

TECHNOLOGY IS NOT GENDER NEUTRAL:

Factors that influence the potential adoption of agricultural technology by men and women



V. Polar, C. Babini, C. Velasco, P. Flores y C. Fonseca

This report is based on the primary data collected from male and female farmers who live in the areas of intervention of the International Potato Center (CIP) in the Andean Region. This work was undertaken as part of and supported by the CGIAR Research Programs on Roots, Tubers and Bananas ([RTB](#)) and Policies, Institutions, and Markets ([PIM](#)). [CGIAR](#) is a global research partnership for a food-secure future. CGIAR research centers and programs are financially supported by the [CGIAR Funders](#).

Acknowledgments:

To male and female small holder farmers, technicians and institutions working to evaluate, validate and adapt agricultural technology to improve food security and productivity of family agriculture in the Andes. To the technicians of the International Potato Center in Bolivia, Ecuador and Peru, who coordinated the collection of information in the field.

Technology is not gender neutral: Factors that influence the potential adoption of agricultural technology by men and women.

Authors:

Vivian Polar, Claudia Babini, Claudio Velasco, Paola Flores and Cristina Fonseca

Cover Image: Gender and agriculture

Artist: Mariana Nogales

Produced by AGRIDEL SRL

Citation:

Polar, V., Babini, C., Flores, P., Velasco, C. (2017) **Technology is not gender neutral:** Factors that influence the potential adoption of agricultural technology by men and women. International Potato Center. La Paz – Bolivia. 41 pp.

TABLE OF CONTENTS

Presentation	4
Executive Summary	5
Background and institutional framework	7
PART ONE.- Theoretical framework and study design.....	8
1. FACTORS THAT INFLUENCE THE ADOPTION OF AGRICULTURAL TECHNOLOGY	8
2. RESEARCH QUESTIONS	8
3. EPISTEMOLOGICAL APPORACH, THEORETICAL PERSPECTIVE AND TYPE OF REASONING ..	9
4. RESEARCH STRATEGY AND METHODOLOGY	10
5. SCOPE AND LIMITATIONS OF THE RESEARCH.....	11
6. RESEARCH METHODS.....	11
6.1. Focus Groups	11
6.2. Interviews to technical staff	14
6.3. Data analysis methodology.....	14
PART TWO.- The voices of men and women and the relationship between factors.....	16
1. Relation between factors: an embedded interaction.....	16
2. Internal factors	17
2.1. Productive context.....	18
2.2. Destination of production.....	18
2.3. Importance of the crop.....	19
2.4. Level of education.....	20
2.5. Personal perceptions and socially accepted gender roles (culture).....	21
3. Technology attributes.....	22
3.1. Size, strength and/or knowledge required for the operation or implementation.....	22
3.2. Compatibility with local conditions of the productive system	23
3.3. Cost and ease of application.....	24
4. External factors.....	24
4.1. Land	25
4.2. Labor	26
4.3. Capital.....	26

4.4. Physical access (road, commercial)	27
4.5. Access to information	28
PART THREE. - Conclusions and recommendations of the study	29
BIBLIOGRAPHY.....	31
Annexes	35
Annex 1.....	35
Annex 2.....	40

TECHNOLOGY IS NOT GENDER NEUTRAL

Factors that influence the potential adoption of agricultural technology by men and women

Presentation

Closing gender gaps in the agricultural sector is a key element in reducing poverty and improving food security. Women today are the hidden face of agriculture. They play a fundamental role in all stages of the food production cycle (SOFA and Doss, C., 2011), and yet they do not only have unequal access to resources and technological advancements, but often technologies are not designed considering their needs and conditions.

The present study seeks to contribute to the reduction of gender gaps, through the generation of information that allows the design of agricultural technologies considering the needs and conditions of women. The main objective of the study is to answer the question:

What factors influence the adoption of agricultural technology by men and women in agricultural systems of the Andean region that base their production on potato cultivation?

This work was based on the collection of qualitative information with farmers and technical personnel from institutions in areas of intervention of the International Potato Center (CIP) in the Andean Region, with the support of the Research Programs on Roots, Tubers and Bananas (RTB), and Policies, Institutions and Markets (PIM) of the CGIAR. Focus group discussions, observation and interviews with technical personnel working directly to promote agricultural technology innovation for food security in Bolivia, Ecuador and Peru were conducted.

For CIP, RTB and PIM, reducing gender inequalities in agricultural technology innovation processes is a basic condition to achieve the objectives of improving food security and reducing poverty in agricultural production systems (CGIAR, 2011, CGIAR RTB, 2013, CGIAR PIM, 2017). The results presented in this document seek to formulate recommendations to analyze gender inequalities during project design and planning, based on the analysis and consideration of factors that affect the potential adoption of technology by men and women.

Executive Summary

The main objective of this study was to identify and analyze the factors that influence the potential adoption of technology by men and women. The study was developed with information gathered in high Andean communities where production systems are based on potato cultivation, and where the International Potato Center (CIP), the CGIAR Programs on Roots Tubers and Bananas (RTB), and Policies and Institutions and Markets (PIM), have operational actions.

The study was grounded on a constructivist epistemological approach and on the theoretical perspective of interpretivism. It had an open ended and exploratory character based on inductive reasoning. A qualitative research methodology with case studies was used. It included the collection of information through focus groups with men and women, and in-depth interviews with technicians from institutions working in the promotion of agricultural technological innovation. The information collected went through an interpretative phenomenological analysis to identify the main factors that influence the potential adoption of technology by men and women, as well as the interactions and relationships between the different factors.

The results of the study show that the potential adoption of an agricultural technology may be different between women and men depending on the manifestation of different factors and their interactions. These factors in turn can be grouped into three levels according to their influence on the potential adoption of agricultural technologies. On a first level, with more influence on the potential adoption of technology, is a group of factors that can be called "Internal Factors". These internal factors are the basis for subsequent decisions made by men and women around technology adoption and include elements of productive context (social, political, environmental, economic, cultural), elements of culture, history and education, and gender. At a second level, with less influence on the potential adoption of agricultural technology, there is a group of factors that can be called "Technological Attributes". Technological attributes are inherent to the technology and its use, including: a) technical, structural and operational characteristics of the technology; b) the crops for which this technology is intended; and c) the inputs or services necessary for its operation. At a third level is a group of factors that can be called "External Factors". These external factors are related to access to productive resources (land, capital, labor), physical access to producing areas and access to information.

Although there are variations among factors depending on their level of influence, these variations do not imply a dependence or linear conditioning. There are interaction relationships embedded between factors that can maximize or minimize the potential expression of another factor.

One important result of the study is that technology itself is not neutral and entails gender biases that can occur when the conditions of the target group (men, women, youth, or other disadvantaged groups) are not considered at different times. Another important result of the study is that factors do not independently influence farmers' adoption of technology, but rather interact with each other to determine the potential adoption of agricultural technologies.

The document is structured in three parts. The first part of the document describes some theoretical elements that support the study and the methodological framework of the research. The second part

presents the analysis of the information collected through focus groups and interviews in the different areas of intervention in Bolivia, Ecuador and Peru. The analysis focuses on the identification of differences and similarities in relation to factors that influence the potential adoption of technology by men and women. Finally, the third part presents a series of conclusions and final recommendations of the study.

Background and institutional framework

The International Potato Center (CIP) recognizes that gender equality and the empowerment of women are essential elements for economic growth and poverty reduction. For this reason, CIP's strategic plan and one of its strategic objectives (SO5) include gender as central to all its operations. This objective highlights the importance of improving rural development, food security and nutrition as well as reducing gender inequalities in agriculture to improve productivity and generate more economic and social benefits.

The CGIAR Research Program on Roots, Tubers and Bananas (RTB) has developed an intervention strategy that seeks to improve food security and reduce poverty by pursuing gender equity. To this end, RTB seeks to achieve two types of results: a) respond to gender needs by ensuring that both men and women benefit from the technologies generated and are not adversely affected; (b) transforming gender relations through technologies and interventions that transform gender roles and promote more equitable relationships between men and women.

The gender strategy of the CGIAR Research Program on Policies, Institutions and Markets (PIM) states that to reduce rural poverty, improve food security, improve health and nutrition, and sustainable management of natural resources; agricultural research should facilitate participation, empowerment and investment in women. Because gender roles affect production and consumption decisions, research should consider these roles in specific contexts. The PIM Program supports research that will: (a) create and implement new tools and methods to understand how the gender approach can contribute to rural poverty reduction, improve food security, health and nutrition, and management of natural resources; and (b) make gender-related issues explicit to participants in multi-level policy processes.

To achieve these objectives, different CIP interventions focus on areas with potato-based production system and promote technological innovation in response to the needs of the most vulnerable rural groups. One of these vulnerable groups is women, given the gender differences in the region. Based on the experience of different CIP initiatives with gender analysis, the need of an in-depth analysis of factors influencing the adoption of agricultural technology was identified, particularly for the context of family agriculture and food security, and from the perspective of men and women.

As part of the efforts of CIP, RTB and PIM to incorporate the gender approach into agricultural technological innovation processes for food security, this study gathers information on the factors that influence the potential adoption of agricultural technologies by men and women. This paper analyzes these factors and makes recommendations for technology design and for technology dissemination strategies with a gender focus.

PART ONE.- Theoretical framework and study design

1. FACTORS THAT INFLUENCE THE ADOPTION OF AGRICULTURAL TECHNOLOGY

A broad set of knowledge on gender and adoption of agricultural technology has been generated through quantitative analysis. Studies in this line of analysis show that female farmers are less likely to adopt technology compared to male farmers (Taneralli et al., 2014, Akudugu et al., 2012, Ragasa, 2012). Some variables that have an explanatory power on technology adoption in general are: gender (Taneralli et al., 2014, Akudugu et al., 2012), age, education (Fisher and Kandiwa, 2014, World Bank and IFPRI, 2010), access to services (World Bank and IFPRI 2010), access to complementary inputs (Doss and Morris, 2001), access to labor (Fisher and Kandiwa, 2014, Rathgeber, 2011), transport, energy (Singh and Kotwaliwale, 2011), among others. However, while in some cases the variables are positively correlated with gender as a variable, in other cases there are negative or nonexistent correlations. The reasons for these differences may vary between cultures and regions.

While some argue that men and women do not necessarily make different adoption decisions, and that adoption is influenced primarily by differential access to complementary inputs (Doss, 2001; Doss, 2006; Peterman et al., 2010); others argue that farmers, both female and male, play different roles in the adoption of technology (Taneralli et al., 2014) and thus differ in their adoption patterns (World Bank and Government of Malawi, 2007; Njiro, 2003). The fact is that there is an ongoing debate around the factors that influence the adoption of agricultural technology and there is a lack of research that systematically analyzes whether women and men differ in their adoption decisions and whether these decisions are in fact due to differences in access to complementary inputs or resources (Ragasa, 2012), or to the differentiated roles played by men and women in adoption. According to Taneralli, studies examining these differences will be useful for designing policies that improve the development, dissemination, and adoption of technology (Taneralli et al., 2014).

In this context, and in the light of the current debate, the present study seeks to explore from an alternative perspective the factors that influence the adoption of agricultural technology, based on farmers' own perceptions (men and women) and the perceptions of researchers and extension workers working in the field. An important line of study that analyze the processes of technology adoption and the factors that influence these processes, are of a positivist nature, with emphasis in quantitative analysis. The present study seeks to provide an alternative view from a constructivist approach based on qualitative methods. The next section of the document presents a description and justification of the approach used and the research design.

2. RESEARCH QUESTIONS

The study draws on the experience of the International Potato Center with the IssAndes project in the dissemination of agricultural technology for food security in high Andean potato producing communities from Bolivia, Ecuador and Peru. The technology dissemination process in the project sought to improve

food security and nutrition, and included gender mainstreaming processes in its design. However, there were differences in the use of technologies by men and women. Giving way to the following questions:

What factors influence the potential adoption of technologies by men and women in high Andean communities where production systems are based on potato cultivation?

How do different factors identified influence the potential adoption of technology by men and women?

3. EPISTEMOLOGICAL APPROACH, THEORETICAL PERSPECTIVE AND TYPE OF REASONING

To address the research questions, a **constructivist epistemological approach** was considered, emerging as an alternative approach to objectivism. In constructivism, the idea that there is only an objective truth waiting to be discovered is rejected (Feast and Melles, 2010), arguing that knowledge is a process of active interpretation and construction of individual representations of knowledge (Bryman, 2012, Jonassen, 1991) where different people can construct different meanings regarding the same phenomenon (Feast and Melles, 2010). One of the most valuable contributions of the constructivist approach is that it encompasses multiple perspectives on a research context (Barillaro, et al., 2009). In this way, constructivism poses a mechanism for overcoming the systemic or cultural biases embodied in empirical research methods (Fischer, 2003).

The research rationale is based on the **theoretical perspective of interpretivism**, which arises as a logic different than positivism. It is used because the subject of study in the social sciences are people and institutions, which essentially differ from the subject of study in the natural sciences (Bryman, 2012) and therefore require a different research logic. Interpretativism postulates that reality is composed of the subjective experiences of people regarding the external world (Barillaro, et al., 2009), where the researchers are not neutral and are involved in the process of interpretation of the elements of the study. According to interpretivists, knowledge and its meaning are acts of interpretation, and therefore there is no objective knowledge independent of thought and human reason (Myers, 2009). According to the interpretative logic, the reality (given or socially constructed) is accessed through social constructions such as language, consciousness, shared meanings and instruments. This logic of research recognizes that there can be multiple explanations for different social actions or phenomena and tries to derive its results from a deep examination of the phenomenon of interest (Gephart, 1999).

The research had an open ended and exploratory character, under **inductive** reasoning. The inductive analysis starts from specific observations trying to detect patterns and regularities that allow the formulation of tentative hypotheses (Tashakkori and Teddlie, 2003).

In the present study, the **constructivist** approach allows us to assume that the factors influencing the adoption of technology are not an objective truth independent of the actors' consciousness and experience, but rather a truth constructed in different ways depending on the context, local culture and the personal experience of each individual (man or woman). In this way, we try to understand the factors and the multiple interactions generated rather than identify an absolute truth. The **interpretative** perspective allows one to visualize the factors influencing the potential adoption of technology as a context-influenced perception of men and women, recognizing multiple explanations for the potential

adoption of a technology. In this same line of thinking, interpretivism recognizes the role of the researcher in the interpretation of phenomena based on a set of determined social constructs.

The main contribution of the constructivist approach and the interpretative perspective in this study is the possibility of an in-depth exploration of the factors that influence the potential adoption of technology by men and women and the analysis of the multiple interactions that influence their adoption decisions.

Finally, through **inductive** reasoning patterns and regularities in the interaction of factors that influence the potential adoption of technology by men and women can be analyzed.

4. RESEARCH STRATEGY AND METHODOLOGY

The focus of the study is to identify factors and the way they influence the potential adoption of technology by men and women in high Andean communities where the production systems are based on potato cultivation. To conduct the work, a **qualitative research methodology based on case studies**, was selected. It considered the perceptions of men and women in different types of high Andean communities with production systems based on potato cultivation.

Case studies are an appropriate research strategy when formulating research questions such as how? or why? regarding contemporary events or phenomena over which the researcher has little or no control (Yin 1994). Cases are studied in themselves and not as a population sample (Robson, 1993).

The definitions and concepts of Yin and Robson have been adopted in this study because:

- The research questions are related to contemporary social phenomena such as the potential adoption of agricultural technology by men and women in communities where production systems are potato-based.
- While it is possible to find information on the research topic (factors that influence the adoption of agricultural technology by men and women), no in-depth studies have been found that contribute to theoretical or empirical knowledge about the factors that affect adoption of technologies by men and women.
- Potential technology adoption is an ongoing social phenomenon that evolves as participants learn, relate, and interact with each other. All these qualitative and subjective elements suggest that there are multiple narratives whose meanings must be understood and explained using qualitative approaches.
- Technology adoption is a complex process because it involves multiple actors with diverse ways of thinking and working, knowledge, goals and interests; which determine how actors develop their perceptions and ultimately shape the process of technology adoption. Complexity must be studied in and of itself, not just as a population sample.

From a theoretical perspective, the justification to consider multiple cases is to follow a logic of replication (Yin, 1994). This is different from the sampling logic in which a representative sample of a population is studied and the results are statistically generalized to the population. The strategy of multiple case studies

seeks to challenge the theoretical ideas developed, so that much more solid theoretical generalizations can be made (Thomas, 1998).

This last idea is related to the importance of using multiple sources of evidence (Yin, 1994; Woodhouse, 1998), whose most significant advantage is the possibility of triangulation (Yin, 1994). This means that evidence is obtained about the same element from different points of view (Thomas, 1998). This research adopts Thomas' definition of triangulation using multiple sources of data and multiple methods to collect it, in order to obtain contrasting and convergent evidence that allows to understand the complexity of the cases studied.

5. SCOPE AND LIMITATIONS OF THE RESEARCH

The geographical scale of the research covers intervention areas of the International Potato Center (CIP) in 3 countries (Bolivia, Ecuador and Peru) where the production system is based on potato cultivation. A double comparative cross-sectional study was conducted. A first level of comparison relates the perceptions of men and women and a second level of comparison relates communities (geographical areas of intervention) to each other.

This study is based on cases located in Bolivia, Ecuador and Peru, where agricultural production systems are based on potato cultivation. Geographically these cases are located in Andean valleys and Puna regions inhabited by small and medium agricultural producers. Communities intervened through focus groups were contacted through CIP operational partners in each country. Participation in the events was voluntary based on the motivation generated by the development institutions present in the territory.

It is important to mention that the information collected in this study does not follow a population sample pattern but rather a structure of case studies. Information can therefore not be used for generalizations or statistical inference, but rather to deepen understanding of the factors that influence the potential adoption of agricultural technology by men and women in potato-based, high-Andean production systems.

6. RESEARCH METHODS

Two complementary methods were used to collect data. The main tool was the focus groups with men and women in each community and country. In addition, interviews were conducted with technicians working in research and development institutions, for the promotion of agricultural technological innovations with men and women.

6.1. Focus Groups

Perception is a central theme in epistemology or theory of knowledge. Perception can be defined as a set of mental processes by which an individual organizes and interprets information in a logical or meaningful way, from his previous experience. Perception involves objective and subjective elements. The objective

elements of perception are those that can be verified. Objectivity poses a reality independent of mental processes; which is related to or is an object, phenomenon or condition within the framework of reality perceived by all observers, independent of individual thought (Calise, 2003). The subjective elements of perception involve psychological elements because they involve our spheres of interest (Henley, 2014). An individual's prior knowledge, experiences, and emotions condition his perception (Calise, 2003). The way in which people perceive social and technological processes, and their outcomes, depend on what they think and feel, rather than on just objective data.

In the construction of epistemology, a basic phenomenon that must be accepted is the collective mental differentiation of individuals (Cohen and Schnelle, 1986). People perceive and think differently and these differences structure groups. These groups perceive and think in the same way and act very similarly (Cohen and Schnelle, 1986). A form of collective perception, thought and action is influenced by gender roles. Gender roles determine the type of activities that are socially assigned to individuals, and are a collective construction that emerges from a group based on their prior knowledge, experiences and emotions.

Focus groups are a research method based on group interaction designed to obtain qualitative information. Focal group members share common elements and focus on discussions related to the research topic (Kruger and Casey, 2000). The objective of the focus groups is not to generalize or develop a hypothesis for a broad population group. It seeks instead to understand how individuals experience and give meaning to different phenomena (Longhurst, 2016); by exploring, discovering and fostering the understanding of specific topics (O'Sullivan et al., 2008) through a closer proximity with the human experience.

The focus group method is a disciplined, systematic, and verifiable process of inquiry (Kruger and Casey, 2000), which, although performed in a flexible and relaxed environment, has a general structure and requires careful preliminary planning (Desimini et al. 2008). Focus groups can often be replicated with different participants to identify trends and patterns within the perspectives expressed by the participants (Krueger, 1994, Morgan, 1988).

To structure a focus group, having a certain level of homogeneity among the participants to facilitate communication is recommended (Krueger, 1994; Manheim et al., 2008). If the group is very diverse or if the participants have opposite roles, individual participation may be suppressed or group discussions inhibited (Stewart et al., 2007). For this reason, focus groups of men and women were held separately, and in some cases jointly.

A total of eight focus groups were conducted with men and women, both separate and jointly, as detailed in Table 1. Focus group discussions had two central parts: a) identify the reasons why farmers decide to use a technology or not; and b) in depth understanding of the reasons for the potential adoption of a technology.

Table 1. Detail of focus group discussions held

Country	Community	Local context	Quantity and type of Focus Groups (FG) and participants
Bolivia	Tiahuanacu	Potato-based production system with development of dairy production and other high Andean crops. Farmers have not had access to new technologies or technical assistance. Agricultural estates over 1 ha in size.	1 Men's FG (6) 1 Women's FG (6)
	Jacopampa	Potato based production system complemented by other crops such as quinoa, maca, vegetables and poultry rearing. Farmers have received technical assistance and have adopted technologies for seed production. Agricultural estates over 1 ha in size.	1 Men's FG (6) 1 Women's FG (6)
	Chiarumani	Potato based production system combined with cattle and sheep rearing for milk and meat production. Farmers have received technical assistance and have adopted technologies for seed production. Agricultural estates over 1 ha in size.	1 Mixed FG (Women 6, Men 10)
Ecuador	Achullay	Potato based production system with crop diversification including: beans, barley, quinoa, oats, mashua, oca, melloco, corn, wheat, lupin and rye. Farmers have had access to new technology and technical assistance. Agricultural estates of less than 1 ha.	1 Men's FG (16) 1 Women's FG (15)
	Basquitay Quillincocha	Potato based production system with crop diversification including: beans, barley, quinoa, oats, mashua, oca, melloco, corn, wheat, rye and vegetables. Farmers have had access to new technology and technical assistance. Agricultural estates of less than 1 ha.	1 Men's FG (9) 1 Women's FG (9)
	La Vaqueria	Potato based production system with crop diversification including: beans, barley, mashua, oca, melloco and vegetables. Farmers have had access to new technology and technical assistance. Agricultural estates of less than 1 ha.	1 Mixed FG (Women 5, Men 3)
Perú	Conayca	Potato based production system with crop diversification including: beans, barley, wheat, quinoa, oats, maize and alfalfa. Farmers have had access to new technology and technical assistance. Agricultural estates with an average size of 1 ha.	1 Men's FG (7) 1 Women's FG (7)
	Mariscal Cáceres	Potato based production system with crop diversification including: beans, barley, wheat, quinoa, oats, mashua, oca, olluco, maca, peas and corn. They have had access to new technology and technical assistance. Agricultural estates larger than 1 ha.	1 Men's FG (14) 1 Women's FG (6)

Source: Personal elaboration

During focus group discussions, farmers were consulted about the technologies they used most for their crops in general and for potato cultivation in particular. Based on this initial information, the reasons why men and women decided to use technology or not were explored. Subsequently they were asked which were the technologies that they knew about but did not use, and the reasons why they had decided not

to use them were further explored. This information was disaggregated to identify the reasons mentioned by the farmers, comparing them to each other to identify the existence of priorities or interaction. The reasons mentioned were later grouped to identify whether they were technology attributes or a different type of factors. Finally, context information collected for each focus group (level of education, productive context, importance of the crop, gender roles) was analyzed to identify possible relationships with the reasons mentioned for adoption or non-adoption mentioned. The detail of the workflow used during the focus groups is described in Annex 1.

6.2. Interviews to technical staff

Interviews are a research method based on the individual interaction between the interviewer and the interviewees. It is a verbal exchange where the interviewer seeks information from the interviewee by asking questions (Longhurst, 2016). Qualitative interviews generally have a structure based on the interests of the researcher but function flexibly, providing room for spontaneous descriptions and narrative of the respondent (Brinkmann, 2014). The selection of interviewees was based on the objectives and logic of the research. However, in this case it was also important to recognize the background of the research team and the access to potential interviewees (Longhurst, 2016).

In the specific case of the study developed to identify the factors that affect the potential adoption of technology, interviews were conducted with technical personnel (men and women) who work in technical assistance and promotion of agricultural technology innovation. The research team was linked to the activities of the International Potato Center (CIP) in Bolivia, Ecuador and Peru. Therefore, technical personnel of CIP partner institutions with a predisposition to participate in the interview were identified. The participants were technical staff of NGOs and public institutions: 4 in Bolivia, 7 in Ecuador, 4 in Peru. These technicians responded to a general questionnaire about their perceptions regarding the factors that affect the potential adoption of technology and the differential effect these factors have on men and women. Annex 2 presents the general structure of the interview conducted.

6.3. Data analysis methodology

Interpretive phenomenological analysis (AFI) is an approach for the qualitative analysis of information. It focuses on the ways in which people give meaning to or experience different phenomena (Smith et al., 2009). The AFI involves a meticulous examination and codification of the data generated, identification of emerging patterns (convergences and divergences) and classification of topics, articulation of themes and identification of thematic groups, and production of abstracts with illustrative citations (Storey L., 2008; Larkin and Tompson, 2012).

The information from the focus groups was initially systematized in a standardized format for further analysis. Each focus group report was analyzed in terms of the expressions and perceptions regarding different variables (factors) that influence the adoption of technology. For each factor (variable) several perceptions related to one or more technologies, mentioned in the focal group dynamics, were registered. Once the perceptions for different variables (factors) were registered independently, a comparison of

results, variable by variable, was conducted between the different focus groups (by country, by community, by gender). This comparative analysis made possible the identification of lines of convergence and divergence between the different types of evidence collected.

As lines of convergence and divergence between variables (factors) were identified, groupings were made based on the relationship between factors.

The information on interviews to technical personnel was recorded in a standardized form for later systematization and analysis. For the systematization, a matrix of variables was elaborated and all the qualitative answers were codified. This matrix allowed an aggregated analysis of the perceptions of technicians, which in turn informed the larger analysis conducted with information from the focus groups.

PART TWO.- The voices of men and women and the relationship between factors

This section presents the results of the focus group discussions implemented in communities of Bolivia, Ecuador and Peru, and the information gathered through the interviews with the technicians working in the intervened communities.

Using the **interpretive phenomenological analysis** (AFI) to study the perceptions of male and female farmers to the potential adoption of agricultural technology in potato producing areas of the Andean region, several factors of influence were identified along with some patterns of relationship between them. The patterns of convergence and divergence identified in the study enabled grouping and classification of factors according to their effect on the potential adoption or non-adoption of agricultural technologies in potato based agricultural production systems.

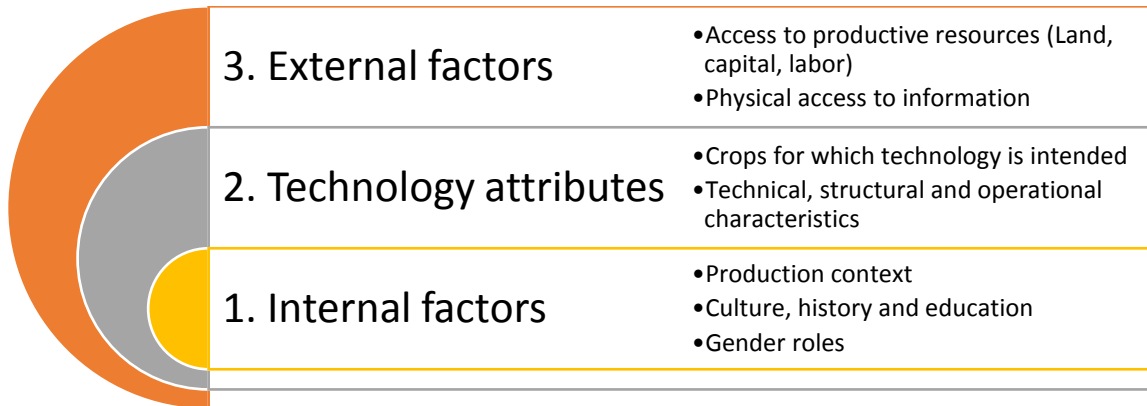
1. Relation between factors: an embedded interaction

The study shows that there are different factors that have a different impact on the adoption of agricultural technologies by men and women. From the results generated, a classification of three types of factors is proposed. These factors have dependence or embedded interaction relations between them (See Figure 1).

1. **Internal factors** have the highest level of influence. They can be determinant for the potential adoption of a technology. The productive characteristics of a region, the importance of the crop and its destination, cultural and historical practices, and socially constructed gender roles are the first filter for the potential adoption of a technology.
2. A second filter are **technology attributes**, or specific technology characteristics that create positive or negative predispositions for its potential adoption by men and women.
3. **External factors** are at a third level of definition (influence), and are generally related to access to productive resources.

This study shows that factors do not independently influence male and female farmers' adoption of technology, but rather interact and influence one another. The **embedded interaction** between different levels of influence is what determines the potential adoption of agricultural technologies by men and women (Figure 1). The results of the analysis of male and female farmers' perceptions on the potential adoption of agricultural technology are presented considering this classification of factors.

Figure 1. Embedded interaction between the different types of factors that influence the potential adoption of technology by men and women

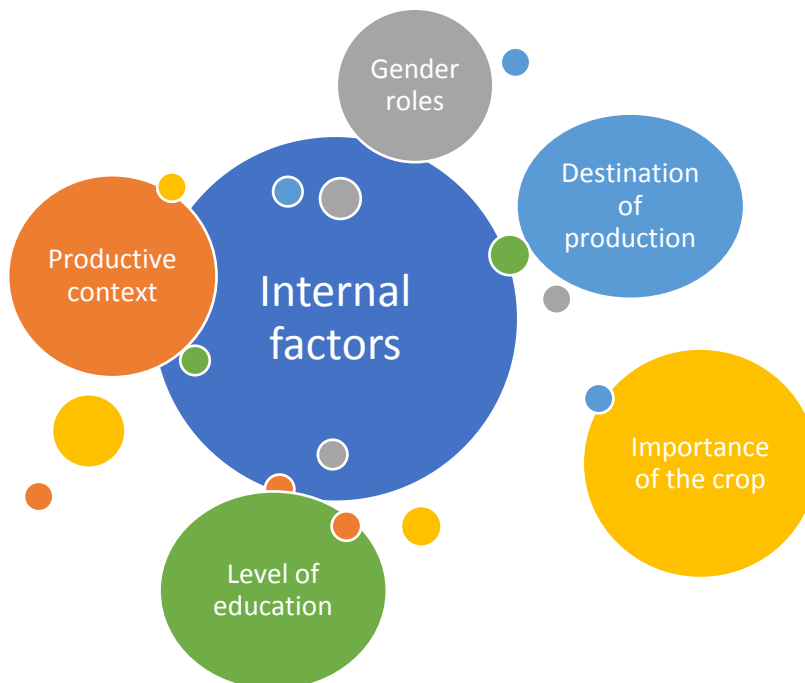


Source: Personal elaboration

2. Internal factors

Internal factors are a first filter for potential technology adoption. Men and women prioritize the adoption of technology based on multiple and different factors and each one of them has different importance according to the specific conditions of every producing region. The factors observed and their effect on potential adoption are detailed below.

Figure 2. Internal factors that affect the adoption of technology by men and women



Source: Personal elaboration

2.1. Productive context

Within the framework of this study and the evidence found, productive context refers to the agroecological conditions and the political-economic normative framework that influence agricultural production and the use of technologies.

Environmental, political and economic components that shape a productive context can in turn influence the expression of technology as well as the expression of other factors that influence the decisions of individuals on the potential adoption of agricultural technologies. That is why it is necessary to think of multiple technological options for different contexts.

In all the focus groups conducted in Bolivia and Ecuador, farmers mentioned that, despite the preference for the use of organic products because of their health safety, there are cases where agroecological conditions and access to technologies motivate the use of agrochemicals. In the three areas intervened in Ecuador, chemicals are used to control late blight, due to the high losses in potato production generated by this phytosanitary problem. The same happens with the control of the Andean potato weevil in the three areas intervened in Bolivia, where male and female farmers mention using this technology (agrochemicals) because of the high incidence of the pest in the context, and the lack of other technological alternatives. However, despite the high incidence of pests in potato crops, women in general are less prone to the use of agrochemicals because they are responsible for the crops of less economic importance or that are destined for self-consumption.

2.2. Destination of production

Within the framework of this study and the evidence found, the destination of production refers to market or family consumption, or a combination of both.

When the crop is destined to the market there is a greater tendency to the use of higher-cost, labor and input intensive technologies. On the contrary, for technologies destined to home-consumption crops to be adopted, they must reduce the use of productive resources, address specific constraints or enhance the interaction between crops (associated crops, agroforestry systems, etc.). This trend takes on different nuances due to gender differences. In all crops managed exclusively by women, priority is given to the use of technologies that require low investment of resources, labor or productive inputs because they are destined for family consumption.

However, there are exceptions to this trend that manifest when the productive context is favorable to the use of inputs and labor, or when the specific crop has higher priority. This can clearly be observed in the case of the Achullay community in Ecuador where men and women generally prefer not to use agrochemicals. However, men claim that organic manure is less effective and therefore use chemical fertilizer when potatoes are for sale and not for home-consumption. Women, on the other hand, claim that the native potatoes they grow are for home-consumption and therefore do not use chemical fertilizers. This prioritization of technology use according to the destination of production is also related to preferences and gender roles. This is evident in the case of the community of Achullay, Ecuador, where

women say that the use of fertilizers changes the taste of the potato destined for home-consumption and in their opinion, it is less healthy. This is linked to the perception that women have about taste and health, and gender roles in food preparation.

A similar case is observed in the community of Jacopampa in Bolivia where men and women claim not to use quality seed for crops such as beans, quinoa, barley and oats. In this case, most men mentioned that this technology is not used because there is no local availability of this product. They mention that in some cases they had to travel outside the community in search of certified seed and had many difficulties obtaining it (referring to seed of high categories for commercial production). Women, on the other hand, stated that they do not use quality seed (certified) because their crops are for home consumption, certified seed is very expensive and difficult to access (although they recalled that they had never tried to go outside community). Another similar case occurred in Jcopamp, Bolivia where men and women claim not to use lime sulfur for the disinfection of seeds for different reasons: men do not use this technology for seeds because the production is destined to home consumption where they often seek to reduce the expenses; women as well as men do not use this technology because it is destined to a home consumption crop, but also because they consider the elaboration process difficult and time-consuming.

In addition, as observed in the focus group discussions in the three countries, the varieties of potato selected for production differ depending on the destination of the final product. Improved varieties are produced by men and women and are mainly destined to the market. Native varieties, on the other hand, are generally managed by women and are intended for family consumption. In this scenario, there is a greater tendency to use technologies that are intensive in the use of resources and inputs, for commercial production; compared to the production for home consumption. This is clearly seen in the focus groups of Achullay and Basquitay Quillincocha, Ecuador, where women claim to use agrochemicals to control late blight in commercial potato production but not in native potatoes. Something similar happens in Bolivia where men and women report using certified quality seed for commercial crops, but not for home-consumption crops.

2.3. Importance of the crop

Within the framework of this study and the evidence found, the importance of the crop refers specifically to the relative participation of a given crop in the generation of family income.

The study shows shared responsibilities between men and women for crops of economic importance or that have greater importance for family consumption. However, men have more participation in the decisions on the technologies to be used, being technological efficiency more important than the use of resources. In crops that are less important in terms of income or food security, women are more involved in decisions about the use of technologies.

This is observed in the focus groups of Achullay-Ecuador, where crops mentioned by men and women are the same except for lupine and rye, which are minor crops managed exclusively by women for family consumption. Something similar occurs in the community of Basquitay Quillincocha, Ecuador, where men and women share responsibility for larger scale crops, but women take responsibility for crops such as

onions, chard, cabbage and peas, which are destined to home consumption. In the case of the community of Mariscal Cáceres, Peru, responsibility for major crops is shared, but women take responsibility for crops such as oats, peas and maize, which due to agro-ecological conditions (low temperatures and altitude) are essentially produced for family consumption. In Tiahuanacu, Bolivia, responsibilities are also shared in larger scale crops such as potatoes, barley, broad beans, and peas, but women manage by themselves crops for family consumption or animal feed such as oats, oca and papalisa.

Within this generic framework there is a greater tendency to adopt technologies that improve yields and reduce losses for crops that are highly important for family income. Other variables in technology such as: optimization of the use of productive resources (labor, capital, land), interaction with other crops (associated crops, agroforestry systems, etc.), perceptions of safety and variables of transformation or consumption, among others; are prioritized in crops with lower importance for family income.

2.4. Level of education

Women, elderly and indigenous people, and other disadvantaged groups are often poorly educated, communicate in native languages and their management of official languages is limited. This hinders the potential adoption of technologies requiring technical knowledge, calculations, reading or social interaction with actors outside their immediate environment (technicians, promoters, service providers).

The level of schooling found in all focus groups in Bolivia, Ecuador and Peru was low. Men in general had primary education and some even secondary education. As for women, the majority had primary education and some were illiterate. Additionally, in the Bolivian cases, most men and women spoke Spanish and Aymara, but some women spoke only Aymara. The fluency of communication in Spanish varied also, as men understood and used this language more easily than women. In Peru, men and women spoke Spanish and Quichua, although as in the case of Bolivia, men are more fluent with Spanish. In Ecuador, there was no record of the use of native languages.

Although during the work with the focus groups there was no specific mention about the level of education as a direct influence factor in the adoption of technology, it was observed that women in general were less inclined to adopting technologies that require higher levels of education, literacy or special technical knowledge. An example of this trend was observed with the focus group in Tiahuanacu, Bolivia where women mentioned not using agrochemicals for pest control because of lack of knowledge about their use and application. In the same way, men with lower levels of schooling mentioned that they did not use products for spraying, whereas those with a higher level of schooling knew and in some cases used these products.

In the same line of analysis, women from Chiarumani, Bolivia with lower level of schooling and who used only the Aymara language to communicate, were less inclined to adopt technologies in general.

2.5. Personal perceptions and socially accepted gender roles (culture)

As mentioned in the previous section, personal perceptions play an important role when defining the use of a technology. In the same way, gender roles determine the type of activities that are socially assigned to individuals. Women are usually responsible for seed selection and selection of potato sizes for the market. Therefore, technologies designed for these purposes should consider the different physical and social characteristics of women in the context. On the other hand, the application of agrochemicals is generally a role assigned to men except in regions of high migration where women have assumed this productive role. In this case, the activities and gender roles in the specific context should be analyzed to determine how this factor affects the prioritization of technologies by men and women.

In all the focus groups from Bolivia, Ecuador and Peru, both men and women mentioned that the use of organic products (fertilizers and extracts for pest control) was prioritized because it is considered healthier and not harmful to health. This perception is prioritized above issues of efficiency, economy and ease of use of technologies. In some specific cases (when there is a late blight attack in potato, Ecuador, Andean potato weevil attack, Bolivia and Peru), men prioritize the use of chemical products due to their efficiency. However, this use is also related to aspects such as: a) destination of production - for the market; and b) product efficiency - higher compared to organic options. In all cases, the alternative of using chemicals is more frequently mentioned by men. Women mentioned the use of chemicals only as a last resort.

In all the focus groups conducted, a relationship between gender roles (accepted in the context) and the type of technology adopted by men and women, was observed. These gender roles are most clearly seen in the case of focus groups in Peru, where women tend to adopt technologies related to food processing, seed selection, composting, and sprinkler irrigation. These technologies respond to their assigned roles in the household such as food preparation, production of minor crops for self-consumption and waste management. In the case of men, they more frequently adopt technologies related to productive infrastructure (seed storage, construction of platforms), building organization (rotation of crops), and technologies that require physical force and / or intensive use of labor.

In Bolivia, the three focal groups conducted also showed differences in the prioritization of technology based on gender roles. Seed selection is a practice generally performed by women, particularly in the case of potato seed. Technologies such as seed selection, seed protection with native aromatic plants (rue and fabiana bush) and use of sieves were mentioned only by women. On the other hand, in one of the cases of Bolivia (Patacamaya), mechanized equipment for the selection of potato seed was mentioned. In this context, equipment that required greater physical strength, height or external power source for its operation, were not adopted. Women, who have the role of selecting the seed, preferred more simple equipment and without external power source because this aspect makes the operation more difficult for them.

In the case of Ecuador, high migration rates have undermined the traditional structures of gender roles and distribution of activities for the productive area. However, the distribution of roles in food preparation and waste management are still observed. When prioritizing technologies, women more frequently

mention aspects related to food (safety, good taste) and to the use of waste (composting, fermentation, extracts).

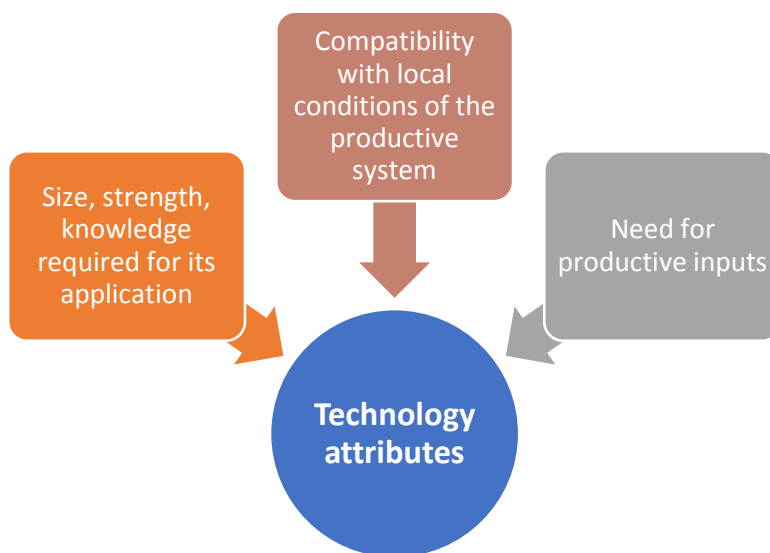
This clearly shows that, when designing technological alternatives, we must first consider who would be targeted, according to the gender roles assigned in the specific context, and subsequently the needs and constraints faced by the user.

3. Technology attributes

Technology attributes refer to the intrinsic characteristics (design, cost, domain of recommendation, effectiveness, use of complementary inputs, among the most important) of the technologies that are sought to be disseminated or promoted.

Technology in itself is not neutral because it holds a gender bias from its design. Below are some groups of attributes that influence the potential adoption of technologies.

Figure 3. Technology attributes that influence the adoption of technology by men and women



Source: Personal elaboration

3.1. Size, strength and/or knowledge required for the operation or implementation

The study shows that in addition to general context factors, some characteristics and conditions of individuals interact in favor or against the adoption of technologies. In this case, the size of the individual and his/her physical strength can favor or hinder adoption based on the characteristics or attributes of the technology.

Some technologies, especially equipment, have specific characteristics that make it more difficult for women to use them. This is the case of: a) equipment, large and / or heavy; and, b) practices that require a lot of physical strength or special knowledge for their application.

According to testimonies of farmers from Jacopampa in Bolivia and staff working on technology dissemination, one of the important tasks for the commercialization of potatoes is the selection by size. This task is usually performed by women manually. To reduce the time allocated to this work, equipment for mechanized potato selection was introduced. The evaluations showed positive results but after introduction, the equipment was little used. This happened because the validation events involved a greater number of men and they gladly operated the equipment. However, within the families it was still the women who performed this task. They found the operation difficult due to: a) the height of the equipment; b) the force necessary to lift the bags of potatoes to load the equipment; and c) the strength and knowledge necessary to operate the sieving crank. Understanding these conditions, a much simpler equipment was introduced; low bearing, without cranks, where potatoes slide down by gravity and were pushed through sieves manually. This equipment fulfilled the function of reducing the time allocated to manual selection, and because of its simplicity, low bearing and lower requirement of physical strength, it was gradually adopted by women.

On the other hand, female farmers from Achullay and Basquitay Quillincocha, Ecuador, when comparing the use of tractor, yoke plow or hoe for land preparation during sowing, stated that the tractor is the most efficient technology, followed by the yoke plow and finally the hoe. However, most of them used hoes because the yoke plow requires more physical strength and renting a tractor is very expensive. They mentioned that some people who have trained oxen do use the yoke plow because it allows a faster soil preparation, but it is generally men who lead the oxen because of their greater physical strength.

3.2. Compatibility with local conditions of the productive system

Many times, technologies are generically designed and are sought to contribute to problem solving in large recommendation domains¹. However, it is important to consider that, in mountainous regions, variations in climatic and environmental conditions are wide. Thus, it is important to provide a diversified basket of technological alternatives that can be adapted to the different contexts.

A case of incompatibility with local conditions or recommendation domain was clearly observed in the community of Jacopampa, Bolivia. In this case, one groove potato harvesters were introduced to reduce the investment in labor and the time of family members assigned to this work. According to the retrospective expressions of the participants in the focus group, the evaluations with men and women showed high satisfaction of the potential users. However, after some time, the technology stopped being used despite: a) being of easy operation and maintenance; b) being available to members of the community (men and women) through loans. The main reason why it stopped being used was that the equipment worked well in the sectors near the evaluation sites, with loam soils; but did not work well in

¹ A recommendation domain is the socio-economic, ecological and productive context for which a specific technology is recommended.

most of the plots with stony soils. This shows us the need to reconcile the characteristics and recommendation for equipment use with local conditions.

3.3. Cost and ease of application

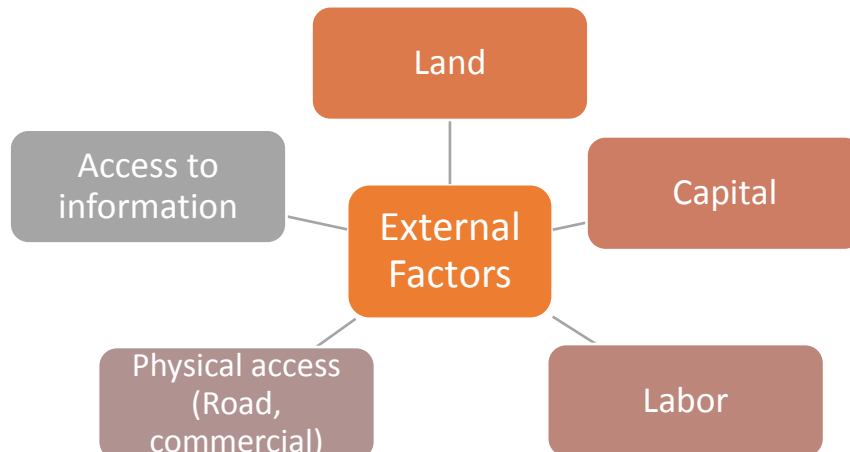
One aspect mentioned in all the focus groups, by both men and women, was the cost of technology. In general, farmers and particularly women, seek to minimize costs and tend to prefer technologies that are cheap or do not require resource investment. The exceptions to this preference arise when dealing with crops of high economic importance, intended for the market, or when the production system so requires. This is the aforementioned case of the use of a tractor in Chiarumani, Bolivia, or the case of the use of certified seed of high categories for the sale of seed in Jacopampa, Bolivia. In these cases, due to the importance of the crops, both men and women prefer efficiency over cost. These cases clearly show that there are interactions between technological attributes and other factors.

Something similar happens with the ease of use of technologies. In the focal groups of Ecuador and Peru, men and women prioritize technologies that are easy to apply, but in the face of phytosanitary and pest problems that put their entire production at risk, they opt for more complex processes such as the preparation of ferments, soil amendments and / or the use of agrochemicals.

4. External factors

The external factors are the factors of production and context elements that make technology access viable. In some cases, the utility and contribution of technologies is evident, but its implementation requires inputs or services that cannot be easily accessed and this hinders the potential adoption of technology despite all the benefits it could bring for both men and women. Much of the literature focuses on the effect of access to these inputs and services to promote or limit access to technology by men and women. An important element to consider is that women in general have less access to these factors, which negatively affects their ability to adopt new technologies.

Figure 4. External factors that influence the adoption of technology by men and women



4.1. Land

Land is the main factor of production for male and female farmers in all parts of the world. In potato producing regions of the high Andes, the land is usually communal, family and / or individual property, with some cultural restrictions for equal access to this resource by women. Other access mechanisms, although less frequent, include “split production” and rent. This is a favorable situation when compared to access conditions in other regions of the world. However, despite favorable arrangements, land is a limited resource. The division of land for inheritance from father to son has given rise to smallholdings, especially in regions with high productive potential. This limits the possibilities of extensive production or diversification of agricultural production. However, based on the results of the study it is inferred that access to land (size and condition) influences the type of technology to be adopted and the potential adoption by farmers.

The conditions of land tenure and size for male and female farmers from the communities that participated in the study, in Bolivia, Ecuador and Peru, are similar. The reported size of land varies between 0.5 - 2 ha, with individual use of land reported in all cases. Additionally, few variations were reported in the conditions and size of land holding between men and women. However, it is important to note that, according to information provided by local technicians, the land size in the case of Jacopampa and Chiarumani, Bolivia, is greater than that reported by farmers; averaging 5 ha.

In this context, the size of the agricultural properties can define the type of technology used. In the community of Vaqueria, Ecuador, men and women mentioned that they stopped using yoke plow to prepare the soil because, although this technology facilitates and speeds up work, their agricultural land is very small and they have stopped rearing oxen. Something similar happens with the use of tractor that is reported by men and women as an efficient technology for soil preparation, that due to its high cost is not used in smaller land holdings such as those managed in Ecuador (Achullay, Basquitay Quillincocha, Vaqueria). On the other hand, in larger farms, the objective is to use less labor-intensive technologies. This is clearly observed in the community of Chiarumani, Bolivia, where the use of tractor is prioritized for agricultural activities such as plowing, fallowing, sowing, hilling and even harvesting of potatoes, because the plots are larger. In these cases, both men and women rent the service because the product is intended for the market.

Although different studies show inverse relationships between land tenure and technology adoption, it is also important to note that many of the quantitatively evaluated technologies were designed for extensive production. In this context, women who in different regions of the world face greater difficulties accessing land may also show lower levels of adoption.

Based on results from the focus groups, where land tenure and land size are relatively similar between men and women, it can be inferred that it is not necessarily the size of the land that affects adoption, but rather the type of technology and the type of user for whom it is designed.

4.2. Labor

Access to labor is a factor that can affect the adoption of technology. In areas with labor availability at affordable prices, labor-intensive technologies are much more likely to be adopted. In contrast, technologies that reduce the use of labor are more likely to be adopted in regions where access to this factor of production is limited.

On the other hand, it is important to highlight that the participation of men and women in the labor market varies according to multiple internal and external factors. This must be analyzed before designing a technology that reduces or increases the use of labor, since it could have adverse effects on men and / or women according to their participation in the labor market.

In the different communities that were part of the study, access to labor was one of the main restrictions for the adoption of technology. Due to the high rates of temporary and / or permanent migration of men, women are left in charge of both household tasks and agricultural production, and tend to depend on family labor for different agricultural activities. Accordingly, for food security crops or crops of lesser commercial importance, both women and men prioritize technologies that minimize the use of labor.

In the case of Tiahuanacu in Bolivia, the production of quinoa is mainly managed by women in small plots and for home consumption, so there is no adoption of technology that requires the investment of economic resources or intensive use of labor. In the case of Jacopampa, Bolivia, a different phenomenon is observed with the same crop. In this community men and women share the responsibility of producing certified quinoa seed, with a high economic value. For this reason, they work on larger areas, acquire inputs (seed of high quality) and use a lot of labor to harvest and thresh the product. This shows a differentiated use of inputs (capital, labor, land) according to the productive conditions of the context, the importance of the crop and its destination.

Therefore, based on the findings of this study, it is inferred that, although access or availability of labor is influential, it is not the main factor that determines the potential adoption of a technology.

4.3. Capital

Access to financial resources, whether in the form of credit, savings, income, or physical resources such as machinery or infrastructure, positively influences the potential adoption of technologies that require investment such as tractors, plows, machinery, and others. In the case of women, they have lower access to capital, low schooling and self-esteem; limiting much more the adoption of technologies that require investment and special operation such as agricultural machinery. However, the study shows that the investment of capital by men and women is feasible and viable depending on the technology and other contextual factors such as the importance of the crop, the destination of production and the characteristics of the production system.

The availability of capital and labor are factors that affect the potential adoption of technology. In Conayca, Peru men claim to use plastic barriers to control the Andean weevil because they have the

material (plastic) for the implementation. Women on the other hand, claim not to apply the practice because it requires a lot of labor. In relation to this same technology, the women from Mariscal Cáceres, Peru say they do not use it due to the cost of the input (plastic) and the contamination it generates eventually. Men in Mariscal Cáceres, however, claim not to use the practice due to the Laymes rotation system that locates plots at great distance from one another. In these two cases, the interaction of factors such as capital (resources - cost), labor, perception and characteristics of the productive system are observed; all interacting to define the adoption and non-adoption of a certain technology by men and women.

Another example of priority for the use of technologies that requires heavy capital investment is the use of a tractor in Chiarumani, Bolivia. In this case men and women prioritize the use of a tractor despite the high cost, due to the productive conditions (crops of greater extension), the importance of the crop and its destination (production of potatoes for the market).

This process of interaction to define potential adoption is common in factors such as land, capital and labor. It is not the condition of access to land, capital or labor alone that ultimately determines the potential adoption, but the interaction between factors. Unlike other factors such as gender roles, importance of the crop or destination of production, which can become determinant for decisions about the use of a particular technology.

4.4. Physical access (road, commercial)

The conditions of roads and / or commercial access are also a factor that can determine the potential adoption of technologies that require the use of productive inputs or mobilization of some kind. This factor affects women more since they have additional limitations for mobilization and access to markets, mainly due to their productive and reproductive roles in the household.

In the focus group of Jacopampa, Bolivia, difficulties of access to productive inputs negatively affect the potential adoption of technology by men and women. According to stories told by male and female farmers themselves, one of the most widespread technologies among potato producers in the central highlands of Bolivia is the production and use of quality seed. A group of farmers who produce and market certified quinoa seed recognized that quality seed contributes to improving agricultural productivity. Being quinoa seed marketers, they started a process of quality seed use in other crops. Men reported that they acquired potato seed for their plots, but to acquire the product they had to travel to the seed producing areas located more than six hours away from their communities. This had time and money implications so the practice was discontinued.

When reporting these difficulties, male and female farmers were sorry to inform that there are no possibilities of access to commercial seed in town centers near their communities. On the other hand, women reported that for crops they manage in rotation such as: barley, oats and beans; there is no seed available in local fairs and that they have greater difficulties in travelling to look for seed. That is why they did not try to look for it in the past. This shows that accessibility affects both men and women, but its effect is increased based on specific conditions such as gender roles.

Similarly, male farmers from the community of Mariscal Cáceres, Peru, claim to know the benefits of using plastic barriers to control Andean weevil in potatoes, and sustain that they have access to the necessary material. However, within the framework of their Layme based productive system, there are multiple production plots that are located at great distances from one another and with limited road accessibility. This prevents them from moving the plastic rolls, installing and monitoring the barriers in their plots with sufficient ease every year.

4.5. Access to information

Access to information, that includes various media sources such as radio, television, internet, extension services, among others; is an external factor that can promote or limit the potential adoption of technologies. However, in the case of women this factor may also depend on internal factors such as low literacy, language, cultural restrictions on mobilization or participation in events, among others.

Both male and female farmers mention that in some cases they know about the existence of some technologies and have access to them, but do not use them. In the community of Jacopampa, Bolivia, a farmer mentioned that she received the product "Matapol Plus" as a prize at a fair, but did not receive any explanation or technical assistance for its application. She knows that it should be used for the storage of potatoes, but she doesn't know about its characteristics (whether it is toxic or not), how to apply it and is not clear about the final utility of the product or the benefits for the control of the potato moth in storage. That is why she has the product at home, but does not use it. A more detailed observation of the previous case showed that the "Matapol Plus" bag has a label that describes in detail the utility and mode of use of the product. This shows that access to information is in turn influenced by factors such as the literacy, which in the case of women is lower.

However, the results of the research also show that it is not the educational level alone that influences the adoption of technology, but the interaction of this factor with the possibility of accessing written or technical information. For example, in the case of Chiarumani, Bolivia, both women and men claimed to use chemical and natural products for pest control because they received information on the subject. In the same way, low-educated women who only used the Aymara language in Jacopampa, Bolivia, had adopted technologies to control pests such as natural repellents and Karate, because they received training and technical assistance in their native language. This leads us to infer once again that, alike level of education, the use of native languages can influence access to information, regardless of gender.

PART THREE. - Conclusions and recommendations of the study

The research conducted had the objective of identifying the factors that, according to the voices and perceptions of men and women, influence the adoption of agricultural technology differentiated by gender; and at the same time, provide inputs on how to consider gender differences when designing and disseminating agricultural technology in agrarian systems of the Andean region that base their production on potato cultivation.

The results of the study show that the potential adoption of an agricultural technology is not gender neutral and that the different factors influence adoption decisions of men and women differently.

Findings from the research show us that these factors do not act independently, it is the embedded interaction between them that really determines the potential adoption of a technology by a man or a woman. To understand and analyze the different factors and their interactions, they have been grouped into three levels, according to their typology. The first level comprises internal factors, such as characteristics of the productive context, cultural, historical and educational elements, in addition to specific gender roles. These factors may have a higher or more important effect on technology adoption decisions. At a second level of importance in terms of influence, are the attributes of the technology, which include technical and operational characteristics, in addition to the crops for which a specific technology is destined. In general, these attributes can have a determining role only under specific conditions of internal factors. Finally, a third level of influence is given by external factors that include access to land, capital and labor, access to information and physical accessibility. This third level influences the potential adoption of technology according to the configuration of the other two levels.

The evidence gathered through the study also shows that the “how” and the “extent” of the influence of factors on adoption, depends on the perceptions, experiences, preferences and priorities established by men and women; and that these vary according to the gender roles defined in each context and culture.

The study shows that technology involves gender biases that must be considered at the different stages of technology design, validation and dissemination. The potential negative effect of these biases can be reduced by taking into account the internal factors outlined in this study, for two main reasons: a) the high level of influence of internal factors; and b) the interaction effect of these internal factors with external factors and attributes of the technology. This seems to be a crucial point to be considered by research programs.

In line with the literature that analyzes the limitations of women's access to agricultural technology, which emphasizes the limitations of access to factors of production, the present study shows that limitations of access to production factors are a strong restriction for the potential adoption of technology. This is valid for the generality of cases and particularly for women. However, it is important to highlight that the effect of internal factors and / or technological attributes is greater and can even revert the limitations of access to external factors that include productive resources such as land, capital and labor; market access (road, commercial) and access to information in general.

Finally, it should be noted that this study sheds some light on the importance of considering gender differences when designing and disseminating different agricultural technologies. In this sense, future research can contribute to the definition of a conceptual framework that enables the study of the interaction between the different factors that influence the adoption of agricultural technologies in a systematic and structured process; analyzing how these interactions vary according to the conditions of the context and culture, where men and women make their adoption decisions.

BIBLIOGRAPHY

- Akudugu, M. A., Gou, E., Dadzie, S. K. (2012). *Adoption of Modern Agricultural Production Technologies by Farm Households in Ghana: What Factors Influence their Decisions?* Journal of Biology, Agriculture and Healthcare 2(3): 1-14.
- Barillaro, P., Metz, J. L., Perran, R., and Stokes, W. (2009). *Constructivist Epistemology: An Analysis*. <http://studylib.net/doc/7527138/constructivist-epistemology--an-analysis>
- Brinkmann S., 2014. Interview. In Teo, T. (Eds.) *Encyclopedia of critical psychology*. Pp 1008-1010.
- Bryman, A. 2012. *Social Research Methods*, London, Oxford University Press.
- Calise, G. (2003). *Perceptions of reality: An exploration of consciousness*. Victoria, BC: Trafford. Victoria, Canada.
- CGIAR. (2011). *Consortium Level Gender Strategy*. November, 2011. In: https://library.cgiar.org/bitstream/handle/10947/2630/Consortium_Gender_Strategy.pdf?sequence=4
- CGIAR RP-PIM. (n.d.) *Research Program on Policies, Institutions and Markets (PIM): Gender Strategy*. In: <https://library.cgiar.org/bitstream/handle/10947/2839/CGIAR%20Research%20Program%20on%20Policies%2C%20Institutions%20and%20Markets%20-%20Gender%20Strategy.pdf?sequence=1>
- CGIAR RP-RTB. (2013). *Gender Strategy, Web Version*. February 22, 2013. In: <https://cgspace.cgiar.org/bitstream/handle/10568/83400/RTB-Gender-Strategy.pdf?sequence=1&isAllowed=y>
- Cohen, R.S. and Schnelle, T. (1986). *Cognition and fact: Materials on Ludwik Fleck*. D. Reidel Publishing Company, Dordrecht, Holland.
- Desimini, N., Fox, J., Geise, H. and Lee, B. (2008). *Using Focus Groups as a Research Method: An Evaluation*. Unpublished manuscript, University of Victoria, Victoria, BC.
- Doss, C. R. (2001). *Designing Agricultural Technology for African Women Farmers: Lessons from 25 Years of Experience*. World Development 29(12): 2075-2092.
- Doss, C. (2006). *Engendering agricultural technology for Africa's farmers. Promises and pitfalls*. In: Baker, K. and Baker, D. K.(Ed.), *Feminist Economics and the World Bank. History, theory and policy*. (pp. 79-91). New York, USA: Routledge

- Doss, C. R., Morris, M. (2001). *How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana*. *Agricultural Economics* 25: 27-39
- Feast, L. and Melles, G. 2010. *Epistemological Positions in Design Research: A Brief Review of the Literature*. 2nd International Conference on Design Education, 28 June - 1 July 2010. Sydney, Australia: University of New South Wales.
- Fischer, F. (2003). *Reframing public policy: Discursive politics and deliberative practices*. New York: Oxford University Press.
- Fisher, M., Kandiwa, V. (2014). *Can agricultural input subsidies reduce the gender gap in modern maize adoption? Evidence from Malawi*. *Food Policy* 45: 101-111.
- Gephart, R. (1999, January). *Paradigms and research methods*. In *Research methods forum* (Vol. 4, No. 1, p. 11).
- Henley, N. M., (2014). *Women as a Social Problem: Conceptual and Practical Issues in Defining Social Problems*. In: Seidman, Edward, & Rappaport, Julian. (Eds.) *Redefining Social Problems*. Springer Verlag. New York.
- Jonassen, D. H. (1991). *Objectivism versus constructivism: Do we need a new philosophical paradigm?* *Educational Technology Research and Development*, 39(3), 5-14.
- Krueger, R. A. (1994). *Focus groups : A practical guide for applied research* (2nd ed ed.). Thousand Oaks, Calif: Sage Publications.
- Krueger, R. A., and Casey, M. A. (2000). *Focus groups: A practical guide for applied research*. Sage Publications Inc.
- Larkin, M. and Thompson, A. (2012). *Interpretative phenomenological analysis*. In A Thompson & D Harper (eds), *Qualitative research methods in mental health and psychotherapy: a guide for students and practitioners*. John Wiley & Sons, Oxford, pp. 99-116.
- Longhurst, R. 2016. *Semi-structured interviews and Focus Groups*. In: Clifford, N., Cope, M., Gillespie, T. W., & French, S. (Eds.). *Key Methods in Geography*. Los Angeles: Sage.
- Manheim, J. B., Rich, R. C., Willnat, L., & Brians, C. L. (2008). *Empirical political analysis: qualitative and quantitative research methods* (7th ed). New York: Pearson Education Inc.
- Myers, M. D. (2009). *Qualitative Research in Business & Management*. London: Sage Publications.
- Morgan, D. L. (1988). *Focus groups as qualitative research*. Newbury Park, Calif: Sage Publications.

- Njiro, E. I. (2003). *The gender variable in agricultural technology: a case study of rural farmers in Machakos District, eastern Kenya*. African Technology Policy Studies Network, Nairobi, Kenya.
- O'Sullivan, E., Rassel, G. R., & Berner, M. (2008). *Research methods for public administrators* (5th ed). New York: Pearson Education Inc.
- Peterman, A., Behrman, J., and Quinsumbing, A. (2010). *A review of empirical evidence on gender differences in non-land agricultural inputs, technology, and services in developing countries*. Washington D.C. IFPRI.
- Ragasa, C. (2012). *Gender and Institutional Dimensions of Agricultural Technology Adoption: A Review of Literature and Synthesis of 35 Case Studies*. Paper presented at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil.
- Rathgeber, E. M. (2011). *Rural Women's Access to Science and Technology in the Context of Natural Resources Management*. UN Women. Expert Group Meeting. Enabling rural women's economic empowerment: institutions, opportunities and participation. Accra, Ghana. September 20-23.
- Ravenga, A., Shetty, S. (2014). *Empowering women is smart economics*. Finance & Development 49: 1-40.
- Robson, C. (1993). *Real world research: a resource for social scientists and practitioner researchers*. Oxford, Blackwell.
- Smith, J.A., Flowers, P. & Larkin, M. (2009). *Interpretative phenomenological analysis: Theory, research, practice*. London: Sage
- SOFA and Doss, C. (2011). *The role of women in agriculture*. ESA Working Paper No. 11-02, FAO, Rome.
- Stewart, D. W., Shamdasani, P. N., & Rook, D. W. (2007). *Focus groups : Theory and practice* (2nd ed.). Thousand Oaks: SAGE Publications.
- Storey L., 2008. *Doing Interpretative phenomenological analysis*. In.: Lyons, E, & Coyle, A. (2008). *Analysing Qualitative Data in Psychology*. Sage Publications Ltd.
- Taneralli, E., Kostandini, G., Bonabana-Wabbi, J., Murray, A. (2014). *Gender impacts on adoption of new technologies: the case of improved groundnut varieties in Uganda*. African Journal of Agricultural and Resource Economics 9(4): 300-308.
- Tashakkori, A. and Teddlie, C. (2003). *Handbook of mixed methods in social & behavioral research*. London: SAGE Publications.

Thomas, A. (1998). *Challenging Cases*. In Thomas, A., Chataway, J. and Wuyts, M. (eds). Finding out fast: investigative skills for policy and development, Milton Keynes, UK. The Open University, SAGE, pp. 307-396.

Woodhouse, P. (1998) *People as Informants*. In Thomas, A., Chataway, J. and Wuyts, M. (eds) Finding out fast: investigative skills for policy and development, Minton Keynes, UK, The Open University, SAGE, pp. 127-146.

World Bank and IFPRI (2010). *Gender and governance in rural services: Insights from India, Ghana and Ethiopia*. Washington D.C.: IFPRI and World Bank.

World Bank and The Government of Malawi (2007). *Malawi poverty and vulnerability assesment (PVA): Investign in our future. Synthesis report: Main findings and recommendations*. Poverty Reduction and Economic Management 1, Report 36546-MW. Washington D.C.: Wolrd Bank.

Yin, K. R. (1994). *Case Study Research: Design and Methods*. 2nd edn, London, New Delhi. SAGE.

Annexes

Annex 1

Focus groups

Work in focus groups was divided into two parts:

The first part presents a story that motivates the generation of questions related to the potential for technology adoption. In the second part, we work on the results achieved in the first stage, going in depth to identify the factors and attributes of origin, and the priority of each one in adoption and non-adoption.

Depending on the time of day, a brief snack can be served before the second part begins.

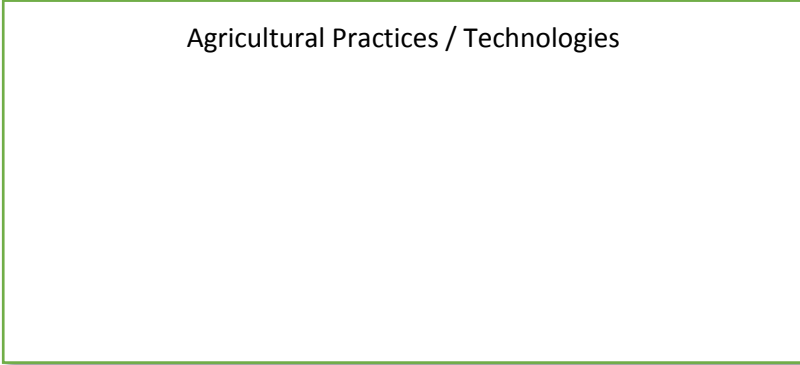
Therefore, the agenda of the focus groups is detailed below:

Activity	Approximate time
Presentation of what will be done and why	5 minutes
Development of the first part (Steps 1-4)	45 minutes
Coffee Break	15 minutes
Development of the second part (Steps 5 – 7)	45 minutes

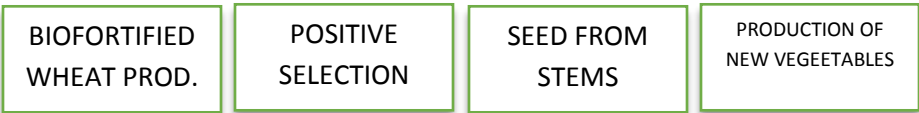
The steps to be followed during the two parts of the work with the focus groups are presented below.

FIRST PART: Understanding the use of technology in general

Before starting, a flip chart with a story and a flipchart with the title "Agricultural Practices / Technologies" are placed in front of the participants:



Before the workshop, cards are also prepared with the names of the practices / technologies that were promoted by IssAndes, or practices/technologies that we know were disseminated in the area, these can be accompanied by a photo on a white card. For example:



Step 1 (story)

The story presented by flipchart D is read:

(example)

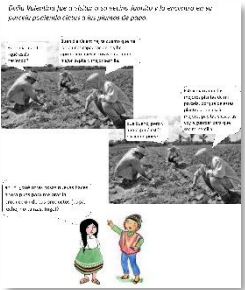
Mrs. Valentina went to visit her neighbor Juanito and found him in her plot putting ribbons on the potato plants.

Valentina: Good morning Juanito. What are you doing?

Juanito: Good morning Valentina. Let me tell you that I have gone to some training and I have learned new things to have a better potatoes and better seed.

Valentina: ...that is good, but now, what are you doing?

Juanito: I am marking the best plants of my plot, because these plants will produce better



	<p>potatoes and I will keep those to be my seed.</p> <p>Valentina:ah! And what other new things do you do now to improve the production of your products (potatoes, milk, vegetables, wheat ... depending on the place)?</p> <p>The characters can change when the focus group is conducted with women, so that the woman is the one who is interested in the practice that is being applied by the man.</p>
<p>Step 2 (general questions)</p>	<p>When the story telling has ended, the following question is asked:</p> <p>What new practices / technologies will Don Juanito apply to improve food production: potatoes, milk, vegetables, wheat?</p> <p>As they respond, the cards with the agricultural practices / technologies mentioned are placed on the flipchart.</p> <p>Cards should be placed in the order in which they are mentioned. This will give an idea of which ones they remember the most and if they coincide with the ones they use the most.</p> <p>Once participants have finished mentioning practices / technologies, the practices that were not mentioned but that we know were promoted in the area are included in the list. After this the following questions are asked:</p> <ul style="list-style-type: none"> ○ Which are the practices used the most, and why? ○ Which practices are not applied but would like to, and why? ○ Regarding practices that were left loose, ask: Why are these practices not applied?

	<p><u>Agricultural practices /technologies</u></p> <table border="1"> <thead> <tr> <th>Technology</th> <th>Crop</th> <th>Why</th> </tr> </thead> <tbody> <tr> <td>PROD. TRIGO BIOFORTIFICADO</td> <td>Wheat</td> <td>Porque a mis hijos les gusta y además puedo vender a buen precio.</td> </tr> <tr> <td>PRODUCCIÓN DE NUEVAS HORTALIZAS</td> <td>Vegetables</td> <td>Porque se me arranca rápido, no puedo guardar mucho tiempo y a veces no voy a vender.</td> </tr> <tr> <td>SEMILLA A PARTIR DE BROTES</td> <td>Potato</td> <td>Porque es fácil y junto con mis vecinas después vendemos la semilla a mejor precio.</td> </tr> </tbody> </table>	Technology	Crop	Why	PROD. TRIGO BIOFORTIFICADO	Wheat	Porque a mis hijos les gusta y además puedo vender a buen precio.	PRODUCCIÓN DE NUEVAS HORTALIZAS	Vegetables	Porque se me arranca rápido, no puedo guardar mucho tiempo y a veces no voy a vender.	SEMILLA A PARTIR DE BROTES	Potato	Porque es fácil y junto con mis vecinas después vendemos la semilla a mejor precio.
Technology	Crop	Why											
PROD. TRIGO BIOFORTIFICADO	Wheat	Porque a mis hijos les gusta y además puedo vender a buen precio.											
PRODUCCIÓN DE NUEVAS HORTALIZAS	Vegetables	Porque se me arranca rápido, no puedo guardar mucho tiempo y a veces no voy a vender.											
SEMILLA A PARTIR DE BROTES	Potato	Porque es fácil y junto con mis vecinas después vendemos la semilla a mejor precio.											
<p>Step 3</p> <p>Understanding the reasons for the adoption or non-adoption of a technology</p>	<p>In this step, the reasons for the answers given are written on the flipchart to get a better understanding of the reasons for adopting or not adopting a technology.</p> <p>The reasons may be related to attributes or factors. The attributes that influence refer to the technology itself (for example: because it is easy to apply, because it is quick to apply, etc.); the factors can be effects of some attributes or reasons that are external to the technology itself (social, cultural, economic factors, etc.), such as not having access to credit, labor, roads to transport their products, etc.</p> <p>Therefore, the objective is to understand in depth if the reason mentioned is a cause of origin or if it is a consequence of another factor, or of an attribute of the technology. That is why a better understanding is sought through asking the question Why?</p> <p>For example, if the reason mentioned was ...</p> <ul style="list-style-type: none"> • “it is hard to apply” • Why is it hard to apply? • “Because we have to pay laborers to hill again” • And how much does labor cost? • “It depends on the time of the year, sometimes it is 80 and some others 120, but labor is hard to find” • ¿But aren’t resources from harvest enough to pay for labor? • No, we produce potatoes for our own consumption not for sale, so it is not enough to pay for labor... additionally production increases when a second hilling is done, but it increases very little. 												

	<p>Through this in-depth dialogue the facilitator can extract the following factors and attributes</p> <ul style="list-style-type: none"> • Access to labor • Effect of technology • Type of crop (commercial, food security) <p>This exercise is repeated for each of the justifications for both the use and non-adoption of a technology.</p>
--	---

Phase 2 (Coffee break)

<p>Step 4</p> <p>Valuation of factors and attributes</p>	<p>From the results obtained in the previous step, attributes of technology and factors that influence adoption are selected separately. To have more clarity, attributes and the factors mentioned are written on a new flip chart.</p> <p>This list is submitted to two ratings.</p> <ol style="list-style-type: none"> 1. Assessment of the factors or attributes that influence the most in the adoption of the technology. 2. Assessment of the factors or attributes that influence the most in the NON-adoption of the technology. <p>The technique of the 100 units, is applied to rank factors and attributes.</p> <p>The technique of the 100 units (100 grains of corn) is used to rank the alternatives. 100 grains are given to the group and they are asked to distribute the grains among the factors or attributes that influence the most so that a technology is adopted. The same is done with the factors or attributes that influence so that a technology is not adopted.</p>
<p>Step 5</p> <p>Factors vs attributes</p>	<p>Comparison of the effect between factors and attributes</p> <p>After the ranking, the implications are verified. This is done by formulating the following statements and promoting an open dialogue.</p> <ul style="list-style-type: none"> • If a technology is 1, 2 and 3 (mention of the attributes that influence adoption) then you would use it, although 1, 2, 3 (mention the factors that influence NON-adoption)? • If a technology is 1, 2 and 3 (mention of the attributes that influence NON-adoption) then you would not use it, although 1, 2, 3 (mention the factors that influence adoption)? <p>This section will enable a better understanding of the comparative priorities between attributes and factors, know if the attributes of the technology or the factors influence more.</p>

Annex 2

Interview with technicians on adoption and dissemination of agricultural technologies

Name..... Sex

Institution..... Country

Region Date

1. Which are the main crops for men and women in your region? List up to 3 in order of importance.

Crops important for men	Crops important for women
1.....	1.....
2.....	2.....
3.....	3.....

2. Which are the technologies / practices most used by men and women for the most important crop in their region of intervention? And why?
3. What technologies / practices were disseminated, but not adopted by men and women? And why?

FILL THE TABLE BELOW WITH THE INFORMATION PROVIDED BY THE INFORMANT.

CROP 1*:

Technologies / practices used	H: Men; M: Women; A: Both	Why are they used?
Technologies / practices NOT used	H: Men; M: Women; A: Both	Why are they NOT used?

*Repeat for all crops and technologies that need to be researched

4. *What do you think are the main reasons that influence the adoption of technologies / practices by men and women? List up to 6 reasons in order of importance. (Example: the sorter is too heavy for women to use, the sorter only serves for round potatoes, not for the elongated ones existing in a certain area, etc.)*

Reasons that influence the adoption of technology by men	Reasons that influence the adoption of technology by women
1.	1.....
2.	2.....
3.	3.....
4.	4.....
5.	5.....
6.	6.....

5. Do you consider that the means through which technology is disseminated influence their subsequent adoption or use by men and women? Why?