IFAD
Investing in rural people

IMPACT ASSESSMENT PLAN

Ethiopia

Participatory Small Irrigation Development Programme (PASIDP)

Authors:
Alessandra Garbero
Bezawit Chichaibelu
Tisorn Songsermsawas

IMPACT ASSESSMENT PLAN[1]

Ethiopia

Participatory Small Irrigation Development Programme (PASIDP)

Authors:
Alessandra Garbero[2]
Tisorn Songsermsawas[3]

Garbero, A., Songsermsawas, T., October 2016. Impact Assessment Plan: Participatory Small Irrigation Development Programme, Ethiopia. Rome: IFAD.

[1] The contents suggested in this concept note follow the recommendations of the book "Impact Evaluation in Practice" (Gertler el al., 2011). The authors thank Romina Cavatassi, Daniel Higgins, Pierre Marion, and Paul Winters for comments and suggestions for earlier versions of this document.

[2] Senior Econometrician, Strategy and Knowledge Department, International Fund for Agricultural Development (IFAD), Via Paolo di Dono 44, Rome 00142, Italy. Email: a.garbero@ifad.org

[3] Research Analyst, Strategy and Knowledge Department, International Fund for Agricultural Development (IFAD), Via Paolo di Dono 44, Rome 00142, Italy. Email: t.songsermsawas@ifad.org

Table of Contents

Introduction 1
The PASIDP Project 3
Impact assessment design 9
Sampling and data collection 12
Budget, deliverables and workplan 18
References 20

©IFAD/ Wairimu Mburathi

Introduction

Researchers at IFAD selected the Participatory Small-scale Irrigation Development Programme (PASIDP) in Ethiopia as a candidate for an *ex-post* impact assessment as part of the IFAD9 Impact Assessment Initiative (IFAD9 IAI). This document describe the impact assessment plan for the high-frequency data collection, which is a component of the *ex-post* impact assessment study of the PASIDP project in Ethiopia, specifically aimed at measuring farmers resilience to idiosyncratic and covariant shocks. The impact assessment of the PASIDP project conducted as part of IFAD9 IAI mainly focused on evaluating the impact of the project on agricultural production and marketing, and household consumption, both of which are related the PASIDP project's main goal to reduce rural poverty by increasing household income.[4]

The PASIDP project was approved in 2008, and closed in 2015. During this time, 121 schemes were constructed and the total land area under irrigation increased by more than 12,000 hectares. The PASIDP project is estimated to have benefited 311,000 individuals in 62,000 households. The total cost is US$ 57.8 million. The activities implemented by the project reached more than 62,000 beneficiary households in four regions (Amhara, Oromia, SNNPR, and Tigray) of Ethiopia, which were selected by the Government of Ethiopia (GOE). In Table 1, we present the distribution of PASIDP irrigation schemes by region and by type of irrigation schemes chosen to be constructed. Figure 1 presents the locations of the irrigation facilities constructed and upgraded as part of the PASIDP project.

Access to improved water supply through irrigation infrastructures is claimed to be one channel that may help farmers in the developing world significantly improve their agricultural production, welfare, and resilience. However, there is still little empirical evidence to support this claim. The purpose of the present proposal is to conduct a high-frequency data collection exercise to supplement a recently conduct *ex-post* impact assessment as part of the IFAD9 Impact Assessment Initiative (IFAD9 IAI), with the purpose of investigating the impact of a small-scale irrigation infrastructure on farmers' livelihood outcomes in four regions of rural Ethiopia.

This high-frequency data collection exercise is an add-on component to an *ex-post* impact assessment study of the PASIDP project conducted in March 2015. The three *ex-post* impact assessment-related activities undertaken under this collaborative work include: (1) the main *ex-post* impact assessment conducted in March 2015, (2) the *ex-post* impact assessment using a high-frequency dataset, and (3) an *ex-ante* modelling component that aims at developing multiple policy scenarios for Ethiopian farming systems.

The key outcome indicators of interest in this impact assessment using the high-frequency dataset are consumption-expenditure and resilience, as well as agricultural production and marketing. These outcomes are closely related to the strategic objectives (SO's) of IFAD: increased agricultural productive capacity (SO1), strengthened linkages between smallholder farmers and agricultural markets (SO2), and greater environmental sustainability and climate resilience (SO3).

[4] This impact assessment of the PASIDP project as part of IFAD9 IAI used the data collected by the Ethiopian Institute of Agricultural Research (EIAR), and was completed in early 2016.

Table 1: Distribution of PASIDP Irrigation Schemes

Region	Scheme Type	Number of Locations
Amhara (28 schemes)	River Diversion	26
	Spate	2
Oromia (30 schemes)	River Diversion	20
	Spate	8
	Spring	2
SNNPR (17 schemes)	River Diversion	12
	Spate	4
	Spring	1
Tigray (46 schemes)	River Diversion	21
	Spate	4
	Pump Supported	14
	Shallow Well	7
Total		**121**

Figure 1: PASIDP small-scale irrigation locations (Source: IIASA)

The PASIDP Project

The Project Interventions

Ethiopia's Ministry of Agricultural (MoA) was the main implementation unit of the PASIDP project, responsible for coordinating the project activities with other implementation institutions in the four regions covered by the project. The project was specifically designed to have the local WUA's responsible for the construction, operation, and maintenance activities of the irrigation schemes. This is mainly to create a sense of ownership among the WUA members, incentivizing them to be more committed to maintaining the installed and upgraded facilities.

The target group of the project is households under the poverty line, with an average income of less than US$ 0.3 a day. Most of these households are subsistent farmers, most of which are food-deficit, and net buyers of food since their own agricultural production is not sufficient to meet their demands for the entire year. As women are the most vulnerable group of people in the communities covered by the project, the project specifically designed a number of activities for women.

Before the implementation of the project, food-deficit *woredas* (districts) under the Productive Safety Net Programme (PSNP), implemented by the GOE, were selected. Then, *woreda* and *kebele* (sub-districts) officials along with community leaders, selected the type of small-scale irrigation scheme most appropriate for the area based on the local conditions and implementation capacity of the targeted beneficiaries.[5] To supplement the development of the small-scale irrigation schemes, the project implementation officials and the community leaders also selected the most suitable training activities to offer to project beneficiaries. Within the scope of the PASIDP project, there are three main components offered according to the project's implementation manual:

1. **Institutional Development**
    - Promote a highly participatory approach to irrigation development by community empowerment and the development of WUA's
    - Strengthen institutional capacity at the grassroot level and at the regional level
    - Improve the monitoring and evaluation (M&E) system
2. **Small-scale Irrigation Development**
    - Improve catchment planning areas of small-scale irrigation schemes covering over 12,000 hectares of irrigable land
    - Support planning, design, supervision and construction of small-scale irrigation development
    - Improve scheme-to-market access roads
3. **Agricultural Development**
    - Strengthen agricultural support services, including the preparation of agricultural development plans
    - Improve farming practices mainly through better soil and water conservation measures
    - Promote seed production systems
    - Promote home gardens for women

[5] Irrigation engineers surveyed the PASIDP project locations to choose and design the most suitable type of irrigation scheme for each project location based on geographical attributes (elevation and slope), and the maximum number of possible beneficiaries of the project. The types of small-scale irrigation scheme constructed include river diversion, spate, spring, pump-supported, and shallow well. Table 1 presents the types of irrigation schemes built in each region. For the next phase of the PASIDP project, microdams are expected to be built as well apart from the five types of irrigation schemes built during the first phase of the project.

Theory of Change

A number of studies have documented that public investments in agriculture, designed, and rolled-out to suit local conditions, contribute to increased agricultural productivity and resilience capacity of the same group (Asfaw et al., 2012; Azzarri et al., 2015; Minde et al., 2008). Investment in irrigation facilities illustrates a special example of improving the agricultural performances of farmers in the developing world by raising their productivity levels. Several empirical studies have found irrigation to have a positive impact on agriculture and poverty amongst small-scale farmers (Hussain and Hanjra, 2004; Lipton et al., 2003; Smith, 2004). Although the returns to investments in irrigation can be potentially high, the World Bank (2007) reports that irrigation coverage in Sub-Saharan Africa remains low. With this information in mind, a strong case could be made for investing in the expansion of irrigation coverage across Sub-Saharan Africa as a means of improving agricultural productivity and alleviating rural poverty (Dillon, 2011).

Ethiopia's geographical and climatic attributes provide a greater amount of rainfall than the rest of Africa on average (Kassahun, 2007). However, the agricultural sector in the country is constantly stricken by frequent drought and soil degradation (Matouš et al., 2013). These idiosyncratic shocks to agricultural production are closely linked to the persistence of poverty in rural Ethiopia. Insufficient functioning of irrigation infrastructures also exacerbates the presence of poverty amongst rural farmers, especially among the poorest of the poor (Del Carpio et al., 2011; Escobal, 2005). A report by the World Bank (2006) shows that only 5% of irrigable land are covered with irrigation.

As part of Ethiopia’s second generation Poverty Reduction Strategy Paper (also referred to as the Plan for Accelerated and Sustainable Development to End Poverty: PASDEP), the PASIDP project was launched. The overall objective of the PASIDP project was to reduce rural poverty (IFAD, 2007). To achieve such objective, the project aimed to reduce rural poverty by improving household food consumption and agricultural revenue mainly through the development of small-scale irrigation infrastructures.

Given the structure of the project and the details of activities involved, we can summarize the project’s theory of change in Table 2. Project’s interventions, which include constructing irrigation schemes, forming WUA's, training of WUA leaders and members, and providing capacity building and training activities, should help project’s beneficiaries in the following ways. First, the WUA's are formed within each community that receives the project. Second, the WUA leaders and members are provided with the necessary knowledge by project’s extension agents to manage and distribute/allocate water more efficiently and effectively. Third, beneficiaries increase their knowledge and awareness on agricultural technologies and options through capacity development activities. And finally, with a well-functioning irrigation infrastructure system in place, project beneficiaries would obtain (1) a more constant supply of water, (2) higher amount of water overall, (3) improved timing of water available to agriculture when it is most needed over the course of a cultivation season.

From the activities highlighted above, the beneficiaries of the irrigation scheme would be able to adopt new agricultural technology, increase their production both at the intensive and extensive margins, increase crop yields, grow higher amount and more diversified types high-value crops, increase livestock production, diversify their agricultural production, use water from irrigation in case of erratic rainfall (as a risk management or risk coping strategy against erratic rainfall), and therefore increase their agricultural income as well as its stability which in turn would increase asset accumulation and savings. These outcomes should lead to more stable and higher household income, which will be measured through increase in agricultural revenues, and household consumption, and more stable and higher household income. Last, a more stable income would lead to a higher adaptive and coping capacity as well as resilience to shocks.

Table 2: PASIDP Logical Framework

Inputs/Activities	• Formation of water user associations (WUA's) • Training of WUA leaders and members about water management and water distribution/allocation • Provision of agricultural capacity building and training services • Construction of irrigation infrastructure system
Outputs	• Greater access to water available for crops (through construction of irrigation infrastructure system) • More efficient water management (through formation and training of WUA leaders and members) • More efficient water distribution/allocation (through formation and training of WUA leaders and members) • Greater ability to adopt risk management and risk coping strategies (through construction of irrigation infrastructure system) • Improved access to information about agricultural knowledge and technology (through training activities)
Outcomes	• Adoption of new and more suitable agricultural technology • Expansion of cultivation areas (extensive margin) and crop rotations (intensive margins) • Increased crop production/higher yields of crop • More higher-valued crops cultivated • Increased agricultural diversification • Greater resilience against negative shocks
Impacts	• More stable and increased household income • Higher ability to adopt risk coping and risk management strategies against negative shocks

Main Impact Assessment Questions

This assessment investigates the impact of the PASIDP project on two main sets of outcomes. The first set of outcomes relates closely to the main goal of the project to reduce poverty by raising income: agricultural production and household consumption. Agricultural production is measured by the value of crop production, crop yields, and crop revenues. Farmers welfare is measured through money metrics, household consumption expenditure, which is a more appropriate indicator to illustrate households' disposable income than measuring household income.

The second set of outcomes, though less examined, is resilience outcomes. According to Barrett and Constas (2014), the concept of resilience refers to "the capacity over time of a person, household or other aggregate unit to avoid poverty in the face of various stressors and in the wake of myriad shocks." In our study, we focus on the resilience outcomes at the household-level, and investigate how the strategies adopted by a household to achieve greater resilience interact with the strategies adopted by the households within the same community. The first set of outcomes, agricultural production and household consumption, were evaluated in both the main impact assessment and will continue to be central also in this high-frequency impact assessment. However, the latter will focus more specifically on resilience outcomes.

According to the TOC of the PASIDP project, a number of research questions can be advanced in this impact assessment study. Research questions 1-5 have already been investigated using the dataset collected by EIAR as part of the main *ex-post* impact assessment of the PASIDP project. In this impact assessment study using the high-frequency dataset, our focus is on research questions 6 and 7 only.

Question 1: Have the levels of cash input expenditures of PASIDP beneficiaries increased as a result of the project?
Question 2: Have the cultivation areas of PASIDP beneficiaries expanded as a result of the project?
Question 3: Have the agricultural productivity levels of PASIDP beneficiaries increased as a result of the project?
Question 4: Have the PASIDP beneficiaries diversified their crop cultivation (growing more types of crop) as a result of the project?
Question 5: Have the levels of agricultural revenue among PASIDP beneficiaries increased as a result of the project?
Question 6: Have the consumption levels of food and non-food items among PASIDP beneficiaries increased as a result of the project?
Question 7: Has the ability to adopt risk coping and risk management strategies among PASIDP beneficiaries increased as a result of the project?

Relevant Literature

The impact assessment of the PASIDP project using the high-frequency dataset explores the impact of the project on two sets of outcomes: poverty and resilience outcomes. We ask whether the small-scale irrigation schemes, along with other capacity building and training activities offered as part of the project help their beneficiaries have more stable and higher income level by increasing agricultural production and household consumption, and improve their resilience to shocks by allowing them to better cope with and recover from negative shocks. In addition, we explore the heterogeneity of impact due to the fact that project's results may depend on the individual characteristics of farmers. Finally, we explore the heterogeneity of impact by accounting for individual risk preferences, which might be correlated with the household decisions to adopt agricultural practices, and take up risk management and risk coping strategies.

The first objective of this study focuses on the impact of the PASIDP project on household income, as we measure by two main indicators: agricultural production and household expenditures (of both food and non-food items). Specifically in the case of rural Ethiopia, a number of studies have documented positive effects of small-scale irrigation on food consumption and agricultural revenue (Ersado, 2005; Van Den Burg and Ruben, 2006; Tesfaye et al., 2008; Bacha et al., 2011; Aseyehegu et al., 2012), the majority of existing studies that assess the returns to irrigation investments do not contain either valid comparison groups or random allocations of individuals or local communities to receive benefits from irrigation projects. Thus, this study helps complement the small, but growing literature that analyzes the impact of an irrigation project using impact assessment methodologies (Del Carpio et al., 2011; Dillon, 2011; Rejesus et al., 2011).

The additional objective of this study is to analyze the impact of the PASIDP project on resilience using a high-frequency household survey. As mentioned earlier in this document, resilience is the ability to sustain, adapt , or recover from negatively exogenous shocks. Dercon (2002) emphasizes a few important concepts related to shocks and resilience. First, one needs to distinguish between common (covariant) risks and individual (idiosyncratic) risks. While common (aggregate or covariant) risks affects all individuals in an area, individual (idiosyncratic) risks are specific to a household or a group of households within the same area. In the context of rural Ethiopia, Dercon (2002) reports that the most common sources of risks include harvest failures (due to floods, drought, frost, etc.), policy changes (taxation, ban on labor, etc.), market shocks (low crop prices or low demand), and labor constraints (due to illnesses or deaths).

Following the definition of resilience provided by Barrett and Constas (2014), there can be at least three possible types of capacity strengthening mechanisms that can help increase farmers resilience (Mitchell 2013). **Absorptive capacity** refers to "the ability of a system to prepare for, mitigate or prevent the impacts of negative events" (Cutter et al. 2008). For example, farmers might harvest their crops earlier than usual during a bad year to prevent additional crop losses. **Adaptive capacity** may be defined as "the ability of a system to adjust, modify or change its characteristics and actions to moderate potential future damage and to take advantage of opportunities" to maintain the same level of well-being (Béné et al. 2012). For instance, farmers might adopt drought-tolerant crop variety in response to growing climate vulnerability. **Transformative capacity** is the "ability to create a fundamentally new system so that the shock will no longer have any impact" (Béné et al. 2012). Farmers within a community may increase their transformative capacity by engaging in a community-based forest conservation program to prevent excessive logging within the community. It is important to note these three types of mechanisms to enhance resilience are not mutually exclusive, and in many instances may take place concurrently.

Another interesting aspect of the study on is the distinction between risk management and risk coping strategies (Alderman and Paxson, 1994**). Risk management strategies** are associated with the adoption of strategies to deal with the uncertain nature of the income-generating activities *ex-ante* (also referred to as *income smoothing*) conducted by the households, even at the cost of possibly receiving lower returns. For example, not having sufficient and reliable of crop prices, might induce farmers to participate in contract farming arrangements, which would help them guarantee the price of their crops even though the guaranteed price might be lower than the average price in the market.

Risk coping strategies are strategies which households take up to account for the uncertainty of income-generating activities *ex-post* (also referred to as *consumption* or *expenditure smoothing*). For instance, after a successful cultivation season, households might use the unusually high revenue from selling their crops to accumulate livestock asset, which they could sell back in the market in case the amount of crop losses from the following growing season is higher than expected. While a number of studies have focused on analyzing risk coping strategies (Morduch 1991; Kochar, 1995; Dercon, 1996; Mazzocco and Saini, 2012; Munshi and Rosenzweig, 2016; among others), not many studies have paid particular attention to risk management strategies, or distinguishing the differences between the two mechanisms (Dercon, 2002). In this study, we acknowledge the difference between the two mechanisms, and ask whether the negative shocks are associated with greater adoption of the two mechanisms to buffer farmers against negative shocks. To measure the prevalence of the negative shocks, we also supplement the high-frequency household survey including observational data about vegetation index, temperature, and precipitation levels to control directly for the negative shocks.

Within the context of the PASIDP project, the development of small-scale irrigation schemes may allow farmers with access to irrigation to take advantage of the improvements in the water supply from irrigation to adopt risk management (*ex-ante*) strategies in preparation of shocks, and to adopt risk coping (*ex-post*) strategies in response to shocks. As climate is rapidly becoming a major constraint to farmers who rely heavily on agriculture, the reliance on water for agriculture from irrigation is seen as one option to adaptation practices due to the variability in climate (Di Falco and Veronesi, 2014). Other forms of adaptation may include soil conservation measures (Kurukulasuriya, 2011) and switch of crop choices to more higher-valued crops (Seo and Mendelsohn, 2008). On the one hand, as a means to foster the adoption of risk management strategies, farmers with access to irrigation are better able to grow crops throughout the year, allowing them to have greater opportunities to earn income from selling their crops rather than relying mostly on water from rainfall. On the other hand, irrigation may also help beneficiaries reduce the need to adopt negative risk coping strategies such as sale of assets, reduction of consumption, or migrate to other areas in search of other wage opportunities. Therefore, this study aims at providing evidence of how investments in irrigation may substitute to other risk management strategies, thus allowing farmers to improve their resilience through “positive” risk management strategies and “less harmful” risk coping strategies.

The literature also reports that the treatment effects of an irrigation project may be heterogeneous among its beneficiaries (Tucker and Yirgu, 2010). In this regard, we seek to identify the characteristics of the households whose benefits from the project are the greatest, and the characteristics of the households whose benefits are limited. Specifically in the case of small-scale irrigation in Ethiopia, Kaur et al. (2010) identify that pastoralists are the ones most affected by increasing climate variability as they require water for their grazing land and livestock herds. Tucker and Yirgu (2010) report that more well-off farmers usually receive higher benefits from an irrigation project since they have greater means to take advantage of the improvements in the supply of water by investing in productive farm inputs, renting additional land, and hiring additional labor to work on their farms.

Another plausible, but less analyzed hypothesis is the source of differential impacts of irrigation. Specifically, the lack of adoption of other agricultural technologies complementary to irrigation, which may be necessary to fully harness the potential of irrigation, might hinder the full impact potential (Byerlee and Polanco, 1986; Mann, 1978). Also, a sizable body of literature has documented that the decision to adopt a new technology may be driven by individual unobserved characteristics (Bandiera and Rasul, 2006; Liverpool and Winter-Nelson, 2012; Songsermsawas et al., 2016). One component of the individual unobserved characteristics of the household is their risk preferences. A number of studies have documented that the adoption (or lack, thereof) of other technologies complimentary to irrigation is correlated with individual risk preferences or ambiguity aversion (Leathers and Smale, 1991; Esrado et al., 2004). Thus, to test this claim, we also plan to collect information about individual risk preferences or ambiguity aversion in our survey to test whether differential risk preferences or ambiguity aversion behavior among farmers may help explain the heterogeneity in the impact of the PASIDP project. Two studies by Andersen et al. (2008) and Dave et al. (2010) confirm that if individual risk preferences are not taken into account, estimates of inter-temporal choices (in our context – input investments decisions, and risk management and risk coping strategies) might contain bias, and confound the treatment effects estimates of the PASIDP project. It is important to note that we cannot directly observe risk preferences. Rather, we measure risk preferences through proxies, i.e. from the choices individuals make in experiments and answers from specific survey questions.

Economists have long worked to measure individual-level risk preferences and personal resilience (Connor and Davidson, 2003; Eckel and Grossman, 2008; Holt and Laury, 2002). Within the context of developing countries, Binswanger (1980; 1981) developed a framework to measure risk preferences in rural villages in India by letting farmers make choices between several pairs of fair gambles. Several subsequent studies also have measured risk preferences using the expected utility framework in many developing country settings including in Indonesia (Miyata, 2003), Zambia (Wik et al., 2004), Uganda (Hill, 2009), China (Liu, 2013), and Vietnam (Tanaka, 2016). In the case of Ethiopia, the studies that have measured household risk preferences in a lottery or gambling framework include Mosley and Verschoor (2005), Yesuf and Bluffstone (2009), and Wossen et al. (2015).

Building on the existing literature that measures risk preferences, a number of studies conducted in developed countries have shown that risk preferences are rather stable over time (Levin et al., 2003; Kimball et al., 2008). More recent studies conducted in developing countries have shown inconclusive evidence of changes in risk preferences when households are negatively affected by climatic shocks (Page et al., 2014; Cameron and Shah, 2015; Said et al., 2015; Samphantharak and Chantarat, 2015). Our study builds on the existing literature, by testing whether preferences change over time, and measures whether outcomes observed over a higher time frequency, are associated with both time-varying risk preferences choices, and subsequent decisions over time (Chuang and Schechter, 2015).

Impact assessment design

Identifying the impact of the PASIDP project on poverty and resilience outcomes is challenging due to several reasons. First, the project contains multiple components, and the details of project delivery and project implementation vary according to the capacity of local institutions, timing, geographical landscape, characteristics of beneficiary, and selection of capacity building or training activities offered.[6] Second, there is insufficient documentation about the project's target group, targeting strategy, list of activities offered, and list of beneficiaries.[7] Third, project interventions were delivered in an ad-hoc fashion, which is not uncommon in the case of irrigation or other investments related to infrastructure that are subject to varying uncertainty regarding engineering complexity, procurement process of construction firms, length of construction times, among others. The non-random nature of project placement is particularly important for impact evaluation since the presence of an irrigation project is likely to be correlated with geographical suitability, unobservable underlying characteristics leading to participation in the project, and pre-existing local conditions such as access to markets and roads (Dillon, 2011).

In this *ex-post* impact assessment, we have adopted a mixed method approach by collecting both qualitative and quantitative information. In both sets of survey, a household is the unit of analysis. The qualitative information will focus on extracting the information related to the project assignment rule, the implementation details, and the channels through which the project activities affect the changes in the key outcome indicators. The quantitative information is in the form of a panel household survey collected in four rounds over a 12-month period. The purpose of collecting the quantitative household survey for one entire year is to capture the seasonal variation the outcomes within at least one agricultural cycle.

It is necessary to note that this evaluation is an *ex-post* impact evaluation, which means that the evaluation is conducted after the project had already taken place. Thus, to strengthen the knowledge about the project assignment rule, implementation details, and its expected effects on poverty and resilience outcomes of its beneficiaries, we adopt a mixed-method research design which contains both qualitative and quantitative components. Although the main focus of the PASIDP project is small-scale irrigation development, the project includes two other components: institutional development (e.g. training for WUA's) and agricultural development (e.g. capacity building/training activities related to agriculture). In this evaluation, we account for the institutional development and the agricultural development components in our analysis.

Considering the activities of the PASIDP project, some of them may generate positive impacts to both direct beneficiaries of the project, and other non-beneficiaries living in the same community, i.e. farmers whose plots are located outside the irrigation command area. For example, increased demand for agricultural labor from irrigated plots covered by PASIDP may be beneficial for other

[6] The PASIDP project contains three components: institutional development, small-scale irrigation development, and agricultural development. While the main focus of this exercise is on irrigation development (making up approximately 70% of the total project cost), one cannot separate out these other two components from the irrigation development component. Thus, this impact assessment also covers the impact of the other two components as well.

[7] To address the limitation about the insufficient documentation about the details about the project, we conduct a qualitative survey consisting of key-informant interviews (KII's) of local project implementers, and focus-group discussions (FGD's) of project beneficiaries in a sample of project areas in all four regions in May 2016.

farmers living in the same area. As a result, farmers who do not benefit from PASIDP irrigation directly may receiving the benefits indirectly due to this increase in demand for labor. Therefore, in the treatment *kebeles*, we focus on collecting data from only households whose plots are located inside the PASIDP command areas, which would allow us to focus on estimating the impact of the benefits from irrigation.

The impact assessment activities started in May 2016 with a qualitative study. The methodology of the qualitative study encompassed a series of narratives from focus-group discussions (FGD's) and key-informant interviews (KII's). The results from the qualitative study document positive impacts of the project on agricultural production, both in terms of yields, crop income, and diversification. The findings from the qualitative study also inform the design of the questionnaires for the high-frequency survey. The quantitative high-frequency data collection will start with the enumerators training in September 2016. The data collection activities will start in November 2016, and will continue until November 2017 for a total of four rounds, with three months between each of the rounds.

The study collects information from a sample of all the *kebeles* covered by the PASIDP project. Specifically, we choose to collect information from approximately 26 *kebeles* per region to obtain a sufficiently representative sample of all *kebeles* covered by the project. In each *kebele*, we collect information from 10 households (from a total of approximately 300-400 households in a *kebele*), which would result in a total of 260 households from each region in our sample (130 households in each treatment and control group from each region).[8] Overall, our sample contains information from approximately 1,040 households.

Our sampling strategy is a three-stage random sampling stratified by region, by agro-ecological zone, and precipitation levels. From the full list of 105 *kebeles* with small-scale irrigation schemes as shown earlier in Table 1, we applied a number of selection criteria to arrive at the final list of candidate locations that our survey will collect information from. Specifically, the PASIDP *kebeles* that are part of the final list of candidates to sample contain at least one small-scale irrigation scheme the following characteristics.

1. The scheme is considered to be functional the program management unit (PMU).
2. The projected abstraction rate of the irrigation scheme is not too high (no greater than the 90th percentile ranks of all irrigation schemes), which would prevent the random selection of irrigation schemes that may not be representative of the majority of the schemes built by PASIDP.
3. The information about the size of command area after the construction of the irrigation scheme is available.

After applying these three criteria, there are 93 *kebeles* remaining from a total of 105 *kebeles* in four regions. Then, we merge the average normalized difference vegetation index (NDVI) and average precipitation data of each *kebele* to the list of selected *kebeles*. After verifying that all the *kebeles* in each region have similar NDVI and precipitation values, we randomly selected the *kebeles* to proportionately sample according to the stratification by the precipitation levels. The randomly-selected households in the selected *kebeles* within close proximity of the irrigation schemes are part of the treatment group.

[8] Using the data collected by EIAR for the main ex-post impact assessment of the PASIDP project under IFAD9 IAI, we find that households within the same *kebele* exhibit relatively high intracluster correlation coefficient (ICC). Thus, we decide to collect information only from 10 households per *kebele*.

To avoid possible spillovers of project activities, we decided to collect information from the randomly-selected households in a different *kebele* in the same *woreda* to be part of the control group. The control group are the households in the *kebele* which exhibit similar characteristics with the treatment *kebele* in terms of geographical attributes and agricultural practices. We first compare the selected treatment *kebeles* to all other *kebeles* within the same *woreda* that are not covered by the PASIDP project, and choose *kebeles* that are closest to the selected treatment *kebeles* in terms of NDVI and precipitation levels to become candidates of the *kebeles* in the control group. This is to ensure that the treatment and control *kebeles* are similar in terms of agro-climatic conditions. To further confirm the similar characteristics of the *kebeles* in the treatment and the control groups, we consulted the local project coordinator in each region to select the final list of control *kebeles* in our sample from the list of candidate *kebeles* for the control group.

Sampling and data collection

Key Indicators

Outcome	Measurement	Source
Output		
Irrigation access	Seasonal access to irrigation	Household survey
Input investments	Cash and other physical input purchases	Household survey
Information access	Access to information from difference sources	Household survey
Market access	Travel time and seasonal access to agricultural markets	Household survey
Outcome		
Agricultural productivity	Agricultural record, by crop	Household survey
Market participation	Input and output purchases, Amount of produce brought to market	Household survey
Improved resilience	Exposure to negative shocks	Household survey
Impact		
Agricultural income	Agricultural record, by crop	Household survey
Household consumption	Food and non-food spending	Household survey

Qualitative Information

The collection of qualitative information is important and useful because for evaluation purposes it helps clarifying a number of issues related to project targeting, implementation, and contextualizing the socio-economic and cultural setting in which the project had taken place. Also, collecting qualitative information is useful to document the details about some of the reasons behind the changes in the observed outcomes among the project beneficiaries (Rao and Woolcock, 2004; Ravallion, 2003). We conducted a qualitative survey consisting of FGD's and KII's in eight randomly chosen *kebeles* in four regions of the PASIDP project in May 2016.

The information gathered from the qualitative research helped inform the design of the high-frequency data collection to ensure that our survey is comprehensive enough to investigate the impact of the PASIDP project on poverty and resilience outcomes. First, the qualitative research allowed us to include the most common or relevant risk management and risk coping strategies since the initial reference list at hand did not contain an exhaustive list of all the possible risk management and risk coping strategies within the context of our setting. Second, it helped us design the sampling strategy of the high-frequency survey to collect the information from by identifying the most common types of negative shocks the households face, and corresponding risk management and risk coping strategies they adopted in response to those shocks. One important piece of information that we learned during the qualitative research work is that PASIDP irrigation beneficiaries were exclusively households with plots located within the irrigation command area. Thus, the design of the high-frequency survey will collect information from only farmers who have their plots in the command for the treatment group.

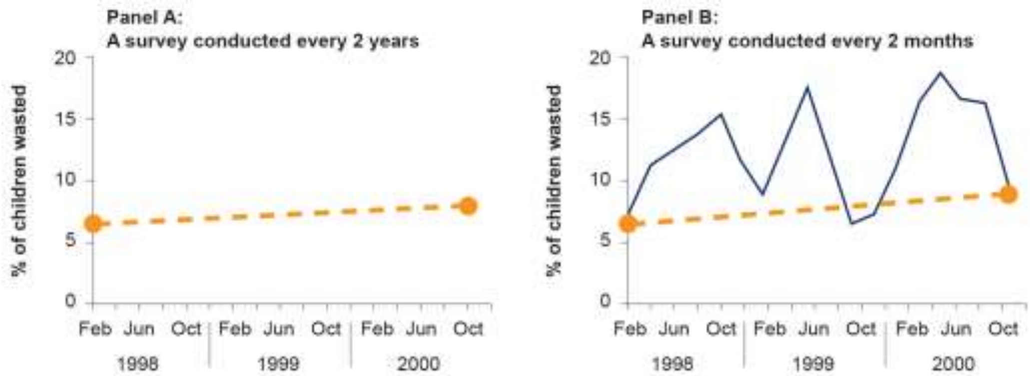
Third, we found out from the qualitative research work that farmers whose plots are not located within the command area could still benefit from the project activities from attending the capacity building and training activities offered by the project implementers. As a result, they could be considered indirect beneficiaries of the project, and might not be appropriate as the control group. Thus, we decided to select households for the control group from another *kebele* within the same *woreda* with similar conditions top the *kebeles* with PASIDP irrigation schemes. Last, the findings from the qualitative research pointed out at the substantial variation in the agro-climatic conditions across different regions of Ethiopia. Given the broad coverage of the PASIDP project across the country, we would need to design our survey to cover a broad scope of the country to help ensure that our findings would be generalizable to the entire scope of the project.

Quantitative Information

Previous studies have documented that an irrigation project may lead to considerable improvements in welfare measures of its beneficiaries. Where such favorable impacts exist, the results are largely obtained from traditional household surveys conducted at least a few years apart (Dillon, 2011; Del Carpio et al. 2011). However, the traditional surveys may not always be ideal to assess the impact of an irrigation project since researchers may lose substantial information about the changes in the outcomes of interest over time. This is mainly because outcomes including agricultural production, consumption decisions, risk perception, and risk management and risk coping strategies of households may vary greatly within the same year or cropping season in responses to agro-climatic or economic shocks.

Thus, measuring these outcomes requires a household survey conducted more repeatedly than traditional panel household surveys conducted at least a few years apart (Barrett and Headey, 2014). For example, a high-frequency dataset conducted in Bangladesh as part of the Nutrition Surveillance Program (NSP) reveals a considerable difference in measuring child nutritional outcomes using traditional and high-frequency household surveys, as shown in Figure 2. In another study by McKenzie (2012) calls for multiple rounds of data collection at short intervals to measure outcomes that are relatively noisy, and less correlated with time such as business profits, and household expenditures. This will allow researchers to average these outcomes to estimate treatment effects. Therefore, due to the fact that our outcomes of interest, shocks and expenditures, may be measured with considerable noise and may not contain high autocorrelation over time, collection of such data multiple times with short intervals is reasonable.

Figure 2: Wasting prevalence of children in Bangladesh from a study by Bloem, Moench-Pfanner, and Panagides (2003)



For the purpose of assessing the impact of the PASIDP project on the outcomes of interest, we will collect high-frequency data from the beneficiaries and non-beneficiaries in all four regions covered by the project. In each region, we randomly select one location of PASIDP irrigation scheme, and then collect information of the households living in close proximity to that irrigation scheme. Therefore, the beneficiaries (treatment group) are those living in areas that with a functioning PASIDP irrigation scheme in place for at least one year to ensure that the benefits from irrigation to their agricultural activities can be observed. The non-beneficiaries (control group) are those in living in areas without any PASIDP-related activities, but exhibit similar agro-climatic indicators, geographical landscape, and agricultural activities.

Qualitative Instruments and Methods

In our evaluation, the qualitative information was collected through two main components: FGD's and KII's. Both the FGD's and the KII's were conducted using semi-structured interview instruments. In the FGD's, the key themes of the interviews included socio-economic backgrounds, prevalence of shocks and the associated strategies related to shocks, participation in the WUA, small-scale irrigation, and capacity building/training activities related to agriculture. These FGD's were particularly important for our evaluation because they helped identify the most common types of negative shocks facing the households in our sample, and gathered information about the most common risk management and risk coping strategies adopted by the households to deal with those shocks. For the KII's, the content of the interviews consisted mainly about the project targeting and implementation. The total sample in the qualitative survey consisted of approximately 100 farmers (both treatment and control), WUA leaders, village/traditional/religious leaders, and about 10-15 technical and policy staff members from the government. The field activities of the qualitative survey had already been completed in May 2016, and the results are currently being put together in a technical report format.

As described earlier in Section 4.2, our qualitative survey contained for FGD's and KII's. The sample in the FGD's contained smallholder farmers in both treatment and control villages. In each treatment *kebele*, at least four FGD's were conducted: two groups of households whose plots are located inside the command area (one consisting only of men and the other consisting of only women), and two groups of households whose plots are located outside the command area (also one consisting only of men and the other consisting of only women). In each control *kebele*, at least two FGD's were conducted, where one would consist only of men and the other consisting of only women. Each FGD consists of approximately 5-8 persons.

The sample in the KII's contained village/traditional/religious leaders, PASIDP focal persons, WUA leaders and administrators, development agents (DA's), extension agents, from each *kebele*, which resulted in approximately three to four KII's conducted per *kebele* in our sample. The KII's in the qualitative study included interviews with PMU officers from the Ministry of Agriculture and Natural Resources (MoANR) at the regional and the national levels, which included approximately four to five additional KII's in total.

Quantitative Instruments and Methods

The first round of data is expected to start in November 2016. Afterwards, the same will be conducted every four months for three more rounds (April 2017, August 2017, and November 2017). The household survey used in our impact evaluation of the PASIDP project covers the following topics shown in Table 3.

Table 3: Summary of data category to be collected

Module	Question	Frequency	No. of Rounds
Expenditure	How much money (value) did you spend on X food item?	Every 4 months	4
	How much of food item X (quantity, by category/calorie) did you consume (both own production and purchased)?	Every 4 months	4
	How much money (value) did you spend on X non-food item?	Every 4 months	4
Livelihood	What are the household socio-economic and demographic characteristics of your HH?	Every 4 months	4
	What are the agricultural activities and other income-generating activities of your HH?	Every 4 months	4
	What is the current asset stock of the HH?	Every 4 months	4
	What is the access to irrigation services, markets, financial services, information, and assistance programs of your HH?	Every 4 months	4
Resilience	What are the shocks that the household faced?	Every 4 months	4
	What are the strategies that the households do to prepare for the shocks?	Every 4 months	4
	What are the strategies that the households do in response of the shocks?	Every 4 months	4
Migration	Are there HH member migrating out of the HH?	Every 4 months	4
Social capital	What is the access to social and capacity building support of your HH?	Every 4 months	4
Risk preference	What are the risk and time preference parameters of your HH?	Every 4 months	4

We have budgeted our data collection plan to collect information from 10 households per *kebele*, 26 *kebeles* per region (13 treatment and 13 control *kebeles*). Thus, the final sample will consist of 1,040 households from four regions. To ensure that there exists sufficient statistical power given our budgeted sample size, we perform power calculations to validate our sampling strategy. We take advantage of another primary household survey collected by EIAR. The survey is a cross-sectional survey, and was conducted primarily for an impact evaluation exercise of the PASIDP project as part of the IFAD9 Impact Assessment Initiative between March and April 2015.

We calculate the desired sample size across a number of outcome variables that are relevant to the project's logical framework, and are available in the EIAR household survey. We obtain the intraclass correlation coefficient (ICC) values for each outcome variable, and then calculate the desired sample size for each outcome variable as shown in Table 4. We also add 10% to the desired sample size for each outcome to account for potential attrition in the sample size given the panel nature of the dataset. The calculations of the desired sample size shown in Table 4 confirm that our budgeted sample size should be sufficient to detect any significant changes in the key indicator outcomes in this impact assessment.

Table 4: Recommended sample size across different outcome variables

Outcome variable	ICC	Sample size	Sample size + 10%
Household expenditure	0.1007	580	609
Food expenditure	0.1415	358	394
Crop income	0.0559	570	627
Average crop yields	0.0181	818	900
Number of crops grown	0.2557	66	73

For the impact assessment of this project, we follow a triple difference (DDD) specification as outlined formally in Imbens and Woolridge (2007). The three main sources of differences are (1) time in each period, (2) treatment status, and (3) prevalence of drought or other erratic weather events. Taking advantage detailed precipitation level and vegetation index, we identify the prevalence of drought using observation data to merge with a household survey. Specifically, the DDD model takes the following specification:

$$y_{it} = \beta_0 + \beta_1 I_i + \beta_2 S_{it} + \beta_3 T_t + \beta_4 I_i S_{it} + \beta_5 I_i T_t + \beta_5 S_{it} T_t + \beta_6 I_i S_{it} T_t + \varepsilon_{it},$$

where y_{it} is the outcomes of interest, I_i represents the treatment status, S_{it} represents the prevalence of drought, T_t is the time dummy variable, and ε_{it} is the error term. In this specification, β_6 is the coefficient of our interest, which we hypothesize to be statistically different from zero if a household which receives the PASIDP project experiences drought.

As alternative specification, an adaptation of the standard empirical growth model could also be used in our setting (Dercon et al. 2012). Dercon et al. (2012) note that while the standard growth model (Temple 1999) does not account for transitory shocks (for example, changes in rainfall levels), previous studies using a panel dataset of Ethiopia households survey observe significant impacts of transitory shocks on household consumption levels (Dercon 2004, Dercon et al. 2005). According to this specification, one estimates the changes in outcomes from the baseline period, controlling for the initial conditions. This specification can be expressed as follows:

$$\Delta y_{it} = \beta_0 + \beta_1 I_i + \beta_2 \Delta S_{it} + \beta_3 I_i \Delta S_{it} + \beta_4 y_{i,t-1} + \beta_5 y_{i1} + \beta_6 X_{i1}$$

where $\Delta y_{it} = y_{it} - y_{i1}$ is the change in outcome of interest over time from the baseline round, I_i is the treatment status, $\Delta S_{it} = S_{it} - S_{i1}$ is the change in the prevalence of shocks over time from the baseline round, $y_{i,t-1}$ is the outcome of interest from the previous time period (first-ordered lag), X_{i1} is the household characteristics at the baseline round (initial conditions), T_t is the time dummy variable, and ε_{it} is the error term.

To ensure that the households in the treatment and the control groups are statistically comparable, we will perform covariate matching of the households in the two groups to control for any selection on observable characteristics using the observations using data from the baseline round. The matched sample will be used for the rest of the analysis.

Complementary Data

We plan to supplement the qualitative and the quantitative information collected as part of this impact assessment study with observational data. We include monthly data of NDVI, precipitation, and temperature data, and also the long-run averages of the three indicators to measure the monthly deviation from long-run averages and the coefficient of variation of these three indicators. The observational data used in this impact assessment come from the database of the International Institute for Applied Systems Analysis (IIASA).

Budget, deliverables and workplan

Planned Budget

The estimated total budget for this impact assessment study of the PASIDP project using the high-frequency dataset is given below in Table 7.

Table 7: Estimated budget

No	Description	TOTAL (USD)
1	HF data – Household survey (4 rounds)	239 272.85
2	Training and miscellaneous costs	10 705.00
	Grand Total Costs	**249 977.85**

List of Deliverables

Table 8: Expected outputs

Stage	Output	Completion Date
Qualitative report	Research report	July 2016
Survey program	ODK system to store data from survey	August 2016
Final report	Technical note	February 2018

Workplan

Table 9: Workplan

Stage	Output	Completion Date
Planning	Concept note	March 2016
Qualitative survey	Research report	May 2016
Survey revisions	Household questionnaire	June 2016
Pilot survey	Household questionnaire	September 2016
Baseline survey	Cleaned data/dictionary	November 2016
Follow-up surveys	Cleaned data/dictionary	April 2017, August 2017, December 2017

Impact Assessment Team and Main Counterparts

Table 10: Research team and main counterparts

Name	Role	Affiliation
Alessandra Garbero Bezawit Chichaibelu Tisorn Songsermsawas	Principal Investigator Post-doctoral Researcher Research Analyst	RIA, IFAD
Han Ulaç Demirag Frew Behatu	Country Programme Manager Country Programme Officer	Ethiopia ICO, IFAD
Befekadu Behute Zenagebril Degu Solomon Brhane	Research Coordinator Field Coordinator	RIA, IFAD GPS
Daniel Tedla Kefyalew Tshegaw Yohannes Kebede	Project Management Unit	MoANR, Ethiopia

References

Alderman, H., and Paxson, C. H. (1994). *Do the poor insure?: a synthesis of the literature on risk and consumption in developing countries*. World Bank Publications. Washington, DC.

Andersen, S., Harrison, G. W., Lau, M. I., and Rutström, E. E. (2008). "Eliciting risk and time preferences." *Econometrica*, 76(3), 583-618.

Aseyehegu, K., Yirga, C., and Rajan, S. (2012). "Effect of small-scale irrigation on the income of rural farm households: The case of Laelay Maichew District, Central Tigray, Ethiopia." *Journal of Agricultural Sciences*, 7(1).

Asfaw, S., Kassie, M., Simtowe, F., and Lipper, L. (2012). "Poverty reduction effects of agricultural technology adoption: A micro-evidence from rural Tanzania." *Journal of Development Studies*, 48(9), 1288-1305.

Azzarri, C., Haile, B., Roberts, C., and Spielman, D. (2015). "Targeting bias or early impact of agricultural innovations? A case study from Malawi." Working paper, International Food Policy Research Institute (IFPRI), Washington, DC.

Bacha, D., Namara, R., Bogale, A., and Tesfaye, A. (2011). "Impact of small- scale irrigation on household poverty: Empirical evidence from the Ambo district in Ethiopia." *Irrigation and Drainage*, 60(1), 1-10.

Bandiera, O., and Rasul, I. (2006). "Social networks and technology adoption in Northern Mozambique." *Economic Journal*, 116(514), 869-902.

Barr, A., and Genicot, G. (2008). "Risk sharing, commitment, and information: An experimental analysis." *Journal of the European Economic Association*, 6(6), 1151-1185.

Barrett, C. B., and Constas, M. A. (2014). Toward a theory of resilience for international development applications. *Proceedings of the National Academy of Sciences*, 111(40), 14625-14630.

Barrett, C. B., and Headey, D. D. (2014). Measuring resilience in a volatile world: A proposal for a multicountry system of sentinel sites. In 2020 Conference papers (No. 1). International Food Policy Research Institute, Washington, DC.

Béné, C., Wood, R. G., Newsham, A., and Davies, M. (2012). "Resilience: new utopia or new tyranny? Reflection about the potentials and limits of the concept of resilience in relation to vulnerability reduction programmes." Working paper, Institute of Development Studies, Brighton, United Kingdom.

Binswanger, H. P. (1980). "Attitudes toward risk: Experimental measurement in rural India." *American Journal of Agricultural Economics*, 62(3), 395-407.

Binswanger, H. P. (1981). "Attitudes toward risk: Theoretical implications of an experiment in rural India." *Economic Journal*, 91(364), 867-890.

Bloem, M. W., R. Moench-Pfanner, and D. Panagides. (2003). *Health and Nutritional Surveillance for Development*, Helen Keller Worldwide, Singapore.

Byerlee, D., and De Polanco, E. H. (1986). "Farmers' stepwise adoption of technological packages: Evidence from the Mexican Altiplano." *American Journal of Agricultural Economics*, 68(3), 519-527.

Cameron, L., and Shah, M. (2015). "Risk-taking behavior in the wake of natural disasters. *Journal of Human Resources*." 50(2), 484-515.

Chuang, Y., and Schechter, L. (2015). "Stability of experimental and survey measures of risk, time, and social preferences: A review and some new results." *Journal of Development Economics*, 117, 151-170.

Connor, K. M., and Davidson, J. R. (2003). "Development of a new resilience scale: The Connor-Davidson resilience scale (CD- RISC)." *Depression and Anxiety*, 18(2), 76-82.

Cutter, S.L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E. and Webb, J., (2008). "A place-based model for understanding community resilience to natural disasters." *Global Environmental Change*, 18(4): 598-606.

Dave, C., Eckel, C. C., Johnson, C. A., and Rojas, C. (2010). "Eliciting risk preferences: When is simple better?" *Journal of Risk and Uncertainty*, 41(3), 219-243.

Del Carpio, X. V., Loayza, N., and Datar, G. (2011). "Is Irrigation Rehabilitation Good for Poor Farmers? An Impact Evaluation of a Non- Experimental Irrigation Project in Peru." *Journal of Agricultural Economics*, 62(2), 449-473.

Dercon, S. (1996). "Risk, crop choice, and savings: Evidence from Tanzania." *Economic Development and Cultural Change*, 44(3), 485-513.

Dercon, S. (2002). "Income risk, coping strategies, and safety nets." *The World Bank Research Observer*, 17(2), 141-166.

Dercon, S. (2004). "Growth and shocks: Evidence from rural Ethiopia." *Journal of Development Economics*, 74(2): 309-329.

Dercon, S., Hoddinott. J., and Woldehanna, T. (2005). "Consumption and shocks in 15 Ethiopian villages, 1999-2004." *Journal of African Economies*, 14: 559-585.

Dercon, S., Hoddinott. J., and Woldehanna, T. (2012). "Growth and chronic Poverty: Evidence from rural communities in Ethiopia." *Journal of Development Studies*, 48(2): 238-253.

Di Falco, S., and Veronesi, M. (2014). "Managing environmental risk in presence of climate change: the role of adaptation in the Nile Basin of Ethiopia." *Environmental and Resource Economics*, 57(4), 553-577.

Dillon, A. (2011). "The effect of irrigation on poverty reduction, asset accumulation, and informal insurance: Evidence from Northern Mali." *World Development*, 39(12), 2165-2175.

Duflo, E., and Pande, R. (2007). "Dams." *Quarterly Journal of Economics*, 122, 601-646.

Eckel, C. C., and Grossman, P. J. (2008). "Forecasting risk attitudes: An experimental study using actual and forecast gamble choices." *Journal of Economic Behavior and Organization*, 68(1), 1-17.

Ersado, L., Amacher, G., and Alwang, J. (2004). "Productivity and land enhancing technologies in Northern Ethiopia: Health, public investments, and sequential adoption." *American Journal of Agricultural Economics*, 86(2), 321-331.

Ersado, L. (2005). "Small-scale irrigation dams, agricultural production, and health: theory and evidence from Ethiopia." Working paper. *World Bank Policy Research*. World Bank. Washington, DC.

Escobal, J. (2005). "The role of public infrastructure in market development in rural Peru." Working paper, Munich Personal RePEc Archive, Lima, Peru.

Holt, C. A., and Laury, S. K. (2002). "Risk aversion and incentive effects." *American Economic Review*, 92(5), 1644-1655.

Hussain, I., and Hanjra, M. A. (2004). "Irrigation and poverty alleviation: review of the empirical evidence." *Irrigation and Drainage*, 53(1), 1-15.

Imbens, G. W., and Woodridge, J. D. (2007). What's new in econometrics? Lecture notes. NBER

Jacoby, H. G. (2000). "Access to markets and the benefits of rural roads." *Economic Journal*, 713-737.

Kassahun, D. (2007). "Rainwater harvesting in Ethiopia: Capturing the realities and exploring opportunities." Technical report, Forum for Social Studies, Addis Ababa, Ethiopia.

Kaur, N., Getnet, M., Shimelis, B., Tesfaye, Z., Syoum, G., and Atnafu, E. (2010). " Adapting to climate change in the water sector: Assessing the effectiveness of planned adaptation interventions in reducing local level vulnerability." Working paper, RiPPLE, Addis Ababa, Ethiopia.

Kimball, M. S., Sahm, C. R., and Shapiro, M. D. (2008). "Imputing risk tolerance from survey responses." *Journal of the American statistical Association*, 103(483), 1028-1038.

Kochar, A. (1995). "Explaining household vulnerability to idiosyncratic income shocks." *American Economic Review*, 85(2), 159-164.

Kurukulasuriya, P., Kala, N., and Mendelsohn, R. (2011). "Adaptation and climate change impacts: a structural Ricardian model of irrigation and farm income in Africa." *Climate Change Economics*, 2(02), 149-174.

Leathers, H. D., and Smale, M. (1991). "A Bayesian approach to explaining sequential adoption of components of a technological package." *American Journal of Agricultural Economics*, 73(3), 734-742.

Levin, I. P., Hart, S. S., Weller, J. A., and Harshman, L. A. (2007). "Stability of choices in a risky decision- making task: A 3- year longitudinal study with children and adults." *Journal of Behavioral Decision Making*, 20(3), 241-252.

Lipton, M., Litchfield, J., and Faurès, J. M. (2003). "The effects of irrigation on poverty: A framework for analysis." *Water Policy*, 5(5), 413-427.

Liu, E. M. (2013). "Time to change what to sow: Risk preferences and technology adoption decisions of cotton farmers in China." *Review of Economics and Statistics*, 95(4), 1386-1403.

Liverpool-Tasie, L. S. O., and Winter-Nelson, A. (2012). "Social learning and farm technology in Ethiopia: Impacts by technology, network type, and poverty status." *Journal of Development Studies*, 48(10), 1505-1521.

Mann, C. K. (1978). "Packages of practices: A step at a time with clusters." *Studies in Development*, 21, 73-81.

Matouš, P., Todo, Y., and Mojo, D. (2013). "Roles of extension and ethno-religious networks in acceptance of resource-conserving agriculture among Ethiopian farmers." *International Journal of Agricultural Sustainability*, 11(4), 301-316.

Mazzocco, M., and Saini, S. (2012). "Testing efficient risk sharing with heterogeneous risk preferences." *American Economic Review*, 102(1), 428-468.

McKenzie, M. (2012). "Beyond baseline and follow-up: The case for more T in experiments." *Journal of Development Economics*, 99. 210-221.

Minde, I., Jayne, T.S., Crawford, E., Arega, J., and Govereh, J. (2008). "Promoting fertilizer use in Africa: Current issues and empirical evidence from Malawi, Zambia, and Kenya." Working paper, Regional Strategic Analysis and Knowledge Support System, Southern Africa (ReSAKSS-SA), Pretoria, South Africa.

Mitchell, A. (2013). " Risk and resilience: From good idea to good practice - A scoping study for the experts group on risk and resilience." Working paper, Organisation for Economic Co-operation and Development, Paris, France.

Miyata, S. (2003). "Household's risk attitudes in Indonesian villages." *Applied Economics*, 35(5), 573-583.

Montgomery, M.R., Gragnolati, M., Burke, K.A. and Paredes, E., 2000. "Measuring living standards with proxy variables." *Demography*, 37(2): 155-174.

Morduch, J. (1991). Consumption smoothing across space: Tests for village-level responses to risk. Working paper, Harvard University, Cambridge, MA.

Mosley, P., and Verschoor, A. (2005). "Risk attitudes and the 'vicious circle of poverty'." *European Journal of Development Research*, 17(1), 59-88.

Munshi, K., and Rosenzweig, M. (2016). "Networks and misallocation: Insurance, migration, and the rural-urban wage gap." *American Economic Review*, 106(1), 46-98.

Page, L., Savage, D. A., and Torgler, B. (2014). "Variation in risk seeking behaviour following large losses: A natural experiment." *European Economic Review*, 71, 121-131.

Rao, V., and Woolcock, M. (2004) "Integrating qualitative and quantitative approaches in program evaluation." In Bourguignon, F. and da Silva, L. A. (ed.). *The Impact of Economic Policies on Poverty and Income Distribution: Evaluation Techniques and Tools*. World Bank and Oxford University Press, New York, NY.

Ravallion, M. (2003) "Qualitative and quantitative approaches to poverty analysis: Two pictures of the same mountain?" in Kanbur, R. (ed.). *Q-squared: Combining Qualitative and Quantitative Methods in Poverty Appraisal*, Permanent Black Publishing, Delhi, India.

Rejesus, R. M., Palis, F. G., Rodriguez, D. G. P., Lampayan, R. M., and Bouman, B. A. (2011). "Impact of the alternate wetting and drying (AWD) water-saving irrigation technique: Evidence from rice producers in the Philippines." *Food Policy*, 36(2), 280-288.

Said, F., Afzal, U., and Turner, G. (2015). "Risk taking and risk learning after a rare event: Evidence from a field experiment in Pakistan." *Journal of Economic Behavior and Organization*, 118, 167-183.

Samphantharak, K., and Chantarat, S. (2015). *Disaster Risks, Social Preferences, and Policy Effects: Field Experiments in Selected ASEAN and East Asian Countries*. Economic Research Institute for ASEAN and East Asia, Jakarta, Indonesia.

Seo, S. N., and Mendelsohn, R. O. (2008). "An analysis of crop choice: Adapting to climate change in Latin American farms." *Ecological Economics*, 69, 109-116.

Skoufias, E., and Quisumbing, A. R. (2005). "Consumption insurance and vulnerability to poverty: A synthesis of the evidence from Bangladesh, Ethiopia, Mali, Mexico and Russia." *European Journal of Development Research*, 17(1), 24-58.

Smith, L. E. D. (2004). "Assessment of the contribution of irrigation to poverty reduction and sustainable livelihoods." *Water Resources Development*, 20(2), 243-257.

Smith, L., Frankenberger, T., Langworthy, B., Martin, S., Spangler, T., Nelson, S., and Downen, J. (2014). "Ethiopia Pastoralist Areas Resilience Improvement and Market Expansion (PRIME) Project Impact Evaluation: Baseline Survey Report." Technical report, United States Agency for International Development, Washington, DC.

Songsermsawas, T., Baylis, K., Chhatre, A., and Michelson, H. (2016). "Can peers improve agricultural revenue?" *World Development*, 83, 163-178.

Tanaka, T., Camerer, C. F., & Nguyen, Q. (2016). *Behavioral Economics of Preferences, Choices, and Happiness*, Springer, Tokyo.

Temple, J. (1999). "The new growth evidence." *Journal of Economic Literature*, 37(1): 112-156.

Tesfaye, A., Bogale, A., Namara, R. E., and Bacha, D. (2008). "The impact of small-scale irrigation on household food security: The case of Filtino and Godino irrigation schemes in Ethiopia." *Irrigation and Drainage Systems*, 22(2), 145-158.

Tucker, J., and L. Yirgu. (2010). "Small-scale irrigation in the Ethiopian highlands: What potential for poverty reduction and climate adaptation?" Background paper, RiPPLE, Addis Ababa, Ethiopia.

USAID. (2012). Building resilience to recurrent crisis: USAID Policy and program guidance. Washington, DC.

Van Den Berg, M., and Ruben, R. (2006). "Small-scale irrigation and income distribution in Ethiopia."*Journal of Development Studies*, 42(5), 868-880.

Vargas Hill, R. (2009). "Using stated preferences and beliefs to identify the impact of risk on poor households." *Journal of Development Studies*, 45(2), 151-171.

Wik, M., Aragie Kebede, T., Bergland, O., and Holden, S. T. (2004). "On the measurement of risk aversion from experimental data." *Applied Economics*, 36(21), 2443-2451.

World Bank. (2006). *Ethiopia: Managing Water Resources to Maximise Sustainable Growth: A World Bank Water Resources Assistance Strategy for Ethiopia*. Washington, DC.

World Bank. (2007). *World Development Report 2008: Agriculture for Development*. Washington, DC.

Wossen, T., Berger, T., & Di Falco, S. (2015). "Social capital, risk preference and adoption of improved farm land management practices in Ethiopia. *Agricultural Economics*." 46(1), 81-97.

Yesuf, M., and Bluffstone, R. A. (2009). "Poverty, risk aversion, and path dependence in low-income countries: Experimental evidence from Ethiopia." *American Journal of Agricultural Economics*, 91(4), 1022-1

IFAD
International Fund for Agricultural Development
Via Paolo di Dono, 44 - 00142 Rome, Italy
Tel: +39 06 54591 - Fax: +39 06 5043463
Email: ifad@ifad.org
www.ifad.org
www.ruralpovertyportal.org
ifad-un.blogspot.com
www.facebook.com/ifad
instagram.com/ifadnews
www.twitter.com/ifadnews
www.youtube.com/user/ifadTV