DETERMINING POTENTIAL DEMANDERS OF UREA BRIQUETTES IN THE CANTONS OF DAULE AND SANTA LUCIA IN THE ECUADORIAN COAST: EX-ANTE TECHNOLOGY ADOPTION ANALYSIS

By

JORGE J. AVILA S.

A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2012

To Malena Santamaria, Alfredo A. “El Cholo”, Xavier A. and Belen M. son mi vida

ACKNOWLEDGMENTS

Firstly, I thank God for giving me everything. I will always thank my parents, my family and Belen for their constant love. I am sincerely grateful to Dr. Bowen, Dr. Espinel, Dr. Herrera, Dr. Sterns and Dr. Useche for the trust, support and contribution that allowed me to develop this academic research. I would like to thank my great team of enumerators Angie A., Karen R., Robinson M., Victor B., villagers of Daule and Santa Lucia cantons and my friend Samuel whose invaluable help let me obtain the primary data. I have to acknowledge Alfredo A., Belen M and Guido G. for having spent their time on the tabulation of this thesis' primary data. I would like to thank Centro de Investigaciones Rurales of Escuela Superior Politecnica del Litoral, Food and Resource Economics Department of University of Florida, the PL-480 of USDA and the Secretaria Nacional de Educacion Superior, Ciencias, Tecnologias e Innovacion of Ecuadorian government for having funded my master's studies. I also thank Fatima at ESPOL and Jessica at UF for having facilitated my life with all the paperwork. Last but not least, I also thank all my friends, especially Amanda, Belinda, Clay, Imelda, Isnel, Lara, Lee, Natasha and Olga who helped me in different ways during this time of my life.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BM	Briquetting Machine
HA	Hectare
HYVs	High-Yielding Varieties
HR	Hour
IA	Intensity of Adoption
Kg	Kilogram
MT	Metric Ton
N	Nitrogen
PUS	Production Units
USDA	United States Department of Agriculture
UBS	Urea Briquettes
UDP	Urea Deep Placement
WTP	Willingness to Pay with Economic Benefits/Cost
EWTP	Willingness to Pay with Economic Benefits/ Costs and Environmental Impacts

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Master of Science

DETERMINING POTENTIAL DEMANDERS OF UREA BRIQUETTES IN THE CANTONS OF DAULE AND SANTA LUCIA IN THE ECUADORIAN COAST: EX-ANTE TECHNOLOGY ADOPTION ANALYSIS

By

Jorge J. Avila S.

December 2012

Chair: Pilar Useche
Cochair: James Sterns
Major: Food and Resource Economics

In Ecuador, the main fertilizer for rice cultivation, Urea, may be lost as much as 60% when it is applied with Broadcast technique. Urea Deep Placement (UDP), originally utilized in Asia, has been shown to enable rice farmers to reduce such a loss. This thesis is an ex-ante analysis of the potential for UDP adoption in two major rice producing cantons in the Ecuadorian Coast, Daule and Santa Lucia. A survey was implemented to collect information of rice farmers across 35 villages. A descriptive analysis explored variables that may affect adoption decision. For instance, some farmers obtained negative net incomes, implying the need of more efficient innovations like UDP. In the Double-bounded exploratory analysis was detected that 93.25% of the sample farmers were willing to pay extra for Urea briquette sacks with the introduction economic benefits/costs and with the inclusion of economic and environmental impacts. In analyzing the Intensity of Adoption (IA), potential adopters would dedicate a 49.7% of their total land for UDP production, on average. Finally, the two-limit Tobit model of the technology adoption decision (in terms of the IA) suggests that the smaller a farmer, the higher his probability of UDP adoption. However, the subsidy of Urea fertilizer may be

an obstacle for UDP acceptance. Social network was also significant in the model; potential adopters' behaviors may influence a farmer's adoption decision. Other significant variables were small kids in a household, market access, rented land, credit solicitation, agricultural insurance, risk aversion, UDP knowledge and on-farm hours.

CHAPTER 1
INTRODUCTION

According to the Food and Agriculture Organization (2011), rice consumption has increased rapidly in developing countries where rice intake was expected to raise by 461 million tons (3% more than 2010); per capita world rice consumption was 57 kg/year, on average, in 2011 (half a kilogram higher than in 2010). Moreover, around half of the world population has this cereal as a staple food (International Rice Research Institute 2012). In Ecuador, rice is important in term of diet, whose per capita consumption is 112 kg/year. But also, it is the main occupation for 75,813 production units. Additionally, small farmers are ensuring the access to this grain as 80% of rice production units are small, less than 20 ha (Instituto Nacional de Estadística y Censos, Ministerio de Agricultura, Ganaderia, Pesca y Acuacultura and Sistema de Informacion Agraria 2012). However, small farmers are struggling against poverty; official statistics shows that 50.9% of the rural population was poor in 2011(Instituto Nacional de Estadística y Censos 2012). Also, the most important rice producing zones, Guayas and Los Rios, are part of the provinces with the greatest number of poor people in rural zones, around 350000 and 250000 habitants respectively (see Manuel Chiriboga y Brian Wallis 2010).

At national level, rice is also relevant for Ecuador. In 2009, rice production contributed to the Agricultural Growth National Product and the Growth National Product in 11.49% and 0.69% respectively (Instituto Nacional de Estadística y Censos 2011).

The Problem

The most important fertilizer for rice crops is Urea. According to the Instituto Nacional de Preinversion (2011), the total Urea demand is determined in about 500,000

MT in Ecuador; mean Urea importation was 270,000 MT, during 2009-11. Particularly, the 2011 Urea importation was 291,114 MT (in monetary terms, US$146,645,000); comparing the first quarter of 2011 and 2012, urea importation decreased in 14.9% (Sistema de Información Nacional de Agricultura, Ganadería, Acuacultura y Pesca 2012). In 2011, farmers could access Urea sacks (50 kg) at a subsidized price of US$10; having a market price of around US$25. Thus, the government paid the 60% of the price (Banco Central del Ecuador 2011). This is the pressure that Ecuador must face as a non-producer of Urea given the absence of infrastructure to produce this fertilizer[1].

Knowing the actual situation of Ecuador with respect to Urea fertilizer, it is time to define the problem inside the rice sector. As is well known, Urea is the main fertilizer applied on rice crops. Ecuadorian rice farmers principally apply Urea by throwing it on their crops; such technique is called “broadcast fertilization” (Alvoleo, in Ecuador). N. K. Savant and P. J. Stangel (1990) determined that this fertilization technique entails to a loss of Urea up to 60%, which is provoked by NH_3 volatilization, denitrification, leaching, and/or runoff. To observe the magnitude of this problem, let’s first take a look at the fertilized and total rice land over time in Ecuador (see Figure 1-1). One can observe that the majority of rice land has been fertilized over time; 97%, on average. The greatest amount of fertilized land was 416,416 ha in 2004, followed by 413,266 ha in 2009. However, between 2005 and 2006, fertilized land dedicated to rice production dropped 42%; maybe, this reduction was caused by the adverse climatic situation, low prices, etc. Since 2008, both types of lands were recovered.

[1] Instituto Nacional de Preinversion 2011 pointed out that Ecuador has been developing a plan to start the production of urea.

Considering the 2010 fertilized land and assuming that everyone used 200 kg/ha of Urea needed to fertilize the rice crop, according to Achim Dobermann (2012). In total, 80,751.6 MT of Urea could have been used for 403,758 ha. As mentioned above, given the Urea loss of 60%, 29,070.58 MT could have lost because of the inefficient Broadcast application. This value could have represented, on average, a 10.78% of the imported Urea over time (last two years).

A potential solution to this problem is the adoption of Urea Deep Placement, which promises more benefits than costs at different levels. For instance, the farm-level benefits and costs are: Urea saving up to 40%; yield increase up to 25% (per se income increase); reduction of weed-control cost; labor increase (hired and/or family) and; harvest cost augmentation. At national level, the benefits from adopting this technology are: employment creation (production of Urea briquettes, briquetting machines and day laborer requirement by farmers); gender income equity; Urea import decline; reduction of Urea subsidy pressure and; reduction of N in the atmosphere and water resources (International Fertilizer Development Center 2008). These impacts motivate the development of UDP adoption analysis in this thesis.

Research Question

In Ecuador, UDP was also introduced to reduce Urea loss. Some rice farmers and students from Escuela Superior Politecnica del Litoral several UDP trials, during 2009-10. There were reduction on Urea fertilizer cost of up to 44.75%; corroborating the efficiency of this method. Additionally, rice yield ranged was improved, obtaining increases in a range of 8.92% to 56.22% (Escuela Superior Politecnica del Litoral, University of Florida and PL-480 of USDA 2008). These results were diffused through several communication channels: radio, press, television, extension work and agricultural fairs. As a result, there is an interest of responding the following research question:

> What would be the incentives and constraints that may make an Ecuadorian rice famer be willing to adopt the Urea Deep Placement Technology?

Objective

UDP was brought to Ecuador by Escuela Superior Politecnica del Litoral, University of Florida and PL-480 of USDA (2008). As UDP is a new technology going into the rice farmers, there is still a need of research about this innovation. Moreover, a big restraint of this innovation is the production of the Briquetting Machine whose cost is about US$7500 in Ecuador (Orlando D. Contreras and Marcelo Espinosa L. 2010); while, the importation cost was estimated in US$2000. Thus, the objective of this thesis is to:

> Present valuable information about the potential demanders of UDP technology to possible briquette investors in order to create a Briquette Market in Ecuadorian Coast; and finally, provide general information to policymakers for implementation of agricultural policies.

In determining such demand, I could encourage investors to participate in the production of this machine. In order to answer the research question and reach the objective, a questionnaire was designed to estimate a Tobit model through which I establish what factors may affect UDP adoption and perhaps, agricultural innovation in general.

Thesis Structure

Without including the Introduction, this thesis is finally organized as follows: Chapter 2 reviews the agricultural adoption literature in which the main factors affecting adoption decision are described. Chapter 3 presents the results of UDP adoption in

Bangladesh and those experiments' outcomes in Ecuador. Chapter 4 describes important variables of the Ecuadorian rice market. Chapter 5 introduces the sample design, the survey instrument and, the theoretical and empirical model used in this study. Chapter 6 reports a descriptive analysis and the Tobit estimation outcomes with the collected data in Daule and Santa Lucia cantons. Finally, Chapter 7 presents the conclusions and policy implications of this thesis.

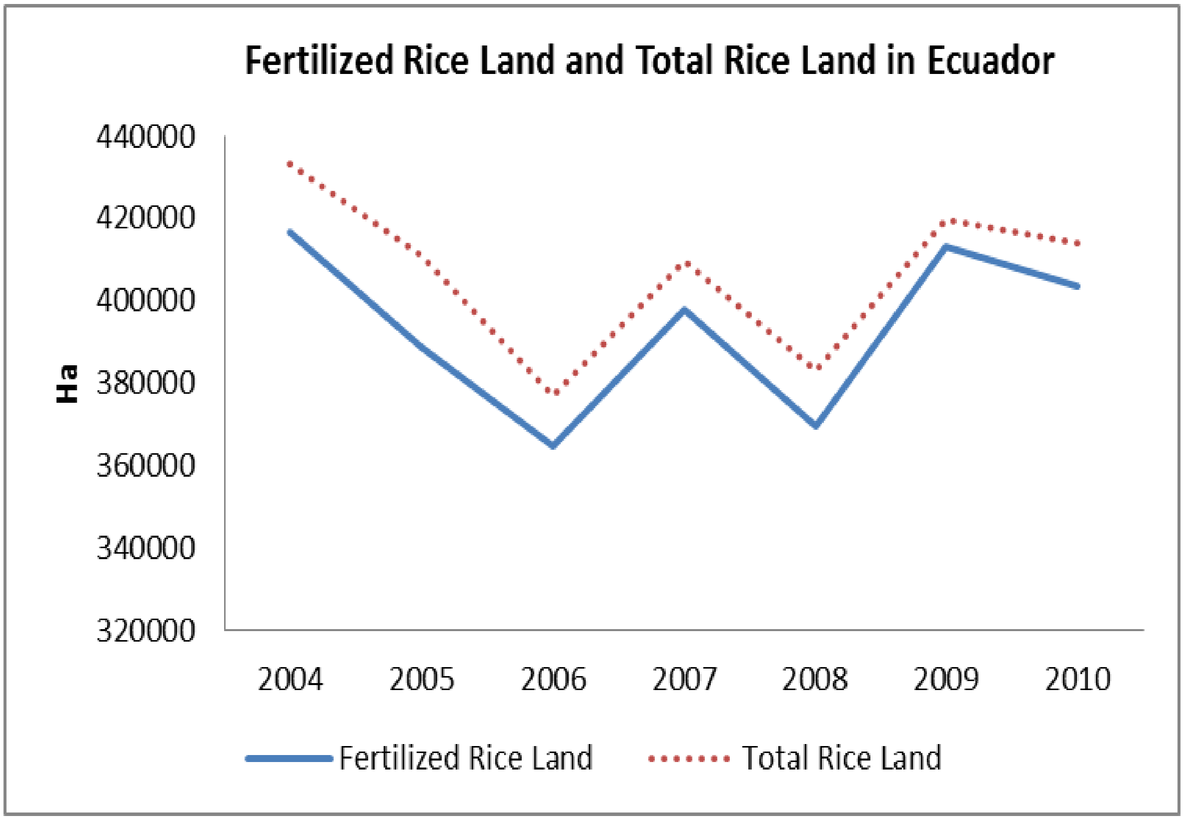

Figure 1-1. Fertilized rice land and total rice land in Ecuador (Source: Ecuador en cifras 2012. http://www.ecuadorencifras.com/cifras-inec/main.html. (accessed June 10, 2012).)

CHAPTER 2
LITERATURE REVIEW

In countries like Ecuador, small farmers are ensuring food access to an entire nation. Contradictory, those farmers are the poorest and commonly suffer famine, with children and young people being the most stricken (Organización de las Naciones Unidas para la Agricultura y la Alimentación, Fondo Internacional de Desarrollo Agrícola and Programa Mundial de Alimentos 2002). Such a problem can be overcome with the productivity improvements in farming, ensuring income and food access. One response to accomplish this objective is the introduction of improved technologies which would allow enhancing farmers' welfare; thus, farmers keep producing staple food, such as rice (Timothy Besley and Anne Case 1993; Cheryl R. Doss 2006). As a result, UDP adoption could represent an important improvement for Ecuadorian agriculture. Indeed, UDP would accomplish those required objectives to ensure food security: food must come from environmental and efficient innovations that take into consideration the biodiversity (see Magdalena Kropiwnicka 2005). Given the aforementioned reasons, the potential determinants and conceptual foundations of the technology adoption are explored in this section.

Technology Adoption Overview

In defining an agricultural innovation or technology, diverse conceptions are found. Mahajan and Perteson (1985) defined any new idea, practice or object implemented in the agriculture as a technology (see Lawrence Loh and N. Venkatraman 1992). Gershon Feder and Dina L. Umali (1993) provided a more complete definition: a technology is referred to a factor which modifies the way how a farmer produces, where uncertainties can be undermined with experiences over time.

All these three definitions are consistent with what UDP represents: a new method/idea/factor going to change rice farmers' production function. Now, a discussion is presented about technologies that were introduced in agriculture in two important periods of times: Green Revolution and Biotechnology Era. These two periods were taken into account because they are breaking points for agriculture development.

Technological changes or innovations have been proven to have a great influence in the economic progress in The Green Revolution. The introduction of such technologies improved the capability of a farmer to produce a certain crop. High Yielding Varieties (HYVs), inorganic fertilizers, other chemical inputs and water control were the most accepted innovations in developed and developing countries, during the 1940s and 1970s. For instance, the widely recognized and named "Father of the Green Revolution", Norman Borlaug, introduced the high-yield wheat to combat starvation worsened by the rapid population growth, first in Mexico and later in Asia. According to the International Food Policy Research Institute (2002), the problem of starvation in industrial countries could be avoided by the adoption of improved plant breeding, fertilizers and pesticides during the half of the 20th century. R. E. Evenson and D. Gollin (2003) carried out a study of the adoption of HYVs over developing countries. They first defined two periods of time, Early and Late Green Revolution, being the difference that in the late one the adoption of improved varieties had a greater positive impact of yield growth across all developing regions (Asia, Latin American, Middle-East North Africa and Sun-Saharan Africa). In the early era, Asia and Latin American nations were the regions that most benefited from HYVs. While in the late era, they found that the rest of the regions reached an improvement of yield when suitable HYVs were introduced.

Haitao Wu et al. (2010) demonstrated that the adoption of HYVs and chemical fertilizers affected the producers' well-being positively (i.e. increasing income and reducing poverty measurement); they also recognized that newest technologies should be adopted to be better off.

Being more specific, HYVs, fertilizers and other chemical inputs were widely adopted by rice producers in Asia and Latin America. For instance, R. W. Herdt and C. Capule (1983) performed an analysis of 11 Asian countries where modern rice varieties were introduced. They estimated the increase of rice production monetary value because of HYVs which was $4.5 billion per year since 1965 to 1980 (only Bangladesh, Burma, China, India, Indonesia, Philippines, Sri Lanka and Thailand were considered in this estimation; where 85% of rice production comes from). Also, they pointed out to fertilizers, irrigation and other factors as other sources that contributed to the improvement of rice production. Dana Dalrymple (1986) also developed a descriptive analysis of the introduction of HYVs in the rice sector of Latin American Countries. HYVs introduction took place in Colombia with the help of the International Center for Tropical Agriculture (CIAT, in Spanish) in 1967. Thus, Latin America was the second region, far behind Asia, in adopting rice HYVs' (not including Brazil due to its big portion rice land), a 70% of the rice area was cultivated with this technology in the season 1981-82, when in 1969-70 was around 3%.

Additionally, the increment of rice production in these regions was more by the improvement of yield per hectare rather than land expansion, demonstrating the efficiency of these HYVs. Rice yield augmented 109% from 1960 to 2000 (see Prabhu Pingali and Terri Raney 2005).

Finally, the introduction of rice HYVs were also encouraged by Institutions specialized in this field such as International Rice Research Institute in Philippines, International Maize and Wheat Improvement Center in Mexico, International Center for Tropical Agriculture, Agricultural Research for Development in Africa, etc.

On the other hand, different researchers had observed that there was still a need of developing innovations in agriculture. As a respond, Biotechnology Era came to replace past technologies in order to continue improving productivity. Biotechnology or Gene Revolution has its start point with the ascertainment of the principle of heredity made by Gregor Mendel, known as the Founder of Genetics. Frederick H. Buttel, Martin Kenney and Jr. Jack Kloppenburg (1985) suggested that this Biotechnology Era would be the replacement of Green Revolution. They also made an important differentiation between the Green Revolution and Biorevolution. In the former, yield was meant to be mainly improved per hectare; meanwhile, the latter promoted the expansion of crops.

According to Matin Qaim (2005), the adoption of biotechnologies may be considered as the most rapid diffused innovation not seen before. He notes that the most popular biotechnology is Genetically Modified Organisms (GMO) in agriculture which is a not irreversible technology. He also mentioned to the herbicide tolerance as the most utilized GM event. Biotechnologies were analyzed for rice production, during the 1990s. For instance, IRRI was researching on a type of rice with characteristics such as resistant to biotic and abiotic stress and, blast and drought tolerant (see J. Bennett 1995). Leonard Gianessi, Sujatha Sankula and Nathan Reigner (2003) simulated the benefits for Greece, Italy, Spain and Portugal (countries representing a 97% of rice production in Europe) from adopting a GM rice variety to alleviate the herbicide-resistant weed problem, as this biotechnology had not been introduced at that moment. For instance, Greece, Spain and Portugal utilizing the glyphosate-resistant rice variety would reduce the cost on weed control by 50%. Moreover, Kym Anderson, Lee A. Jackson and Chantal P. Nielsen (2005) also reproduced the economic gains of adopting GM crops in Asia. Among those GM crops is golden rice which a type of modified rice providing vitamin A. According to them, this GM rice was to better feed to those malnourished in Asian countries rather than productivity enhancement. They found that those unskilled workers would benefit from this biotechnology because the better nourishment would cause a productivity improvement. Meanwhile, Bao-Rong Lu and Allison A. Snow (2005) noted that the glufosinate-resistant rice was the unique event deregulated in United States by that time. However, there was a little acceptance of that biotechnology over rice farms.

Biotechnology on rice production is still an ongoing research. Most of the papers present potential benefit of this biotechnology for rice farmers. Various authors emphasized that the real adoption of biotechnology has not started yet. For example, Ecuador does not allow any type of transgenic crops (Ecuadorian Const. of 2008):

> Art. 401. - Ecuador is declared a free-transgenic-crop-and-seed country. Only in exceptional cases and of National Interest, the President may demand the introduction of this technology, giving proper fundaments which will be approved by the Congress. Risky experimental biotechnologies are strictly prohibited.

Issues of negative externalities of those technologies were also parts of The Green and Gene eras (e.g. adverse environmental impacts, monoculture, soil erosion, labor displacement, biodiversity loss, etc.). Some pointed out that biotechnologies address environmental concerns in some ways that HYVs did not. Yet, uncertainty still exits about full effects on biodiversity. However, those technologies presented a potential in increasing the productivity of staple crops, contributing to combat against famine and poverty in developing countries, mainly. For that reason, the development of research on technology adoption is imperative to better comprehend the impact of those technologies on welfare, biodiversity, and other economic and non-economic development variables.

A quick glance was presented of two important phases in agriculture, Green and Gene Revolution, where a wave of innovations or technological changes arrived to enhance agriculture's efficiency. In the Green revolution, HYVs were analyzed given its great influence on rice yield increase. Meanwhile, herbicide-resistant rice varieties were the most researched biotechnology for rice production in the still Gene Revolution. UDP is a technology that use efficiently an innovation adopted in The Green Revolution, Urea fertilizer (widely used to increase rice yield in the 1970s).

Determinants of Adoption Decision

After having seen some technologies introduced in agriculture, it is time to observe the main factors affecting the decision of whether adopt or not. To maintain an order, these factors are grouped in global topics such as: Adoption Phases; Credit Market, Risk Aversion and Insurance; Household's Characteristics; Farmer's Characteristics; On-farm and Off-farm activities and Non-work Income; Production Factors; and Social Network and Information Sharing.

Adoption Phases

Some researchers have thought of technology adoption divided into phases. P. Kristjanson et al. (2005) examined the entire phases of Improved Dual-Purpose Cowpea adoption in the dry Savannas of Nigeria. They separated such adoption process into 4 phases: 1) Introductory training and demonstration; 2) Farmers' participatory trials; and 2) Farmer-to-farmer seed diffusion. Similarly, David Pannell (2007) proposed 6 stages that an innovation introduction should face: 1) Awareness of the problem or opportunity; 2) Non-trial evaluation; 3) Trial evaluation; 4) Adoption; 5) Review and modification; and 6) Non-adoption or dis-adoption. Keeping in mind these possible phases, one can think of determinants taking place at each phase. But, this subject is beyond the scope of this thesis and I analyze them as a whole.

On the other hand, one can ask who is in charge in developing and fostering the modern technology to be utilized in farming. As this is a national concern, governments through universities or other institutions are first called to the provision of different agricultural knowledge to farmers. Innovations are believed to take place because of incentives and government policies (see David Sunding and David Zilberman 2001). However, it is important the participation of other actors to develop new ideas in agriculture because of the insufficient government resources. To measure the extent of UDP diffusion, special part of the questionnaire was designed to collect information about the spread of UDP knowledge over the rice zones in Guayas Province.

Credit Market, Risk Aversion and Insurance

To start a production, a farmer needs to have access to different resources. Similarly, some technologies could require initial investment and access to credit may be a determinant to adopt an innovation. Given the characteristics of UDP, increase of labor, a farmer would probably be more willing to introduce it in the rice production having possibilities to borrow money.

In Gershon Feder's and Dina L. Umali's (1993) reviews was noted that access to credit market would be affecting the adoption behavior positively. For instance, the introduction of MVs into the production system demands a farmer to buy other inputs such as fertilizers. But, this influence of credit availability is stronger in the early phases of adoption. Similarly, Franklin Simtowe and Manfred Zeller (2007) analyzed the acceptance of hybrid maize in Malawi. They first separated adopters, based on probabilities, in two types: credit constrained and unconstrained. Then, using a Double-Hurdle model, the probability of hybrid maize was estimated. As a result, access to credit significantly and positively determined adoption of this maize, only in the credit-constrained group. According to Rajni Jain, Alka Arora and S.S. Raju (2009), one of the impediments of technological changes adoption found in India is the lack of rural credit due to the low profitability and no-viability of rural finance sector.

Risk aversion is also other variable included to determine adoption. One can think of small farmers who are the most needed of new improved technologies are constrained by scarce resources that make them more risk averse. For instance, Rajni Jain, Alka Arora and S.S. Raju (2009) mentioned that poverty would hinder the adoption decision, making more risk averse to farmers. And, poverty would finally be intensified itself. Conor Keelan et al. (2009) used as risk measure a dummy variable (i.e. 1, if one is willing to grow a crop and 0, otherwise); but this variable was not significant. They also mentioned that solvency ratio was utilized as a risk measurement: the higher the ratio, the more risk averse. Having adopted technologies in the past may explain the willingness to adopt new ones. This fact may also work as a measure of risk aversion or entrepreneurship. Perhaps, depending on the design of the risk adverse variable, a different effect on adoption could be obtained.

Agricultural insurance acquisition can also be considered as a determinant of technology embracing. Crop insurance availability make farmer encourage to adopt improve technologies (see S. S. Raju and Ramesh Chand 2008). María José Castillo (2011) made the same affirmation: counting with an insurance market may give better capacities to a farmer to take risks from innovative changes implementation. She also noted that given the complexities of acquiring an insurance (i.e. risk coverage, high prices, etc.) and low demand of insurance have not let the insurance market develop totally, in Ecuador.

Households' Characteristics

There are several factors that may affect the adoption decision at the farm level. For instance, land tenure, land size, household members, consumption, distance of a farm to main town, etc. Here, I discuss about these variables.

Being a landowner has not been clearly seen as a determinant of adoption choice. D. Joshua Qualls et al. (2012) indicated that literatures related to the effects of land tenure have not presented consistency on describing the real impact on adoption. On the other hand, Gershon Feder and Dina L. Umali (1993) pointed out that tenure is an important determining the adoption speed. However, the affection of land tenure is relied on the type of new technology being introduced (see Conor Keelan et al. 2009).

Farm size is also thought of factor to be included in the adoption model. Madhu Khanna (2001) demonstrated that the farm size had a significant influence on the adoption of variable rate technology (input application through computer-controlled device); one of the reasons of the farm size influence is because of return to scale from fixed costs of equipment, the cost of information acquisition and learning. Correspondingly, D. Joshua Qualls et al. (2012) observed a positive influence of land size on the adoption of switchgrass in United States. Utilizing the intensity of adoption ratio as a dependent variable, they show that an increase of one acre would lead to a farmer to dedicate 0.0019 acres to switchgrass.

Looking at the family size, if a farmer has a high number of members to take care of, the adoption of any technology may be affected negatively, as this farmer must devote his time to their children or even his elderly parents. Jorge Fernandez-Cornejo, Chad Hendricks and Ashok K. Mishra (2005) studied the acceptance of herbicide-resistant soybean in United States. Through a Multivariate Probit Model, they determined a negative impact of number of children in the household on the adoption of this genetically modified crop. Fidelia N. Nnadi and Chidi Nnadi (2009) obtained a negative impact of farm size on maize/cassava intercrop adoption. According to their Logistic Regression, an augment of one member in the household would lead to a reduction of 3% on the probability of adoption. Their implication of this result is large family needs more responsibility to ensure the food access and therefore, there would be less resources to finance the production of maize/cassava production. Finally, Gunnar Breustedt, Jörg Müller-Scheeßel and Uwe Latacz-Lohmann (2008) studying the adoption of GM oilseed rape in Germany, also found that children have negative effect on adoption decision when female farmers are carrying out the production. The problem presented here is that female farmers have to take care of their children, dedicating time to other activities rather than farming activities.

The distance between a household and the marketplace could be a measure of market access. Madhu Khanna (2001) observed that farmers’ willingness to adopt increase in certain states of USA because of the proximity to professional services, which in the end means facility to access the market. Moreover, S. J. Staal et al. (2002)

showed the importance of location (embracing market access, demographics and agro-climate) on technologies improving diary production in Kenya through the utilization of Geographic Information System (GIS) data.

Two common problems faced by rice producers are flood and drought. Maybe, these problems can encourage farmers to find technologies to some extent overcome such natural affectations. Progress H. Nyanga et al. (2011) could observe an insignificant influence of drought and flood perception made by small farmers on the adoption of conservation agriculture. They conclude that there are other major reasons to adopt this new practice.

Farmers' Characteristics

In adopting a new technology, farmers' characteristics can also play an important role. Some of the most common characteristics are education, gender and age that may result in different affections on adoption decision.

In term of education, perhaps a farmer with higher level of education may be more receptive to new ideas or innovations. However, there have been different impacts. Rajni Jain, Alka Arora and S.S. Raju (2009) found that literacy was not a key determinant of adoption in India; States having educated people have a low rate of adoption. They conclude that this low ratio is because those educated young farmers opt to look for other alternatives. Conor Keelan et al. (2009) demonstrated that general education has insignificant effect on the adoption of GM crop. But, looking at the agricultural education, this variable has a great impact on adoption; ideas and the willingness to analyze technological alternatives are sought by those farmers having higher level of agricultural adoption. Instead, Sanzidur Rahman (2008) found that the level of household head education has significance in explaining the acceptance of only diversified cropping systems. His study was carried out to explain the adoption of diversified cropping systems and/or MVs, given the fact that rice monoculture become popular in Bangladesh. Thus, his results, using a Bivariate Probit model to estimate the adoption, showed that one more year of education obtained by the household head may increase the adoption of this diversified cropping system by 3%. Gershon Feder and Dina L. Umali (1993) also mentioned education as those factors affecting the adoption decision in the initial stage of a technology adoption process; in the later phases this factor was no longer significant. Finally, the education level would have different effects depending on the technology being examined because some technologies would be less complex than others.

By history, males have been in a bigger proportion in agriculture. However, female producers, given the needs of welfare improvement, have been integrating in agricultural production. Males and females have different perspectives, objectives and constraints and as a result, innovation adoption may be affected significantly. For instance, Joseph Bwire (2008) highlighted in his study of improved meat goat adoption in Uganda that women represent the highest portion of non-adopters of this technology. He suggests the empowerment of women through education and small business encouragement in order to compete fairly with male producers. Cheryl R. Doss and Michael L. Morris (2000) did not find a significant effect of gender on HYVs and fertilizer adoption in Ghana. However, they asked themselves if gender may affect adoption indirectly. For instance, they show that land ownership is positive related to the adoption of both technology and land is also related to gender; women are less likely to access land. Other fact is that women are not in touch with extension worker frequently;

affecting the transfer of technology. In spite of this gender insignificance, I introduce this variable in the model to really know its effects on UDP case.

Age is also an explanatory variable for adoption selection. For instance, D. Joshua Qualls et al. (2012) cited that because of the long-term benefits return of some technologies, older farmer, with life expectancy shorter than younger farmers', would less likely to adopt those technologies. Conor Keelan et al. (2009) also showed that age has a negative effect on adoption choice even though it is insignificant. Haitao Wu et al. (2010) did not find a significant effect of age on adoption decision.

On-farm and Off-farm Activities and Non-work Income

UDP technology is labor intensive, requiring doubling the workers per hectare with respect to the traditional production system. However, having a large family labor with members involved in rice production would produce better gains adopting UDP. According to Samuel Mora and Paul Herrera (2010), UDP technology would be more accepted in those very small farms where there is family labor available; this family labor use would not really signify an expense, which may make UDP more attractive.

Cheryl R. Doss (2006) noted an important fact about access to labor market. Given a new technology, if a farmer cannot satisfy the labor required with household members, he/she must go to the labor market. And, if this labor market is not available, labor-intensive technologies would not be adopted. This conclusion emphasizes not only the importance of family labor, but also a correct access to the labor market. Gershon Feder and Dina L. Umali (1993) mentioned that the decision of how much land must be allocated with HYVs production is taken simultaneously with the levels of family and hired labor. On the other hand, Gerard E. D'Souza, Douglas Cyphers and Tim T. Phipps (1993) estimated, through a logit model, the probability of sustainable agricultural practices in West Virginia. Among the variables with insignificant effects was labor (defined as 1 if a producer hire worker and 0, otherwise).

Off-farm work must be also considered in the adoption modeling. If a farmer could make a good income with off-farm work, the adoption of a technology may be hampered; he may not have incentives to change their production system while making enough money to subsist. Thus, off-farm work and income would tend to be negatively correlated with the adoption of UDP. For instance, Haluk Gedikoglu and Laura M.J. McCann (2007) found a negative impact of off-work income on the adoption of labor-intensive technologies. Joseph Bwire (2008) referred to ambiguous effect of off-farm work. Off-farm work may reduce the time availability to be dedicated to the production activities of the new technologies. But, the extra income from this off-farm work may work as a resource of capital for the production.

Similarly, government cash transfer to poor people may function as off-farm income. Some farmers are beneficiaries of these transfers in Ecuador. Human Development Bonus is given to those most needed families in order for them to ensure access to basic needs such food and education (Ministerio de Inclusion Economica y Social 2012). Thus, farmers would have more resources to be used in the production system and they might take risks from adopting new technologies given that their basic needs are being satisfied. In contrast, a farmer may be disincentive to improve his production to get a higher income because of these basic needs satisfaction.

Rice Production Factors

The main benefit of UDP is the reduction of Urea applied. Hence, a farmer would liberate resources to other expenses adopting this technology. Moreover, this technology makes rice business have economies of scale; better rice yield by utilizing less Urea fertilizer and spending less on weeding (assuming that labor requirement is satisfied by family labor).

Those having greater production costs may be more likely to adopt this technology. Timothy H. Hannan and John M. McDowell (1984) examined the adoption of automatic teller machines (ATMs) in the banking industry, in United States. They found that ATMs adoption may occur in those zones having a high wage rate paid to the employers because of the cost savings; ATMs are labor-saving. Biotechnologies are also labor-saving, reducing the cost of pesticide/herbicides application. Similarly, technology adoption such as agricultural-precision innovation would be more likely to happen in zones where inputs or labor are scarce which ultimately mean highest total production costs (see S. M. Swinton and J. Lowenberg-deboer 2001).

On the other hand, current yield may negatively explain adoption of a new improved practice. Keeping a perception that current production practices are sufficient to get appropriate yield, a farmer could be less willing to innovate. Truong Thi Ngoc Chi (2008) carried out a study about those factors associated with the adoption decision of three technologies: Integrated Pest Management, row seeding and three reductions, three gains and among others; qualitative data were collected in the rice region of Mekong Delta, Vietnam. In general, education, lack of suitable extension work and perception of yield loss made farmer have a low adoption ratio of these technologies.

Most of the income of Ecuadorian rice farmers comes from on-farm activities. This on-farm income can be treated as measure of the cash availability (see Cheryl R. Doss 2006). Gershon Feder and Dina L. Umali (1993) mentioned in his review that income has been a positive determinant of erosion control practices in some research.

Social Network and Information Sharing

One of the common assumptions among references is the full information in the introduction of an agricultural adoption. This means information about the technology is a public good available to everyone. Also, it is important to study how such information may be spread within farmers; social network and the information sharing would overcome constrained diffusion budget of some Institution promoting this technology. Gershon Feder and Dina L. Umali (1993) defined two types of learning about a certain technology: when a farmer experiment himself the new technology (own learning) and when a farmer could get information from others (learning from others). Also, A. D. Foster and Rosenzweig (1995) demonstrated the importance of social network and the information sharing through the experiment of HYVs; own experience and neighbors' experiences considerably augment the HYVs' profitability. Conley, Timothy G., and Christopher R. Udry (2010) found that farmers care not only their own experiences utilizing the technology, but also other famers' realizations; they employ an optimal input choice model affected by others' choices. Also, Heidi Hogset (2005) highlighted that adoption decision may be affected positively by participating in a social network which can work as a channel of information. In fact, he concluded that the government of Kenya must better comprehend the functionality of social network to successfully diffuse an innovation to farmers. However, Oriana Bandiera and Imran Rasul (2006) revealed behaviors that restrain this social learning; some of the farmers will prefer to just observe to the others' experimentation and then, when the results are visible to decide whether or not adopt. Moreover, they dealt with the endogenous problem of peers' effect (being in a group where my adoption behavior may be influenced by others' conducts and vice versa). Dividing social network of these farmers into three groups:

religious, family and friends/neighbors, they assume that the unique source of endogeneity would come from the latter group as they select friends/neighbors. If this variable is insignificant in a model, one can say that social network effects may be free of this endogeneity when explaining the adoption decision. They found such results in their adoption model (this approach is implemented in the Tobit model in this thesis).

I have discussed about factors that are included in the empirical model of this thesis. There are immense varieties of references with different determinants of adoption choice. But, I limit this analysis to these aforementioned variables.

CHAPTER 3
UREA DEEP PLACEMENT TECHNOLOGY

A summary of UDP experiences in Asian countries, specifically in Bangladesh, is presented in this Chapter. Also, a brief story is given of how UDP was introduced in Ecuador and the results of the experiments carried out by Escuela Superior Politecnica del Litoral, University of Florida and PL-480 of USDA (2008). Keeping in mind that UDP is a technology developed to reduce the loss of the main fertilizer used in rice production, Urea. This chemical fertilizer is composed of nitrogen "N".

Urea Deep Placement Functionality

UDP is a simple technology that has been tested and developed by various organizations. Among these are the International Fertilizer Development Center and International Rice Research Institute. Some of the countries where this technology has been applied are: Afghanistan, Burkina Faso, India, Madagascar, Malawi, Mali, Niger, Nigeria, Rwanda, Senegal and Togo. However, the nation where UDP was most widespread is Bangladesh where the Bangladeshi government introduced UDP to more than 2 million of farms in 2009 (International Fertilizer Development Center 2012). Two aspect of this innovation must be differentiated: a) the production of Urea Briquettes (UBs) through the Briquetting Machine (BM) and; b) the new deep application. In this study, the second aspect is examined as the new technology, taking the first for granted.

Before describing the real method to be adopted by rice farmers, the briquetting process needs to be explained. This process has been used commercially since 1840s. But, it was also related to produce compacted balls or pellets of Urea (or UBs); briquette's weight ranges in 0.8 g. to 2.2 g. (M. S. Lupin et al. 1983; N. K. Savant et al.

1991). N. K. Savant and P. J. Stangel (1990) pointed that the first developers of a level-village BM were the Fujian Academy of Agricultural Sciences and Yongtai Farm Machinery Factory. Then, International Fertilizer Development Center, Metal Industries Development Center and Soil Research modified this machine whose cost was reduced to less than US$1200.

Figure 3-1 shows the briquetting machine which is a straightforward device, but with a great importance. Thus, farmer only has to load BM with conventional Urea (top of the machine) and then, Urea briquettes are made by pressuring. The production per hour depends on the type of machine, but considering one with diesel engine it can prepare 200-250 kg/hr.

In relation to the new Urea application, Figure 3-2 is presented in order to describe this innovation visually. Explaining Figure 3-2, “X” represents a rice seedling; as is seen, there are 6 groups of 4 seedlings. Every seedling is separate 15 cm. from each other in the same group and each group holds a distance of 25 cm to another one. The “o” symbolizes a Urea briquette that must be placed by hand (sometimes feet are used) to a depth of around 5-10 cm. Such briquettes are allocated into the soil right in the middle of the four seedlings and this placement is similar to the transplantation of rice plants. UBs must be placed up to 20 days after transplanting. Finally, a farmer only has to fertilize once during the whole rice season.

The reason to follow UDP technique is to avoid the loss of Urea. When Urea is applied as in its traditional manner (broadcast/spreading), fertilizer may only be seized in a 40% by rice plants because a 60% may be lost through leaching, volatilization, denitrification and/or runoff (N. K. Savant and P. J. Stangel 1990). In applying placed-deep briquettes, Urea would not be exposed to such losses and rice plants can catch more of N which is now released slowly. In the end, the benefits of UDP are: Urea saving (not exposed to common losses), yield increase (N is better caught by plants) and per se better income, and positive environment impact (N is part of gasses contributing to the global warming and affects Aquatic resources through runoff). On the other hand, UDP is labor extensive given the way of how to apply Urea fertilizer. Additionally, International Fertilizer Development Center (2008) reported that costs of harvest and post-harvest are increased as well, but weeding control cost is reduced, instead. At national level, benefits are: reduction on Urea subsidy and importation, job creation and food security.

Bangladeshi Experiences

As said before, UDP has been widely adopted in Asia principally. Bangladesh is a representative example with more than 1 million of hectares dedicated to this innovative fertilization method (International Fertilizer Development Center 2012). In order to document the results of UDP, I base this discussion on two fundamental studies: 1) International Fertilizer Development Center. 2008. "Expansion of Urea Deep Placement Technology in 80 Upazilas of Bangladesh during Boro 2008: An Assessment of Project Impact." and; 2) Thompson, Thomas P., and Joaquin Sanabria. 2009. The Division of Labor and Agricultural Innovation in Bangladesh: Dimensions of Gender. Muscle Shoals: International Center for Soil Fertility and Agricultural Development. These two investigations were developed in Bangladesh during the period of time known as Boro (rice cultivation season from December to February), 2007-08. Moreover, a total of 3,230 UDP production units (or households) were considered for this analysis. In this part, a discussion is given about the most important benefits/costs of UDP found in

Bangladesh. Such impacts are: Urea saving, income increase, labor impact, and subsidy and import reduction.

In 2008, there were 384,550 farmers that adopted UDP across Bangladesh. From this number was taken the sample farmers (3,230) whose mean number of hectares dedicated to UDP was 0.26 ha[1]. Meanwhile, traditional paddy production land was 0.54 ha, on average; meaning that traditional hectares were the double of UDP's. In conclusion, this result shows that most of the adopters were small farmers.

Also, there was a reduction on the applied Urea of around 36% when applying UBs. On average, 170 kg/ha of Urea was applied in UDP lands. Meanwhile, Urea use in conventional paddy hectares was 267.2 kg/ha, on average. In terms of costs, this reduction signified a 25.3% of saving. A significant reduction experimented by the 97.3% of the interviewed farmers. Other objective of UDP was to improve rice yield and income per se. On average, an augmentation of UDP rice yield per hectare of 17.3% let farmers make a 60% of net income per hectare contrasting to conventional Urea application. In absolute numbers, the mean UDP rice yield was 7,646kg/ha and non-UDP yield was 6,520 kg/ha; the incomes were US$694.56 (UDP) and US$433.62 (non-UDP). Finally, the cost-benefit ratio was for UDP 1.53 and for conventional Urea application 1.33, meaning that per each dollar invested in rice production a farmer got US$1.53 in UDP and US$1.33 for conventional fertilization. These yield and income increases were reported by the 95.5% and 51.9% of the farmers, respectively. In terms of subsidy, Bangladeshi government could save US$6 million given the reduction of 14,000 Urea tons (or 93 kg/ha). Meanwhile, Urea importations were also diminished,

[1] A total of around 280,000 ha dedicated to UDP.

totalizing US$7 million of saving (adapted from International Fertilizer Development Center. 2008. "Expansion of Urea Deep Placement Technology in 80 Upazilas of Bangladesh during Boro 2008: An Assessment of Project Impact.").

Bangladeshi labor market was also impacted by UDP adoption. According to Thomas P. Thompson and Joaquin Sanabria (2009), hired labor decreased in an absolute value of 8.6 days/ha, on average. They noted that UDP extra labor requirement was supplied by household labor whose increase was 19 days/has. Eventually, the authors concluded that UDP should not influence positively the hired labor cost because household members will cover that demand; of course, this would depend on the household structure in each adopting region. One can think of two facts of UDP adoption: 1) remaining household time that could be dedicated to UDP; and 2) these farmers were small ones (average UDP land size was 0.26 ha). Perhaps, these two points should be taken into account for other countries to introduce UPD. On the other hand, other costs were also affected by UDP. For instance, hired labor costs for weed control were reduced in 11.3% (weed did not grow because roots did not receive enough Urea because of deep placement and due to UDP plants sooner growth, weed cannot receive sunlight to develop itself) and post-harvest labor, which is an activity done by women, rose in 20-50 days/ha (yield was improved with UDP). At national level, new employments were very significant in Bangladesh. There were a total of 1.43 million of direct agricultural jobs created in 2008. However, this number did not contain those working on briquetting process (production of UBs and BM). An important consequence of UDP is the wage equality improvement between men and women; only a 3.62% of women received a lower wage than men. This fact is related to the increase of post-harvest demand (a women's activity) due to the enhancement of yield (adapted from Thompson, Thomas P., and Joaquin Sanabria. 2009. The Division of Labor and Agricultural Innovation in Bangladesh: Dimensions of Gender. Muscle Shoals: International Center for Soil Fertility and Agricultural Development).

Putting benefits and costs in a scale, one can clearly see the huge positive impact produced in Bangladesh after UDP adoption. Trials of UDP were also performed in Ecuador. A brief summary of the results of these trials are presented in the following part.

Ecuadorian Experiences

In order to improve agricultural efficiency in Ecuador, UDP was brought through the project "Implementation of a Program for Improvement of Rice Small Farmers' Income in the Ecuadorian Coast: Urea Deep Placement and Microcredit (Escuela Superior Politecnica del Litoral, University of Florida, and USDA-PL-480. 2008. "Implementación de un Programa para Mejoramiento Del Ingreso de Pequeños Productores de Arroz en el Litoral Ecuatoriano: Aplicación Profunda de Briquetas de Urea y Microcrédito.")". Eventually, the introduction of UDP started with a study called "Agro-Socio Economic and Ecologic Conditions of Diverse Rice Production Systems of Small Farmers in Guayas and Los Rios, Ecuador (Hildebrand, P. E., L. Andrade, W. Bowen, R. Espinel, P. Herrera, P. Jaramillo, I. Medina, S. Mora, A. Santos, C. Toledo, et al. 2008. "Condiciones Agro-Socio Económicas y Ecológicas de los Diversos Sistemas de Producción de Arroz de Pequeños Productores en Guayas y Los Ríos, Ecuador.")". The main objective of study was to observe the feasibility of this innovation in Ecuadorian rice zones. Subsequently, UDP promotion took place through extension work and experiments[2]; its final production will be two master's theses (the present thesis is one of them). In this part, I describe the work done since 2009.

Starting with the first study mentioned above, a technique known as "Sondeo" was implemented. "Sondeo" is a survey instrument consisting of visits to farmers in order to collect relevant information through, more than interview, an informal conversation without a determined list of topics to be discussed. The idea behind this method is that farmers feel more comfortable and relax and without a frame of questions, the quality and the quantity of information are improved. As mentioned earlier, the main goal of this study was to better understand the livelihood system of Ecuadorian rice farmers in Guayas and Los Rios Provinces mainly[3]. The following is a summary of the most important findings of this study (adapted from Hildebrand, P. E., L. Andrade, W. Bowen, R. Espinel, P. Herrera, P. Jaramillo, I. Medina, S. Mora, A. Santos, C. Toledo, et al. 2008. "Condiciones Agro-Socio Económicas y Ecológicas de los Diversos Sistemas de Producción de Arroz de Pequeños Productores en Guayas y Los Ríos, Ecuador."):

- Farmers are very organized in term of rice production but not in commercialization.
- There are diverse types of rice production systems; some farmers differ in their rice practices even in the same Cooperative or sector.
- Urea price growth resulted to a great incentive for UDP adoption.
- The majority of farmers only have elementary education
- Despite the risk aversion level, farmers showed interest for innovations.

With a better understanding of the farmers' production systems through the aforementioned study, the following phases were organized to effectively introduce UDP

[2] Some experiments were conducted by students of Escuela Superior Politecnica del Litoral: J. Aguiar, D. Aguirre, L. Barzola, O. Calle, J. Mayorga, R. Romero, C. Saenz and T. Villalva.

[3] A total of 39 visits were set in 18 villages of Guayas and Los Rios.

in Ecuador. A basic replication of BM was made while the original machine was being imported from Bangladesh (see Figure 3-3). This let controlled and uncontrolled UDP experiments be developed[4]. In general information is provided below (adapted from Escuela Superior Politecnica del Litoral, University of Florida, and USDA-PL-480. 2008. "Implementación de un Programa para Mejoramiento Del Ingreso de Pequeños Productores de Arroz en el Litoral Ecuatoriano: Aplicación Profunda de Briquetas de Urea y Microcrédito."):

- There were 5 controlled experiments were analyzed. The land size used in such experiments ranged between 0.01-0.41 ha.
- There were 11 uncontrolled experiments with farmers who were willing to try UDP. Their areas were between 0.18-0.52 ha.
- UDP project gave incentives in order to make farmers try UDP fertilization: 50% of the Urea fertilization cost of a land size of 0.17 ha would be covered by the project.

The results of such experiments are now listed as follows (see Table 3-1):

- The mean amount of Urea applied was 154.99 kg/ha for UDP land and 222.31 kg/ha for broadcast land; meaning a reduction of 30.28% of Urea used in a hectare.
- In almost all of the experiments, UDP yield (Kg/ha) were superior to the broadcast yield. For instance, the best UDP yield of 10,017.43 kg/ha exceeds the conventional production yield in 2,636.17 kg/ha. However, there were 3 farmers with UDP yield inferior to broadcasts'; the lowest UDP yield was 3,197.80 kg/ha, 2,070.81 kg/ha less than the broadcast yield.
- There were UDP yields superior to broadcast yields even with a lower amount of Urea applied in a hectare. For instance, the best UDP yield used 170 kg/ha of Urea less than the traditional fertilization. This explains the inefficiency of this broadcast Urea application.
- On average, a farmer could make US$1487.92/ha of net income when producing with UDP. In broadcast fertilization, the mean net income was US$1222.03/ha. In this sense, rice net income was increased by 21.75%, on average. The average

[4] Controlled experiments (C.E.) are referred when students worked themselves with UDP production. Uncontrolled experiments (U.E.) are for those students who based their analysis on results of farmers experimenting with UDP production.

cost of UDP was almost equal to broadcast cost, US$1149.81/ha and US$1149.76/ha, respectively.

- Finally, BM replication could produce UBs with different weights. Meanwhile the imported BM only created 2.7 g; the best yield was obtained with 2.7 g.

These are those very encouraging results of UDP experimentation. In addition to these experiments, there were various ways that UDP was promoted in Ecuador. For instance, UDP was in two agricultural fairs: “La LXIV Feria Ganadera del Litoral and “La Feria Agricola de Babahoyo”. Regarding to the first fair, it is the most important one happening every year in Guayas Province. Moreover, several meetings were set in different rice agricultural associations in Guayas mainly. One of the most representative meetings occurred in Higueron Irrigation Board where around 150 farmers were present for UDP hearing. Finally, UDP was also fostered through television, radio, printing press and internet.

At this moment, the biggest constraint of this technology in Ecuador is the elaboration of the BM which is very costly given that Ecuador is not a steel producer. A thesis carried by Orlando D. Contreras and Marcelo Espinosa L. (2010) showed that an investment of US$7947.45 is needed to produce a BM having the characteristics of the imported one whose final cost was around US$2000.

Figure 3-1. Briquetting machine and Urea briquettes (Sources: Internet)

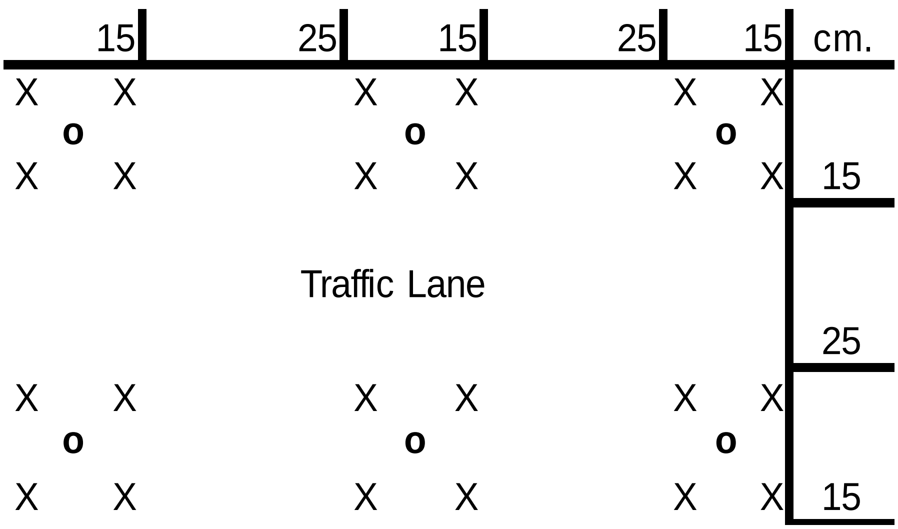

Figure 3-2. Urea briquettes placement (Sources: Author)

Figure 3-3. Replication of briquetting machine and imported briquetting machine (Sources: Escuela Superior Politecnica del Litoral, University of Florida, and USDA-PL-480. 2008. "Implementación de un Programa para Mejoramiento Del Ingreso de Pequeños Productores de Arroz en el Litoral Ecuatoriano: Aplicación Profunda de Briquetas de Urea y Microcrédito.")

Table 3-1. Results of UDP experiments in Ecuador

Type of Experiment	Ha	UBs' weight (gr)	UDP Urea (kg /ha)	Broadcast Urea (kg/ha)	UDP yield (kg /ha)
C. E	0.41	4.33	214.50	260.00	8386.45
C. E	0.01	3.60	80.00	120.00	6221.21
C. E	0.01	3.60	80.20	120.00	7146.94
C. E	0.15	3.60	80.20	120.00	7397.07
C. E	0.01	2.70	120.00	120.00	3197.80
U. E.	0.23	2.70	180.00	250.00	7552.36
U. E.	0.52	2.70	180.00	350.00	6281.23
U. E.	0.11	2.70	180.00	200.00	10544.66
U. E.	0.18	2.70	180.00	300.00	10017.43
U. E.	0.18	2.70	180.00	250.00	5272.33
U. E.	0.18	2.70	180.00	200.00	10170.86
U. E.	0.18	2.70	180.00	250.00	9298.64
U. E.	0.18	2.70	180.00	350.00	9879.81
U. E.	0.13	2.70	-	-	5128.65
U. E.	0.13	2.70	-	-	4485.15
U. E.	0.13	2.70	-	-	4434.30
Mean	0.17	2.97	154.99	222.31	7213.43

Type of Experiments	Broadcast Yield (kg/ha)	UDP total costs (US$/ha)	Broadcast total cost (US$/ha)	UDP Income (US$/ha)	Broadcast Income (US$/ha)
C. E	7728.10	969.49	974.77	2525.45	2326.99
C. E	6810.44	-	-	-	-
C. E	6613.20	1193.25	1170.76	3012.91	2588.77
C. E	6840.08	1219.36	1053.48	3088.96	2206.40
C. E	5268.61	558.50	558.51	790.97	1303.18
U. E.	6934.00	1085.05	1128.42	2274.16	2087.96
U. E.	4020.73	1050.87	1050.10	1891.40	1210.72
U. E.	8582.65	1128.50	1135.75	3175.20	2584.40
U. E.	7381.26	1151.32	1140.45	3016.44	2222.64
U. E.	5281.63	1023.75	1084.00	1587.60	1590.40
U. E.	10080.66	1120.37	1129.87	3062.64	3035.48
U. E.	8585.44	1022.37	1067.37	2800.00	2585.24
U. E.	9824.02	1022.37	1137.87	2975.00	2958.20
U. E.	4578.75	1575.57	1534.93	3419.00	3052.40
U. E.	4422.60	1565.15	1529.36	2990.00	2948.40
U. E.	4313.25	1561.18	1550.69	2956.20	2875.60
Mean	6704.09	1149.81	1149.76	2637.73	2371.79

Source: Escuela Superior Politecnica del Litoral, University of Florida, and USDA-PL-480. 2008. "Implementación de un Programa para Mejoramiento Del Ingreso de Pequeños Productores de Arroz en el Litoral Ecuatoriano: Aplicación Profunda de Briquetas de Urea y Microcrédito."

CHAPTER 4
ECUADORIAN RICE MARKET AT A GLANCE

An examination of Ecuadorian official data of rice market is carried out in this section. In doing so, data from this thesis can be compared with the national statistics. The analysis is focused on the main producing zones, farm size, production costs, rice production over time, exports and imports, international rice partners, and credit and labor markets. It is important to clarify that III Agricultural Census of 2000 is the last national census; the sample was 162.818 production units (PUs) in total (Sistema de Información Nacional de Agricultura, Ganadería, Acuacultura y Pesca. 2012). However, there exists the Continuous Survey of Agricultural Land and Production, which has been carried out every year after the 2000 Census to permanently monitor Ecuadorian agriculture; its sample consists of 6,000 PUs in general.

In Ecuador, the main rice zones have always been placed in two provinces, Guayas and Los Rios. These provinces represent the 94% of the rice cropland in 2010, according to the Instituto Nacional de Estadística y Censos (2012). However, there are more provinces producing rice:

- Provinces in Coast region: Esmeraldas, Guayas, El Oro, Los Rios, Manabi and Santa Elena
- Provinces in Sierra or Andean: Bolivar, Cañar, Cotopaxi, Loja and Pichincha.
- Provinces in Middle-Southeast and Northeast (Amazon region): Napo, Orellana, Sucumbios, and among others.

In terms of yield, the best provinces of those mentioned above are: Cañar (4.56 MT/ha), Los Rios (4.64 MT/ha), Guayas (4.25 MT/ha) and El Oro (4.15 MT/ha); the lowest yield was seen in Middle-Southeast, 0.89 MT/ha. At national level, rice yield is 4.34 MT/ha in 2010, while Colombia and Peru (bordering countries) have 5.19 and 7.5 MT/ha respectively; United States presents 8 MT/ha approximately (Food and Agriculture Organization 2012).

Farm size is analyzed but only for single-crop rice PUs in Ecuador. The 2000 Census data are considered for this analysis. Figure 4-1 shows the number of RPUs and hectares categorized into farm size groups. Almost all rice PUs (15,165) hold a farm size between 5 ha and 10 ha (>=5 ha/<10 ha). The smallest (<1 ha) and largest farm (>=200ha) groups contain 6,797 and 498 rice PUs respectively. According to the Ministry of Agriculture (MAGAP), farms with less than 20 ha are acknowledged as small ones (Sistema de Información Nacional de Agricultura, Ganadería, Acuacultura y Pesca 2012). Thus, around 80% of the rice PUs are falling below this threshold.

In looking at the total rice hectares, group of >=20ha/>50ha presents the biggest amount, 63107 ha. Meanwhile, the smallest and largest farm size groups possess 3,473 ha and 43,872 ha respectively. In combining these RPUs and hectares, on one hand, the 80.52% of rice PUs holds 49.68% of the rice hectares approximately and on the other hand, a 19.48% of rice PUs owns a 50.32% of rice hectares. This disparity of land holding is one of current hotspot issues being discussed in agriculture at this moment in Ecuador. As a result, Ecuadorian government developed the “Land Plan (Plan Tierras)” in order to distribute the land that is not fulfilling the environmental and social condition (not including small farms’ land)[1].

Also, average rice production costs are described; costs of 2011. In Table 4-1, one can see three types of mean per-hectare production costs: traditional, semi-technified

[1] See Ministerio de Agricultura, Ganaderia, Acuacultura and Pesca 2012

and technified[2]. Thus, traditional production has its main direct cost per hectare on labor (soil cleaning, sowing and fertilizer/herbicide/insecticide application); US$518/ha or 59% of total cost. Another import cost is related to the expenses on fertilizers (the main is Urea), US$75.50/ha (9%). While, in the indirect costs administration and technical assistance, financial cost and rent cost add up to US$144.48/ha. Hence, a person would go to invest on this rice production US$875.97/ha in a season. Meanwhile, the semi-technified production demands more use of machine/equipment/material; such cost represents the 48% of the total cost (direct and indirect). Fertilizer cost is also significant for a semi-technified farmer, 13% (US$151/ha). Here, indirect costs are equal to US$185.39/ha. Consequently, a farmer with this specific production is making an investment of US$1124.03/ha. Finally, technified rice cultivation also shows its strongest expense on machine/equipment/material, US$517.25ha (38% of total cost). The second relevant expense is the Labor with US$252/ha (19%), followed by fertilizers' items with US$217/ha (16%). A farmer dedicates US$221.58/ha to indirect costs. Total investment in this production is up to US$1343.52/ha. To sum up, labor cost decrease for semi-technified and technified productions because of the machine/equipment/material increase. Seed costs are the same for three types, fertilizer costs increase importantly and Phytosanitary cost is not so different between semi-technified and technified but with respect to traditional, this cost increases in around US$57/ha, on average. In conclusion, if a traditional farmer wants to change to semi-technified, his cost would

[2] The degree of technification is related to the new processes being introduced to improve production (e.g. type of irrigation systems, machines, control of herbicides, and among others). Such degree makes traditional, semi-technified and technified be different between each other.

increase in absolute term around US$248/ha (or 22% more); and from semi-technified to technified the cost augment would be US$219/ha (or 16% more).

Rice yield, rice harvested land and rice production are examined over time (2000-10). In Figure 4-2 is seen that rice harvested lands look relatively constant over the ten years in analysis (blue line). In 2003, these lands was the lowest number put into rice production, 332,837 has. However, this number peaked up to 433,377 has in the next year. Since then, rice hectares have not changed dramatically over time. With reference to the rice production (MT), it presents a volatile behavior compared to the harvested land. During 2000-03, rice production was constant. Afterward, there is a drastic change in 2004, when the rice production soared to 1,778,380 MT. According to the Instituto Nacional de Estadística y Censos (2011), the latter fact was because of external influences such as Proclamation of the Rice Year and FAO's perspective of global growth for 2005. Regarding to the yield (MT/ha), it exhibits an invariable trend during 2000-03. As harvested land and production, yield also raised in 2004. The best yield was of 4.36 MT/ha, in 2007; and the worse was 2.73 MT/ha, in 2003.

In Table 4-2 is showed a ranking of rice yield (MT/ha) of different countries, during 2000-10. Egypt was selected as the best rice yielding country, having 10.62 MT/ha on average, over time. It demonstrates a stable yield range of 10.03 MT/ha (2000) to 11.11MT/ha (2011). Australia was the second in this ranking, showing a mean yield of 9.58MT/ha during this period; its worse yield was 7.29 MT/ha, in 2005 and its best is 11.95 MT/ha, in 2010. The third country was USA with 8.36 MT/ha on average, over time. It shows its lowest and highest yields of 7.76 MT/ha (2000) and 8.92 MT/ha (2007), respectively. Focusing on two neighbors, Colombia (24 place) and Peru (7 place), they show an average yields of 6.39 MT/ha and 7.74 MT/ha, respectively. Ecuador is placed in the 49 position of this ranking with 4.42 MT/ha. In conclusion, Ecuador presents a big gap between bordering countries and other countries in term of rice yield, requiring improving production through new technology such as UDP.

A brief analysis of Ecuadorian rice production in the international market is presented, looking at the importations, exportations, competing countries and main commercial partners in the world. Figure 4-3 shows that Ecuador has unstable exports over time (blue line). During 2002-03, the exports held constant; right after, they plummeted to the lowest level, US$566,160. Exports recovered their rising trend during 2005-07, having their maximum of US$62,014,430 in 2006. However, they again sank to low levels in 2008-09. On the other hand, imports have a steady climbing trend over these years; the highest values is found in 2009, US$167,860. Though volatile exports and constant increasing imports, Ecuador presents a positive balance of rice trade (NX) over time; meaning that Ecuador is, in the end, a rice seller. For instance, the best NX was of US$61,942,440 in 2006.

In Table 4-3 is observed the types of rice and commercial partners with which Ecuador participates internationally. Ecuador has mainly 6 countries to import and/or export rice production: Chile, Colombia, France, Italy, Spain and USA. For instance, the main rice buyers of Ecuadorian broken, white or semi-white and huller rice production are Italy (96.59%), Colombia (99.76%) and Chile (81.51%), respectively. On the other hand, Ecuador only imported white or semi-white rice primarily from USA, 86.75%. Recently, there was a reduction on rice exports to Colombia because of a prohibition to stabilize the internal price and also, Ecuador and Colombia broke up commercial relationship due to a military issue. However, that portion (FOB: US$8,170,930) was taken by Venezuela that signed up agricultural agreements with Ecuador. Maybe, Ecuador may lose Colombian rice market participation given the Free Trade Agreement between this country and United States (USA has a rice yield of 8.31 MT/ha, around 4 MT/ha more than Ecuador). Then, new proposals must appear to be better rice competitors in the international market; UDP might improve that competitiveness.

Focusing on the credit market, there are some credit programs being given to farmers currently[3]. Such programs are: Credito 5-5-5 (up to US$5000, 5 years, 5%, and no collateral), Credito de Desarrollo Humano (up to US$420, 1 year, 5% and no collateral) and microcredits (up to US$20,000, 5 years, 11% and collateral). As is observed in Figure 4-4, loans acquired by rice farmers have an increasing tendency over time. For instance, a drastic growth of 155.45% was observed in 2001. However, this curve presented negative variations in 2002 (-6.78%), 2003 (-5.45%) and 2006 (-11.90%). While, credits dramatically increased in 100.85%, in 2008. Finally, BNF started lending money at a level of US$2,580,032.00 in 2000 and ended up at US$22,513,164.00 in 2009. To sum up, it seems that farmers are able to access credits, especially to those credit programs fostered by Ecuadorian government. In relation to rice cropland insurance, Ecuadorian government through MAGAP and the “Unidad de Seguros Agricolas” is offering insurance to mainly four crops: rice, corn, potato and wheat. Also, disasters to be covered by this insurance are: drought, flood, cold season, humidity excess, fire, uncontrolled plagues and diseases, hailstorm and hurricane winds. Insurances are subsidized in 60% by the government; around 1,939.78 hectares

[3] See Banco Nacional de Fomento 2012.

have been assured in provinces such as Guayas, Los Ríos, Manabí, Bolívar, Canar and Loja so far; totalizing US$1,918,857.94.

In describing the labor market in the rice sector, the Central Bank provides an updated description of last rice production season. Rice producers hire day laborer for activities like sowing, fertilizer/herbicide/insecticide application and harvest. Thus, a day laborer may cost, on average, around US$9 when the employer affords food; otherwise, the day laborer cost is US$10. Additionally, Daule and Santa Lucia presented a low cost of hiring day laborer, US$7 (employer does not pay food). However, there rice producers also paid US$15 per day laborer without food (Banco Centra del Ecuador 2011). The III Agriculture Census of 2000 shows that in general there were 493,003 hired day laborers shared out by 127,834 production units; around 3 laborers a production unit. In conclusion, having observed the lowest laborer cost in the analyzed cantons may indicate good labor market access; many people participating makes prices go down.

To sum up, Guayas, where this study took place, is an important producing province. Also, official data demonstrated that small farmers are the majority in the rice sector, around 80%. But, they are holding not more than 50% of the land for rice. Similarly, this study surveyed very small farmers. On the other hand, mean cost a hectare changes importantly from type of production. For those traditional producers, UDP could significantly reduce their costs given that they mostly base their production on the use of fertilizer (knowing that Urea is the main). In order to be a competitive rice producer internationally, Ecuador needs to improve its rice yield. Countries like Colombia and Peru exceed Ecuadorian yield in 2 and 3 TM/ha. In terms of credit and labor, rice farmers have good access to these markets. Given UDP characteristics, national statistics presents a scenario where UDP may occur with high probabilities. However, this adoption would be analyzed in the empirical examination.

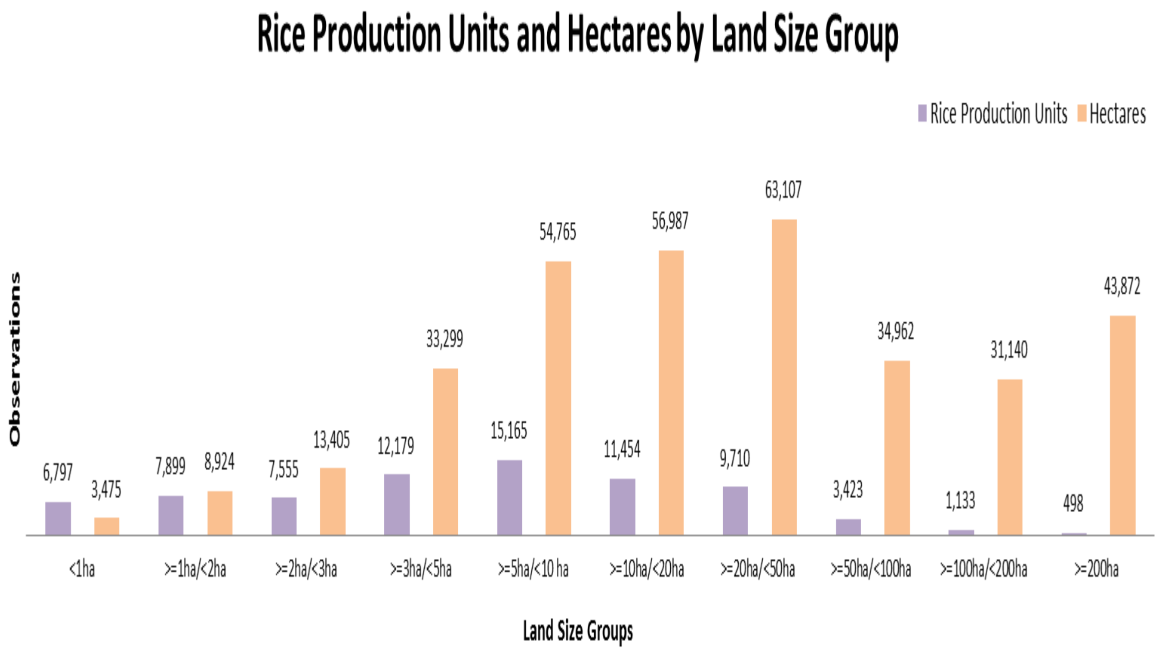

Figure 4-1. Rice production units and hectares by land size groups (Source: Instituto Nacional de Estadistica y Census, Ministerio de Agricultura y Ganaderia and Sistema de Informacion Agropecuaria 2012)

Table 4-1. Rice production costs in 2011 (US$/ha)

			US$/ha	
		Traditional	Semi-technified	Technified
Direct costs	Labor	518.00	120.00	252.00
	Seed	47.00	47.00	47.00
	Fertilizers	75.50	151.00	217.00
	Phytosanitary	30.00	86.65	88.69
	Machine/equipment/materials	61.00	534.00	517.25
Total Direct Costs (US$/ha)		731.50	938.65	1121.94
Indirect Costs	Technical assistance and administration (10% direct costs)	73.15	93.87	112.19
	Financial costs (yearly interest rate 9.50%/6 months)	34.75	44.59	53.29
	Rent costs (5% of total costs)	36.58	46.93	56.10
Total Indirect Costs (US$/ha)		144.47	185.38	221.58
Total Cost (US$/ha)		875.97	1124.03	1343.52

Source: Instituto Nacional de Estadística y Censos (2011).

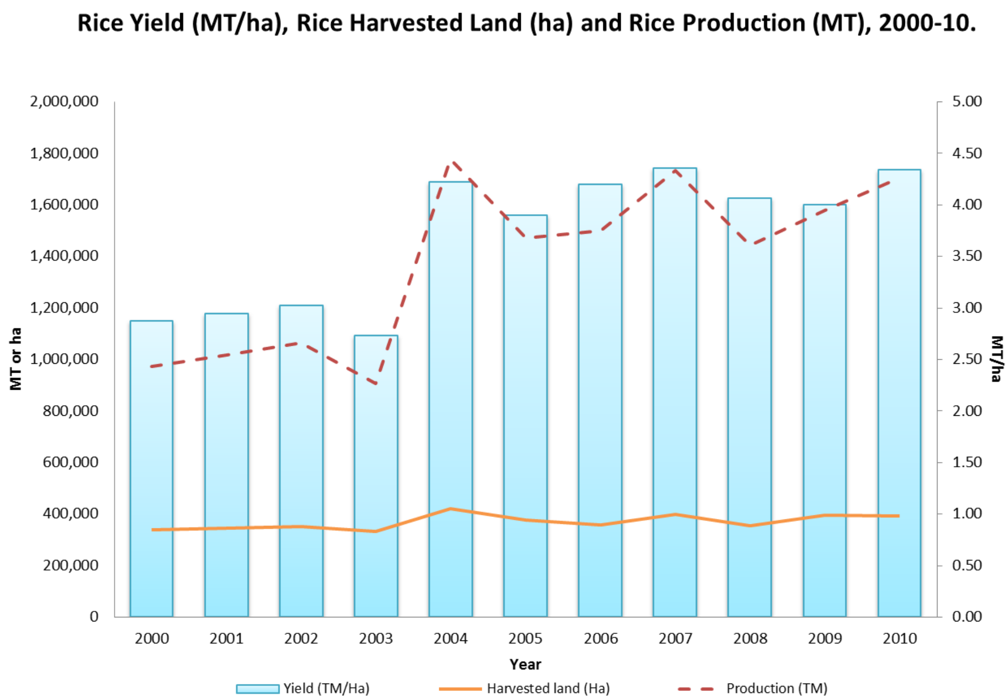

Figure 4-2. Rice yield (MT/ha), rice harvested land (ha) and rice production (MT), 2000-10 (Source: Instituto Nacional de Estadística y Censos 2012)

Table 4-2. World ranking of rice yield, 2000-10 (MT/ha)

Ranking	Country	2000	2001	2002	2003	2004	2005
1	Egypt	10.03	10.23	10.35	10.75	10.84	11.01
2	Australia	9.1	10.23	9.12	10.54	9.18	7.29
3	USA	7.76	8.03	8.13	8.24	8.63	8.18
4	Greece	7.72	7.85	8.13	7.71	8.77	7.98
5	Spain	7.79	8.35	7.96	8.02	7.94	7.62
6	Uruguay	7.04	7.39	6.46	6.51	7.46	7.28
7	Peru	7.26	7.38	7.37	7.49	7.1	7.6
8	Turkey	6.65	6.73	6.61	6.31	7.72	7.78
9	El Salvador	6.38	6.65	6.55	7.48	7.32	7.95
10	Korea Republic	7.4	7.54	7	6.53	7.42	7.24
24	Colombia	6.32	6.23	6.47	6.46	6.54	6.39
49	Ecuador	4.06	3.97	4.27	4.27	4.65	4.3
	World	4.29	4.35	4.27	4.36	4.45	4.51
Ranking	Country	2006	2007	2008	2009	2010	Average (2000-10)
1	Egypt	11.11	10.77	10.73	10.57	10.39	10.62
2	Australia	11.17	8.98	8.82	8.98	11.95	9.58
3	USA	8.52	8.92	8.46	8.75	8.31	8.36
4	Greece	8.5	8.41	7.42	7.79	7.44	7.98
5	Spain	7.49	7.85	7.63	8.31	8.34	7.94
6	Uruguay	8.04	8.69	8.71	8.83	7.82	7.66
7	Peru	7.58	7.95	8.11	8.15	8.03	7.64
8	Turkey	7.74	7.62	8.35	8.57	9.58	7.6
9	El Salvador	8.15	8.23	8.75	7.61	6.75	7.44
10	Korea Republic	7.4	7	8.15	8.37	7.17	7.38
24	Colombia	6.51	6.65	6.94	6.06	5.72	6.39
49	Ecuador	4.63	4.8	4.48	4.41	4.78	4.42
	World	4.55	4.67	4.82	4.77	4.82	4.53

Source: Food and Agriculture Organization 2012

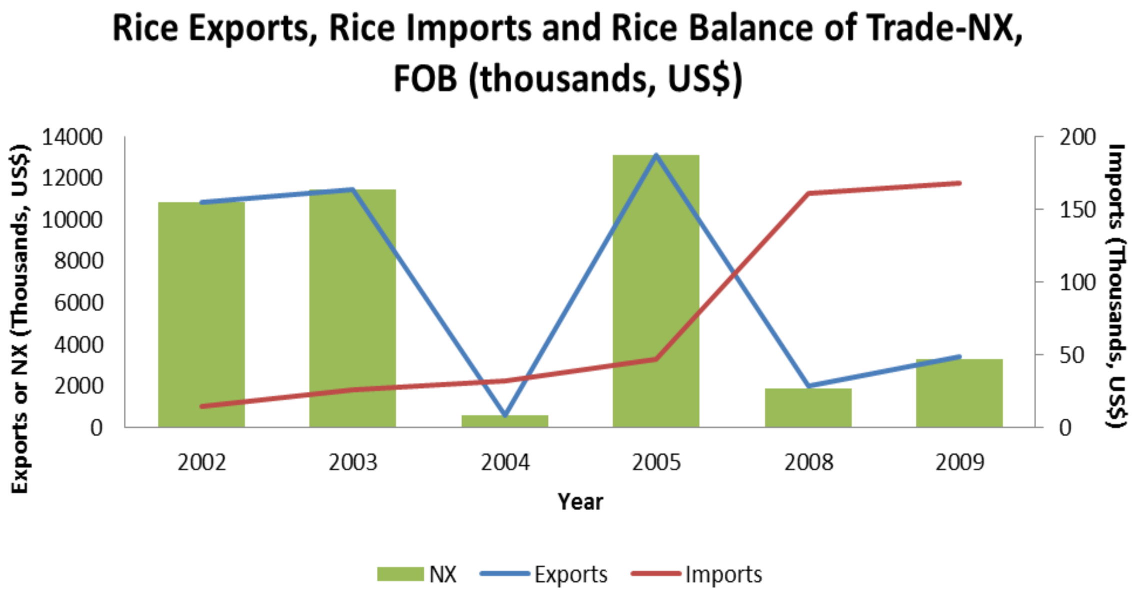

Figure 4-3. Rice exports, rice imports and rice balance of trade-NX, fob (thousands, US$) (Source: Instituto Nacional de Estadística y Censos 2011)

Table 4-3. Average international participation of the three types of rice, 2000-09

	Broken		White or Semi-white		Hulled	
	Exports	Imports	Exports	Imports	Exports	Imports
Chile	-	-	-	-	81.51%	-
Colombia	-	-	99.76%	-	-	-
France	3.41%	-	-	-	12.68%	-
Italy	96.59%	-	0.24%	13.25%	3.38%	-
Spain	-	-	-	-	2.44%	-
USA	-	-	-	86.75%	-	-

Source: Instituto Nacional de Estadística y Censos (2011).

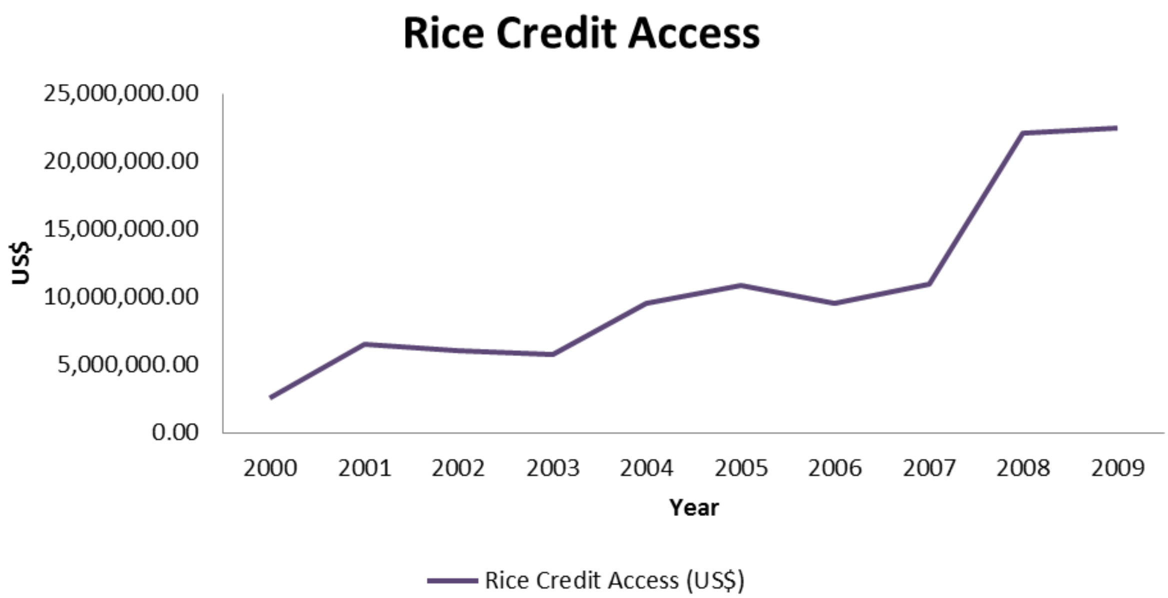

Figure 4-4. Rice credit access (US$) (Source: Instituto Nacional de Estadística y Censos 2011)

CHAPTER 5
METHODOLOGY

This section focuses on the justifications and explanations of the instruments that are employed to respond the research question and to achieve the objective. Thus, the following parts are discussed: 1) The sampling method; 2) questionnaire and primary data; 3) introduction of the theoretical model and; 4) empirical model of willingness to adopt (or pay).

Sampling

Unit of Analysis and Target Population

In Ecuador, an 80% of the rice production units are small farmers having less than 20 ha. Thus, they are key actors allowing the food security in Ecuador. Furthermore, those small farmers are part of a family (or household) who makes decisions about their own production systems. In this sense, the units of analysis are rice producers (or households) in this study. Thus, all the observations are rice farmers.

In Ecuador, there are different types of rice sowing: transplantation, broadcast and other mechanized methods. Given the UDP technology's characteristics, the target population would be those rice farmers utilizing transplantation technique because plants are placed in rows or lines and the placement of Urea briquettes is easier and more precise. However, conversion from broadcast sowing to transplanting may happen without any inconvenient (both techniques incur in similar costs). In fact, sometimes some farmers use transplantation in one season and broadcast in others. Given this chance of conversion and with the purpose of having a greater number of observations, the target population considers either type of farmers (see Figure 5-1). Those producing with mechanized sowing are not taken into account because UDP would not be suitable for them at this moment.

Currently, most of the target population is located in the Ecuadorian Coast. This study examined the acceptance of the UDP in one of the two main rice Provinces of Ecuador, Guayas. The fieldwork was developed during the 2011 summer (June-July-August). Table 5-1 lists all the villages where the survey instrument was applied, 35 villages in total. Figure 5-2 shows the distribution (percentages) of the surveys per villages. There was no a visit plan: survey application started out in Daule, followed by Santa Lucia and ended up in Daule. In this sense, Peninsula de Animas, El Mate and Bermejo with similar percentages, and Naupe were the zones with the majority of applied questionnaires, 8.31%, 7.53% and 6.75% of the surveyed rice farmers respectively. In total, 401 rice farmers were surveyed but after data cleaning, 385 farmers were included in the analysis. This latter number represents a 3.82% of the total rice production units across Daule and Santa Lucia cantons.

Sampling Design

A non-random sampling method was used to collect the primary data given that there are problems regarding to the information gathering for agricultural research: incomplete sample frame, interview rejection, observation absence, among others. Unfortunately, there was not any leader or representative of the cooperatives who can provide a members' list. While doing the pilot survey application, some farmers said no to the questionnaire and others were not at home; these problems turn more complicated because of the location of units of analysis and the difficulties to reach them to apply the survey in rural zones. Coming back to the same household was not suitable due to budget constraint. In this sense, disadvantages and reasons of having chosen this process of case selection are better explained here.

There are some disadvantages weakening a non-random sampling design. Jr. Royce A. Singleton and Bruce C. Straits (2010) refer to two weaknesses: 1) the investigator bias could be presented in the selection of the units and 2) Sampling errors and sample precision cannot be estimated because the cases were not taken randomly or probability theory would not be applicable. Consequently, any generalizations cannot be made as a product of an uncertain representativeness of this non-random selection.

However, there are also strong reasons to consider the application of a non-probability sampling. Even if I consider a list of all farmers participating in all agricultural cooperatives as sample frame, which I could not obtain, would be incomplete because a significant number of rice farmers are not affiliated to any cooperative. As a consequence, the entire population could not be identified and then assign a probability to the cases is not possible. Also, difficulties come from the individuals' cooperation or availability. A common situation is that a farmer is not available or simply refuses to participate in a study and the problem is to reach units of analysis given their locations in rural zones and the dedication of more time and money is needed. Because of the limited resources, selecting cases not randomly was very feasible.

According to Jr. Royce A. Singleton and Bruce C. Straits (2010), given that one is more interest in knowing more about the problem or the topic being examined that random selection may be needless at the very early phase. In this case, UDP technology has hardly been introduced to rice farmers in Ecuador; being this technology unknown by farmers and this study is the very first work on the adoption of this innovation. This is also a justification of a non-random sampling.

Thus, the non-random sampling considered was the Snowball or Referral sampling. However, there are some disadvantages utilizing this sampling: 1) statistical inferences must be done on the initial sample, as the inclusion of new individuals in the sample is not random; 2) sample bias could be generated by the participation of the most willing people to be surveyed because they would be considered outliers based on cooperation; 3) sample selection bias because some individuals would not refer to their friends with privacy concerns; protecting their friends from possible sensitive questions in the survey and; 4) those who have a larger social network would have more chances to be referred and those with smaller social network would be more likely to be excluded from the survey, creating the bias in the sample selection (see Douglas D. Heckathorn 1997). The lack of a sample frame first moved to implement this method. As said above, UDP introduction is a very beginning phase where awareness about random selection could be forgotten at this moment. Also, the problem of privacy concerns could be avoided or at least reduced in this study because the survey did not ask for very sensitive information. The social network bias may also be reduced given that these farmers live in relative small villages and the probability that farmers know each other and refer to any other farmer is high. The problem would come from the willingness to participate in the survey or the cooperation bias. However, a researcher could find in any sampling very enthusiastic individuals and very reluctant people that could provide true or fake information. Still, the aforementioned disadvantages are present in this thesis but there are reasons to think of a reduced affectation of these problems.

Thus, enumerators went to households asking for the application of a questionnaire. If they got a positive respond from the famer, this farmer was asked to name other rice producers. Perhaps, what can make random this sampling method is the probability of finding a farmer willing to participate (or finding a farmer at home). In all villages visited, nobody knew beforehand about this fieldwork. On the other hand, a basic assumption of this sampling design is the desirable cases (households represented by the head) know each other. One reason to hold this assumption is because these rice farmers live in villages composed of 20 up to 200 households. I cannot access any available data to certainty know how many households are in each village, but I based these numbers on the fieldwork. In addition, farmers might also be related through cooperatives, irrigation boards other groups.

Questionnaire and Primary Data

In this part, a description of the questionnaire is given. The primary data were collected through 11 sections of the survey instrument. The most important sections for this study were: UDP diffusion; social network; past adoption, perceptions and willingness to pay; production system; credit market; labor participation; households' and farmers' characteristics. These sections are described briefly.

Filter section: This section works to identify the units of analysis correctly. The first question asks if the person is a rice producer; a second identifies the type of sowing (broadcast or transplantation); the last question is to see if a farmer is in charge of the rice. If it was found a person not accomplishing one of these questions, enumerators just moved to other household.

UDP diffusion section: Due to the extension work, I use this section to identify users of this UDP, information channels, UDP results, level of knowledge and current users. To know the results, a matrix asking for amount of inputs and their cost was set in this section. A particular objective of this section is to evaluate the performance of the diffusion work and how this information was shared or transmitted among the households.

Social network section: Questions about affiliation in an agricultural association or other groups, members, relatives, frequency of meetings, and behavior in each meeting were asked in this section. The goal is to collect valuable data to carry out a social network analysis.

Past adoptions, perceptions and willingness to pay section: This section has questions asking for past technology adoption, time of the adoption and the overall performance of those technologies. Additionally, perceptions on communication among farmers and the possible use of a new fertilization method also were measured through statements. Questions of willingness to pay were included in this section; Double-bounded dichotomous choice was used. In order to measure the environmental impact of UDP on the farmers' willingness, two rounds of questions were performed: one round considering all the tangible benefits/costs of the UDP and; the other describing both tangible benefits/costs and environmental impacts. Then, farmers were told to respond whether accept or not to pay extra dollar for one Urea briquette sack (50 kg). There were three version of the extra payment for the initial and second question of the Double-bounded format in both rounds. The first bid versions were US$1, US$2 and US$3. Then depending on the answer of the first question, farmers faced a lower or higher bid: US$0.50, US$1.50, US$2.50 and US$3.50. For example, if farmer said yes to the first bid of US$2, he would have faced a second bid of US$2.50; otherwise, the second would have been US$1.50 (see Appendix: Questionnaire). These initial bids were established based on: 1) previous conversations with rice farmers when recognizing all villages to be surveyed, farmers pointed out that Urea price changed very drastically from place to place, between US$1 to US$3 and; 2) there is the Urea type called “Superurea”, similar to briquettes whose cost is two dollar more than the conventional Urea. Such bids were accepted by rice farmers (see Chapter 6: Empirical Results). However, a Double-bounded estimation is not utilized in this study; only an exploratory analysis is held later. In addition, an open-ended question of willingness to pay was asked in both rounds. The decision of asking first the binary questions and then, the open-ended question was based on the pilot survey application, where farmers spent too much time idealizing what extra payment should be the correct. The risk is to have biased farmers to respond the open-ended question with values below or as much as the bids of the Double-bounded questions. But, these bids are consistent with the reality and overestimated extra payments could be avoided from this analysis. Besides, the resource time could be saved and used in other survey applications. Finally, if farmers responded positively to one of questions in any aforementioned round, they were able to respond how many hectares they would be willing to dedicate to UDP production. This question is to construct the key variable Intensity of adoption (UDP potential land divided by the total operated land). This ratio is the dependent variable for the Tobit model because it is more informative, giving the interest in adopting UDP but also the intensity of that adoption in terms of the hectares dedicated for UDP production.

Production system section: A matrix with specific questions about the rice production was constructed in this section. As farmers do not have any accountability of their productions, it is understandable that such data obtained from this matrix might be exposed to errors. Latterly, the data related to the following information: soil preparation cost, seed cost, irrigation system cost, labor cost, harvest information, etc. These questions are associated with the last period of production. A more summarized matrix was created to ask for other types of cultivation.

Credit market section: The questionnaire also contains a section incorporating data of the credit availability. The objective is to know from what sources families can get a credit, the amount of money, the uses of that money and etc. Actually, the Ecuadorian government is providing subsidies to agricultural insurances; 60% of the cost. Those subsidies are for the short-cycle cultivations (e.g. rice or corn) mainly. A question was also set to observe if farmers own an agricultural insurance.

Labor participation section: There are questions asking for both on-farm and off-farm activities. Thus, the household head was asked about his time availability and other household members (i.e. mother and one son/daughter). The intention is to estimate the available time of each household and its uses. In addition, a set of questions was determined to obtain information of other incomes from off-farm jobs and non-worked money (e.g. remittances, donations, etc.); also, there are questions regarding savings.

Households' health section: One of the environmental benefits of this technology UDP is that there could be a reduction of N going into the atmosphere and the Daule River (N is harmful in high levels in the water for the aquatic lives but also for those living close to the river who drink that water). This section asks for the water consumption, stomach illness suffering, and expenses on that illness, etc. The objective is to know what people could be affected by “N” in the river and calculate approximately the money saved by implementing the UDP. However, this topic was not considered in this thesis because it is beyond the scope of the thesis’ objective.

Households’ characteristics section: The instrument also contains a section dedicated to obtain information for households’ particularities. Through a set of questions, household head provided information of his assets, types of utilities, consumption expenses (e.g. food, clothes, and school items), etc. Also, farmers were asked if their cropland faced natural disasters such as flood and drought in the last year. One complicated question for farmers was related to the land size. The government has been discussing a new land law which promotes the redistribution of lands. There is article stipulating the basis to expropriate lands and it remarks that small famers will not be affected by this law. However, those farmers could have been afraid of telling the true. As a result, this question was placed at the end of the questionnaire to not bias other answers.

Farmers’ characteristic section: In this part farmers respond questions about their gender, age, education and marital status. There was a question asking particularly for the agricultural education received; I could identify what agricultural knowledge was learned by these farmers and who facilitated that education (e.g. government, cooperative, universities, etc.).

Geographic information system section: Spatial data were also collected in this study. Farmers were asked for their location of their households and location codes were taken through a Global Positioning System device.

To sum up, this questionnaire included nine sections, or 57 questions. To survey a person took around 30 minutes, on average. The most time-consuming questions were the willingness to pay, which should be explained to the farmers carefully to have a better understanding of it and the production system section that contains several questions about rice cultivation. Finally, 5 enumerators were hired; three men and two women. As three of the enumerators lived in one of the target zones, they helped to this study recommending sectors where rice producers could be found. This fieldwork started in June and ended in August of 2011.

Theoretical and Empirical Model

The setting of the theoretical and empirical model is discussed in this part. In order to estimate the Intensity of Adoption (the percentage of total land that would be dedicated for UDP production) model, to comprehend farmers' behavior is first needed. In doing so, a typical producer-consumer household model was determined, following Howard N. Barnum and Lyn Squire (1979). Then, this conceptual model with the empirical one is associated. Finally, the Tobit model is explained as well as its maximum likelihood estimation in this section.

Theoretical Model

In this section, I developed a theoretical model through which I expect to see the affection of the UDP adoption on Farmers' Utility. Therefore, I first need to set out the theoretical agricultural-household model (Howard N. Barnum and Lyn Squire 1979). Suppose that a household is only producing rice "Y", whose price is "p_R", on a given cropland "A". Therefore, this production unit demands inputs, vector "f_j" (i.e. "j" is equal to Urea, insecticide, herbicides, etc.) at prices "θ_j". Moreover, as there is a competitive labor market, household has to decide how to use its time "T": for rice production "H" (family and hired); for leisure "L"; or when household can dedicate time to off-farm activity (Z>0) or when it has to hire labor (Z<0) in a marketplace where everyone offers homogenous work at equal price "w". Additionally, this household can obtain other incomes "B" such as remittance, rent payment, and so on. Finally, this household has an own rice consumption "R" given a competitive market; also it consumes other marketable goods "M" whose prices are represented with "p_M". Therefore, the typical problem to be faced by this household is:

$$\underset{R,\,M,\,L}{\text{Max}}\ U\,(R, M, L; E, o_i)$$

subject to:

$$Y=Y\,(H, f_j; A, C)$$

$$T=H+L+Z$$

$$p_R R+ p_M M = p_R Y+B+ wZ - \sum \theta_j{*}f_j$$

Where U(*) is the household's utility which is also explained by environmental factors "E" and the vector of household's characteristics "o_i" (i.e. "i" can be number of children, agricultural affiliation, etc.); Y(*) is the production function affected by those aforementioned factors and for current broadcast Urea fertilization "C". Thus, the first restriction is associated with the level of rice production, the second is the time availability and the third is the expenditure constraint. This is a partial representation of rice farmers' behavior, during one rice season. Replacing the optimal amounts in the utility function, I may rewrite this function as follows:

$V\ [p_R,\ p_M,\ L^*,\ B,\ w,\ Y^*(H^*,\ f_j^*;\ A,\ C);\ E,\ o_i]$ (5-1)

Where V [*] is the indirect utility and L*, Y*, H* and f_j * are the optimal amount of leisure, hired or sold labor, rice production, on-farm labor and inputs, respectively. Now, let's say UDP is introduced in the rice production livelihood of this household; all the land is for UDP production. From Equation 5-1, I set out the new welfare level at:

$V_{UDP}\ [p_R,\ p_M,\ L_{UDP}^*,\ B,\ w,\ Y_{UDP}^*\ (H_{UDP}^*,\ f_{UDP,j}\ ^*;\ A_{UDP},\ UDP)\ -\ G;\ E_{UDP},\ o_{UDP,i}]$

As is known, UDP is technology that let farmers save Urea as well as improve rice yield and per se, income. Also, it has a positive environmental impact given the lower amount of "N" released to the atmosphere and aquatic resources; I assume that environmental enhancement takes place in a short term as farmers breath less contaminated air and use cleaner water from rivers. However, one requirement is to increase the labor for rice production. Finally, this technology has a direct monetary cost as well, G[1]. Thus, UDP adoption occurs if a farmer, assuming the cost of UDP, would at least obtain an equal or better utility (Bryan J. Hubbell, Michele C. Marra and Gerald A. Carlson 2000):

$V_{UDP}\ [*] \geq V\ [*]$

Thus, factors impacting directly and indirectly the new level of welfare given the adoption of a new improved technology can be identified. Following Bryan J. Hubbell, Michele C. Marra and Gerald A. Carlson (2000), I assume a stochastic utility function:

$VUDP\ [IUDP\ -\ G;\ EUDP,\ X] + \varepsilon UDP \geq V\ [IC;\ E,\ X] + \varepsilon C$ (5-2)

Where "X" is a matrix of all those factors affecting the utility (not including environment), "I" is the net income of this family (most of the income would come from rice production)

[1] The cost may be for the acquisition of BM in order to produce UBs or only extra cost for UBs sacks.

and ε is the error term depending on the Urea fertilization, UDP or broadcast “C”. The deterministic part of the utility is assumed to be a particular linear form:

$$V = X^*\beta_i + \pi^* I_i$$

Where “β” is vector of coefficients of each factor in X (households’ characteristics, environment, etc.) and “π” is the marginal utility of income and subscript “i” is for UDP or C. Thus, Equation 5-2 could be rewritten as follows:

$$\pi^*(I_{UDP} - I_C - G) \geq (X^*\beta_C - X^*\beta_{UDP}) + (\varepsilon_C - \varepsilon_{UDP})$$

By assuming any distribution of the stochastic terms, the vector of parameters β and π can be estimated by employing a Likelihood Estimation (see Bryan J. Hubbell, Michele C. Marra and Gerald A. Carlson 2000). Hence, the probability that a farmer is willing to adopt UDP can be estimated, but with a binary model. Instead, this study utilizes a more informative model, the Intensity of Adoption, that not just shows the interest in adopting UDP but also the level of that interest in terms of the land dedicated for such production. Now, the econometric process is shown in the next section.

Empirical Model

The IA ratio was designed to examine rice farmers’ willingness to adopt UDP. In defining IA, farmers first took the decision whether pay or not extra for acquiring Urea briquettes sacks, through the Double-bounded and open-ended questions set in the questionnaire (see Appendix: Questionnaire). Then, if a farmer responded positively to any of these questions, they select the hectares to work with UDP.

In calculating IA, I divided the possible area dedicated to UDP production by the total current operated area. Again, IA is a more informative variable given that it presents farmers’ interests in UDP and also, the level of those interests in terms of hectares given to UDP production. On the other hand, some values are missing because some farmers showed no interest in UDP production (they were not asked for potential UDP land, skip the question because of not interest) or even presenting awareness, they do not want to experiment on their operated land (e.g. they could experiment on donated land). In this sense, this variable was censored at 0. On the other hand, there were values that exceeded the limit of 100%, meaning, farmers want to acquire more than their current hectares (buying or renting) to work with UDP. However, to base this study on the actual resources of these farmers or be more realistic (they can just give what they have currently), IA is also censored at 100%. In sight of such results, IA must be treated as a two-limit Tobit. In this section is developed the presentation of the empirical model and how it is estimated[2].

Tobit model: Defining the latent Intensity of Adoption as "IA*", which is explained by a set of independent variables. The empirical model is defined as follows:

$$IA_i^* = X'\beta + \mu_i$$

Where "X" is a matrix of exogenous variables (e.g. social network factors, production variables, farm's characteristics, farmer's characteristics, environmental concerns and among others), "β" is vector of the parameters belonging to each regressand (including a constant), "μ_i" is the error term following a normally identically and independently distributed with mean 0 and variance σ_μ^2; and subscript "i" is for observation 1, 2, 3…..n. As a result, the distribution of the conditional latent variable IA* given X is also Normally Distributed ($X'\beta$, σ_μ^2). However, this variable can only be observed in a certain range. Let's call the observable intensity of adoption "IA", which is defined as follows:

[2] As first thought, a Heckman Model was estimated to solve the problem of the self-selective bias. However, there was no significant result of the correlation between the error term of the selection rule and the IA model. Therefore, the analysis is based on a two-limit Tobit model.

$IA_i = 0$ if $IA_i^* \leq 0$ or $X'\beta + \mu_i \leq 0$

$IA_i = X'\beta + \mu_i$ if $0 < IA_i^* < 100$ or $0 < X'\beta + \mu_i < 100$

$IA_i = 100$ if $IA_i^* \geq 100$ or $X'\beta + \mu_i \geq 100$

IA is censored at 0 and 100 percent. Estimating this model with Ordinary Least Square, bias estimators are produced because this method does not take into consideration the censoring created in the observations (see Peter Kennedy 2008; Damodar N. Gujarati and Dawn C. Porter 2009). Maximum Likelihood Estimation will allow estimating the three parts of this model as follows:

$$L(\beta, \sigma_\mu/IA_i, X) = \Pi_{IAi^* \leq 0}[1- \Phi(X'\beta/\sigma_\mu)]^*\Pi_{0 < IAi^* < 100}\{(1/\sigma_\mu)\emptyset[(IA_i - X'\beta)/\sigma_\mu]\}^* \Pi_{IAi^* \geq 100}\{1-\Phi[(100 - X'\beta)/\sigma_\mu]\} \quad (5\text{-}3)$$

Where L is the Maximum Likelihood function, Φ and ∅ are the Normal Distribution and Density Functions respectively. The first term is the probability of being censored at 0, the second is the probability of taking continues values of IA_i (uncensored) and the third is the probability of being censured at 100 (see William H. Greene 2012). From Equation 5-3, I obtain the unbiased and consistent estimators, holding the aforementioned assumptions. Also, the conditional mean of the censored model is as follows:

$$E(IA_i/X) = 0^*[1- \Phi(X'\beta/\sigma_\mu)] + \{(1/\sigma_\mu) \emptyset[(IA_i - X'\beta)/\sigma_\mu]\}^*E(IA_i^*/0< IA_i^*<100, X) + 100^*\{1- \Phi[(100 - X'\beta)/\sigma_\mu]\}$$

$$= X'\beta + \sigma_\mu^*(\{[\emptyset(X'\beta/\sigma_\mu) -\emptyset[(100 - X'\beta)/\sigma_\mu]\} / \{\Phi[(100 - X'\beta)/\sigma_\mu]- \Phi(X'\beta/\sigma_\mu)]\})$$

$$\partial E(IA_i = IA_i^*/X)/\partial xj = \{\Phi[(100 - X'\beta)/\sigma_\mu] - \Phi(X'\beta/\sigma_\mu)\}^* \beta_{xj} \quad (5\text{-}4)$$

Where "β_{xj}" is the coefficient of the independent variable "x_j" being examined. Thus, I can calculate the marginal impact of each exogenous variable as is seen in Equation 5-4. These marginal effects are calculated by the difference between the probability of being censored at 100 and the probability of being censored at 0 (in parenthesis) times the coefficient of the variable that is being analyzed.

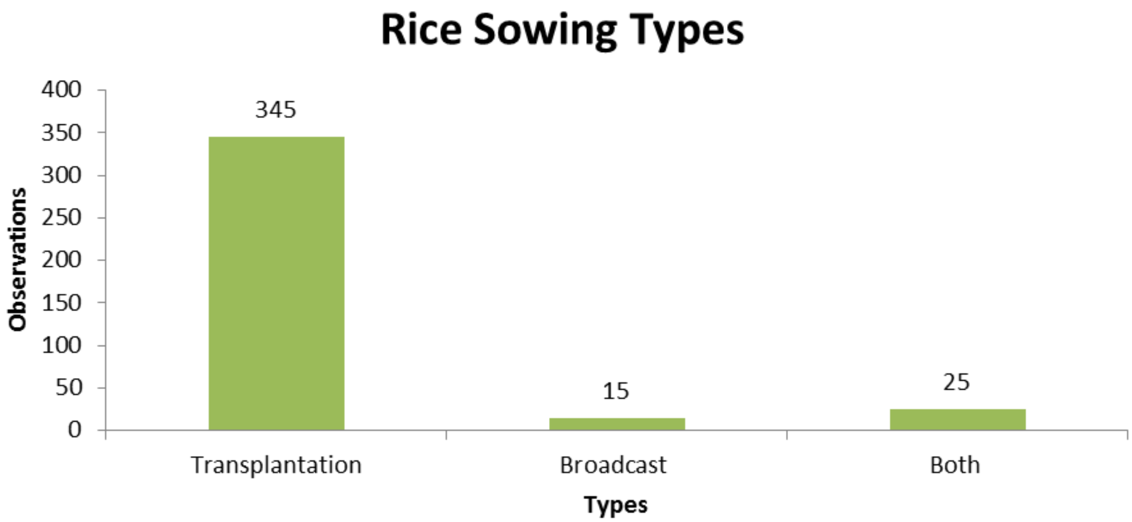

Figure 5-1. Types of rice sowing (Source: Author)

Table 5-1. Target zones

Province	Canton	Villages
Guayas	Daule	Brisas de Daule, Bella Esperanza, Clarisa, Coloradel, El Limonal/Los Almendros, Flor de Maria, Huanchichal, Jesus del Gran Poder, Jigual, La Aurora, La Elvira, Las Maravillas, Loma de Papayo, Los Moranillos, Los Quemados, Pajonal/Arriba/Abajo, Patrio Nuevo, Península de Animas, Pinal, Porvenir, Rebeldia, Rio Perdido, San Gabriel, San Vicente, Villa Filadelfia and Yurima.
	Santa Lucia	Barbasco/Central, Barranquilla, Bermejo/Abajo/del Frente, Cooperativa 14 de Octubre, El Mate/El Encanto, El Limon, El Porvenir , Higuerón, , La Fortuna, La Carmel, Marcela, San Jacinto, San Pablo and Playones,

Source: Author

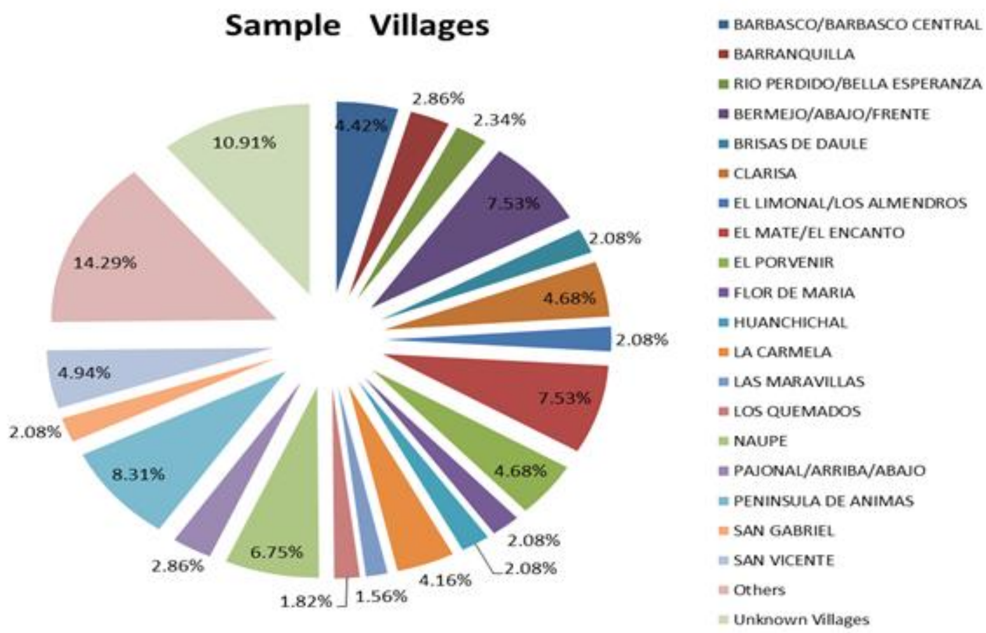

Figure 5-2. Distributions of applied surveys by sample (Source: Author)

CHAPTER 6
EMPIRICAL RESULTS

In this Chapter, a descriptive analysis of the primary data is developed. Afterwards, the results of the econometric model are introduced. As said before, these analyses were based on information from two cantons, Daule and Santa Lucia. Finally, MICROSOFT EXCEL®, EVIEWS and STATA® were utilized to develop the empirical analyses.

Two types of data were found: missing and extreme values. For the first case, those observations were replaced with the mean (or mode depending on the variable). Regarding the second type of data, I decided to leave them in the analysis to avoid further manipulation of the real data and to show what is happing in these zones in reality (these values would be totally justified because of the different agricultural practices or beliefs of these farmers; other source of these outliers is the extrapolation to mainly rice production data to a hectare). In addition, I estimated the Tobit model with and without extreme values, getting similar results. Therefore, I did not have any motive to manipulate these extreme values. In total, 385 farmers are taken into consideration in these analyses.

Farmers' Characteristics

This section is to understand the demographic structure of the rice farmers in the sample. I examine gender and age of household heads, education and agricultural instruction.

Most of the household heads are male, 92.21%; being a 7.79% female (see Figure 6-1). However, women are currently participating in the agricultural activities directly or indirectly. I could observe female have rice production knowledge when they answered some questions related to production costs on behalf of males. Moreover, some females are in charge of buying inputs such as fertilizers, pesticides and so on, and others are directly involved in sowing and fertilizers/pesticides application. Such helps liberate time needed by the farmer working on the rice crop.

On the other hand, Figure 6-2 shows that farmers are in a range of 40 and 60 years old mainly. On average, a farmer is 51 years old over all the villages analyzed. One thing that must be pointed out is that some farmers are managing their parents' lands. Perhaps, the average age could be increased if I would have included the formal owners of the lands[1].

Farmers also mentioned their maximum level of education. As Figure 6-3 shows, the majority, 233 farmers got elementary school level, 63 finished high school, 3 obtained a bachelor's degree and 1 studied other thing (nurse profession). Meanwhile, an important number of farmers said they did not attend any formal education, 85.

Subsequently farmers were asked if they have received any agricultural education, provided by any organization/institute/government in any place, formally or informally. Figure 6-4 demonstrates that only 20% of these producers have received such instruction. What happened to the other farmers, why they said to not have received such education, are interesting questions to be responded. Maybe, they thought of formal education. However, some questions arise due to this fact: do extension workers not visit all farmers? Do farmers not accept any help from others? Would this lack of agricultural education and general education be a problem with UDP adoption?

---

[1] This study decided to include who are actually producing rice, not matter if farmers have not inherited lands formally. In the end, these farmers are in charge of the rice business and who make the decisions.

According to Figure 6-5, the types of agricultural education received were as follows: pesticides/herbicides (32), fertilization (30), soil preparation (9), harvest (6), sowing (7) and others (3). Again, fertilization was important in term of education. Figure 6-6 shows that cooperative organizations were the main sources of this education, 48 farmers mentioned that fact. Government was also a provider of agricultural knowledge according to 16 farmers. Elementary school/high school/universities and others such as agricultural fair, extension workers and specialized companies were also providers of this education, 6 and 10 farmers respectively.

Households' Characteristics

In this section, an analysis at farm-household level is developed with the collected data in these two cantons. The variables to be examined are: land size, land ownership, drought/flood affection, consumption (i.e. food, clothes, schooling supplies, etc.), and distance to the main town. Additionally, wealth index was constructed with a Factor Analysis. This wealth index is associated with households' assets such as car, water pump, household ownership, etc.

First, I describe hectares given for rice production. This number is very high because these zones are plenty for rice production. As a result of the data analysis, I found that 382 farmers dedicated the whole operated land size to rice cultivation, and just three cases did not fully utilized their land. After all, their main occupation for these farmers is the rice production. In this thesis, all the studied farmers are small because land size ranges between 0.04 and 16.33 hectares (less than 20 ha is a small farm). Looking at Figure 6-7, most of these farmers hold less than 1 hectare, 154 cases. Then, landholders with land size between 1 and 2.99 hectares also represent a significant portion of this sample, 140 observations. Finally, the least landholders are those maintaining an area between 3 and 4.99 hectares and those having 5 or more hectares, 60 and 31 cases respectively. On average, a farmer holds 2 hectares for rice production.

On the other hand, Figure 6-8 demonstrates that a vast number of producers own their land, 331 observations (85.97%). Meanwhile, 54 farmers rent their land partially or totally. In detail, a person rented 1.6 hectares, on average; while the smallest and largest renter got 0.04 and 9 hectares, respectively. In addition, the mean cost of renting a hectare was US$193 for these farmers.

Also, information of the recent expenses on food, clothes, school supply, household arrangements and other items was captured. Figure 6-9 presents such expenses by land size groups. A slightly positive relationship between these two variables is perceived. In fact, the largest landholders are those who most spent on these items on average, US$175.26. However, some farmers of the two smallest land size groups spent more than those on the largest land size groups. These results may have taken place because a greater number of members existed in some small farms. For instance, controlling the sample by family size and land size, the smallest farmers had a per capita food consumption of US$13, while, the largest group had US$25. On average, the per capita food consumption was US$16.

Expending more on household consumption does not completely define how much poor or wealthy a farmer can be. According to M. Dekker (2006), income and expenditure are subjected to measure problems (e.g. fake information) and they can be seen as short-term wealth index (WI) because they represent information of a certain point in time (time when the survey was applied). As a result, I utilize Factor Analysis to estimate the WI considering variables pertaining to the households' assets and services (with relatively long –term duration):

- Utilities: electricity, drinkable water, telephone service, etc.
- Household assets: motorcycle/car, tractors, water pump, electric generator, etc.
- Household construction materials: wall, roof, floor, etc.
- Household ownership: own, rented, shared and borrowed.

The computation of the Factor Analysis is shown in Table 6-1 and Table 6-2. In Table 6-1 is presented the eigenvalue of each factor that are used to decide how many factors should be considered in the analysis; the rule of thumb is that a factor with eigenvalue greater than 1 should be taken into consideration. However, one factor is only required to represent the WI. Such a factor explains the 12.45% of the total variance of the linear combination of these variables. Table 6-2 shows the coefficient of each variable in the linear model of the factor 1 (or WI). For instance, having storeroom, irrigation pump, electric plant and harvester impact the WI positively; meaning that those with these assets enjoy a better wealth. Also, having a car as well as phone service increases the wealth of a farmer; these items may help to the commercialization of their rice production. In terms of health, drinkable water is an important factor for better life. Meanwhile, those with a rented or borrowed household would have a lower wealth as well as those with household built with cane; cane is a construction material very cheap and found in poor household usually. However, the unique variable that would not make sense in its coefficient is the Electricity Service whose impact is negative; having this service lets to enjoy the benefits of assets that enhance wellbeing such as refrigerators, television sets and among others. One assumption about the negative impact of this variable on WI may be that farmers may not have many of these appliances and the Electricity Service is not so indispensable and farmers must pay for that service anyway. The variable shared household (more than one family living in the same household) would almost have a null effect on WI; its coefficient tends to zero. In general, 17 variables were included in the Factor Analysis, which determine the wealth index. In Figure 6-10 is shown the WI scores, which can be interpreted as follows: the higher the index, the wealthier a farmer is in terms of assets. In Figure 6-11, the wealth level variable, constructed with the continuous WI variable, is showed: “Low” embraces the lowest 25% percentile of the WI, “High” represents the highest 25% percentile of WI, and between the aforementioned percentiles are “Average” wealthy farmers. Thus, those having a low, average and high wealth level sum 100, 189 and 96 farmers respectively.

Also, information about natural affections such as drought and flood suffered by farmers was captured in the questionnaire. Figure 6-12 shows that 51 farmers said to have been affected by drought during the last year (2010-11). Meanwhile, 49 producers suffered flood during the same time. These results demonstrate that the majority of farmers did not face these natural threats. Also, drought and flood were detrimental to the rice production in the season January-April of 2011. Also, Daule River passes through some of the villages visited for this study. Therefore, they are most exposed to suffer flood; meanwhile, those far from the river would be more likely to have drought.

Market access was measured through the variable named “Time to get the main town”. Over these villages, transportation (busses and trucks) was a service very limited; the fare was between 25-50 cents. As is shown in Figure 6-13, three groups of time spent to get the market were set: less than 15 minutes, 20-30 minutes and more than 30 minutes. Most of the farmers (171) are placed in the group of 20-30 minutes to get the main town in both Daule and Santa Lucia cantons (average spent time: 25 minutes). There are 162 farmers in group less than 15 minutes, the closest to the market (average spent time: 11 minutes). Also, there are 52 farmers in group of more than 30 minutes, the further to the market (average spent time: 54 minutes). This measurement reveals, in some way, the difficulties of some farmers to go to the market, in terms of time. Based on the fieldwork, one big obstacle was identified to access the market from some villages: bad condition of the roads.

Urea Deep Placement Diffusion

To know how UDP knowledge was spread within farmers in the Rice Zones in Guayas Province, a section was designed to collect this information in the questionnaire. It is important to highlight UDP was first introduced to the rice farmers with meetings in Cooperatives such as Bermejo, Alianza Definitiva and Agricultores de Babahoyo. Other diffusion tools were: flyers, radio, television, agricultural fair and informal meetings with farmer over the Rice Zones of Daule and Santa Lucia. In this part, a discussion is presented of how many farmers were familiar with UDP, how they obtained that knowledge, if they used this innovation and so on.

At the midterm of July 2009, the diffusion of UDP started with the visits of extension collaborators to Daule and Santa Lucia cantos mainly. According to Figure 6-14, such diffusion was not captured by the majority of these sample farmers; 90.65% (349) said not to have knowledge about UDP technology[2]. Perhaps, such a result is a consequence of forgetfulness given the time of introduction of UDP (2009) and the

[2] I was not asked for UDP per se, but for the urea briquettes or better recognized by them as small urea balls which are put into the soil. Besides, we provided farmers flyers to let them identify the technology at the moment of the interview.

questionnaire application (2011). However, a 9.35% (36) of farmers knew about this new fertilization method. In Table 6-3 is given some statistics of these farmers who knew and did not know about UDP. For instance, farmers who had knowledge about UDP were, on average, 53 years old, had elementary school studies, lived in the El Mate/El Encanto village in Santa Lucia in their majority, affiliated to an agricultural group and held less than 1 ha of rice land size. Meanwhile, farmers who said to not have any UDP knowledge presented an mean age of 51 year old, with elementary school instruction mainly as well, with location in the village of Peninsula de Animas in Daule (majority of these farmers), with agricultural group affiliation and with land size group less than 1 ha. However, farmers who knew and did not know about UDP presented other characteristics of the same variables such as high school level, location in other villages (across all the 35 villages found here), with and without affiliation in an agricultural cooperative and with different land size groups. A systematic pattern was not seen of having UDP knowledge or not.

On the other hand, those 36 farmers with knowledge of UDP were asked how they accessed such information. As is showed in Figure 6-15, the ways to access UDP knowledge were: neighbors (8 farmers), Higueron meeting (6 farmers), friends (5 farmers) and flyer announcements, agricultural fairs and Alianza Definitiva meeting (3 farmers, for the three categories). For those who said others (10 farmers), the main sources of information were family members, other relative, input suppliers and informal meetings with the extension workers.

Moreover, some experiments were developed in some villages in the Guayas rice zones. Therefore, farmers who knew about UDP were asked if they also observed the results of the UDP application (i.e. yield increase, Urea reduction, etc.). Figure 6-16 demonstrates that only 13 out of those 36 farmers were familiar with the final results of UDP experiments. They observed these results from others' experiments. Unfortunately, these observers could not identify the location of the experiments or enumerators did not find experimenters at home. In the end, only one of these farmers was an UDP experimenter, seeing the results of UDP in his own rice crop (See results in Chapter 3). Also, seven of these farmers affirmed to have heard about UDP technologies again. Currently, the imported BM is broken, stopping the promotion and adoption process (BM was transferred to a Cooperative in Daule Canton and there it was broken).

Finally, a Likert scale was employed to measure the UDP knowledge of these farmers (see Figure 6-17). Having three categories for the scale, the results show that 29 farmers know a little about UDP, 4 somewhat and only 3 much. Those who said to have a better understanding of UDP are the farmers who had experience with it.

As a conclusion of this part, the diffusion and promotion the UDP technology must continue for the better understanding of it. 80% of the Ecuadorian rice farms are small and on which this innovation will have high probabilities of being successfully adopted.

Social Network Analysis

In the surveyed zones are some well organized groups whose main purpose is to discuss any affair connected with their likelihood production system. Such groups may facilitate the transfer of new technology knowledge within farmers in the group and maybe, between groups. Moreover, social network as part of the so called Social Capital has played an important character to the development of some rural zones in Ecuador (see Paúl Herrera et al. 2010).This section is intended to confer a modest description of the actual relationship among farmers in the Daule and Santa Lucia Cantons mainly. The survey instrument contains an elaborated social network section which consists of queries respecting to agricultural group affiliation, groups' name, frequency of the meetings, voluntary/obligated attendance of meetings, farmers' behavior in meetings, identification of influential groups on farmers' production decision and the estimated number of the social network of each farmer.

As said above, a majority is involved in agricultural groups, 64.42% of farmers (see Figure 6-18). Also, two types of groups were found: Irrigation Boards and Farmers' Cooperative Organizations. Now taking a look at Figure 6-19, one can see that the sample is concentrated in the following agricultural groups: Alianza Definitiva Cooperative (56), Mate Irrigation Board (49) and Higueron Irrigation Board (41). In category "Others" were clustered several associations and that is why the number is important, 46 farmers. Additionally, these agricultural associations can be deemed as small and large, relying on the number of members. On average, a farmer said to be part of organization of 515 members; one pointed out to be in one with only five farmers and other alleged to participate in a group of 9000 members. Unfortunately, the verification of these numbers with official documents from those cooperatives or irrigations boards was not possible because there was nobody at the offices at the time of the visits (coming back was not suitable due to budget constraints). In general, 39 agricultural associations were found in this study.

On the other hand, I could also see how often farmers meet with their group fellows. Figure 6-20 demonstrates that groups may principally hold their meetings monthly; 214 farmers confirmed such statistic. Also, weekly and even yearly meetings are attended by these farmers.

In addition, these affiliated farmers were required to declare if they are enforced to attend such meetings. As is beheld in Figure 6-21, a 68.95% participated voluntarily without any enforcement. However, 31.05% argued that they have to go in order for them to avoid any pecuniary punishment.

Once in the meetings, farmers said not to be very participative: non-participative and somewhat participative, 21 and 159 respectively (see Figure 6-22). As personal experience, I witnessed the development of a meeting in Higueron where around 200 or 300 farmers were present to hear about UDP technology, of course, after finishing their own discussion. Based on fieldwork, their participation was more active in subgroups inside the association; as there were more than 200 members; farmers built their own small cluster. However, no constraints were observed for these farmers to convey their doubts or ideas.

In Figure 6-23 is revealed those influential groups which, to certain extent, sway famers' production decisions. According to their responses, neighbors/friends, input suppliers and family might be deemed as the most relevant groups; 243, 241 and 210 responses respectively[3]. Neighbors/friends and family are obvious important groups. Also, farmers are usually in touch with input suppliers while the rice production season is taking place. Interestingly, these sample farmers did not perceive agricultural group

[3] It is not an attempt that farmers separate people who are neighbors or friends or agricultural group members because of the difficulty. What was wanted from them is to affirm where most significant or influential people come from.

nor extension workers as influential in their majority; only 54 and 6 cases see them as important, respectively.

Finally, Figure 6-24 shows a Likert-scaled measure of communication level. A total of 271 farmers rated communication in their villages as good or very good; while 105 declared the opposite; and 9 farmers were indifferent. Paúl Herrera et al. (2010) described farmers' relationship in Higueron, San Jacinto and El Mate as of respect, reliable and fellowship. Still, there is a need of further research on social network as cooperatives or irrigation boards and extension workers are sources of new technology knowledge.

Technology Adoption Analysis

In this section, there is a review of the past technologies that have been introduced in the production systems by these surveyed rice farmers. However, there is a particular interest to analyze the willingness to adopt UDP technology as well as the key variable, Intensity of Adoption.

Let's first start with past adoptions. Farmers were asked if they have introduced a new technique (or technology/innovation) into their production system before. Figure 6-25 indicates that only 18% of these producers responded positively. In contrast, 79% declared not to have included any innovation; the rest said they did not remember (3%). Perhaps, some farmers may have been using the same techniques the whole life; or others may have said no to this question because they did not perceive a past innovation as a big change. However, Agriculture is always in constant adjustment and its methods as well; implying the persistent introduction of new techniques.

Additionally, those past adopters pointed out the innovations introduced in their rice activities (see Figure 6-26). For instance, the most common innovation accepted was linked to the fertilization procedure (39 farmers); one of fertilization techniques mentioned was organic method. In this sense, UDP might be an option that can be taken by these farmers given its simple, innovative and efficient fertilization technique. Also, 18 farmers affirmed to have included new sowing methods. While pesticides techniques were also adopted in 14 farmers' cropping system. Finally, 7 farmers noted to have utilized new other methods on harvest, soil preparation, irrigation system, and plant disease treatment.

Consequently, farmers were also asked for their experience by adopting the aforementioned innovations. Thus, they could see an experience as bad, equal or good[4]. For example, those adopters of past fertilization techniques had a good (37) and equal (2) experiences. Again, results of new fertilization methods are seeing as positive, encouraging UDP introduction in agriculture. The rest of the innovations were also considered as good in its majority.

In addition, a statement was included to observe how disagree or agree farmers are to adopt a new fertilization method. A positive response predominated, 350 farmers were agreed. At a glance, one can say UDP adoption could occur without any problem. To clearly observe so, I prepared a section addressing the willingness to adopt Urea Deep Placement.

Willingness to Pay: A Double-bounded format was used to measure producers' willingness to adopt UDP (see Chapter 5 Methodology). Here, I name the willingness to pay considering the first round, where the economic benefits and costs of UDP were

[4] In term of production, maybe a bad experience is for a decline; equal is for no improvement at all; and a good is for improvement. However, these experiences were not specified to farmers and then, they decided what to select.

introduced, as “WTP”. The second round with the introduction of all impacts (economic and environmental) is identified as “EWTP”. For this analysis, I do not divide the observations into the three bid versions; I treat the data as a whole.

Firstly, I analyze the WTP whose benefits and costs are: reduction of applied Urea, yield improvement, income increase and labor increase. According to Figure 6-27, a high percentage of this studied farmers are willing to pay extra for Urea briquette sacks, independently of the land size: 91.56% (less than 1 ha), 95.71% (1-2.99 ha), 93.33% (3-4.99 ha) and 90.32% (equal/more 5 ha), respectively. In general, 359 producers are willing and 26 are hesitant for UDP adoption.

Subsequently, the second question was asked with a higher or lower bid based on the negative or positive first answer (see Figure 6-28). From 359 positive responses in the first question, 321 farmers ratified their response at higher extra payment; only 38 cases rectified their decision facing a higher bid. While those farmers who answered no to UDP in the first question, they also held their negative response in the second question, even with a lower bid (see Figure 6-29). Also, these farmers decided what extra payment for the briquette sack would be the best, according to their thoughts. Figure 6-30 shows that these producers might pay extra US$2.45 on average. The majority of values range in $1 and $3.50 normally at all land size category. However, observations with highest monetary WTP were found in less than 1 ha category.

Then, the above questions were repeated to these farmers but now introducing the environmental impacts of UDP; capturing how important the environment is for these sampled farmers (EWTP). Once again, Figure 6-31 presents that high portion of farmers said yes to UDP, at all land size categories: 92.21% (less than 1 ha), 95.71% (1-2.99

ha), 93.33% (3-4.99 ha) and 83.87% (equal/more than 5 ha). Only one farmer in the largest category changed his mind about WTP and become unwilling; the other categories maintained similar responses like in the first round. What made this farmer to rectify his decision would be answered with the econometric model where I identify the most relevant factors affecting adoption decision. In general, 358 farmers said yes and 27 said no in the first question of the second round.

Now, 323 out of those 358 positive responses ratified their interest in possibly adopting UDP; only 35 changed their decision (see Figure 6-32). A point to be pointed out is that the positive responses of the high-bid question augmented by two farmers compared to the first round; this result implies that environmental may have made these two individuals reconsider the negative response to the adoption of UDP even with higher extra payment.

Going through the second question with a lower bid (see Figure 6-33), I found that only 1 out 27 people is willing to adopt at this lower extra payment; the rest is still reluctant to pay for Urea briquettes.

Meanwhile, in the open-ended question of the second round, the monetary EWTP has a similar distribution as that in the first round. Looking at Figure 6-34, one can see that EWTP ranges in $0 to $3.50. On average, a farmer would pay US$2.57 extra for a Urea briquette sack, 12 cents more than in the first round.

On the other hand, the potential hectares that can be dedicated for UDP production are seen in Figure 6-35. One person was decided to use 6 hectares with this technology; while one, even presenting interest in UDP, would not give any hectare (he might try UDP on donated land). On average, a farmer would utilize 0.80 ha for UDP production; the data are concentrated on 0.04 and 0.71 ha hypothetical UDP land sizes. Now, the key variable is the intensity of adoption; this variable is more informative because it does not just present the willingness of adoption, but also a level of adoption in term of the percentage of total land given to UDP production. Figure 6-36 shows that those in the smallest landholders (less than 1 ha) would dedicate more land than those largest ones (equal/more than 5 hectares). Particularly, I identified a vast number of farmers would expect to use UDP on 100% of their land, 131 cases. This result is based on the decision to censor the data at 100% (all values greater than 100% would be converted at 100%). Considering the uncensored IA, there were 22 farmers with the interest in utilizing more than their total land with UDP; valid answers because they can rent more land. On average, 49.70% of the total land may be dedicated to the UDP technology by these potential adopters.

In conclusion, this analysis allowed seeing a surprising high rate of adoption with this Double-bounded format. However, there was not a significant change of UDP adoption rate when the environmental impacts were introduced; WTP and EWTP presented the same adoption rate; when introducing environmental impacts , 2 farmers were willing to pay extra with a higher bid and 1 farmers, who said no to the first question, said yes to pay extra for urea briquettes. The rest of the reluctant farmers maintained their negative responses. In the end, one can assume that environment benefits might not be a significant factor when deciding the adoption of a certain technology. Additionally, the acceptance of UDP could also be seen through the IA, which shows some farmers willing to dedicate more than the current rice hectares for UDP production.

Rice Production System Analysis

One of the most important and time-consuming section in the questionnaire was Rice Production System Section. Fortunately, most of the farmers were willing to dedicate a significant time in order to collect valuable data such as: rice field, rice variety, inputs' costs (e.g. Urea, foliar fertilizers, herbicides, etc.), hired labor, and yield, among others; this information corresponds to the last cultivation season (production of 2011 spring). Finally, for comparison reasons, I divided all variable related to production by the total rice hectares.

I start out with the type of rice field of these rice producers. As is shown in Figure 6-37, almost every farmer employed the Paddy field in the data, 98.44%; the rest, 1.56%, implemented Poza field[5].

Farmers were also asked for rice varieties being used. The characteristics of these varieties are differentiated by: yielding, vegetative cycle, and grain size, among others (see Figure 6-38). Taking a look at Figure 6-39, variety 11 is the most utilized by the sample farmers, 288; varieties 14 and 15 were sown in 84 and 39 crops respectively. Finally, there are other varieties (e.g. 9, 10, 12, 16, 18, 21, Carvajal, Mancha Costa and Arroz el Pavo) being employed by 30 farmers[6].

In Figure 6-40, I have the total soil preparation cost per hectare given that a famer owned or did not own a tillage tractor (there are small tractor that can be afforded by farmers). I observe that those having tractor considerably reduced this cost: these

[5] Poza field are natural hollow which accrues water from rain. When the raining season is over, farmers cultivate rice in this land, only sowing on the top of this hollow at the beginning. As water goes down, farmers sow more rice seedlings. This traditional production is principally found in Los Rios Province, not visited by this study.

[6] A confirmation that Carvajal, Mancha Costa and Arroz el Pavo are native ones or only commercial varieties recognized with these names could not be reached.

farmers paid for this soil preparation US$35 less than producers without having tractor, on average. On the other hand, analyzing this cost per hectare by land size categories, those farmers with the less than one hectare spent more on average than other landholders: US$218.03 (less than 1 ha); US$139.22 (1-2.99ha); US$115.81 (3-4.99ha); and US$136.60 (equal/more than 5 ha).

In Figure 6-41 is presented seed costs (US$/ha). How the cost decreases while the land size increases is observed. Again the smallest landholders, on average, invested more than those largest ones on seed cost per hectare: US$89.60 (less than 1ha); US$52.10 (1-2.99 ha); US$53.80 (3-4.99 ha); and US$60.96 (equal/more than 5 ha).

Acquisition of the main rice fertilizer, Urea, is also analyzed in this part. In Ecuador, there are different ways to obtain Urea sack (50 kg): government provision, market and others. Ecuadorian government is providing subsidized Urea sacks for those small farmers, but they can also buy at the marketplace. In addition to these alternatives, there is a black market (or other providers) where the Urea sacks are sold informally (such black market is composed of those farmers or other people who buy Urea sacks to resell them at higher prices; perhaps, these people buy and resell the subsidized Urea). There is a question asking farmers for the Urea sacks bought in the last season. Displayed in Figure 6-42 is the total Urea (sacks/ha) bought by landholder groups. In the smallest land size group, there is a farmer acquiring up to 100 sacks/ha. However, the other groups present a less wide range, between 2 up to 40 sacks/ha. On average, the group of less than 1 ha bought 12 sacks/ha, 1-2.99 ha and 3-4.99 ha purchased 6 sacks/ha, and equal/more 5 ha obtained 5 sacks/ha. This result may show that some farmers may be utilizing more than the necessary, keeping Urea sacks for future seasons or reselling them. In the first case, 4 Urea sacks are appropriate to fertilize one hectare. For instance, a producer said to have had 0.04 ha and bought one Urea sack; if he used the entire sack, this represents 25 Urea sacks in a hectare, utilizing 19 sacks in exceed. In the second case, Urea is not produced in Ecuador and this fertilizer is imported. As a result, a farmer might have gotten more Urea sacks to prevent production from possible shortages. The last case, based on the fieldwork, farmer informed that buying Urea sacks and resell them at higher prices is a common activity there. A problem can occur when subsidized Urea is resold at a better price; if so, this subsidy would not be reaching its objective of reducing costs as low as possible. An example of these two latter cases is a farmer with 10 ha bought 100 sacks, presenting exceed of around 40 sacks. In detail, subsidized, marketplace and black-market acquirers summed 174, 248 and 10 cases respectively.

Similarly, data about Urea sack prices were also collected for these different markets. Figure 6-43 presents these prices. An interesting point is associated with the government price. As farmer were asked for Urea sack price of the last season (December, 2010-Marzo, 2011). The government prices that should have received as an answers are: US$10/sack or US$15/sack[7]. However, farmers' responses demonstrate that the subsidized Urea sack price fluctuates between US$10/sack and US$29/sack (blue line). On average, subsidized price, market price and black-market price were US$14.88/sack, US$28.92/sack and US$24.11/sack. Different Urea markets

[7] The price increased in January of 2011

with several prices. Such results demonstrate how a farmer faces uncertainties not only in the end of the production with variation of rice prices but also in the beginning.

Figure 6-44 shows costs of other fertilizers a hectare. Once again, the smallest landholder group presents observations spending more than those in the largest group. On average, one farmer in group less than 1 ha invested US$191/ha on these additional fertilizers, followed by 1-2.99 ha cluster with US$129/ha, 3-4.99 ha with US$127/ha and equal/more than 5 ha with only US$66/ha.

Furthermore, herbicides/insecticides costs per hectare were displayed in Figure 6-45. Only four farmers mentioned not to have acquired these inputs in the last season. Most of the farmers spent less than US$200/ha in these inputs. Still, the smallest farmers spent, on average, more than the other others categories. Thus, less than 1 ha groups exceeds to the other groups in US$45/ha (1-2.99 ha), US$54 (3-4.99 ha) and US$38/ha (equal/more than 5 ha).

Day laborers are hired to mainly work on sowing and application of inputs (i.e. Urea, other fertilizers, herbicide and pesticides). Therefore, in Figure 6-46 are plotted day laborer cost per hectare by numbers of household members. As a first thought, one can assume that if there are more members in a family, the cost of the hired day laborer should be lower. However, the aforementioned intuition is not seen clearly. Having 1 or 8 members in a household does not significantly the mean hired labor cost according to the sample. Actually, comparing the average hired labor cost of one-member households (US$192/ha) with five-member ones (US$194/ha), I found that the latter spent even more, US$2. In general, a farmer invested US$188/ha for this resource, on average. Finally, analyzing the mean cost by land size group, still those smallest farmers, less than 1ha, paid US$13/ha, US$14/ha and US$17/ha in exceed compared to 1-2.99 ha, 3-4.99 ha and equal/more 5 ha groups respectively.

Furthermore, water provision cost was also asked. There are two different sources of water provision: by the Agricultural Organization or/and by taking from the river or raining (there could be no cost or the cost comes from buying fuel to transfers water from the river to the crop with water pump). To simplify, I added these source of water provision as unique cost per cultivation. Then this cost was divided by the total hectares. Thus, Figure 6-47 shows that the average cost of each group is as follows: less than 1 ha with US$75/ha, 1-2.99ha with US$41/ha, 3-4.99ha with US$36/ha and equal/more than 5ha with US$26/ha.

In the harvest time, farmers have several costs. For example, they usually rent a combine from their agricultural organization, hire day laborer to pack rice grains into the sacks, pay for transportation of these rice sacks, etc. However, some farmers do not rent any combine or hire labor and this is the reason for what costs differ within farmers. To simplify the information gathering, I estimated the total cost a hectare. As is seen in Figure 6-48, farmers' harvest costs per hectare do not exceed US$1500 in all land size categories. However, on average, a farmer spent in the groups as follows: US$368 (less than 1 ha), US$282 (1-2.99 ha), U$354 (3-4.99 ha) and US$280 (equal/more than 5 ha).

In Figure 6-49 is presented the rice yield (kg/ha) by land size group. The range of this variable is between 1,000 kg/ha to 19,000 kg/ha. Surprisingly, a farmer got 743.89 kg (8 sack of 205 lb.), having 0.04 ha which means 18,597.28 kg/ha. This is why there are some observations with extreme values, but those are, in fact, real values. On average, a farmer could get 5,892.15 kg/ha (the national mean is 4360 kg/ha). Taking a look at land size groups, the mean yields are as follows: 6,427.95 kg/ha (less than 1 ha); 5,590.57 kg/ha (1-2.99 ha); 5,475.65 kg/ha (3-4.99 ha) and; 5,398.51 kg/ha (equal/more than 5 ha). A surprising fact was found those smallest farmers have better rice yield per hectare than the largest landholders.

Once harvested and know the amount of rice sacks yielded, farmers decided how many sacks would be for own consumption and for sales. Figure 6-50 presents the percentage of rice sacks sold by land size category. As is seen, much of the production is sold, 87.73%, on average. Few farmers just produced for own consumption, 5 in total. Furthermore, those in 3-4.99 ha and equal/more than 5 ha groups may be categorized as complete rice sellers because the majority of their production was put into the marketplace. On average, the percentages of rice sacks sold by land size category are as follows: 81% (less than 1 ha), 91% (1-2.99 ha) and 94% (3-4.99 ha and equal/more than 5 ha).

Incomes per hectare are shown in Figure 6-51. On average, a farmer got US$1556.60/ha. In contrast, three farmers did not gain any income because they produce for own consumption. The mean incomes per hectare by land size group were: US$1648/ha (less than 1 ha), US$1508 (1-2.99 ha), US$1539/ha (3-4.99-ha) and US$1354 (equal/more than 5 ha). On the other hand, calculating the rice net income is a special task because these production costs may not only be representing to the last season but also future ones (e.g. Urea sacks bought for futures fertilizations or resale). Assuming that those costs were incurred only for the last rice production, a farmer would make, on average, US$305.51/ha. However, an important portion of farmers would make a negative or zero rice net income, 118 cases. Comparing the land size categories, I got as mean net rice income: US$71/ha (less than 1 ha), US$464 (1-2.99 ha), US$480 (3-4.99 ha) and US$413/ha (equal/more than 5 ha). The smallest landholders made the lowest net income per hectare because of their higher costs.

Credit and Insurance Market Analysis

A credit section was also prepared in the survey instrument in order to know about the credit access of these sampled farmers. The collected information attempts to identify those credits solicitants, moneylenders, sum of money, etc. The analysis of these data is limited to the last year (2010-11).

The question to observe credit market participation of these farmers was: have you ever asked any credit during the last year? Figure 6-52 shows that a 47% (181) of these farmers applied for a credit. However, the majority did not ask for a credit, 52.88% (204). In the end, those credit solicitants actually obtained the credit without any problem. The last result may demonstrate that there is credit availability over the rice zones visited.

Additionally, farmers mentioned to those institutions, people or others that provided credits in their zone. As shown in Figure 6-53, the most mentioned provider is the so called “Chulquero”; 79 farmers acquired a credit. A “Chulquero” is a person offering loans usually at usurious interest rate. This is an illegal practice that is very common not just in the rural areas, but also in big cities. However, many farmers opt for credits from these providers because there are no requirements to get the credit; just to pay off the loan at a higher price. Other mentioned sources of credit were banks (46), Rice Mill (31), Cooperative (12), Friends/relatives (10) and others (1).

Farmers were also asked for the amount of money they required as a credit. Taking a look at Figure 6-54, one can see that being a larger landholder requested more money. For instance, a farmer with equal/more than 5 ha asked, on average, US$3964.706. Meanwhile, those have less than 1 ha solicited US$700.625, on average. This is a logic result given that the majority of the credit was spent on inputs.

Figure 6-55 demonstrates that most of the farmers (133) utilized the money borrowed on inputs such as seeds, fertilizers, herbicides, etc. In addition, 130 rice producers employed the credit on machine and equipment for the production; machine stands for the tillage tractor that some farmers must rent or sometimes acquire to prepare the soil before sowing. Credit was also used for family expenses such as health and education and the payment of previous debts, 79 farmers. Other items on what the credit was spent are: vehicle parts (54), house arrangements (14) and other such as entertainment and household consumption (8).

Finally, there was also question identifying if these farmers were crop-insurance holders in these zones. In Figure 6-56 is seen that only a 4.67% (18 observations) of the sample was insurance holders. Such results can be justified by María José Castillo (2011) about the insurance market situation in Ecuador: lack of insurance culture and the complexities of insurance agricultural market (i.e. risk coverage, high prices, etc.). According to MAGAP, there were a total of 3,885 insurance policies in 2011 (January-August). Ecuadorian government is subsidizing a 60% of the crop insurance cost mainly for rice, wheat, maize and potato[8]. None of these insurance holders mentioned to have a subsidized insurance.

[8] See Ministerio de Agricultura, Ganaderia, Acuacultura y Pesca 2011.

Time Availability and Non-Work Income Analysis

Another interest of this thesis was to gather information about the family workforce over these households and the main source of income. Consequently, this section is to analyze labor data such as main occupation and the hours spent on on-farm and off-farm work, and education. This information is available for the father, mother and the first son/daughter of a household. Additionally, a question about non-work income (e.g. donation or government monetary transfers) was introduced.

Starting with the main sources of money, Figure 6-57 demonstrates that the main occupation of these farmers is the on-farm activities (or rice production). For instance, 358 out of 375 fathers work in rice production and 15 in off-farm activities. Meanwhile, 5 fathers do not generate any income; these fathers were mentioned as household heads but their sons/daughters were in charge with the rice production. On the other hand, mothers are also participating in farming and in other activities. In total, 20 mothers were related to the rice family business directly, 38 in off-farm work and 304 in housework. Additionally, main occupation of a son/daughter was also collected. Thus, 126 son/daughters were included in the rice activities; but there were 36 sons/daughters working outside of the rice production. Finally, some of these sons/daughters were not making any income, 195.

Similarly, Table 6-4 presents hour availability of a household in a day. On average, a household dedicated 6.05 hrs/day to the rice business; off-farm jobs demanded 1.75 hrs/day; and those studying utilized 1.99 hrs/day in this activity. Taking into consideration to only those with off-farm and on-farm work, the mean hours spent on these activities are 6.65 hrs/day and 6.76 hrs/day respectively. Two points should be highlighted here: 1) there are job alternatives which can be produced income that could function as extra capital for family rice production; and 2) this insignificant difference between hours of off-farm and on-farm activities may tell that job alternatives could be being becoming in more profitable over time[9]. However, if farmers are changing their work on these substitute activities, such a fact may be a threat for the rice production in the Ecuadorian Coasts in the long time. Further research may be clarified this fact.

Figure 6-58 shows that a big part of these rice farmers is receiving non-worked income, 60% (154 farmers). The unique source of a non-worked mentioned by these farmers was the government transfers. In Ecuador, Human Development Bonus (US$35 monthly transfers), the Solidarity Credit and Human Development Credit (credits up to US$840 for two years) are programs mainly for poor people. The last two programs are directed for those who want to develop a business (e.g. rice production). The final objective is to allow these poor to alleviate poverty. To simply the analysis, all these transfers and credits were converted to monthly. Figure 6-59 shows these monthly transfers. On average, a farmer received US$34.95[10].

Econometric Results

At this moment, a descriptive picture of the sample farmers' likelihood system was examined with a descriptive analysis. Now, results of the dependent analysis are presented in this section. The econometric model that better fits UDP adoption was a Tobit. Intensity of Adoption is a right and left censored variable through which the research question will be answered: Who are the potential adopters of UDP?

---

[9] Off-farm works mentioned by these farmers were: livestock, apiculture, handicraft, clothes' trading, education, convenience store, tailor's trade, etc. Some of these activities are known as sub-occupations or informal occupations which are temporary (handicraft, clothes, trading and tailor's trade).

[10] Those credits are paid off with the same Human Development Bonus, so, farmers would not receive any transfers until cancel all the debts. These credits assumed to be transfers in advance.

Determinants of adoption were established based on the extensive literature consulted in this thesis. Therefore, this section is managed in the following order: 1) explanation of the independent variable; 2) Tobit model outcomes and the marginal effects; and 3) Post-estimation analysis.

Descriptive Summary of the Variables

Table 6-5 provides a statistic summary of the data that is employed to estimate the IA model: mean, standard deviation, minimum and maximum values. Each variable was labeled with the real name to have a better understanding. The Tobit model is finally composed of variables related to subjects such as farms' and farmers' characteristics, production variables, credit participation, agricultural insurance and risk aversion, UDP diffusion, income sources and social network.

Starting with the dependent variable, it is a measure that indicates the percent of the hectares that will be given for UDP production (D. Joshua Qualls et al. 2012). This variable does not just provide a farmer's interest for UDP but also, the level of the adoption of such technology. The values are in percentages.

Referring to farmers' characteristics, gender, age and education have been largely used to explain adoption decision (Cheryl R. Doss and Michael L. Morris 2000; Rajni Jain, Alka Arora and S.S. Raju 2009; Conor Keelan et al. 2009; D. Joshua Qualls et al. 2012). Gender is a binary variable taking values of 1 for male and 0 for female. The age of a household is represented by the variable Age which is in years. Also, there are two types of education variable, one containing the years of general education (continuous variable) and a binary variable specifying if a farmer attained any agricultural education (i.e. fertilizer, harvest, tillage and other techniques).

Farm's characteristics have also been introduced in adoption models (Khanna and Madhu 2001; Gunnar Breustedt, Jörg Müller-Scheeßel and Uwe Latacz-Lohmann 2008). As a result, land size, number of small kids, wealth index, drought or/and flood affections, and distance to the main town were included. Particular interest is focused on the land size because the UDP technology seems to better work in small farms. On the other hand, distance to the main town may be seen as a market access variable; some household are really far away to market which is placed in the downtown of Daule and Santa Lucia.

Similarly, variables related to the production system were also included in the model: binary rented land variable; per-hectare subsidized Urea sacks (50 kg) and non-subsidized Urea sacks (50 kg); labor cost per hectare (it contains costs of sowing and fertilizer/herbicide/insecticide application); total other cost per hectare (it includes costs of tillage, seeds, herbicides/insecticides, non-urea fertilizers, irrigation and harvest); and yield variable (sacks of 205 lb/ha). Moreover, Urea sacks and labor cost require special attention given the UDP characteristics: reduction of Urea sacks applied and increase of labor[11].

Also, past adoption variables was taken into consideration in this analysis. This binary variable refers if a farmer has introduced a technique, idea or technology into his rice production system (yes is 1 and no is 0). In this sense, one could see how likely a farmers was in the past to adopt a technology. The effect of this factor must be positive as farmers who adopted agricultural innovations before would be more willing to utilize new ones, like UDP, in the present.

[11] The consideration of urea sacks are discussed in the Rice Production System Analysis in Chapter 6.

Credit participation, Insurance solicitation and risk aversion were also explanatory factors taken into account (Gershon Feder and Dina L. Umali 1993; Franklin Simtowe and Manfred Zeller 2007; Conor Keelan et al. 2009; María José Castillo 2011). Credit and insurance variables are binary response. Meanwhile, the risk aversion is measured through the following statement: I will use a new Urea fertilization method without caring if others used it firstly; the Likert scale is 1=disagree, 2=Indifferent and 3=agree.

Other determinants of adoption are related to: hours spent on on-farm and off-farm works (hours on education is considered as well) and if a farmer obtained non-work income (Cheryl R. Doss 2006; Haluk Gedikoglu and Laura M.J. McCann 2007). Total on-farm hours stand for the hours dedicated to the own rice activity by a household. In contrast, total off-farm hours represent the time used in other works by a household (e.g. daily laborer, teacher, janitor, etc.). Finally, there is the binary variable non-work income which 1 if a farmer received such income and 0 otherwise.

The last variables are linked to the peers effects or social network in general (A. D. Foster and Rosenzweig 1995; Conley, Timothy G., and Christopher R. Udry 2010; Oriana Bandiera and Imran Rasul 2006). In order to avoid the endogenous problem of these variables, I followed Oriana Bandiera and Imran Rasul (2006). Therefore, three variables were designed: numbers of people in their religious group, number of people in the extended family group and number of people in the agricultural/other groups. In this sense, one can know by intuition the social network size of a farmer.

Thus, 27 regressands were placed in the model, trying to take into considerations the widely utilized variables in different technology adoption researches and also, attempting to maintain the parsimony of the model.

Tobit Estimation

The final Tobit model was grounded by the evaluation of measurements of goodness of fit[12]. Also, Intensity of Adoption was censored at 0 (19 observations) and 100% (131 observations). On the other hand, regarding the Heteroscedasticity, there are data with values that behave very different to the rest of other observations (outliers) but they were left because of the total logical sense with reality. Moreover, this study is dealing with microeconomic data. Those two aforesaid facts may be sources of Heteroscedasticity (Damodar N. Gujarati and Dawn C. Porter 2009). In order to obtain robust estimators, the variant estimation of Bootstrapped Tobit Model was applied (A. Colin Cameron and Pravin K. Trivedi 2010). Also, the assumption of well specified model is held. Finally, in the Post-estimation analysis is discussed the possible Multicollinearity problem and the analysis of the Residuals.

Table 6-6 contains the outcomes of the Tobit estimation. Utilizing a Maximum Likelihood approach, a total of 11 significant variables were found: rented/owned land size (ha), numbers of small kids in a household, time to get the main town, binary rented land variable, subsidized Urea sacks per hectare, binary credit solicitation, binary agricultural insurance, Likert-scaled risk aversion, binary UDP knowledge, on-farm hours/ha and social networking variable number of people in the family group. These variables were significantly important at confidence levels of 1%, 5% and 10%, according to the t-test. As additional information, the marginal effects on the continuous part of IA Tobit model are also displayed in Table 6-6. These significant regressands

[12] Several Tobit models were estimated which did not differ significantly in any of measurements of goodness of fit and producing stability in estimators (similarity in signs and magnitude).

have the hypothesized effect (correct sign) on adoption decision based on the literature review.

Urea Deep Placement would better function in small parcels because the cost of placing the Urea briquette in soil can be absorbed by the family labor without hiring people (Thomas P. Thompson and Joaquin Sanabria 2009). On the other hand, large farmers would have to hire more people given the harder work to apply the briquettes. As a result, the total rented/owned operated land (ha) coefficient is negative: the smaller cropland, the higher intention to adopt UDP. In order words, if a farmer acquires one more hectare, the mean value of IA would decrease in 1.74%, ceteris paribus. In this study, all these farmers are considered small (less than 20 hectares). Also, a possible endogenous problem of farm size can be faced because land size can be related to wealth or capacity to bear risks, and so on (see D. Joshua Qualls et al. 2012). However, as these farmers present similar characteristics (e.g. they are holding small farms, facing the same credit market, hving slightly different level of wealth, etc.), no endogeneity is assumed in this thesis.

Regarding the children in a household, this could restrain the experimentation/adoption of an innovation given that farmers must dedicate enough time to the caring of their children. Gunnar Breustedt, Jörg Müller-Scheeßel and Uwe Latacz-Lohmann (2008) corroborated this result in the adoption of Oilseed Rape where the presence of small kids may influence such adoption negatively. Following this intuition, this variable produces the same effect in this Tobit model, signifying a reduction of 1.30% of the expected average hectares dedicated to UDP when a child is added to the household, holding other factors constant. Not just mothers have to take care of their children but also the fathers. Perhaps, further research, having a comparable sample size between female and male farmers, may conclude that females would be less likely to adopt because they are more related to the housework and kids caring than males.

Unsurprisingly, the time to get to the main town seen as the market access measure is negatively associated with the Adoption of UDP. This coefficient asserts that being close to the market (or less time needed to get the main town) so that reduction of transaction cost of reaching agricultural services, input suppliers, trading house or in this case, Urea briquettes, increases the probability of UDP adoption (Madhu Khanna 2001; S. J. Staal et al. 2002). According to the marginal effect of the market access, on average, if a farmer increases one minute to get the main town, he would dedicate 0.18% less of their total land to the UDP production, holding other things constant.

According to the Literature Review, it is difficult to clearly know what effects land tenure (owned or rented) could have on adoption (Gershon Feder and Dina L. Umali 1993; Conor Keelan et al. 2009; D. Joshua Qualls et al. 2012). In this Tobit model, if a farmer rented his cropland, he is more enthusiastic for UDP innovation. Thus, a farmer will on average put into UDP production 5.03% more of his rented/owned land when he is a renter, ceteris paribus.

As a first ideation, more Urea sacks applied per hectare would imply a higher willingness to adopt UDP because of Urea reduction benefit. However, the subsidized Urea sacks in a hectare yielded a negative affection on Adoption: one more subsidized Urea sack acquired reduces the expected hectares for UDP in about 0.37%, ceteris paribus. As said earlier, this variable encloses different effects in reality: the subsidy, resale and future employment. Analyzing the final result carefully, this study assumes that a peasant purchasing subsidized Urea may perceive UDP as a threat: they are bearing a relatively low Urea cost with the subsidy (or profiting with the resale at higher prices) and the coming of UDP technology may make government reconsider the subsidy as farmers would utilize Urea more efficiently. As practical exercise, more than the 50% of those subsidized farmers, who bought more than the required amount of Urea sacks, were willing to give less than 50% of their hectares to UDP technology.

Credit solicitation would impact positively on UDP adoption. The intuition of this result may be that cash resource is available to invest on new and improved ideas. These sources of cash let farmers have the capacity to face the costs of UDP or any innovation inside their production system (e.g. more labor). Thus, they would be the first that will take advantages of the benefits of UDP (e.g. yield and income increase and Urea reduction). According to the estimated Intensity of Adoption model, farmers that asked for a credit would probably give, on average, 3.04% more of their total hectares for UDP production, ceteris paribus.

Additionally, having rice insurance may positively explain the occurrence of UDP in these surveyed farms. Being covered from different risks (e.g. drought, flood, uncontrolled plagues, etc.) makes a farmer allocate 8.37% of his total land in UDP production, ceteris paribus.

Also, the risk aversion gauged by a statement exhibited a positive association with the adoption behavior. This means that those more risky farmers may on average increase the UDP hectare by 2.79%. These types of farmers can also be properly names as “Entrepreneurs”.

Possessing information of UDP would intensify the adoption of UDP. Although these farmers affirmed to need more knowledge of UDP, some of them could observe the encouraging outcomes of UDP experiments in Daule which stimulates its adoption in the future. The marginal effect is of 5.17% on IA.

UDP technique requires labor for its development. Therefore, one solution is to hire more workers. However, the ideal situation is to have more household members or in its defect more time available for on-farm work. Consequently, those households with more on-farm hours used in a hectare are more likely to insert UDP method in their production; an additional hour spent on on-farm work may make farmers add 0.23% of their total hectares to UDP production, ceteris paribus. These households have enough family workforces to avoid the main obstacle of UDP “increase of hired labor”.

Finally, the social network effect was positive on Intensity of Adoption. According to the results, endogenous problem would be avoided given the insignificancy of the number of people on agricultural/other group. In the end, this coefficient states that a farmer having a numerous social network with potential UDP adopters may dedicate 0.46% more of his total rice land for UDP production, holding the rest constant.

Post-Estimation Analysis

There some issues that the any estimation can arise. However, those affecting this econometric analysis are: multicollinearity, Heteroscedasticity and Normality. Through the section, they will be explained and tested. The methods to analyze these problems are through tests, graphs and indexes.

Multicollinearity may always be present in all models even more when 26 regressands have been incorporated in this Tobit setting. In the presence of collinear variables, error standards and variances tend to be infinite and estimators are not converging to a unique solution (see Damodar N. Gujarati and Dawn C. Porter 2009). In William H. Greene (2012) are pointed out some of the consequences of the collinearity: enormous fluctuation in estimators with small data changes; jointly significance of the estimators and elevated R-square but high standard errors and insignificance t ratios of these estimators; and mistaken signs and magnitudes of the estimators. None of these symptoms are observed in the Tobit model. However, using the tolerance index and the variance inflation factor, one is able to see to what extent is found such problem (Damodar N. Gujarati and Dawn C. Porter 2009).

Tolerance index and the VIF are reciprocal. Therefore, the interpretation of the variance inflation factor is that the higher the value, the more eminent the collinearity; meanwhile, for tolerance is the opposite. As is shown in Table 6-7, the variance inflation factor of each 27 variables is not greater than 10 and the tolerance is not so close to zero. As a conclusion, one can make the assumption of relatively low presence of multicollinearity in the Tobit model proposed in this thesis.

In examining the Residuals, Figure 6-60 demonstrates that they have volatile behaviors. As said above, this econometric examination is facing with some atypical observations and microeconomic data which are important Heteroscedasticity sources. In the end, I may conclude that the model is suffering this problem. However, bootstrapping estimation would let estimators be robust (A. Colin Cameron and Pravin K. Trivedi 2010).

On the other hand, once I computed the Residuals of the Tobit model, Jarque-Bera test was used to analysis the Normality Distribution of the model. The null hypothesis under this test is Normality. Figure 6-61 shows Residuals' distribution that slightly looks as a Normal. However, the test produces a p-value of 0.05% telling that Normality is not reached by the Residuals' distribution.

The purpose is to circumvent any violation of the regression assumption. As a result, I went over these tests and used the bootstrapping method. A more profound analysis is left for further research.

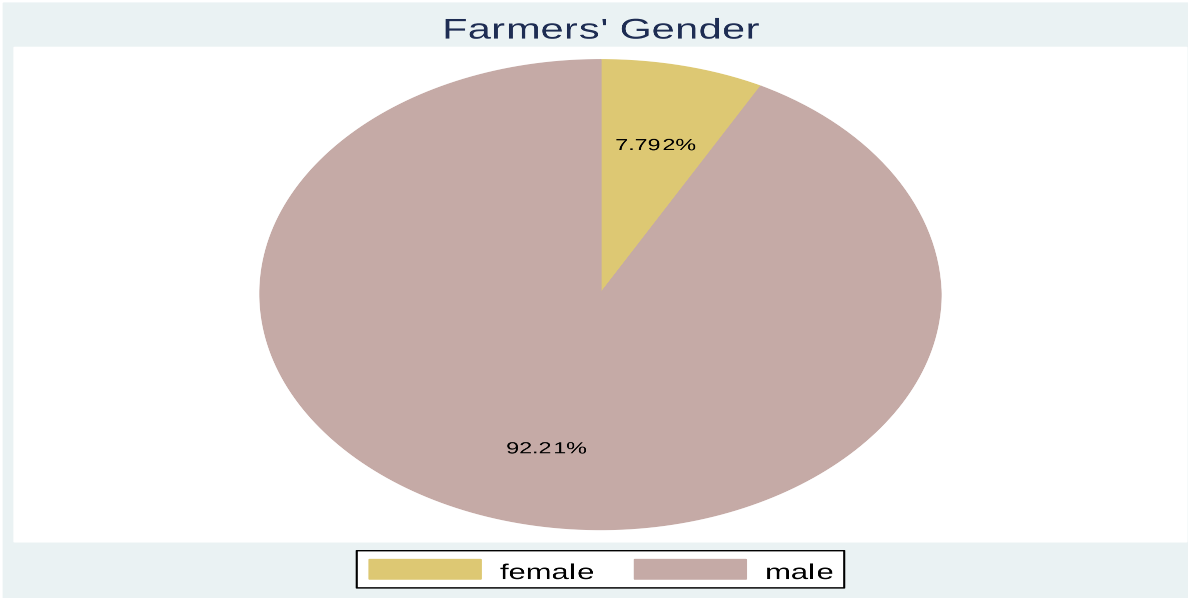

Figure 6-1. Farmers’ gender (Source: Author)

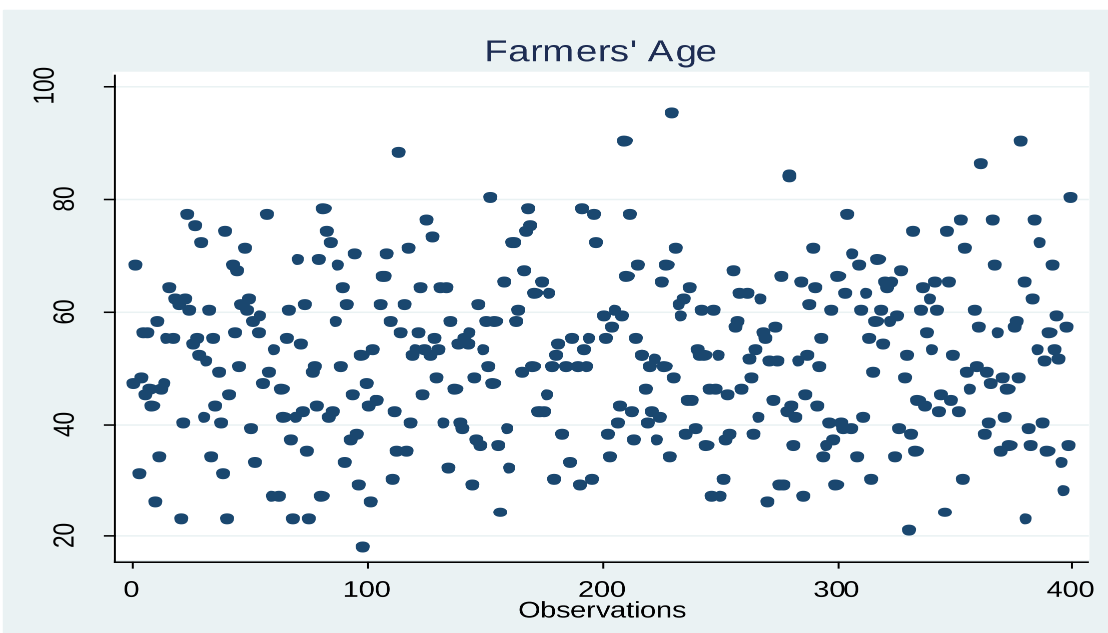

Figure 6-2. Farmers’ age (Source: Author)

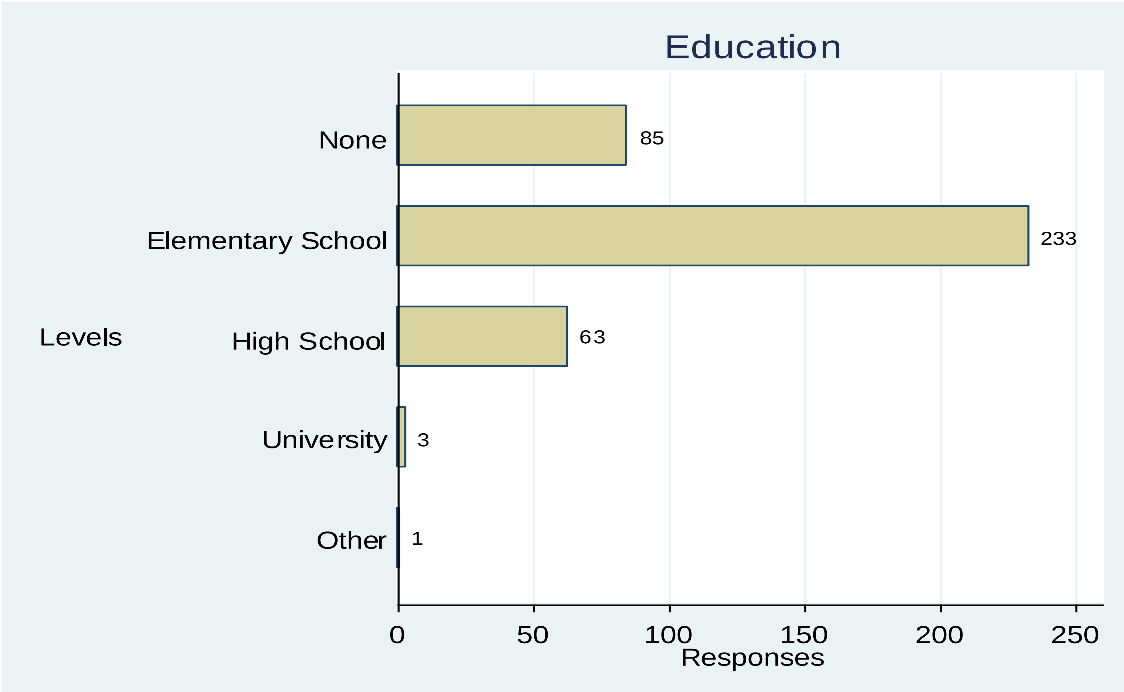

Figure 6-3. Education (Source: Author)

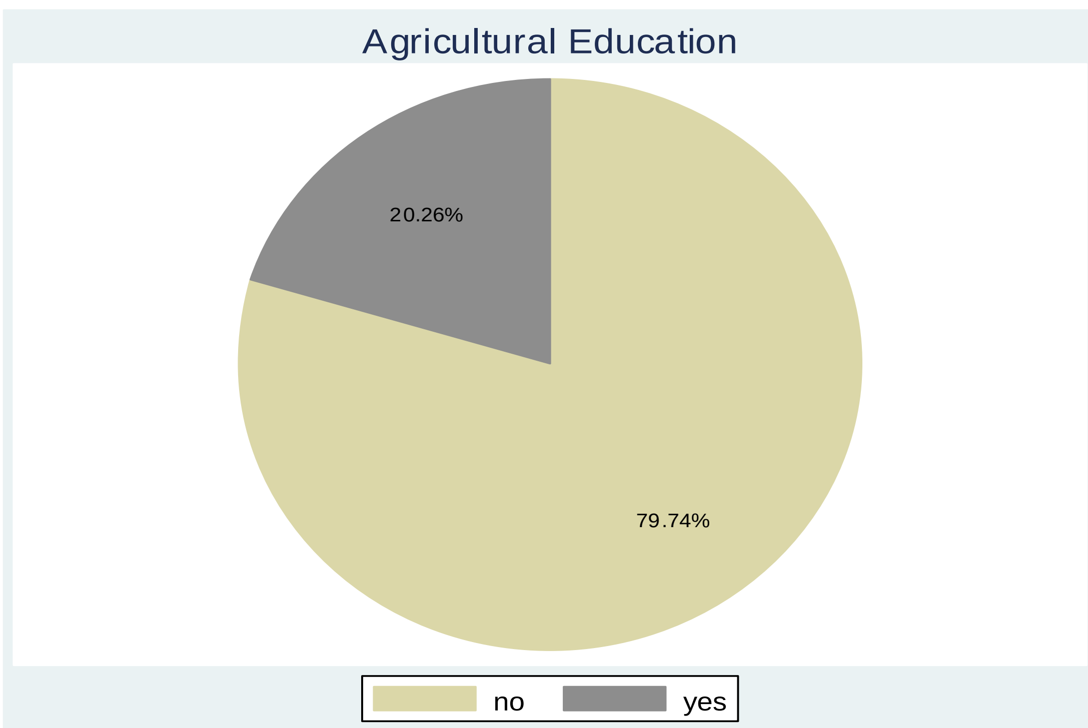

Figure 6-4. Agricultural education (Source: Author)

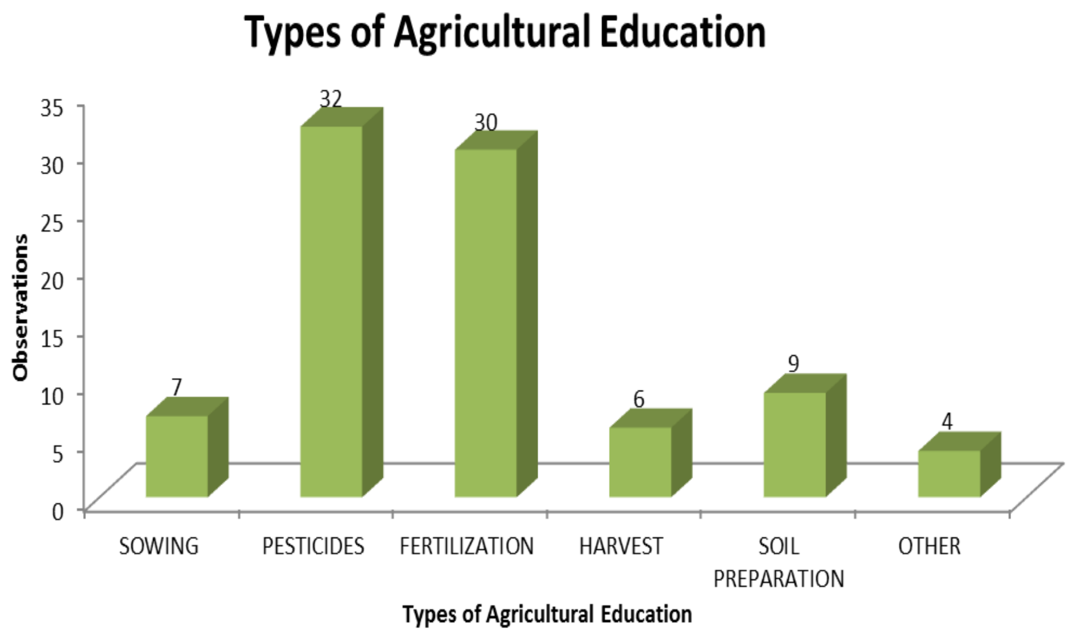

Figure 6-5. Types of agricultural (Source: Author)

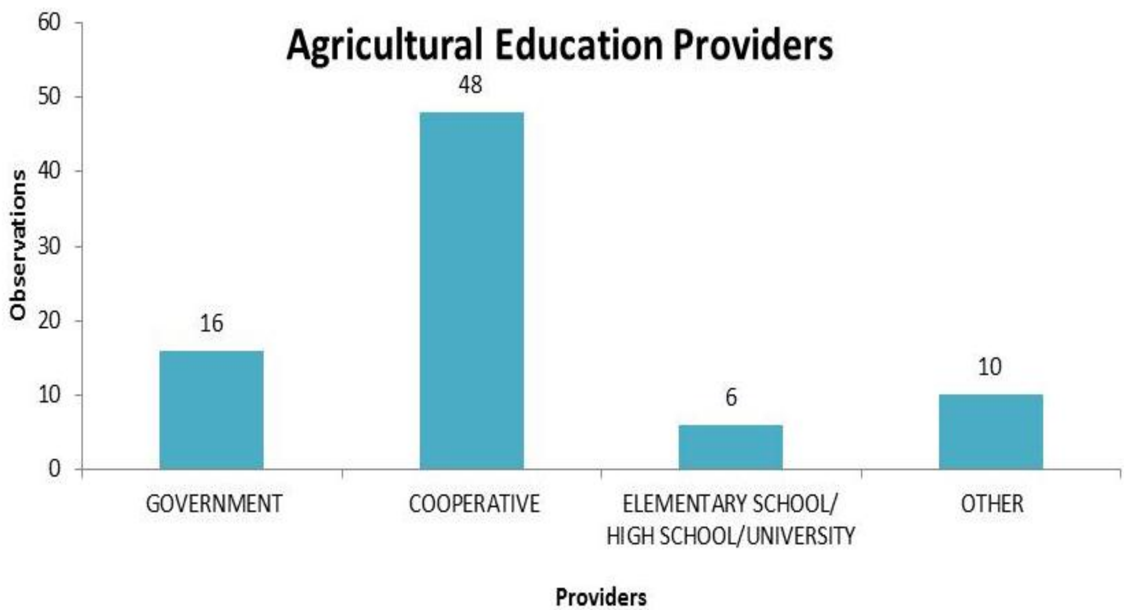

Figure 6-6. Agricultural education providers (Source: Author)

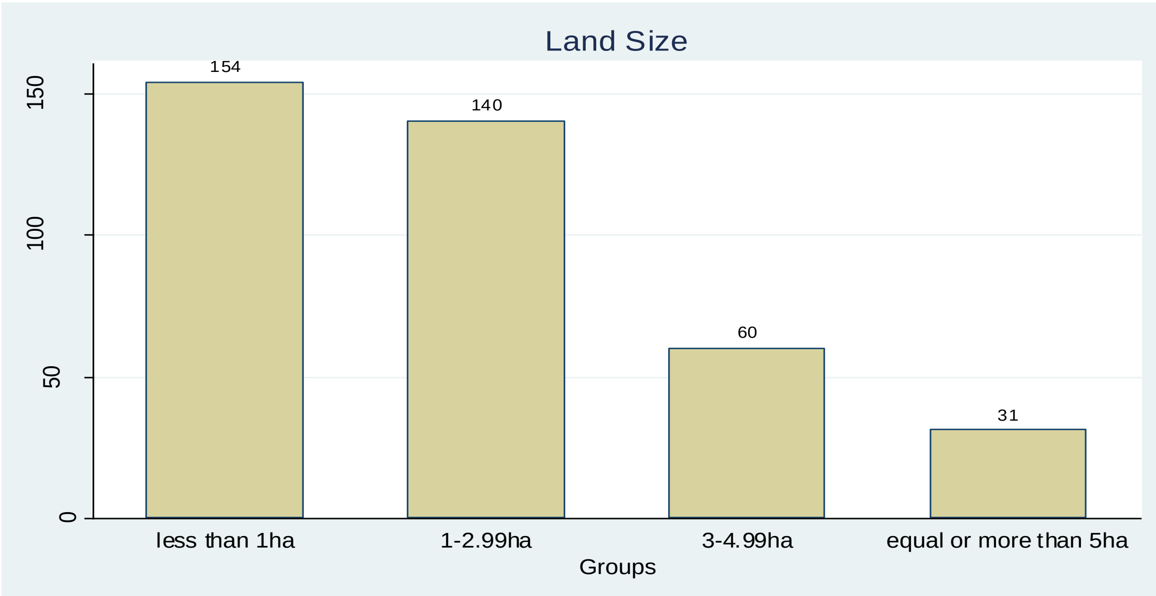

Figure 6-7. Land size groups (Source: Author)

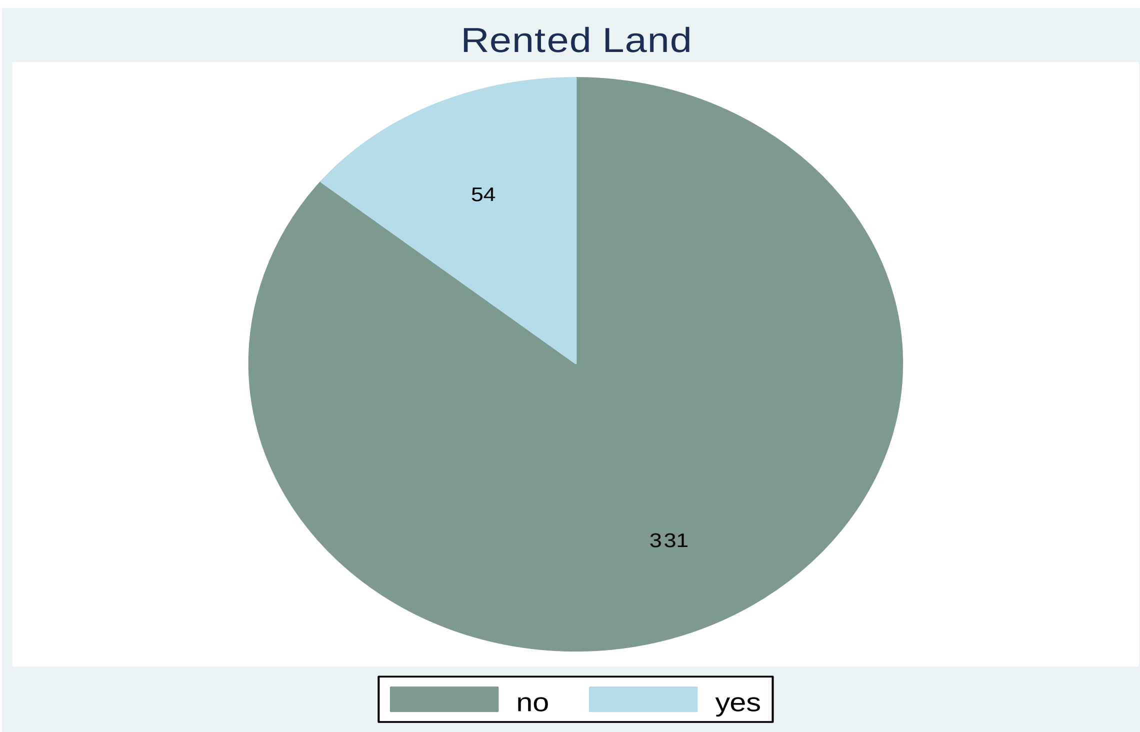

Figure 6-8. Rented land (Source: Author)

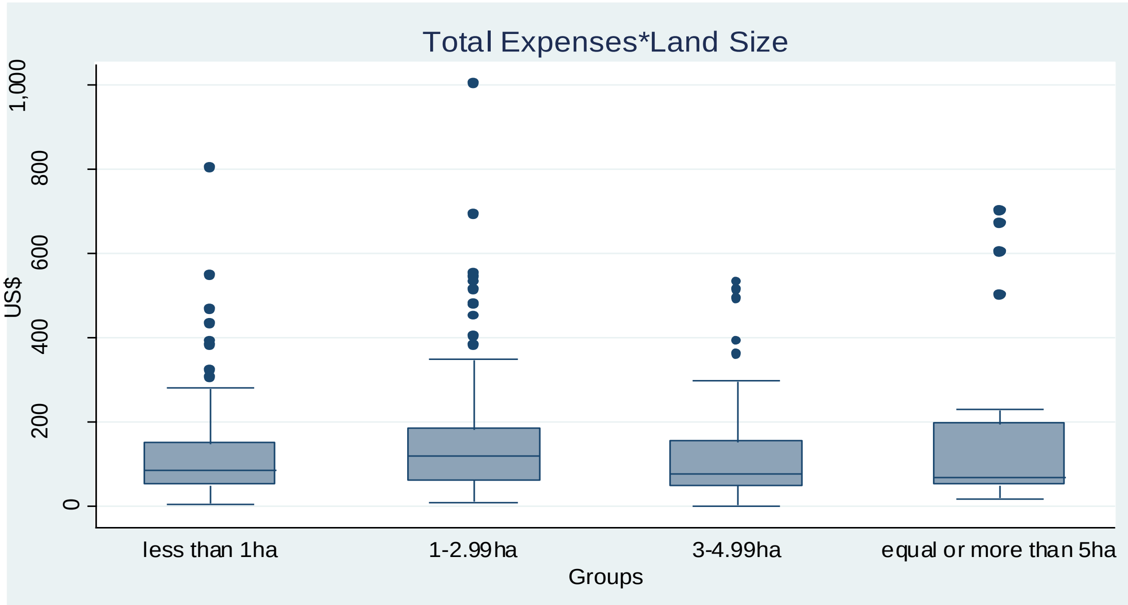

Figure 6-9. Total expenses by land size groups (Source: Author)

Table 6-1. Factors matrix (Factor Analysis)

Factor analysis/correlation		Number of obs	=	385
Method: principal-component		Retained factors	=	1
Rotation: (unrotated)		Number of params	=	17
Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	2.1171	0.155	0.1245	0.1245
Factor2	1.9621	0.2662	0.1154	0.24
Factor3	1.6959	0.5262	0.0998	0.3397
Factor4	1.1697	0.015	0.0688	0.4085
Factor5	1.1548	0.0292	0.0679	0.4764
Factor6	1.1256	0.0359	0.0662	0.5427
Factor7	1.0896	0.062	0.0641	0.6068
LR test: independent vs. saturated: chi2(136) = 1.4e+04 Prob>chi2 = 0.0000				

Source: Author

Table 6-2. Coefficient matrix (Factor Analysis)

Scoring coefficients (method = regression)	
Variable	Factor
Tractors and other major equipment	0.23339
Storeroom	0.25414
Irrigation Pump	0.18732
Harvester	0.2138
Fumigation machine	0.29288
Car	0.27204
Electric Plant	0.10194
Drinkable water service	0.06549
Electricity Service	-0.02403
Phone Service	0.23968
House made up of cement	0.05945
House made up of wood	0.0854
House made up of cane	-0.13946
Own household	0.0878
Rented household	-0.03919
Borrowed household	-0.03865
Shared household	0

Source: Author

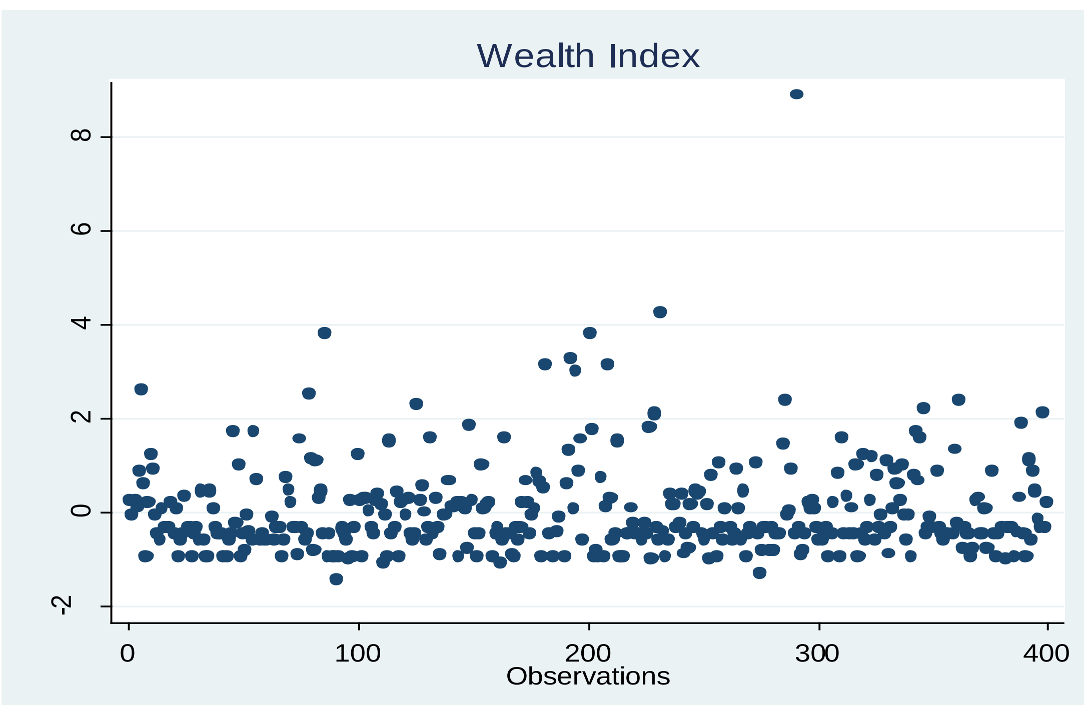

Figure 6-10. Wealth index (Source: Author)

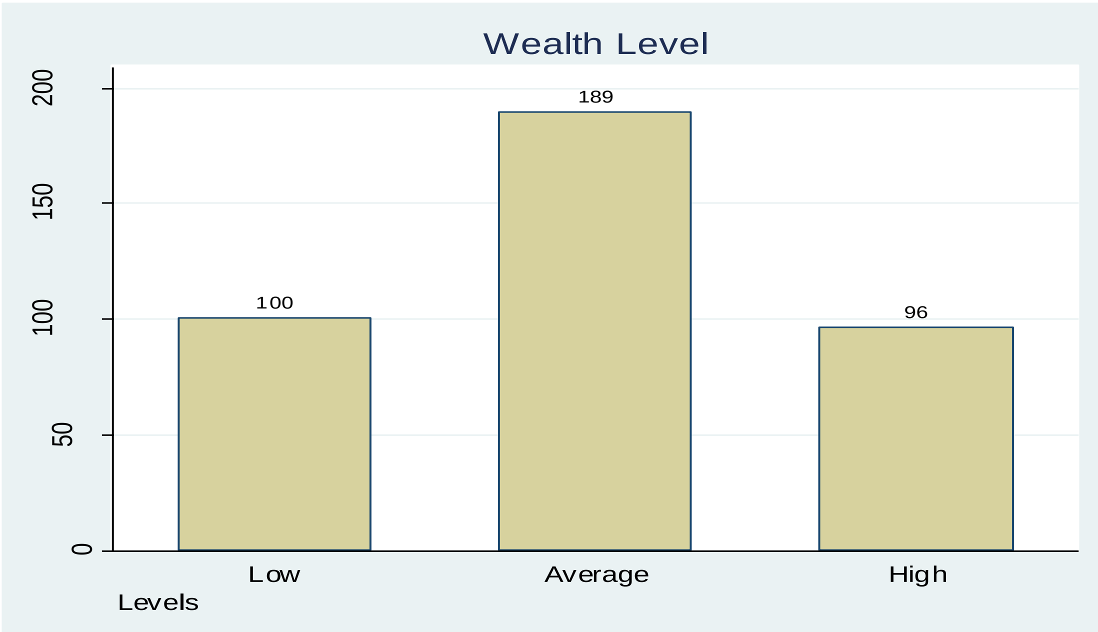

Figure 6-11. Wealth level (Source: Author)

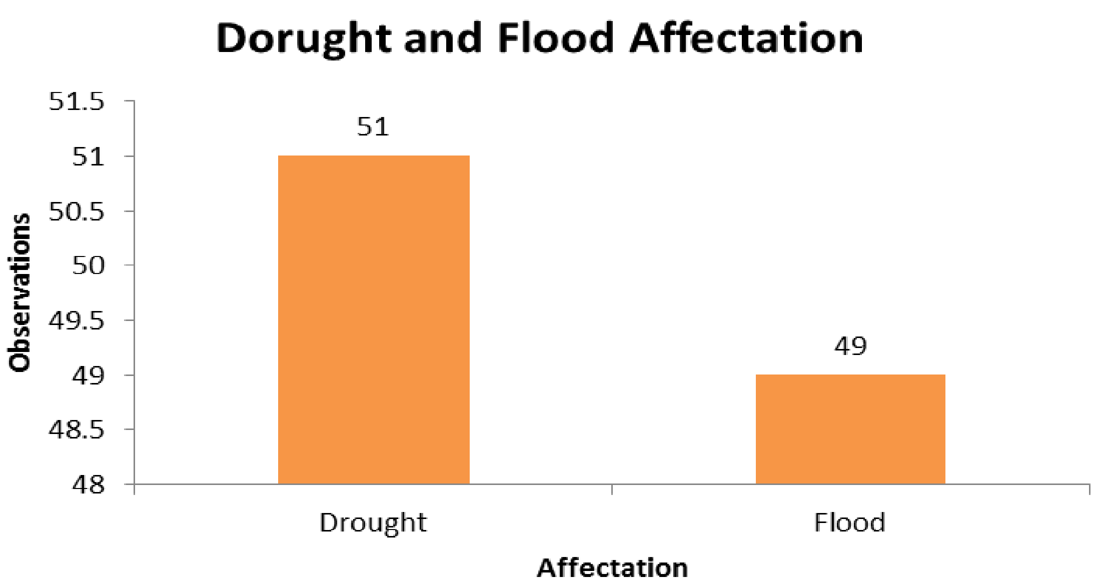

Figure 6-12. Drought and flood affectation (Source: Author)

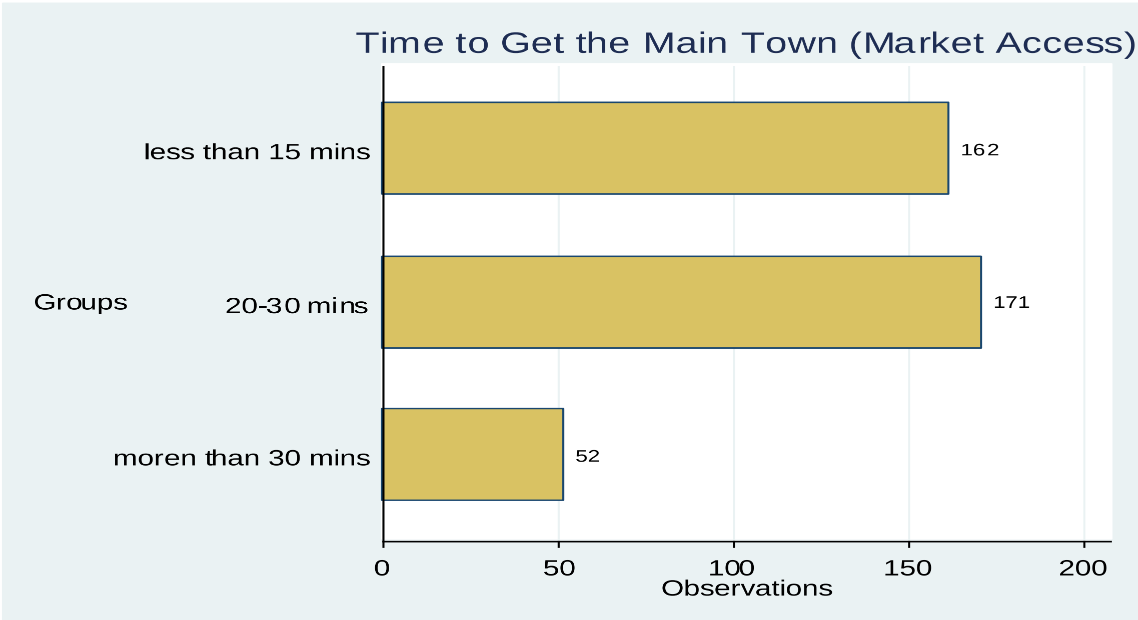

Figure 6-13. Time to get the main town by spent time groups (Market Access) (Source: Author)

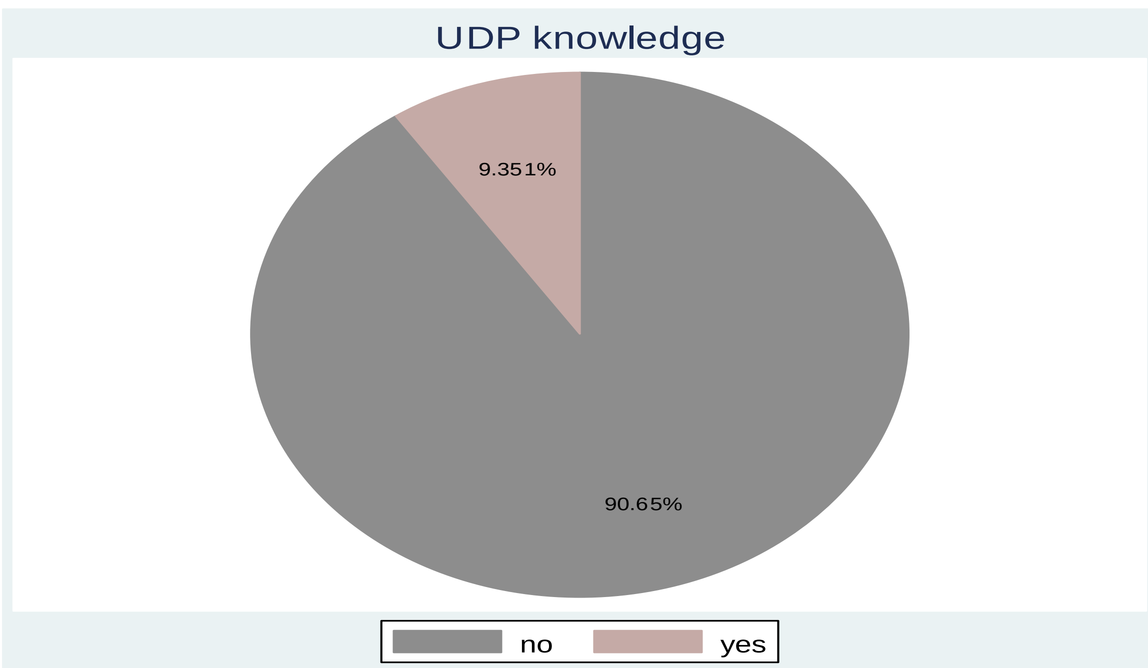

Figure 6-14. UDP knowledge (Source: Author)

Table 6-3. Statistics of those who knew and did not know about UDP

Variable	Who knew UDP	Who did not know UDP
Age (years)	53.88	51.28
Education (majority)	Elementary School	Elementary School
Village (majority)	El Mate/El Encanto	Peninsula de Animas
Agricultural Group Affiliation (majority)	Yes	Yes
Land Size Groups (majority)	Less than 1 ha	Less than 1 ha

Source: Author

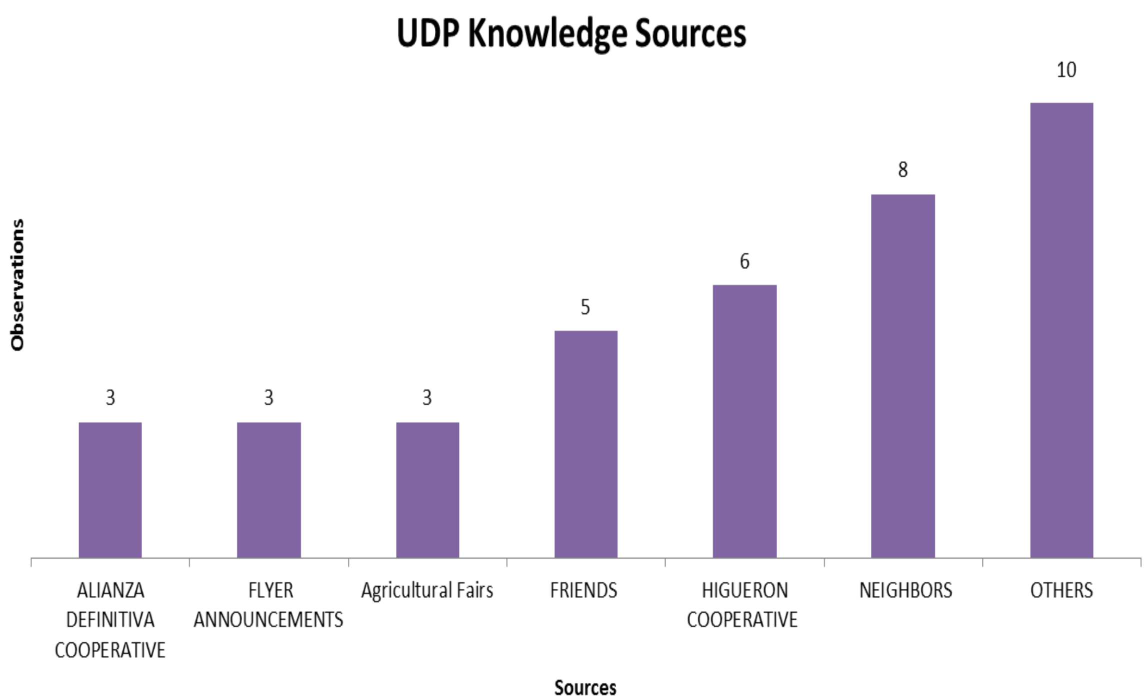

Figure 6-15. UDP knowledge sources (Source: Author)

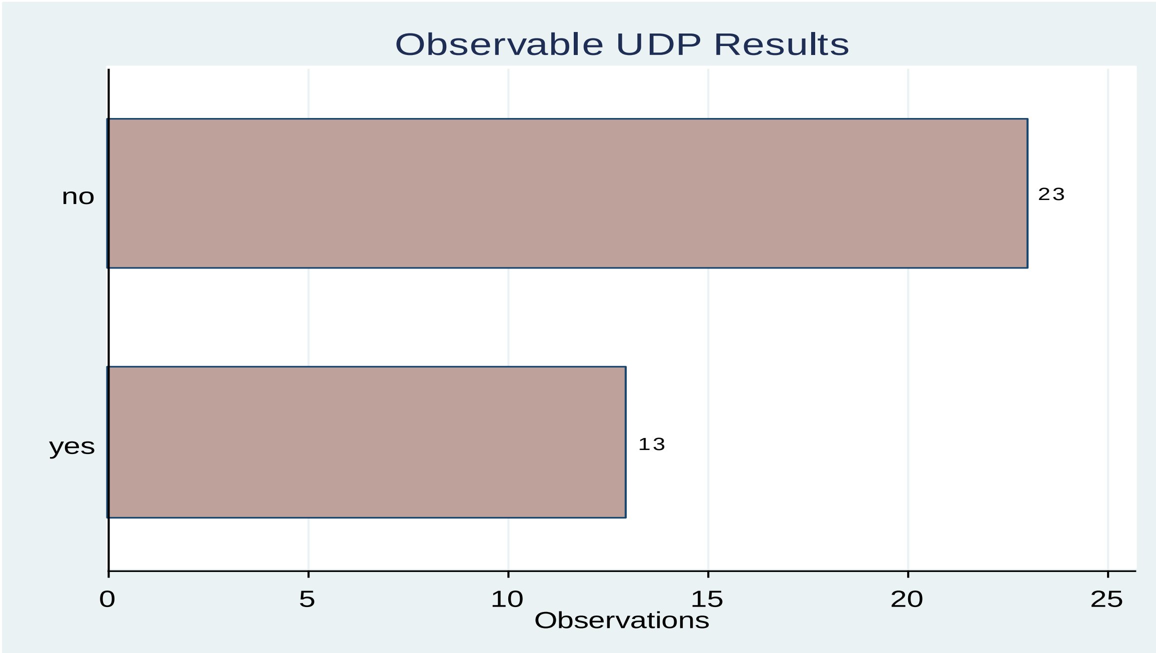

Figure 6-16. Observable UDP results (Source: Author)

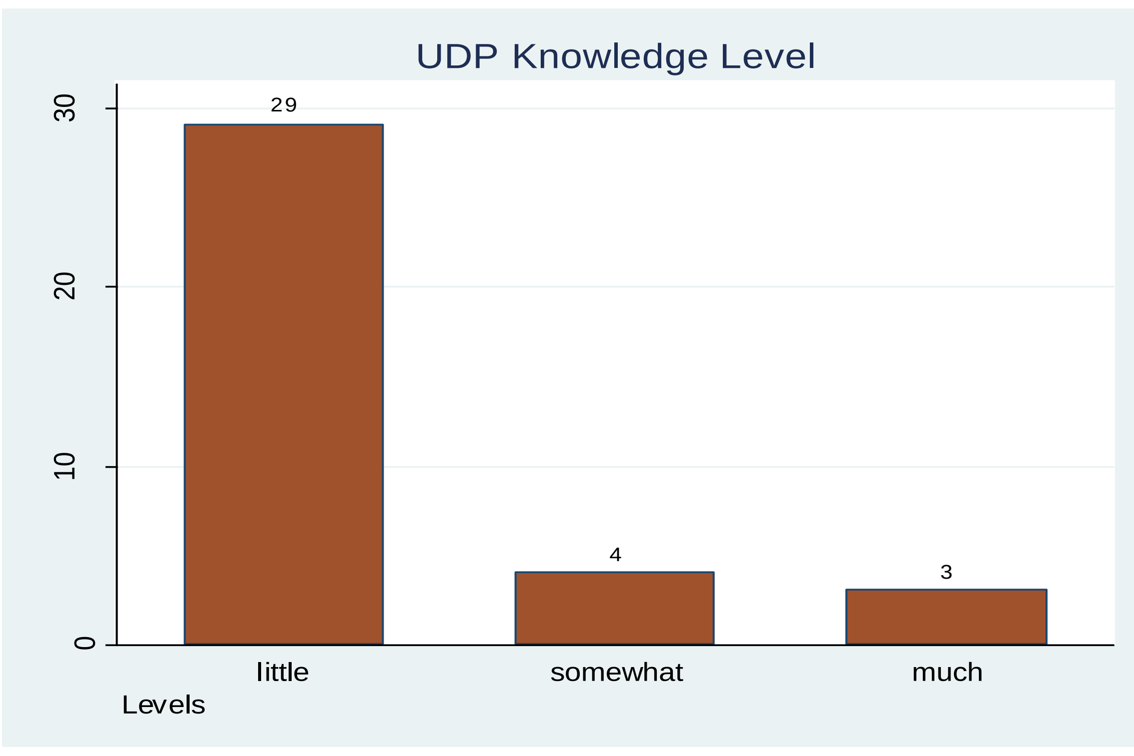

Figure 6-17. UDP knowledge level (Source: Author)

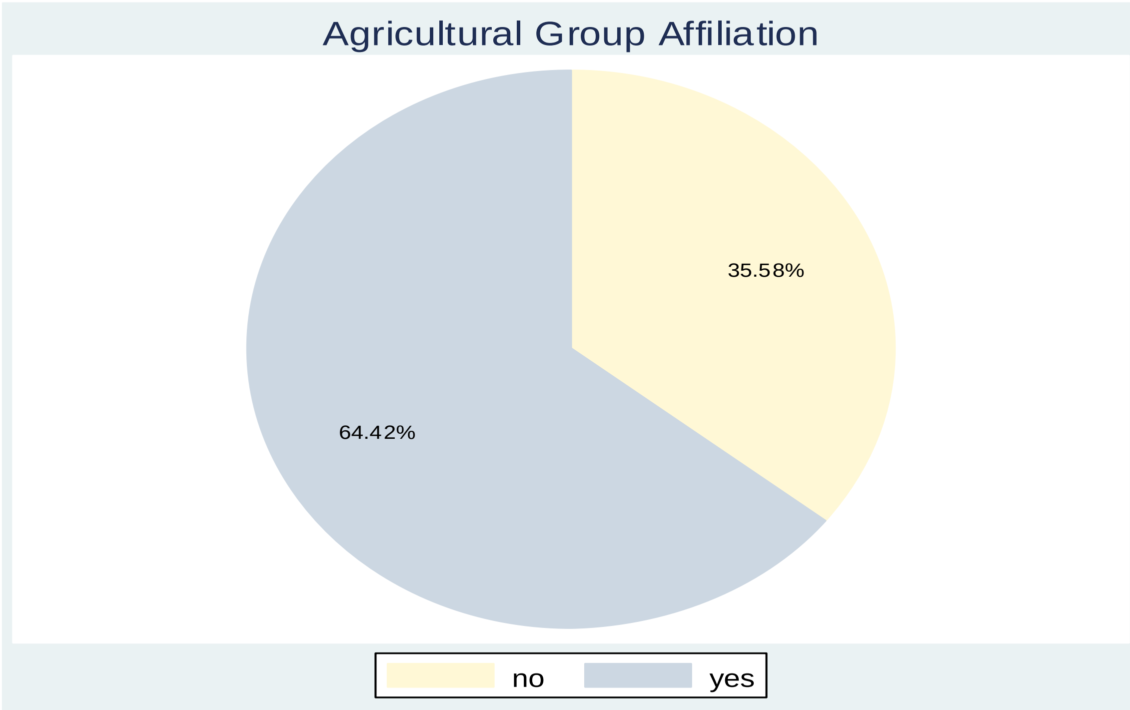

Figure 6-18. Agricultural group affiliation (Source: Author)

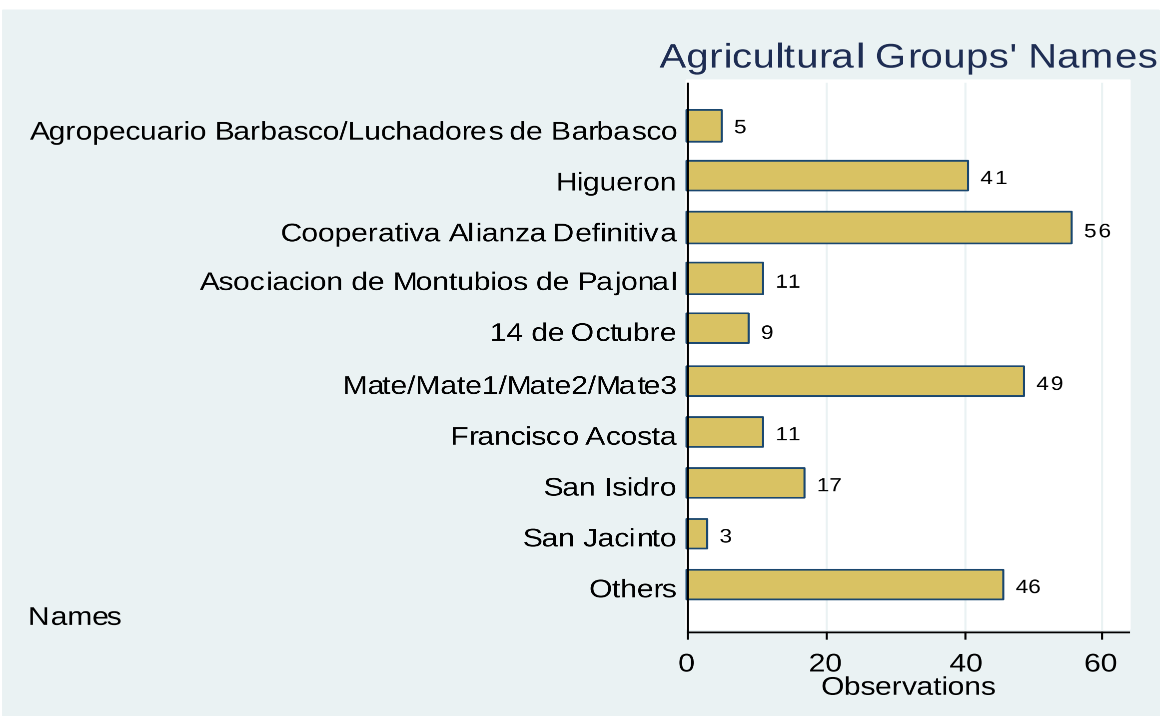

Figure 6-19. Agricultural groups' names (Source: Author)

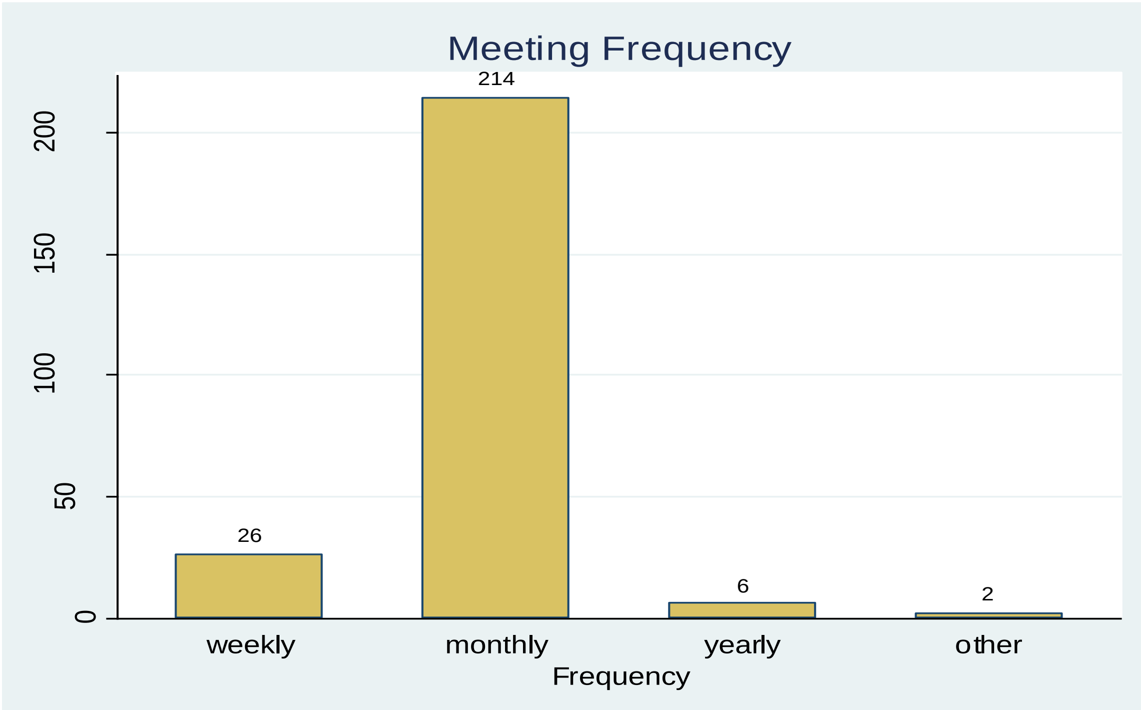

Figure 6-20. Meeting frequency (Source: Author)

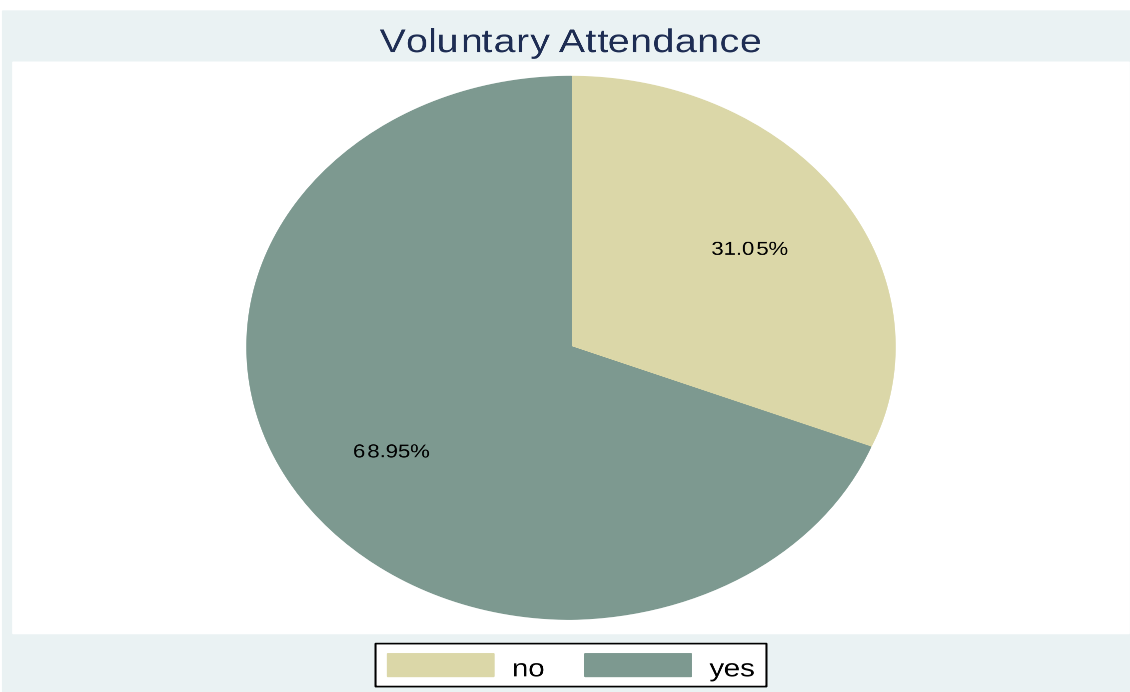

Figure 6-21. Voluntary attendance (Source: Author)

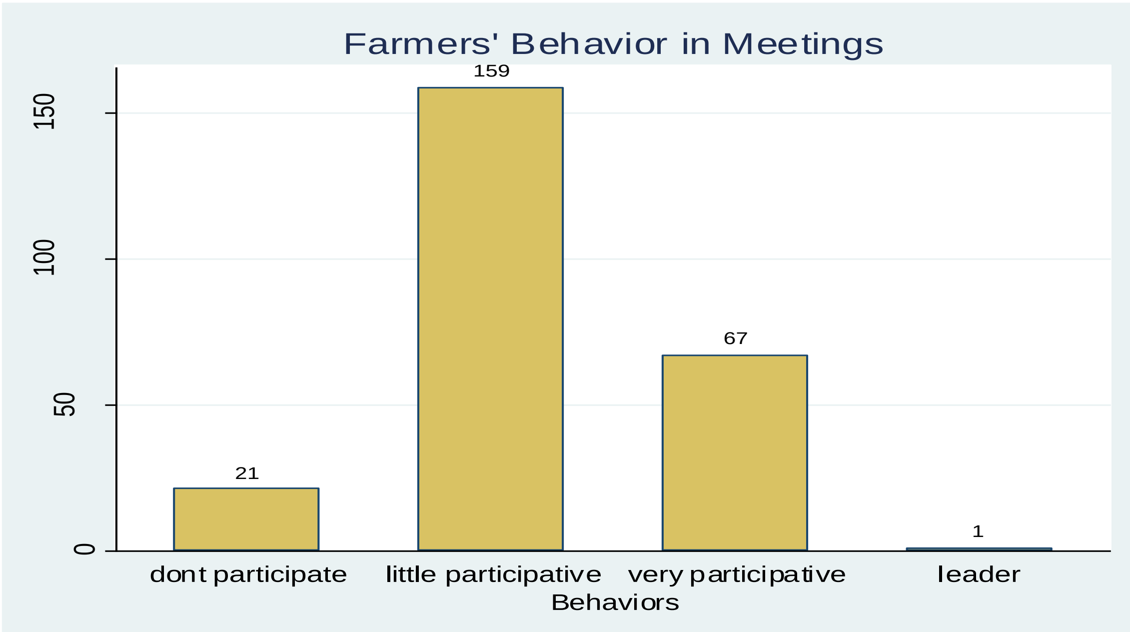

Figure 6-22. Farmers’ behavior in meetings (Source: Author)

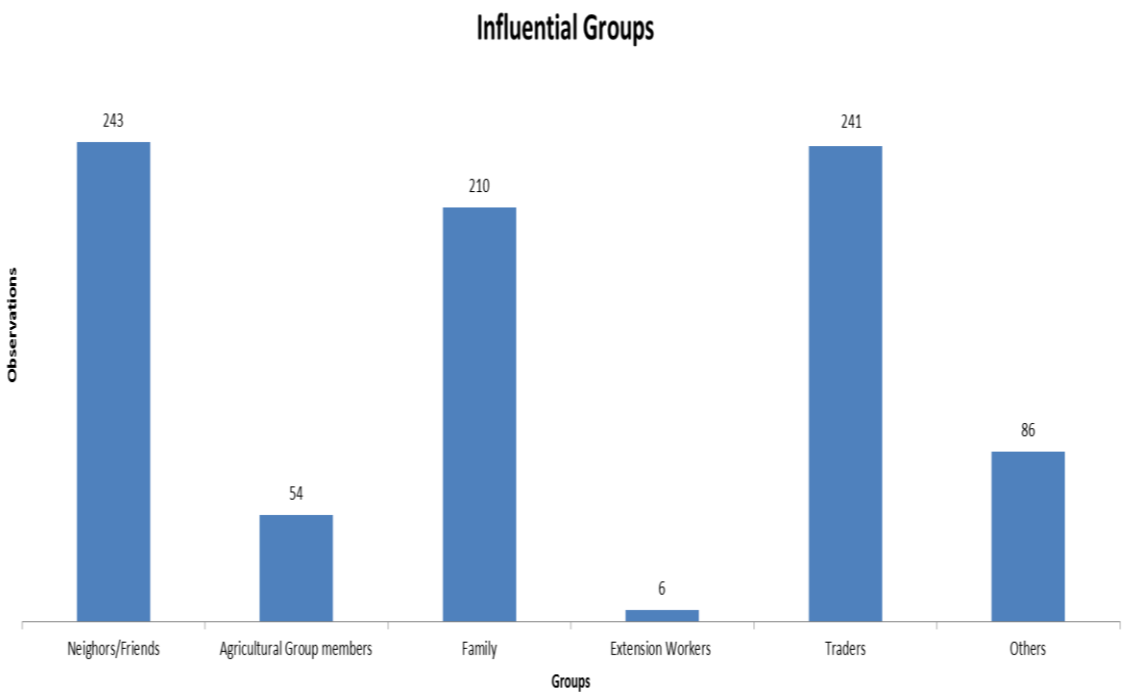

Figure 6-23. Influential groups (Source: Author)

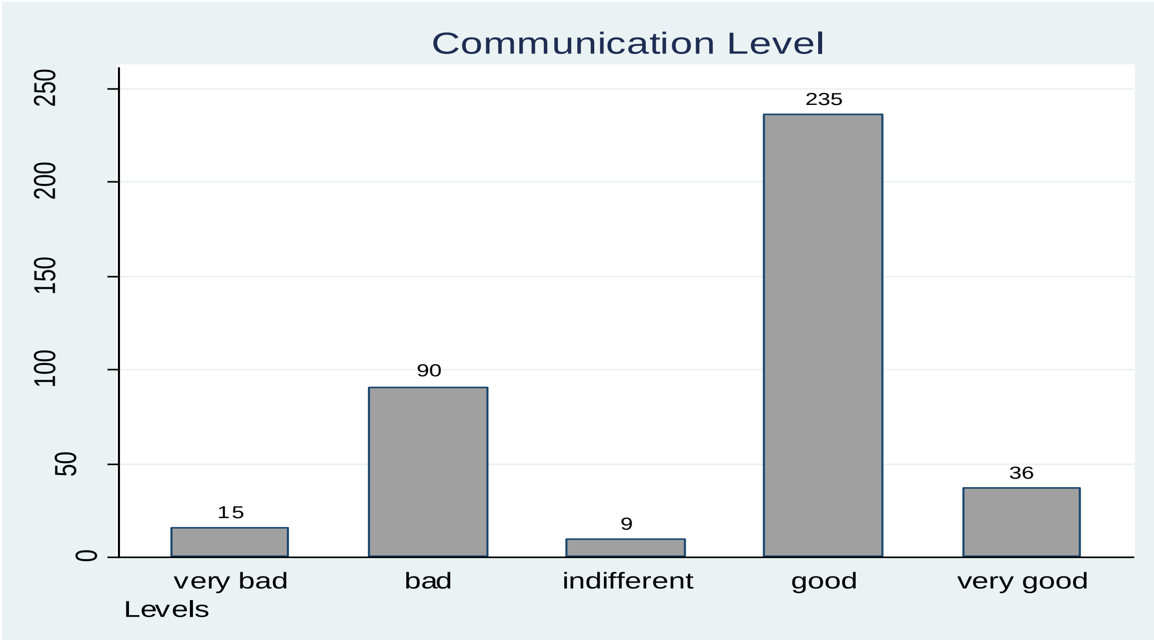

Figure 6-24. Communication level (Source: Author)

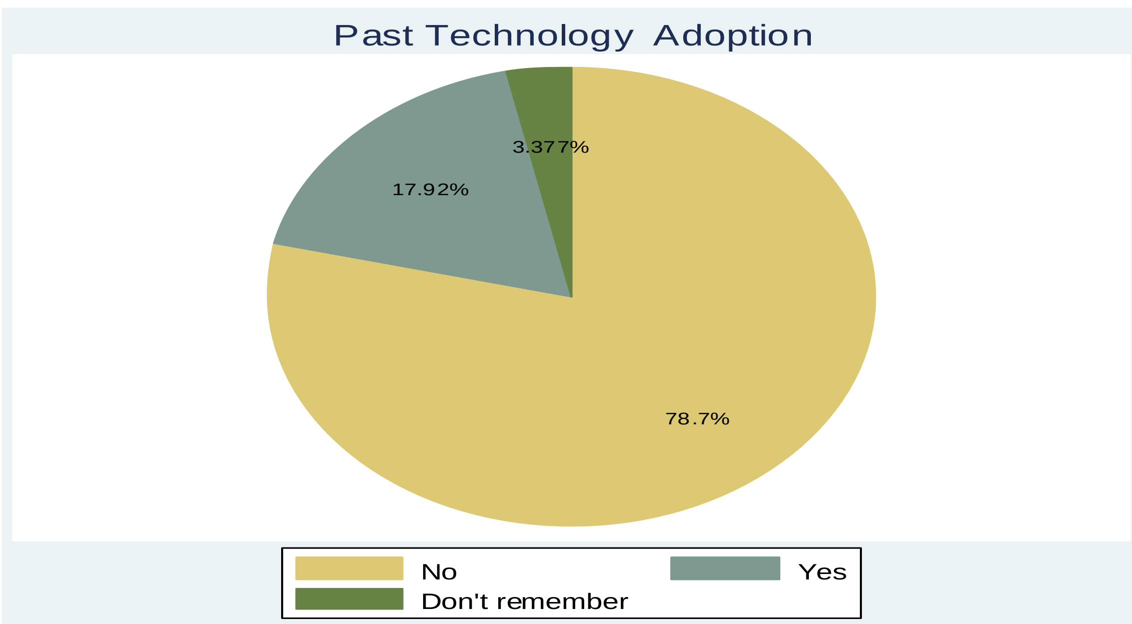

Figure 6-25. Past technology adoption (Source: Author)

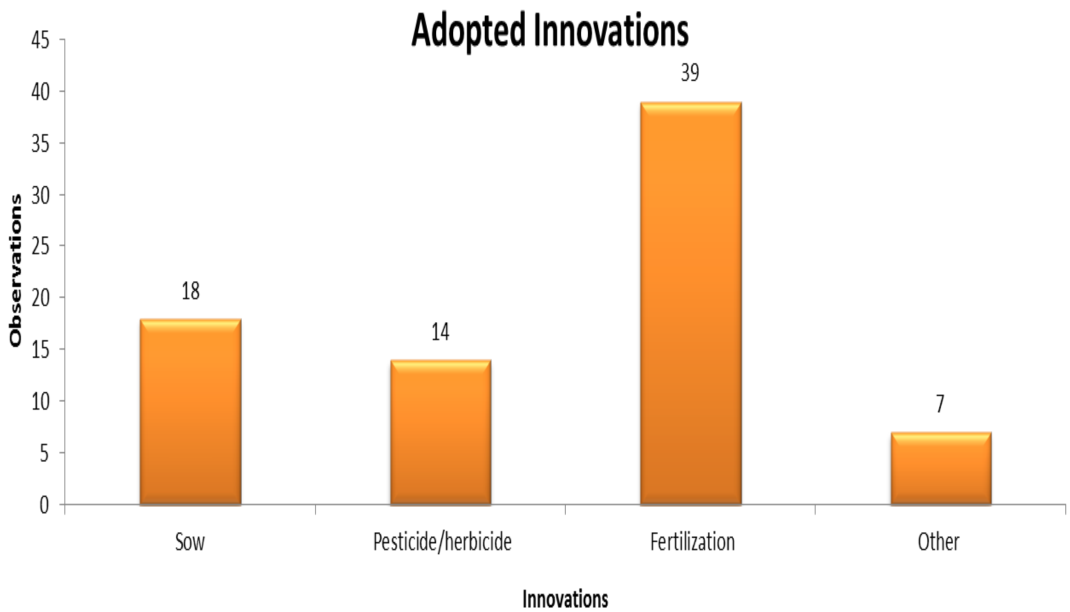

Figure 6-26. Adopted innovations (Source: Author)

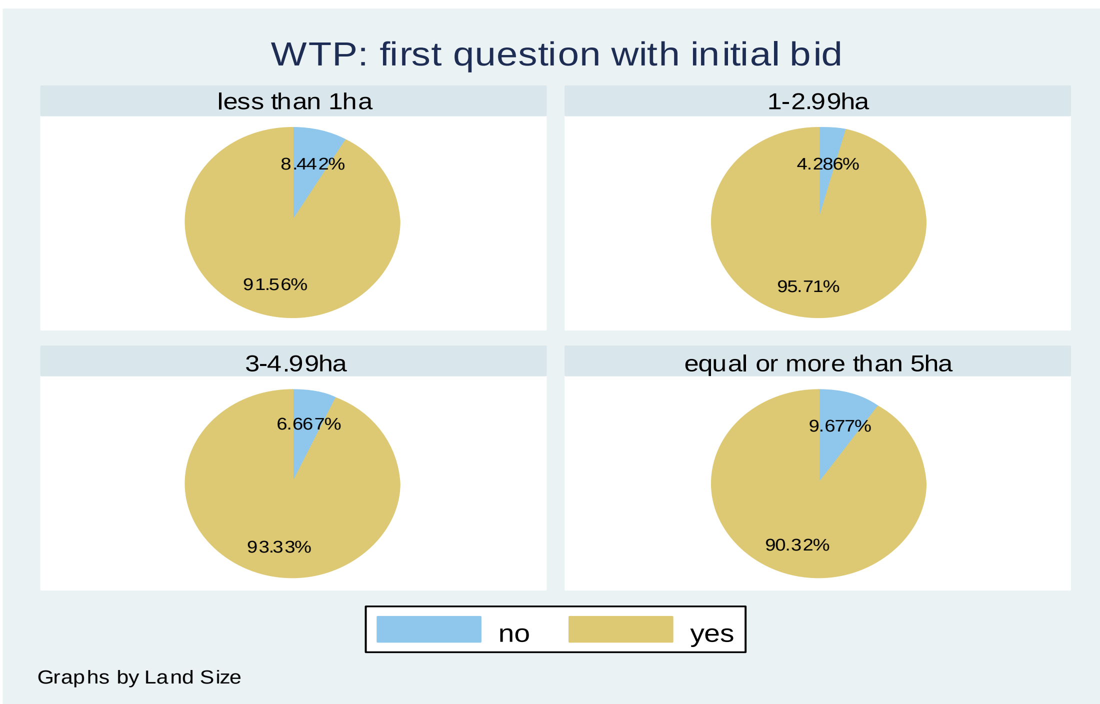

Figure 6-27. WTP: first question with initial bid by land size groups (Source: Author)

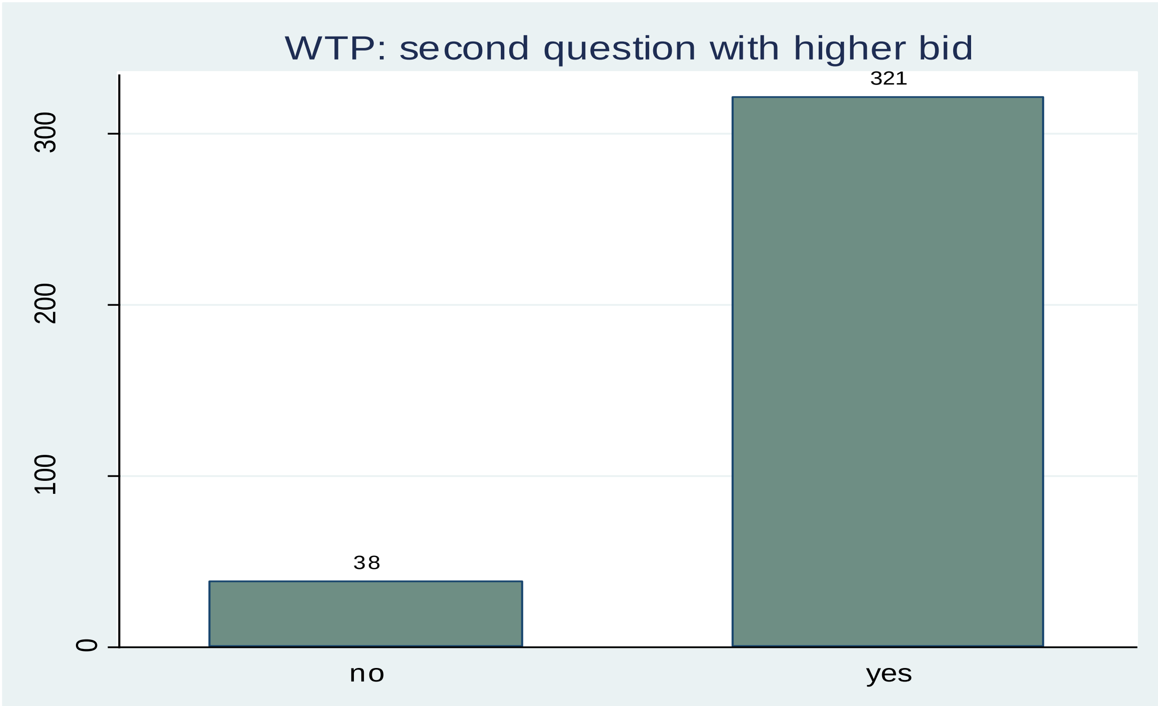

Figure 6-28. WTP: second question with higher bid (Source: Author)

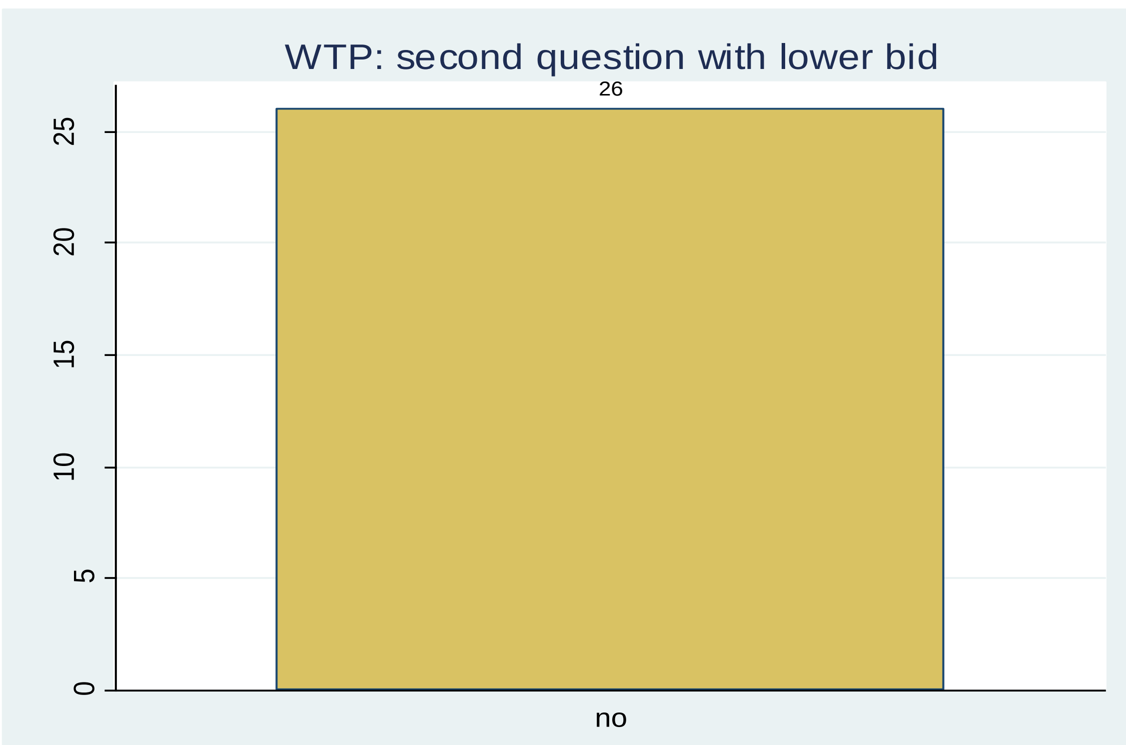

Figure 6-29. WTP: second question with lower bid (Source: Author)

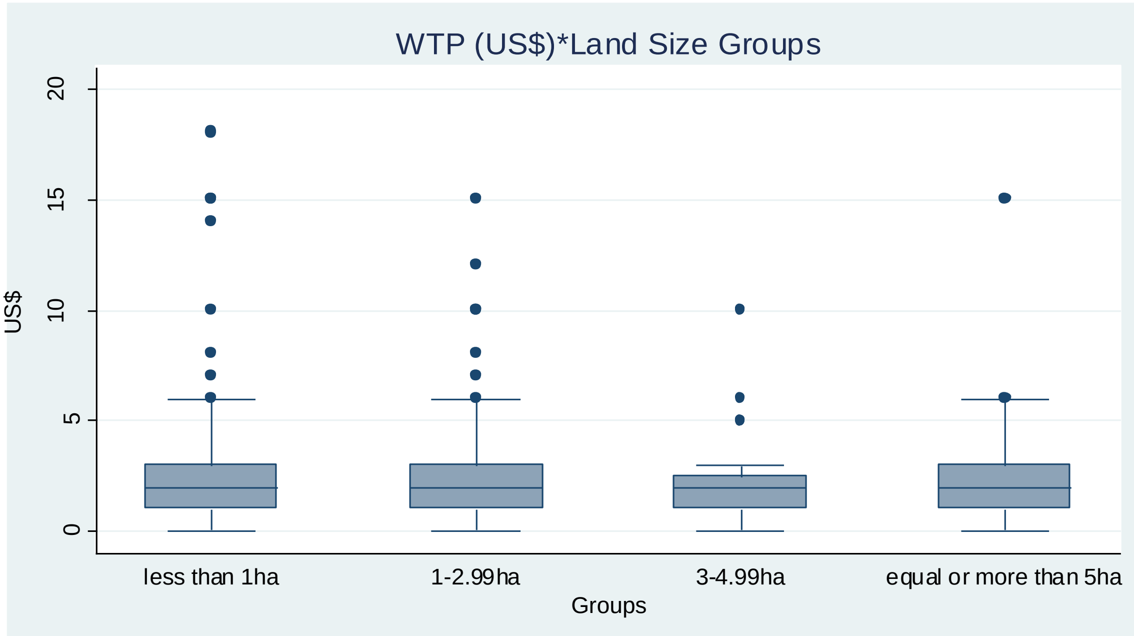

Figure 6-30. WTP (US$) by land size groups (Source: Author)

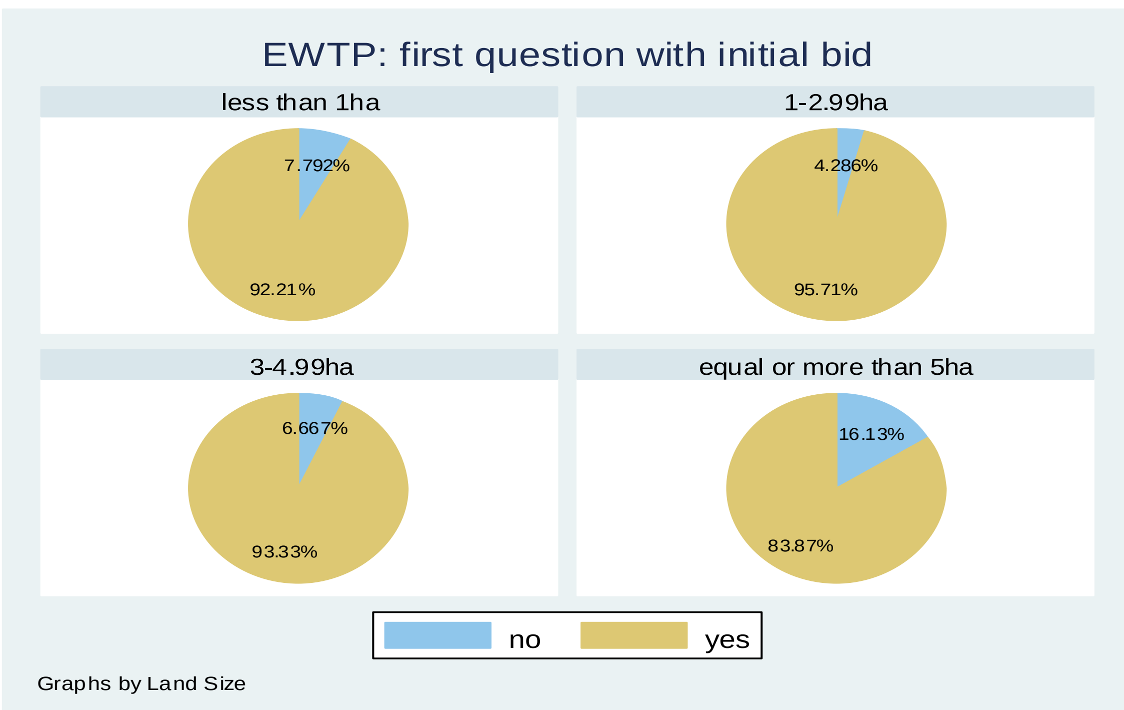

Figure 6-31. EWTP: first question with initial bid by land size groups (Source: Author)

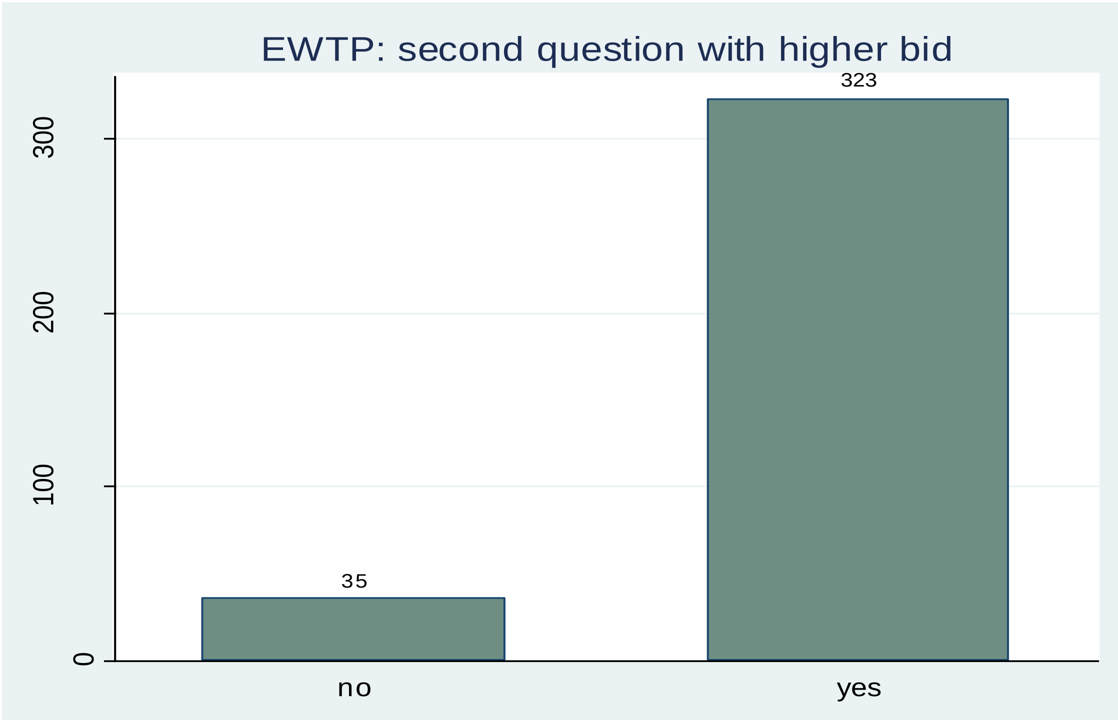

Figure 6-32. EWT: second question with higher bid (Source: Author)

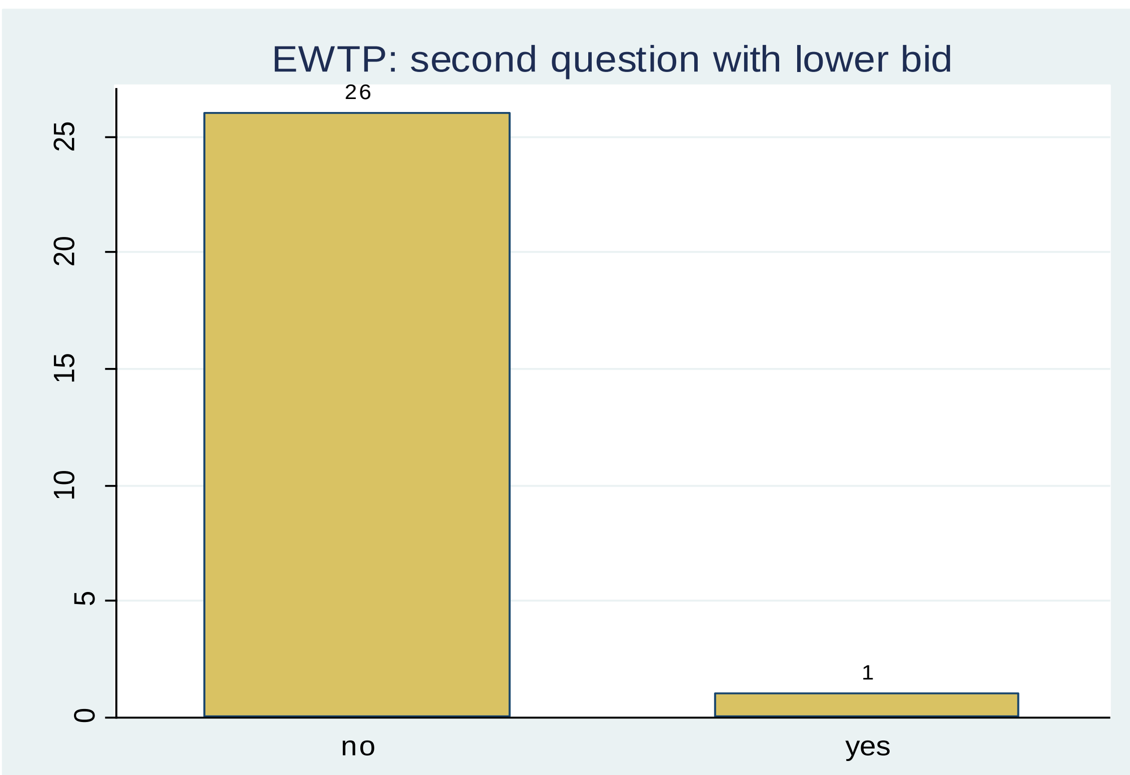

Figure 6-33. EWTP: second question with lower bid (Source: Author)

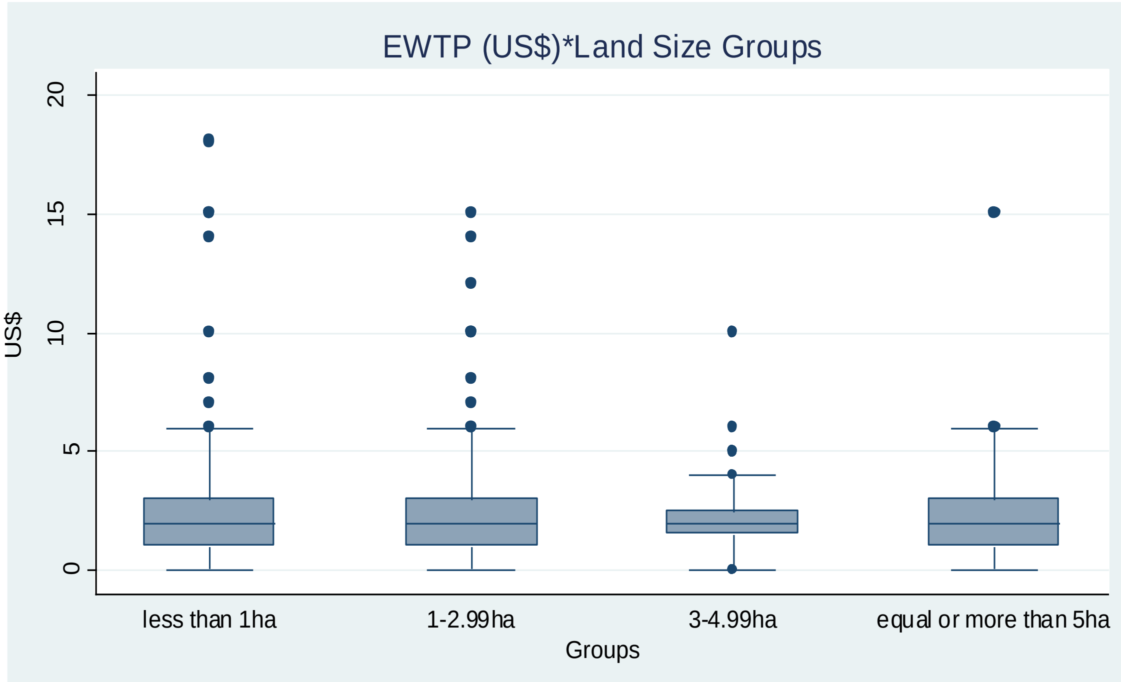

Figure 6-34. EWTP (US$) by land size groups (Source: Author)

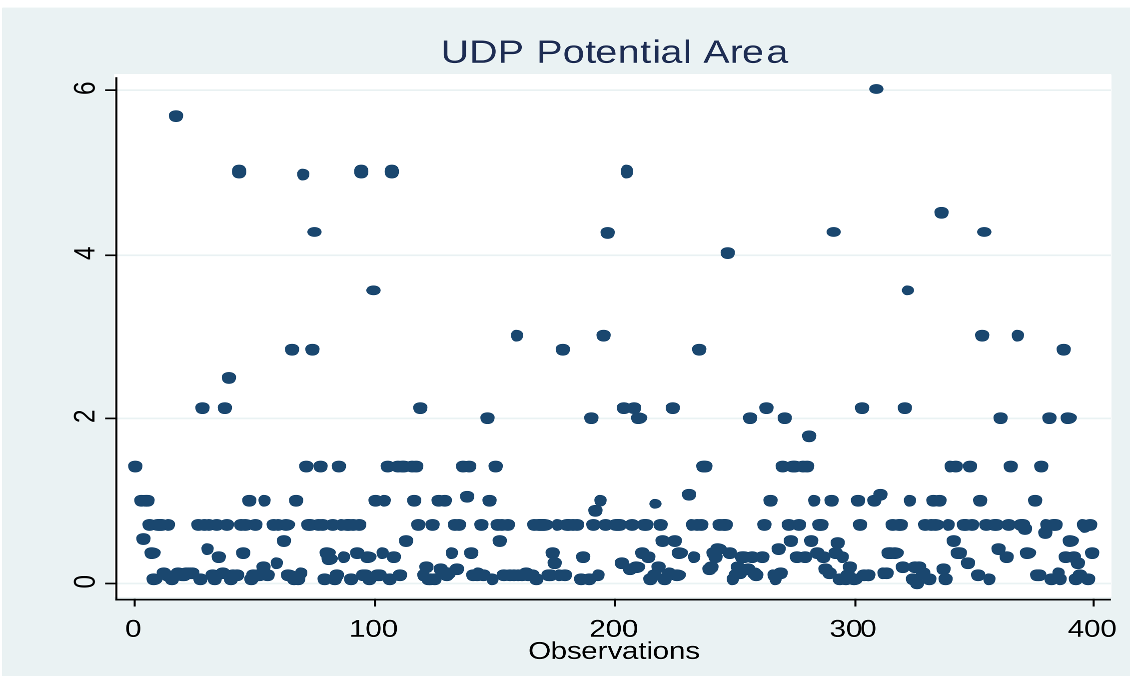

Figure 6-35. UDP potential area (ha) (Source: Author)

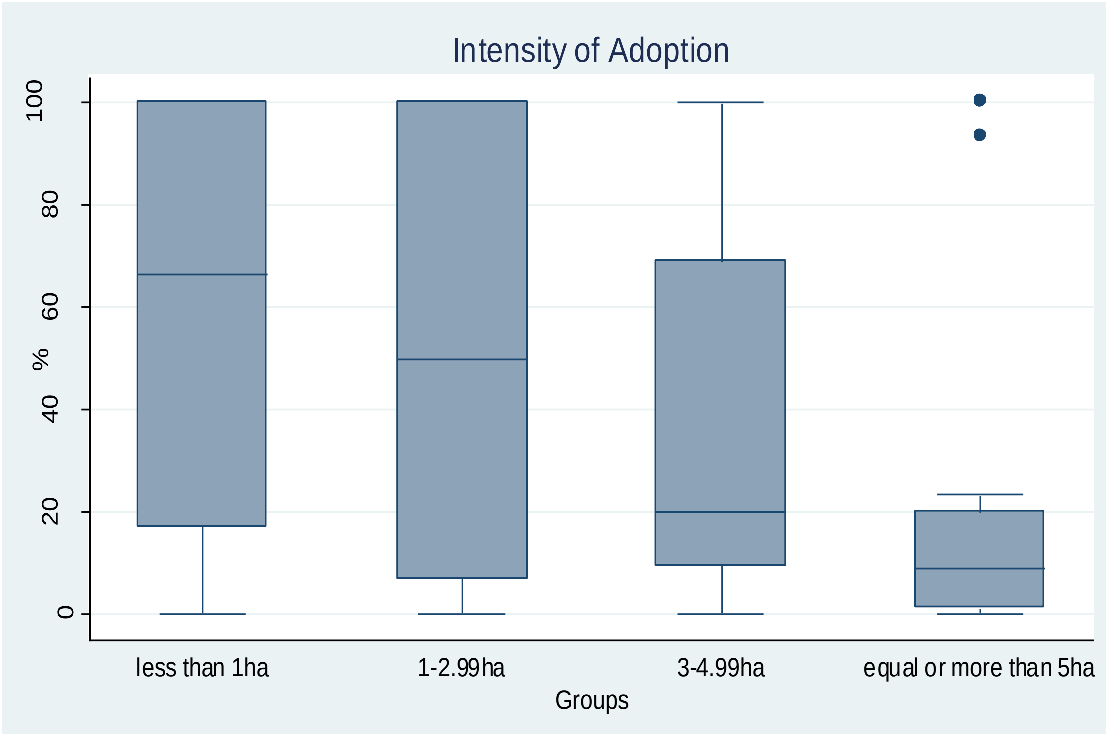

Figure 6-36. Intensity of Adoption by land size groups (%) (Source: Author)

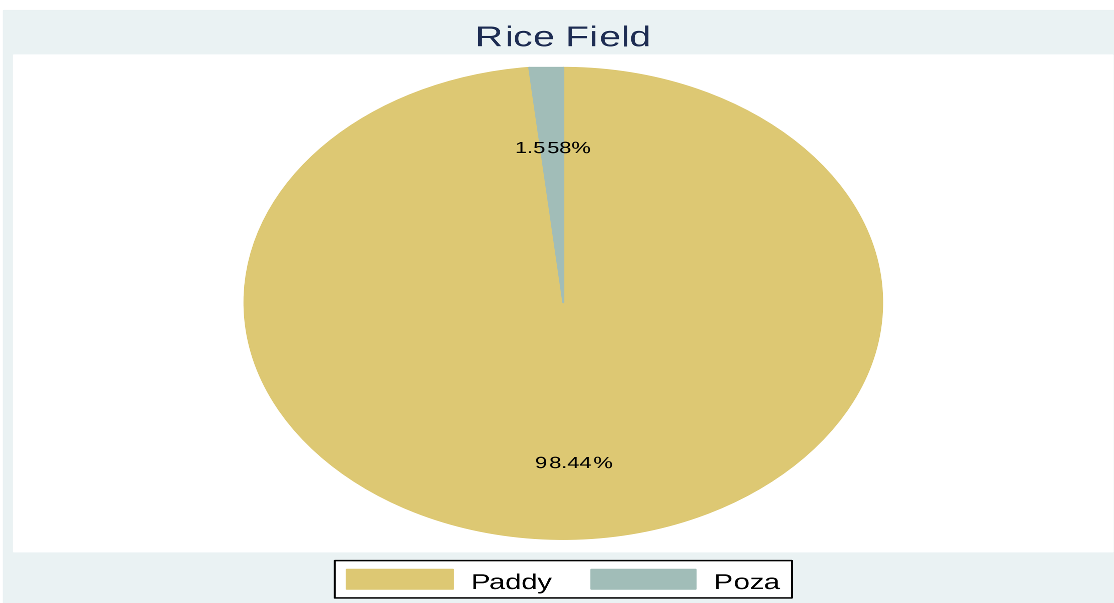

Figure 6-37. Rice field (Source: Author)

Característica Año de liberación	INIAP 7 1976	INIAP 415 1979	INIAP 11 1989	INIAP 12 1994	INIAP 14 1999	INIAP 15 BOLICHE 2006	INIAP 16 2007
Origen	CIAT	CIAT	CIAT	CIAT	IRRI	INIAP	INIAP
Rendimiento en riego	4,5 a 9	4,4 a 9	5 a 9	5 a 9	5,8 a 11	5,1 a 9.0	5.0 a 9.0
Rendimiento en racimo (t/na)	-	4,2 a 4,9	5,5 a 6,8	5 a 7	4,8 a 6	-	4,8 a 8,0
Ciclo vegetativo (dias)	125 – 145	135 - 150	110 – 115	95 – 108	113 -117	117 – 128	106 - 120
Altura de plantas (cm)	102 – 127	100 – 118	100 – 111	100 – 111	99 – 107	89 – 108	93 – 109
Longitud de grano mm	Largo	Largo	Largo	Extra Largo	Largo	Extra Largo	Extra Largo
Indice de pilado (%)	67	69	68	71	66	67,00	68,00
Desgrane	Resistente	Resistente	Resistente	Resistente	Intermedio	Intermedio	Intermedio
Latencia en semanas	9 -12	4 – 6	4 – 6	4 – 5	4 - 6	4 – 6	7 – 8
Pyricularia grisea Sacc. (quemazon)	Resistente	Resistente	Resistente	Resistente	Moderadamente susceptible	Moderadamente susceptible	Tolerante
Manchado de grano	Moderadamente Susceptible	Moderadamente Resistente	Moderadamente Resistente	Moderadamente Resistente	Moderadamente Resistente	Tolerante	Tolerante
Hoja Blanca	Moderadamente Susceptible	Moderadamente Susceptible	Moderadamente Susceptible	Moderadamente Susceptible	Moderadamente Resistente	Moderadamente Resistente	Tolerante
Manchado de vaina	Moderadamente Resistente	Moderadamente Resistente	Moderadamente Resistente	Moderadamente Resistente	Moderadamente Resistente	Moderadamente Resistente	Moderadamente Suscept

Figure 6-38. Description of rice varieties (in Spanish) (Source: Instituto Nacional Autonomo de Investigacion Agropecuaria)

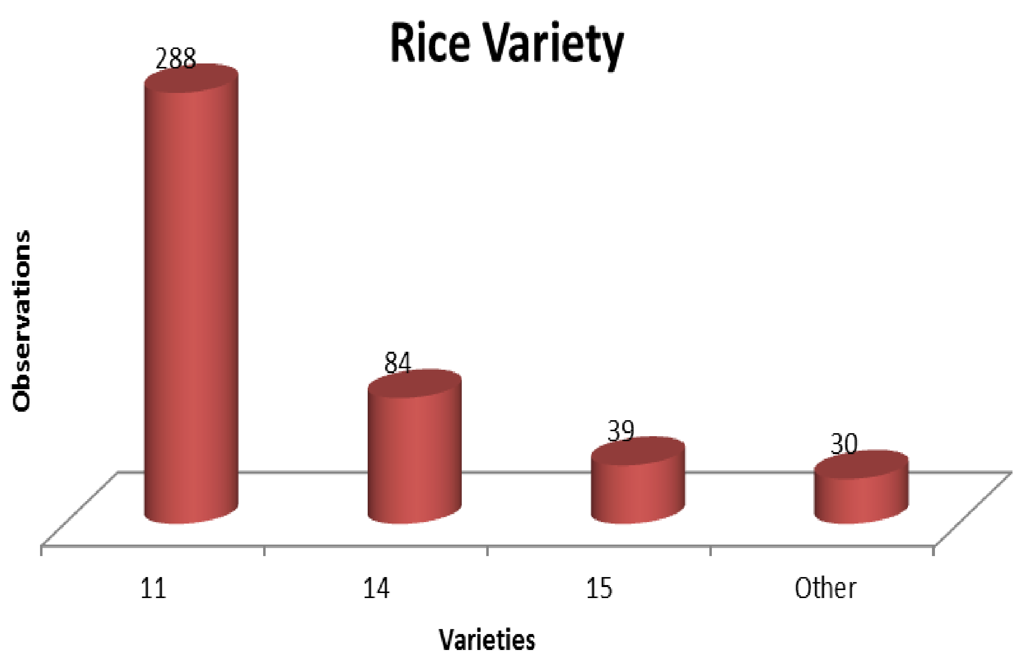

Figure 6-39. Rice variety (Source: Author)

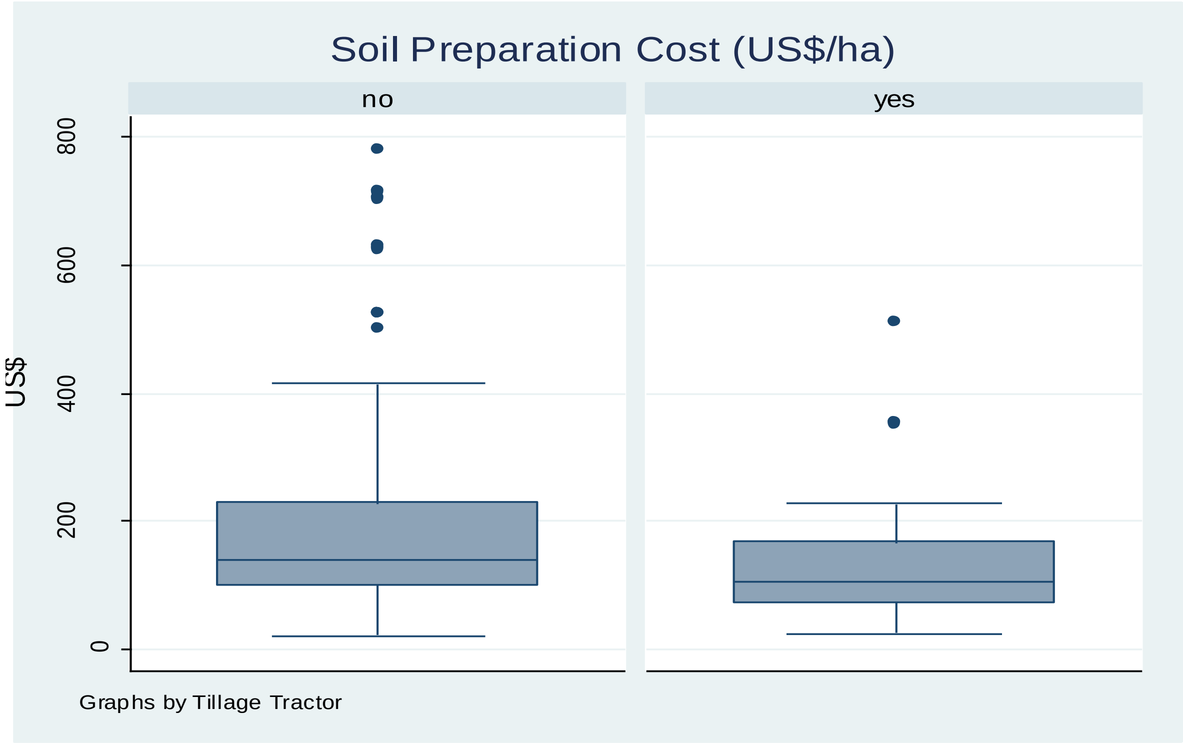

Figure 6-40. Soil preparation cost (US$/ha) by tillage tractor (Source: Author)

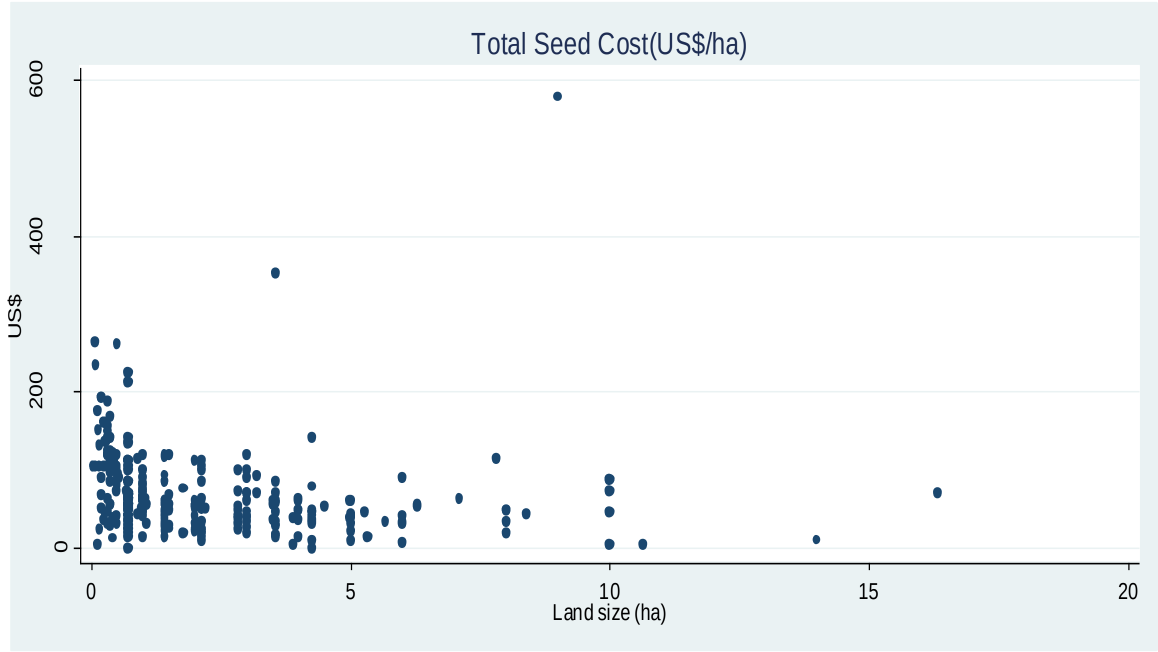

Figure 6-41. Total seed costs (US$/ha) plotted with land size (ha) (Source: Author)

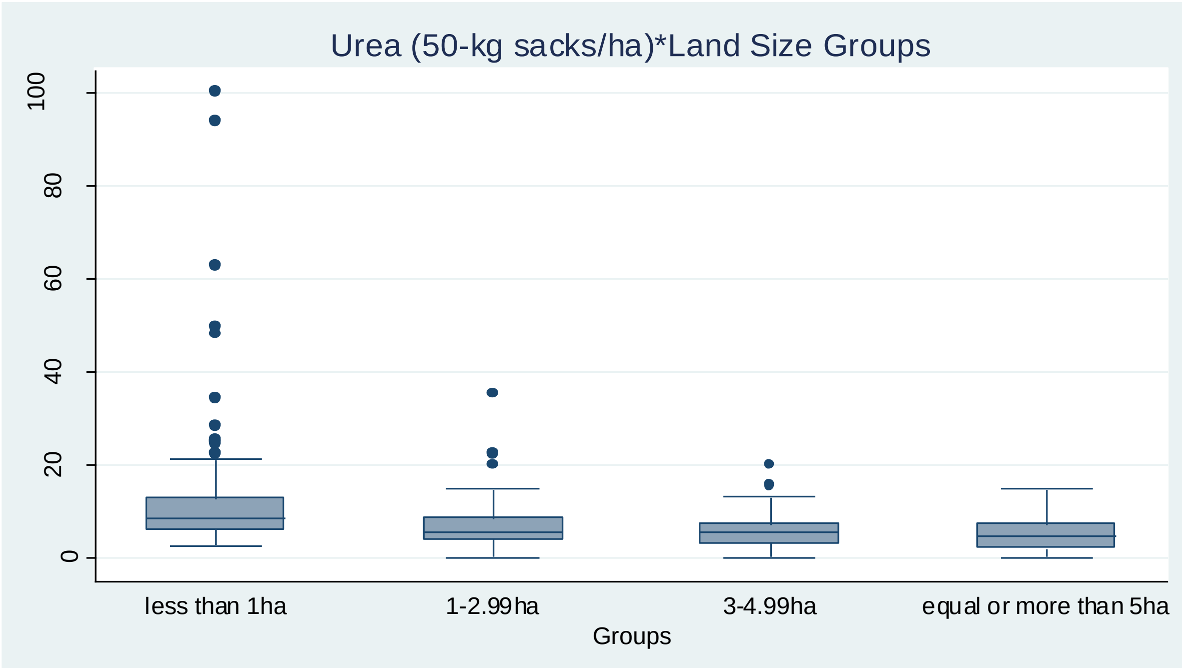

Figure 6-42. Urea (50-kg sacks/ha) by land size groups (Source: Author)

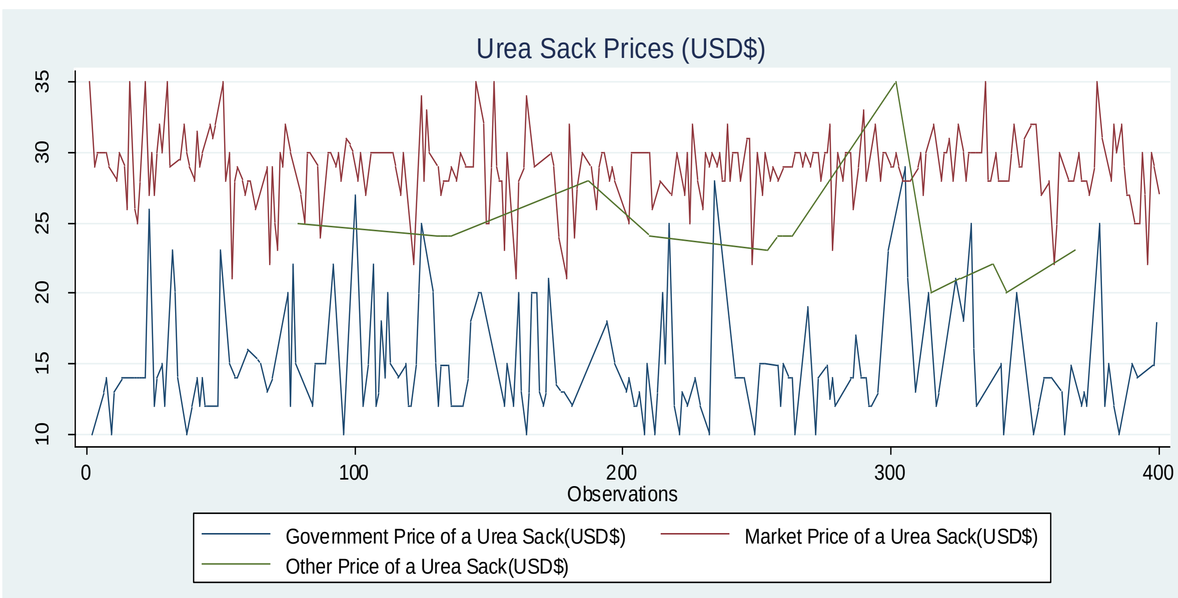

Figure 6-43. Urea prices (US$/sack) of subsidized, real and black markets (Source: Author)

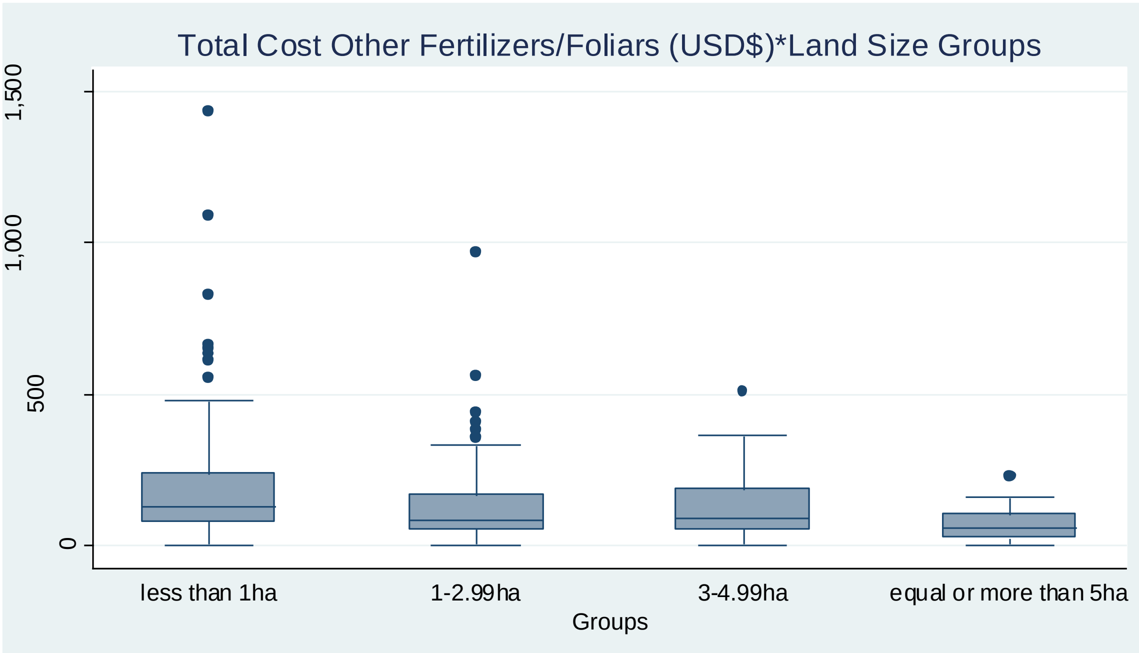

Figure 6-44. Total cost of other fertilizers (US$/ha) by land size groups (Source: Author)

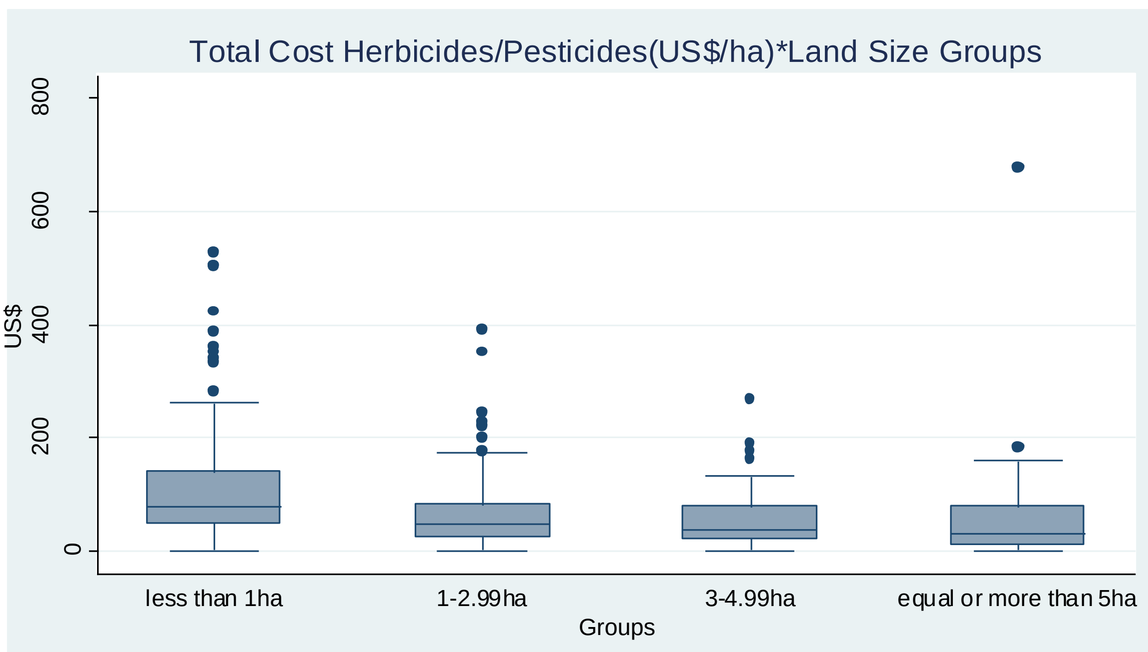

Figure 6-45. Total cost of herbicides/pesticides (US$/ha) by land size groups (Source: Author)

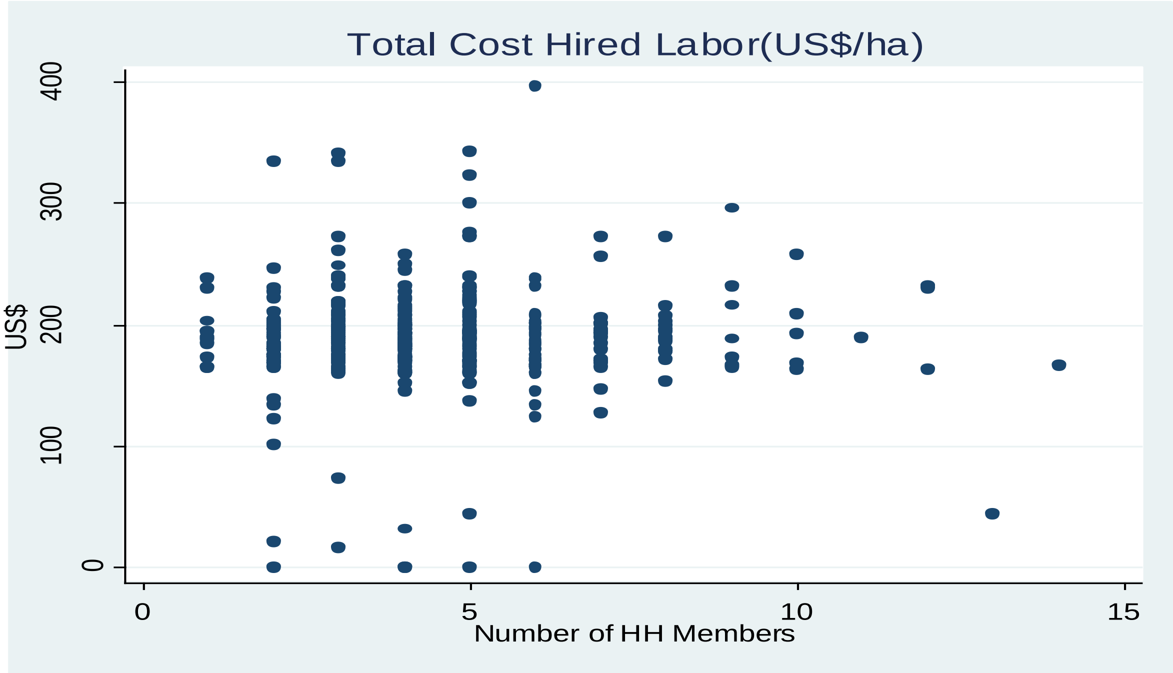

Figure 6-46. Total cost of hired labor (Source: Author)

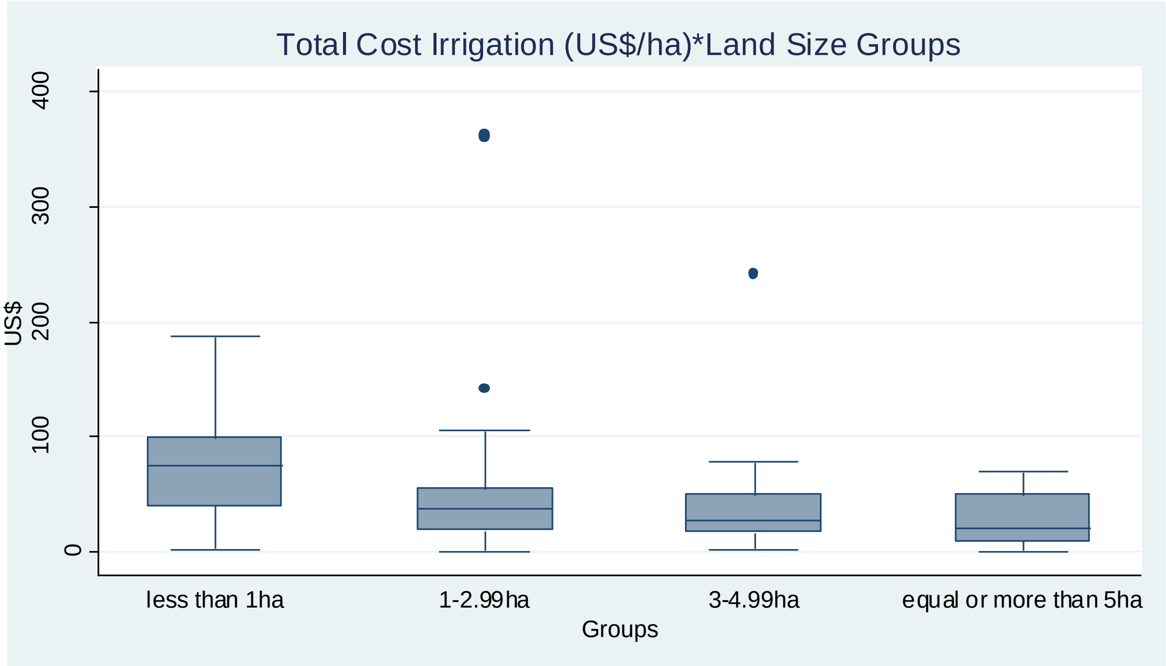

Figure 6-47. Total irrigation cost (US$/ha) by land size groups (Source: Author)

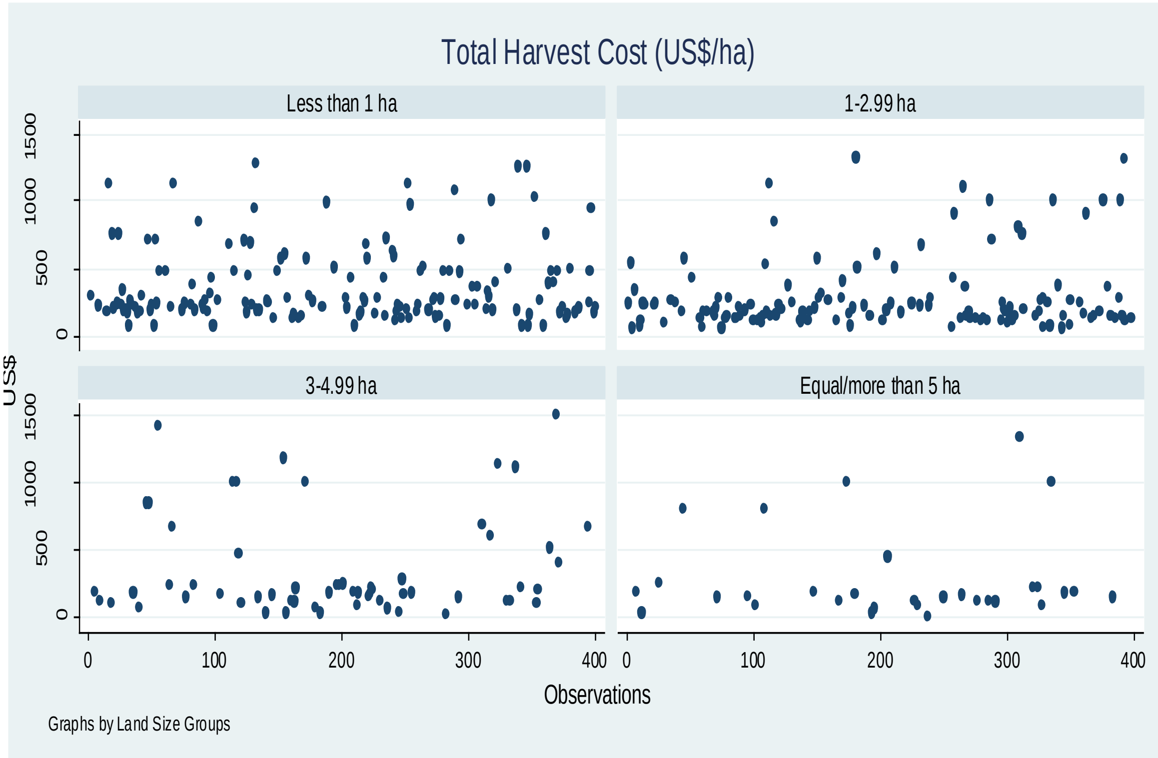

Figure 6-48. Total harvest cost (US$) by land size groups (Source: Author)

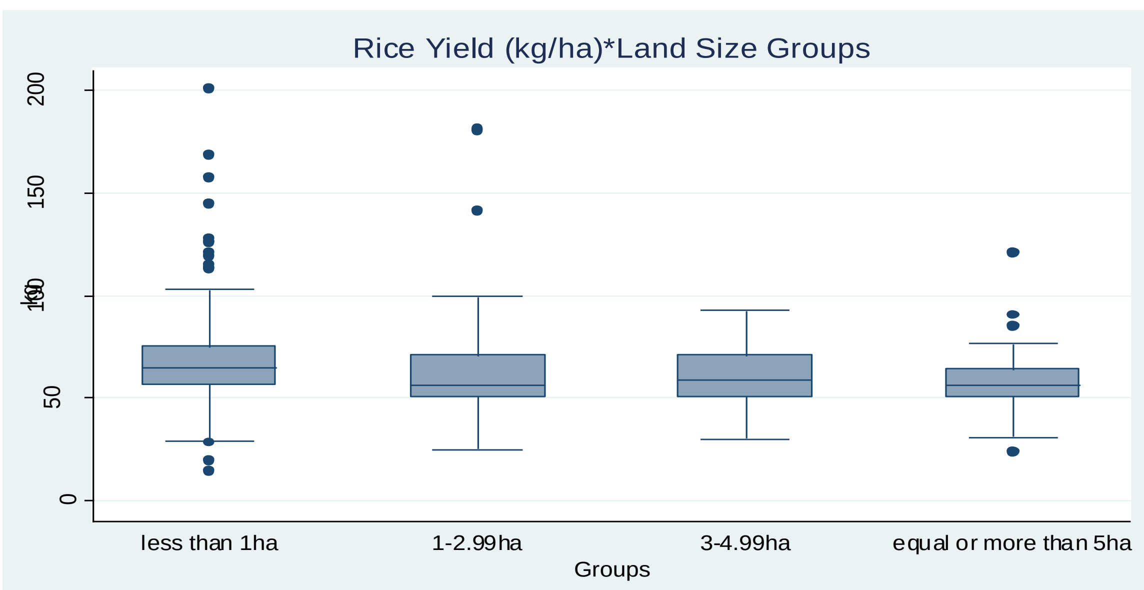

Figure 6-49. Rice yield (kg/ha) by land size groups (Source: Author)

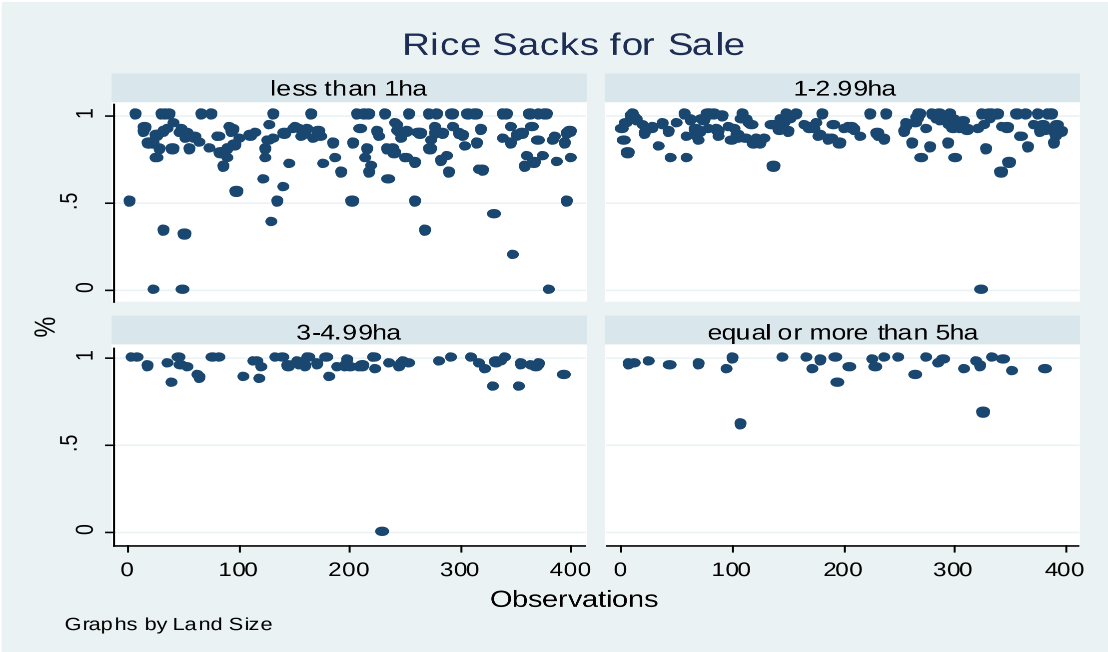

Figure 6-50. Rice sack sold (%) by land size groups (Source: Author)

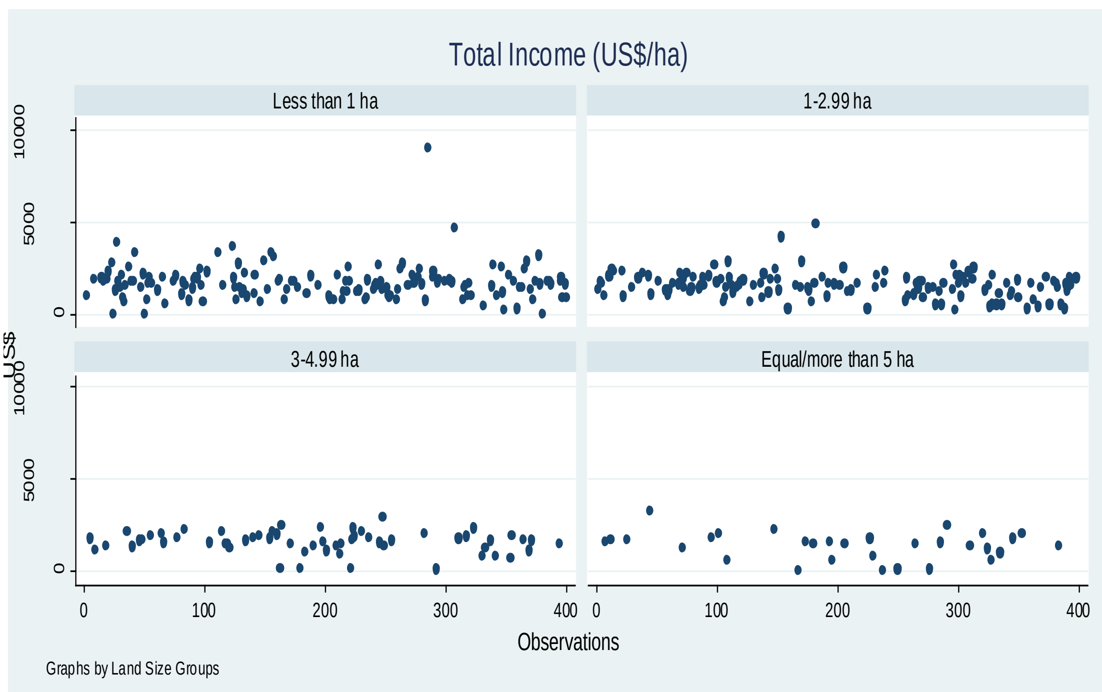

Figure 6-51. Total income (US$/ha) by land size groups (Source: Author)

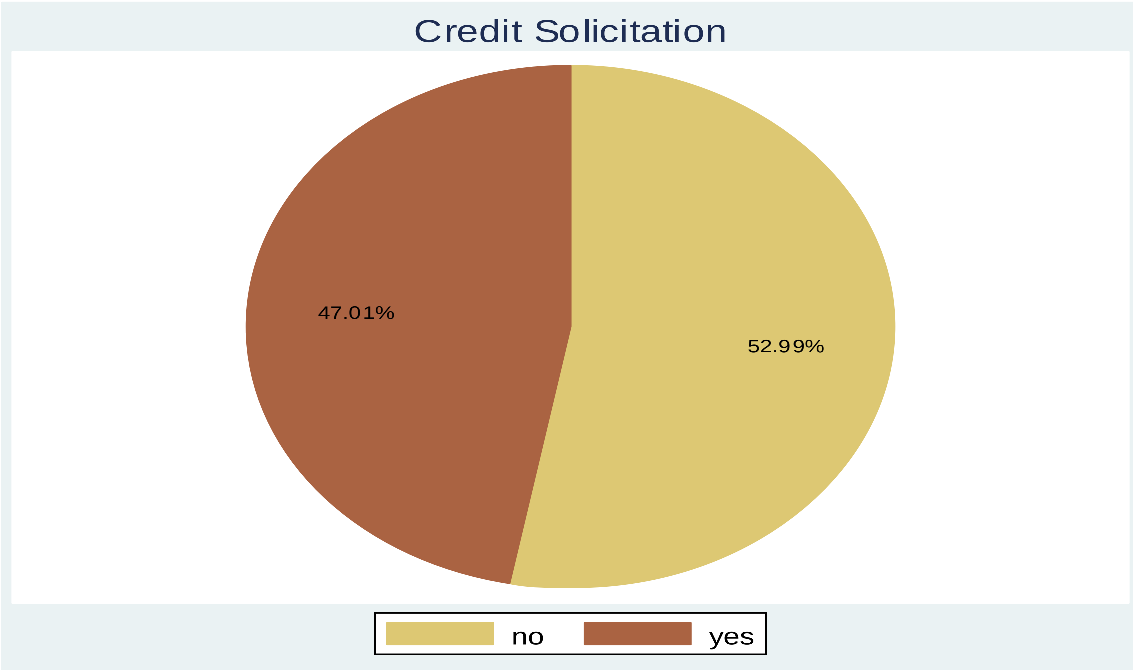

Figure 6-52. Credit Solicitation (Source: Author)

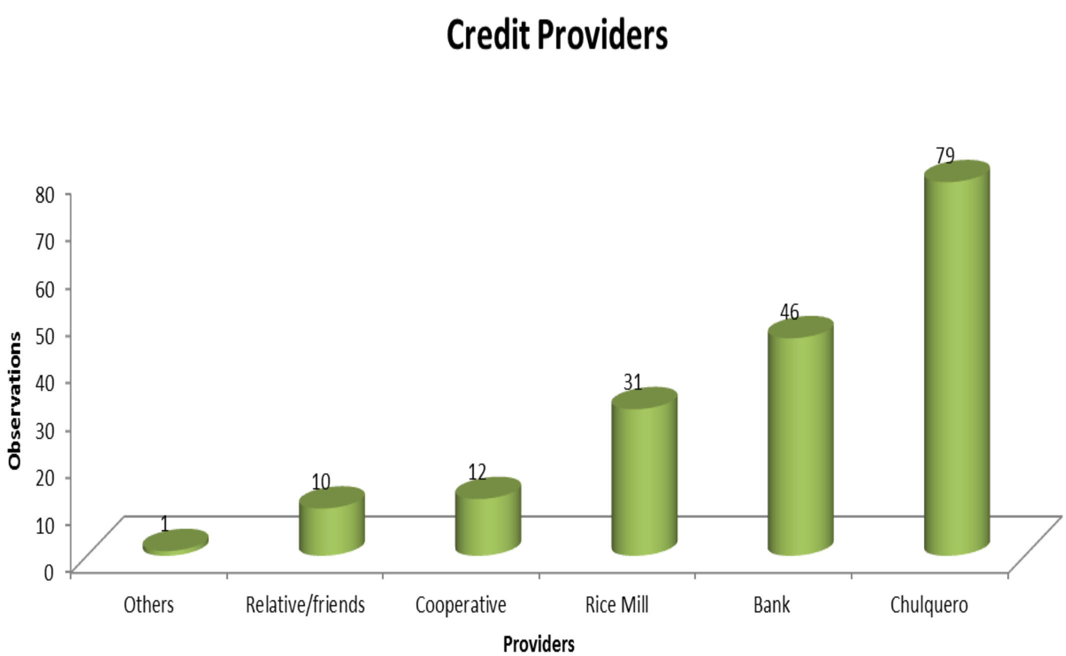

Figure 6-53. Credit providers (Source: Author)

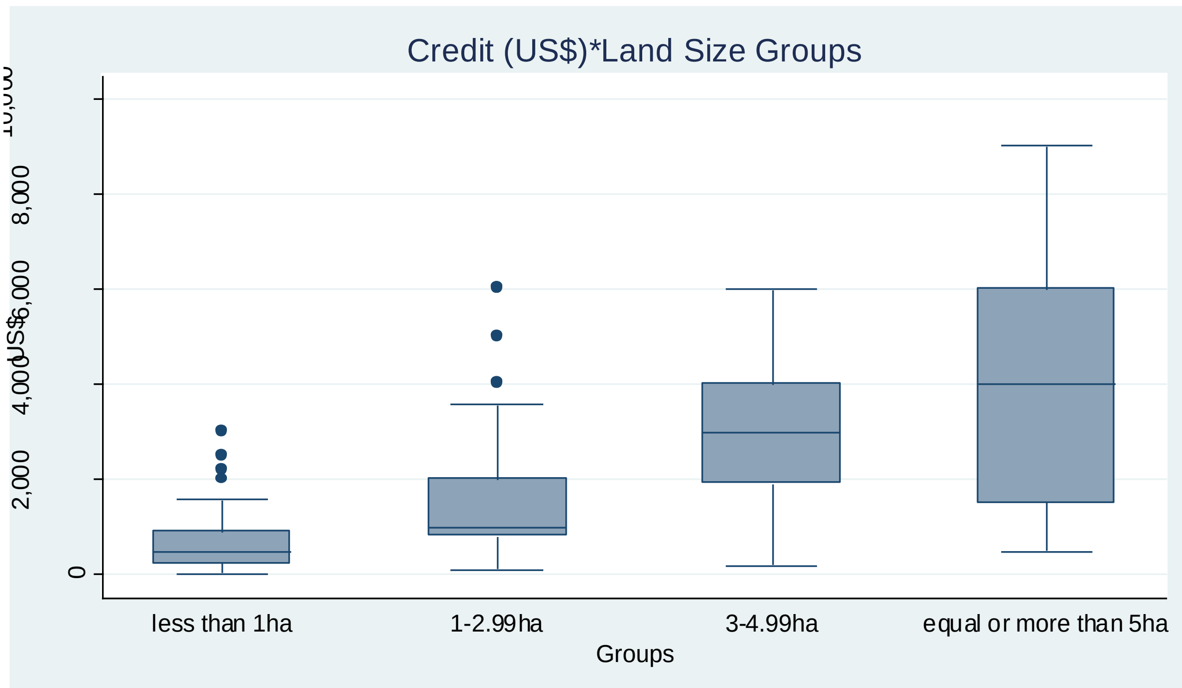

Figure 6-54. Credit (US$) by land size groups (Source: Author)

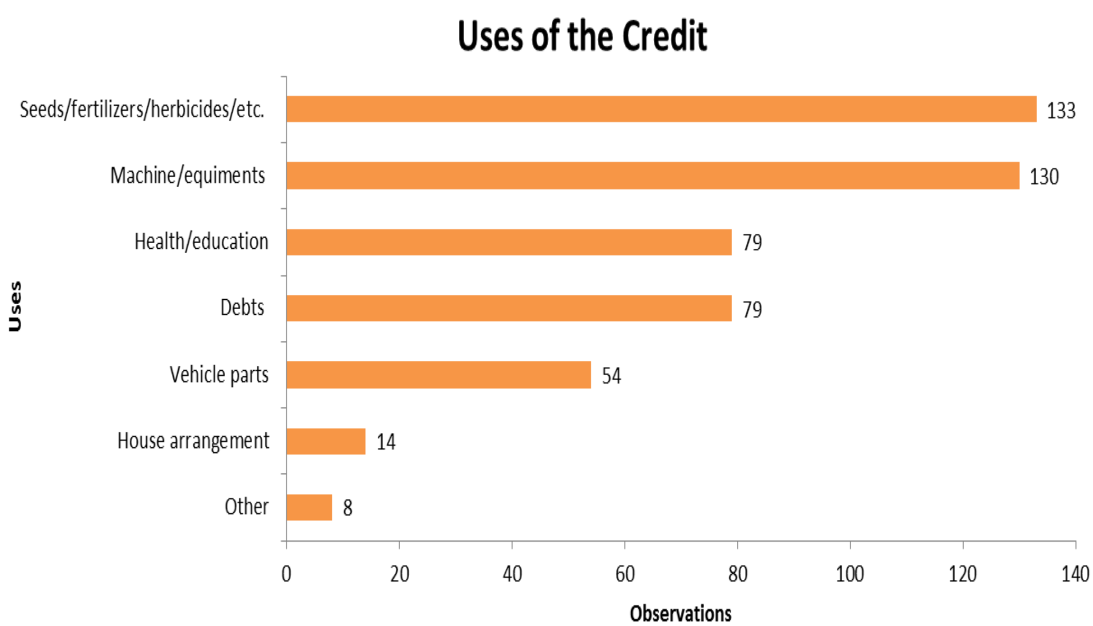

Figure 6-55. Uses of the credit (Source: Author)

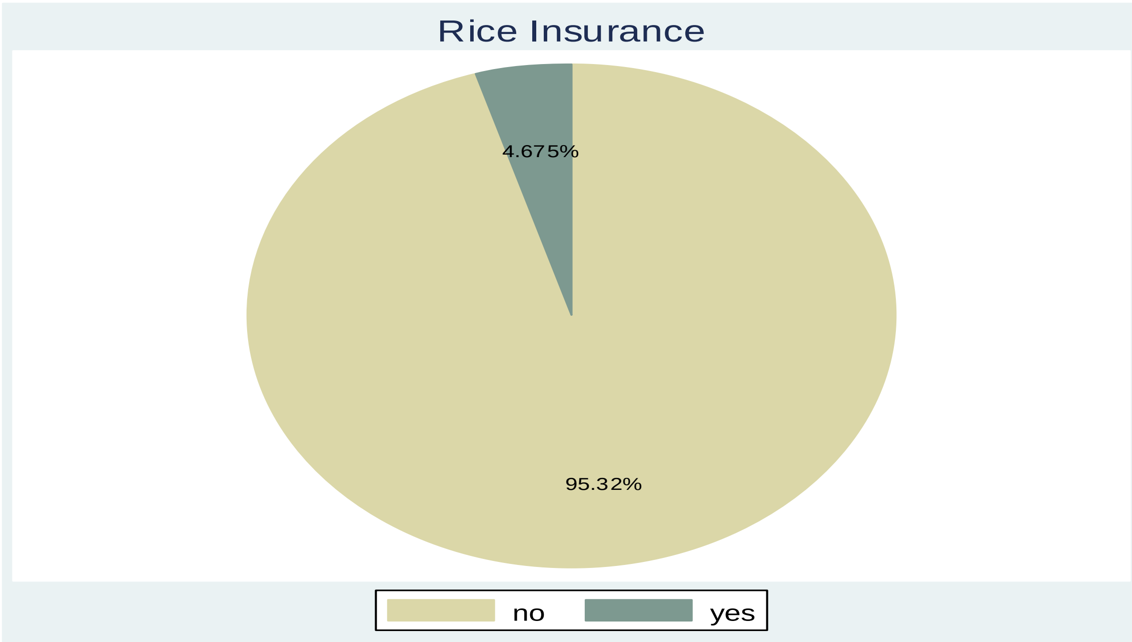

Figure 6-56. Rice insurance (Source: Author)

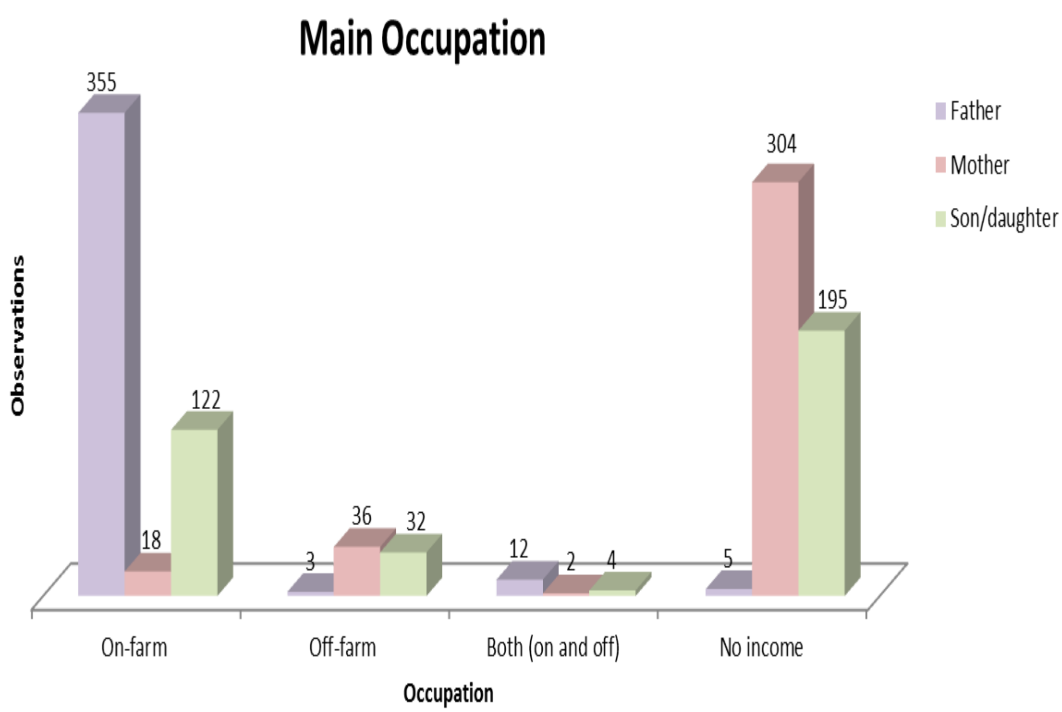

Figure 6-57. Main occupation (Source: Author)

Table 6-4. Time availability (hrs/day)

Variable	Obs	Mean	Std. Err.	Min	Max
On-farm	385	6.05	2.45	0.50	18.00
Off-farm	385	1.75	3.12	0.00	14.00
Education	385	1.99	3.05	0.00	14.00

Source: Author

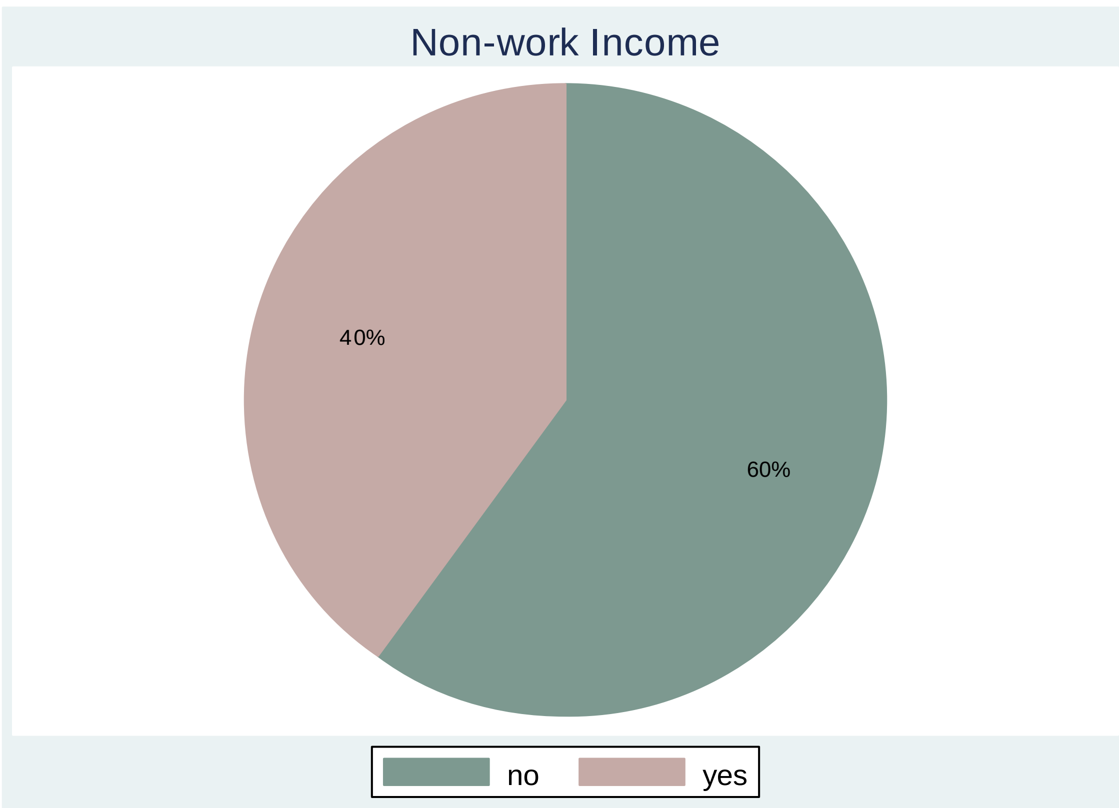

Figure 6-58. Non-work income (Source: Author)

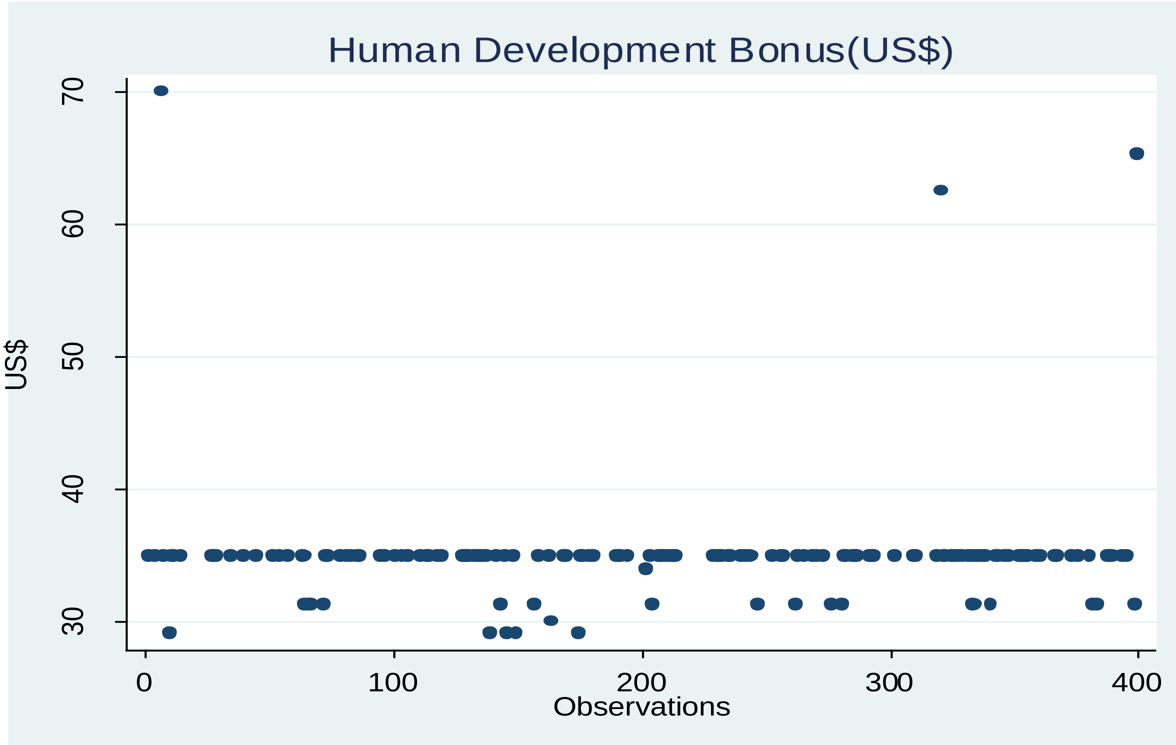

Figure 6-59. Human Development Bonus (US$) (Source: Author)

Table 6-5. Descriptive summary of dependent and independent variables

Variables	Mean	Std. Dev.	Min	Max
Intensity of Adoption (%)	49.70	40.69	0	100
Gender (1=male/0=female)	0.92	0.27	0	1
Age (years)	51.52	14.26	18	95
Education (years)	5.89	3.49	0	17
Agricultural education (1=yes/0= no)	0.2	0.4	0	1
Total operated land size (Ha)	2.01	2.18	0.04	16.33
Number of small kids in a household	1.3	1.39	0	8
Wealth index	0	1	-1.46	8.86
Flood or/and Drought affection (1=yes/0= no)	0.23	0.42	0	1
Time to get the main town (minutes)	23.5	15.34	1	120
Rented land (1=yes/0= no)	0.14	0.35	0	1
Past adoption (1=yes/0=no)	0.18	0.38	0	1
Subsidized Urea sacks (50 kg/ha)	3.19	4.97	0	42.25
Non-subsidized Urea sacks (50 kg/ha)	7.14	30.94	0	583.33
Labor cost (US$)/ha	188.06	43.73	0	395.77
Total other cost (US$/ha)	845.48	468.57	215.21	2674.33
Total yield (sacks 205 lb/ha)	63.37	21.51	14.08	200
Credit solicitation (1=yes/0= no)	0.47	0.5	0	1
Agricultural insurance (1=yes/0= no)	0.05	0.21	0	1
Risk aversion	2.8	0.52	1	3
UDP knowledge (1=yes/0= no)	0.09	0.29	0	1
Total on-farm hours/Ha	8.15	11.69	0.36	100
Total off-farm hours	1.75	3.12	0	14
Total education hours	1.99	3.05	0	14
Non-worked income (1=yes/0= no)	0.4	0.49	0	1
# of people of a religious group	4.81	43.63	0	650
# of people of a family group	2.11	4.29	0	65
# of people of an agricultural group/other group	106.08	296.84	0	3000

Source: Author

Table 6-6. Tobit model estimation of Intensity of Adoption

Regressors	Observed Coef.	Boostrap Std. Err.	Z-value	Marginal Effects
Gender (1=male/0=female)	-1.08	14.88	-0.07	-0.28
Age (years)	-0.14	0.30	-0.46	-0.04
Education (years)	-0.51	1.17	-0.43	-0.13
Agricultural education (1=yes/0= no)	-1.78	8.50	-0.21	-0.46
Total operated land size (Ha)	-6.77*	1.48	-4.58	-1.74
Wealth index	3.77	8.06	0.47	0.97
Number of small kids in a household	-5.05**	2.39	-2.11	-1.30
Flood or/and Drought affection (1=yes/0= no)	-3.42	3.25	-1.05	-0.88
Time to get the main town (minutes)	-0.71*	0.19	-3.69	-0.18
Rented land (1=yes/0= no)	19.72**	7.99	2.47	5.02
Past adoption (1=yes/0=no)	-1.24	8.80	-0.14	-0.32
Subsidized Urea sacks (50 kg/ha)	-1.43**	0.59	-2.43	-0.37
Non-subsidized Urea sacks (50 Kg/ha)	0.13	0.36	0.37	0.03
Labor cost (US$)/ha	0.04	0.08	0.51	0.01
Total other cost (US$/ha)	0.01	0.01	1.12	0.003
Total yield (sacks 205 lb/ha)	-0.09	0.17	-0.52	-0.02
Credit solicitation (1=yes/0= no)	11.86**	5.89	2.01	3.05
Agricultural insurance (1=yes/0= no)	33.55***	18.18	1.85	8.37
Risk aversion	10.85***	5.60	1.94	2.79
UDP knowledge (1=yes/0= no)	20.35***	12.12	1.68	5.17
Total on-farm hours/Ha	0.89***	0.48	1.86	0.23
Total off-farm hours	1.56	0.98	1.58	0.40
Total education hours	1.38	1.00	1.37	0.35
Non-worked income (1=yes/0= no)	7.87	6.79	1.16	2.02
# of people of a religious group	0.001	0.77	0.00	0.0003
# of people of a family group	1.77***	0.97	1.83	0.46
# of people of an agricultural group/other group	-0.0032	0.01	-0.23	-0.001
Constant	40.70	32.16	1.27	-
Variance of the error term	53.47	2.75		
Log likelihood	-1397.80			
Akaike's Information Criterion	7.41			
Pseudo R2	0.035			
Obs. Summary:	19 left-censored observations at SIA<=0 235 uncensored observations 131 right-censored observations at SIA>=100			

Significant at *1%, **5% and ***10%. (Source: Author)

Table 6-7. Collinearity evaluation of the independent variables

	VIF	Tolerance	R-Squared
Gender (1=male/0=female)	1.04	0.92	0.08
Age (years)	1.17	0.73	0.27
Education (years)	1.17	0.73	0.27
Agricultural education (1=yes/0= no)	1.04	0.92	0.08
Total rented/owned operated land size (Ha)	1.19	0.71	0.29
Number of small kids in a household	1.09	0.84	0.16
Wealth index	1.08	0.85	0.15
Flood or/and Drought affection (1=yes/0= no)	1.11	0.82	0.18
Time to get the main town (minutes)	1.03	0.95	0.05
Rented land (1=yes/0= no)	1.04	0.92	0.08
Past adoption (1=yes/0=no)	1.08	0.85	0.15
Subsidized Urea sacks (50 kg/ha)	1.13	0.79	0.21
Non-subsidized Urea sacks (50 kg/ha)	1.09	0.84	0.16
Labor cost (US$)/ha	1.09	0.84	0.16
Total other cost (US$/ha)	1.20	0.69	0.31
Total yield (sacks 205 lb/ha)	1.14	0.77	0.23
Credit solicitation (1=yes/0= no)	1.12	0.80	0.20
Agricultural insurance (1=yes/0= no)	1.07	0.87	0.13
Risk aversion	1.02	0.96	0.04
UDP knowledge (1=yes/0= no)	1.08	0.86	0.14
Total on-farm hours/Ha	1.33	0.56	0.44
Total off-farm hours	1.06	0.88	0.12
Total education hours	1.07	0.87	0.13
Non-worked income (1=yes/0= no)	1.07	0.87	0.13
# of people of a religious group	1.05	0.91	0.09
# of people of a family group	1.01	0.97	0.03
# of people of an agricultural group/other group	1.13	0.78	0.22

Source: Author

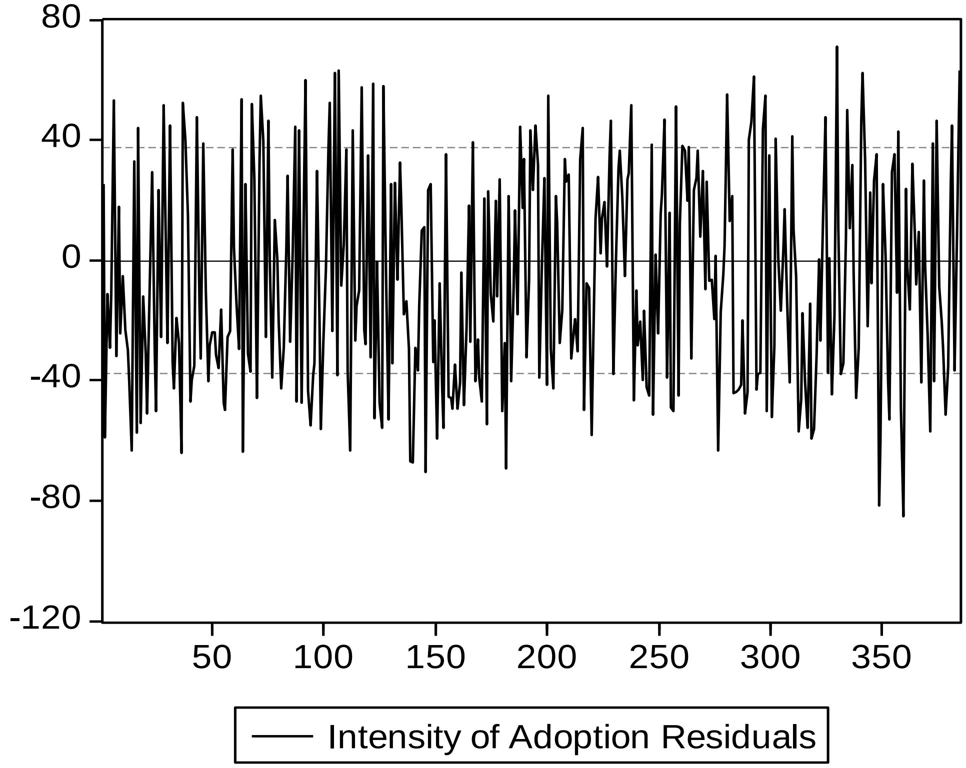

Figure 6-60. Intensity of Adoption Residuals (Source: Author)

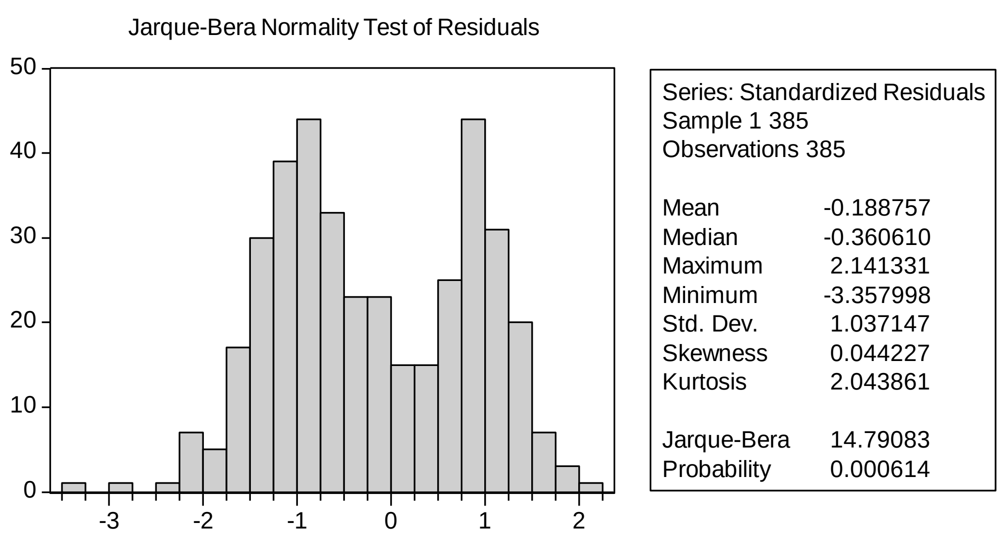

Figure 6-61. Jarque-Bera Normality test of Residuals (Source: Author)

CHAPTER 7
CONCLUSION REMARKS AND POLICY IMPLICATIONS

An ex-ante analysis was carried out to ascertain which factors may affect the adoption process of Urea Deep Placement in the Ecuadorian Coast. This study only takes into consideration small rice farmers in Daule and Santa Lucia cantons. The use of primary data, which were collected through a survey instrument, made possible the development of the descriptive and econometric analyses. Such analyses allow responding the research question of this thesis. Consequently, I could obtain interesting findings that are summarized in this section. Such findings would let to better comprehend the decision making of rice farmers (and perhaps, farmers in general) on the adoption of new technologies. Moreover, I provide recommendations for a suitable introduction of UDP.

As a relevant observation, I noted that farmers were principally males (92.2%), but behind these males there are wives also contributing with the rice activities directly or indirectly. Some wives have the responsibility to purchase inputs, interacting with input dealers and learning about rice business; a participation more intellectual than physical on rice production.

I observed that few farmers mentioned to have adopted an innovation/technology/technique, 18%. Additionally, only a 20% of the sample farmers declared to have received agricultural instruction. This result would imply that farmers need to be updated about new knowledge and new improved technology present in agriculture currently. A further research is suggested on technology adoption and agricultural education over time.

In spite of the fact that the smallest farmers obtained a better yield (kg/ha), their production costs were the highest. Some of these farmers presented a negative net income. There is a need of innovations that make rice business more profitable. For instance, UDP would let these farmers not just increase their yield (income increase per se) but also reduce their cost through Urea saving and weeding cost reduction; when the labor requirement is supplied by family labor (remaining time not used by these farmers). Also, UDP requires more labor that may augment costs. But, the labor required might be satisfied by family labor, especially in small farm, without incurring in any cost (Thomas P. Thompson and Joaquin Sanabria 2009). However, the opportunity cost of working in rice production must be analyzed. As seen before, some households are using considerable amount of hours on off-farm activities; being this cost high if there exits more profitable jobs. Since farmers in these two rice producing zones have rice production as main activity (there are not many jobs being offered in these zones and Guayaquil city is the best place with more profitable alternatives but it is far away from farmers' household), one may think of a low opportunity cost and farmers would dedicate the required hours for UDP production if adoption occurs. Thus, economy of scale is produced by UDP having a better yield but reducing mean cost of rice production as there are urea saving and weeding cost reduction.

Moreover, land size is significantly and negatively associated with Intensity of Adoption. This effect was expected because UDP becomes more labor intensive as rice cropland size increases. Moreover, UDP adopters were mainly small farmers in Bangladesh. In Ecuador, 80% of the farmers are considered as small (less than 20 ha). Therefore, the main adopters' target would be those small farmers.

Another substantial variable was number of children in the household. This factor was found inversely related to IA. As farmers have to take care of their small kids, they would be constrained to dedicate time to experiment new technologies.

Also, while a farmer is closer to the market, he would be more willing to give more land for UDP production. The two main constraints for market access were bad conditions of the roads and lack of transportation. Construction of paved roads and transportation service would not just work for UDP and other technology adoption but also for the ease of rice trade, in general.

Being a land renter would apparently affect IA positively. These farmers are willing to rent or possibly buy land to implement UDP as this technology produces benefits such as urea saving and income increase, making rice business more attractive. Thus, a land market is important to integrate more people to UDP production. In fact, with the new land law being discussed at this moment, new rice farmers may be interest in starting their rice production with this technology.

Additionally, the effects of three different markets of Urea fertilizer were able to be differentiated: a subsidized market, a real market and a black market. In the end, only the total number of subsidized Urea sacks had a significant and negative impact on IA. I conclude that the effects of the subsidy and the black may be being reflected in this variable. UDP might be perceived as a threat for those benefiting from the subsidy (including those Urea resellers) because Urea saving with UDP may make government reconsider about the subsidy. Hence, subsidies may be an important restraint for UDP or other innovation adoption. However, the introduction of these types of technologies that make farmers more competitive, requiring less help from government, are required to reduce this fiscal pressure.

It seems that farmers have no problem with credit access; those who applied for credit received the loan. These credits were important for rice production because this money was spent on inputs mainly. On the other hand, special credit providers were the “Chulqueros”, Rice Mill and friends; playing a relevant role in the development of rice business (an important research to be developed is the impact of the aforementioned credit sources on technology adoption). According to Tobit model, credit participation determines IA positively; cash availability lets farmers try new techniques in their production system. Thus, a credit market, with accessible agricultural credits, is strongly recommended for the UDP adoption in rice production; the availability of these types of credits could also work for adoption of other innovations related to the efficient uses of rice production inputs as credits were used for inputs acquisition mainly.

Insurances were also significant and positive influence in the determination of UDP adoption; being protected from natural disasters makes a farmer willing to try new ideas as agricultural resources are ensured. As said before, Ecuador does not have a developed insurance market because of different reasons. For instance, in agriculture everyone is exposed to many natural disasters every year such as flood and drought; this makes agricultural insurance market too risky and companies decide not to participate in it. It is very important the current participation of the Ecuadorian government in this market subsidizing such agricultural insurances. However, it seems that there still a need of a development of an insurance market (e.g. only 18 farmers mentioned to be a crop-insurance holder in this study). With a better accessibility to these insurances and with an insurance culture, adoption of UDP and other improved technology can take place in the Ecuadorian agriculture.

Moreover, the risk aversion measurement (the higher the value, the riskier) was directly and significantly related to the IA. One can think of these risky farmers as entrepreneurs. They are more willing to adopt new ideas, of course, with the availability of resources such as money. Again, the importance of accessible credit market is relevant for those more enthusiastic for adoption of UDP or any agricultural technique.

In estimating household time availability, I could note that those working on-farm and off-farm dedicated almost the same hours to both activities, on average. I think of two possible scenarios: 1) off-farm work would mean extra income that would be taking as an extra capital for family rice production; or 2) other alternatives could be more profitable than rice production and household time is being allocated to them over time; this might mean a threat for rice production in the future. In the Tobit model, on-farm hours are positively significant in explaining the Intensity of Adoption; those with more hours spent on on-farm activities are more willing to give hectares for UDP production. Farmers were also told that UDP is labor intensive and for that reason those spending few hours on rice production hesitate to provide land for UDP production. Thus, improved technologies are needed to make rice production more profitable. UDP is an incentive that could maintain these people working in agriculture given the rice income improvement and cost reduction.

Also, the majority of farmers belong to a formally built agricultural organization. However, in asking famers for groups that may influence on their rice production decisions, they named neighbors/friends, input suppliers and family as the most influential. Additionally, with a simple methodology proposed by Bandiera and Rasul (2002), social network effect may be caught without falling in the endogeneity problem in the econometric model. Social network has a positive impact on IA which means that a farmer would be more willing/reluctant to adopt UDP if there are potential/non-potential adopters in his social network. In the end, the purpose was to identify the most important social channels of these rice farmers. Working on the establishment of these agricultural groups would be very decisive for the UDP adoption as these channels can be used to spread UDP knowledge across all villages.

Despite the fact that the extension work carried out in Ecuador to diffuse UDP, the promotion of this innovation is still needed: a 9.36% (36) of farmers knew about this new fertilization method. Briquetting machine must be reproduced in order for farmers to have access to briquettes and try this technology. Given the budget constraint, only one briquetting machine was imported to experiment with UDP, obtaining very promising results in term of yield and Urea saving. However, in the descriptive analysis of the Double-bounded Questions, one could observe a surprising number of the studied farmers willing to buy Urea briquette at a price higher than the normal Urea sack's, 93.25% when introducing economic benefits/cost (WTP) and adding environmental impacts (EWTP). Moreover, they showed their willingness to adopt UDP when they adduced to give, on average, 49.70% of their land to produce with this technology. This willingness could have been even greater if the diffusion of UDP would have continued. In the Tobit estimation, having knowledge about UDP makes a farmer more interesting in dedicating hectares for UDP production. Consequently, investments are needed to start out this market. I encourage public and private investors to take part of this project that have shown benefits for both firms and government (see International Fertilizer Development Center 2008). Finally, one point that must be highlighted is the possible lack of interest in environmental benefits of this technology. Education about environment benefits must be considered in order to make farmers more aware of this relevant resource (e.g. Daule River is a source of water for agricultural production and for family consumption).

Considering the most significant variables, the potential adopter is defined as a farmer having few hectares and small kids, being close to the market, renting land, buying few subsidized Urea sacks, participating in the credit and insurance market, taking risks, having UDP knowledge, spending most of his time on on-farm activities and keeping potential UDP adopters in his social network.

There are two investigations that should be taken into consideration for UDP development: 1) elaboration of a device to facilitate the Urea briquette placement (N. K. Savant et al. 1991) and; 2) examination of UDP impact on the environment (reduction of "N" going into the atmosphere and aquatic resources).

To sum up, important factors were identified, which would be determining adoption of UDP, but also of any agricultural innovation in general. For instance, important constrains for UDP adoptions would be a lack of credit and insurance markets. Hence, information was provided to investors and policymakers of potential demanders of a market with economic and social benefits. Finally, this thesis is a contribution to the Ecuadorian agricultural technology adoption literature.

APPENDIX
QUESTIONNAIRE (SPANISH VERSION)

Preguntas de Filtro

¿Usted maneja un cultivo de arroz?	____Si ____No(Pase a Sección 7: Salud, hoja 6)
¿Qué clase de manejo usted ha llevado en su cultivo de arroz?	____Arroz al trasplante ____Arroz Al voleo ____Otro: ¿Cuál?_________
¿Usted toma las decisiones sobre su cultivo de arroz?	____ Si ____No (siga a otra casa)

SECCIÓN 1: DIFUSIÓN DE LA APLICACIÓN PROFUNDA DE BRIQUETAS DE UREA

1. ¿Usted ha escuchado, visto o utilizado la Aplicación Profunda de Briquetas de Urea (las bolitas de Urea que se enterraban en el suelo)?	___Si ___No(pase sección 2: Redes sociales)

2. ¿De qué forma conoció la Aplicación Profunda de Briquetas de Urea (las bolitas de Urea que se enterraban en el suelo)? (Ponga sí o no, o escoja el número de acuerdo a las claves)

Reuniones en Asociaciones (clave1)	Conversaciones con (clave 2)	Recibió folletos de la APBU(si/no)	En Ferias Agrícolas (si/no)	Medios de Comunicación (clave3)	Otros (escriba cuales)

3. ¿De qué forma por primera vez conoció personalmente los resultados de la Aplicación Profunda de Briquetas de Urea (las bolitas de Urea que se enterraban en el suelo)?(Marque X o escoja el número de acuerdo a la clave4)

No he observado	Experimento en mi finca	Experimento en finca ajena	Observo a (clave4)	Otras (escriba cuales)

NOTA: SI OBSERVO (CLAVE4) A OTRA PERSONA LOS RESULTADOS DEL APBU, CONTESTE PREGUNTA 4. EN OTRO CASO PASE A LA PREGUNTA 5.

4. ¿Cuál es el nombre del dueño y la distancia aproximada desde su finca hasta la finca en donde usted observó los resultados de la Aplicación Profunda de Briquetas de Urea (las bolitas de Urea que se enterraban en el suelo)? (Distancia en tiempo que el encuestado le diga)

Unidad	Cantidad	Nombre

5. Si usted volvió a saber sobre la Aplicación Profunda de Briquetas de Urea (las bolitas de Urea que se enterraban en el suelo), ¿hace cuánto tiempo y como volvió a saber? (Poner cero en cantidad si no supo nunca más y pasar a la pregunta 6 o 7)

¿Hace cuánto?		¿Cómo supo de nuevo sobre la Aplicación Profunda de briquetas de Urea (las bolitas de Urea que se enterraban en el suelo)?					
Unidad	Cantidad	Reuniones en Asociaciones	Experimento en finca propia	Experimento en finca ajena	Conversando u Observando a (clave4)	Por esta encuesta	Otros (escriba cuales)

6. <u>NOTA: CONTESTE ESTA PREGUNTA SI EL ENCUESTADO EXPERIMENTO CON LAS BRIQUETAS DE UREA EN LA PREGUNTA 3 O 5.</u> Por favor, díganos la información aproximada sobre la producción con la Aplicación de briquetas de Urea de la última vez que la utilizó (VER HOJA PRODUCCIÓN CON APBU O PÁGINA 2).

7. De lo que ha escuchado, observado o experimentado, ¿Qué conocimiento tiene sobre la Aplicación Profunda de Briquetas de Urea(las bolitas de Urea que se enterraban en el suelo)? (marque con una X el casillero correspondiente)

Poco	Regular	Bastante

SECCIÓN 2: REDES SOCIALES

8. Indique todos los Grupo u Organización que usted u otro miembro de su hogar pertenece.

Miembro de su hogar (Jefe del hogar, esposa, hijo, etc.)	Tipo de Organización / Grupo (clave5)	Nombre del Grupo u Organización	Número de personas dentro de su Grupo u Organización	Cuántas de estas personas son familiares	Participa en su grupo voluntariamente (si/no)	Frecuencia de participación			Señale como es su participación en cada organización			
						Semanal	Mensual	Anual	No participa	Algo Activo	Muy Activo	Líder
						☐	☐	☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐	☐	☐

SOLO SI HA USADO LA APLICACIÓN PROFUNDA DE BRIQUETAS DE UREAS: PRODUCCIÓN CON APBU

6. BASADA EN LA ÚLTIMA PRODUCCIÓN DE ARROZ CON LAS BRIQUETAS DE UREA (LA BOLITAS DE UREA QUE SE ENTERRABAN EN EL SUELO)

Ciclo Corto				Producción de Arroz			
Cultivo	Rubros		Unidad	Cantidad	Valor Unitario	Observaciones	
Arroz	Gastos en Semilla				$	Nombre de la semilla:	Tipo: R _ V_ H _
	Gastos en Fertilizantes	¿Qué Cantidad de Urea usó y a quien se la compró?		Gobierno: ……...	$		
				Casas Comerciales……...	$		
				Otros:……….	$	Quien:	
		¿Qué cantidad de NPK (Completo) usó?			$		
		¿Qué cantidad de DAP (el de la pata, inicio) usó?			$		
	Gastos en Foliares (escriba el costo total de todo el ciclo del cultivo de arroz)		$				

	Gastos en Herbicidas/Malezas (escriba el costo total de todo el ciclo del cultivo de arroz)		$			
	Gastos en Insecticida /Bichos y otros /líquidos (escriba el costo total de todo el ciclo del cultivo de arroz)					
	Gastos en pago a Jornales	¿Qué cantidad de jornales/personas uso para el Trasplante?			$	
		¿Qué cantidad de jornales/personas uso para Aplicaciones de Productos?			$	
		¿Qué cantidad de jornales/personas uso para cosechar?			$	
	Costos relacionados a Cosecha y Pilado: Cosechadora, transporte, cargada, sacos y pilada (escriba el costo total en el cultivo de arroz)		$			
Arroz	Cosecha	En el último cultivo, ¿Qué cantidad cosechó?				
		En el último cultivo, ¿Qué cantidad dejó para consumo propio?				
		¿Qué cantidad y a qué precio vendió en Sacas (arroz en cascara)?			$	
		¿Qué cantidad y a qué precio vendió en Arroz Pilado?			$	
		De esta cosecha ¿Qué cantidad de dinero destinó para ahorro (escribe solo la cantidad de dinero)	$			

a) ¿Cuánta área utilizó para producir con las briquetas de Urea? __________Cuadras ____________Tareas	C) Si alquilo las tierras, ¿cuánto pago en total? $__________
b) De esta área ¿Cuánto alquilo? (**PONGA CERO SI NO ALQUILO Y PASE A LA PREGUNTA 9**) ______Cuadra _______Tareas	

9. Por favor, conteste el siguiente conjunto de preguntas. (Para el encuestador: mencionar los grupos al encuestado en cada pregunta)

Preguntas	Vecinos	Miembros de Asociación/Grupo	Amigos no incluidos en las anteriores categorías	Familiares	Dirigentes, Presidentes o líderes	Trabajadores de extensión	Comerciante	Otros (detalle nombre y que es para el encuestado)
¿De quién aprendió el uso de fertilizantes? (puede escoger más de una opción)								
¿Con qué frecuencia y con qué grupo usted habla sobre técnicas agrícolas? (Clave7)								
Si tiene un problema ¿a quién pediría								

un consejo o ayuda?								
Elija los 3 grupos que influye más en sus decisiones sobre el manejo de su cultivo de arroz. (Siendo 1 el más importante y 3 el menos importante)								

¿Cuál es el nombre de la persona a la que gente le pide consejos sobre el manejo de cultivos? (Anote en el nombre incluso cuando el encuestado mismo sea esa persona y cualquier otra identificación que sea posible encontrarlo)

Nombre: _____________________ ¿Qué es para usted?:_______________ ¿A cuántos minutos de distancia esta la casa de esta persona?:_____________________

10. Indique con cuántos hombres y mujeres aproximadamente usted conversa sobre técnicas agrícolas y a que grupo pertenecen. (escriba el número de personas en todos los grupos que diga el encuestado)

	Grupo Religioso	Familiares	Asociación/otro grupo/vecinos/amigos
Hombres			
Mujeres			

11. En general, ¿Cómo usted considera la comunicación entre los agricultores de su sector? Marque con una X

Baja	Regular	Indiferente	Buena	Muy Buena

SECCIÓN 3: ANTERIORES ADOPCIONES DE TÉCNICAS AGRÍCOLAS, PERCEPCIONES Y DISPONIBILIDAD A PAGAR

12. ¿Usted ha usado nuevas técnicas agrícolas en sus cultivos?
___Si ___No (pase 14) ____ No recuerdo(pase 14)

13. Si usted ha usado nuevas técnicas agrícolas en sus cultivos, ¿Cuáles fueron, hace cuánto tiempo las usó y cómo calificaría sus experiencias con los mismas?

¿Cuáles fueron los Cambios? (Clave 6)	¿Hace cuánto tiempo?		¿Cómo calificaría sus experiencias con esas formas de producir?		
	Unidad	Cantidad	Pésima	Me dio Igual	Buena

14. Por favor, responda si esta desacuerdo, indiferente o acuerdo sobre las siguientes oraciones (Marque con X)

	Desacuerdo	Indiferente	Acuerdo
a) Usted comparte cualquier conocimiento agrícola con los agricultores de su sector.			
b) TODOS los agricultores de su sector comparten experiencias del manejo de cultivos.			
c) Usted utilizaría un nuevo método de aplicar la Urea en su cultivo de arroz, aunque otros no hayan usado este método.			

NOTA: PARA EL ENCUESTADOR: Debe de leerle este texto al encuestado antes se preguntarle la Pregunta 15:
Explicación de la Aplicación Profunda de Briquetas de Urea y de sus Beneficios y Costos.
La Aplicación Profunda de Briquetas de Urea (APBU) es una tecnología que convierte la Urea normal en briquetas (o pequeñas bolas de Urea) mediante una máquina llamada Briquetadora. Estas briquetas, que pesan alrededor de 2.7 a 4 gramos, son enterradas manualmente en medio de cuatro plantas en el suelo fangoso por debajo de la lámina de agua, después del trasplante y se lo hace por una sola vez en el ciclo de cultivo. Mediante las briquetas de Urea se puede evitar alrededor del 50% de la pérdida de la Urea por evaporación y escorrentías. De esta forma, las plantas podrán captar más el Nitrógeno contenido en la Urea.
Los beneficios y costos de la Aplicación de las briquetas de Urea serían:
Beneficios:

- Con las briquetas de Urea se aplicaría de 4 a 4,5 quintales de Urea por hectáreas. Una reducción de Urea usada del 40%.
- Incremento de la Producción de arroz del 25%, y por ende mayores ingresos.
- Posible creación de pequeñas empresas encargadas de vender las briquetas de Urea y por ende generación de empleos.
- Costos:
- Se necesitaría dos jornales más por hectárea para aplicar la Urea.
- Se debe tener comprados los 4 o 4,5 quintales de Urea para la aplicación entre los 15 a 20 días después del trasplante, ya que se fertiliza una solo vez durante todo el ciclo del cultivo. Po cual se debe hacer un solo gasto en todos los quintales de Urea al inicio

15. Considerando los beneficios y costos de las Briquetas de Urea:

Version 1:

<table>
<tr>
<td rowspan="2">a. ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea UN DÓLAR DE MÁS de lo que usted paga por la Urea normalmente?</td>
<td>☐ Si
(siga b)</td>
<td>b. Ya que está dispuesto a pagar un dólar, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea UN DÓLAR y CINCUENTA CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente?
☐ Sí ☐ No</td>
<td rowspan="2">d. Sin importar las respuestas anteriores, En Su Mente ¿Cuánto usted estaría dispuesto a pagar por cada quintal de briquetas de Urea adicionalmente a lo que usted paga por la Urea normalmente?
$______</td>
</tr>
<tr>
<td>☐ No
(siga c)</td>
<td>c. Ya que no está dispuesto a pagar un dólar, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea CINCUENTA CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente?
☐ Sí ☐ No</td>
</tr>
</table>

Version 2:

a. ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea TRES DÓLARES DE MÁS de lo que usted paga por la Urea normalmente?	☐ Si ⇨ (siga b)	b. Ya que está dispuesto a pagar tres dólares, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea TRES DÓLARES Y CINCUENTA CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente? ☐ Sí ☐ No	d. Sin importar las respuestas anteriores, En Su Mente ¿Cuánto usted estaría dispuesto a pagar por cada quintal de briquetas de Urea adicionalmente a lo que usted paga por la Urea normalmente? $______
	☐ No ⇨ (siga c)	c. Ya que no está dispuesto a pagar tres dólares, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea DOS DÓLARES Y CINCUENTA CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente? ☐ Sí ☐ No	

Version 3:

a. ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea DOS DÓLARES DE MÁS de lo que usted paga por la Urea normalmente?	☐ Si ⇨ (siga b)	b. Ya que está dispuesto a pagar dos dólares, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea DOS DÓLARES Y CINCUENTA CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente? ☐ Sí ☐ No	d. Sin importar las respuestas anteriores, En Su Mente ¿Cuánto usted estaría dispuesto a pagar por cada quintal de briquetas de Urea adicionalmente a lo que usted paga por la Urea normalmente? $______
	☐ No ⇨ (siga c)	c. Ya que no está dispuesto a pagar dos dólares, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea UN DÓLAR Y CINCUENTA CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente? ☐ Sí ☐ No	

NOTA: PARA EL ENCUESTADOR: Debe de leerle este texto al encuestado antes se preguntarle la Pregunta 16:
Beneficios ambientales de la Aplicación Profunda de Briquetas de Urea.
Sabiendo que los primeros beneficios y costos de las briquetas de Urea son:
Beneficios: Reducción del uso de Urea en un 40%, Incremento de la producción de un 25% y una Posible generación de empleo.
Costos: Aumento de los jornales utilizado y Compra al inicio de todos los quintales de Urea que van a ser aplicados.
En cuanto al medio ambiente, cuando se utiliza la aplicación “Al voleo”, la cantidad de Urea que se puede estar perdiendo por escorrentías o por evaporación sería alrededor del 50%, lo cual afecta negativamente al medio ambiente. Mediante la aplicación con las briquetas de Urea se reduce la perdida de la Urea, consiguiendo los siguientes impactos ambientales:

- Se reduciría los gases, en este caso el Nitrógeno contenido en la Urea, que generan el Calentamiento global.
- Se reduciría el nitrógeno en los ríos, conservando el oxígeno en el agua y la vida acuática.
- Se evitarían enfermedades de las personas que beben aguas de los ríos, ya que se reduce el nitrógeno en esas aguas y el cual es malo para la salud cuando existe en grandes cantidades en el agua que es bebida.

16. Considerando los beneficios y costos de las Briquetas de Urea, pero ahora considerando el beneficio ambiental:

Version 1:

<table>
<tr>
<td rowspan="2">a. ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea UN DÓLAR DE MÁS de lo que usted paga por la Urea normalmente?</td>
<td>☐ Si
(siga b)</td>
<td>b. Ya que está dispuesto a pagar un dólar, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea UN DÓLAR y CINCUENTA CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente?
☐ Sí ☐ No</td>
<td rowspan="2">d. Sin importar las respuestas anteriores, En Su Mente ¿Cuánto usted estaría dispuesto a pagar por cada quintal de briquetas de Urea adicionalmente a lo que usted paga por la Urea normalmente?
$______</td>
</tr>
<tr>
<td>☐ No
(siga c)</td>
<td>c. Ya que no está dispuesto a pagar un dólar, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea CINCUENTA CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente?
☐ Sí ☐ No</td>
</tr>
</table>

Version 2:

<table>
<tr><td rowspan="2">a. ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea TRES DÓLARES DE MÁS de lo que usted paga por la Urea normalmente?</td><td>☐ Si
(siga b)</td><td>b. Ya que está dispuesto a pagar tres dólares, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea TRES DÓLARES Y CINCUENTAS CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente?
☐ Sí ☐ No</td><td rowspan="2">d. Sin importar las respuestas anteriores, En Su Mente ¿Cuánto usted estaría dispuesto a pagar por cada quintal de briquetas de Urea adicionalmente a lo que usted paga por la Urea normalmente?
$______</td></tr>
<tr><td>☐ No
(siga c)</td><td>c. Ya que no está dispuesto a pagar tres dólares, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea DOS DÓLARES Y CINCUENTAS CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente?
☐ Sí ☐ No</td></tr>
</table>

Version 3:

<table>
<tr><td rowspan="2">a. ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea DOS DÓLARES DE MÁS de lo que usted paga por la Urea normalmente?</td><td>☐ Si
(siga b)</td><td>b. Ya que está dispuesto a pagar dos dólares, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea DOS DÓLARES Y CINCUENTA CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente?
☐ Sí ☐ No</td><td rowspan="2">d. Sin importar las respuestas anteriores, En Su Mente ¿Cuánto usted estará dispuesto a pagar por cada quintal de briquetas de Urea adicionalmente a lo que usted paga por la Urea normalmente?
$______</td></tr>
<tr><td>☐ No
(siga c)</td><td>c. Ya que no está dispuesto a pagar dos dólares, ¿Estaría usted dispuesto a pagar por cada quintal de briquetas de Urea UN DÓLAR Y CINCUENTA CENTAVOS DE MÁS de lo que usted paga por la Urea normalmente?
☐ Sí ☐ No</td></tr>
</table>

17. NOTA: SE RESPONDE ESTA PREGUNTA SI ES QUE HUBO UNA DISPONIBILIDAD A PAGAR POR LAS BRIQUETAS DE UREA EN LAS PREGUNTAS 15 0 16. Dado que usted está dispuesto a pagar por las briquetas de Urea. ¿En cuántas cuadras-tareas usted estaría dispuesto a utilizar la Aplicación Profunda de Briquetas de Urea?

______Cuadra(s) ________ Tarea(s)

SECCIÓN 4: SISTEMA DE PRODUCCIÓN

17. BASADA EN LA ÚLTIMA PRODUCCIÓN DE ARROZ, INDIQUE LOS COSTOS E INGRESOS QUE TUVO						
a) ¿Cómo lleva su cultivo? Piscina______ Poza__________						
Ciclo Corto			Producción de Arroz			
Cultivo	Rubros		Unidad	Cantidad	Valor Unitario	Observaciones
Arroz	Gasto en alquiler de cada unidad de terreno (Para el encuestador: el pago depende de la cantidad de tierra que se alquila para cultivar)				$	
	Gasto en preparación de cada unidad de Terreno: arado y fangueado				$	
	Gastos en Semilla				$	Nombre de la semilla: / Tipo: R _ V_ H _
	Gastos en Fertilizantes	¿Qué Cantidad de Urea usó y a quien se la compró?		Gobierno: ……..	$	
				Casas Comerciales… …...	$	
				Otros:……….	$	Quien:
		¿Qué cantidad de NPK (Completo) usó?			$	
		¿Qué cantidad de DAP (el de la pata, inicio) usó?			$	
	Gastos en Foliares (escriba el costo total de todo el ciclo del cultivo de arroz)		$			
	Gastos en Herbicidas/Malezas (escriba el costo total de todo el ciclo del cultivo de arroz)		$			
	Gastos en Insecticida /Bichos y otros /líquidos (escriba el costo total de todo el ciclo del cultivo de arroz)					
	Gastos en pago a Jornales	¿Qué cantidad de jornales/personas uso para el Trasplante?			$	
		¿Qué cantidad de jornales/personas uso para Aplicaciones de Productos?			$	
		¿Qué cantidad de jornales/personas uso para cosechar?			$	
	Gastos en acceso al agua de riego	Paga a Junta de Riego_____ (cada cuanto tiempo y cuánto paga)			$	
		Paga por Riego por bomba_____ (gasto por cada galón de diesel para la bomba o pago con sacas de arroz)			$	
	Costos relacionados a Cosecha y Pilado: Cosechadora, transporte,		$			

	cargada, sacos y pilada (escriba el costo total en el cultivo de arroz)					
Arroz	Cosecha	En el último cultivo, ¿Qué cantidad cosechó?				
		En el último cultivo, ¿Qué cantidad dejó para consumo propio?				
		¿Qué cantidad y a qué precio vendió en Sacas (arroz en cascara)?			$	
		¿Qué cantidad y a qué precio vendió en Arroz Pilado?			$	
		De esta cosecha ¿Qué cantidad de dinero destinó para ahorro (escribe solo la cantidad de dinero)	$			

¿Cuánta área dedico a este cultivo? _____ cuadras _______tareas
¿Cuántos ciclos de cultivos de arroz usted tiene al año? __________ciclo(s)

18. LLENE LA TABLA SI ES QUE TIENE OTROS CULTIVOS (PONGA EL NOMBRE DEL CULTIVO A LA IZQUIERDA) DE CICLO CORTO O CULTIVOS DE CICLO PERMANENTE

CICLO CORTO						
Cultivo	Rubros		Unidad	Cantidad	Valor Unitario	Observaciones
De ciclo corto: ______ ___	Costo Total Estimado (escriba el costo total solo)		$			
	COSECHA	¿Qué cantidad cosechó?				Área: ………
		¿Qué cantidad dejó para consumo propio?				
		¿Qué cantidad vendió y a qué precio?			$	
		De esta cosecha ¿Qué cantidad de dinero destinó para ahorro (escribe solo la cantidad de dinero)	$			
CICLO PERMANENTE						
De ciclo perman ente: ______ ____	Costo Total Estimado (escriba el costo total solo)		$			
	COSECHA	¿Qué cantidad cosechó?				Área: ………
		¿Qué cantidad dejó para consumo propio?				
		¿Qué cantidad vendió y a qué precio?			$	
		De esta cosecha ¿Qué cantidad de dinero destinó para ahorro (escribe solo la cantidad de dinero)	$			
De ciclo perman ente: ______ ____	Costo Total Estimado (escriba el costo total solo)		$			
	COSECHA	¿Qué cantidad cosechó?				Área: ………
		¿Qué cantidad dejó para consumo propio?				
		¿Qué cantidad vendió y a qué precio?			$	
		De esta cosecha ¿Qué cantidad de dinero destinó para ahorro (escribe solo la cantidad de dinero)	$			

19. Cuánto tiempo usualmente se demora en vender su producción de:	Verano	Invierno
Arroz	Unidad: Cantidad:	Unidad: Cantidad:
Otro cultivo ¿Cuál?:	Unidad: Cantidad:	Unidad: Cantidad:
20. ¿A cuántas piladoras usualmente usted puede ir a vender su producción de arroz? (si no va a las piladoras poner 0 y pasar 22)	__________piladora(s)	__________piladora(s)
21. (No conteste si no va a vender su arroz a las piladoras). En las piladoras que usualmente usted vende su producción de arroz, díganos un número aproximado de cuanto otros productores de arroz venden su producción en esa misma piladora	_________ productor(es)	_________ productor(es)

SECCIÓN 5: MOVIMIENTOS DE DINERO

22. En el último año, ¿Usted pedio un préstamo? ____Si ____No(pase a 28A)

22A ¿A quién ha acudido? (marque con una X y puede elegir más de una opción)

- ☐ Bancos
- ☐ Cooperativas
- ☐ Cajas de ahorro
- ☐ Banco Comunal
- ☐ Fundaciones
- ☐ Chulquero
- ☐ Piladoras
- ☐ Familiar o amigo
- ☐ Almacenes
- ☐ Otro: __________

22B Si le aprobaron el crédito, díganos un aproximado del monto que le prestaron y quien se lo presto. (Marque con una X en el casillero si no le aprobaron el préstamo)

☐ No me aprobaron el préstamo (pase a 23)

$______Bancos
$______Cooperativas
$______Cajas de ahorro
$______Banco Comunal
$______Fundaciones
$______Chulquero
$______Piladoras
$______Familiar o amigo
$______Almacenes
$______Otro:___________

Nota: Si logro algún préstamo, conteste desde la 24

25. ¿En que gastó el préstamo que hizo de mayor monto? Elija los 3 gastos más importantes, siendo 1 el más importante y 3 menos importante.

Gastos (mencione los gastos al encuestado)

….Gastos en insumos o semillas,
….Gastos por Comprar o alquilar maquinaria, equipos,
….Gastos en repuestos para equipos vehículos,
….Gastos en arreglo de la casa,
….Gastos en pago de deudas,
….Gastos en familia: Salud, Educación,
.... Gastos en entretenimiento, viajes,
.... Otros gastos: ¿Cuáles?__________

26A. ¿Usted vendió su arroz a algún prestamista? … Si ….No(Pase 27)

26B. ¿El precio que vendió al prestamista fue precio al del mercado? … Si ….No

26C. ¿Cuál fue el precio y como lo vendió su arroz? Precio: $……. ¿Cómo? Por: ..... Saca …. Quintal

27. En el siguiente ciclo va a intentar pedir un préstamo a la misma persona/institución: Si …. No ….

23. En caso de NO haberse concretado el préstamo, ¿Cuáles fueron los motivos? (Conteste y luego continúe desde la 27)

___Motivos del prestamista ____Motivos relacionados a usted
____Otros: ¿cuáles?_________

24A. ¿Cuál fue el plazo de pago para el préstamo que hizo de mayor monto?(Marque con X, puede escoger solo 1 opción)

__Pagos diarios
__ Pagos semanales
__ Pagos quincenales
__ Pagos mensuales
__ Pagos trimestrales
__Otros: ¿Cuáles?____________

24B. De acuerdo al plazo de pago, ¿Cuánto usted pago por este préstamo?

Pago:$___________

28A. ¿Usted tiene seguro agrícola? Si…. No….(pase 29)

28B. ¿Para qué cultivo? C1: Arroz…. C2:Mango… C3:Maíz… C4:Otro……

28C. ¿Cuánto paga por cultivo? C1:……. Dólares, C2:……. Dólares, C3:…….Dólares; C4:…….Dólares

28D. ¿Cada qué tiempo? C1: Anual…, Trimestral…, Mensual…, Semestral…; C2: Anual…, Trimestral…, Mensual..., Semestral…; C3: Anual…., Trimestral…., Mensual…., Semestral….;C4:Anual…., Trimestral…., Mensual…., Semestral….

28E. ¿Tiene algún seguro subsidiado por el gobierno? Si … No …;
¿Para qué cultivo? (escriba C1, C2, etc, según el cultivo): ……………..

SECCIÓN 6: MERCADO LABORAL		
29. TRABAJO (Nota: Las siguientes preguntas están basadas en un día normal de trabajo (número de horas))		
Integrante		
Padre	¿Cuál es la principal fuente de ingreso? (Puede trabajar en agricultura o en otra cosa)	Agricultura ___ ; No agrícola __ No ingresos __
	¿Cuántas horas usted trabaja en actividades agrícolas?	hora(s)
	¿Cuántas horas usted trabaja en actividades NO AGRÍCOLAS? (Si contesta esta pregunta, ver a qué actividad se dedica en pregunta 33)	hora(s)
	¿Cuántas horas le ocupa los estudios?	hora(s)
	¿Cuántas horas le ocupa en las actividades de casa?	
Madre	¿Cuál es la principal fuente de ingreso?(Puede trabajar en agricultura o en otra cosa)	Agricultura ___ ; No agrícola __ No ingresos __
	¿Cuántas horas su pareja trabaja en actividades agrícolas?	
	¿Cuántas horas su pareja trabaja en actividades NO AGRÍCOLAS? (Si contesta esta pregunta, ver a qué actividad se dedica en pregunta 33)	
	¿Cuántas horas su pareja le ocupa los estudios?	
	¿Cuántas horas su pareja le ocupa en las actividades de casa?	
Hijo	¿Cuál es la principal fuente de ingreso?(Puede trabajar en agricultura o en otra cosa)	Agricultura ___ ; No agrícola __ No ingresos __
	¿Cuántas horas su hijo(a) trabaja en actividades agrícolas?	
	¿Cuántas horas usted trabaja en actividades NO AGRÍCOLAS? (Si contesta esta pregunta, ver a qué actividad se dedica en pregunta 33)	
	¿Cuántas horas le ocupa los estudios?	
	¿Cuántas horas le ocupa en las actividades de casa?	
30. ¿Cuántas personas en su hogar trabajan en la agricultura, incluyendo a usted?		___________persona(s)
31. ¿Cuántas personas en tu hogar trabajan en actividades NO AGRICOLAS, incluyen a usted?		___________persona(s)
32. ¿Cuántas personas en su hogar estudian, incluyendo a usted?		___________persona(s)

33. ¿Trabaja Usted o alguien más de su familia en alguna otra actividad además de la agrícola que les de dinero?	___ Si(llene tabla de abajo) ___No(pase 34)		
Nota: Responda las siguientes preguntas de acuerdo a las actividades que usted trabajó en el último año.			
Preguntas / Actividades	¿Cuál fue su Ingreso Aproximado por esta actividad?	¿Cada cuánto tiempo recibía este ingreso?	¿De este monto cuanto ahorró?
Pesca	$	____Diario ____Semanal ___Mensual	$
Proyectos forestales	$	____Diario ____Semanal ___Mensual	$
Crianza de animales	$	____Diario ____Semanal ___Mensual	$
Apicultura (Abejas)	$	____Diario ____Semanal ___Mensual	$
Algún proceso Agroindustrial	$	____Diario ____Semanal ___Mensual	$
Turismo	$	____Diario ____Semanal ___Mensual	$
Artesanía	$	____Diario ____Semanal ___Mensual	$
Algún tipo de Comercio	$	____Diario ____Semanal ___Mensual	$
Alquiler de equipos	$	____Diario ____Semanal ___Mensual	$
Otras: ___________________	$	____Diario ____Semanal ___Mensual	$

34. EN EL ÚLTIMO AÑO, indique si recibió algún tipo de dinero que no es resultado del trabajo como por ejemplo de:

	Monto en $	**Frecuencia en la recibió este dinero**		**Del dinero que recibió, ¿cuánto ahorró?**
Familiares en otras partes del país		Unidad:	Cantidad:	
Familiares en el extranjero		Unidad:	Cantidad:	
Bono solidario		Unidad:	Cantidad:	
Arriendos		Unidad:	Cantidad:	
Ganancias financieras		Unidad:	Cantidad:	
Donaciones		Unidad:	Cantidad:	
Otros: ________________		Unidad:	Cantidad:	

SECCIÓN 7: SALUD			
35. Responda el siguiente conjunto de preguntas:			
a) ¿De dónde obtiene el agua para el uso diario?	Pozo …. Rio …. Agua potable por tubería ….. Agua potable por tanquero …. Agua embotellada…… Otro …..		
b) ¿Usted usa el agua del rio o pozo para beber y cocinar?	Si ….. No …..		
c) ¿Qué métodos usa para purificar el agua?	Química ….. Físico…. Filtros ….. Otros ….. Ninguno (Pase a pregunta e) …..		
d) ¿Cuánto gasta por purificar esa agua?	…… dólares	POR CADA …. litros …. canecas …. tanques	CADA …. Día ….. Semana …… Mes
e) ¿Se ha enfermado del estómago en el último año?	Si ….. No ….. (Si responde NO; Pasar a pregunta m)		
f) ¿Usted cree que esa enfermedad estuvo relacionada al tipo de agua que bebe?	Si ….. No …..(Si responde NO; Pasar a pregunta m)		
g) ¿Dónde se hizo ver?	Subcentro de salud de la comunidad…….	El pueblo más cercano ..... Cuál …………..	Ciudad ……… ¿Cuál?..................
h) ¿Cuán lejos queda el dispensario médico desde su casa?	….. minutos de distancia		
i) ¿Cuánto gastó por transportarse hasta ese lugar?	….. Dólares		
j) ¿Cuánto gastó en la consulta?	….. Dólares		
k) ¿Cuánto gastó en la medicina?	….. Dólares		
l) En total, ¿Cuántas veces se enfermó del estómago este último año?	……. Veces		
m) ¿Otras personas dentro de su hogar se han enfermado del estómago en el último año?	Si …. No ….(Si responde NO; Pasar a pregunta 36)		
n) ¿Cuántos?	…………persona(s)		
o) ¿Usted cree que esas enfermedades estuvieron relacionadas al agua que ellos beben?	Si … No ….		

SECCIÓN 8: CARACTERÍSTICAS DEL HOGAR			
36. Indique cuales de los siguientes bienes posee y en cuanto usted cree que están.			
Ítem	Valor	Ítem	Valor
__Casa		__ Cosechadora	
__ Tractor u otros equipos mayores		__ Fumigadora u otras equipos	
__ Bodega		__ Carro	
__ Piscina o Reservorio		__ Planta eléctrica	
__ Bombas de riego		__ Empacadora	

37.Su casa es:	__ Propia; __ Alquilada; __ Prestada; __ Compartida
38.Servicios que posee:	__ Agua Potable; __ Luz; __ Alcantarillado; __ Teléfono; __ Alumbrado Público; ____Internet
39. Su casa está hecha de :	__ Madera; __ Caña; __ Cemento; __ Mixta

40. ¿Cuál es la distancia en tiempo del pueblo más cercano y cuánto gasta en ir y regresar de allá?	Unidad: Cantidad:	____ dólares
41. ¿Cuántos trasbordos necesita hacer hasta llegar allá?	__ 1; __ 2; __3; __4; __5	

42. ¿Cuántas personas están viviendo en su hogar?
_______ adulto(s) ______niño(s) ______joven(es)

43. Cuál fue el gasto que hizo la última vez en				
Alimentos	Ropa	Útiles Escolares	Arreglos en la casa	Otros: ¿Cuáles?
$	$	$	$	$

44A. ¿Durante el último año, su finca ha sufrido INUNDACIONES? Si ….. No ….
44B. ¿Durante el último año, su finca ha sufrido SEQUIAS? Si…. No….

45. De la última vez que sufrió estas INUNDACIONES Y/O SEQUIAS, qué porcentaje de tierra perdió en donde tenía cultivos de:				
Arroz	Mango	Maíz	Otros: 1) 2) 3) 4)	
…. %(Inundación) …. % (Sequia)	…. %(Inundación) …. % (Sequia)	…. %(Inundación) …. % (Sequia)	1) …. %(Inundación) …. % (Sequia)	2) …. %(Inundación) …. % (Sequia)
			3) …. %(Inundación) …. % (Sequia)	4) …. %(Inundación) …. % (Sequia)

46. ¿De la última vez que sufrió estos INUNDACIONES Y/O SEQUIAS, ¿cuánto gastó para recuperar la normalidad en su actividad agropecuaria?
….. Dólares (Inundación) …..Dólares (Sequia)

47. Actualmente ¿Cuánta área en total usted tiene para cultivar?	……….…Cuadras ……….. Tareas	
48. Señale si alquila o da en alquiler esta área para cultivo(marque con una X): ____doy en alquiler (1) ____ alquilo(2) _____Ninguna de las anteriores	1: ……..….Cuadras ……….. Tareas	2: ………..Cuadras ……….. Tareas
49. Actualmente ¿Cuánta área es destinada al cultivo de Arroz?	….….Cuadras ……... Tareas	……….Cuadras ……….. Tareas
50. Actualmente ¿Cuánta área es destinada a otros cultivos?	……….Cuadras ……….. Tareas	………..…Cuadras ……….. Tareas
51. ¿Cuánta área tiene sin usar?	……….…Cuadras	………….. Tareas

SECCIÓN 9: CARACTERÍSTICAS DEL INDIVIDUO				
52. Sexo	M ☐ F☐	53. Edad_______ años	54. Cuántos años en total ha estudiado Usted: ____ años	
55. Máximo nivel de educación terminado		Analfabeto ☐	Secundaria ☐	☐ Otros:¿Cuále s?
		Primaria ☐	Universitaria ☐	Ninguno ☐
56A ¿Usted ha recibido estudios agrícolas? ☐ Sí ☐ No(pase 57)		56B ¿Qué temas estudio en esos cursos? (Clave6)	56C ¿Mediante quién o como recibió esos estudios agrícola? ____Gobierno ____ Organización ____ Ferias Agropecuarias ____ Escuelas	____ Colegios ____Universidades ____ Otros(cuales): __________
57. Estado civil		____Soltera(o) ____Casada(o) ____Divorciada(o)	____Viuda(o) ____Unión Libre.	

IDENTIFICACIÓN DEL HOGAR			
Canton:___________	Sector:___________	Recinto/Barrio:____________	Tel.: _______
A29.Otras Indicaciones exactas para llegar a la casa:			
GPS Código:			

LIST OF REFERENCES

Anderson, Kym, Lee A. Jackson, and Chantal P. Nielsen. 2005. "Genetically Modified Rice Adoption: Implications for Welfare and Poverty Alleviation." *Journal of Economic Integration*, 20(4): 771-788.

Banco Central del Ecuador. 2011. Encuesta de Coyuntura Sector Agropecuario. http://www.bce.fin.ec/documentos/PublicacionesNotas/Catalogo/Encuestas/Coyuntura/Integradas/etc201004.pdf.

Banco Nacional de Fomento. 2012. Microcreditos. https://www.bnf.fin.ec/index.php?option=com_content&view=category&id=5&Itemid=4&lang=es (accessed June 18, 2012).

Bandiera, Oriana, and Imran Rasul. 2006. "Social Networks and Technology Adoption in Northern Mozambique." *The Economic Journal*, 116(514): 869–902.

Barnum, Howard N., and Lyn Squire. 1979. "An Econometric Application of the Theory of the Farm-Household." *Journal of Development Economics*, 6: 79-102.

Bennett, J. 1995. "Biotechnology and the Future of Rice Production." *GeoJournal*, 35(3): 333-335.

Besley, Timothy, and Anne Case. 1993. "Modeling Technology Adoption in Developing Countries." *The American Economic Review, Papers and Proceedings of the Hundred and Fifth Annual Meeting of American Economic Association*, 83(2): 396-402.

Breustedt, Gunnar, Jörg Müller-Scheeßel, and Uwe Latacz-Lohmann. 2008. "Forecasting the Adoption of GM Oilseed Rape: Evidence from a Discrete Choice Experiment in Germany." *Journal of Agricultural Economics*, 59(2): 237–256.

Buttel, Frederick H., Martin Kenney, and Jr. Jack Kloppenburg. 1985. "From Green Revolution to Biorevolution: Some Observations on the Changing Technological Bases of Economic Transformation in the Third World." *Economic Development and Cultural Change*, 34(1): 31-55.

Bwire, Joseph. 2008. "Factors Affecting Adoption of Improved Meat Goat (Boer) Production in Rangelands of Sembabule District." http://news.mak.ac.ug/documents/Makfiles/theses/Bwire_Joseph.pdf.

Cameron, A. C., and Pravin K. Trivedi. 2010. *Microeconometrics Using Stata*, Revised Ed. Texas: Stata Press.

Castillo, María J. 2011. "Seguro Agrícola en Ecuador: ¿Un Servicio a la Comunidad o un Negocio Rentable?" Paper presented at Coffe Break Opinion desde la Academia, Graduate School of Management ESPAE, Guayaquil, Ecuador.

Chiriboga, Manuel, and Brian Wallis. 2009. *Diagnostico de la Pobreza Rural en Ecuador y Respuestas de Politica Publica.* Quito: Centro Latinoamericano para el Desarrollo Rural.

Conley, Timothy G., and Christopher R. Udry. 2010. "Learning about a New Technology: Pineapple in Ghana." *American Economic Review*, 100(1): 35–69.

Contreras, Orlando D., and Marcelo Espinosa. 2010. "Diseño y Cálculo de una Máquina para Producir Briquetas de Urea." http://www.dspace.espol.edu.ec/bitstream/123456789/8027/1/Dise%C3%B1o%20y%20C%C3%A1lculo%20%20de%20una%20m%C3%A1quina%20para%20producir%20Briquetas%20de%20Urea.pdf.

Dalrymple, Dana. 1986. *Development and Spread of High-Yielding Rice Varieties in Developing Countries*. Washington, D.C.: Agency for International Development.

Dekker, M. 2006. "Estimating Wealth Effects without Expenditure Data: Evidence from Rural Ethiopia." *Ethiopian Journal of Economics*, 15(1): 35-54.

Dobermann, Achim. 2012. "IRRI Agronomy Challenge: How Much Fertilizer." http://www.irri.org/index.php?option=com_k2&view=item&id=11712%3Airri-agronomy-challenge-how-much-fertilizer&lang=en.

Doss, Cheryl R. 2006. "Analyzing Technology Adoption Using Microstudies: Limitations, Challenges, and Opportunities for Improvement." *Agricultural Economics*, 34: 207–219.

Doss, Cheryl R., and Michael L. Morris. 2000. "How does Gender Affect the Adoption of Agricultural Innovations? The Case of Improved Maize Technology in Ghana." *Agricultural Economics*, 25(1): 27–39.

D'Souza, Gerard E., Douglas Cyphers, and Tim T. Phipps. 1993. "Factors Affecting the Adoption of Sustainable Agricultural Practices." *Agricultural and Resource Economics Review*, 22(2).

Ecuadorian Const. of 2008, art. CDI.

Escuela Superior Politecnica del Litoral, University of Florida, and USDA-PL-480. 2008. "Implementación de un Programa para Mejoramiento Del Ingreso de Pequeños Productores de Arroz en el Litoral Ecuatoriano: Aplicación Profunda de Briquetas de Urea y Microcrédito." Unpublished.

Evenson, R. E., and D. Gollin. 2003. "Assessing the Impact of the Green Revolution, 1960 to 2000." *American Association for the Advancement of Science*, 300(5620): 758-762.

Feder, Gershon, and Dina L. Umali. 1993. "The Adoption of Agricultural Innovations A Review." *Technological Forecasting and Social Change*, 43: 215-239.

Fernandez-Cornejo, Jorge, Chad Hendricks, and Ashok K. Mishra. 2005. "Technology Adoption and Off-Farm Household Income: The Case of Herbicide-Tolerant Soybeans." *Journal of Agricultural and Applied Economics*, 37(3): 549-563.

Food and Agriculture Organization of the United Nations. 2012. FAOSTAT http://faostat.fao.org/?lang=en. (accessed May 15, 2012).

Food and Agriculture Organization of the United Nations. 2011. "Rice Market Monitor." http://www.fao.org/docrep/013/am156e/am156e00.pdf.

Foster, A. D., and M. R. Rosenzweig. 1995. "Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture." *The Journal of Political Economics*, 103(6): 1176-1209.

Gedikoglu, Haluk, and Laura M.J. McCann. 2007. "Impact of Off-Farm Income on Adoption of Conservation Practices." Paper presented at the Annual Meeting from American Agricultural Economics Association, Oregon, TN.

Gianessi, Leonard, Sujatha Sankula, and Nathan Reigner, ed. 2003. *Plant Biotechnology: Potential Impact for Improving Pest Management in European Agriculture: A Summary of Nine Case Studies.* Washington, D.C.: The National Center for Food and Agricultural Policy.

Greene, William H. 2012. *Econometric Analysis*, 7th Ed. Boston: Prentice Hall.

Gujarati, Damodar N., and Dawn C. Porter. 2009. *Basic Econometrics*, 5th Ed. New York: McGraw-Hill Irwin.

Hannan, Timothy H., and John M. McDowell. 1984. "The Determinants of Technology Adoption: The Case of the Banking Firm." *The RAND Journal of Economics*, 15(3): 328-335.

Heckathorn, Douglas D. 1997. "Respondent-Driven Sampling: A New Approach to the Study of Hidden Populations." *Social Problems*, 44(2): 174-199.

Herdt, R. W., and C. Capule. 1983. *Adoption, Spread, and Production Impact of Modern Rice Varieties in Asia*. Los Banos: International Rice Research Institute.

Herrera, Paúl, Katherine Jiménez, Graciela Prado, and Ramón Espinel. 2010. "Capital Social y Desarrollo Comunitario: El Caso de las Juntas de Usuarios del Sistema de Riego del Valle del Daule." In *Tierra y Agua: Interrelaciones de un Acceso Inequitativo*, ed. Edgar Isch, and Alex Zapatta, 111-130. Quito: Sistema de Investigación sobre la Problemática Agraria en el Ecuador.

Hildebrand, P. E., L. Andrade, W. Bowen, R. Espinel, P. Herrera, P. Jaramillo, I. Medina, S. Mora, A. Santos, C. Toledo, et al. 2008. "Condiciones Agro-Socio Económicas y Ecológicas de los Diversos Sistemas de Producción de Arroz de Pequeños Productores en Guayas y Los Ríos, Ecuador." Unpublished.

Hogset, Heidi. 2005. "Social Network and Technology Adoption." Paper presented at the American Agricultural Economics Association Annual Meeting, Providence, Rhode Island.

Hubbell, Bryan J., Michele C. Marra, and Gerald A. Carlson. 2000. "Estimating the Demand for a New Technology: Bt Cotton and Insecticide Policies." *American Journal of Agricultural Economics*, 82: 118–132.

Instituto Nacional de Estadística y Censos. 2011. "Sistema Agroalimentario del Ecuador." http://www.ecuadorencifras.com/sistagroalim/pdf/Arroz.pdf

Instituto Nacional de Estadística y Censos. 2012. Ecuador en Cifras. http://www.ecuadorencifras.com/cifras-inec/main.html (accessed June 10, 2012).

Instituto Nacional de Preinversion. 2011. "Enfoques De Preinversion." http://www.preinversion.gob.ec/pmo/enfoquespreinversion.pdf

International Fertilizer Development Center. 2008. "Expansion of Urea Deep Placement Technology in 80 Upazilas of Bangladesh during Boro 2008: An Assessment of Project Impact." Unpublished.

International Fertilizer Development Center. 2012. Fertilizer Deep Placement (FDP). http://www.ifdc.org/Expertise/Fertilizer/Fertilizer_Deep_Placement_(UDP). (accessed March 20, 2012)

International Food Policy Research Institute. 2002. "Green Revolution: Curse Or Blessing?" http://www.ifpri.org/sites/default/files/pubs/pubs/ib/ib11.pdf.

International Rice Research Institute. 2012. http://www.irri.org. (accessed June 6, 2012).

Jain, Rajni, Alka Arora, and S.S. Raju. 2009. "A Novel Adoption Index of Selected Agricultural Technologies: Linkages with Infrastructure and Productivity." *Agricultural Economics Research Review*, 22: 109-120.

Keelan, Conor, Fiona S. Thorne, Paul Flanagan, Carol Newman, and Ewen Mullins. 2009. "Predicted Willingness of Irish Farmers to Adopt GM Technology." *The Journal of Biotechnology Management and Economics*, 12(3&4): 394-403.

Kennedy, Peter. 2008. *A Guide to Econometrics*, 6th Ed. Malden: Wiley-Blackwell.

Khanna, Madhu. 2001. "Sequential Adoption of Site-Specific Technologies and its Implications for Nitrogen Productivity: A Double Selectivity Model." *American Journal of Agricultural Economics*, 83(1): 35-51.

Kristjanson, P., I. Okike, S. Tarawali, B. B. Singh, and V. M. Manyong. 2005. "Farmers' Perceptions of Benefits and Factors Affecting the Adoption of Improved Dual-Purpose Cowpea in the Dry Savannas of Nigeria." *Agricultural Economics*, 32: 195–210.

Kropiwnicka, Magdalena. 2005. "Biotechnology and Food Security in Developing Countries: The Case for Strengthening International Environmental Regimes." *Journal on Science and World Affairs*, 1(1): 45-60.

Loh, Lawrence, and N. Venkatraman. 1992. "Diffusion of Information Technology Outsourcing: Influence Sources and the Kodak Effect." *Information Systems Research*, 3(4): 334-358.

Lu, Bao-Rong, and Allison A. Snow. 2005. "Gene Flow from Genetically Modified Rice and its Environmental Consequences." *BioScience*, 55(8): 669-678.

Lupin, M. S., J. R. Lazo, N. D. Le, and A. F. Little. 1983. *Alternative Process for Urea Supergranules*. Muscle Shoals: International Fertilizer Development Center.

Ministerio de Agricultura, Ganaderia, Acuacultura and Pesca. 2011. El MAGAP, a través de la Unidad de Seguro Agrícola se reúne con Productores Arroceros del Cantón Daule. http://www.magap.gob.ec/mag01/index.php/prensa-boletinesprensa/1783-seguro-agricola-se-reune-con-productores-arroceros-del-canton-daule. (accessed March 12, 2012).

Ministerio de Agricultura, Ganaderia, Acuacultura and Pesca. 2012. Plan Tierras. http://www.magap.gob.ec/mag01/index.php/boletines-viceministerio-desarrollo-rural/122. (accessed June 1, 2012).

Ministerio de Inclusion Economica y Social 2012. Programa de Proteccion Social. http://www.pps.gob.ec/PPS/PPS/QuienesSomos.aspx. (accessed June 01, 2012)

Mora, Samuel, and Paul Herrera. 2010. "Comparación de dos Tecnologías de Aplicación de Nitrógeno (Urea) en Diferentes Niveles en el Cultivo de Arroz: Aplicación Profunda de Briquetas de Urea y la Aplicación Tradicional Alvoleo." http://www.dspace.espol.edu.ec/bitstream/123456789/11362/10/Resumen%20CICYT.pdf.

Ngoc Chi, Truong T. 2008. "Factors Affecting Technology Adoption among Rice Farmers in the Mekong Delta through the Lens of the Local Authorial Managers: An Analysis of Qualitative Data." *Omonrice*, 16: 107-112.

Nnadi, Fidelia N., and Chidi Nnadi. 2009. "Farmers' Sustained Adoption Decision Behaviors of Maize/Cassava Intercrop Technology in Imo State: Lessons for Extension Policy Development." *World Rural Observations*, 1(2): 87-92.

Nyanga, Progress H., Fred H Johnsen, Jens B Aune, and Thomson H Kalinda. 2011. "Smallholder Farmers' Perceptions of Climate Change and Conservation Agriculture: Evidence from Zambia." *Journal of Sustainable Development*, 4(4): 73-85

Organización de las Naciones Unidas para la Agricultura y la Alimentación, Fondo Internacional de Desarrollo Agrícola, and Programa Mundial de Alimentos. 2002. "La Reducción de La Pobreza y el Hambre: La Función Fundamental de la Financiación de la Alimentación, la Agricultura y el Desarrollo Rural." Paper presented at Conferencia Internacional sobre la Financiación para el Desarrollo, Monterrey, Mexico.

Pannell, David J. 2007. "Influences on Technology Adoption in Different Phases." http://www.pannelldiscussions.net/2007/06/.

Pingali, Prabhu, and Terri Raney. 2005. "From the Green Revolution to the Gene Revolution: How Will the Poor Fare?" Agricultural and Development Economics Division of Food and Agriculture Organization of the United Nations Working Paper 05-09.

Qaim, Matin. 2005. "Agricultural Biotechnology Adoption in Developing Countries." *American Journal of Agricultural Economics*, 87(5): 1317–1324.

Qualls, D. J., Kimberly L. Jensen, Christopher D. Clark, Burton C. English, James A. Larson, and Steven T. Yen. 2012. "Analysis of Factors Affecting Willingness to Produce Switchgrass in the Southeastern United States." *Biomass & Bioenergy*, 39: 159-167.

Rahman, Sanzidur. 2008. "Determinants of Crop Choices by Bangladeshi Farmers: A Bivariate Probit Analysis." *Asian Journal of Agriculture and Development*, 5(1): 29-42.

Raju, S. S., and Ramesh Chand. 2008. "Agricultural Insurance in India Problems and Prospects." *National Centre for Agricultural Economics and Policy Research*, 8: 1-80.

Savant, N. K., and P. J. Stangel. 1990. "Deep Placement of Urea Supergranules in Transplanted Rice: Principles and Practices." *Fertilizer Research*, 25: 1-83.

Savant, N. K., P.S. Ongkingco, I.V. Zarate, F.M. Torrizo, and P.J. Stangel. 1991. "Urea Briquette Applicator for Transplanted Rice." *Fertilizer Research*, 28: 323-331.

Simtowe, Franklin, and Manfred Zeller. 2007. "The Impact of Access to Credit on the Adoption of Hybrid Maize in Malawi: An Empirical Test of an Agricultural Household Model Under Credit Market Failure." *Munich Personal RePEc Archive*, 45: 1-28.

Singleton, Royce A., Jr., and Bruce C. Straits. 2010. *Approaches to Social Research*, 5th Ed. New York: Oxford University Press.

Sistema de Información Nacional de Agricultura, Ganadería, Acuacultura y Pesca. 2012. III Censo Nacional Agropecuario. 2012. http://www.magap.gob.ec/sinagap/index.php?option=com_wrapper&view=wrapper&Itemid=400 (accessed June 3, 2012).

Sistema de Información Nacional de Agricultura, Ganadería, Acuacultura y Pesca. 2012. Principales Productos de Importacion. http://www.magap.gob.ec/sinagap/index.php?option=com_wrapper&view=wrapper&Itemid=100 (accessed May 29, 2012).

Staal, S. J., I. Baltenweck, M.M. Waithaka, T. DeWolff, and L. Njoroge. 2002. "Location and Uptake: Integrated Household and GIS Analysis of Technology Adoption and Land use, with Application to Smallholder Dairy Farms in Kenya." *Agricultural Economics*, 27(3): 295–315.

Sunding, David, and David Zilberman. 2001. "Chapter 4 The Agricultural Innovation Process: Research and Technology Adoption in a Changing Agricultural Sector." In *Handbook of Agricultural Economics*, Vol. 1A, ed. Bruce L. Gardner, and Gordon C. Rausser, 207-261. North-Holland: Elsevier science.

Swinton, S. M., and J. Lowenberg-deboer. 2001. "Global Adoption of Precision Agriculture Technologies: Who, when and Why?" Paper presented at the Third European Conference on Precision Agriculture, Montpellier, France.

Thompson, Thomas P., and Joaquin Sanabria. 2009. The Division of Labor and Agricultural Innovation in Bangladesh: Dimensions of Gender. Muscle Shoals: International Center for Soil Fertility and Agricultural Development.

Wu, Haitao, Shijun Ding, Sushil Pandey, and Dayun Tao. 2010. "Assessing the Impact of Agricultural Technology Adoption on Farmers' Well-being using Propensity-Score Matching Analysis in Rural China." *Asian Economic Journal*, 24(2): 141–160.

BIOGRAPHICAL SKETCH

Jorge Avila was born in the city of Guayaquil, Ecuador. He went to the university Escuela Superior Politecnica del Litoral “ESPOL”. While specializing in Economic Politics and Theory, he received fundamental classes such as Econometrics, Microeconomics, Macroeconomics, Public Economics and Development and Economic Welfare Theory. At 23 years old, he finished his bachelor’s studies and started his professional life as a research assistant at Rural Research Center and Graduate School of Management of ESPOL. He was engaged in works such as Social Corporate Responsibility and Socioeconomic Analysis. With Dr. Espinel and Dr. Herrera, he developed a research paper “Determinants of the Current Trends of Agricultural Products Consumer and Markets” which was presented in the academic event held by the Latin American Council of School Administration (CLADEA, in Spanish). Afterwards, he was included in the Urea Deep Placement Project carried out by ESPOL and UF. His function was to promote and understand rice farmers’ livelihood system and technology adoption process for his coming master’s thesis. In 2010, he began his master’s program which was funded by ESPOL, UF, PL-480 of USDA and the Secretaria Nacional de Educacion Superior, Ciencias, Tecnologias e Innovacion “SENESCYT”. While at UF, he complemented his economic studies with two practical and innovative tools in agriculture: Geographic Information System “GIS” and Network Analysis. Currently, his research interests are associated with agricultural technology adoption, social networks functionality and biodiversity. Taking advantage from his econometric and GIS knowledge, he expects to combine his research interests during his PhD program which would begin in August of 2012.