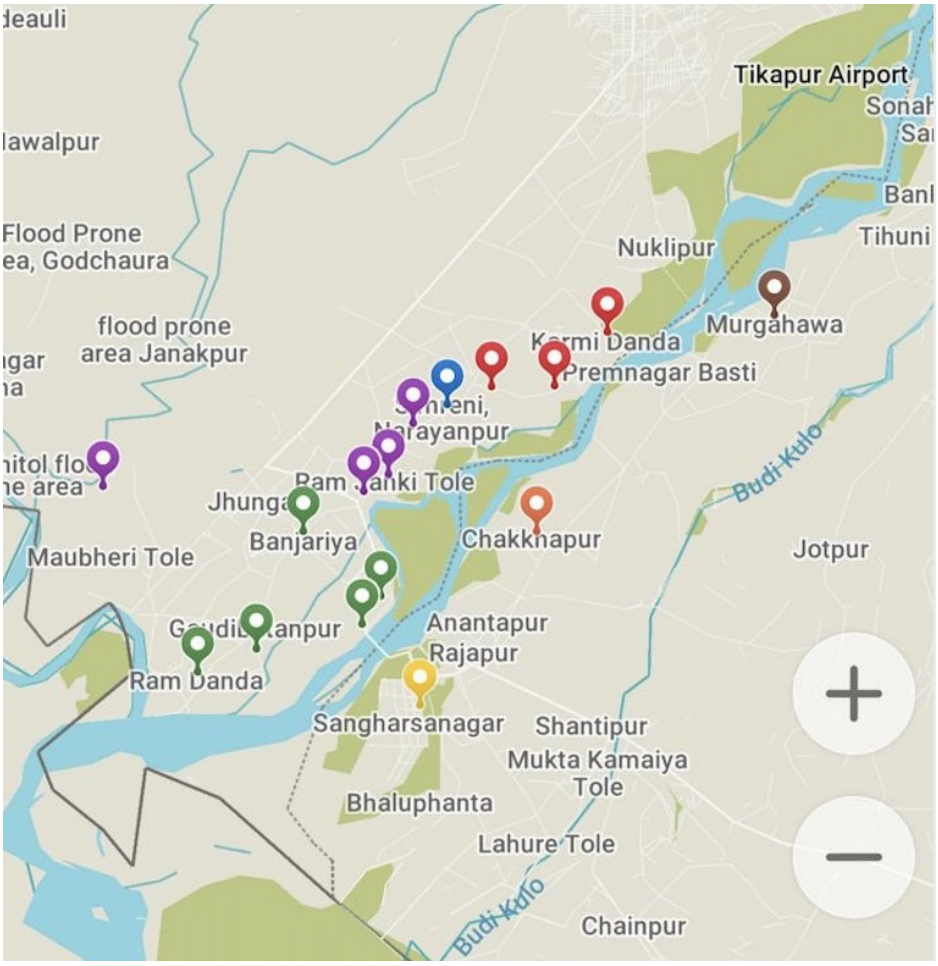


Figure 3.9: Visited communities during main fieldtrip data collection, map taken from the *maps.me* app (IOS edition, https://maps.me) last accessed January 26, 2020

visited communities. Two of them were in ward 5 and eight in ward 8. These ten farmers were identified with the snowballing method as, during the survey, an extra effort was given to increase the sample of farmers who had bought the existed crops or livestock insurance.

Table 3.2: Quantitative collected data

Incr. No.	District	Municipality	Ward	Community	Collected Questionnaires
1	Kailali	Tikapur	5	Karmidanda	37
2	”	”	5	Dakshina Shahipur	20
3	”	”	5	Simreni	25
-	”	”	5	-	2
4	”	”	6	Simreni	51
5	”	”	7	Baidi	65
6	”	”	7	Ram Janaki Tole	17
7	”	”	7	Dhami Tole	23
8	”	”	7	Mahadev Tole	30
9	”	”	8	Bangau	35
10	”	”	8	Arnawa	66
11	”	”	8	Phata	25
12	”	”	8	Ramdada	20
13	”	”	8	Banjariya	15
-	”	”	8	-	8
14	Bardiya	Rajapur	4	Sangharsanagar	162
15	”	”	1	Murgahuwa	53
16	”	”	3	Chakkhapur	51
				Sum	705

3.6.2 Qualitative components of the research

The most essential methods, in the qualitative research, for data collection are the research interviews, which provide rich data when are well prepared [Qu and Dumay, 2011]. Interviews can be individual or in groups (FGDs), where more than one people are interviewed at the same time allowing interactions between the participants, while the interviewer has the role of the moderator (ibid.). FGDs provide rich data as the participants respond in their own words and activities, while a variety of ideas within the group can be revealed [Stewart et al., 2009]. One of the interview methods is the semi-structured interviews, that contains interview guides with the goal to ensure that the same thematic approach is used during the interview [Qu and Dumay, 2011]. Some of the advantages of the

semi-structured interviews are their accessibility and flexibility (ibid.).

The tools used for the qualitative primary data collection are semi-structured KIIs and FGDs, which included open-ended questions. The semi-structured questionnaires were used as a guide during the interviews (a sample of the actual questions and questionnaires is presented in Appendix B). An effort was made to cover the most crucial questions, depending on the time availability and the participants' feedback.

During the scoping trip KIIs were conducted at the local and national level while during the main data collection at the community, local, provincial and national level. FGDs were conducted only at the community level. The qualitative data collected are presented in Table 3.3.

Table 3.3: Qualitative Data collected

Level	**FGDs**	**GD**	**Interviews**	**Fieldtrip**	**Interviewees**
Community	3			Scoping	Farmers
	16	1	13	Main	Farmers, community leaders
Local			3	Scoping	Local government officials
			14	Main	Ward and municipality local government officials, a co-operatives officer, a micro-finance officer, insurance companies officers,
Provincial			5	Main	An insurance company officers, INGOs, government officials
National			12	Scoping	an INGO, government officials, a multilateral organisation, a bilateral organisation, private research companies
			1	Main	An insurance company officer
Sum	19	1	48		

The qualitative interviews in this thesis are analysed in Chapter 6 from the demand side and only at the community level (KIIs with farmers and community

leaders, FGDs with farmers and game sessions). The interviews at the local, national and provincial level, although useful during data collection and in framing the further work that I present in this thesis, were not used in the analysis.

3.6.3 Index-based insurance game

Two versions of the index-based insurance game existed when starting the fieldwork. In one version, the game was introduced with a subsidy at the beginning of the game and the other version with subsidy introduced during the game (explanation follows in Chapter 6).

Table 3.4: Summary of games played

Incr. No.	**Community**	**Subsidy first**	**Subsidy after**	**Players**
1	Karmidanda		yes	6
2	Simreni (ward 5)	yes		8
3	Simreni (ward 6) & Mahadev Tole		yes	6
4	Ram Janaki Tole	yes		6
5	Dhami Tole	yes		6
6	Baidi	yes		8
7	Bangau	yes		6
8	Phata	yes		6
9	Arnawa	yes		11
10	Banjariya	yes		7
11	Ramdada	yes		8
12	Sangharsanagar	yes		8
13	Sangharsanagar	yes		8
14	Sangharsanagar	yes		5
15	Chakkhapur	yes		10
16	Murgahuwa	yes		8
17	-	yes		6
	Sum	15	2	123

After some initial games in the fieldwork sites, the game version with subsidy first was chosen. In total, 17 games were played with 123 players, as presented

on Table 3.4. Fifteen games were played with the assumption of subsidy first and two games with the assumption of subsidy afterwards. Sixteen games were played in the researched communities and one game with livestock farmers familiar with insurance outside the researched communities.

3.7 Research Methods

The following sections Sections 3.7.1 to 3.7.3 give a brief introduction to the methods followed in the empirical Chapters 4 to 6.

3.7.1 Research methods for risk aversion

Two methods for extracting the risk preferences from field data in developing countries are commonly employed in the existing literature.

The first commonly used method developed by Binswanger [1980], identifies farmers' attitudes towards risk by real and hypothetical payoffs games by an Ordered Lottery Selection (OLS). The participant is presented a list of options and asked to choose one of the presented sets of options [Jacobson and Petrie, 2009]. A considerable number of studies based their research on this method when collecting field data from rural areas in low-income countries; for instance, Clarke and Kumar [2016] adopted this method to research the willingness to pay for index-based insurance in rural Bangladesh, Yesuf and Bluffstone [2007] analyse households' risk aversion in rural Ethiopia whilst Hill et al. [2013] study the willingness to pay for weather index insurance in rural Ethiopia.

The second method commonly used in the literature to explore farmers' risk attitudes is by using a modified Multiple Price List (mMPL) based on Holt and

Laury [2002]. The Multiple Price List (MPL) method uses a list of paired options, and the participant chooses one option per pair sequentially [Andersen et al., 2006]. The MPL by Holt and Laury [2002] uses fixed payoffs and changing probabilities in the list of paired options [Brick et al., 2012]. The latter adopted this method when collecting field data for risk aversion in fishing communities in South Africa by modifying the method to fixed probabilities and changing payoffs. This modified MPL (mMPL) method is easy to be described and applied [Jin et al., 2016]. The method is adopted by a considerable number of studies in the literature; for instance, Jin et al. [2016] on farmers' risk preferences and weather index insurance in rural China adopted this method for the identification of the degree of risk aversion and Ihli et al. [2016] collected data about the risk preferences of farmers in rural Uganda by applying the MPL by Holt and Laury [2002] and the modified version developed by Brick et al. [2012] mMPL and compared the findings of the two methods.

Apart from Ihli et al. [2016] who employed the MPL and mMPL methods during the data collection in a developing country, another attempt to employ and compare two methods was made by Dave et al. [2010] in a developed country; they compared the MPL by Holt and Laury [2002] method to Eckel and Grossman [2008][11]. Dave et al. [2010] argue that the MPL method developed by Holt and Laury [2002] is more accurate but also more complicated and suggest that this method is more applicable to participants with higher mathematical skills, as it produces noisy data for participants with low mathematical skills. On the other hand, the OLS by Eckel and Grossman [2008] is more applicable for participants

[11] Eckel and Grossman [2008] is similar to Binswanger [1980] method [Dave et al., 2010].

with lower educational achievements due to its simplified form[12] [Dave et al., 2010].

In this study, the Binswanger [1980] method is adopted in the form of Clarke and Kumar [2016], which is explained in Section 4.1.2. The second method employed in this study is the mMPL by Holt and Laury [2002] method as used by Brick et al. [2012] with fixed probabilities and changing payoffs, explained in Section 4.1.3, with the purpose to compare them and answer to the research question:

Is the degree of farmers' risk aversion in the study area the same when employing and comparing the two risk aversion methods employed in this study?

3.7.2 Research methods for WTP and preliminary analysis

The following subsections, discuss some of the more complex factors identified based on the literature review regarding the WTP in Chapter 5 as possibly affecting factors of other studies, and are included in the analysis of this study. Some preliminary results of these factors, which are used to prepare the more advanced statistical analysis that follows in Section 5.2, are also discussed. The data are extracted from the 705 collected questionnaires from the quantitative survey of the main fieldwork. Chapter 5 answers the research question:

Which are the factors affecting farmers' WTP for hypothetical IBFI for crops in the study area that can be identified by a quantitative survey?

[12]The participant had to choose one among binary sets of choices with 50/50 probability.

Mathematical skills, financial literacy skills and ambiguity aversion: This study adopted four mathematics questions from Cole et al. [2013] and/or Hill et al. [2013], while two probability questions were asked to the participants which utilised a similar approach as the two previously mentioned studies. Additionally, utilising a similar approach as Lusardi and Mitchell [2011] and/or Cole et al. [2013] four financial literacy questions were asked. Following the same approach as Chantarat et al. [2009] the ambiguity aversion of the respondents was identified. The questions and the scores of correct responses are presented in Table 3.5.

The respondents performed better in probability and financial literacy than the mathematics questions. Similar results can be found in Cole et al. [2013] for India that reveal higher percentages in probability scores than mathematics questions. Besides, 79.4% of the respondents were categorised as ambiguity averse as they chose the bag with the known instead of the bag with the unknown probabilities.

Understanding of IBFI: A set of questions[13] was asked to the respondents to explore whether their understanding of the hypothetical IBFI was correct, having initially explained insurance and briefly introduced the hypothetical IBFI. As already mentioned, insurance and specifically IBFI was explained to the farmers with two separate approaches; one approach was through the explanation flyer that the enumerator used as a guide or through the game sessions with groups of farmers (in case the farmer had played the game before the interview, the enumerator skipped the explanation part).

The sketch presented in Figure 3.10a was used as a guide during explanation

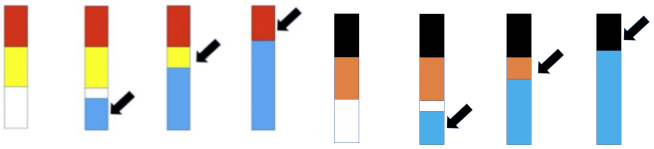
[13]The studies of Hill et al. [2013] and Cole et al. [2013] inspired the formulation of the questions related to *Understanding IBFI*.

Table 3.5: Mathematical and probability skills, financial literacy and ambiguity aversion

Mathematical skills	**Correct responses %**
$4 + 3$	73.9
$35 + 82$	18.2
$3 * 6$	34.0
1/10 of 400	16.0
Probability skills	
Showing a clear red bag with three blue and one pink counter. Chances of getting a pink counter.	64.7
Showing the previous red bag and a clear green bag with five blue and one pink counter. Bag with more chances of getting a pink counter (red or green).	76.6
Financial literacy skills	
Suppose that you borrow 100 NPR with an interest rate of 2% per month. How much would you have to give back after two months if you have not paid back anything until then? More, less or exactly 102 NPR ?	55.9
Suppose that you need to borrow 1 000 NPR to be paid back in one month. There are two options. Option 1: Someone lends you the money asking you to pay back 1 050 NPR. Option 2: Someone lends you 1 000 NPR with 10% interest. Which option would you choose?	55.5
If you have 1 000 NPR in a savings account and you earn 1% of interest per annum, and the prices of good and services increased 2% over a one year period, can you buy more, less or the same amount of goods as you could today?	22.6
Is it safer to plant one single crop, multiple crops, or it does not matter?	54.2
Ambiguity aversion	**Ambiguity averse**
Showing a transparent blue bag with four pink and three blue counters and a non-transparent orange bag with an unknown number of blue and pink counters. Participant's choice of a counter colour followed by participant's choice of the bag (blue or orange) to pick a counter with the chosen colour.	79.4

(by the enumerator or during the game), where the yellow and red water levels in the sketch represent the trigger water levels in the hypothetical measurement station. When the water level reaches the yellow level, payments for partial losses of the insured crops are assumed to follow. When the water reaches the red level, payments for total losses of the insured crops are assumed to follow.

The sketch in Figure 3.10a was used to explain and ask the questions related to understanding of IBFI of the interview. The second sketch given in Figure 3.10b



(a) Sketch used during explanation and understanding questions

(b) Sketch used during only understanding questions

Figure 3.10: Hypothetical water level tables

was used only to ask the questions related to understanding[14]. At the set of questions related to the understanding of IBFI, the enumerator would introduce a hypothetical IBFI scenario. In that scenario, the farmer is assumed to have bought flood insurance for their crops. Various scenarios of the water level in the hypothetical measurement station were assumed to occur in combination with various scenarios at the farmer's crops conditions. The farmer was asked if they would get paid under a variety of combinations of the abovementioned scenarios and how much they would get paid. The questions can be found in the quantitative questionnaire in the appendix A questions 95-97[15], while the scores of the correct answers and the way the data are used are discussed in Section 5.2.

Willingness to pay for IBFI: Hypothetical IBFI for crops was introduced with the approaches explained in the previous paragraphs. During the interview the respondent was asked if they would be willing to buy such type of flood insurance in case it existed in their area and was offered to them at an affordable price. The next question further asked if the farmer would be willing to buy if

[14]The number of participants asked questions using sketch Figure 3.10b was substantially less than those asked with sketch Figure 3.10a.

[15]The questions 95-97 could be asking for yellow/red or orange/black water levels. The questions and water level table would change accordingly.

the government subsidised this type of flood insurance, as presented in Table 3.6.

Table 3.6: Willingness to pay for index-based flood insurance questions

	Yes (Valid %)	**No (Valid %)**
1. After being explained, would you be willing to buy such type of flood insurance if it existed in your area and if it was offered to you at an affordable price?	594 (84.5)	109 (15.5)
2. After being explained, would you be willing to buy such type of flood insurance, if it existed in your area and if it was offered to you at an affordable price or being subsidised (shared part of participation costs) from the government?	656 (93.0)	49 (7.0)

Approximately 84.5% of the respondents would be willing to buy IBFI for crops, which was increased to 93.0% in the question where subsidy was assumed to be offered. The results suggest a substantial demand for IBFI for crops in the study area.

Willingness to pay for flood insurance and basis risk: Following the approach of Hill et al. [2013], three hypothetical questions were asked to the participants regarding their willingness to purchase flood insurance for crops and the sensitivity towards basis risk, which are presented in Table 3.7. The respondents were asked if they would renew their flood insurance for their crops after:

- one monsoon cropping season where it was assumed that flood insurance was bought, but no flood event occurred
- five monsoon cropping seasons where it was assumed that flood insurance was bought, but no flood event occurred

Table 3.7: Willingness to pay for flood insurance and sensitivity towards basis risk

	Yes (%)	**No (%)**	**Don't know (%)**	
1. Imagine you bought flood insurance for the next cropping season/monsoon season and you paid the money requested to buy insurance coverage for your crops. There was not flood event this cropping season. Would you be willing to continue buying insurance the next cropping season?	76.8	14.1	9.1	
2. Suppose you bought flood insurance for five cropping seasons, and you paid the money requested to buy insurance coverage for your crops. There was no flood event for five cropping seasons. Would you be willing to continue buying insurance after five cropping seasons?	52.1	31.8	16.1	
	Keep (%)	**Doubt (%)**	**Definitely not buy (%)**	**Don't know (%)**
3. Imagine you bought flood insurance for your crops for the next cropping season/monsoon season, and you paid the money requested to buy insurance coverage for your crops. There was flood on your field, but you received no payment. Would you be willing to continue buying insurance after one cropping season, where you had flood on your field and received no payment?	20.4	12.5	65.2	1.8

- one monsoon cropping season where it was assumed that flood insurance was bought, a flood event occurred in the farmer's field, but the farmer received no payment[16].

In total 76.8% of farmers would be willing to purchase insurance after having bought flood insurance for their crops for one monsoon period and not experienc-

[16]The questions were about a hypothetical scenario. Therefore, the option "*I don't know*" was included in the options of the questionnaire, as it is possible that the respondent might not be sure in advance about their reaction in such a hypothetical and not real scenario. The "*I don't know*" responses were the lowest percentage compared to the rest of the proposed options.

ing flood event that year. 52.1% would continue buying insurance after five years of purchasing insurance but not experiencing a flood event during these years. One possible explanation could be that a substantial number of farmers might have under-evaluated the benefit of protection, therefore they would not wish to continue purchasing flood insurance after five years when no flood event occurred during these years.

As already mentioned in Section 2.2.2, basis risk is an important topic to be included in future studies to understand its effect on demand for insurance [Cole et al., 2013]. From the poverty's point of view, the downside basis risk is in a greater concern than upside basis risk, see Morsink et al. [2016] citing Clarke [2016] for additional discussion. Therefore, in this study, the farmers' sensitivity towards downside basis risk was identified by the third abovementioned hypothetical question. In the remainder of this analysis, the basis risk variable stands for downside basis risk.

Approximately 20.4% of the farmers would continue buying flood insurance after experiencing basis risk. 77.7% would definitely not renew or doubt if they would renew their contract after experiencing basis risk. The result indicates that the majority of the farmers had a sensitivity towards basis risk. The basis risk sensitivity was included as an independent variable in the regression analysis, explained in Section 5.2.

3.7.3 Index-based insurance game structure

Four flood scenarios were assumed in the game; no flood, low flood, high flood and extreme flood. The condition on the agricultural field of each player would

be represented either by a green card (no loss of crops), a green-blue card (partial loss of crops) or a blue card (total loss of crops). The hypothetical measurement station's water level indicators can be in the white, yellow or red area. The combinations of the condition on the field cards, floods scenarios and water level indicators are presented in the example of eight players in Figure 3.11. The game was initially designed for eight players but could be adjusted to be played from five to twelve players, by removing and adding cards accordingly.

The assumptions for the four flood scenarios, presented in Figure 3.11, are:

No flood scenario: The water level at the hypothetical measurement station was on the white area, and it is assumed that none of the players experienced loss.

Low flood scenario: The water level at the hypothetical measurement station was still on the white area, most of the players had no loss (green cards) apart from two players who had faced partial losses. These players would not get compensation as the measurement station's water level is assumed to be on the white area, and the payments are not triggered. By this, the players were introduced to downside basis risk.

High flood scenario: The water level at the hypothetical measurement station reaches the yellow level. Most of the players had partial losses and would get paid for their partial losses. However, two players faced total loss and got paid only for partial losses (downside basis risk) and one who had no loss and got compensated for partial losses (upside basis risk). Thus, the players were introduced both to upside and downside basis risk.

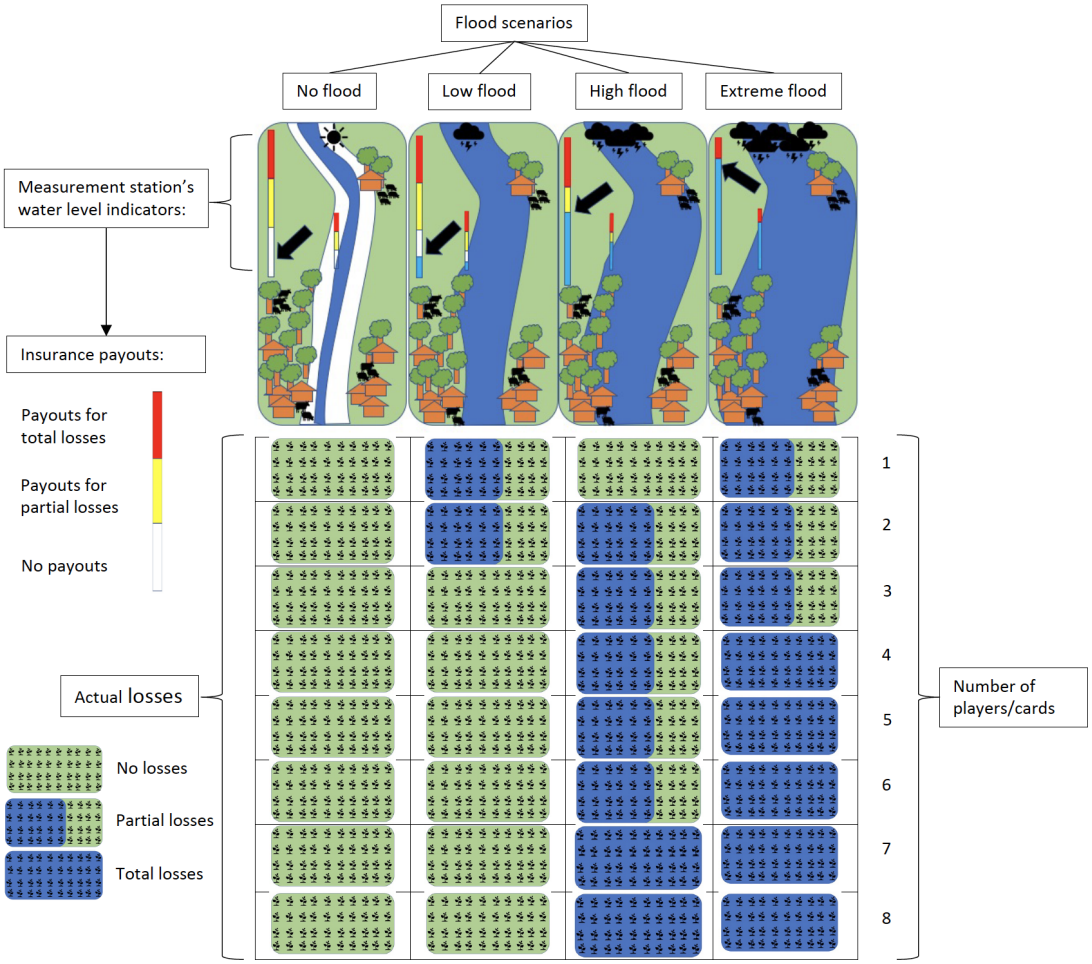


Figure 3.11: Floods scenarios and players' cards

Extreme flood scenario: The water level at the hypothetical measurement station reaches the red level. Most of the players faced total losses and would get paid for total losses. However, three players faced partial losses and got compensated for total losses. The players were introduced to upside basis risk.

Two testing rounds with no insurance were played before the game started. The purpose of the testing rounds was to introduce to players the research assistant and myself and gain confidence with the game. During the testing rounds, the farmers could observe that they were in flood-prone areas and could poten-

tially face losses. The testing rounds were additionally a way for the farmers to compare later, when the game started and insurance was offered as an option, that insurance was not a free product and they had to pay to get it (in the game, money were represented by tokens).

After the testing rounds, the game started. Five tokens were distributed to the players representing their initial wealth. The players and the game were assigned an identity number (e.g. Game 2 Player 3). All players were assumed to own the same amount of agricultural field represented with the colourful cards (green, green-blue, blue), as shown in Figure 3.11. In each round, the farmers should pay three tokens for their living costs. There were three pots (insurance, market and government) representing three different stakeholders, as shown in Figure 3.12.

The insurance pot: When the players bought insurance, they put the tokens for the contract to the insurance pot, and when the company paid the players for their losses, the tokens were drawn from the pot as well.

The market pot: The players who had no losses or partial losses could go to the market to sell their crops and get the payments for their products from that pot. When one player had a green card, the player could sell the crops and get back five tokens and when the player had a green-blue card could get back two tokens. Additionally, the players put the three tokens for their living expenses in the market's pot.

The government pot: In the rounds when subsidy by the government was assumed to be offered, the insurance would get paid for the contract by the player who was buying insurance and by the government's pot the remaining subsidised

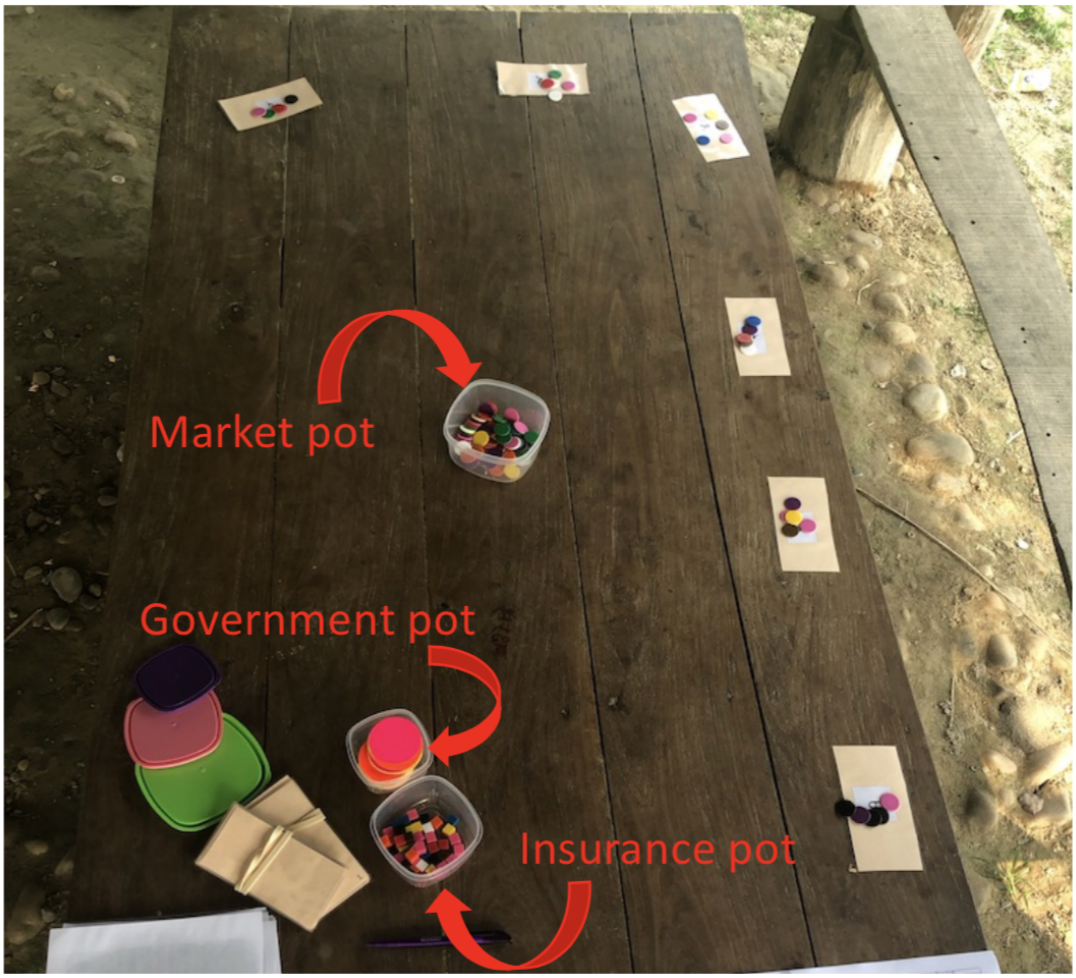


Figure 3.12: Preparing for a game session, photo credit author

part.

Initially, two versions of the game were tested. One version had the subsidy in the first three rounds; the other version gave subsidy in the final rounds with a different sequence of the flood scenarios during the rounds. As in reality the programmes are introduced by subsidising the insurance premium to attract more farmers [Ghimire and Kumar, 2014], the games with the version of the first three rounds subsidised were finally played. As a result, the two games with the subsidy

in the last rounds are not included in the games' analysis but only the FGDs that followed these two games[17].

During the first round, the players were informed that an insurance provider came to the market and sold crop flood insurance with the following conditions. In the case where the water level reached the yellow area in the measurement station, the insurance would pay the insurance holders three tokens for their partial losses (Figure 3.11). If the water level reached the red area in the measurement station, the insurance would pay five tokens to the insurance holders. If the water level remained in the white area the insurance would not pay. However, to get a contract with the insurance company, they had to pay two tokens. The government would subsidise this service by paying on behalf of the player who would buy insurance one token (50% subsidy assumed). Thus, the player would have to pay only one token when a subsidy was offered.

Starting the game, the players were asked if they wanted to pay one token to get an insurance contract. The players who decided to purchase insurance would receive a card named "insurance contract".

Nine flood scenarios were played at each game, representing nine rounds; no flood, low flood, extreme flood, high flood, extreme flood, no flood, low flood, no flood and high flood. I predetermined the sequence of flood scenarios to explore the effect of consecutive good or bad weather years[18], the effect of subsidy etc. Additionally, the rounds were predetermined to be comparable between them by

[17]Therefore, this chapter includes the analysis of 15 games ranging from 1 to 15. However, the chapter includes 16 FGDs ranging from 1 to 16. As a result, the game numbering does not reflect the FGD numbering.

[18]As good years in the analysis are considered the no and low floods, most of the players do not experience losses. As bad years are considered the high and extreme floods, most of the players experience losses.

keeping them as identical as possible by only changing the number of participating players at each game. The first three rounds were subsidised by the government by 50%, while from the fourth round onwards, the government would step back, and the player would have to pay the whole amount of the insurance cost, which was two tokens.

Having sold the insurance contracts to the players, the weather scenario would be revealed. In case of a high or extreme event, the insurance company would pay the insurance contracts holders usually before choosing their agricultural field cards. That was done to mimic reality as much as possible: fast payments, no loss adjustment by the company and the correlation between the losses on the agricultural field and the measurement station. As a next step the players saw what actually happened in their agricultural field card. Most of the players were paid from the insurance company (in high flood and extreme flood) according to their losses, apart from the upside and downside basis risk cases. The market pot's payments to the players with green or green-blue cards followed, and the next round would begin. A photo during one game session is presented in Figure 3.13.

The index-based insurance game in combination with the qualitative approaches in Chapter 6 answer the research question:

Which are the factors affecting the demand for potential IBFI for crops in the study area that can be identified by qualitative approaches and an index-based insurance game?

Figure 3.13: During a game session, photo credit author

3.8 Participants' Consent and my Positionality

Interacting with human participants involves taking into account ethical matters such as the researcher's integrity, respect for others, avoidance of harm, voluntary nature of participation, right to withdraw, informed consent, ensuring confidentiality [Saunders et al., 2016].

First of all, the study received ethical approval from the Ethics Committee of Durham Business School. During the data collection, the research description was verbally communicated to the interviewees either by me (and the senior research assistant who was translating on my behalf) or by the enumerators who led the quantitative data collection questionnaires. The consents were verbal as

this was more appropriate to the Nepali context. The interviewee was informed briefly about the topic of the research, the purpose of the interview (i.e. research) and how the data will be used (i.e. academic purposes). The participants were informed, for instance, that the information they provide will be kept anonymised and confidential, that they do not have to participate in the research if they do not wish to, they can refuse to answer any question etc. Additionally, during the qualitative interviews and the game sessions, which were usually audio-recorded permission for recording was asked. In some situations to put the participant at ease, I did not record the interview but used only hand notes.

Social research is influenced by various values and practical considerations [Bryman, 2012]. For instance, in some questions the participants might answer what they feel that the researcher needs to hear as an answer [Lavers, 2007]. The main idea of this research was to learn from the farmers and their experiences and my research was at the largest part quantitative with structured questionnaire and methods. Additionally, the quantitative interviews were guided by the enumerators and I, as an "outsider", was not present during most of the quantitative interviews. Therefore, the risk of this happening is low. However, it should be acknowledged that there is a possibility that situations like this might have occured, during the quantitative or the qualitative approaches, as the qualitative interviews and games were guided by me and the senior research assistant. During the game, for instance, when I felt it was needed I would highlight that there is no right or wrong choice or answer.

The researcher's personal beliefs or feelings might bias the research [Bryman, 2012]. The recognition and shedding light on aspects of how the researcher might have influenced the study (e.g. effect on questions, data collection etc.) is the

concept of reflexivity [Berger, 2015]. Therefore, it is essential to mention my positionality, which is impacted by my work experience, studies and personal background.

I was from a country and culture different from that of Nepal and did not speak the Nepali language. To this end, the research assistants who were both from Nepal, Practical Action Nepal and researchers who had previously conducted research in Nepal played a crucial role in enriching my understanding and knowledge. For instance, researchers from Durham University who have conducted research in Nepal or other developing countries and the senior research assistant gave their reflections to the questionnaires and game before reaching the fieldwork sites. The game was played during the preparatory week in the presence of Practical Action's and Practical Action's local partner members. All these activities were undertaken to ensure that the range of questions to be asked are appropriate to the local context. Furthermore, local codes of behaviour and other cultural aspects (e.g. clothing) were adopted when reaching Nepal.

My academic and work experience in civil engineering and the water sector trained me to think through technical solutions and approaches. For instance, having experienced difficulty explaining index-based insurance during the scoping trip, due to my engineering background, I thought a game could be useful tool to communicate with and learn from farmers.

To summarise, I am conscious that the methodology and information gained is subject to my background, experiences, and reflections. Anyone else with the same respondents and the same topic might have utilised other approaches leading to possibly different conclusions.

3.9 Challenges

Even though the research team was supported by Practical Action's local partner and the difficulties were minimal, there were still some challenges. It is important to acknowledge some of these challenges and how they were minimised for the research process's transparency.

Language came up as an issue during some games as the senior research assistant was not speaking the local dialect and some of the farmers did not speak Nepali. In some of these cases, one of the enumerators would support the game session to translate in the local dialect to minimise this challenge.

During the scoping trip, IBFI was explained using some prepared sketches (left sketch in Figure 3.14). However, this approach appeared to be challenging for the communication of IBFI. Hence, the creation of colourful tables was initiated for the preparation of the main fieldtrip, which had a simpler form (right sketch in Figure 3.14). The purpose was to focus more on index-based insurance's basic concepts, e.g. the payments are triggered according to predetermined conditions and not on the farmer's losses. The main hypothesis for the water level table is that when the water reaches the yellow and red levels in a hypothetical station close to the participant's community, the payments would be triggered. In contrast, when the water remains in the white area, there are no payments.

Figure 3.15: Water level indicators within the communities, photo credit author

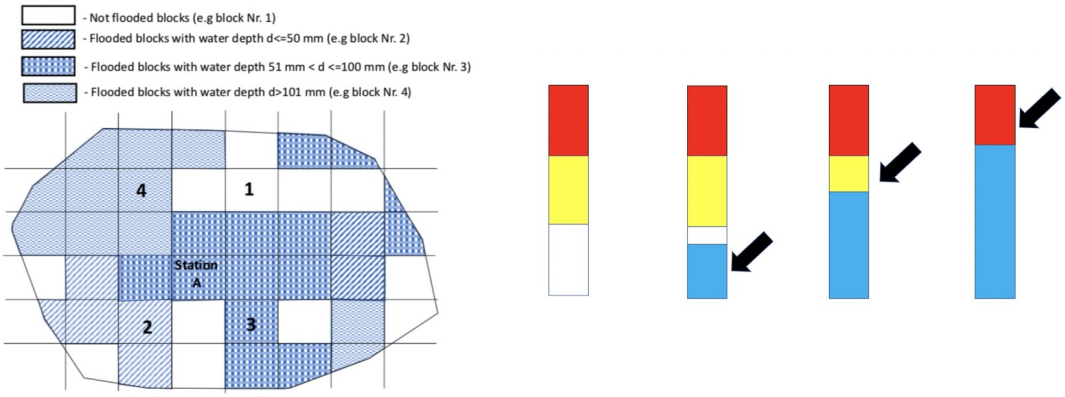


Figure 3.14: Old and new version of IBFI explanation approach

Plenty of similar colourful water level indicators were observed in most of the visited communities, as shown in Figure 3.15, which could demonstrate familiarity of the farmers with this type of indicators.

Even though the participation during the games and the FGDs that followed most of the times was satisfactory, there were occasions were the responses during the FGDs were limited. On those occasions, it was repeated that there is no

right or wrong answer and that the purpose is to gain their opinion on the topic. For ethical reasons, when there was no new information added, or there was no substantial feedback on the concept of index-based insurance, the FGD would finish after playing the game to avoid putting participants at unease.

3.10 Chapter Summary

This chapter presented the thesis's research framework, in detail, the fieldwork activities before and during data collection and the data collected. A scoping trip took place approximately six months before the main primary data collection, contributing to the contextual understanding of the area and the research topic.

The primary data were collected using an interdisciplinary mixed-methods approach, which included both quantitative and qualitative methods. The quantitative part employed a large face-to-face questionnaire survey with farmers who live in flood-prone areas of the Karnali River's lowlands. In contrast, the qualitative components of the research employed KIIs and FGDs at the community level and a game that was used among other reasons as a participatory approach to introduce IBFI to farmers. Additionally, the qualitative components of the research consist of KIIs in the ward, municipality, provincial, and national levels. As this thesis focuses on the demand side, i.e. the WTP of the farmers for IBFI, these interviews contributed to the overall contextual understanding of the topic and framing the further work that I present in this thesis.

The research scope of the present study is to understand the factors affecting the WTP for IBFI of smallholder farmers living in flood-prone areas of the lowlands of the Karnali River basin in Nepal, given a hypothetical case for this type

of insurance in their area. In the available literature, the degree of risk aversion is often explored as one of the factors affecting the decisions on purchasing insurance such as the studies of Hill et al. [2013]; Jin et al. [2016] and List et al. [2019]. The following chapter, the first empirical chapter of the thesis, focuses on the topic of farmers' risk aversion in the study area.

Chapter 4

Risk preference methods in developing countries: A comparison of two methods

This chapter contributes to the literature by bringing empirical evidence of smallholder farmers' risk preferences in rural agricultural flood-prone areas of Nepal by employing two methods to estimate the degree of risk aversion. The analysis presented in this chapter is based on two commonly used methods in developing countries for exploring the choice under uncertainty methods: the Ordered Lottery Selection (OLS) by Binswanger [1980] and the modified Multiple Price List (mMPL) based on Holt and Laury [2002] as modified by Brick et al. [2012].

Although commonly employed separately, to the best of my knowledge, this is one of the first studies which is based on both methods when collecting field data in a developing country with the purpose to compare them and answer to the research question:

Is the degree of farmers' risk aversion in the study area the same when employing and comparing the two risk aversion methods employed in this study?

The purpose of this chapter is not to provide uncontested evidence on the performance of the two employed methods, but instead to bring exploratory insights on the comparability of the two approaches. The combination of using these approaches together provides a basis for future studies on adoption of financial risk management techniques in developing countries.

The remainder of this chapter is organised as follows: an introduction to the two methods through a review of the existing literature and a short description of how the methods are adapted in the Section 4.1; followed by the results in Section 4.2; the discussion in Section 4.3 and the chapter summary in Section 4.4.

4.1 Introduction

The two methods were employed during the primary data collection of the quantitative survey. The enumerator asked one set of hypothetical (not real) payoffs games questions for each method depending on the income range. The hypothetical payoffs games were in the neighbourhood of the average monthly income[1]. The income ranges in the sample[2] were $< 5\,000$ NPR/month, $5\,000 - 15\,000$ NPR/month, $15\,000 - 25\,000$ NPR/month, $25\,000 - 35\,000$ NPR/month, $35\,000 - 45\,000$ NPR/month, $45\,000 - 55\,000$ NPR/month, $55\,000 - 75\,000$ NPR/month, $75\,000 - 95\,000$ NPR/month and $> 95\,000$ NPR/month[3]. An analytical description of the

[1] 1£ = 144.22 Nepali Rupee (NPR) on 14-10-2019 according to https://www.xe.com/currencytables/?from=GBP&date=2019-10-14 last accessed October 19, 2020.

[2] Remittances (if received any) were not included in the income ranges.

[3] The set of games of the range $75\,000 - 95\,000$ NPR/month was jointly used for income levels $> 95\,000$ NPR/month.

way the methods were adopted in this study is presented in Section 4.1.2 and Section 4.1.3.

4.1.1 Utility function

Farmers are interested in buying insurance when insurance increases their well-being or expected utility, which is correlated with their degree of risk aversion, see Patt et al. [2009] citing Churchill [2006] for additional discussion. "*The economic model of the individual posits that people make decisions to maximise their utility, which is the total amount of enjoyment, comfort, and happiness that they derive from a set of experiences.*" [Patt et al., 2009, p.739-740].

In the example of Figure 4.1 it is assumed that there is a hypothetical coin that is presented to a farmer, who has an average monthly income in the neighbourhood of 10 000 NPR. When flipping the coin there is 50% probability the farmer gets hypothetically 10 000 NPR and 50% probability to get nothing.

The utility is at the lower level when the farmer gets nothing and at the highest level when the coin drops at the highest amount side. The probability weighted average of the two utilities of 0 and 10 000 NPR of the two sides of the coin is lower than the utility of the average (5 000 NPR). This occurs due to the curvature of the utility function [Patt et al., 2009]. More wealth creates higher utility, but as people consume more, they extract less happiness from each additional amount of wealth [Patt et al., 2009]. This is the reason why the utility function is curved, which consequently generates the risk aversion (ibid.).

For example, the last option of Table 4.2, a highly risk averse farmer with $r = 0.7$ would hypothetically prefer 1 000 NPR for sure than flipping a coin with

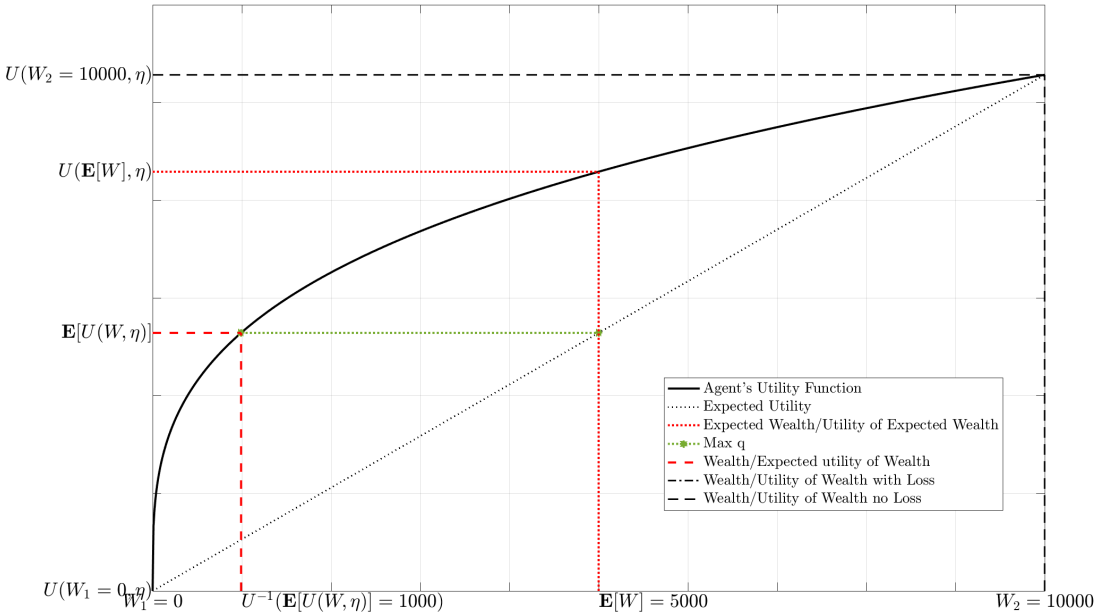


Figure 4.1: Expected utility and Jensen's inequality

50% probability to get 10 000 NPR and 50% probability to get nothing. The 1 000 NPR, which is less than 5 000 NPR, is called the certainty equivalent (max q), as shown in Figure 4.1. The certainty equivalent reveals that the farmer is willing to pay more than the actuarially fair price and this could generate an insurance market [Patt et al., 2009].

Both methods employed in this study used a Constant Relative Risk Aversion (CRRA) utility function to categorise the degree of risk aversion. The CRRA utility function gives the utility of income by:

$$U(x) = \frac{x^{1-r}}{1-r} \tag{4.1}$$

where r is the latent risk coefficient, and x is the lottery prize, see Brick et al. [2012] citing Andersen et al. [2008], Jin et al. [2016] citing Anderson and Mellor [2008] for additional discussion. The power utility for each lottery preference

gives a CRRA range. A value of $r > 0$ indicates a risk averse preference, a value of $r = 0$ a risk neutral preference and a value of $r < 0$ a risk loving preference [Brick et al., 2012; Jin et al., 2016].

4.1.2 The ordered lottery selection method by Binswanger [1980]

Following the OLS Binswanger [1980] method, in this study identical values to those of Binswanger [1980] in the form of Clarke and Kumar [2016] were used, multiplied by a constant to reach the mean monthly income level[4].

A participant whose income range is between 5 000-15 000 NPR for example, follows the basic structure of the method as presented in Table 4.1. A constant of 200 is multiplied at the values of Binswanger [1980] for the hypothetical payoffs[5] to reach the average monthly income level of 10 000 NPR. The participant is asked to choose between option A (safe option with lowest expected value) and option B[6]. In option A the participant has 100% probability of getting 10 000 NPR. In option B, the participant has a 50% probability[7] of getting 9 000 NPR and 50% to get 19 000 NPR.

If the participant chooses option A over B, the method is completed. In that case, the risk aversion class of the participant at the OLS method is categorised as

[4]The multiplied constant is chosen according to the income range.
[5]Games and payoffs were all hypothetical.
[6]The table was not presented to the participants.
[7]To avoid using probabilities in the questionnaire the option B is explained in a simpler form by imagining having a coin, which if flipped the heads represented the 9 000 NPR and tails 19 000 NPR.

extreme risk averse during the analysis, as shown in Equation (4.2) and Table 4.1.

$$0.5\times 10000^{1-r}+0.5\times 10000^{1-r} > 0.5\times 9000^{1-r}+0.5\times 19000^{1-r} \rightarrow r \geq 7.51 \quad (4.2)$$

If the participant chooses option B, the method continues asking the participant if they would choose option B over option C. If the participant chooses option B, the method is completed, and the risk aversion class at the OLS method of the participant is categorised as *severe risk averse* during the analysis, as shown in Equation (4.3) and Table 4.1.

$$0.5\times 9000^{1-r}+0.5\times 19000^{1-r} > 0.5\times 8000^{1-r}+0.5\times 24000^{1-r} \rightarrow r \geq 1.74 \quad (4.3)$$

If the participant chooses option C, the method continues accordingly until option F (highest risk option with the highest expected value[8]).

Binswanger [1980] presents a list of all of the lottery options and the participant is asked to choose one set of options [Jacobson and Petrie, 2009]. In this study, the enumerator reads the questions sequentially as explained in the previous paragraph to the participant[9], as presented in Part H of the questionnaire in Appendix A questions 125-129.

[8]Jointly with option E.

[9]To avoid putting the respondents with low literacy rate at unease, none of the participants were invited to read any part of the questionnaire.

Table 4.1: Structure of OLS method design of average monthly income level in the neighbourhood of 10 000 NPR (based on Binswanger [1980] in the form of Clarke and Kumar [2016])

Task	Prob. 0.5 (NPR)	Prob. 0.5 (NPR)	EV	CRRA ranges	Risk aversion class
A	10000	10000	10000	$(+\infty, 7.51)$	Extreme risk averse
B	9000	19000	14000	(7.51, 1.74)	Severe risk averse
C	8000	24000	16000	(1.74 , 0.81)	Intermediate risk averse
D	6000	30000	18000	(0.81 , 0.32)	Moderate risk averse
E	2000	38000	20000	(0.32, 0)	Slight-to-risk neutral
F	0	40000	20000	$(0, -\infty)$	Neutral-to-negative

4.1.3 The Holt and Laury [2002] in the form of Brick et al. [2012] modified multiple price list method

Following Brick et al. [2012], identical values multiplied by a constant to reach the average monthly income of the participant were used.

A participant whose income range is between 5 000-15 000 NPR, for example, followed the method as presented in Table 4.2. A constant of 500 is multiplied to the values of Brick et al. [2012] to reach the average monthly income level of 10 000 NPR, as presented in Table 4.2. There were eight tasks that the participant had to choose between options A and B for all tasks[10]. Starting from 0-1 task, the participant was asked to choose between the option A getting 10 000 NPR for sure or option B with 50% probability to get 10 000 NPR and 50% probability[11] of getting nothing. The same approach was used for the rest of the tasks[12].

The approach of Holt and Laury [2002] presents all the options at once [Jacob-

[10]The table was not presented to the participants.

[11]To avoid using probabilities, option B was explained in a simpler form of imagining having a coin, which if flipped the heads represented the 10 000 NPR and tails nothing.

[12]Games and payoffs were all hypothetical.

Table 4.2: Structure of mMPL Method design of average monthly income level in the neighbourhood of 10 000 NPR (based on Holt and Laury [2002] in the form of Brick et al. [2012])

Task	Option A (NPR)	Option B (NPR)	EV^A	EV^B	CRRA ranges	Risk aversion class
0-1	10000	0.5 of 10000; 0.5 of 0	10000	5000	$(-\infty, -1.4)$	Highly risk loving
2	7500	”	7500	5000	$(-1.4, -0.4)$	Very risk loving
3	6000	”	6000	5000	$(-0.4, 0)$	Risk loving
4	5000	”	5000	5000	$(0, 0.2)$	Risk neutral
5	4000	”	4000	5000	$(0.2, 0.4)$	Slightly risk averse
6	3000	”	3000	5000	$(0.4, 0.6)$	Risk averse
7	2000	”	2000	5000	$(0.6, 0.7)$	Very risk averse
8	1000	”	1000	5000	$(0.7, +\infty)$	Highly risk averse

son and Petrie, 2009]. In this study, the options were asked from the enumerator sequentially, as outlined in part H questions 117-124 of the questionnaire in Appendix A, an approach followed by similar studies (e.g. Jacobson and Petrie [2009]).

The option A reduces systematically, while the hypothetical flipping coin numbers remain unchanged [Brick et al., 2012]. A highly risk-averse participant chooses always option A, a highly risky one chooses always option B, while a risk-neutral chooses option A for the first four times and option B for the remaining four times [Jin et al., 2016]. A participant who chooses option A for the first four times and option B thereafter reveals a CRRA between 0 to 0.2 [Jin et al., 2016]. Similarly, a participant who choose six times option A and option B thereafter reveals a CRRA between 0.4 to 0.6 [Brick et al., 2012]. A participant who for example choose option A for the first five tasks and option B thereafter has a risk aversion parameter ranging between 0.2 and 0.4, as shown in Equations (4.4)

and (4.5) when solving for r:

$$4000^{1-r} = 0.5 \times 0^{1-r} + 0.5 \times 10000^{1-r} \rightarrow r = 0.2 \tag{4.4}$$

$$3000^{1-r} = 0.5 \times 0^{1-r} + 0.5 \times 10000^{1-r} \rightarrow r = 0.4 \tag{4.5}$$

4.2 Results

4.2.1 Inconsistency of mMPL method

Inconsistent choices are often reported in field studies [Jacobson and Petrie, 2009]. For instance, when employing the MPL method, it is often observed that participants shift repeatedly between lotteries, see Brick et al. [2012] citing Andersen et al. [2006] for additional discussion. However, some methods provide a limited amount of options eliminating inconsistency to be observed, such as the Binswanger [1980] method [Jacobson and Petrie, 2009].

In this part of the analysis, 698 questionnaires were used after the cleaning process[13]. The results of the mMPL method of this study record 21.06% (147/698) of inconsistency.

Brick et al. [2012] when studying fishing communities in South Africa reported 41% of the participants' choices to be switching back and forth at least once, as they moved down to the decision rows. Similarly, Jacobson and Petrie [2009] for Rwanda observed 55% of inconsistent choices. One low percentage in this method is found by Ihli et al. [2016], which reached 7.5% of inconsistency in the

[13]When one or both methods were missing of part H of the survey (risk aversion method) the questionnaire was excluded in the analysis of this chapter.

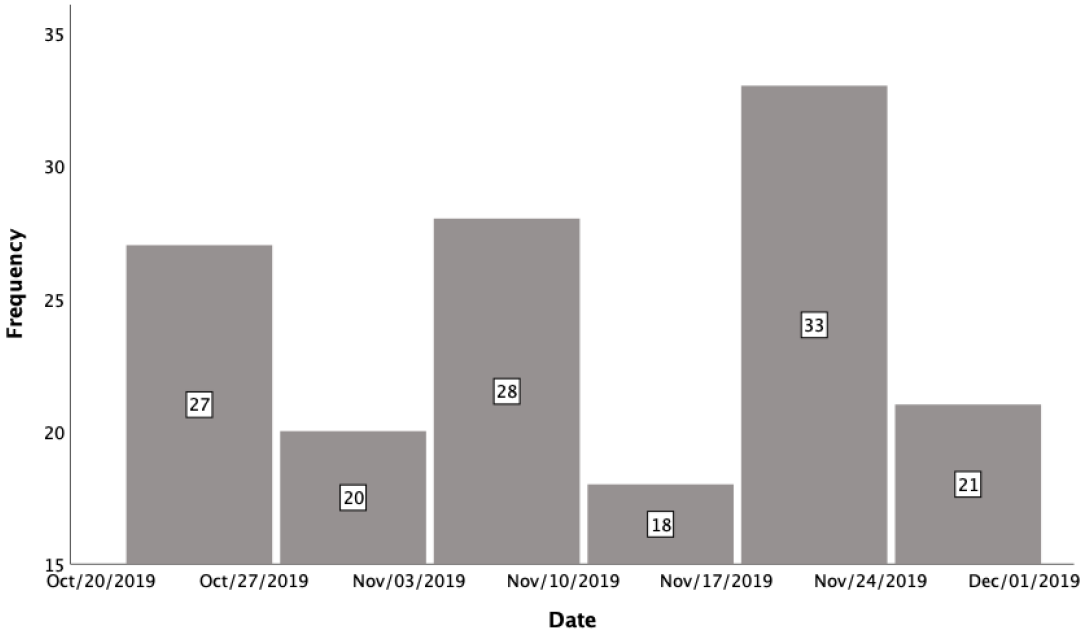


Figure 4.2: Distribution of inconsistent responses during the data collection phase by collection date

mMPL method, arguing that this low inconsistency rate might reveal that the participants understood very well the games.

The results of this study are lower in comparison to previously mentioned research studies in developing countries, excluding the one from Ihli et al. [2016].

During the first weeks of the data collection, the enumerators made themselves familiar with the questionnaires, which could influence the way the questions were asked. Therefore, as a robustness check, the 147 inconsistent responses were distributed to a bar chart shown in Figure 4.2, where the x-axis represents the collection dates in weeks. The number of inconsistent responses is present during the entire fieldwork exercise and not accumulated at the initial period of the data collection. This is prima facie evidence that the occurrence of inconsistent responses is not systematically related to enumerator bias.

Several possible reasons for such an inconsistency are proposed: first, indifference to the outcome, see for instance Dave et al. [2010]; second, a lack of understanding Ihli et al. [2016]; or third, the lack of attention and incentive Jacobson and Petrie [2009]. Moreover, Jacobson and Petrie [2009] suggest that the inconsistency tends to be lower at high payoffs. For this study the range of payoffs covers medium to high options for the participants who are carefully briefed on the purpose of the game by the enumerator. This choice of hypothetical payoff ranges and introductory briefing are the possible explanations for the relatively low inconsistency rate compared to the average study of this type.

Authors argue that large inconsistency responses in studies in developing countries might indicate that this method might not be the most suitable tool for a developing country context [Brick et al., 2012; Ihli et al., 2016]. Methods such as the approach of Binswanger [1980] might be more valid for identifying risk preferences in populations with limited educational qualifications, see Brick et al. [2012] citing Dave et al. [2010] for additional discussion.

It is not possible to identify the degree of risk aversion of the participants with inconsistent choices, nor for this to be subsequently compared to the OLS method. Therefore, the inconsistent sample is removed, and the comparison of the two methods in the next section consisted of 551 questionnaires[14].

4.2.2 Degree of risk aversion of each method

In this section, the degree of risk aversion of 551 participants for OLS and mMPL methods is analysed. The two methods have different risk aversion categories. As shown in Table 4.1 the OLS method has six classes whilst the mMPL method in

[14]Apart from the inconsistent sample, the missing values of both methods are also excluded.

Table 4.3: Distribution of sample: OLS method by Binswanger [1980]

Task (N=551)	**Decision row that the participant stopped swapping**	**Risk aversion class (OLS)**	**%**	**Redistribution of classes**	**Sum %**	**Mean (SD)**
A	1	Extreme	61.5	Highly (=1)		1.51
B	2	Severe	6.2	”		(0.98)
C	3	Intermediate	7.3	”	75.0	
D	4	Moderate	8.2	Moderate (=2)	8.2	
E	5	Slight-to-neutral	7.6	Slight-to-neutral (=3)	7.6	
F	6	Negative	9.3	Negative (=4)	9.3	

Table 4.2 has eight classes.

The results of the OLS method are presented in Table 4.3. Most of the participants choose option A (safe option with lowest expected value) when offered to choose between the hypothetical payoff options A and B. Therefore the highest percentage reaching 61.5% of the sample is ranked to extreme risk-averse category. On the contrary, 9.3% of the participants always swap to the riskier option (A for B, B for C. . . and finally E for F) and are ranked in the category negative risk-averse.

Binswanger [1980] found that at low payoff levels risk aversion is concentrated between the intermediate and risk-neutral classes. At high payoff levels in the neighbourhood of monthly income, the risk neutrality disappeared, and the risk aversion is between the moderate and intermediate classes (ibid.). Yesuf and Bluffstone [2007] found that farm households in Ethiopia are much more averse at high stake risks with more than 50% of households in Ethiopia to be severely or extremely risk-averse. Furthermore, Clarke and Kumar [2016] found both men and women in Bangladesh to be in the severe risk aversion class.

The hypothetical payoffs of the results in this study are at high levels (neighbourhood of average monthly income). The results are consistent with Yesuf and Bluffstone [2007] for Ethiopia who reported that more than 50% were severely or extreme risk-averse, the fieldwork study herein reports 67.7% of the sample are classified as being extremely or severely risk-averse. The results are also consistent with Binswanger [1980], who reported that risk neutrality disappeared at high payoff levels, as the risk neutrality of this study is low at 7.6%.

Table 4.4: Distribution of consistent sample: mMPL by Holt and Laury [2002] method in the form of Brick et al. [2012]

Task (N=551)	**Decision row the participant switched to option B**	**Risk aversion class (mMPL)**	**Classes %**	**Redistribution of classes**	**Sum %**	**Mean & (SD)**
0	Always option B	Highly risk loving	7.1	Negative (=4)		2.21 (1.18)
1	2	Highly risk loving	4.0	”		
2	3	Very risk loving	4.4	”		
3	4	Risk loving	3.6	”	19.1	
4	5	Risk neutral	12.0	Slight-to neutral (=3)		
5	6	Slightly risk averse	13.1	”	25.0	
6	7	Risk averse	8.3	Moderate (=2)		
7	8	Very risk averse	5.6	”	14.0	
8	Always option A	Highly risk averse	41.9	Highly (=1)	41.9	

The results of the mMPL method are presented in Table 4.4. Most of the participants are categorised as high risk-averse reaching 41.9%, choosing always option A and never choosing to flip the hypothetical coin. On the contrary, 7.1% always choose option B (flip the hypothetical coin) instead of selecting the option

A for sure and are categorised as highly risk loving.

Brick et al. [2012] found that 32% of the sample was highly risk-averse; similarly, Jin et al. [2016] found farmers to be risk-averse.

In my study 41.9% of the participants are categorised as high risk-averse, higher than Brick et al. [2012].

4.2.3 Comparison of the degree of risk aversion of both methods

Risk aversion for both methods is categorised into four parallel classes to allow comparison. There are eight risk aversion classes in the mMPL method and six in the OLS method. Therefore, the two methods are further re-distributed into new classes to make the comparison possible and to test the consistency between them. The original classes of both methods are re-distributed to four comparable classes, namely highly risk-averse, moderate risk-averse, slight to risk-neutral and negative, which are presented in Table 4.5.

The first class *highly risk-averse (HRA)* included the intermediate, severe and extreme risk-averse classes of the OLS method $(+\infty, 0.81)$, which represent tasks A, B and C in Table 4.1. The same class includes the highly risk-averse class of the mMPL method $(+\infty, 0.7)$, which represents task 8 in Table 4.2.

The second class, *moderate risk averse (MRA)*, includes the moderate class of OLS (0.81, 0.32) and the risk averse and very risk averse classes of the mMPL method (0.7, 0.4). The same methodology is followed accordingly for the redistributed classes, *slight-to-neutral (StN)* and *negative risk averse (NRA)* classes, as shown in the last column of Tables 4.3 to 4.5.

Dave et al. [2010] compared two similar methods and provides evidence that the MPL[15] by Holt and Laury [2002] recorded a higher accuracy. This method performed better for participants with high mathematical skills (ibid.). On the other hand, due to its complication, the participants with low mathematical skills generated noisy data (ibid.). The OLS by Eckel and Grossman [2008], similar to the Binswanger [1980] method, was simpler and performed better to participants with lower educational background, but the results were coarser [Dave et al., 2010].

In this study, as presented in Figure 4.3, the highest percentages of both methods are accumulated in the high-risk aversion class. Specifically, the percentage of high risk-averse participants of the OLS method is higher than the mMPL; 75% and 41.9%, respectively. For the remaining three classes, the mMPL method records almost double percentages compared to OLS.

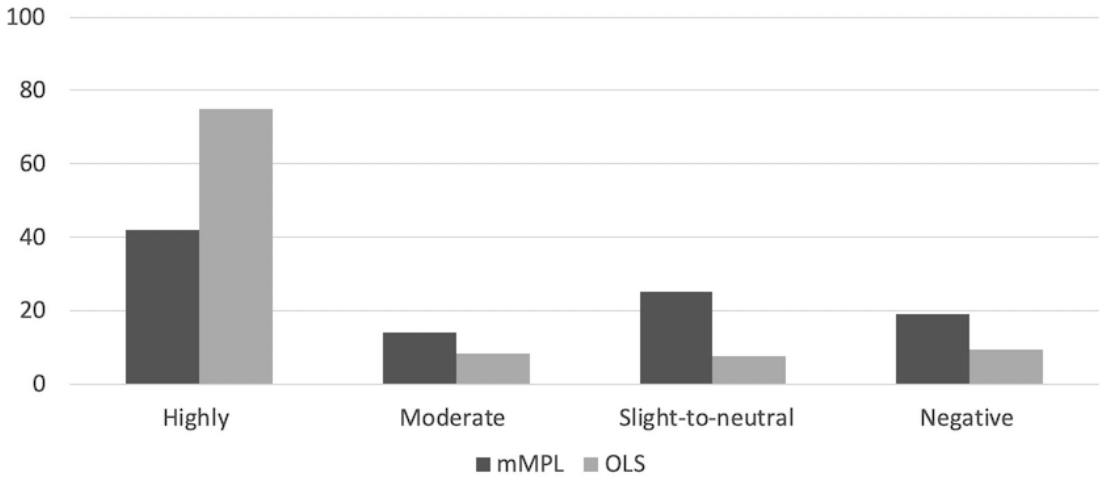


Figure 4.3: Degree of risk aversion after redistribution of methods: OLS and mMPL

Even though both methods captured the highest percentage in the high risk-

[15]Note, Dave et al. [2010] does not assess the modified mMPL proposed by Brick et al. [2012] and utilised in this study.

averse class, the mMPL method has a more even distribution across the risk aversion classes, while the OLS method records a high percentage at the highly risk-averse class, but percentages less than 10% to the rest of the classes, which indicates a coarser distribution; consistent with Dave et al. [2010].

The mMPL method records a mean value of 2.21 (s.d 1.18), which indicates that on average, the participants are between the moderate and slight-to-neutral classes but closer to moderate. The OLS method records a mean value of 1.51 (s.d 0.98), which indicates that on average the participants are between the moderate and highly risk-averse classes[16].

4.2.4 Exploring the consistency of risk aversion across the two methods

The next step is to understand the consistency of the samples within the two methods by implementing four tests presented in Table 4.5 and Table 4.6, graphically in Figure 4.4.

Table 4.5: Comparison of mMPL to OLS

Test	Risk aversion class	OLS	mMPL	
1	Highly risk averse (HRA)	$(+\infty, 0.81)$	$(+\infty, 0.7)$	$r_{OLS} \subseteq r_{mMPL}$
2	Moderate risk averse (MRA)	(0.81, 0.32)	(0.7, 0.4)	$r_{mMPL} \subseteq r_{OLS}$
3	Slight-to-neutral (StN)	(0.32, 0)	(0.4, 0)	$r_{OLS} \subseteq r_{mMPL}$
4	Negative (NRA)	$(0, -\infty)$	$(0, -\infty)$	$r_{OLS} \subseteq r_{mMPL}$

For the re-distributed high risk-averse class it is valid that the risk aversion of the OLS method is a subset of the mMPL ($r_{OLS} \subseteq r_{mMPL}$). Therefore, at test

[16]The four re-distributed classes were coded in SPSS as follows: 1=Highly risk-averse, 2=Moderate risk-averse, 3=Slight to risk-neutral, 4=Negative.

Table 4.6: Comparison of consistency of the degree of risk aversion between the methods

Test	Risk aversion class	HRA %	MRA %	StN %	NRA %	Inverse test %
1: $r_{OLS} \subseteq r_{mMPL}$	Highly (HRA) of OLS	48.4 (cons.)	13.3	21.5	16.7	86.58
		200/413	55/413	89/413	69/413	200/231
2: $r_{mMPL} \subseteq r_{OLS}$	Moderate (MRA) of mMPL	71.4	7.8 (cons.)	16.9	3.9	13.33
		55/77	6/77	13/77	3/77	6/45
3: $r_{OLS} \subseteq r_{mMPL}$	Slight-to-Neutral (StN) of OLS	19.0	31.0	40.5 (cons.)	9.5	12.32
		8/42	13/42	17/42	4/42	17/138
4: $r_{OLS} \subseteq r_{mMPL}$	Negative (NRA) of OLS	35.3	5.9	19.6	39.2 (cons.)	19.05
		18/51	3/51	10/51	20/51	20/105

1 it is expected that all of the HRA participants of the OLS method also belong to the HRA of the mMPL method. The first test is performed to understand the percentage of the three classes of OLS methods (Tasks A, B and C of Table 4.1 $(+\infty, 0.81)$) corresponding to the mMPL method class under Task 8 of Table 4.2 $(+\infty, 0.7)$. If they did not belong to the new high risk-averse class it is further researched at which class of the mMPL they belong.

Similarly, at test 2 it is valid that $r_{mMPL} \subseteq r_{OLS}$. It's therefore tested whether both classes (Tasks 6 and 7) of mMPL also correspond to moderate (Task D) of OLS class. Those who do not correspond to moderate OLS class are further researched to determine to which class they belong. The same methodology is followed accordingly to the remaining two classes, as shown in Table 4.5. The results are presented in Table 4.6 and graphically in Figure 4.4.

In total, 413 participants belong to HRA category of OLS $(+\infty, 0.81)$. In contrast, 231 participants belong to the HRA category of mMPL $(+\infty, 0.7)$. Out

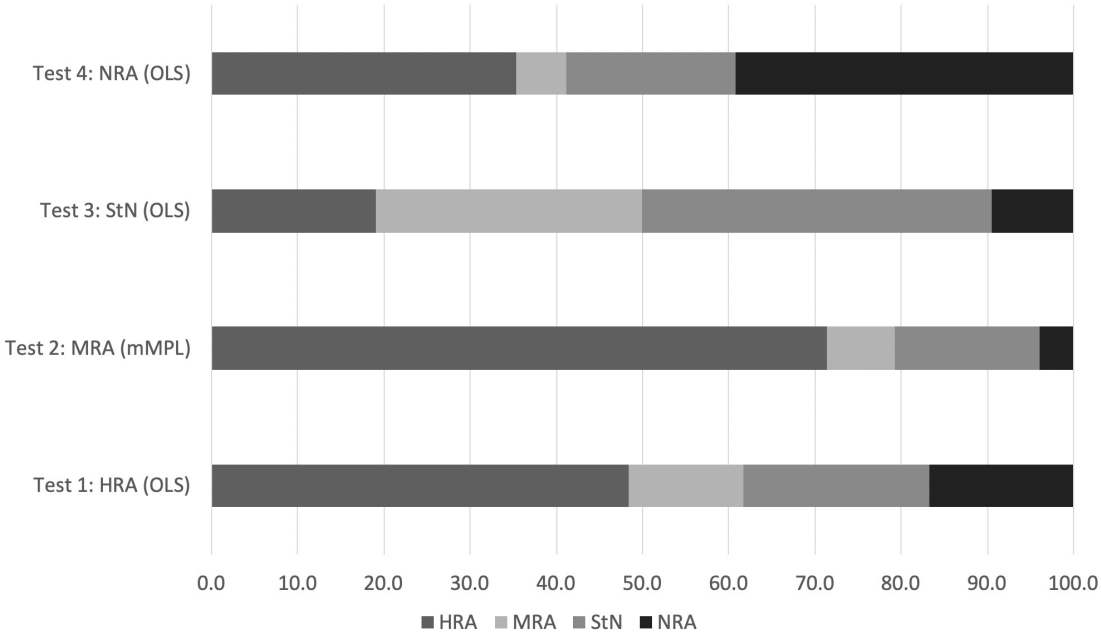


Figure 4.4: Consistency tests of risk aversion methods: OLS and mMPL

of 413 of the HRA category of OLS method 200 participants belong at the same time in the HRA class of the mMPL method, according to Test 1. The agreement of the two methods reaches 48.4%. This reveals that almost half of the participants of the HRA category of the OLS method were also classified as HRA in the mMPL method. However, the remaining 213 participants (51.5 %) of the OLS method are classified in other categories in the mMPL. The highest amount of the inconsistent sample is 21.5%, which is categorised as HRA in the OLS method but to StN in the mMPL method (two risk aversion degrees lower). This can be interpreted as the primary mechanism why the StN is the second highest class in the mMPL method, as shown in Figure 4.3.

Jointly, 200 participants are classified as HRA using both the mMPL and OLS methods. However, given the differentiated numbers classified using each

method the overlap represents 86.58% of those classified by the mMPL method versus the 48.4% in the HRA class for OLS. Taking into account our assumption that $r_{OLS} \subseteq r_{mMPL}$ I conclude that 200 participants have a degree of risk aversion $(r : +\infty, 0.81)$ and 31 participants of mMPL method have a degree of risk aversion $(0.7 < r < 0.81)$.

Forty-five participants belong in the MRA class of OLS method (0.81, 0.32) and 77 belong in MRA of mMPL (0.7, 0.4) method. Test 2 shows very low consistency between the two methods, as only six participants are categorised MRA at the same time from both methods.

It is important to note the lack of consistency between the estimated risk aversion class for the OLS and mMPL method. For example, only six out of 77 participants were estimated to have the same degree of risk aversion for test 2, the second row of Table 4.6. Furthermore, looking at the HRA classes we can see that the least consistent pair are when mMPL categorised the participant as MRA, while the OLS categorised as HRA; indeed for the MRA classified by mMPL 92.2% of the classified individuals fell outside of the joint class.

Six out of 45 participants are categorised as being MRA jointly by the OLS and mMPL methods. This highlights a key difference between the tests. The mMPL approach provides certainty versus a lottery, hence the estimate forms a lower bound on the rejection of the risky outcome. In contrast the OLS forces the participant to sequentially choose between uncertain lotteries. As such we can view the OLS as essentially a point estimate within each test. This is borne out in the sample where the OLS tends to deliver a high degree of risk aversion compared to the mMPL, see Table 4.6.

4.2.5 Statistical analysis

A final step is to statistically test the re-distributed classes of both methods. In Table 4.7, the amount of participants that are classified in each re-distributed class is presented. An appropriate for this dataset test to compare the distribution of the two methods is a non-parametric Wilcoxon test, which is performed on the two methods, presented in Figure 4.5. The null hypothesis tested is: "Is the distribution of outcomes of the two methods statistically indistinguishable?"

Table 4.7: Redistributed classes of both methods

	mMPL	**OLS**
Highly risk averse (=1)	231	413
Moderate (=2)	77	45
Slight to risk neutral (=3)	138	42
Negative (=4)	105	51
Sum	551	551

Out of the 551 participants, 243 are categorised in the same class of both re-distributed methods. Fifty-seven participants have positive differences which means that a participant is categorised in a higher risk aversion class in mMPL than OLS. In contrast, 251 have negative differences, which means that the mMPL tends to rank in more risky classes a participant who in OLS is categorised in more risk-averse classes.

The Wilcoxon signed-rank test determines that there is a statistically significant difference between the two methods $z = -10.159, p < 0.0005$, which indicates that the mMPL tends to rank in more risky classes compared to OLS.

Total N	551
Test Statistic	8130.500
Standard Error	1541.672
Standardized Test Statistic	-10.159
Asymptotic Sig.(2-sided test)	.000

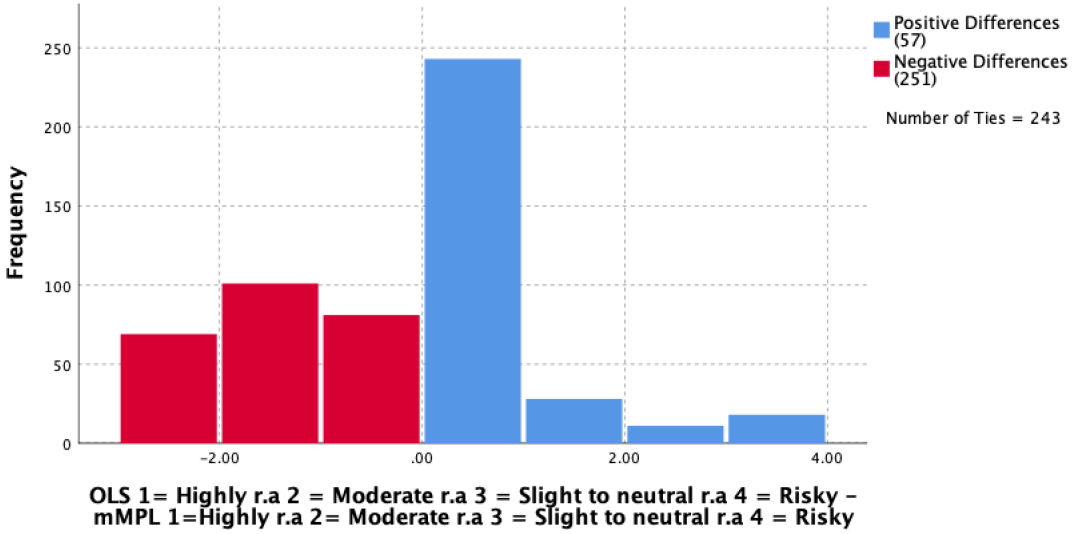


Figure 4.5: Related-samples Wilcoxon signed rank test in risk aversion methods: OLS and mMPL

4.3 Discussion

This chapter provides a comparison between two different methods of measuring risk preferences in the fieldwork sites. The objective is to provide a better understanding of the complementarities between the two methods of estimating risk based decision making in field studies. In particular, for assessing risk aversion levels for farmers' operating in developing countries exposed to substantial hazard events.

The two methods: first the Binswanger [1980] OLS approach and second the Brick et al. [2012] modification of the Holt and Laury [2002] mMPL method are adapted carefully to my fieldwork setting.

The mMPL method in this study reports 21.06% inconsistency within the sample, which is slightly lower than two similar studies from the extant literature employing either the original MPL or mMPL method [see Brick et al., 2012; Jacobson and Petrie, 2009]. However, the degree of inconsistency is higher than that found in another similar mMPL study by Ihli et al. [2016]. Hence, I draw the conclusion that my sample is broadly in line with the extant literature and this allows me to draw similar inferences from my research.

Research suggests that simpler methods might be more applicable to populations with lower educational background [see for instance the discussion in Dave et al., 2010]. Other studies argue that the mMPL method might not be the most applicable in a developing country context [see for instance Brick et al., 2012], especially when the amount of participants making inconsistent choices in developing countries is large [Ihli et al., 2016]. An explanation for this assessment can be given by the degree of inconsistency, which can mostly be ascribed to the combination of testing and explanatory approach as well as the educational background of the participants. In my study, I spent a great deal of time to ensure that the methods used to evaluate risk aversion were carefully communicated to the participants. Hence, my inconsistency rate is close to Ihli et al. [2016] rather than to Brick et al. [2012]. I have a far fewer instances of inconsistent answers (under a standard utility framework) and as such draw the conclusion that with proper explanation the mMPL approach is certainly applicable in most cases. However, when a suitable mechanism or time is not available for careful explanation to participants, then the critique of Brick et al. [2012] would not be an unreasonable conclusion.

Having removed the inconsistent choices data of the mMPL method and re-

distributed the classes, the remaining sample of the two methods is then compared. Both methods revealed that the highest percentages of participants when played hypothetical payoffs games in the neighbourhood of average monthly income are categorised in the highly risk-averse re-distributed class. Specifically, in the re-distributed classes the OLS method recorded 75% of highly risk-averse participants, while the mMPL recorded 41.9%. The OLS method recorded a mean value of 1.51 (s.d 0.98), which was between the moderate and highly risk-averse classes while the mMPL recorded a mean value of 2.21 (s.d 1.18), which is between the moderate and slight-to-neutral classes. The results are consistent with similar studies in which farmers in developing countries are risk-averse [e.g. Ihli et al., 2016; Jin et al., 2016; Yesuf and Bluffstone, 2007].

The mMPL method has a finer distribution of risk aversion classes relative to the OLS approach. In the same vein, the OLS accumulates the degree of risk aversion with higher risk aversion classes, while the rest of the classes recorded less than 10% each. This is also consistent with prior literature.

As farmers' degree of risk aversion is related to their interest in buying insurance and their willingness to forego the premium to purchase protection see Churchill [2006]; Patt et al. [2009], the mMPL method in this study suggests a lower demand profile when compared to the OLS method. The mMPL method, therefore, might be useful in a developing country context as the design of the product would be driven by only the highest level of physical risk as opposed to highly risk averse individuals insuring against smaller risks. Further evidence from fieldwork studies is clearly warranted to cross validate the two methods in a number of developing country contexts.

My study is conducted in rural flood-prone areas of two municipalities in two

districts of Nepal. The majority of the participants are smallholder farmers[17], as the following chapter in Section 5.2.1 explains. As this study does not represent all agricultural zones and inundation types of the country it can not be assumed that the degree of risk aversion of the smallholder farmers is representative for Nepal or other developing-countries context. Further empirical studies from other locations are needed to verify the findings of the comparison of the two methods and bring further insights for the the applicability of mMPL methods in developing countries.

4.4 Chapter Summary

This chapter compared the OLS method by Binswanger [1980] and the mMPL approach based on Holt and Laury [2002] as modified by Brick et al. [2012]. Having introduced the two methods and the way they are adapted in this study, the degree of risk aversion of the farmers for each method was identified. Furthermore, the methods were re-distributed into comparable risk aversion classes and subsequently compared.

The following chapter, Chapter 5, explores the factors affecting farmers' interest in flood insurance and willingness to pay for hypothetical index-based flood insurance in case it existed in the study area.

[17] In Chapter 4, there is no separation between smallholder and commercial farmers.

Chapter 5

Exploring factors affecting farmers' interest in flood insurance and WTP for IBFI

This chapter examines the farmers' WTP for hypothetical Index-Based Flood Insurance (IBFI) in the lowlands of the Karnali River basin in Nepal. Specifically, the chapter explores:

- The factors possibly leading to farmers' lack of interest in flood insurance for crops by employing a bivariate analysis and
- The factors possibly affecting the farmers' WTP for IBFI for crops by employing logistic regression analysis. The logistic regression follows a specific procedure to determine the most relevant variables by a sub-model selection.

The purpose of this chapter is to answer to the research question:

Which are the factors affecting farmers' WTP for hypothetical IBFI for crops in the study area that can be identified by a quantitative survey?

The remainder of the chapter is organised as follows: Section 5.1 reviews studies of the existing literature of agricultural insurance in developing countries and presents the selected factors examined in this study. Following the section gives an overview to the analysis procedure of the chapter. Section 5.2 presents the results, followed by the discussion in Section 5.3 and the chapter summary in Section 5.4.

5.1 Introduction

This section discusses previous research and factors found in the literature, presented in Table 5.1. Based on this review, this section introduces the factors that are examined in this analysis as possible factors affecting the WTP for IBFI. Additionally, information gained during the scoping trip in April 2019, which were incorporated in the questionnaire of the main fieldwork (e.g. local saving groups) are also included in the analysis.

Fonta et al. [2018] for West Africa found that male-headed households had higher WTP than female-headed households when estimating the WTP for weather index-based crop insurance. In contrast, Budhathoki et al. [2019] studied the Tharu community in the lowlands of Nepal, they observed that female household heads were willing to pay more for wheat insurance than male household heads. Tharu are indigenous communities living in the Karnali area who depend on farming activities for their income [Rai et al., 2020]. My research was also conducted in a part of the lowlands of Nepal; therefore, this analysis examined

Table 5.1: Literature on agricultural insurance in developing countries studies

Studied country & Authors	**Insurance type**	**Hazard**
Kedah Malaysia, Afroz et al. [2017]	WTP for crop insurance	Flood
Nepal, Budhathoki et al. [2019]	WTP for area-based crop yield insurance	Natural hazards
Northern Kenya, Chantarat et al. [2009]	WTP for index-based livestock insurance using remotely sensed vegetative cover	Livestock mortality
India, Cole et al. [2013]	Demand for index-based crop insurance	Rainfall deficit/excess
Southwestern Burkina Faso, Fonta et al. [2018]	WTP for weather index-based crop insurance	Dry spell
Ethiopia, Hill et al. [2013]	WTP for weather index insurance	Rainfall deficit
China, Jin et al. [2016]	Weather index crop insurance	Drought
Systematic review on index-based insurance in developing countries, Marr et al. [2016]		

not only the gender but belonging to the Tharu community. Afroz et al. [2017] found that younger household heads were willing to pay more than the elderly when studying the WTP for crops insurance in Malaysia. Budhathoki et al. [2019] found the number of household members to be negatively correlated with WTP for paddy rice. Therefore, age and family size are also included in this analysis.

Afroz et al. [2017] for Malaysia and Jin et al. [2016] for rural China found that the years of farming experience had a positive effect on the WTP of crops insurance. Farmers with larger farms are willing to pay more than farmers with small farms [Afroz et al., 2017; Fonta et al., 2018; Jin et al., 2016]. Budhathoki et al. [2019] found that households with larger plots of lands had a positive relationship with WTP for paddy rice but did not affect WTP for wheat insurance. In the same vein, agricultural experience and cultivated land size are included in this analysis.

While researching index-based livestock insurance in Kenya, Chantarat et al.

[2009] found wealthier households had a negative relation between herd size and WTP, explaining that more affluent households might be able to self-insure. Similarly, Afroz et al. [2017] and Jin et al. [2016] found that farmers' household income was negatively related to WTP for crop insurance. In contrast, Fonta et al. [2018] observed that wealthier households are willing to pay more. Budhathoki et al. [2019] found that households with higher income had a positive relationship with WTP for paddy rice but did not affect WTP for wheat insurance. Hence, the income level ranges of the household of the participant are identified and included in this analysis[1].

People are more likely to buy insurance during the period in which they have taken a loan and have higher liquidity [Patt et al., 2009]. Cole et al. [2013] for India found that demand is reduced when there are liquidity constraints. According to the systematic review by Marr et al. [2016] on index-based insurance for smallholder farmers in developing countries, most studies showed a positive relationship between liquidity and insurance uptake. However, the literature has mixed output regarding credit constraints (ibid.). Hill et al. [2013] for rural Ethiopia found that having access to formal credit mechanisms such as having a bank account increased the WTP. Credit and liquidity characteristics are taken into account in this study to identify the abovementioned characteristics. Having a bank account, having a loan currently, the number of loans taken during the last three years, and the level of difficulty in case the farmer needs to borrow are included in this analysis. Additionally, this analysis examines the number of local saving groups the farmer participates in and the participation in the related

[1]The income level range in the sample of this study does not include potential remittances received.

disasters group.

The relation between exposure to risk and demand for insurance is ambiguous [Marr et al., 2016]. According to Budhathoki et al. [2019], farmers who had experienced floods in the last five years had lower WTP for rice insurance. The number of floods the respondents had experienced during their farming years, the number of floods the respondents had experienced the last five years, and if the farmer had ever experienced a flood that destroyed all their crops are questions included in this analysis as indicators for the risk exposure.

Marr et al. [2016] state that the demand for insurance is expected to be lower in the presence of other risk mitigation strategies such as other means of income, planting a variety of crops and receiving remittances, three variables which are included in this analysis.

Poor understanding of insurance and experience with insurance were mentioned as factors resulting in low uptake [Marr et al., 2016]. Fonta et al. [2018] found that knowledge of crop insurance was positively correlated to WTP, meaning that the more the farmers were informed, the higher the demand. In the same direction, Cole et al. [2013] found that villages with previous experience with insurance had higher insurance demand. Trust is also related to understanding, while mistrust reduces the demand [Marr et al., 2016]. Cole et al. [2013] found that the level of trust significantly affects the demand. In my analysis, experience with any type of insurance, awareness of the existing crop and livestock agricultural insurance scheme, and the level of trust towards a hypothetical index-based flood insurance product that would be sold by a private company are factors included in this analysis.

An increase in basis risk usually reduces demand [Marr et al., 2016]. Cole

et al. [2013] asked the respondents insurance questions and found that the understanding and the demand for insurance were positively correlated. Following similar approaches as those of Hill et al. [2013] and Cole et al. [2013], a series of questions to capture the understanding of IBFI were asked to the respondents. Inspired by Hill et al. [2013], this analysis attempts to get a sense of whether the respondents have a sensitivity towards basis risk.

Education has an ambiguous effect and sometimes insignificant to insurance take up [Marr et al., 2016]. Fonta et al. [2018] found that household heads with no formal education had higher WTP. In contrast, Hill et al. [2013] found that educated farmers will likely be the first adopters of insurance. Furthermore, Cole et al. [2013] observed that the respondents' mathematical skills, probability skills and financial literacy were positively correlated with insurance demand. Therefore, the level of education, mathematics, probability and financial literacy scores are examined in this study. The mathematics questions used are adopted from Cole et al. [2013] and/or Hill et al. [2013], whereas the probability questions utilised a similar approach as the two previously mentioned studies. The financial literacy questions were adapted from Lusardi and Mitchell [2011] and/or Cole et al. [2013].

Chantarat et al. [2009] found that demand decreases with ambiguity aversion when studying the WTP for index-based livestock insurance. Utilising a similar approach as Chantarat et al. [2009] ambiguity aversion data were collected. A considerable number of studies contradict the theory that insurance demand increases with risk aversion [Marr et al., 2016]. For instance, Hill et al. [2013] following the Ordered Lottery Selection (OLS) method by Binswanger [1980] to elicit risk preferences and found that risk-averse respondents were related to low

insurance uptake. Jin et al. [2016] eliciting farmers risk preferences and index insurance uptake in rural China adopted the modified Multiple Price List (mMPL) based on Holt and Laury [2002] as modified by Brick et al. [2012] risk aversion method and found, in contrast, that the more risk-averse farmers had higher chances of willing to pay for index insurance. In my study to identify risk aversion, both OLS and mMPL methods were adopted, as explained previously in Chapter 4. Therefore, both methods are used initially in the analysis of this chapter.

The following paragraphs give an overview of the analysis procedure for the statistical analysis.

An initial pre-process of the data revealed a sub-group of farmers in the sample who would never choose insurance as a potential risk management option. This group was excluded from the WTP analysis and was analysed separately, as presented in Section 5.2.2. The analysis[2] is, therefore, conducted into two parts, as presented in Figure 5.1. The first part analyses factors that might lead to a lack of interest in the general concept of flood insurance for crops. The second part follows a sub-model selection procedure by performing logistic regression analysis that identifies the factors possibly affecting the farmers' WTP for IBFI for crops (Figure 5.1).

As presented in Figure 5.1 44 farmers are identified that might have no interest in flood insurance for crops. In Table 3.6, these 44 respondents would not be interested in purchasing IBFI with or without subsidy. The same 44 respondents in the first question of Table 3.7 did not reply that they would renew their contract, had they bought flood insurance for one cropping season, and a flood

[2]The analysis was conducted by the use of SPSS 26.0 software.

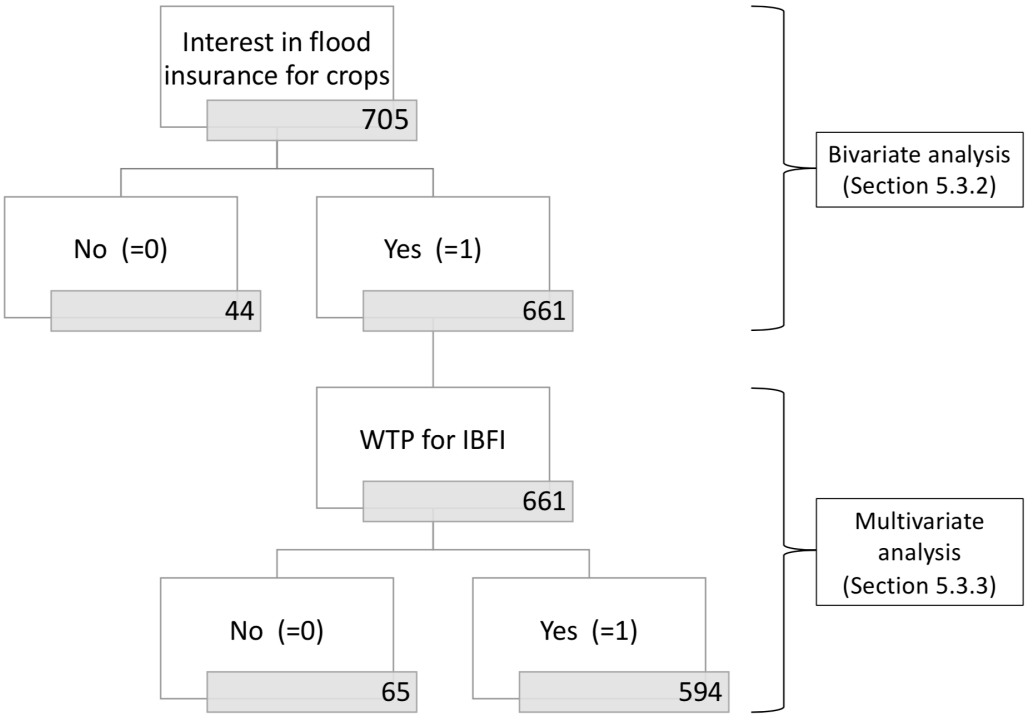


Figure 5.1: Analysis procedure

event did not occur during that season[3]. The same response[4] was obtained for the second question in Table 3.7, asking if they would renew their contract after purchasing for five years and no flood event occurred. Finally, the same 44 respondents did not reply that they would keep[5] their contract in the scenario where they had bought flood insurance for one year for their crops and faced basis risk (third question in Table 3.7). In other words, these 44 farmers did not reply positively to any of the abovementioned five questions. Hence, a new variable for the *interest* in flood insurance observations was generated. The 44 *non-interested* observations were coded with 0, and the remaining 661 observations of the study

[3]The reply was "*no*", or "*I don't know*".
[4]The reply was "*no*" or "*I don't know*".
[5]The reply was "*no*", "*doubt*" or "*I don't know*".

were coded with 1. A bivariate analysis explored the factors leading to the non-interest in flood insurance for crops. The bivariate analysis explored the interest in flood insurance with each of the indicators examined in this study. However, the basis risk variable was not part of the bivariate analysis as this variable contributed to the identification of the 44 non-interested in insurance observations. The analysis is presented in Section 5.2.2.

Following the bivariate analysis, the data were analysed using logistic regressions to identify the factors possibly affecting the farmers' WTP for IBFI. The Wald test in SPSS is used to identify the joint significance of the independent variables. The regression analysis was conducted using the full model of *Enter* method in SPSS. The dependent variable was the WTP for IBFI first question in Table 3.6. The variable was coded with 1 when the farmers replied "*yes*" and 0 when the farmers replied "*no*", as shown graphically in Figure 5.1.

The regression analysis sample consisted of 661 observations, presented schematically in Figure 5.1, as the 44 non-interested in flood insurance for crops observations were subtracted from the regression analysis.

Initially, 109 observations replied "*no*" to the dependent variable in Table 3.6. Therefore, subtracting the 44 observations, 65 "*no*" answers were included in the regression analysis, which are not willing to pay for IBFI. These 65 observations under specific circumstances could be potentially interested in the general concept of flood insurance or IBFI specifically, as they replied positively to at least one out of the five questions explained above. For instance, a substantial number of these 65 farmers changed their answer for their WTP for IBFI from "*no*" to "*yes*" when the subsidy was assumed to be offered.

The logistic regression follows a sub-model selection procedure. As presented

schematically in Figure 5.2, two initial logistic regression models were set up in SPSS, including 30 independent variables. Using the full model of *Enter* method in SPSS, one regression model included the risk aversion measured by the OLS method. The second model included the risk aversion measured by the mMPL method. The 30 independent variables were coded either continuous or dichotomous, as presented in Table 5.3.

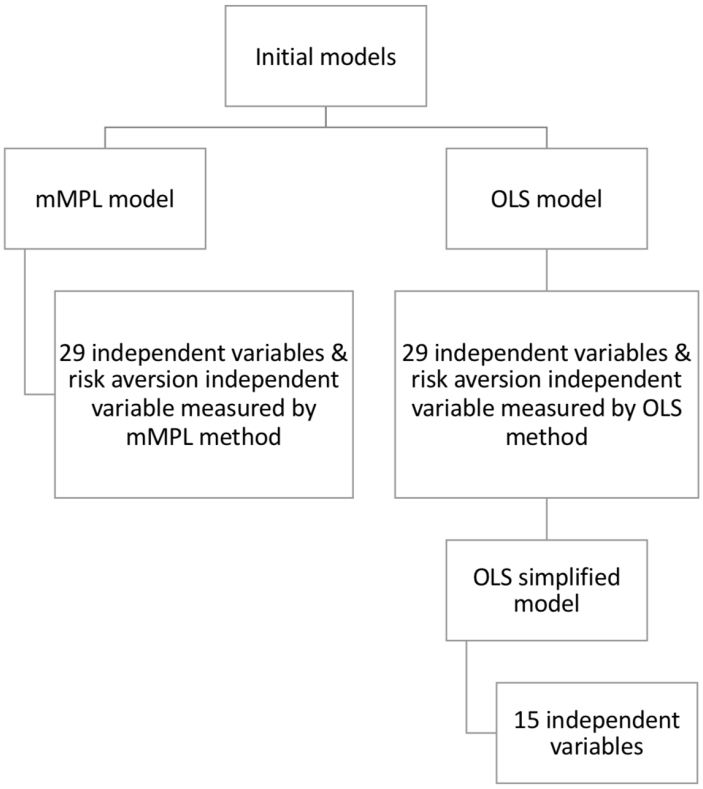


Figure 5.2: Sub-model selection procedure

By the logistic regression, the probability that the insurance is accepted is estimated as a function of the independent (explanatory) variables. A prediction rule can be based on this probability estimate, by assigning the value "*insurance*

will be taken" if this probability is larger than a cut value; otherwise, the value "*insurance will be refused*" is assigned. A selection procedure for the cut value was followed to approach the best prediction for the WTP. The relation between the cut value choice and the correct prediction is shown in Table 5.2.

Table 5.2: Selecting the cut value for the initial and simplified regression models

	OLS				**mMPL**			
Cut value	Correct prediction (%)			Nr. of	Correct prediction(%)			Nr. of
Initial models	Yes	No	Overall	Obs.	Yes	No	Overall	Obs.
0.5	99.4	13.1	90.5	589	99.3	13.7	89.8	461
0.7	95.5	31.1	88.8	589	95.9	27.5	88.3	461
0.8	87.5	52.5	83.9	589	86.6	56.9	83.3	461
0.85	82.0	65.6	80.3	589	79.3	68.6	78.1	461
0.9	**70.6**	**77.0**	**71.3**	589	**66.6**	**76.5**	**67.7**	461
Simplified model								
0.8	88.3	52.3	84.6	630	-	-	-	-
0.85	81.8	66.2	80.2	630	-	-	-	-
0.9	**69.2**	**78.5**	**70.2**	630	-	-	-	-

Five calculations for each of the two initial models were performed with cut values 0.5, 0.7, 0.8, 0.85 and 0.9. By increasing the cut value, the correct prediction for the "*no*" answers improved. However, the correct prediction for the "*yes*" worsened. The 0.9 cut value seemed to be the best for the OLS model, as the model had a correct prediction of "*yes*", "*no*" and "*overall*" higher than 70%. On the other hand, the best prediction for the mMPL model was difficult to identify. The 0.85 cut value resulted in a correct prediction of "*no*" less than 70%. In contrast, a cut value of 0.90 resulted in a correct prediction of "*yes*" and "*overall*" less than 70 %.

The OLS method included 589 observations (72 missing cases) in the initial models' analysis. The mMPL model included 461 observations (200 missing cases) in the initial models' analysis. The inconsistent observations of the mMPL

method of this study (discussed in Chapter 4) were coded as missing values during the analysis of this chapter. Therefore, the mMPL initial model included a higher number of missing cases than the OLS initial model.

Taking into account the higher number of observations used in the initial OLS model and the higher than 70% correct prediction with a cut-off value of 0.9, the OLS initial model was used for the further steps of the analysis of this chapter.

A simplified OLS model was set up, which included 15 variables, as explained in Section 5.2.3. The simplified model of the fifteen variables resulted in the identification of the most significant indicators. As shown in Table 5.2, the simplified OLS model kept the same cut value of 0.9, which had correct prediction in the neighbourhood of 70% and higher. The included observations of the simplified model were 630 with 31 missing cases.

5.2 Results

5.2.1 Descriptive statistics

The descriptive statistics of the sample of 705 observations and the coding in SPSS are presented in Table 5.3. The selected variables in this study are presented in groups of background (1), agricultural characteristics (2), wealth (3), credit and liquidity (4), risk exposure (5), risk mitigation (6), experience with insurance (7), index-based insurance (8), educational background (9) and risk preferences (10).

Background (1): The average age of participants was 42.7 (SD 12.7) years old, slightly higher than Rai et al. [2020] in the lower Karnali River basin in Nepal, which was 38.08. Approximately 53.8% of the participants' were of Tharu ethnic-

ity, lower than Budhathoki et al. [2019] in another Terai region of Nepal, whose sample consisted of 78.4% Tharus ethnicity respondents. In Tharu communities "*[...] women are more empowered and highly aware of agricultural insurance and climate hazards*" [Budhathoki et al., 2019, p.8]. Of the total respondents, 67.9% were female, close to Rai et al. [2020], where the female participants were 62.0%. The study's average family size was 6.22 (SD 3.12), which is in agreement with Rai et al. [2020] that reported an average household size of 6.48 in the lower Karnali River basin in Nepal.

Agricultural characteristics (2): In developing countries, farmers are predominantly smallholder households [Collier et al., 2009]. In many countries, smallholder farmers' farms are less than 2 hectares, while 95% of the smallholder farms are smaller than 5 hectares [Andrade, 2016; FAO, 2014]. On average, the farmers in this study cultivated a cultivated land size area[6] of 20.3 (SD 25.2) Kattha[7]. 58.5% of the farmers in this study cultivate a land size area less than 15 Kattha ($\approx 0.51ha$). 93.9% cultivate less than 60 Kattha ($\approx 2ha$) and 99.3% less 150 Kattha ($\approx 5.1ha$), which indicates that most of the sample was smallholder farmers. In the data analysis of Chapter 5, there was no separation between smallholders cultivating for livelihood or commercial purposes. Finally, almost half of the respondents, reaching 48.2%, had more than 20 years of agricultural experience.

[6]The midpoints of the land size ranges were coded as presented in Table 5.3. The last class $>$ 150 Kattha was coded as 165.0 Kattha.

[7]1 Kattha = 0.034 ha [Budhathoki et al., 2019].

Table 5.3: Descriptive statistics

Group & Indicator	Variable measure	Description & coding in SPSS	Valid N & Valid %	Mean	SD
Background (1)					
Gender	Dichot.	Male (=1), Female (=0)	226 (32.1)	0.32	
Age	Contin.			42.7	12.7
Ethnicity	Dichot.	Tharu (=1), Other (=0)	379 (53.8)	0.54	
Household members	Contin.			6.22	3.12
Agricultural characteristics (2)					
Agricultural exper.	Contin.			2.29	0.77
		$5-10$ (=1)	133 (18.9)		
		$11-20$ (=2)	231 (32.9)		
		>21 (=3)	339 (48.2)		
Cultivated landsize	Contin.			20.3	25.2
		<5 (=2.5)	192 (27.3)		
		$5-10$ (=7.5)	141 (20.1)		
		$10-15$ (=12.5)	78 (11.1)		
		$15-20$ (=17.5)	59 (8.4)		
		$20-30$ (=25.0)	90 (12.8)		
		$30-45$ (=37.5)	66 (9.4)		
		$45-60$ (=52.5)	34 (4.8)		
		$60-90$ (=75.0)	24 (3.4)		
		$90-120$ (=105.0)	10 (1.4)		
		$120-150$ (=135.0)	4 (0.6)		
		>150 (=165.0)	5 (0.7)		
Wealth (3)					
Income without remitt. (monthly)	Contin.			1.69	0.80
		<5000 (=1)	343 (48.7)		
		$5000-15000$ (=2)	267 (37.9)		
		$15000-25000$ (=3)	66 (9.4)		
		>25000 (=4)	28 (4.0)		
Credit & liquidity (4)					
Had a bank account	Dichot.	Yes (=1), No (=0)	387 (55.2)	0.55	
Loan currently	Dichot.	Yes (=1), No (=0)	493 (69.9)	0.70	
Loans last 3 years	Contin.			3.08	2.26
Borrowing difficulty	Contin.			2.01	0.79
		Easy (=1)	212 (30.2)		
		Average difficulty (=2)	270 (38.5)		
		Very difficult (=3)	219 (31.2)		
Number of local financial schemes	Contin.			1.99	1.72
		0 (=0)	177 (25.3)		
		1 (=1)	137 (19.6)		
		2 (=2)	138 (19.7)		
		3 (=3)	117 (16.7)		
		4 (=4)	59 (8.4)		
		5 (=5)	38 (5.4)		
		More than 5 (=6)	33 (4.7)		

Continued.

Group &	Variable measure	Description & coding in SPSS	Valid N & Valid %	Mean	SD
Participate in CDMC	Dichot.	Yes (=1), No (=0)	130 (18.9)	0.19	
Risk exposure (5)					
Floods experienced	Contin.			6.30	4.21
Floods exper. last 5 years	Contin.			1.69	0.95
Floods destroyed all crops	Dichot.	Yes (=1), No (=0)	684 (97.0)	0.97	
Risk mitigation (6)					
Mixed Crops	Dichot.	Yes (=1), No (=0)	627 (89.4)	0.89	
Other means of income	Dichot.	Yes (=1), No (=0)	413 (58.7)	0.59	
Remittances	Dichot.	Yes (=1), No (=0)	204 (29.0)	0.29	
Experience with insurance (7)					
Insur. exper. in general	Dichot.	Yes (=1), No (=0)	367 (52.1)	0.52	
Agricultural insurance scheme aware	Dichot.	Yes (=1), No (=0)	443 (62.9)	0.63	
Trust	Contin.			0.72	0.60
		Don't trust (=0)	252 (35.8)		
		Medium (=1)	396 (56.3)		
		Highly (=2)	56 (8.0)		
Index-based insurance (8)					
Understanding of IBFI				10.6	2.87
Basis risk sensitivity	Contin.			2.46	0.82
		Keep (=1)	144 (20.8)		
		Doubt (May/May not) (=2)	88 (12.7)		
		Definitely not renew (=3)	460 (66.5)		
Educational background (9)					
Education	Contin.			0.78	0.89
		No education/ No formal education (=0)	330 (46.8)		
		Primary school (=1)	235 (33.3)		
		Secondary school (=2)	108 (15.3)		
		High school (=3)	26 (3.7)		
		University or higher (=4)	6 (0.9)		
Mathematics	Contin.	Average score		1.42	1.26
Probability	Contin.	Average score		1.41	0.73
Financial lit.	Contin.	Average score		1.88	1.07

Continued.

Group &	Variable measure	Description & coding in SPSS	Valid N & Valid %	Mean	SD
Risk preferences (10)					
Ambiguity aversion	Dichot.	Not Amb. Av. (=0), Ambiguity averse (=1)	560 (83.3)	0.83	
Risk aversion OLS	Contin.			3.73	1.76
		Neutral to negative risk averse (=0)	65 (9.3)		
		Slight to risk neutral (=1)	50 (7.2)		
		Moderate risk averse (=2)	65 (9.3)		
		Intermediate risk averse (=3)	57 (8.2)		
		Severe risk averse (=4)	53 (7.6)		
		Extreme risk averse (=5)	409 (58.5)		
Risk aversion mMPL	Contin.		n=555	1.61	2.62
		Highly risk loving (=-4)	40 (7.2)		
		Highly risk loving (=-3)	23 (4.1)		
		Very risk loving (=-2)	24 (4.3)		
		Risk loving (=-1)	20 (3.6)		
		Risk neutral (=0)	66 (11.9)		
		Slightly risk averse (=1)	72 (13.0)		
		Risk averse (=2)	46 (8.3)		
		Very risk averse (=3)	31 (5.6)		
		Highly risk averse (=4)	233 (42.0)		

Wealth (3): Of the respondents, 48.7% reported that their household's income range[8] was less than 5 000 NPR/month. Each income range was coded as a continuous variable. The mean of the income ranges was 1.69 (SD 0.80), which indicates that the income of the respondent's households was on average between the first two classes ($< 5\,000$ and $5\,000 - 15\,000$ NPR/month). The result is lower than the average monthly household income in rural areas of 20 997 NPR[9] in the

[8]Income ranges in the sample do not include potential remittances.

[9]Average monthly household income with remittances in rural areas was 27 511 NPR out of which the remittances were 6 514 NPR [Kaphle et al., 2016]. In this analysis, the potential

fiscal year 2014/2015 [Kaphle et al., 2016].

Credit & liquidity (4): Out of the sample, 55.2% had a bank account. 69.9% of the respondents' households had a loan at the period of the survey. The average number of loans during the last three years was 3.08 (SD 2.26). Of the respondents, 31.2% replied that it is very difficult to borrow if someone needed it, 38.5% categorised the difficulty to borrow as average and 30.2% as easy. The respondents were asked if their community had any saving schemes. The farmers who replied that their community had saving schemes were asked further if they participated in any of these schemes. The farmers who replied positively were further asked the number of the schemes they participated in. The number of the saving schemes the farmer participated in was used in the regression analysis[10]. The average number of schemes the farmers participated[11] was 1.99 (SD 1.72). Approximately 18.9% of the respondents replied that they participate in the fund for disasters (CDMC)[12].

Risk exposure (5): On average, the respondents had experienced 6.30 (SD 4.21) flood events during their farming years. During the last five years, the respondents had, on average experienced 1.69 (SD 0.95) flood events. 97% of the

remittances were not included in the income. Therefore, the data are compared with the income without remittances of the Kaphle et al. [2016] survey, which is 27 511-6 514=20 997 NPR.

[10]The number of schemes was coded as continuous. The sixth option indicated participation in more than five schemes.

[11]167 farmers replied that their community has a saving scheme, but they do not participate. Ten farmers replied that their community does not have a saving scheme. These 177 observations were coded to participate in zero number of schemes at the *Number of local saving schemes* variable. Six observations replied that they do not know if their community has saving schemes and were coded as missing values *Number of local saving schemes* variable.

[12]109 farmers replied that their community does not have a CDMC fund. These observations were coded as zero at the CDMC participation variable, meaning that they do not participate in the CDMC. Sixteen observations replied that their community does not have saving schemes or does not know if their community has saving schemes. These 16 observations were coded as missing values at the CDMC participation variable.

respondents had experienced a flood that destroyed all their crops during their farming years.

Risk mitigation (6): Of the farmers, 89.4% plant mixed crops, 58.7% of the respondents' households had other means of income apart from agriculture, and 29% of the respondents' households received remittances from abroad.

Experience with insurance (7): Of the respondents, 52.1% had experience with insurance in general. 62.9% had heard about the existing crops and livestock insurance scheme. Approximately 56.3% replied that they would have medium trust towards a private insurance company that would potentially sell an index-based flood insurance product.

Index-based insurance (8): On average, the participants replied with a mean of 10.6 (SD 2.87) correct out of 12 hypothetical IBFI understanding questions. The result suggests a good understanding of the hypothetical IBFI for crops. 66.5% of the respondents would definitely not renew their contract if they had bought flood insurance for their crops, experienced flood in their field and did not receive payment indicating a sensitivity towards basis risk.[13].

Educational background (9): Of the participants, 46.8% did not have formal education. The average score in mathematics was 1.42 (SD 1.26) out of four correct answers. Respondents performed better on probability questions reaching 1.41 (SD 0.73) out of two correct answers. The result is similar to Cole et al. [2013] for India that revealed higher percentages in probability scores than mathematical questions. The average score of the financial literacy skills was 1.88

[13]Basis risk was coded as a continuous variable with increasing basis risk sensitivity; values 1,2,3. The "*I don't know*" option of the basis risk question explained in Section 3.7.2 was treated as a missing value in the regression analysis. Therefore, the valid (%) responses of Table 3.7 and Table 5.3 are slightly different.

(SD 1.07) out of four correct answers[14].

Risk preferences (10): Of the respondents 83.3% were identified as ambiguity averse[15]. The six CRRA ranges of the OLS method were coded as continuous with values ranging from zero to five. Similarly, the CRRA mMPL risk aversion ranges were coded from minus four to four. The OLS risk aversion method reported a mean of 3.73 (SD 1.76), indicating that the average participant was severely risk-averse. The mMPL risk aversion method had a mean of 1.61 (SD 2.62), indicating that the average participant was risk-averse.

5.2.2 Factors leading to lack of interest in a potential flood insurance

As explained in Section 5.1, forty-four observations were identified that might have no interest at all in flood insurance for crops. A bivariate analysis was performed to observe the relationship between indicators that might be related to the lack of interest in flood insurance for crops variable. The bivariate analysis was performed between the interest in flood insurance variable and each of the variables of the ten abovementioned groups examined in this study[16]. Eight indicators are significantly correlated with the interest in insurance variable, as shown in Table 5.4.

[14]The scores in mathematics varied between 0-4 correct answers, probability between 0-2 and financial literacy between 0-4 correct answers in the regression analysis.

[15]This is the valid percent excluding the "*I don't know/I don't want to reply*" answers, which were coded as missing values. This is why there is a difference with the Table 3.5 where the percentage presented was out of the whole sample including the "*I don't know/I don't want to reply*" answers.

[16]The bivariate analysis was performed between the *Interest in insurance* variable and the independent variables identified to be used in the regression analysis. However, as already mentioned in Section 5.1 the basis risk variable was not part of the bivariate analysis as this variable contributed to the identification of the 44 non-interested in insurance observations.

Table 5.4: Bivariate analysis for the non-interested in insurance variable

Indicator	**Significance level**	**Correlation coefficient** (Spearman's ρ)
CDMC	0.016	0.092*
Trust	0.001	0.123**
Understanding IBFI	0.001	0.125**
Mathematical scores	0.013	0.094*
Probability scores	0.021	0.087*
Financial literacy	0.012	0.095*
Risk aversion (OLS)	0.026	-0.084*
Risk aversion (mMPL)	0.015	-0.103*

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)

The interest in flood insurance variable was positively correlated with the participation in the local community group for disasters (CDMC)($\rho = 0.092$, $p \leq 0.05$). The results suggest that the farmers who did not participate in the CDMC fund might not be interested in flood insurance. One possible explanation could be that these farmers might not be interested in the informal risk-sharing mechanisms for disasters (such as the CDMC) or the formal ones (such as the insurance). A substantial number of farmers replied that their community does not have a CDMC[17]. Hence, another possible explanation could be that when farmers are not familiar with informal mechanisms for disasters' preparedness, they might not be interested in formal ones.

The interest in flood insurance variable was positively correlated to the trust towards a private company, which would hypothetically provide the IBFI described ($\rho = 0.123$, $p \leq 0.05$). The result indicates that farmers who have low trust towards private insurance companies might not be interested in flood insur-

[17]The farmers who replied that their community does not have a CDMC were coded as not participating in CDMC.

ance. One possible explanation could be previous bad experiences with insurance, resulting in low trust and low interest. A substantial number of farmers did not have experience with insurance in general; therefore another possible explanation could be that the lack of experience with insurance might result in low interest and trust as it might be perceived as something new.

The risk aversion measured by the OLS method ($\rho = -0.084$, $p \leq 0.05$) and the mMPL method ($\rho = -0.103$, $p \leq 0.05$) were both negatively correlated with the interest in insurance, which indicates that the higher the risk aversion the less the interest in flood insurance. One possible explanation for the negative relationship could be that farmers with high-risk aversion might perceive insurance as a lottery and not as a protection mechanism and do not want to engage with it. A considerable number of studies contradict the theory that insurance demand increases with risk aversion [Marr et al., 2016]. Technology adoption studies have shown that risk-averse households might not be early adopters of new technologies [Hill et al., 2013]. As a result, another possible explanation for the negative relation of interest in insurance and risk aversion could be that flood insurance might be perceived as new technology.

The understanding of IBFI was positively correlated with the interest in flood insurance ($\rho = 0.125$, $p \leq 0.01$). The result suggests that those who were not interested in flood insurance might have low understanding of IBFI. Among the significant variables were also the mathematics ($\rho = 0.094$, $p \leq 0.05$), probability ($\rho = 0.087$, $p \leq 0.05$) and financial literacy scores ($\rho = 0.012$, $p \leq 0.05$). Farmers with low scores in those three variables might not be interested in insurance. As Table 5.5 indicates, the education level was positively and significantly related to the understanding of IBFI, the math, probability and financial literacy scores.

Table 5.5: Bivariate analysis for the education variable

	Spearman's ρ	**Sign.**
Education & Understanding IBFI (N=705)	0.172**	0.000
Education & Mathem. scores (N=705)	0.606**	0.000
Education & Probab. scores (N=705)	0.332**	0.000
Education & Finan. Lit. scores (N=705)	0.302**	0.000

** Correlation is significant at the 0.01 level (2-tailed)

Therefore, the results suggest that there is a relationship between education and interest in flood insurance, indicating that farmers with low levels of education might have no interest in flood insurance for crops.

5.2.3 Factors affecting the WTP for IBFI

The dependent variable question asked the participants if they would be willing to buy such type of flood insurance (after having been introduced to IBFI) if it was offered at an affordable price. The dependent variable of the regression analysis is the first question presented in Table 3.6. As already introduced in Section 5.1 and presented graphically in Figure 5.1, the regression analysis included 661 participants out of whom 594 replied "*yes*" to the dependent variable and 65 replied "*no*".

As already introduced in Section 5.1 and presented schematically in Figure 5.2, the logistic regression analysis was conducted into two parts. The initial model included 30 independent variables[18] and the simplified model 15. The initial model's regression analysis results are presented in Table 5.6. Through model

[18] A municipality dummy (Tikapur =1, Rajapur=0) was tested and was not significant under the initial model's configuration and was dropped.

selection with multiple information criteria, I selected the following sub-model to construct the more parsimonious model shown in Table 5.7. The variables, which set-up the simplified model were gender, age and ethnicity, agricultural experience, bank account, borrowing difficulty, number of local financial schemes the farmer participated, number of floods the farmer had experienced in total and during the last five years, planting mixed crops, other means of income, awareness of the existing agricultural insurance scheme, understanding of IBFI, basis risk sensitivity and scores in mathematics. The variables belonged in the presented groups of background data (1), agricultural characteristics (2), credit and liquidity (4), risk exposure (5), risk mitigation (6), insurance (7), index-based insurance (8) and educational background (9).

As presented in Table 5.7, the simplified model indicated that five factors might affect the WTP for IBFI with significance level ≤ 0.05. The five variables were the age, the agricultural experience, the number of floods experienced during the last five years, the scores in mathematics and the basis risk sensitivity, which belonged in the presented groups of questions background (1), agricultural characteristics (2), risk exposure (5), IBFI (8) and educational background (9), accordingly.

The age was negative and significant ($p \leq 0.05$). The result indicates that younger farmers have higher odds of WTP for IBFI than older farmers. The result agrees with the findings of Afroz et al. [2017] that found younger farmers in Malaysia are willing to pay more for crop insurance than the elderly and gave as an explanation that younger farmers might be more open to new ideas.

The agricultural experience was positive and significantly related to WTP ($p \leq 0.05$). The result suggests that the higher the farming experience, the

Table 5.6: Logistic regression analysis initial model

	Group	Indicator	$\hat{\beta}$	p-value	exp($\hat{\beta}$)
1	Background (1)	Gender	-0.579	0.161	0.560
2	”	Age	-0.040	0.008	0.960
3	”	Ethnicity	-0.713	0.059	0.490
4	”	HH size	-0.029	0.568	0.971
5	Agricult. characteristics (2)	Agricult. experience	0.377	0.080	1.458
6	”	Cultivated landsize	-0.002	0.786	0.998
7	Wealth (3)	Income	0.117	0.613	1.125
8	Credit & Liquidity (4)	Bank account	-0.320	0.319	0.726
9	”	Loan currently	0.229	0.506	1.257
10	”	Loans last 3 years	-0.068	0.336	0.934
11	”	Borrowing difficulty	-0.264	0.208	0.768
12	”	Nr. of schemes	-0.140	0.157	0.869
13	”	CDMC	0.334	0.457	1.397
14	Risk exposure (5)	Floods experience	0.06	0.262	1.062
15	”	Floods last 5 years	0.366	0.078	1.441
16	”	Floods destr. all crops	0.630	0.415	1.877
17	Risk mitigation (6)	Mixed crops	-1.848	0.086	0.158
18	”	Other means of income	0.405	0.255	1.500
19	”	Remittances	-0.300	0.441	0.741
20	Insurance (7)	Experience insurance	-1.112	0.724	0.894
21	”	Agric. insur. scheme aware	0.541	0.091	1.717
22	”	Trust	0.208	0.443	1.232
23	Index-based insurance (8)	Understanding IBFI	0.058	0.300	1.060
24	”	Basis risk sensitivity	-0.857	0.001	0.424
25	Educ. background (9)	Education	0.058	0.832	1.060
26	”	Mathemat. scores	0.381	0.065	1.464
27	”	Probability scores	0.085	0.727	1.089
28	”	Financ. literacy scores	0.127	0.406	1.135
29	Risk preferences (10)	Ambig. aversion	-0.053	0.895	0.948
30	”	Risk aversion OLS	0.035	0.670	1.036

higher farmer's odds to willing to pay for IBFI. One possible explanation might be that farmers with higher agricultural experience might have higher experience with agricultural losses during their farming years [Jin et al., 2016]. The result is in agreement with the findings of Afroz et al. [2017] and Jin et al. [2016].

The number of floods experienced during the last five years was positive and significant ($p \leq 0.05$). Hence, farmers with a higher number of floods experienced

Table 5.7: Logistic regression analysis simplified model

	Group	Indicator	$\hat{\beta}$	p-value	exp($\hat{\beta}$)
1	Background (1)	Gender	-0.458	0.226	0.633
2	”	**Age**	**-0.033**	**0.011***	**0.967**
3	”	Ethnicity	-0.542	0.098	0.582
4	Agricult. characteristics (2)	**Agricult. experience**	**0.395**	**0.049***	**1.484**
5	Credit & Liquidity (4)	Bank account	-1.999	0.495	0.819
6	”	Borrowing difficulty	-0.325	0.096	0.722
7	”	Nr. of schemes	-0.107	0.226	0.898
8	Risk exposure (5)	Floods experience	0.049	0.325	1.050
9	”	**Floods last 5 years**	**0.374**	**0.047***	**1.454**
10	Risk mitigation (6)	Mixed crops	-1.982	0.056	0.138
11	”	Other means of income	0.097	0.745	1.102
12	”	Agric. insurance scheme aware	0.532	0.070	1.702
13	IBFI (8)	Understanding IBFI	0.046	0.345	1.047
14	”	**Basis risk sensitivity**	**-0.083**	**0.001*** **	**0.436**
15	Educ. background (9)	**Mathemat. scores**	**0.421**	**0.010** **	**1.523**

* $p \leq 0.05$,
** $p \leq 0.01$
*** $p \leq 0.001$

during the last five years have higher odds of willing to pay for IBFI. One possible explanation could be that the experience with losses recently might increase the demand for protection. A further possible explanation could be that the higher number of floods experienced during the last five years might indicate a higher risk exposure and consequently, need protection. It should be noted that the result contrasts with the findings of Budhathoki et al. [2019] who found that the number of floods during the last five years was negatively related to the WTP for paddy rice in the lowlands of Nepal.

The mathematics scores had a positive and significant ($p \leq 0.01$) relation with WTP for IBFI. The higher the mathematical scores, the higher the odds of being willing to purchase IBFI. The result is in agreement with Cole et al. [2013]

who found that farmers in India who performed better in mathematics had a higher WTP. An analysis between the scores in mathematics and education level in the sample of 661 observations revealed a positive and significant relationship between the education and score in mathematics variables (spearman's rho coeff. 0.602, sign. 0.000). Consequently, the results suggest that the higher the farmer's education level, the higher the odds of WTP for IBFI. As a result, the findings can be related to the findings of Hill et al. [2013] for rural Ethiopia and Jin et al. [2016] for rural China who found that educated farmers might be early adopters of insurance. In contrast, Fonta et al. [2018] for West Africa found that educated farmers are willing to pay less than farmers with no formal education.

Finally, the basis risk sensitivity variable had a negative and significant relation with the WTP. The variable had the highest significance level among all ($p \leq 0.001$). The result indicates that farmers with low basis risk sensitivity have higher odds of willing to pay for the hypothetical IBFI.

5.3 Discussion

One important finding of the analysis in this chapter is the identification of a subgroup of farmers who have no interest at all in potential insurance. The following are factors for the lack of interest in flood insurance: the non-participation in local groups for disasters, lower trust towards insurance companies, higher risk aversion and lower education.

An initial model of 30 independent variables was set up for the interested in flood insurance farmers and a simplified one with 15 variables. The simplified model of 15 independent variables indicated five factors possibly affecting farmers'

WTP for hypothetical IBFI. Younger farmers, farmers with more agricultural experience, farmers who experienced a higher frequency of floods during the last five years, farmers with higher education level and farmers with low basis risk sensitivity have higher odds of being the first adopters of a potential IBFI product in the examined area.

Education about the risks and insurance role would possibly lead to higher interest in flood insurance for crops generally and WTP for IBFI specifically. One possible way to deliver education about insurance to farmers might be through workshops and training. Furthermore, farmers with high basis risk sensitivity have higher odds of not being willing to pay for index-based flood insurance. Therefore, a particular emphasis on minimising basis risk should be given when designing these types of products.

5.4 Chapter Summary

This chapter analysed the empirical data of the 705 quantitative questionnaires collected from smallholder farmers exposed to frequent floods of the study area in the lowlands of the Karnali River basin in Nepal. The chapter explored the factors affecting farmers' willingness to pay for IBFI and interest in flood insurance for crops in general.

Chapter 6 explains the game and analyses the game sessions with the farmers and the qualitative data collected during the FGDs and KIIs with the farmers.

Chapter 6

Exploring factors affecting the demand for IBFI: An index-based insurance game and a qualitative approach

Games have become popular in humanitarian and DRM fields, as they combine components of contextual settings (e.g. scientific information) with an element of fun [Mochizuki, 2016]. Games have been and continue to be developed, among other purposes, to communicate information and increase awareness for various topics in the field of DRM [Solinska-Nowak et al., 2018].

This chapter presents the game developed to introduce IBFI for crops during the main fieldwork. The game's purpose was not to educate or raise awareness for insurance, rather to communicate basic characteristics of index-based insurance to farmers in a relatively simple form, through an example of hypothetical IBFI

for crops and get farmers' opinions and insights on the topic.

The chapter explores possible factors that could affect potential IBFI for crops, through insights of the participants during the game sessions and qualitative approaches. The analysis and identification of these factors could bring useful information and insights for designing a potential IBFI product, if offered in the study area.

The remainder of the chapter is organised as follows: Section 6.1 presents the analysis procedure followed in the chapter. Section 6.2 presents the results followed by the discussion in Section 6.3 and the chapter summary in Section 6.4.

6.1 Introduction

The data analysed in this chapter was collected during the main fieldtrip from the game sessions and qualitative approaches. As presented in Figure 6.1, the factors that possibly affect potential IBFI for crops are identified through statistical analysis of the games, the reflections and insights of the participants during the games' sessions, FGDs and KIIs[1].

The analysis of the qualitative components (KIIs, FGDs and reflections during the game) was done using the NVIVO software, where the empirical data were analysed using thematic analysis. Thematic analysis is a method that classifies and divides the data by organising them into themes [Braun and Clarke, 2006].

[1]The KIs had either played the game or been briefly introduced to IBFI during the interview.

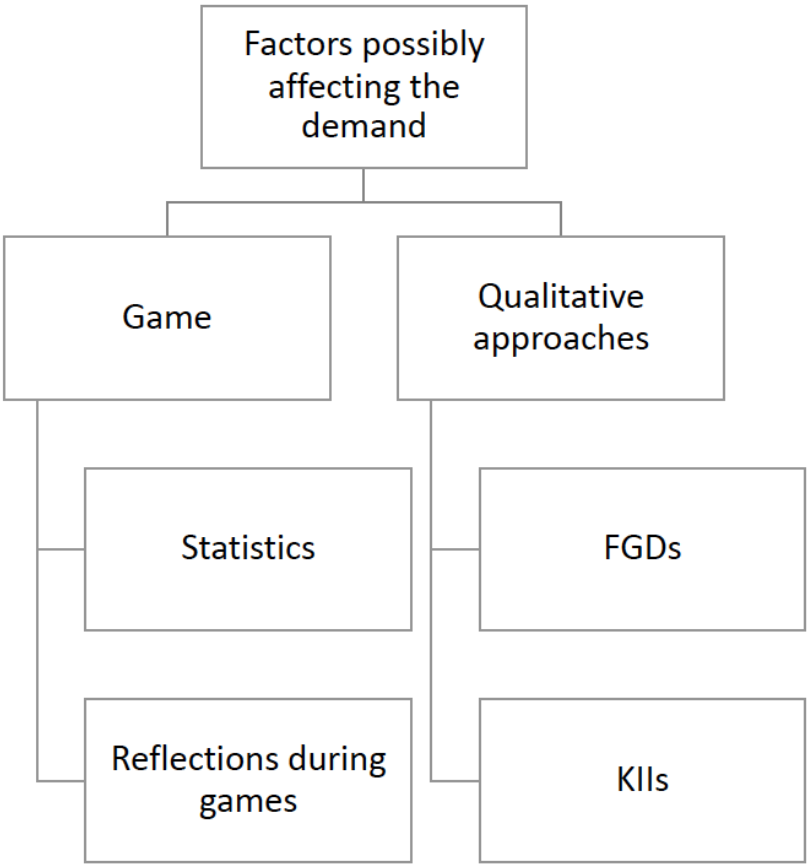


Figure 6.1: Analysis procedure

6.2 Results

This section presents the factors that are likely to affect potential IBFI for crops as identified during the analysis. These factors[2] are:

- Weather conditions
- Government's subsidy-presence

[2]The factors are not placed in order of priority.

- Basis risk
- Understanding of insurance
- Experience with agricultural insurance.

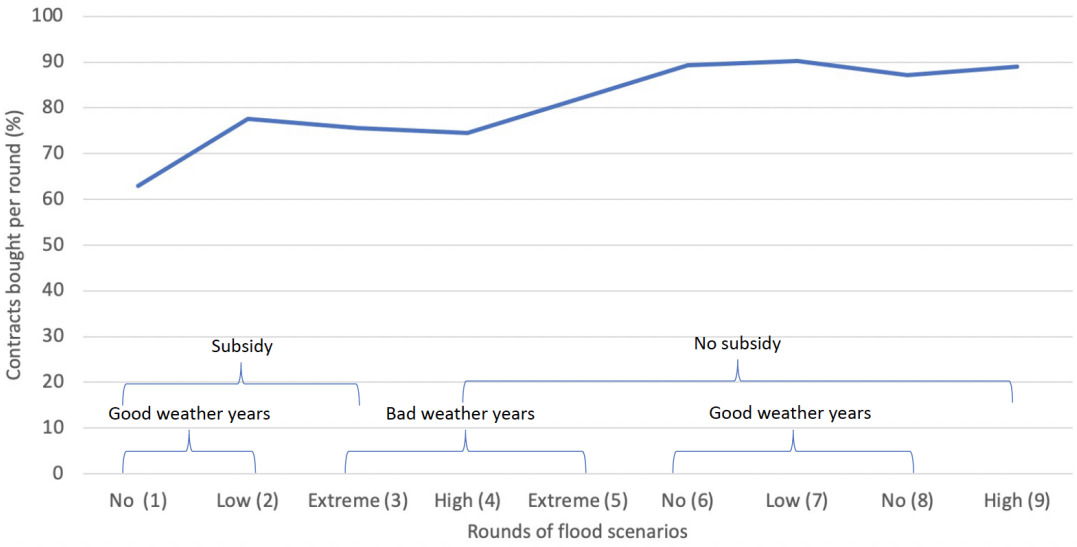


Figure 6.2: Average contracts bought per round

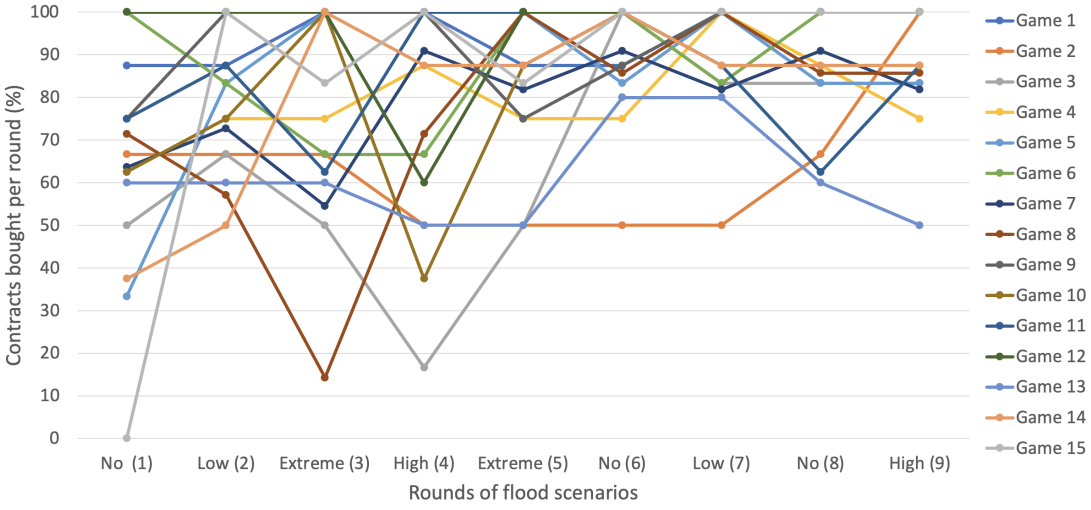


Figure 6.3: Contracts bought per round per game session

Weather conditions: Despite the general increasing demand in Figure 6.2, the slope is decreasing after the second and before the third round ("low flood" to "extreme flood" event). The average demand between those rounds dropped from 77.7 to 75.5 %. As observed in Figure 6.3, which presents the bought contracts of IBFI during each of the game sessions, between the second and third rounds the demand in some of the game sessions decreased. The first and second rounds were good weather years of "no flood" and "low flood" events, respectively. As a result, some of the players who bought insurance during the first and/or second round of the game and did not experience a flood event might not have wished to renew their contract. For instance, 9.0 % of players of all games who had bought insurance before the first round did not renew their contract for the second round. In the second round, most of the players' crops are safe. 17.0 % of the players who bought insurance before the second round and their agricultural field was not flooded at all when the event occurred did not renew their contract for the third round. Turner et al. [2014], when studying the effect of flood experience on individual's behaviour in Pakistan, found that being affected by a severe flood increased the demand for insurance compared with individuals not affected. Therefore, one possible explanation could be that the players' decisions in my game might be affected by the continuous good weather years and those farmers non-affected from floods might wish to stop renewing.

These continuously good weather years of "no flood" and "low flood" events are repeated in the sixth and seventh round of the game, respectively. The demand decreased after the seventh round from 90.2 to 87.2 %. In this case, the players who had bought insurance before the sixth ("no flood") round, did not experience losses in their agricultural field and decided not to renew their

contracts for the seventh round were 4.5 %, which is reduced to half than the 9.0 % before the second round. Accordingly, 5.7 % of the players who bought insurance before the seventh ("low flood") round, did not experience losses and did not renew their contracts for the eighth round, substantially less than the results before the third round, which was 17.0 %. Comparing the initial to the similar latter rounds of the game ("no flood"-"low flood"), the results indicate that there might be a learning process within the game, as fewer players gave up their contracts after not experiencing losses.

Government's subsidy-presence: Insurance was bought, in general, to a high degree during the game sessions. As the game was evolving, the demand showed a generally increasing trend, as observed in Figure 6.2. On average, the bought contracts of all games during the first round were 63.0 %, which reached 88.9 % during the last round of the game, as shown in Figure 6.2. During the first three rounds (which were the subsidised rounds), insurance was bought on average at 72.1 %. During the last six rounds (which were non-subsidised rounds) the average insurance contracts were still bought at a high degree of 85.3 %.

Despite the higher percentage of the non-subsidised rounds on average, the withdrawal of subsidy possibly affected the demand at the round that subsidy was announced that would not be offered any more. Specifically, a decrease in the slope in Figure 6.2 occurred between the third and fourth round (i.e "extreme flood" to "high flood") where the demand decreased from 75.5 to 74.5 %. Similarly, Figure 6.3 shows that some of the game sessions decreased in demand before the fourth round. After the third round, the government stopped providing subsidy, and the price doubled for the players. As a result, the government's

presence or absence might have affected the demand. For instance, one of the reasons why one player decided to buy insurance at one of the subsidised rounds was the government's presence through subsidy:

"*Because my land is prone to the flood and other reason is that government come to support so I am interested*" (Player game 4)

However, players might have been price sensitive and did not renew their contract when there was no subsidy provided. For instance, when some of the players' were asked why they do not renew their contract for the first non-subsidised round their answer was:

"*This time government doesn't support and insurance is expensive*" (Player game 10)

"*Government does not support so it is costly for me*" (Player game 3)

Similarly, during one FGD, one of the participants replied that their decision to buy potential IBFI products would depend on having enough money.

"*It depend upon the money, if we have enough money we are happy to buy and secure our crops and investment.*" (Participant FGD 7)

A substantial number of participants preferred insurance to be offered by the government instead of a private company, when asked what would they choose among some options. Wang et al. [2020] argue that farmers in China prefer insurance providers to be government-owned due to a lack of trust in private insurance companies. One participant replied that they would prefer insurance to be sold through the government and suggested that subsidies are needed:

"*Through government, if government provides some subsidy that would be very good for us, as we are farmers with very low income*" (Participant FGD 8)

The findings suggests that there are affordability issues, therefore the price of insurance and government's subsidy and presence would possibly affect the demand.

The demand increased again after the first non-subsidised round, possibly due to the continuous bad weather years (the demand increased again after the fourth round ("high flood") and continued to increase after the fifth round ("extreme" event)). One explanation could be that there might be a need for protection from floods during the game, especially after continuous bad weather years. For instance, one player who did not buy at the first non-subsidised round (fourth round), decided to buy at the second non-subsidised round (fifth round), and the answer for buying was:

"*When there is flood we might lose our investment*" (Player game 6)

Basis risk: After the second round of the game, 18.8 % of the players who had bought insurance experienced "low flood" and partial losses in their field and did not receive payments for their losses, they did not renew their contract for the next round. Similarly, after the fourth round, 25 % of the players who experienced total losses due to the "high flood" event and received payments for partial losses did not renew their contract for the next round. Finally, 8.7 % of the players who experienced basis risk[3] due to "low flood" after the seventh round, did not renew their contract for the next round. Therefore, the results indicate that basis risk was possibly a factor affecting the demand during the games. However, there

[3]In the remainder of this analysis, basis risk stands for downside basis risk.

were cases where players continued buying even having experienced basis risk in the previous round due to the need for protection from floods and influence of other players' choices:

"*There is no guarantee when a flood will happen so, I saw sometimes buying the insurance is to insure our investment as well as other people in the community are buying therefore, I decide to buy insurance*"(Player game 1)

Understanding of insurance: During the games, the concept of insurance as a risk transfer mechanism might not have been entirely understood by some players. For instance, one player decided to not renew the contract because the player expected to make profit from the insurance:

"*Insurance doesn't give us profit, I am paying only premium*" (Player game 7)

Ghimire et al. [2016a, p.17] argue that "*Farmers are not willing to pay a premium because they don't get any payback in cases they do not suffer any hazard*". Similarly, some players might have felt that they lose their premium when they do not experience losses, and consequently they receive nothing back from the insurance company. Specifically, some players' answer to the question why they decided to give up their contract for the next round was:

"*Previous year flood didn't come and I think I lost my premium*" (Player game 8)

"*Because I am paying premium in a continual basis for two years but there is no such impact happening in my field, I think I am losing my money every year without getting anything back from the company*" (Player game 3)

Experience with agricultural insurance: Two groups of farmers who had experience with existing crop and livestock agricultural insurance scheme are analysed in the following paragraphs.

Commercial farmers: One group of farmers are the commercial banana farmers, who were approached due to their experience with banana insurance and their reflections brought further insights into the research. The banana farmers cultivated in the same wards that the research took place but not necessarily in the researched communities. They cultivated the banana for selling and were possibly slightly more affluent than the smallholder farmers from the researched communities.

Commercial farmers might be more aware than smallholder farmers about agricultural insurance, which might affect the demand. For instance, regarding the information related to insurance one commercial banana farmer explained:

"*Regarding the banana farming I don't think there needs to be a change. But for the other crops insurance, should be proper information to the farmers, awareness campaign should be in community level that is missing I think*" (KI 9)

Despite awareness, commercial banana farmers might experience challenges when renewing the existing insurance scheme. According to one banana farmer:

"*One banana plant produce fruits after an 18 months but the insurance provider only provide for one year so to secure one plant production we have to renew it again for six months. Therefore, this is complicated for the farmer and costly.*" (KI 10)

When briefly introduced to index-insurance the banana farmer replied that index-based insurance would be bought even with 60 % subsidy, while previously

the farmer argued that the current insurance scheme should be provided with 90 % subsidy:

"*Government subsidy should increase up to 90% for insurance [...]*" (KI 10)

"*Yes, exactly I am looking such type of insurance facilities because now we have old version of insurance facilities, which has difficulties for us to follow the many steps and documentation. Based on this index insurance, if the calculation is based on the loss and station, even if government provides low subsidy like 60% we are happy to pay the premium*" (KI 10)

Studying factors affecting the WTP of farmers in China Wang et al. [2020] found that farmers' perception and preference for crop insurance is affected from their experience. According to Berhane et al. [2013, p.2], "*[...] nothing sells insurance like insurance payouts*". For instance, one banana farmer from the researched communities who had bought insurance and got compensation for the losses within a short period expressed satisfaction with the existing scheme and preference of it over index-based due to the multi-peril factor:

"*In my insurance, I have all hazard cover like three months for the flood, two months for wind and storm and three months for cold and four months for the disease. Therefore, I am more secure from this old insurance policy even if there is complication or not.*" (Participant KI 3)

Smallholder farmers: The second group of farmers are the smallholder farmers who had experience mainly with livestock insurance; buffalo or goat insurance. Their experience with agricultural insurance was mostly negative.

This group of farmers cultivate mainly for subsistence or subsistence and selling[4]. From the 705 questionnaires of the quantitative survey, most of participants cultivated for their consumption or consumption and selling. Specifically, 68.5 % of the participants cultivated for their own consumption (home), 0.7 % for selling and 30.8 % for both. 41.3 % of the participants of the quantitative data did not have other means of income apart from farming, while 29.0 % of the participants received remittances from abroad. Considering the previous results in combination with the income level and cultivated land analysed in the descriptive statistics of Chapter 6, the results suggest that a substantial number of the game and FGD participants was subsistence farmers.

Previous negative experiences with agricultural insurance might have affected the trust and consequently the demand during the game, as some players did not wish to purchase insurance even when subsidised. For instance, the demand of Game 2 in Figure 6.3 deviates from the slopes of the rest of the games. One possible explanation could be that some of the players had previous negative experiences with livestock insurance. Some of these players' answers when asked why they decided not to buy insurance in the first round is included:

"*When I had goat farming insurance I did not get the money, we lost time and money that is also one reason I do not like to do insurance again*" (Player game 2)

"*Due to bad impression which I had from the goat farming experiences four years ago*" (Player game 2)

When farmers have a positive experience with insurance programmes they

[4]The game sessions and FGDs mainly consisted of smallholder farmers.

tend to keep them [Wang et al., 2020]. Consistent with literature, farmers' negative experiences with livestock insurance possibly influence their demand and makes them hesitant for future purchases. For instance, one player decided not to purchase IBFI insurance and answered that the reason was:

"*Actually, I am watching insurance company activities in our community to see if they will provide insurance money without any delay if flood affect our crops products. Then I will change my mind to buy insurance from the company regular basis.*" (Player game 3)

In some cases, the negative experiences might be so intense that insurance payouts might not be enough to change opinions. When the insurance company did pay for the first time during the game, the same player still did not want to buy and the reason was:

"*Because I don't believe insurance company activities. Sometimes they paid to influence the farmer but once all farmer trusts them they skip from the community. I am saying this due to my bad experiences from goat insurance.*" (Player game 3)

The negative experiences farmers had during the claiming procedure in the event of a loss might also affect the demand. For instance:

"*When they conducted a meeting in our community regarding the livestock's insurance at that time they explained very nicely and they said there would not be any complication when you are claiming your insurance. But when our goat died, we faced many problems to claim it*" (Participant FGD 5)

The problematic implementation of insurance might have affected the demand for the current insurance scheme. For instance, one participant replied that they did not renew their livestock insurance because:

"*We don't have proper information about the renewed system so, we forget to renew*" (Participant FGD 16)

Furthermore, Ghimire et al. [2016a] argue that renewing the contract every year is inconvenient for smallholder farmers. Other possible factors for not renewing the contracts could be the distance to the insurance provider. Farmers who had bought livestock insurance explained that the distance to the insurance provider (up to three hours of transport) and the travel costs in case they decided to go would be high, which indicates some added challenges.

"*We also didn't go to ask [...] because the cost of travel and other expenses are more than the insurance money therefore, we lost the insurance money*" (Participant FGD 4)

The distance challenges are also indicated by the fact that farmers expect the insurance provider to go to their community to sell insurance. According to some participants:

"*No one come here to provide the insurance scheme so*" (Participant FGD 2)

"*It's been three years, for the first two years I renewed the insurance policy but since one year I have not renewed because I had called many times the insurance agent for the renew but he didn't come. And after months I come to know they already stop to provide insurance.*" (KI 8)

Finally, a substantial number of participants preferred insurance to be offered by the government instead of a private company, when asked what would they choose among some options, explaining that the local government supports them and they have easier access:

"*Because if we buy through the government it would be easier to talk with them because now we have federal system and local government always supports us and it is easy to access from the community.*" (Participant FGD 2)

6.3 Discussion

The chapter explored factors that could affect the demand for a potential IBFI for crops if offered in the study area through experiences from the game sessions and the qualitative approaches. The factors identified from the analysis are related to the weather conditions, government's subsidy-presence, basis risk, understanding the concept of insurance and previous experiences with agricultural insurance.

Understanding the concept of insurance might be a factor affecting the demand as indicated during the analysis. The game sessions indicated a learning procedure as fewer players gave up their contracts in the final rounds of continuous good weather years, after having bought insurance and not experiencing losses. Therefore, insurance should be better communicated to smallholder farmers which could be achieved with trainings or workshops. Additionally, basis risk might be related to demand during the game sessions, which indicates that the design of index-based insurance products should be done with minimised basis risk.

Ghimire and Kumar [2014] argue that the agricultural insurance in Nepal is

considered as a social and not commercial business, while Wehrhahn et al. [2019] explain that agricultural insurance in Nepal aims to be promoted among poor farmers. Budhathoki et al. [2019] argue that the price of the current subsidised scheme is unlikely to be the reason for the low uptake of paddy and wheat insurance in Nepal and additionally found that poor farmers have the most obstacles to enter the scheme. Wehrhahn et al. [2019] recommend that social protection through microinsurance should be provided to households living on or below the poverty line. As indicated throughout the chapter, the government's subsidy and presence could affect demand, not only in terms affordability, but also in terms of strengthening trust towards insurance companies. Even though subsidy is valuable to introduce a product, the negative experiences with agricultural insurance, distance to insurance provider and the complicated claiming procedures for the payouts possibly make smallholder farmers hesitant to purchase insurance and reduce their trust towards insurance companies. The analysis brought further insights from KIIs with commercial farmers, whose experience with agricultural insurance appeared to have challenges different than those of smallholder farmers.

Through index-based insurance some of these types of claiming procedure challenges could be reduced, as some of the benefits of index-based insurance are the quick payments and automated procedures, which could benefit both commercial and smallholder farmers. However, even the best-designed insurance product cannot be sustained if the practical challenges for implementation are not overcome. Lotsch et al. [2010] suggest that local rural organisations (e.g. co-operatives) could act as agents and be the link between insurers and farmers, which could create easier access to isolated farmers. In the same vein, Gehrke [2014] argue that the *partner-agent scheme* combine the advantages of *partner*

scheme, which is a market-based or public insurance scheme, with the *agent*, which can be any organisation or a community based insurance scheme that knows the needs of the clients.

A substantial number of farmers within the study area participate in cooperatives. According to one community leader: "*Almost all of the farmers in this area participate in cooperatives*" (KII12). Furthermore, from the quantitative survey 628 farmers replied that their community had an authorised cooperative[5], 59.6% out of whom participated in the cooperative. More than one cooperatives might work in one community and operate various activities: "*In our community we have 2-3 cooperatives that do financial transaction. Apart from that, we have farmer cooperative that provides fertilisers and seed to farmers.*" (KII12). Therefore, taking into account the above-mentioned literature, one possible way to improve the practical implementations, such as the access to insurance providers of distant and isolated smallholder farmers of the study area, could be through local organisations, such as the cooperatives. In the same direction, Ghimire et al. [2020a] propose a new model of agricultural insurance in Nepal, where farmers' cooperatives and community based schemes could be included to improve the access of remote farmers, while covering the demand and access of all types of farmers (commercial and small farmers) to different insurance schemes.

6.4 Chapter Summary

The chapter analysed the empirical data collected during the game sessions and the qualitative component of the research to explore indicators that could affect

[5] 38 farmers replied *"no"* and 38 replied *"I don't know"*.

farmers' demand for a potential IBFI product. The factors identified in Chapter 6 are likely related to the weather conditions, government's subsidy-presence, basis risk, understanding of the concept of insurance and experience with agricultural insurance.

Chapter 7 summarises the findings of the three empirical chapters, Chapters 4 to 6.

Chapter 7

Further discussion

The three empirical chapters, Chapter 4 to Chapter 6, discussed the findings of the thesis separately, whereas this chapter summarises the results and the findings in an integrated manner.

The remainder of the chapter is organised as follows: Section 7.1 discusses the findings of Chapter 4 on risk aversion and the connection with the following Chapter 5. Section 7.2 provides a summary of the findings of the quantitative Chapter 5 and qualitative approaches in Chapter 6 separately and Section 7.3 discusses the findings of Chapters 5 and 6 combined.

7.1 Findings on Risk Aversion

Due to the increasing interest in extracting smallholder farmers' risk attitudes in developing countries, Chapter 4 analysed empirical data collected from the fieldwork sites, based on two risk preferences methods. The two methods, the Binswanger [1980] OLS approach and the modified MPL (mMPL) by Brick et al.

[2012] basen on the MPL by Holt and Laury [2002], are commonly employed separately when collecting data on farmers' attitudes towards risk in developing countries. The chapter contributes to literature being, to the best of my knowledge, one of the first studies to employ these two methods together with the purpose to compare them.

Both methods categorised a greater percentage to the highly risk-averse redistributed class, which is consistent with similar studies that found that farmers in developing countries tend to be risk-averse [e.g. Ihli et al., 2016; Jin et al., 2016; Yesuf and Bluffstone, 2007]. The mMPL had a finer distribution than the OLS that accumulated the degree of risk aversion in the higher risk aversion class, indicating a coarser distribution for OLS, consistent with Dave et al. [2010]. The mMPL method ranked towards more risky classes than the OLS, which suggests that the mMPL has a lower demand when compared to OLS. Therefore, the mMPL method might be more useful when identifying the degree of risk aversion in a developing country than the OLS method, as the design would be calculated with the highest physical risk.

Insurance is related to risk aversion, and specifically, a farmer has to be risk-averse to buy actuarially fair insurance. Therefore, it is expected that the more risk-averse individuals are, the higher the premium they are willing to pay. Both mMPL and OLS methods showed an agreement in Chapter 5 when factors that could be affecting the interest in flood insurance were explored separately. However, when risk aversion was examined, combined with other possible factors, the WTP for IBFI for crops appeared to be influenced by different factors than that of risk aversion, which was not found to be among the significant ones.

7.2 Summary of the Main Findings of Quantitative and Qualitative Approaches

Chapter 5 followed a quantitative approach to analyse factors possibly affecting the interest in flood insurance and the WTP for IBFI. Chapter 6 explored factors that are likely to affect the demand of a potential IBFI from experiences gained during the index-based insurance game sessions and qualitative approaches. The findings are discussed separately in the chapters' Sections 5.3 and 6.3 while this section provides a summary of the main findings, as presented in Figure 7.1[1].

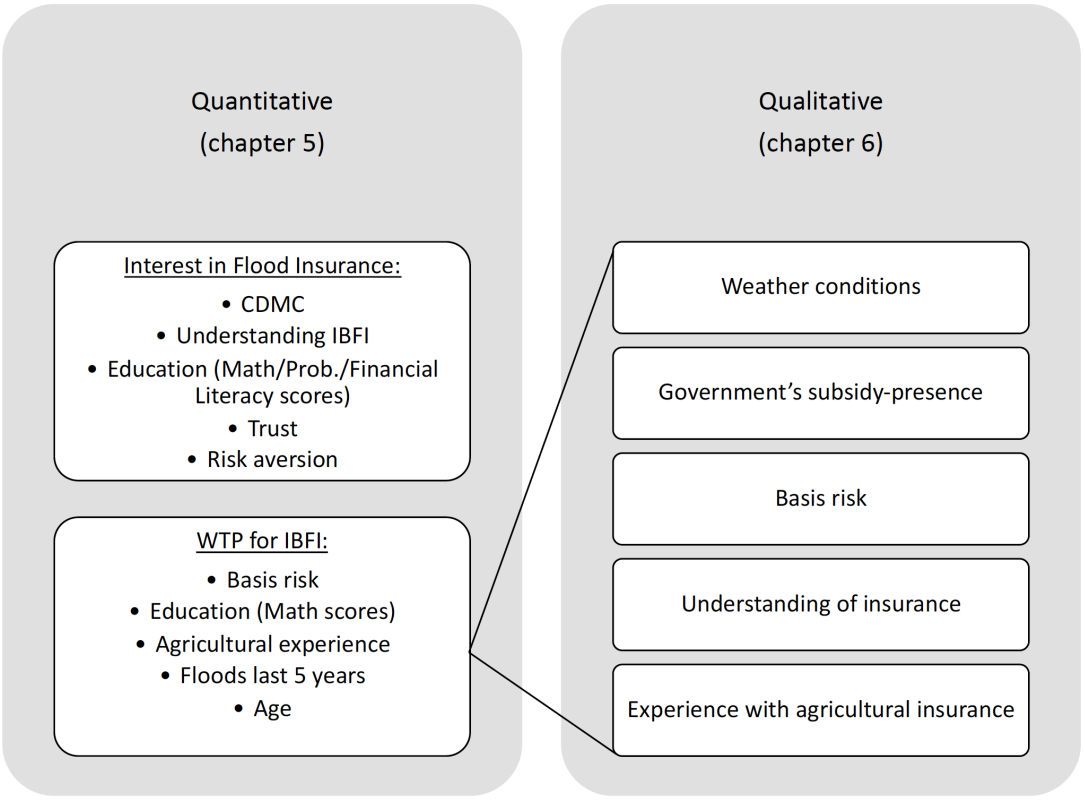


Figure 7.1: Factors affecting the demand in the two approaches

[1]The factors in Figures 7.1 and 7.2 are not listed in order of significance level or priority.

One of the main findings of the quantitative approach was identifying a sub-group of the sample during the analysis that had no interest in flood insurance at all, suggesting that the sub-sample possibly should be treated differently within the concept of WTP for IBFI. The finding contributes both to literature and policy. This is one of the first times it has been suggested that a group is separated and treated differently in WTP literature, which could consequently have policy implications when designing a potential IBFI for crops product.

The index-based insurance game was a route to explain and initiate discussions on relatively complex topics (such as index-based insurance, basis risk) in complex settings, such as rural areas of Nepal. The game contributed to the growing body of literature on games for index-based insurance (see for instance Carter et al. [2008]; McPeak et al. [2010]; Patt et al. [2009]). Furthermore, to the best of my knowledge, the game was among the first to incorporate basis risk in the games' sessions (see for example Helgeson [2015]).

7.3 Summary of the Factors Identified from the Quantitative and Qualitative Approaches

This section extends Section 7.2 by providing an overview of the WTP for IBFI from the quantitative approach findings combined with the results of the qualitative approach, as presented in Figure 7.2.

The two approaches showed a good agreement in the majority of the factors identified. Basis risk was identified as a possible factor in both approaches. The quantitative approach found education as one of the factors, which is possibly

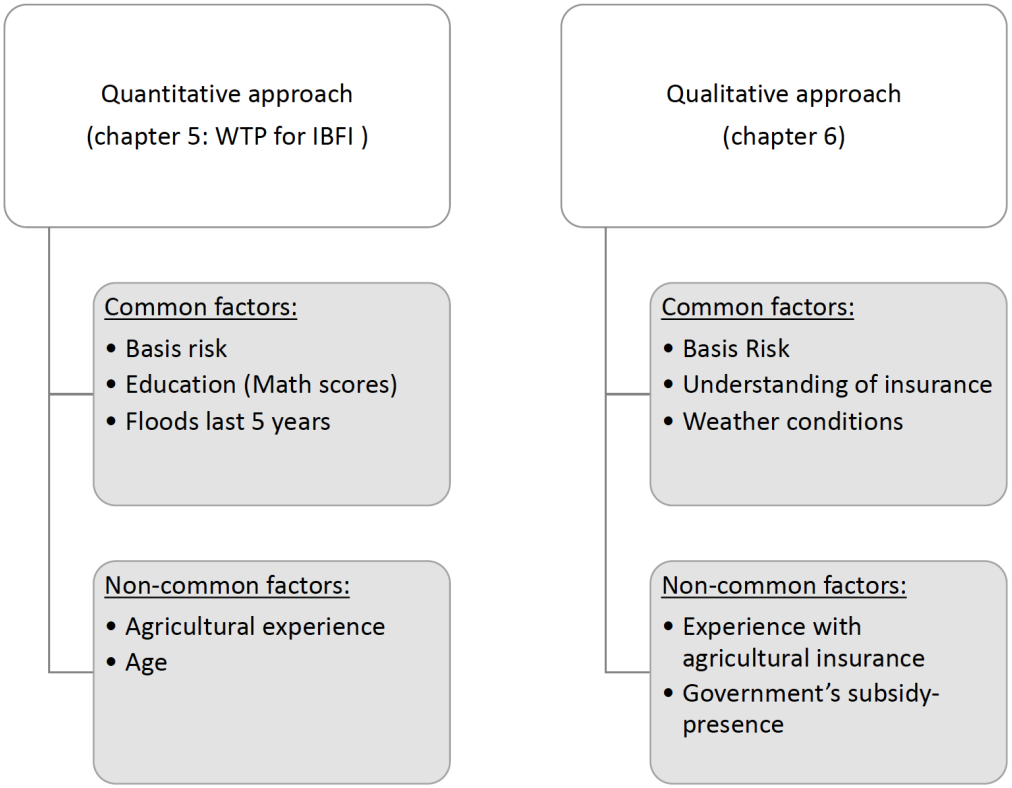


Figure 7.2: Comparison of key factors affecting the demand for IBFI in the two approaches

in the same vein as understanding the concept of insurance identified from the qualitative approach. Finally, the weather conditions identified in the qualitative approach confirm the finding of the number of floods experienced during the last five years from the quantitative approach as a possible factor affecting the WTP for potential IBFI. The quantitative approach and analysis had already categorised these three factors as the most significant. Apart from confirming the findings of the quantitative approach, the qualitative approach, brought further insights regarding these factors, demonstrating the value of employing mixed-methods approach. Therefore, it is further confirmed that these three factors detected from both approaches are among the strongest.

Basis risk was included as an independent variable in the quantitative approach and was also incorporated in the index-based insurance game design. In the quantitative approach, basis risk was found to have the highest significance level possibly affecting the WTP for IBFI. Farmers with high basis risk sensitivity have higher odds of not being willing to pay for IBFI. During the index-based insurance game sessions, basis risk was found to also affect the demand, as a substantial number of players did not renew their contract for the next round when they experienced basis risk. Both approaches contribute to the literature that calls for further empirical studies to understand the effect of basis risk in demand (see Cole et al. [2013] for further discussion) and the policy as the results suggest to design index-based insurance products with minimum basis risk.

Education was the second most significant factor affecting the WTP for IBFI among those examined in the quantitative approach. Therefore, education about IBFI for crops in the community level could increase awareness, improve the understanding of the concept of insurance, the weather-related risks and consequently, affect the demand. Confirmation to this finding came from the qualitative approach as the concept of insurance might not have been understood by all players to the same degree, consequently affecting the demand.

The third common factor identified by the quantitative and qualitative approaches revealed that the weather conditions during the past years also affects the demand. During the game sessions, fewer players stopped renewing their contract after continuous good weather years, which indicates a possible learning process related to weather conditions, risks or possibly the concept of insurance.

Apart from the common indicators of the two approaches, some further indicators were revealed from one of the two approaches, which were not detected

from the other one. For instance, the quantitative approach indicated that the farmers with a higher number of years of farming experience (higher agricultural experience) have higher odds of WTP for IBFI. Additionally, the quantitative approach found that younger farmers have higher odds of WTP for IBFI than older farmers. Furthermore, the qualitative approach during the in-depth discussions on the topic with the participants, identified indicators related to experience with agricultural insurance and government's subsidy-presence that possibly affect the demand.

The experience with crop or livestock agricultural insurance showed that challenges such as renewing the contract, claiming of losses and the distance to the insurance provider might have possibly affected the demand of the existing scheme, which could consequently affect a potential IBFI product. In the same vein, Ghimire et al. [2020a] argue that a substantial number of subsistence farmers have not insured their crops and livestock, one of the reasons is their remote location compared to commercial farmers whose business is based around more accessible locations. The qualitative chapter revealed that smallholder farmers mainly preferred insurance to be provided through the government, which is close and accessible to them. Wehrhahn et al. [2019] recommend that households living on or below the poverty line should be provided social protection microinsurance. Despite the argument by Budhathoki et al. [2019] that the current subsidy in Nepal is unlikely to be sustained in the long term, the findings of my study suggest that households that cannot afford insurance should keep being offered subsidies. This could consequently increase the trust of smallholder farmers in insurance companies through the government's presence via subsidy.

A potential IBFI product would possibly reduce claiming challenges through

simplified and automated procedures. However, challenges such as renewing contracts and distance to insurance provider could still affect the demand for potential IBFI. According to Lotsch et al. [2010], local rural organisations such as co-operatives, could act as agents and link insurers and isolated farmers. In the same vein, Gehrke [2014] discusses the *partner-agent scheme* as one of the proposed in literature routes to improve microinsurance schemes. A substantial number of smallholder farmers in the study area participates in co-operatives. Therefore, as a practice recommendation, the local organisations such as co-operatives could be one possible route to improve access to insurance and reduce such types of posssible practical implementation challenges. Finally, the study revealed that commercial and smallholder farmers experience different types of challenges. In this direction Ghimire et al. [2020a] proposed a new model of agricultural insurance that covers the demand and access of all types of farmers to different insurance schemes.

Summarising the quantitative-qualitative findings, employing a mixed methods approach was valuable due to insights brought from both methods separately and combined. The quantitative approach showed the significance of the factors. In contrast, even though it cannot analyse how strong these factors are, the qualitative approach brought further insights into the research regarding the complexity of factors that form farmers' engagement with insurance. Therefore, the thesis adds to the literature in terms of methodological approach, as to the best of my knowledge, is among the first studies in the literature of WTP that used a mixed-methods quantitative-qualitative approach to identify possible factors affecting the WTP for potential IBFI for crops.

Chapter 8

Conclusions

The chapter provides a summary of the study and the key message in Section 8.1, the contributions of the thesis in literature, policy and practice in Section 8.2, the limitations of the study in Section 8.3 and the suggested future work in Section 8.4.

8.1 Summary

One of the innovative financial instruments for risk transfer mechanisms that the literature review demonstrated is micro-insurance. Index-based insurance is one type of micro-insurance [Linnerooth-Bayer and Hochrainer-Stigler, 2015], and weather index-based insurance for crops specifically is considered an encouraging tool [Fonta et al., 2018]. However, questions remain about the ongoing research on index-based insurance regarding its demand in developing countries [Castellani and Viganò, 2017].

In Nepal, the current crop and livestock insurance scheme has shown a relatively low demand for crop insurance in comparison to livestock insurance (for further discussion see Ghimire et al. [2016b]; MEFIN [2020]). The relevant literature

on Nepal suggests to evolve the existing scheme to index-based (e.g. Wehrhahn et al. [2019]), while the GoN seeks to understand whether index-based insurance could be more beneficial than the existing scheme [Ghimire et al., 2020b].

The study area was the lower Karnali River basin. The communities in Kailali and Bardiya districts of the lower Karnali River basin are exposed to frequent flood events [Rai et al., 2020]. The thesis addressed the identified gaps by bringing quantitative and qualitative empirical evidence regarding farmers' demand for potential IBFI for crops. Knowing factors that possibly affect potential IBFI could contribute to a better understanding when designing and implementing future products, as analysed in Section 8.2.

The two risk aversion methods in Chapter 4 were compared and showed a good agreement in the results, as both categorised most of the farmers to be risk-averse, however the mMPL tends to categorise in riskier classes than the OLS (*Research question 1 - Objective 1*). As discussed in Chapter 7, the level of risk aversion when combined with other possible factors examined in this study did not have a significant effect in farmers WTP.

The research showed a good agreement in the quantitative-qualitative approaches in most of the factors. The quantitative approach in Chapter 5 identified factors such as education, age, agricultural experience, number of floods experienced the last five years and basis risk (*Research question 2 - Objective 2).* Similarly, the qualitative approach in Chapter 6 identified some similar common factors such as understanding of insurance, weather conditions and basis risk. However, the qualitative approach further revealed some practical implementation factors that are possibly related to demand (e.g. experience with agricultural insurance, government's subsidy-presence) (*Research question 3 - Objective 3*).

Therefore, the key message of the study is that apart from factors affecting farmers' willingness for potential index-based flood insurance for crops related to farmers' characteristics and design of index-based insurance, special attention should be given to practical implementations (e.g. distance to insurance provider) that appeared to be crucial when farmers decide if they want to be associated with insurance (*Main research question- Objective 4*).

8.2 Thesis Contributions

The thesis adds to the literature with regard to the methodological approach, by employing quantitative-qualitative mixed-methods combined with an index-based insurance game to bring empirical evidence from a new study area regarding the WTP and demand for potential IBFI for crops in Nepal. Furthermore, the study contributes to the gap in the general literature that calls for further empirical evidence to understand better index-based insurance (e.g. Marr et al. [2016]) and specifically to the literature on Nepal that recommends exploring farmers willingness to participate in index-based insurance (for further discussion see Ghimire et al. [2016c]). Basis risk was approached both by the game and the quantitative survey adding to the gaps that call for further empirical evidence of how basis risk affects the demand (e.g Cole et al. [2013]) and to the literature that argues that games that include basis risk are scarce (for further discussion see Helgeson [2015]). Finally, the thesis adds to the literature related to risk aversion by bringing empirical evidence and comparing two methods of risk aversion, which are commonly used separately.

The finding of the identified sub-group of farmers of the quantitative chapter,

that had possibly no interest at all in flood insurance, has policy implications in addition to the literature. This suggests that this sub-sample should be possibly treated differently within the concept of WTP. Basis risk was identified as possible factor affecting the demand in both methods, which has policy implications, suggesting the design of index-based insurance products with minimised basis risk.

Literature suggests to pilot index-based insurance for specific crops in Nepal (for further discussion see Ghimire et al. [2020b]). By addressing factors that could influence potential IBFI for crops, the study adds not only to the literature but also to policy and practice. Knowing factors that possibly affect the demand and shedding light on possible practical implementations of the existing crop and livestock agricultural insurance scheme, that could affect potential IBFI or other type of index-based insurance products, could contribute to the design of products with minimised risks and better implement these future piloting activities.

8.3 Research Limitations

WTP studies might not definitely represent actual behaviour and the insurance products offered might be oversimplified [Hill et al., 2013]. However, these type of studies can be quite informative for a product that does not exist in the market (ibid.). The thesis explored the demand and possible factors affecting the demand for hypothetical index-based insurance through quantitative and qualitative approaches. The explanation of insurance and index-based insurance were approached in a simplified way, which may have resulted in the loss of some information. Due to the complexity of the topic, significant effort was made to

communicate this type of mechanism simply whilst presenting the main characteristics. Moreover, it is acknowledged that there might have been some loss of information in the way the research material was translated into documents, explained to enumerators, in real time explanation or translation. Furthermore, there might be differences in the way the enumerators explained and presented the material to research participants or the responses they received. However, these limitations present a reality of empirical research on the ground and every effort was made to minimise these. For instance, during the training of the research team, considerable time was invested to approach the explanations and questions similarly in order to ensure the consistency across different enumerators and activities once in the field.

Apart from the data collection challenges, the assumption of linear relationship implicit assumed in the regression analysis may not be fully contented in reality. However, the strong significance levels and furthermore the agreement in most of the factors with the qualitative results, suggest that at least the factors themselves are important while the specific parameters evaluated may be exposed to some bias due to such assumptions.

A substantial number of risk aversion empirical data studies include real payments. For instance, Binswanger [1980] method used real and hypothetical payoffs that varied from very low levels to higher than monthly income levels, Brick et al. [2012] used real payments to one of the participants' choices, Clarke and Kumar [2016] used payments for decision problems. However, in discussion the topic with Practical Action, paying the participants was not considered suitable. Therefore, the games regarding risk aversion were hypothetical in the neighbourhood of the average monthly income of the participant, which might have a bias in the results

due to the absence of lower income levels games and payments.

Possibly there are factors that due to the game's limitations might have influenced the demand during the games' sessions, the analysis in the qualitative chapter or some factors might have not been identified. For instance, having the weather rounds predetermined or the sequence of the flood events could be some of these limitations. Another sequence of flood events might have resulted in other factors emerging. Furthermore, the cost of insurance during the games might have affected the demand (e.g. insurance could be considered expensive, the player could not afford because had run out of tokens etc.). Despite the fact that the average demand at the non-subsidised rounds was higher than the subsidised, the year that the subsidy stopped to be provided possibly influenced the demand instantly but in the following rounds (which were continuous bad weather years) not, which could be one limitation of the game's design. Moreover, the game might have not been fully understood by all players in the same level. For instance, during one FGD, when discussing reflections of players after the game, one player seems to have related tokens to Rupees.

Even though an effort was given to minimise challenges or possible limitations like the previous or similar ones (e.g. by explaining that this is a hypothetical game, this type does not exist in the area etc.) it should be acknowledged that there might be cases that led to misunderstanding or confusion. This is a reality of on-the-ground research of this type and as previously mentioned, an effort was made to reduce these or similar challenges.

8.4 Future Research

The mMPL method used in the risk aversion Chapter 4 showed a low inconsistency rate compared to similar studies in developing countries. However, Ihli et al. [2016] found even lower inconsistency rates than my study. Instead of imagining hypothetical coins, an extension of this study could be to use visual methods, such as Ihli et al. [2016] that used images of bags with coloured balls.

Previous research approaches the maximum amount that farmers are willing to pay for insurance (e.g. Budhathoki et al. [2019]; Helgeson [2015]). Therefore, one possible topic for further extension of the quantitative part of the research in the study area would be to identify the maximum amount for IBFI that the farmers are willing to pay. The findings could bring further insights of how much the farmers can afford for insurance and what amount of subsidy should be provided.

Finally, a general topic for further research would be to identify factors affecting the demand for potential index-based insurance products before and after pilot programmes have been implemented. The similarities and differences of the factors identified before and after the implementation could be compared. The results would assess in what degree the factors identified using stated preference methods could predict factors that actually affect potential micro-insurance products. The research on predicted and actual factors could assess predictions approximated similarly through games and qualitative approaches.

Appendix A: Quantitative questionnaire

The following appendix presents the quantitative questionnaire for the survey of the main fieldwork and the IBFI explanation flyer that was used as a guide to explain hypothetical IBFI in English. A sample of the hypothetical risk aversion games is presented at the Part H of the questionnaire. A sample of the translated Nepali version is presented at the last page of Appendix A.

RETHINKING FINANCIAL INSTRUMENTS FOR DEVELOPING COUNTRIES: THE CASE STUDY OF FLOODS IN NEPAL

Household survey questionnaire

Introduction including ethical statement for data collection fieldtrip
October-December 2019

Instruction 1 to enumerator: Fill up the details below before the interview

Enumerator's Nr: _____

Increasing Number of Questionnaire:____

Date:_____ _____

I. Ward:

☐ 1 = Ward 2

☐ 2 = Ward 5

☐ 3 = Ward 6

☐ 4 = Ward 7

☐ 5 = Ward 8

II. Community:

If 2 = Ward 5 then:
☐ 1 = Karmidanda
☐ 2 = Dakshina Shahipur
☐ 3 = Simreni Ward 5

If 4 = Ward 7 then
☐ 1 = Baidi
☐ 2 = Ram Janaki Tole
☐ 3 = Dhami Tole
☐ 4 = Mahadev Tole

If 5 = Ward 8 then:
☐ 1 = Bangau
☐ 2 = Arnawa
☐ 3 = Phata
☐ 4 = Ramdada
☐ 5 = Banjariya

III. Game:

☐ 1 = Game was not played before the interview

☐ 2 = Game played before the interview

IV. Increasing game number: _____
V. Player Number: _____

Instruction 2 to enumerator: Read the following ethical statement before starting the questionnaire

Ethical Statement

Thank you kindly for agreeing to participate in this survey. I am very grateful for your time. I am a PhD student doing research at Durham University in the UK.

The aim of this study is to understand if farmers living in flood prone areas would be interested to buy a specific type of a hypothetical insurance product named parametric insurance, if it existed in your area. A brief explanation of this type of insurance will be introduced during the interview. The data collected will be analysed by the researcher (Eleftheria Vavadaki) to identify the factors that affect these decisions but also to explore your opinions as well as the opinions of other communities towards this type of insurance. The data analysed will be used for writing a PhD thesis, publications and academic purposes. This research is not related to any project in your area, I am not related with any company or organisation. This is only for my research as a student.

You have been invited to participate in my research because you live or have property (e.g house, farm, livestock, belongings) lying on a flood prone area. Due to this reason there is a possibility that you already have experience with floods in this region which would be very useful for our research.

You can withdraw from the study at any time, without giving a reason, and you may refuse to answer any question. You do not have to participate if you do not wish. All information obtained during the study will be kept **anonymised and confidential**, which means that everything you say will not be related to your name. **Your name will not be asked during the interview.** If you have any questions now or after the session, please don't hesitate to ask me or contact me through my e-mail eleftheria.vavadaki@durham.ac.uk

Instruction 3 to enumerator: Ask if the following criteria are valid

My criteria:

- Head of Household who makes financial decisions VI. 1 = ☐
  - If not there a person who knows about the financial decisions. 2 = ☐
- Experience with farming more than 5 years ☐
- To have experienced flooding and had agricultural losses ☐
- Living in the area for 5 years at least ☐
- Over 25 yrs old in order to be active on financial decision making of HH ☐

Instruction 4 to enumerator: If all of the previous boxes are checked then start the survey

Instruction 5 to enumerator: Start survey

Part A: Background data

1. Gender
   ☐ 1 = Male ☐ 2 = Female

2. How old are you?

Instruction 6 to enumerator: If they do not know ask a specific event that had happened when they were young ?

_____

3. Ethnicity
   ☐ 1 = Tharu
   ☐ 2 = Brahamin/Chhetri/Thakuri
   ☐ 3 = Dalit
   ☐ 4 = Janjati
   ☐ 5 = Other, please specify_____

4. What's your highest level of education?
   ☐ 1 = No education/No formal education
   ☐ 2 = Primary school level of education
   ☐ 3 = Secondary school level of education
   ☐ 4 = High school level of education
   ☐ 5 = University or higher level of education

5. How many years do you live in this area?
   _____

6. Do you have other means of income apart from agriculture?
   ☐ 1 = Yes
   ☐ 2 = No

7. How many family members live in your house including you?
   _____

8. Do you possess a mobile phone?
   ☐ 1 = Yes ☐ 2 = No

9. Do you have a bank account?
   ☐ 1 = Yes ☐ 2 = No

10. Does any member of the family work abroad some period and send you remittances (money)?
    ☐ 1 = Yes ☐ 2 = No

Instruction 7 to enumerator: **If no, go to Question 13**

11. How much money do you usually receive from abroad (from these remittances)?

_____

12. How many times per year do you receive this amount of money?

_____

13. Is your average monthly income **without remittances** from abroad more than 5000 NRP?

☐ 1 = Yes ☐ 2 = No

Instruction 8 to enumerator: **If no, go to Part H: Income less than 5000**

14. Is your average monthly income **without remittances** from abroad more than 15 000 NRP?

☐ 1 = Yes ☐ 2 = No

Instruction 9 to enumerator: **If no, go to Part H: Income 5000-15000**

15. Is your average monthly income **without remittances** from abroad more than 25 000 NRP?

☐ 1 = Yes ☐ 2 = No

Instruction 10 to enumerator: **If no, go to Part H: Income 15000-25000**

16. Is your average monthly income **without remittances** from abroad more than 35 000 NRP?

☐ 1 = Yes ☐ 2 = No

Instruction 11 to enumerator: **If no, go to Part H: Income 25000-35000**

17. Is your average monthly income **without remittances** from abroad more than 45 000 NRP?

☐ 1 = Yes ☐ 2 = No

Instruction 12 to enumerator: **If no, go to Part H: Income 35000-45000**

18. Is your average monthly income **without remittances** from abroad more than 55 000 NRP?

☐ 1 = Yes ☐ 2 = No

Instruction 13 to enumerator: **If no, go to Part H: Income 45000-55000**

19. Is your average monthly income **without remittances** from abroad more than 75 000 NRP?

☐ 1 = Yes ☐ 2 = No

Instruction 14 to enumerator: **If no, go to Part H: Income 55000-75000**

20. Is your average monthly income **without remittances** from abroad more than 95 000 NRP?

☐ 1 = Yes ☐ 2 = No

Instruction 14A to enumerator: Go to Part H: Income 75000-95000

Part B: Agriculture related questions

21. How long have you been farming?
☐ 1 = 5 – 10 ☐ 2 = 10 – 20 ☐ 3 = 20 – more

22. Farming generation: Was your father farmer in this area (2nd generation farmer)?
☐ 1 = Yes ☐ 2 = No, my father was not a farmer

23. Farming generation: Was your grandfather farmer in this area (3rd generation farmer) ?
☐ 1 = Yes ☐ 2 = No, my grandfather was not a farmer

24. Do you own or rent the land that you cultivate?
☐ 1 = Own
☐ 2 = Adia
☐ 3 = Contract
☐ 4 =Own & Adia
☐ 5 = Own & Contract
☐ 6 = Adia & Contract
☐ 7 = Own & Adia & Contract
☐ 8 = Other, please specify_____

25. Is your cultivated farm size (rented and owned it does not matter) more than 5 Kattha?
☐ 1 = Yes ☐ 2 = No

Instruction 15 to enumerator: If no, go to Question 35

26. Is your cultivated farm size (rented and owned it does not matter) more than 10 Kattha?
☐ 1 = Yes ☐ 2 = No

Instruction 16 to enumerator: If no, go to Question 35

27. Is your cultivated farm size (rented and owned it does not matter) more than 15 Kattha?
☐ 1 = Yes ☐ 2 = No

Instruction 17 to enumerator: If no, go to Question 35

28. Is your cultivated farm size (rented and owned it does not matter) more than 20 Kattha?
☐ 1 = Yes ☐ 2 = No

Instruction 18 to enumerator: If no, go to Question 35

29. Is your cultivated farm size (rented and owned it does not matter) more than 30 Kattha?
☐ 1 = Yes ☐ 2 = No

Instruction 19 to enumerator: If no, go to Question 35

30. Is your cultivated farm size (rented and owned it does not matter) more than 45 Kattha?

☐ 1 = Yes ☐ 2 = No

Instruction 20 to enumerator: If no, go to Question 35

31. Is your cultivated farm size (rented and owned it does not matter) more than 60 Kattha?
☐ 1 = Yes ☐ 2 = No

Instruction 21 to enumerator: If no, go to Question 35

32. Is your cultivated farm size (rented and owned it does not matter) more than 90 Kattha?
☐ 1 = Yes ☐ 2 = No

Instruction 22 to enumerator: If no, go to Question 35

33. Is your cultivated farm size (rented and owned it does not matter) more than 120 Kattha?
☐ 1 = Yes ☐ 2 = No

Instruction 23 to enumerator: If no, go to Question 35

34. Is your cultivated farm size (rented and owned it does not matter) more than 150 Kattha?
☐ 1 = Yes ☐ 2 = No

35. Every cropping season do you plant different types of plants?
☐ 1 = Yes ☐ 2 = No

36. Do you plant to more than one fields?
☐ 1 = I plant at more than one fields
☐ 2 = I plant only in one field even though I possess more than one
☐ 3 = I plant only in one field because I possess only one

37. Do you plant for livelihood or for selling as well?
☐ 1 = Home ☐ 2 = Sell ☐ 3 = Both

38. Which of the following do you plant almost every year? (multiple)
☐ 1 = Cereals (e.g paddy, wheat, rice e.t.c)
☐ 2 = Vegetables (e.g cash crops, potatoes e.t.c)
☐ 3 = Fruits (e.g banana, sugar can e.t.c)
☐ 4 = All of the above
☐ 5 = Other

38b. Do you plant definitely paddy rice every monsoon period?
☐ 1 = Yes
☐ 2 = No

Instruction at enumerator if no at 38b, go to Question 39

38c. Do you plant almost all of your land with paddy rice for selling in the monsoon period?
☐ 1 = Yes

☐ 2 = No

Instruction at enumerator if yes at 38c, go to Question 39

38d. If no at 38c, how much percentage of your land is plant with paddy rice in the monsoon period?
please specify_____

39. Would you prefer to save your crops and sell them later or sell now and save the money?
☐ 1 = Save crops ☐ 2 = Save money

Part C: Floods

40. How many floods did you experience during your farming years?
_____

41. How many floods did you experience during the last five years?
_____

42. Have you ever experienced a flood event that destroyed all your crops?
☐ 1 = Yes ☐ 2 = No

Instruction 24 to enumerator: If no, go to Question 45

43. If yes, did you experience a flood that destroyed all your crops in the last 5 years?
☐ 1 = Yes ☐ 2 = No

44. If yes, in your experience, how often do floods come that destroy all of your crops?
☐ 1 = Every one year
☐ 2 = Every two years
☐ 3 = Every three years
☐ 4 = Every four years
☐ 5 = Every five years
☐ 6 = Every ten years

45. In your experience, how often do floods come that destroy part of your crops?
☐ 1 = Every one year
☐ 2 = Every two years
☐ 3 = Every three years
☐ 4 = Every four years
☐ 5 = Every five years
☐ 6 = Every ten years

46. Do the floods come more often/more rarely/the same the last years?
☐ 1 = More often ☐ 2 = More rarely ☐ 3 = The same

47. How much have you been affected from the flood of 2014 ?
☐ 1 =Not affected ☐ 2 = Medium affected ☐ 3 = Extremely affected

48. How much have you been affected from the flood of 2017 ?
☐ 1 =Not affected ☐ 2 = Medium affected ☐ 3 = Extremely affected

49. Have you ever had a flood event that cost you so much loss that you had to sell some belongings of yours (e.g livestock)?
☐ 1 = Yes ☐ 2 = No

50. How much do you worry about floods ?
☐ 1 =Don't worry at all ☐ 2 = Medium worry ☐ 3 = I worry a lot

Part D: Informal risk sharing

Saving schemes

51. Do you have any saving schemes in your community?
☐ 1 = Yes ☐ 2 = No ☐ 3 = I do not know

Instruction 25 to enumerator: If no go to question 59

52. Do you participate in any of the saving groups in your community?
☐ 1 = Yes ☐ 2 = No

Instruction 26 to enumerator: If no go to question 55

53. If yes, at how many saving groups do you participate?
☐ 1 = 1 ☐ 2 = 2 ☐ 3 = 3 ☐ 4 = 4 ☐ 5 = 5 ☐ 6 = More than 5

54. How much do you contribute monthly to all saving groups together?
☐ 1 = up to 100 NRP
☐ 2 = 101 - 300 NRP
☐ 3 = 301 - 500 NRP
☐ 4 = 501 - 700 NRP
☐ 5 = 701 - 1000 NRP
☐ 6 = 1001 - 1500 NRP
☐ 7= more 1501 NRP Please specify _____

55. Does your community have a Community Disaster Management Commitee (CDMC) ?
☐ 1 = Yes ☐ 2 = No

Instruction 27 to enumerator: If no go to question 59

56. If yes, do you contribute to the Community Disaster Management Commitee (CDMC) fund?
☐ 1 = Yes ☐ 2 = No

Instruction 28 to enumerator: If no go to question 59

57. If yes, how much do you contribute each month to the Community Disaster Management Commitee (CDMC) ?
    - ☐ 1 = 1-10 NRP
    - ☐ 2 = 11-20 NRP
    - ☐ 3 = 21-50 NRP
    - ☐ 4 = 51-100 NRP
    - ☐ 5 = 101-200 NRP
    - ☐ 6 = 201 - 500 NRP
    - ☐ 7 = more 501 NRP

58. If yes, when did you contribute last time to Community Disaster Management Commitee (CDMC)?
    ☐ 1 = This month ☐ 2 = 1 month ago (last month) ☐ 3 = 3 months ago ☐ 4 = 6 months ago
    ☐ 5 = last year ☐ 6 = more than 1 year ☐ 7 =Don't remember

Cooperatives

59. Does your community have an authorised co-operative?
    ☐ 1= Yes ☐ 2 = No ☐ 3 = I don't know

Instruction 29 to enumerator: If no go to question 68

60. If yes, do you belong/participate to the co-operative of your community?
    ☐ 1= Yes ☐ 2 = No

Instruction 30 to enumerator: If no go to question 67

61. If yes, how much do you contribute to the co-operatives per month?
    _____

62. If yes, when did you contribute last time to the co-operative?
    ☐ 1 = This month ☐ 2= 1 month ago (last month) ☐ 3 = 3 months ago
    ☐ 4 = 6 months ago ☐ 5 = last year ☐ 6 = more than 1 year ☐ 7 = Don't remember

63. If yes, did you ever turn to co-operatives for borrowing/loan?
    - ☐ 1 = Yes
    - ☐ 2 = No

Instruction 31 to enumerator: If no go to question 67

64. If yes, which is the most possible reason that you would need the most to borrow from your co-operative?
    - ☐ 1 = Most possibly I would borrow for emergency/recovery after a disaster
    - ☐ 2 = Most possibly I would borrow for livelihood
    - ☐ 3 = Most possibly I would borrow for investments

☐ 4 = Most possibly I would borrow for funeral
☐ 5 = Most possibly I would borrow to send the kid to school
☐ 6 = Other, please specify_____

65. If yes, how easy is it to borrow from the co-operative, if you are a member?
☐ 1 = Easy/simple ☐ 2 = Average difficulty ☐ 3 = Very difficult

66. If yes, do you usually turn to co-operatives for borrowing/loan after you have searched other ways of borrowing/getting a loan first?
☐ 1 = Yes
☐ 2 = No

67. If yes a co-operative exists in your community, would you be willing to have the co-operatives being operated more officially (e.g the government, iNGO, other) ?
☐ 1= Yes ☐ 2 = No, I prefer the way it is

68. Which are the savings groups/cooperatives that you participate? **(Multiple answers)**
☐ 1 = VDF (Village Disaster Fund)/ for disasters of VDC Village Development Committee?
☐ 2 = Co-operatives
☐ 3 = Mother's group
☐ 4 = Poverty alleviation
☐ 5 = Women's group
☐ 6 = Not applicable (if they do not have saving schemes and they do not have cooperative)
☐ 7 = Other not mentioned here please specify_____

68b. Of all the saving groups/co-operatives, which do you consider the most important? **(1 answer)**
☐ 1 = VDF (Village Disaster Fund)/ for disasters of VDC Village Development Committee?
☐ 2 = Co-operatives
☐ 3 = Mother's group
☐ 4 = Poverty alleviation
☐ 5 = Women's group
☐ 6 = Not applicable (if they do not have saving schemes and they do not have cooperative)
☐ 7 = Other not mentioned here please specify_____

Borrowing/loans

69. Did you ever turn to family members which live in this or other communities for borrowing/loan?
☐ 1 = Yes ☐ 2 = No

70. Did you ever turn to other risk sharing groups (co-operatives not included) for borrowing?
☐ 1 = Yes ☐ 2 = No

71. In general, how easy is for someone to borrow/get a loan, if they needed?
☐ 1 = Easy/simple ☐ 2 = Average difficulty ☐ 3 = Very difficult

72. Did you need to borrow during the last year?
☐ 1 = Yes, I needed and I managed to borrow
☐ 2 = No, I did not need to borrow during the last year
☐ 3 =Yes, I needed but I did not manage to find to borrow

73. Do you currently have a loan/have borrowed?
☐ 1= Yes ☐ 2 = No

74. How many times did you borrow/got loans the last three years?

Instruction 32 to enumerator: If they don't remember exact number ask them a range and write the average (for example 3-5 times and write the average for example 4)

_____

Part E: Familiarity with insurance

75. Do you have experience with insurance (for example life insurance, health insurance, car, motorbike, livestock, crop etc) ?
☐ 1 = Yes ☐ 2 = No

76. Have you heard/been informed about the existing crop and livestock insurance?
☐ 1 = Yes ☐ 2 = No

Instruction 33 to enumerator: If no go to question Error! Reference source not found.

77. If yes, how have you been informed?
☐ 1 = Insurance company advertisement
☐ 2 = Local Goverment promotion
☐ 3 = Insurance company advertisement & LG promotion together
☐ 4 = Family/Friend/Neighbour
☐ 5 = Other, please specify_____

78. If yes, have you ever bought the existing agricultural crop-livestock insurance?
☐ 1 = Yes ☐ 2 = No

Instruction 34 to enumerator: If no go to question Error! Reference source not found.

79. If yes, did you buy for crops or livestock or both?
☐ 1 = Livestock only ☐ 2 = Crops only ☐ 3 = Livestock and crops

80. If yes, did you renew it the next season? ☐ 1 = Yes ☐ 2 = No

Instruction 35 to enumerator: If no go to question 82

81. If yes, how many seasons did you renew?

_____

Instruction 36 to enumerator: Go to question 83

82. If no, what was the most important reason that made you decide to stop?
- ☐ 1 = Too expensive to afford
- ☐ 2 = Too complicated the procedure to get the payments from the company
- ☐ 3 = The payment from the company was too little
- ☐ 4 = The payment was extremely slow and after a long time
- ☐ 5 = I was paying premium and not a bad event was happening
- ☐ 6 = Other, please specify_____

83. Do you currently have crop and/or livestock insurance?
- ☐ 1 = I have crops insurance but not livestock
- ☐ 2 = I have livestock but I do not have crops
- ☐ 3 = I have both
- ☐ 4 = I do not have currently neither crop nor livestock insurance

84. XXXX

Instruction 37 to enumerator: Orally explain using IBFI Explanation Flyer

Part F: Index Based/Parametric Insurance

Instruction 38 to enumerator: NEXT TWO QUESTIONS MUST BE DEFINITELY ANSWERED !!!

Section 1: Willingness to Buy

85. After being explained, would you be willing to buy such type of flood insurance, if it existed in your area and if it was offered to you at an affordable price?

☐ 1= Yes ☐ 2 = No

86. After being explained, would you be willing to buy such type of flood insurance, if it existed in your area and if it was offered to you at an affordable price or being subsidised (shared part of participation costs) from the government?

☐ 1= Yes ☐ 2 = No

Instruction 39 to enumerator: If no at both 85 and 86 go to question 89

87. If yes at one of the two previous questions, would you prefer to be offered the insurance through your saving schemes groups or through a private company or the government?
- ☐ 1 = Saving schemes or Co-operatives
- ☐ 2 = Private Company

☐ 3 = Government
☐ 4 = Other, please specify

88. If yes at one of the two previous questions, would you prefer to pay to buy insurance in cash or in-kind ?
☐ 1 = Cash
☐ 2 = In kind (e.g livestock, fruits etc)

89. At which level would you trust if such a product was sold to you through a private company?
☐ 1 = I definitely not trust ☐ 2 = Medium Trust ☐ 3 = I would highly trust

90. At which level would you trust if such a product was bought from the community through your saving schemes from a private company?
☐ 1 = I would definitely not trust ☐ 2 = Medium Trust ☐ 3 = I would highly trust

91. Imagine you bought flood insurance for the next cropping season/monsoon season and you paid the money requested to buy insurance coverage for your crops. There was not flood event this cropping season. Would you be willing to continue buying insurance the next cropping season?
☐ 1= Yes ☐ 2 = No ☐ 3 = I don't know

92. Suppose you bought flood insurance for five cropping seasons, and you paid the money requested to buy insurance coverage for your crops. There was no flood event for five cropping seasons. Would you be willing to continue buying insurance after five cropping seasons?
☐ 1= Yes ☐ 2 = No ☐ 3 = I don't know

93. Imagine you bought flood insurance for your crops for the next cropping season/monsoon season and you paid the money requested to buy insurance coverage for your crops. There was flood on your field but you received no payment. Would you be willing to continue buying insurance after one cropping season, where you had flood on your field and received no payment?
☐ 1= Definitely not buy again ☐ 2 = May or may not (I doubt) ☐ 3 = Keep buying
☐ 4 = I don't know

94. Imagine you bought flood insurance for your crops for the next cropping season/monsoon season and you paid the money requested to buy insurance coverage for your crops. There was no flood on your field but you received some payment. Would you be willing to continue buying insurance after one cropping season, where you had no flood on your field but received some payment?
☐ 1= Yes ☐ 2 = No ☐ 3 = I don't know

Section 2: Understanding of index based insurance through examples

Instruction 40 to enumerator: Please explain again that the numbers/idea of all questions that will follow are only examples. Use the scale with the colours yellow and red.

Instruction 41 to enumerator: Show the water level table while explaining.

95. Imagine you bought flood insurance for your crops for the next monsoon period. If the yellow level is reached (then this means there was a big flood), the company will pay you money for loss of half of your seasonal production. If the red level is reached (extremely big flood) the company will pay you money for loss of all your seasonal production. If the water stays in the white area, there will be no payments.
    a) Imagine it rained and the water is at the white area. Your crops are still fine. Will you get paid?
    ☐ 1= Yes ☐ 2 = No ☐ 3 = I don't know
    b) Imagine it rained and the water is at the white area. Imagine you have flood on your field, which destroyed half of your crops. Will you get paid?
    ☐ 1 = Yes ☐ 2 = No ☐ 3 = I don't know

96. Imagine you bought flood insurance for your crops for the next monsoon period. If the yellow level is reached (then this means there was a big flood), the company will pay you money for loss of half of your seasonal production. If the red level is reached (extremely big flood) the company will pay you money for loss of all your seasonal production. If the water stays in the white area, there will be no payments.
    a) Imagine it rained and the water reached the yellow area. Half of your crops are destroyed. Will you get paid?
    ☐ 1= Yes ☐ 2 = No ☐ 3 = I don't know
    b) If yes, how much will you get paid?
    ☐ 1 = Half of my seasonal production
    ☐ 2 = All of my seasonal production
    ☐ 3 = I don't know
    c) Imagine it rained and the water reached the yellow area. All of your crops are destroyed. Will you get paid?
    ☐ 1= Yes ☐ 2 = No ☐ 3 = I don't know
    d) If yes, how much will you get paid?
    ☐ 1 = Half of my seasonal production
    ☐ 2 = All of my seasonal production
    ☐ 3 = I don't know
    e) Imagine it rained and the water reached the yellow area. No water reached your field. Will you get paid?
    ☐ 1= Yes ☐ 2 = No ☐ 3 = I don't know
    f) If yes, how much will you get paid?
    ☐ 1 = Half of my seasonal production
    ☐ 2 = All of my seasonal production
    ☐ 3 = I don't know

97. Imagine you bought flood insurance for your crops for the next monsoon period. If the yellow level is reached (then this means there was a big flood), the company will pay you money for loss of half of your seasonal production. If the red level is reached (extremely big flood) the company will pay you money for loss of all your seasonal production. If the water stays in the white area, there will be no payments.

a) Imagine it rained and the water reached the red level. All your crops are destroyed. Will you get paid?
☐ 1= Yes ☐ 2 = No ☐ 3 = I don't know

b) If yes, how much will you get paid?
☐ 1 = Half of my seasonal production
☐ 2 = All of my seasonal production
☐ 3 = I don't know

c) Imagine it rained and the water reached the red level. Half of your crops are destroyed. Will you get paid?
☐ 1= Yes ☐ 2 = No ☐ 3 = I don't know

d) If yes, how much will you get paid?
☐ 1 = Half of my seasonal production
☐ 2 = All of my seasonal production
☐ 3 = I don't know

Section 3: Maximum Willingness to Pay

98. Would you be willing to pay 100 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
☐ 1= Yes ☐ 2= No

Instruction 42 to enumerator: If no you finished, go to section G(Math)

99. If yes, would you be willing to pay 300 NRP for one monsoon cropping season to buy flood insurance to cover all your crops?
☐ 1= Yes ☐ 2= No

Instruction 43 to enumerator: If yes, go to next question (question 100)

a) If no, would you be willing to pay 250 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
☐ 1= Yes **(Enumerator: go to math questions you finished)**
☐ 2= No **(Enumerator continue with b)**

b) If no, would you be willing to pay 200 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
☐ 1= Yes **(Enumerator: go to math questions you finished)**
☐ 2= No **(Enumerator continue with c)**

c) If no, would you be willing to pay 150 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
☐ 1= Yes ☐ 2= No

Instruction 44 to enumerator: End of this section, go to section G:Math
Instruction 45 to enumerator: End of this section, go to section G:Math

100. Would you be willing to pay 500 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?

☐ 1= Yes ☐ 2= No

Instruction 46 to enumerator: If yes, go to next question (question 101)

a) If no, would you be willing to pay 450 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes **(Enumerator: go to math questions you finished)**
   ☐ 2= No **(Enumerator continue with b)**

b) If no, would you be willing to pay 400 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes **(Enumerator: go to math questions you finished)**
   ☐ 2= No **(Enumerator continue with c)**

c) If no, would you be willing to pay 350 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes
   ☐ 2= No

Instruction 47 to enumerator: End of this section, go to section G:Math
Instruction 48 to enumerator: End of this section, go to section G:Math

101. Would you be willing to pay 1000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?

☐ 1= Yes ☐ 2= No

Instruction 49 to enumerator: If yes, go to next question (question 102)

a) If no, would you be willing to pay 900 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes **(Enumerator: go to math questions you finished)**
   ☐ 2= No **(Enumerator continue with b)**

b) If no, would you be willing to pay 800 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes **(Enumerator: go to math questions you finished)**
   ☐ 2= No **(Enumerator continue with c)**

c) If no, would you be willing to pay 650 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes
   ☐ 2= No

Instruction 50 to enumerator: End of this section, go to section G
Instruction 51 to enumerator: End of this section, go to section G

102. Would you be willing to pay 3000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?

☐ 1= Yes ☐ 2= No

Instruction 52 to enumerator: If yes, go to next question (question 103)

a) If no, would you be willing to pay 2500 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes **(Enumerator: go to math questions you finished)**
   ☐ 2= No **(Enumerator continue with b)**

b) If no, would you be willing to pay 2000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes **(Enumerator: go to math questions you finished)**
   ☐ 2= No **(Enumerator continue with c)**

c) If no, would you be willing to pay 1500 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes
   ☐ 2= No

Instruction 53 to enumerator: End of this section, go to section G

Instruction 54 to enumerator: End of this section, go to section G

103. Would you be willing to pay 5000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?

☐ 1= Yes ☐ 2= No

Instruction 55 to enumerator: If yes, go to next question (question 104)

a) If no, would you be willing to pay 4500 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes **(Enumerator: go to math questions you finished)**
   ☐ 2= No **(Enumerator continue with next question b)**

b) If no, would you be willing to pay 4000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes **(Enumerator: go to math questions you finished)**
   ☐ 2= No **(Enumerator continue with next question c)**

c) If no, would you be willing to pay 3500 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes
   ☐ 2= No

Instruction 56 to enumerator: End of this section, go to section G

Instruction 57 to enumerator: End of this section, go to section G

104. Would you be willing to pay 10 000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?

☐ 1= Yes ☐ 2= No

Instruction 58 to enumerator: If yes, go to next question (question 105)

a) If no, would you be willing to pay 9000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
   ☐ 1= Yes **(Enumerator: go to math questions you finished)**
   ☐ 2= No **(Enumerator continue with next question b)**

b) If no, would you be willing to pay 8000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
☐ 1= Yes **(Enumerator: go to math questions you finished)**
☐ 2= No **(Enumerator continue with next question c)**

c) If no, would you be willing to pay 6500 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
☐ 1= Yes
☐ 2= No

Instruction 59 to enumerator: End of this section, go to section G

Instruction 60 to enumerator: End of this section, go to section G

105. Would you be willing to pay 50 000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
☐ 1= Yes ☐ 2= No

Instruction 61 to enumerator: If yes, end of this section, go to section G

a) If no, would you be willing to pay 40 000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
☐ 1= Yes **(Enumerator: go to math questions you finished)**
☐ 2= No **(Enumerator continue with next question b)**

b) If no, would you be willing to pay 30 000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
☐ 1= Yes **(Enumerator: go to math questions you finished)**
☐ 2= No **(Enumerator continue with next question c)**

c) If no, would you be willing to pay 20 000 NRP for one monsoon cropping season to buy flood insurance to cover all your crops ?
☐ 1= Yes
☐ 2= No

Instruction 62 to enumerator: End of this section, go to section G

Instruction 63 to enumerator: End of this section, go to section G

Part G: Math and financial literacy questions

I will ask you now some math questions. If you don't want to answer or you don't know the answer don't worry because some of them are very difficult and it is just a matter of research.

Section 1: Math Questions

106. How much is 4+3 ?
☐ 1 = They said 7
☐ 2 = They said another number
☐ 3 = They said I don't know/don't want to answer

107. How much is 35 + 82 ?
☐ 1 = They said 117

☐ 2 = They said another number
☐ 3 = They said I don't know/don't want to answer

108. How much is 3 x 6 ?
☐ 1 = They said 18
☐ 2 = They said another number
☐ 3 = They said I don't know/don't want to answer

109. What's the 1/10 of 400?
☐ 1 = They said 40
☐ 2 = They said another number
☐ 3 = They said I don't know/don't want to answer

Section 2: Probability Questions

Instruction 64 to enumerator: Take out the red bag. Show that in this bag there are 3 blue and 1 pink counters.

110. In this bag there are 3 blue and 1 pink counters. What are the chances that you will get a pink one (1 in 3 or 33%, 1 in 4 or 25%, 3 in 4 or 75 %, etc)
☐ 1 = If they said 25% or 1 in 4
☐ 2 = They said another number
☐ 3 = They said I don't know/don't want to answer

Instruction 65 to enumerator: Take out now the green bag. Show that in this bag there are 5 blue and 1 pink counters.

111. In this second bag there are 5 blue and 1 pink counter. At which bag do you have more chances to draw 1 pink counter if you would close your eyes and pick?
☐ 1 =3 blue and 1 pink (red bag)
☐ 2 = 5 blue and 1 pink (green bag)
☐ 3 = The same
☐ 4 = I don't know/don't want to answer

Instruction 66 to enumerator: Place both bags back and take out the blue and orange bags.

Section 3: Ambiguity aversion

112. In this blue bag there are 4 pink and 3 blue counters. At the orange bag I cannot tell you how many pink or blue counters are inside. You can now choose a colour (pink or blue). Which bag would you choose to try to pick the colour you mentioned? You win if you choose the colour you specified.
☐ 1 = Blue bag chosen
☐ 2 = Orange bag chosen
☐ 3 = I don't know/don't want to answer

Section 4: Financial literacy

113. Suppose that you borrow 100 NRP with interest rate 2% per month. How much would you have to give back after 2 months if you have not paid back anything until then? More, less or exactly 102 NRP ?

☐ 1 = More than 102 NRP ☐ 2 = Less than 102 NRP ☐ 3 = 102 NRP
☐ 4 = I don't know/don't want to answer

114. Suppose that you need borrow 1000 NRP to be paid back in one month. There are two options. **Option 1:** Someone lends you the money asking you to pay back 1050 NRP.
Option 2: Someone lends you 1000NRP with 10% interest.
Which option would you choose?

☐ 1 = Option 1 ☐ 2 = Option 2 ☐ 3 = I don't know/don't want to answer

115. If you have NRP 1000 in a savings account and you earn 1% of interest per annum, and the prices of good and services increased 2% over a one year period, can you buy more, less or the same amount of goods as you could today?

☐ 1 = More ☐ 2 = Less ☐ 3 = Same amount of goods
☐ 4 = I don't know/don't want to answer

116. Is it safer to plant one single crop, multiple crops or it does not matter?

☐ 1 = One
☐ 2 = Multiple
☐ 3 = Does not make a difference
☐ 4 = I don't know/don't want to answer

Please thank the farmer for his/her time. Ask if they would like to add something?

Part H: Identifying the degree of risk aversion

Instruction 67 to enumerator: If Question 14 is "NO" then ask the following questions:

INCOME BETWEEN 5000 - 15000 NRP

Section 1

At this game you will be asked to choose between two options for 8 repeated choices. The questions are focused on **whether you would choose a smaller amount of money for sure or you would prefer to to flip a coin with the possibility to get a higher amount of money but also nothing at all. You can never lose any money no matter what you choose. This is hypothetical. There is no right or wrong answer as it is a matter of preference.**

117. What would you choose?
- ☐ 1 = Choice A: You get NRP 10000 for sure
- ☐ 2 = Choice B: Flip a coin. If it comes up heads you get NRP 10000; if it comes up tails you get nothing

118. What would you choose?
- ☐ 1= Choice A: You get NRP 7500 for sure
- ☐ 2 =Choice B: Flip a coin. If it comes up heads you get NRP 10000; if it comes up tails you get nothing

119. What would you choose?
- ☐ 1= Choice A: You get NRP 6000 for sure
- ☐ 2 =Choice B: Flip a coin. If it comes up heads you get NRP 10000; if it comes up tails you get nothing

120. What would you choose?
- ☐ 1= Choice A: You get NRP 5000 for sure
- ☐ 2 =Choice B: Flip a coin. If it comes up heads you get NRP 10000; if it comes up tails you get nothing

121. What would you choose?
- ☐ 1= Choice A: You get NRP 4000 for sure
- ☐ 2 =Choice B: Flip a coin. If it comes up heads you get NRP 10000; if it comes up tails you get nothing

122. What would you choose?
- ☐ 1= Choice A: You get NRP 3000 for sure
- ☐ 2 =Choice B: Flip a coin. If it comes up heads you get NRP 10000; if it comes up tails you get nothing

123. What would you choose?
- ☐ 1= Choice A: You get NRP 2000 for sure
- ☐ 2 =Choice B: Flip a coin. If it comes up heads you get NRP 10000; if it comes up tails you get nothing

124. What would you choose?
- ☐ 1 = Choice A: You get NRP 1000 for sure
- ☐ 2 =Choice B: Flip a coin. If it comes up heads you get NRP 10000; if it comes up tails you get nothing

Section 2

Instruction 68 to enumerator: At the next part I will ask you similar questions as before but with the option of two coins:

125. What would you choose?

☐ 1 = Choice A: Flip a coin. If it comes up heads you get NRP 10000; if it comes up tails you get 10000?

☐ 2 = Choice B: Flip a coin. If it comes up heads you get NRP 9000; if it comes up tails you get 19000?

Instruction 69 to enumerator: If he chose A you finished go back to continue with Part B: Agriculture

126. What would you choose?

☐ 1 = Choice B: Flip a coin. If it comes up heads you get NRP 9000; if it comes up tails you get 19000?

☐ 2 = Choice C: Flip a coin. If it comes up heads you get NRP 8000; if it comes up tails you get 24000?

Instruction 70 to enumerator: If he chose B you finished go back to continue with Part B: Agriculture

127. What would you choose?

☐ 1 = Choice C: Flip a coin. If it comes up heads you get NRP 8000; if it comes up tails you get 24000?

☐ 2 = Choice D: Flip a coin. If it comes up heads you get NRP 6000; if it comes up tails you get 30000?

Instruction 71 to enumerator: If he chose C you finished go back to continue with Part B: Agriculture

128. What would you choose?

☐ 1= Choice D: Flip a coin. If it comes up heads you get NRP 6000; if it comes up tails you get 30000?

☐ 2 = Choice E: Flip a coin. If it comes up heads you get NRP 2000; if it comes up tails you get 38000?

Instruction 72 to enumerator: If he chose D you finished go back to continue with Part B: Agriculture

129. What would you choose?

☐ 1 = Choice E: Flip a coin. If it comes up heads you get NRP 2000; if it comes up tails you get 38000?

☐ 2 = Choice F: Flip a coin. If it comes up heads you get NRP 0; if it comes up tails you get 40000?

Instruction 73 to enumerator: You finished go back to continue with Part B: Agriculture

Brief explanation of Index-Based Insurance

1 What is insurance and risk transfer mechanisms?

- It is a contract/official agreement between you and an insurance provider (this could be a private company, the government or someone else) in order you transfer your risk of losses (fear of lossing something. In this case we will talk about crops so fear of losing your crops).
- In exchange of an amount of money that you pay to the insurance provider **on a regular basis** (e.g every month or every cropping season), you will be covered/paid from them, for example for your losses against a specific hazard event, for example flooding, in case it happens and destroys the thing that you have been insured for. Examples will follow.
- Once you pay this amount of money you get an official document/contract/official agreement with them where the conditions under which you will get paid, in the case that disastrous event that you bought insurance for happens.
- Insurance does not cover losses coming from everything/from every hazard but those ones on the contract you signed. For example, you bought flood insurance for your home, then **you will not** get paid if an earthquake happens and destroys your home.
- Additionally, insurance will not cover you for other type of losses apart from those you insured. For example, **if you buy crop insurance for your crop losses you will not get money back for your flooded house or livestock losses but only for the flooded fields for which you had bought insurance**. The insurance in that case will pay you for your crop losses only.
- If a flood event does not happen for **the period you are insured**, you **will not get back** the amount of money you paid to the company to buy insurance coverage.

2 Experience with insurance and comparison with saving schemes

- In case you belong to a group savings scheme (e.g cooperatives, women's group or similar to cooperatives). There, you pay an amount of money (probably monthly), in

other words, you make a contribution **to ensure** that you will get support in case of emergency (probably funeral money, fire, children's sickness or similar).

- **It does not mean that you will get the money that you contributed (premium) back, if the bad event does not occur. Correct?**
- Insurance/Risk transfer mechanisms work in a similar way but quite more official (provided by a private company, or the government etc) and with quite some differences. When the bad event occurs (e.g flood on your field) and you have bought in advance for example crop weather insurance, you can request payment for your crop losses and then you get an amount of payment for your losses.

3 The idea of Index based Insurance: a specific type of insurance

- **The Index Based Flood Insurance does not exist in your area. This study as previous explained is going to explore opinions towards such an idea. I am not here from an insurance company or organisation. The purpose is only research. It does not mean that it will exist or it will be offered to you to buy in the future. Additionally, the examples presented here are imaginary and this does not mean that if index based insurance would be offered to you it would be under the same conditions or the payments would start because of the same parameter measured. However, through this study I will try to understand what would you think of such a type of insurance, for my research.**

  At parametric/index based insurance the payments start according to an index/table with pre agreed numbers/values. When these pre-agreed conditions are reached/covered then the pre-agreed payments start. The payments are done according to the table and not the losses on your field. These conditions, however, are related to the potential losses on your field. For example at this table of water level (show table):

  - If a specific water level was reached at a hypothetical measurement station on your community then the payments would start. For example, it could be that if the water reaches the yellow level at the measurement station then you will receive payments for partial losses. If the red level is reached at the measurement station then you will get paid for losses of all your crops.

  As a result you don't need to fill up forms and claim your money because the moment the conditions are reached at the station that your contract says are reached, the insurance company is being informed automatically and the payments follow.

4. शैक्षिक स्तर

☐ 1 = निरक्षर
☐ 2 = प्राथमिक तह
☐ 3 = माध्यमिक तह
☐ 4 = उच्च माध्यमिह तह
☐ 5 = विश्वविद्यालय तह

5. तपाइको परिवार यस स्थानमा कहिले देखि बसोबास गरिरहनु भएको छ ? _____

6. कृषि बाहेक परिवारको आम्दानिको अन्य स्रोत छ वा छैन ?

☐ 1 = छ
☐ 2 = छैन

7. यस घरमा तपाइको परिवारको संख्या कति छ ? _____

8. के तपाइ संग मोबाइल फोन छ ?

☐1 = छ ☐ 2 = छैन

9. के तपाइ संग बैक खाता छ ?

☐1 = छ ☐ 2 = छैन

10. के तपाइको परिवारको कुनै सदस्य बैदेशिक रोजगारीमा छन् र पैसा पठाउछन् ?

☐1 = छ ☐ 2 = छैन

सर्वेक्षणकर्तालाइ निर्देशन 7 : यदि छैन भने,प्रश्न 13 सोध्नुहोस् ।

11.बिदेशबाट कति जति पैसा प्राय पाउनुहुन्छ ? _____

12.बर्षमा कति पटक तपाईलाइ यति पैसा बिदेशबाट आउछ ? _____

13.के तपाइको मासिक आम्दानी(बिदेशबाट आउने पैसा बाहेक) रु ५००० छ ?

☐1 = छ ☐ 2 = छैन

सर्वेक्षणकर्तालाइ निर्देशन 8 : यदि छैन भने, भाग H (NRP 5000 भन्दा कम आय भएमा) प्रश्नहरु सोध्नुहोस् ।

14. बिदेशबाट आउने पैसा बाहेक, के तपाइको औसत मासिक आम्दानी रु १५००० माथि छ ?

☐1 = छ ☐ 2 = छैन

सर्वेक्षणकर्तालाइ निर्देशन 9 : यदि छैन भने, भाग H (NRP 5000 -15000 आय भएमा) प्रश्नहरु सोध्नुहोस् ।

15. बिदेशबाट आउने पैसा बाहेक के तपाइको औसत मासिक आम्दानी रु २५००० माथि छ ?

☐1 = छ ☐ 2 = छैन

सर्वेक्षणकर्तालाइ निर्देशन 10 : यदि छैन भने, भाग H (NRP 15000 -25000 आय भएमा) प्रश्नहरु सोध्नुहोस् ।

Appendix B: Qualitative questionnaires sample of questions

The following appendix presents a sample of the qualitative questionnaire guides with a sample of the actual questions during the KIIs, interviews with community leaders and FGDs after the index-based insurance game. Not all of the questions were asked nor in the order presented in the guide or there might be questions asked that were guided from the interview and are not included in the presented sample.

RETHINKING FINANCIAL INSTRUMENTS FOR DEVELOPING COUNTRIES: THE CASE STUDY OF FLOODS IN NEPAL

Household survey/Key Informants questionnaire guide

Introduction including ethical statement for data collection fieldtrip
October-December 2019

Study area (Municipality, Ward, Community) _____ _____ _____

Date_____ Surveyor_____

Increasing Nr. of Questionnaire____

Opening (Ethical statement)

Thank you kindly for agreeing to participate in this survey. I am very grateful for your time. I am a PhD student doing research at Durham University in the UK.

The aim of this study is to understand if farmers living in flood prone areas would be interested to buy a specific type of a hypothetical insurance product named parametric insurance, if it existed in your area. A brief explanation of this type of insurance will be introduced during the interview. The data collected will be analysed by the researcher (Eleftheria Vavadaki) to identify the factors that affect these decisions but also to explore your opinions as well as the opinions of other communities towards this type of insurance. The data analysed will be used for writing a PhD thesis, publications and academic purposes. This research is not related to any project in your area, I am not related with any company or organisation. This is only for my research as a student.

You have been invited to participate in my research because you live or have property (e.g house, farm, livestock, belongings) lying on a flood prone area. Due to this reason there is a possibility that you already have experience with floods in this region which would be very useful for our research.

You can withdraw from the study at any time, without giving a reason, and you may refuse to answer any question. You do not have to participate if you do not wish. All information obtained during the study will be kept **anonymised and confidential**, which means that everything you say will not be related to your name. To ensure that valuable input is documented I will also ask for your permission to audio record the interview. If you have any questions now or after the session, please don't hesitate to ask me or contact me through my e-mail eleftheria.vavadaki@durham.ac.uk

Key informant categories/ Background data

- Gender ☐ Male ☐ Female
- Age over 25yrs old ☐ lower than 35 ☐ between 35-50 ☐ over 50
- Living at this location/area at least 5 yrs ☐
- Experienced with insurance (having bought already) ☐ Yes ☐ No
- Farmers with other source of income ☐ Yes ☐ No
- Farmers who are management members of the co-operatives ☐ Yes ☐ No
- Farming experience more than 5 years ☐

- Farming who played the game ☐

Start recording

Part A: Background data

Introduction

1. How many people is your HH consisted of including you?
2. How many live here?
3. How long have you been living in this area?
4. Have you gone to school ? Until which level ? (e.g No education/No formal education, primary, Secondary or High school level University level or above)
5. How many years do you have farming experience?
    a. *How many years are you the head of your own household/farming ndependently?*
    b. *What are the crops you are cultivating during the whole year, all the cropping seasons?*

Agriculture

6. Is agriculture your only source of income?
    a. If no, could you please explain your other sources of income?
7. Do you rent or own (or both) the land you cultivate?
    a) *How do you prove the ownership of the land?*
8. What type of crops do you plant each season?
    a. Which ones do you plant for sure each season?
    b. Could you please tell me the pattern of the crops you plant within a year?
9. Do you plant for livelihood or do you also sell in the market as a source of income?
10. Is someone of the family working abroad for some months per year?
    a. Does he/she send you remittances?
    b. How much percentage of the montly or yearly income level comes from abroad (e.g 20%, 30% ?50% e.t.c) ?
11. How much is on average your monthly income including all sources of income?

Part B: Floods experience

Now I want to ask you some questions related to flood events.

1. Have you ever experienced a flood event?
    a) *How often?*
    b) *Could you show me until which level on your house or somewhere around did the water reach at one flood that you remember?*

2. Do you worry about floods?
    a) *What are your other worries in daily life?*
3. Does flooding make you worry in the financial sense?
4. Have you observed a change in the flood frequency the last years?

a. Do floods come more often/rarely the last years?
   b) *Change in the water level?*
   c) *Change in the extent?*
   d) *Have you observed any difference with floods now and floods in the past?*
   e) *How long do floods stay nowadays and how did they stay in the past?*
5. *Why do you believe is your area getting flooded?*
6. *What do you believe causes the flood?*
7. What impact does flooding have/how does flooding affect you and your family?
8. How long does it take you usually to go back to your initial condition after a big/heavy flood?

Part C: Finance

Now I would like to ask you questions related to financial decisions and saving schemes

Credit

1. How easy is it to borrow after a heavy flood?
2. Where would you turn to for borrowing if needed in such a case? (e.g relatives, neighbours, social groups schemes or credit from co-operatives or other formal and informal form?)

Saving schemes

3. What do you do to prepare financially for these type of events, such as catastrophic floods ?
4. What do you do in respect to savings?
   a. Do you have savings for this type of emergency? Do you have any community saving schemes for disasters?
   b. If yes, are you an active member of that?
   c. If yes, how often do you participate and how much?
5. Do you participate in other saving schemes?
6. In how many?
7. Which are these?
8. Do you participate at the saving groups you are a member of?
   a. How often do you participate?
   b. Monthly?
   c. How much?
   d. When was it the last time you participated?
   e. What makes you an active member?
9. Do you know what other saving schemes apart from those you participate has your community?
10. Does your community have a co-operative?
    a. Do you participate in this co-operative?
    b. How often do you participate
    c. How much?
    d. How did you decide to make it? How did you learn about it?
    e. Is it a registered cooperative?
    f. How important do you consider it?
11. Do you have a women's group? Ask the same for mother's group
    a. How long does it exist?
    b. How important is it?
       i. Why

g. How did you decide to make it? Who informed you?
h. How much do you participate each month ?
i. How many members do you have?

Financial decisions

12. Who makes the financial decisions in your house?
    a. Who decides at which saving schemes your household will participate?

Loans

13. When was it the last time you borrowed money/took a loan?
14. Do you currently have one loan?
15. How much is it?
16. *How many loans you might take during a whole year (all cropping seasons?)*
17. *From whom do you usually take a loan from? (co-operative, relatives, neighbours, money, other…?)*
18. *What is the interest rate that you pay back to the one that lent you money?*
19. *It is good that your community has saving schemes and that you have co-operatives. Would you be willing to have the co-operatives being operated more officially e.g the government or iNGO?*

    a) Why?

Part D: Familiarity with insurance and Willingness To Buy

Experience with insurance/risk transfer mechanisms

1. What would you do in case a disaster would happen and destroyed your investments (e.g crops,livestock e.t.c) in case you had a loan?
2. Do you have experience with insurance/risk transfer (e.g life insurance, health insurance, motorbike, livestock, crop, car etc) ?
    a. *If yes, what type of insurance/risk transfer is this?*
    b. *If yes, with which company are you co-operating ?*

    If not, we will explain you later if interested

3. Have you been informed about the existing crops and livestock insurance scheme subsidised by the government?
    a. Whose role is in your opinion to inform you the farmers about the existing scheme?
4. If you have been informed,

a) How have you been informed?
b) Which is the company that you have a contract with?
c) How many crops you had insured?
d) How much did you pay for it?
e) During this time that you had bought insurance, did you ever need to ask any money from the insurance after you had losses?
f) If yes, how many times?
g) What was the hazard that destroyed your crops and got compensated?
h) How much did they give you back as compensation? For how many crops/hectares?
i) Was the money that you took as compensation enough? Were you satisfied?
j) Did you renew the next year ?

k) If not, why not?
l) Do you currently have crop insurance?
m) Was it easy for you to claim your money?
n) If not, what were the difficulties that you faced?
o) What would you like to change?
p) Would you like to be explained now another type called parametric insurance?

5. **If you haven't been informed, would you like briefly to be explained?**

Oral explanation

Weather insurance is designed for farmers to transfer their risk of weather losses. Through this study I try to explore yours and other communities' opinions for a specific type of insurance named indexed-based/parametric insurance. This type does not exist in your area and I am not here to promote a product or something similar. I am not a representer of an insurance company or coming here from an organisation. I just try to understand if there would be interest for such a hypothetical type of product in agricultural flood prone areas and the purpose is only research. I have to explain you first what is this type of risk transfer mechanism/insurance.

Read the IBFI explanation sheets in connection to flood scenario sketches to explain parametric insurance

Willingness to Buy

6. **Do you find it a good/bad idea?**
    a. **What do you find good/bad?**
    b. *What would you like to be improved?*
    c. *What would you suggest to change?*
    d. **Why?**
    e. **What would define your choice?**
7. **Would you prefer the type of insurance that was just explained to you, if existed, to be sold to your through your saving schemes or through a private company or government?**
    a. **Why?**
8. **After explaining I would like to ask you if you would be interested to buy such a product for your crops?**
    a. **Why yes/no? What are the reasons willing/not willing to buy?**
9. **Which could be the maximum amount that you would pay to insure all your crops for one cropping season against floods?**
10. **With whom would you discuss to buy such a product for your crops? Who makes the financial decisions in your household?**
11. *Would you discuss it with your neighbours?*
    a. *Would you discuss with other communities?*
12. **Would you buy easier such a product if the whole community would be insured and you pay part of your insurance costs to the community disaster fund**
    a. **Why?**
13. **Would you prefer to pay your insurance costs directly to the insurance provider independently?**

Closure

I would like to thank you very much for your time and ask you if there is anything you think I should know and I did not ask about?

Do you have any questions for me?

RETHINKING FINANCIAL INSTRUMENTS FOR DEVELOPING COUNTRIES: THE CASE STUDY OF FLOODS IN NEPAL

President of the community questionnaire guide

Introduction including ethical statement for data collection fieldtrip October-December 2019

Study area (Municipality, Ward, Community) _____ _____ _____

Date_____ Surveyor_____

Increasing Nr. of Questionnaire____

Opening (Ethical statement)

Thank you kindly for agreeing to participate in this survey. I am very grateful for your time. I am a PhD student doing research at Durham University in the UK.

The aim of this study is to understand if farmers living in flood prone areas would be interested to buy a specific type of a hypothetical insurance product named parametric insurance, if it existed in your area. A brief explanation of this type of insurance will be introduced during the interview. The data collected will be analysed by the researcher (Eleftheria Vavadaki) to identify the factors that affect these decisions but also to explore your opinions as well as the opinions of other communities towards this type of insurance. The data analysed will be used for writing a PhD thesis, publications and academic purposes. This research is not related to any project in your area, I am not related with any company or organisation. This is only for my research as a student.

You have been invited to participate in my research because the community you are president of is lying on a flood prone area. Due to this reason there is a possibility that you already have experience with floods in this region which would be very useful for our research.

You can withdraw from the study at any time, without giving a reason, and you may refuse to answer any question. You do not have to participate if you do not wish. All information obtained during the study will be kept **anonymised and confidential**, which means that everything you say will not be related to your name. To ensure that valuable input is documented I will also ask for your permission to audio record the interview. If you have any questions now or after the session, please don't hesitate to ask me or contact me through my e-mail eleftheria.vavadaki@durham.ac.uk

Start recording

1

Part A : Background and demographic data

1. How long have you been president in this community?
2. *What is your age?*
3. *What's the most majority ethnicity in this community?*
4. How many households does this community has?
5. How many members has each household on average ?
6. What is the main source of income of the farmers in this community ?
    a. *Something else apart from agriculture?*
7. *What is the average monthly income of each family?*
8. Is the cultivated land owned, rented or both?

Part B: Floods

1. Are floods a problem to this community?
    a. How often is this community and the surrounded area getting flooded?
2. When was it the last time this area got flooded ?
    a. How many HHs in your community have been flooded at 2014 flood?
    b. How many HHs in your community have been flooded at 2017 flood?
    c. *Did you have another flood after 2014 that I did not mention?*
    d. Until where did flood reach at the worst flooded event?
    e. *Could you show me? (take photo maybe and measure)*

Part C: Finance

Saving schemes

1. *What are the financial actions taken before a flood?*
2. *What are the financial actions taken after a flood?*
3. Do you have saving schemes?
    a. Which are these?
    b. Which of them do you consider the most active savings groups?
    c. Which of them do you consider the least active that residents do not participate systematically?
4. Does your community have a co-operative?
    a. How have you been informed to create one?
    b. Did someone explain it to you?
5. Who is managing the co-operative?
    a. How much is the interest rate?
    b. Is it dependent on the amount of money borrowed?
    c. Could you please give me an example?
    d. How many households participate at this moment at the co-operative?
    e. How much do they participate on average?
6. Is there any saving scheme related to disasters (e.g floods) in this community?
    a. If yes, is this an active fund?
    b. Why?
    c. How many households participate?
    d. How much and how often?
7. Do you know how many HHs of your community participate in the rest saving schemes of your community?

a. How often?
b. How much each time?

Borrowing/loans

1. *How long does it take to your community to go back to its initial financial condition before the flood?*
2. To whom do farmers turn to in case of emergency for borrowing (e.g relatives, neighbours, social groups schemes, government, other)?
    a. How much easy is it for someone to borrow after a heavy flood?
    b. Why?
3. What are the main reasons someone would take a loan? (e.g livelihood, investment, recovery after a disaster, other)?
4. Do you know many HHs of your community have currently a loan?
    a. *How many of these are from the co-operative?*

Part D: Familiarity with insurance

1. Do you have experience with insurance (e.g life insurance, health insurance, car, motorbike, livestock, crop etc) ?
    a. *If yes, what type of insurance is this?*
    b. *If yes, with which company are you co-operating ? (to check if they understood the question)*
2. Has your community been informed about the existing crops and livestock insurance scheme subsidised by the government?
    a. Whose role is in your opinion to inform the farmers about the existing scheme?
    b. If yes,
        i. How?
        ii. Who informed you?
        iii. Which is the company that most of the HHs in your community have a contract with?

Closure

I would like to thank you very much for your time and ask you if there is anything you think I should know and I did not ask about?

Do you have any questions for me?

RETHINKING FINANCIAL INSTRUMENTS FOR DEVELOPING COUNTRIES: THE CASE STUDY OF FLOODS IN NEPAL

Focus Group Discussions Guide (Played)

Introduction including ethical statement for data collection fieldtrip October-December 2019

Study area (Municipality, Ward, Community) _____ _____ _____

Date_____ Surveyor_____

Increasing Nr. of Questionnaire____

Opening (Ethical statement)

Thank you kindly for agreeing to participate in this survey. I am very grateful for your time. I am a PhD student doing research at Durham University in the UK.

The aim of this study is to understand if farmers living in flood prone areas would be interested to buy a specific type of a hypothetical insurance product named parametric insurance, if it existed in your area. A brief explanation of this type of insurance will be introduced during the interview. The data collected will be analysed by the researcher (Eleftheria Vavadaki) to identify the factors that affect these decisions but also to explore your opinions as well as the opinions of other communities towards this type of insurance. The data analysed will be used for writing a PhD thesis, publications and academic purposes. This research is not related to any project in your area, I am not related with any company or organisation. This is only for my research as a student.

You have been invited to participate in my research because you live or have property (e.g house, farm, livestock, belongings) lying on a flood prone area. Due to this reason there is a possibility that you already have experience with floods in this region which would be very useful for our research.

You can withdraw from the study at any time, without giving a reason, and you may refuse to answer any question. You do not have to participate if you do not wish. All information obtained during the study will be kept **anonymised and confidential**, which means that everything you say will not be related to your name. To ensure that valuable input is documented I will also ask for your permission to audio record the interview. If you have any questions now or after the session, please don't hesitate to ask me or contact me through my e-mail eleftheria.vavadaki@durham.ac.uk

Some rules we should follow during the focus group are:

- To talk one person at a time to show respect and also for quality and recording
- It is very important that everyone participates

- Kindly ask farmers to introduce themselves

- Start recording
- Are there any questions before we start?

My criteria:

- Head of Household who makes financial decisions ☐
  - If not there a person who knows about the financial decisions. ☐
- Experience with farming more than 5 years ☐
- To have experienced flooding and had agricultural losses ☐
- Living in the area for 5 years at least ☐
- Over 25 yrs old in order to be active on financial decision making of HH ☐

Possible Focus Groups with farmers who have played the game

- Farmers experienced with insurance ☐
- Farmers inexperienced with insurance ☐
- Farmers where agriculture is not the only source of income ☐
- Farmers where agriculture is the only source of income ☐

Part A: Floods

1. Do floods present a problem in your community?
   a. If yes, how big of a problem?
2. Do floods affect your cultivated area?
   a. *In what extent?*
   b. *Are there years that all your crops have been destroyed because of floods?*

Part B: Saving schemes and finance

1. Is there any savings scheme for disasters in your community?
   a. *If yes, is this an active fund?*
   b. *How much money and how often does each household have to give in order to be an active member of that fund?*
2. Is this fund enough to cover your losses, in case of a flood for example?
3. What other alternatives do you have for borrowing, in case of need? To whom do farmers usually turn to borrow in case of emergency (e.g relatives, neighbours, social groups schemes, government, other)?
4. What are the main reasons that you would usually borrow/take a loan?
   a. *For an investment in the new cropping season?*
   b. *For another type of investment?*
   c. *For a recovery after a disaster?*
   d. *Any other reason?*
5. How many of you have currently a loan?
   a. What is the reason for that loan?

Part C: Familiarity with insurance

1. How would you react if a disaster (in our case flood) destroyed your livelihoods (e.g crops,livestock?) ? How would you pay back your loan?
2. Do some of you have experience with insurance (e.g life insurance, health insurance, car, motorbike, livestock, crop etc) ?
    a. If yes, how many of you?
    b. What type of insurance do you have?
    c. Could you please tell me more about it?
    d. Why did you buy it?
    e. Did you find it useful?
3. Has anyone of you bought the existing agricultural crop and livestock insurance scheme? (only for experienced)
    a. How have you been informed?
    b. Which is the company that you have a contract with?
    c. How many crops/livestock you had insured?
    d. How much did you pay for it?
    e. During this time that you had bought insurance, did you ever need to ask any money from the insurance after you had losses?
    f. If yes, how many times?
    g. What was the hazard that destroyed your crops and got compensated?
    h. How much did they give you back as compensation? For how many crops/hectares?
    i. Was the money that you took as compensation enough? Were you satisfied?
    j. Did you renew the next year ?
    k. If not, why not?
    l. Do you currently have crop insurance?
    m. Was it easy for you to claim your money?
    n. If not, what were the difficulties that you faced?
    o. What would you like to change?

Oral explanation

Weather insurance is designed for farmers to transfer their risk of weather losses. Through this study I try to explore yours and other communities' opinions for a specific type of insurance named indexed-based/parametric insurance. This type does not exist in your area and I am not here to promote a product or something similar. I am not a representer of an insurance company or coming here from an organisation. I just try to understand if there would be interest for such a hypothetical type of product in agricultural flood prone areas and the purpose is only research. I have to explain you first what is this type of risk transfer mechanism/insurance.

Read the IBFI explanation sheets in connection to flood scenario sketches including the fields that was used to play the game to remind parametric insurance

1. Would you be interested to buy such a product for your crops?
    a. Why?
    b. What would define your choice?
2. What are your thoughts about this type (e.g good/bad idea)? (Write down how many out of how many would buy it)

    a. If not, why wouldn't you buy it? What are the reasons for not buying?
3. What would you suggest to change?
4. How would you prefer insurance/risk transfer mechanisms to be provided to you (e.g from a private company, the government or through you informal saving schemes/co-operatives or something else I did not mention)?
    a. Why?
5. Would it be easier for you to purchase such a product if the whole community would be insured and you pay part of your insurance costs to the community disaster fund (and the disaster fund buys the insurance contract for the whole community)?
    a. Why would you prefer that?
6. Would you prefer to pay directly your insurance costs directly to the insurance provider and have your own contract independently?
    a. Why would you prefer that?

Closure

I would like to thank you very much for your time and ask you if there is anything you think I should know and I did not ask about?

Do you have any questions for me?

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