Intrahousehold decision making on rice varietal trait improvements:

Using experiments to estimate gender influence

Rio Maligalig
(Corresponding author)
Centre for Global Food and Resources, The University of Adelaide
rio.maligalig@adelaide.edu.au

Matty Demont
International Rice Research Institute
m.demont@irri.org

Wendy J. Umberger
Centre for Global Food and Resources, The University of Adelaide
wendy.umberger@adelaide.edu.au

Alexandra Peralta
Centre for Global Food and Resources, The University of Adelaide
alexandra.peralta@adelaide.edu.au

Selected Paper prepared for presentation at the 2017 Agricultural & Applied Economics Association Annual Meeting, Chicago, Illinois, July 30-August 1

Intrahousehold decision making on rice varietal trait improvements: Using experiments to estimate gender influence

Preliminary draft: Please do not cite

Abstract

We study household decision making on rice varietal trait improvements (VTIs) using an experimental methodology based on investment games. Couples have to select, first individually and then jointly, a replacement variety and the traits of this variety that they want to be improved. The objectives then of the paper are to examine (i) how a couple's joint decision relates to the couple's individual decisions with respect to the choice of a replacement variety, and (ii) which factors are related to a stronger influence of the wife on the joint decision with respect to the choice of VTIs. We find that in 72 percent of the households, the replacement variety selected by husband and wife individually is exactly the same with the replacement variety they selected in the joint round. Total agreement in replacement variety choice is more likely if the wife is working on-farm and is a member of an organization; less likely if the wife decides alone or dominates on the amount of rice to store or sell. On the other hand, the wife has a stronger influence on the joint decision on the VTIs if she has off-farm employment, but less influence if she has the same religion with the husband. The findings provide new and useful insights into the dynamics of intrahousehold decision making in farming households. Moreover, the results have implications not only on variety development but also on the importance of gender and gender roles in technology adoption decisions.

Keywords: household decision making, field experiment, farmer preferences, varietal trait improvements, rice

JEL codes: C93, D1, Q16, Q12

Intrahousehold decision making on rice varietal trait improvements: Using experiments to estimate gender influence

Introduction

Women make significant contributions to the agriculture sector in many developing countries (FAO, 2011). Until recently, the common belief is that women are disadvantaged such that they do not have equal access to resources and opportunities compared to men. A recent study on women empowerment in four Southeast Asian countries (Myanmar, Thailand, Indonesia, and the Philippines) reveal that women in this region have actually same level of access to resources such as land and inputs and have greater control over household income (Akter, et al., 2017). With these, they may have greater participation and influence in making decisions within their households compared to women in other regions.

Farming households, like any other households, are faced with multiple tasks or activities to decide on. One particular area of decision in farm production is on the kinds or types of agricultural technologies to adopt. A key area that has been examined in the adoption literature is farmer preferences for technology attributes. Numerous empirical studies focus on this as adoption decisions are influenced not only by socio-economic, demographic or institutional factors, but also by how farmers perceive the specific traits of the technology (Adesina and Baidu-Forson, 1995, Adesina and Zinnah, 1993, Pingali, Rozelle and Gerpacio, 2001, Sall, Norman and Featherstone, 2000).

Most of the studies that have been conducted on farmer preferences for variety traits elicited preferences of the household-head, either the male head or female head, implicitly assuming that his or her preferences represent that of the whole household (Asrat, et al., 2010, Ghimire, Wen-chi and Shrestha, 2015, Hintze, Renkow and Sain, 2003, Horna, Smale and Oppen, 2007, Joshi and Bauer, 2006, Kshirsagar, Pandey and Bellon, 2002, Mahadevan and

Asafu-Adjaye, 2015, Pant, Gautam and Wale, 2011). In some other studies, preferences for variety traits were elicited from both male and female farmers (Dalton, Yesuf and Muhammad, 2011, Ortega and Ward, 2016). In Participatory Varietal Selection (PVS) programs, female farmers were specifically invited to test on their own fields and evaluate selected varieties (Courtois, et al., 2001, Paris, et al., 2008, Paris, et al., 2001). This to better understand women's preferences to be able to develop interventions that can help them in making more informed decisions. But on the other hand, empirical evidence shows that farm production decisions, including adoption, are decided within a household with participation of both husband and wife (Alwang, Larochelle and Barrera, 2017, Doss, Meinzen-Dick and Bomuhangi, 2014, Gilligan, et al., 2014, Lambrecht, Vanlauwe and Maertens, 2016, Marenya, Kassie and Tostao, 2015, Sumner, Christie and Boulakia, 2016, Tiruneh, et al., 2001, Twyman, Useche and Deere, 2015). However, adoption literature rarely examines the intrahousehold dynamics and process of decision making in technology adoption.

Due to difficulties in observing household decision making process, empirical work on intrahousehold issues have increasingly relied on experimental games. Through experimental methods, one can gain deeper understanding of the dynamics of intrahousehold decision making and resource allocation (Doss, 2013). For example, Beharry-Borg, Hensher and Scarpa (2009) used choice experiment to elicit couple's individual and joint preferences for beach sites to visit in Tobago while on vacation. Dosman and Adamowicz (2006) combined stated and revealed preference techniques to obtain both individual and household choice of vacation sites to visit. On the other hand, several studies used experimental games with real pay-offs to examine couple's individual and joint decisions. These studies examined how decisions made individually by couples differ from the decisions they made jointly (Bateman and Munro, 2005, Munro, Bateman and McNally, 2008) and which spouse has more influence on the joint decision (Carlsson, et al., 2012, Carlsson, et al., 2013, de Palma, Picard and Ziegelmeyer,

2011). Similar to these previous studies, we also employ experimental games with real pay-offs to elicit intrahousehold preferences for rice varietal trait improvements (VTIs). Stated preference methods rely on hypothetical scenarios which make them prone to hypothetical bias (Hensher, 2010, List and Gallet, 2001, Little and Berrens, 2004, Murphy, et al., 2005). Although it can be argued that the empirical evidence for this is mixed, we address this by making our approach incentive-compatible.

Using an experimental methodology based on investment games, we elicited both individual and joint preferences of couples for a replacement variety and the corresponding VTIs. In the experiment, husbands and wives individually and jointly identified a replacement variety and the traits of this variety which they want to be improved. This replacement variety can be their most preferred or a popular variety which they may or may not have grown. They were given an endowment fund of 100 Philippine pesos (PHP hereafter) and were asked to invest that in the VTIs they prefer using the Investment Game Application (IGA), a newly developed application for eliciting preferences for rice VTIs (Demont, et al., 2015). Couples played the IGA individually and simultaneously first; they were then asked to join together to come up with a consensus decision.

Using investment games to capture intrahousehold preferences, our aim is to answer the following questions. First, how does a couple's joint decision relates to their individual decisions with respect to the choice of replacement variety? Second, what factors are related to a stronger influence of the wife on the joint decision with respect to the choice of VTIs? To answer these questions, we conducted a framed field experiment using the IGA with selected rice farming households in Nueva Ecija, Philippines.

Our study adds to the literature in three ways. First, we contribute to the adoption literature as we examine farmer preferences both individually and as a household in the context of improvements in rice variety traits. We examine the relative influence of a spouse in a joint

decision, which is not given much consideration in past adoption studies. Second, we contribute methodologically as we employ a new and innovative experimental game to elicit both individual and joint preferences, which provide insights on the dynamics of decision making in farming households. Lastly, we contribute to the growing body of literature on intrahousehold decision making by considering specifically farming households and their intrahousehold preferences for technology attributes.

The Philippines presents an interesting setting in which to examine the dynamics of intrahousehold decision making. Based on the statistics on the marital status of 15 years old and over, 55% are married with majority as being male-headed (Philippine Statistics Authority, 2016). In Philippine rural households particularly, resources are typically pooled and husbands usually entrust part or all of their income to their wives. Wives share the control over these resources with the husband and they decide jointly on how to allocate this. They also decide jointly on household plans and activities. Wives, moreover, have usually more control in decisions related to household budgeting and/or expenditures (David, 1994, Eder, 2006, Hindin and Adair, 2002). In rice farming households, decisions on household and farm activities are jointly made by husbands and wives, although the level of influence a spouse has in the process still depends on several factors such as education level and on-farm employment (Hwang, et al., 2011, Quisumbing, 1994). In terms of land ownership, land titles for most land owning households are under the name of the husband. However, the passage of a new Land Law in 2001 ensured that both husband and wife are identified as owners. Since then, 78 percent of land titles have been granted for joint ownership (Asian Development Bank, 2013). With these, it would then be interesting to examine household preferences in the context of joint decision making.

Conceptual /Approach

Models of household decision making

Early models of household decision making assumed a unitary framework, wherein a household is considered as a single production or consumption unit (Becker, 1965). In this framework, it is assumed that the household pool all its resources like income, labour, land, and information. The allocation of such resources among household members is decided upon by a single member, who is either acting with self-interest motive or altruistic behaviour, and with the idea that all members share the same preferences (Alderman, et al., 1995, Doss and Meinzen-Dick, 2015, Haddad, Hoddinott and Alderman, 1997, Thomas and Chen, 1994). However, this assumption can be misleading since preferences may differ in a household and that they do not necessarily pool resources (Attanasio and Lechene, 2002, Duflo and Udry, 2004, Hoddinott and Haddad, 1995, Lundberg, Pollak and Wales, 1997). These then led to the development of different collective models.

The collective models can be broadly classified into cooperative and non-cooperative models (Alderman, et al., 1995, Haddad, Hoddinott and Alderman, 1997). There are two types of cooperative models. The first one assumes that household decisions will always lead to Pareto-efficient outcomes such that "no one can be made better off without someone being made worse off" (Alderman, et al., 1995). The second type of cooperative models rely on a game theory model in which a specific bargaining process is used to come up with household allocation decisions (Manser and Brown, 1980, McElroy, 1990, McElroy and Horney, 1981). The second group of collective models, the non-cooperative approach, do not assume that households necessarily attain efficient allocation of resources. Household members are not obligated to have a binding contract with each other (Alderman, et al., 1995).

Decision making and allocation of resources within a household are determined by the relative influence or bargaining power of each household member (Quisumbing, 2003).

Bargaining power cannot be observed directly, at best it can be represented by different proxies or indicators (Doss, 2013). Several studies considered the relative contribution to household income, participation in the labour market and property or asset ownership as key determinants of authority in household decisions (Antman, 2014, Attanasio and Lechene, 2002, Doss, 2006, Doss, et al., 2014, Quisumbing and Maluccio, 2003, Swaminathan, Lahoti and Suchita, 2012, Twyman, Useche and Deere, 2015). Other factors such as education (Alwang, Larochelle and Barrera, 2017, Bertocchi, Brunetti and Torricelli, 2014), social and political assets (Carlsson, et al., 2012, Carlsson, et al., 2013, Orr, et al., 2016), and gender institutions and ideology (Bradshaw, 2013, Mabsout and van Staveren, 2010) have also been examined. Participation or involvement in the decision making process is also one of the factors that has been examined to influence the bargaining power of an individual within a household (Lépine and Strobl, 2013, Reggio, 2011, Smith, et al., 2003, Sraboni, et al., 2014).

Conceptual basis

Our conceptual framework is influenced by the insights provided by the different models of intrahousehold resource allocation and decision making. We specifically examine the influence of bargaining power indicators on the outcomes of household decision making on variety trait improvements. We examine this through an experimental methodology, which is increasingly used in the recent years to understand intrahousehold dynamics.

In the study setting, husband and wife from a rice farming household face individually and jointly a two-stage decision making concerning improvements in rice variety traits. In the first stage, they have to select a replacement rice variety that they want to be improved. In the second stage, they have to decide which traits of this variety they want to be improved. To do this, they have to allocate an endowment fund to the different variety traits that they prefer to be improved. The amount of the endowment fund is known to both husband and wife during the

individual decision making, but both will have to decide independently on how to allocate this. Their decisions during the individual round, both on the choice of replacement variety and VTIs are not known to their respective spouses. During the joint round, same amount of endowment fund is provided. They need to decide as a couple on how to allocate this in the VTIs they prefer. However, no structured guidelines on how to go about the joint decision making process is set or implemented.

We expect that husband and wife would have different preferences for varieties and variety traits, which may have been conditioned or influenced by their different roles and responsibilities in the household. With this, the outcome we are going to look at is the outcome of the (joint) decision making process. This decision outcome will depend on the bargaining power of each spouse. We look at some of the indicators of bargaining power and examine how this relate to the couple's joint decision on the replacement variety and on the relative influence of the wife on the VTIs.

Experimental Approach

Study site and sampling

We purposively selected Nueva Ecija to be the study site. Nueva Ecija is a major rice producing province in the Philippines and predominantly irrigated. This allowed us to capture farmers' preferences for VTIs in both wet and dry seasons. Our sample consists of 122 rice producing households, with both husband and wife participating.

We used a multi-stage sampling approach to form our survey sample. In the first stage, we purposely selected three municipalities, where we sampled the participants: Muñoz, Talavera, and Guimba. In the second stage, we randomly selected four villages in each municipality. In the final stage, we randomly selected 10 households per village.

Several steps were carried out in the random selection of the villages and rice producing households. First, we approached the Municipal Agriculture Office (MAO) in each of the municipality to obtain a master list of rice farming households. The master lists include information on the names of the farmers, their respective rice areas classified either under irrigated or rainfed. Second, we approached the local officials of the villages selected and asked them to check and verify the names included in the master list. This is to determine who among in the list meet the criteria for participant selection. The selection criteria are as follows: (i) both husband and wife are involved in rice production and marketing activities; (ii) the household is planting rice on both wet and dry seasons; (iii) the household is selling a portion of their rice production. Once the list was verified and checked, a new list per village was created to include only those households that satisfy the selection criteria. We used a spread-sheet program to randomly select from these lists 10 households to be invited to participate in the experiment. We also randomly selected another set of 10 households to serve as a back-up list just in case those in the original list are unsure or are not available on the schedule of the experiment.

The randomly selected households were invited through the designated local field coordinators in each of the selected village. The local field coordinator is a village official in-charge of the Agriculture Committee in his or her village. The households were invited to participate through a letter, which explains the details of the research, and the schedule of the experiment. The invitation letters were given two weeks before the scheduled experiment. Invited households were then reminded of the schedule two days before the actual experiment.

Experimental design

The experiment is framed around a hypothetical situation wherein a breeding program received a large grant from a donor. The grant is then distributed in small shares among farmers. As

shareholders in the breeding program, farmers are given the opportunity to allocate their share to several alternative breeding programs for improving varietal traits. This is done through the use of IGA, a tablet application written in Microsoft Excel 2010 and designed to run on Windows 8 computer tablets. In IGA, farmers select their preferred traits to be improved by pulling the VTI bars to the level that they wanted a particular trait to be improved. This is done using the up and down spin buttons (Fig. 1). Each level of improvement has a corresponding cost, which is deducted to the farmer's share. Each level of improvement has also a relative investment risk, which is defined as the probability that the level of improvement they selected will be achieved. The initial improvement of a trait is more expensive compared to the succeeding levels due to fixed cost such as establishment of new laboratory or field experiments. The costs of improving the traits, either individually or combination of several traits, were estimated through an expert elicitation workshop of breeders from the International Rice Research Institute (IRRI) and National Agricultural Research Systems (NARS) partners.

Farmers' investments in the VTIs will yield an immediate return subject to risk. Returns to investment in breeding research will normally be realized only after a new variety is released and adopted. This process will take about six years. In our study, breeding investment is framed as a single-period investment such that returns will be calculated and given right after playing the game.

At the start of the experiment, farmers are asked to identify a replacement variety, which is the basis to improve upon to obtain their ideal variety. The replacement variety can be the farmers' most preferred or popular variety, which they may or may not have grown yet. Farmers then select from among the 10 VTIs that they prefer to be improved. These VTIs can be broadly categorized into (i) grain quality traits – slenderness, aroma, stickiness, and head rice recovery; (ii) loss reducing traits – lodging tolerance, disease resistance, insect resistance,

abiotic stress tolerance, and reduction in shattering; and (iii) agronomic – earliness. The specific baseline and target metrics on which the IGA is calibrated is shown in Table 1.

The experiment is comprised of four information treatment to test whether there will be differences in farmers' preferences when given particular information. The first information treatment is the control, where no information is provided. The second is the market information treatment which includes information on the most preferred rice traits of urban (Metro Manila) consumers. The third treatment is the climate change information. The information provided in this treatment includes increasing climate variability and the rise in frequency of extreme weather events, which can bring more frequent droughts, floods, and more uncertainty in rainy/wet season onset. The fourth information treatment combines both market information and climate change information.

The IGA is repeated over six rounds by each participating household. Husband (H) and wife (W) play the IGA for two seasons (wet (WS) and dry (DS)) independently and simultaneously. They then play the IGA jointly (J) for two seasons as well. In each round, participants have an available endowment fund amounting to 100 Philippine pesos (PHP hereafter) (around USD2.10)[1] to invest in the VTIs. This amount, however, is not given in cash as the final pay-off is given at the end of the experiment and is based on one of the six rounds. To determine which among these six rounds will be the basis (binding round) for payment of returns, they are assigned a number in a dice: 1 – H/WS, 2 – H/DS, 3 – W/WS, 4 – W/DS, 5 – J/WS, 6 – J/DS. The dice is rolled after all the participants have finished the IGA.

Implementation and procedures

The experimental sessions were held in a local training hall and in local village halls. Two kinds of venue set-up were used depending on the available facilities and resources in the

[1] At the time of the experiment (February 2016), one US dollar was equivalent to approximately PHP 48.

villages. A classroom set-up was implemented for bigger halls that can accommodate at least 10 tables arranged vertically. For smaller halls, a drive-thru system was used. The explanation and presentation of the experiment were done in one area of the hall. Tables and chairs were set-up in another area of the hall for playing of the IGA.

There were a total of 12 experimental sessions – one for each of the village selected. The sessions were conducted over the course of six days: one morning and one afternoon session on each day. Of the 12 sessions, three followed the control treatment, and three sessions for each of the three other information treatment. The assignment of the information treatment was randomly drawn prior to the start of all the experimental sessions. Each session consisted of the following: (i) registration, (ii) introduction of the research team, (iii) explanation of the experiment, (iv) presentation and explanation of the IGA and VTIs, (v) training on IGA, (vi) six consecutive rounds of IGA, (vii) short post experiment survey, and (viii) payment of returns. The sessions were conducted using the local language Filipino. A household survey questionnaire was also administered to gather data on socio-demographic, rice varieties grown, constraints in rice production and marketing, and marketing practices. This was also administered during the experimental sessions and households answered this either before or after they played the IGA.

Prior to doing the IGA, farmers were trained in the methodology of investing with budget constraints by using the "Training on Investment Game Application" (TIGA). In TIGA, farmers invested in their optimal dish by adding to a fixed amount of rice a vegetable or meat dish using a budget amounting to PHP50 (Fig. 2).The purpose of the training is for farmers to get familiarized with the application, particularly in terms of the budget constraint involved and the use of spin buttons (or up and down arrows) in the tablet. It is important that the participants be given the chance to use the tablet before the actual game as most of them are not familiar and have not used a tablet before.

After the training and explanation of their tasks, husband and wife then played the IGA independently and simultaneously. Each of them was assigned an agent who facilitated the IGA and the post-experiment survey. The post-experiment survey was also answered independently by husbands and wives. This survey includes questions on the motivations behind their allocation decisions in IGA and a short quiz (two questions) to see how well they understood the experiment. After playing the IGA independently, husband and wife were asked to play the IGA jointly. One agent was assigned per couple for the joint round. To provide equal opportunity in answering the IGA during the joint round, husband and wife were given separate stylus pens and the tablet was placed at the middle of their table. There were no strict or structured guidelines implemented for the joint decision; couples were free to decide in order to reach an agreement on their replacement variety and VTIs.

After all the households completed the six rounds of IGA, one participant was requested to roll the dice to randomly draw the binding round. Computation of the returns was based on experts' estimate that the total cost invested in developing a new rice variety through rice breeding program can have a return of investment up to 10 times the total investment cost. Therefore, a maximum investment of PHP100 may earn around PHP1,000, depending on the chosen VTIs. The resulting cash returns were placed in an envelope and distributed to couples one at a time. A single-blind payment protocol was used where the research team knows the participants' earnings but the participants did not know other participants' earnings. On average, the participants earned PHP1,210 (around USD25), which is roughly equivalent to four daily wages for agricultural labour[2]. This return is on top of the fixed show-up fee of PHP250 (around USD5).

[2] At the time of experiment, the typical wage rate for agricultural labour in the province was around PHP 334.

Estimation Strategy

Joint decision on the replacement variety

Our first objective is to examine how a couple's joint decision relates to the couple's individual decisions with respect to the choice of the replacement variety. To estimate this, we use three categories of how couple's individual decisions relate to their joint decision: (i) total agreement, where husband and wife individual replacement variety choice is exactly the same with their joint replacement variety; (ii) joint decision the same with either husband or wife; and (iii) joint decision not same with either husband or wife. We estimate the probability that the decision of the couple falls into one of these categories and the factors that condition this using with a multinomial logit (MNL) specification:

$$Y_i = \alpha + \beta_X X_i + \beta_H H_i + \beta_P P_i + \varepsilon_c$$

where y_i represent the agreement/disagreement in the replacement variety, X are couple characteristics and attitudes, H are household level characteristics, P are two specific farm decision making area and ε_c is the error term, clustered at the household level. α, β_X, β_H, and β_P are the coefficients to be estimated. Summary statistics of the dependent and independent variables are presented in Table 2.

In the MNL framework, the probability that household i falls into category j (P_{ij}) is specified as:

$$P_{ij} = \frac{exp(\alpha_j + \beta_{Xj} X_i + \beta_{Hj} H_i + \beta_{Pj} P_i)}{\sum_{k=1}^{3} exp(\alpha_k + \beta_{Xk} X_i + \beta_{Hk} H_i + \beta_{Pk} P_i)}$$

where the coefficients and variables are described above. The marginal effect estimates show the change in probability of the j^{th} outcome given a change in the independent variable.

The couple characteristics and attitudes are specified as the difference between wife and husband. On the average, the wives are younger by three years and less educated than the husbands by 0.26 years. Moreover, wives are less experienced in rice farming with a difference of about nine years. We find that only the husband attended agricultural training in the past in

more than half of the couples. On the other hand, we find that majority of the couples are either both members of an organization or both are not members. We also find distinct differences in the types of groups to which the husbands and wives belong. The husbands are members of production-oriented groups, such as the water users' association and credit cooperative. Wives, on the other hand, belong to civic groups, such as the women's club and senior citizen association.

We also include the differences in time preference and willingness to invest in rice farming of husband and wife. We measured farmers' time preference through a discount rate, which we estimated from a series of hypothetical questions relating to their preference of receiving a specific amount of cash now or a higher amount in a month's time. We find that there is a difference of 0.22 percent with the wives having lower discount rate at 1.41 percent compared to husbands' discount rate of 1.63 percent. Respondents were also asked to assess their willingness to take risks in investing in rice farming on a Likert scale, with five representing "extremely likely" and one as "extremely unlikely". We find a difference of 0.15 with wives having slightly lower willingness to invest at 4.80 compared to husbands' 4.94. We also asked the couples individually what they considered in prioritizing or selecting traits for improvement. We find that almost half of the couples have the same consideration: either both of them considered their past and current experience or both of them thought about the future. But we also find that more than one third of the couples had different consideration: wives thought about the future while the husbands considered their past and current farming experience.

The differences in the husband and wife characteristics and attitudes have gender implications in the sense that it is not only about women, but gender in general. For example, pronounced differences in favor of men may be associated with husbands dominating and exerting more influence in the household decision making process. We then hypothesize that

the differences will be more likely associated with non-agreement in the joint replacement variety decision.

In terms of occupation, 93 percent of the husbands are primarily in farming, while only about nine percent of the wives are in farming. We would expect that on-farm employment of husband to be related to having less probability of total agreement on the joint replacement variety. The husband may dominate in this case such that the choice of replacement variety is the same with his individual choice. On the other hand, we hypothesize that total agreement is more likely if the wife is also working on-farm. Working in the field would mean that the wife has knowledge in terms of the varieties they grow as well as other varieties available. With this, total agreement is more likely as compared to the husband dominating.

To control for household's production and marketing related factors, we include variables on farm size, proportion of the production that is sold, and whether buyers require certain paddy standards. On average, the households have 1.30 hectares of farm land, which include both own and leased area. Of the total farm size, about 45 percent is leased. About 64 percent of the total production is sold, while the rest is for home consumption. Around 61 percent of the households said that their buyer/s require certain quality standards in terms of moisture content and cleanliness of the paddy.

Lastly, we include two specific farm decision making area: who decides on the amount of rice to sell or store and who decides how to spend income from crop sale (Table 3). In deciding on the amount of rice to sell or store, only 11 percent of the households said that either only the wife decides or the wife dominates in this decision making area. On the other hand, around 82 percent said that either only the wife decides or the wife dominates in deciding how to spend the income from crop sale. We expect these decision making areas will also influence the joint decision on the replacement variety.

Relative influence of wife on the joint VTIs

We then examine the factors that are related to a stronger influence of the wife on the joint decision on the VTIs. For this, we construct a measure of the wife's influence on the joint decision with respect to the choice of VTIs. We only include in this analysis those couples with the same replacement variety, both individually and jointly.

In constructing this measure of relative influence, we first compute for the distance of the VTIs selected by a spouse to the VTIs chosen jointly using the following formula:

$$d_{kis} = \sqrt{\sum \left(VTI_{kst} - VTI_{jst}\right)^2}$$

where d_{kis} is the distance of all the VTIs t chosen by spouse k of the i^{th} household in season s to the VTIs t chosen jointly in household j, $i=j$. We then construct a measure (λ) of wife's influence on the joint decision using the following formula:

$$\lambda_{wis} = \frac{1 - d_{wis}}{d_{wis} + d_{his}}$$

This measure of the wife's relative influence on the joint decision is used as the dependent variable in a fractional regression model. Summary statistics of the dependent and independent variables are presented in Table 4.

The literature suggest that the wife's relative traits in comparison with her husband rather than her absolute traits can better capture the strength of her bargaining power (Grossbard-Shechtman and Neuman, 1988). Thus, we include variables that are related to wife's socio-demographic characteristics and attitudes as well as her relative position compared to her husband in terms of these variables. On the average, the wives are 48 years old. Around 22 percent of them are older than the husbands. Wives have eight years of formal schooling and about 27 percent of them are more educated compared to the husbands. Moreover, they have 19 years of rice farming experience and only seven percent have more farming experience than the husbands. Only 17 percent attended agricultural training in the past while about 39 percent

are members of an organization. As discussed above, we find that only the husband attended agricultural training in more than half of our sample couples but majority of them are either both members or both are not members of an organization.

Wives' discount rate is 1.46 percent on the average, which is lower by 0.30 percent than the husband's discount rate. When asked of their willingness to take risks in investing in rice farming on a Likert scale wives' average rating is 4.80. This is 0.14 points lower compared to the husbands' rate of willingness. Moreover, 56 percent of the wives thought of the future in prioritizing traits for improvement. And as discussed above, more than one third of the sample couples had different consideration such that the wives considered the future while the husbands considered their past and current farming experience.

We also include a variable representing wife's off-farm employment. Studies show that employment opportunities outside the farm provide women an outside option or fall-back position that can improve their bargaining power in household decision making (Doss, 2013, Twyman, Useche and Deere, 2015). Off-farm employment allows them to contribute to household income, learn social and other skills, and provide them knowledge and information which can help them participate in household decision making. Thus, we hypothesize that wives with off-farm work (e.g. vegetable or meat/fish vending, managing small shop/store, dressmaking/tailoring) will have more influence on the joint decision on the VTIs.

We then include a variable that represents similarity in religion. We find that 95 percent of the couples have the same religion, most of which are Roman Catholics, which is the predominant religion in the Philippines. We want to examine whether having the same religious beliefs would affect wife's relative influence on the joint VTIs. Lastly, we include variables related to marketing – production sold and buyer requirement – to account for the wife's important role in post-harvest decisions.

Results and Discussion

Replacement varieties and VTIs selected

Table 5 presents the replacement varieties selected individually and jointly by season. The table shows that one variety dominates in the wet season. NSIC Rc222, an inbred, was identified as the replacement variety by 78 percent of the husbands and 79 percent of the wives. This was also identified by 82 percent of the couples during the joint round. As for the dry season, a major variety identified by both husband and wife individually and jointly was SL-8, a hybrid variety. NSIC Rc222 was also one of the dominant replacement varieties identified in the dry season.

We then examine the agreement in the replacement varieties selected during the individual and joint rounds (Table 2). The replacement variety selected by husband and wife individually is exactly the same with the replacement variety they selected during the joint round in 72 percent of the households. This may imply that the wife is aware or has some knowledge on the varieties their household is planting. This may also imply that although the husband dominates in decisions regarding crop choice, the wife is informed of the decisions made by the husband regarding which variety to plant. This may also imply that the wife is involved in the decision making process. This total agreement in the choice of replacement variety may also be due to the fact the wife has higher involvement in post-harvest decisions which allows her to be familiar with the rice varieties.

On the other hand, we find that 19 percent of the households have their joint replacement variety either the same with the husband or the wife. Specifically, the joint replacement variety is same with husband's replacement variety in 15 percent of the households, and the same with wife's replacement variety in four percent of the households. Lastly, we find that in nine percent of the households, the joint replacement variety is not the same with either spouse.

Table 6 shows the investment allocations made by husband and wife individually and jointly across the different VTIs. Husband and wife individually prioritized loss reducing traits, such as lodging tolerance, disease resistance, and inset resistance by investing more in these VTIs in the wet season. More than 70 percent were allocated in loss reducing traits. Jointly, husband and wife also invested more than 70 percent in loss reducing traits during the wet season. In the dry season, wives increased their investments in grain quality traits, such as slenderness and head rice recovery. Husbands, on the other hand, also invested more in loss reducing traits in the dry season. In the joint decision, we also see increased investments in grain quality traits.

Joint decision on the replacement variety

We then estimated a multinomial logit model to determine the factors that affect the joint decision making on the replacement variety. Interpretation of the estimated coefficients in this kind of model is not straightforward, hence marginal effects are presented in Table 7. We find that the difference in membership in organization has significant impacts on the joint decision on the replacement variety. If only the wife has group membership, total agreement on the joint replacement variety is 14 percentage points more likely, nine percentage points less likely that joint replacement variety the same with one of the spouses, five percentage points less likely that joint replacement variety not the same with either spouse is. These results imply that to some degree, women can be empowered by belonging to a social network where they can benefit from the exchange in information and resources. Through this social network, they can also have the opportunity to participate in collective action and create ties with other members of the community (Meinzen-Dick, et al., 2014).

We also find that if the wife's primary occupation is farming, the more likely that there is total agreement in the joint replacement variety decision. Specifically, wife's on-farm work is

associated with a 22 percentage points higher likelihood that the replacement variety chosen during the joint round is the same with the variety chosen by husband and wife individually. On the other hand, wife's on-farm work is related to a 17 percentage points lower probability that the joint replacement variety is the same with one of the spouses. These results confirm our hypothesis that doing on-farm work provides the wife the opportunity to be informed and knowledgeable regarding the varieties they use as well as those widely adopted. This may have given her the capacity to participate and have her say during the joint decision on their replacement variety. Results also show that if the husband's primary occupation is farming, the more likely that the joint replacement variety is not the same with either spouse. This imply that although the husbands dominate in decisions related to crop and crop variety choice, they did not dominate during the joint decision making on the replacement variety.

The decision regarding the amount of rice to sell or store has negative effect on having total agreement on the joint replacement variety. If only the wife decides or if the wife dominates in this decision making area, total agreement is 27 percentage points less likely. This may reflect the differences in the preferred VTIs of husbands and wives, which also translated to the difference in their preferred replacement variety. Finally, the difference in the couple's willingness to invest in farming is associated with non-agreement in the joint replacement variety. Specifically, an increase in the difference, meaning the wife becomes more willing to invest in rice farming, leads to four percentage points more likelihood of having non-agreement in the joint replacement variety. This result confirm our hypothesis that the differences will be more likely associated with non-agreement in the joint decision on the replacement variety.

Relative influence of the wife on the joint VTI decision

Table 8 shows the results of the regression on wife's relative influence on the joint VTIs. Results show that wife's off-farm employment opportunity has significant and positive relation

to her influence on the couple's joint decision. If the wife is engaged in income-generating activities outside the farm, her relative influence on the joint VTI decision increases by eight percentage points. This is consistent with our hypothesis that off-farm employment provides the wife opportunity to add to the household income and also gives her the chance to gain knowledge and new information. These then contribute to her ability to participate and have a say in household decision making.

Wife's future perspective has also significant effect on her relative influence. If the wife thought of the future, her influence on the joint VTI decision increases by 13 percentage points. This may reflect wife's better planning skills as compared to the husband, which may have been developed through her important role in budgeting household expenses and through her other economic and social activities outside the farm (Eder, 2006).

On the other hand, having the same religion is negatively related to the wife's relative influence. Compared to couples whose religion is not the same, wife's relative influence on the joint VTIs decreases by 22 percentage points if she and her husband have the same religion. This may be explained by the influence of the church in shaping the roles that men and women should play in the family. Bible passages and sections depict the husband-wife relationship based on the obedience and submission of the wife to the husband. Moreover, as far as the church is concerned, a woman should serve her husband and children at home and serve God in church (Collantes, 2016, Eviota, 1994). Thus, it may be the case that in household decision making, the husband has the final say.

Wife's education and farming experience have also negative relation with her influence in the joint decision on the VTIs. A one year increase in the wife's education is associated with about one percentage point decrease in her influence on the joint decision. A possible explanation is that wives with more years of schooling may have more opportunities off-farm, which may limit her opportunity to participate in the household's farming decisions. She may

also decide not to participate at all in the decision making. Thus, her influence during the joint decision on the VTIs may also have been limited or it could also be that the decision was left to the husband. On the other hand, wife's farming experience is weakly associated with her influence on the joint decision. A one year increase in her farming experience is related to a less than one percentage point decrease in her relative influence. This suggests that although the wife has also experience in farming, the husband prevails in the decision making as he is more experienced in farming.

Conclusions

In this study, we examined household decision making on the rice variety and variety traits they preferred to be improved. To do this, we conducted a framed field experiment with 122 rice farming households in Nueva Ecija, Philippines. Both husband and wife of these households were invited to participate and were asked of their preferences individually and jointly. We were particularly interested in examining how a couple's joint decision relates to their individual decisions with respect to the choice of a replacement variety. We also examined the factors that are related to a stronger influence of the wife on the joint decision with respect to the choice of VTIs. Our study provides valuable insights on the importance of gender and intrahousehold dynamics on agricultural technology preferences and adoption decisions.

Our findings indicate that for most of the sample households, the replacement varieties identified individually and jointly by husbands and wives were the same. This implies that although husband dominates in the crop choice decisions, wives are aware and has knowledge on the varieties their household are planting as well as other varieties available. This may also imply that farming decisions are discussed within the household and are not made solely by the husband.

Another important finding is regarding the differences in the characteristics and attitudes between husband and wife. Except for the differences in group membership and willingness to invest in rice farming, all other differences in husband and wife characteristics and attitudes did not influence the household decision making on the replacement variety and the VTIs. Although there are significant differences between husband and wife in some of the traits and attitudes we examined, we find that wives are still able to participate and influence household decision making and even have greater control over household income. This might imply that there is gender equity among our sample households. This finding is consistent with a recent work on women empowerment in four Southeast Asian countries. Akter, et al. (2017) find that in their Philippine study sites, decisions regarding rice farming are jointly made by husband and wife and that the wives have greater control over household income.

The factors that have more influence in the household decision making are the wife's absolute traits such as on-farm and off-farm work, education, farming experience, and her future perspective. It is worth highlighting the influence of both on-farm and off-farm work in household decision making. Wives who do farm work are more likely to be knowledgeable in terms of the varieties and are also more likely to participate in farming decision making. As Twyman, Useche and Deere (2015) suggest, doing farm work can provide the wife with an "earned right" to have a say in decisions related to farming. This finding has implication in terms of making available to wives different agricultural training and extension services that could improve their knowledge on agricultural technologies as well as on management practices. On the other hand, off-farm employment provides the wife a fall-back position that can increase her influence and bargaining power. This bargaining power affects not only the wife's participation in household decision making, but can also have impacts on food and education expenditures and health outcomes (Doss, 2013).

It also worth highlighting the significance of religious beliefs in women's relative influence within the household. We find that most of our sample households have the same religion and that the wife's influence in the decision making decreases when she has same religion with her husband. This result suggest of the important role that religion plays in household decision making. Moreover, such factor as well as other local traditions and culture should be taken into consideration to better examine and understand intrahousehold dynamics.

Overall, the results of our study has implications in terms of the methodological approach in preference elicitation and variety development. As men and women have different preferences and roles that they play within the household, it is important that methods for eliciting preferences should consider interviewing not only the household head, but also other household members involved in household and farm production decision making. The results of such preference elicitation can then feed into the priority setting of breeding programs. Breeding research should take into account intrahousehold preferences for variety traits. Our findings suggest that husband and wife have different preferences but decisions on the replacement variety and the VTIs were discussed to come up with a joint or household optimal variety profile. This reinforce previous findings that farm decisions are not solely made by the household head, rather it involves the spouse or other decision makers in the household.

Our study, however, has a limitation with regard to its sample selection. This means that generalization of the findings to a larger population is also limited. Specifically, variety choice is site-specific and it is recommended that similar research is done to other major rice-growing areas to help in the development of rice variety product profiles that target better their preferences and needs.

References

Adesina, A.A., and J. Baidu-Forson. 1995. "Farmers' Perceptions and Adoption of New Agricultural Technology: Evidence from Analysis in Burkina Faso and Guinea, West Africa." *Agricultural Economics* 13:1-9.

Adesina, A.A., and M.M. Zinnah. 1993. "Technology Characteristics, Farmers' Perceptions and Adoption Decisions: A Tobit Model Application in Sierra Leone." *Agricultural Economics* 9:297-311.

Akter, S., P. Rutsaert, J. Luis, N.M. Htwe, S.S. San, B. Raharjo, and A. Pustika. 2017. "Women's Empowerment and Gender Equity in Agriculture: A Different Perspective from Southeast Asia." *Food Policy* 69:270-279.

Alderman, H., P.-A. Chiappori, L. Haddad, J. Hoddinott, and R. Kanbur. 1995. "Unitary Verus Collective Models of the Household: Is It Time to Shift the Burden of Proof?" *The World Bank Research Observer* 10:1-19.

Alwang, J., C. Larochelle, and V. Barrera. 2017. "Farm Decision Making and Gender: Results from a Randomized Experiment in Ecuador." *World Development* 92:117-129.

Antman, F.M. 2014. "Spousal Employment and Intra-Household Bargaining Power." *Applied Economics Letters* 21:560-563.

Asrat, S., M. Yesuf, F. Carlsson, and E. Wale. 2010. "Farmers' Preferences for Crop Variety Traits: Lessons for on-Farm Conservation and Technology Adoption." *Ecological Economics* 69:2394-2401.

Attanasio, O., and V. Lechene. 2002. "Tests of Income Pooling in Household Decisions." *Review of Economic Dynamics* 5:720-748.

Asian Development Bank. 2013. *Gender Equality in the Labor Market in the Philippines*. Mandaluyong City, Philippines.

Bateman, I., and A. Munro. 2005. "An Experiment on Risky Choice Amongst Households*." *The Economic Journal* 115:C176-C189.

Becker, G.S. 1965. "A Theory of the Allocation of Time." *Economic Journal* 75:493-517.

Beharry-Borg, N., D.A. Hensher, and R. Scarpa. 2009. "An Analytical Framework for Joint Vs Separate Decisions by Couples in Choice Experiments: The Case of Coastal Water Quality in Tobago." *Environmental and Resource Economics* 43:95-117.

Bertocchi, G., M. Brunetti, and C. Torricelli. 2014. "Who Holds the Purse Strings within the Household? The Determinants of Intra-Family Decision Making." *Journal of Economic Behavior & Organization* 101:65-86.

Bradshaw, S. 2013. "Women's Decision-Making in Rural and Urban Households in Nicaragua: The Influence of Income and Ideology." *Environment and Urbanization* 25:81-94.

Carlsson, F., H. He, P. Martinsson, P. Qin, and M. Sutter. 2012. "Household Decision Making in Rural China: Using Experiments to Estimate the Influences of Spouses." *Journal of Economic Behavior & Organization* 84:525-536.

Carlsson, F., P. Martinsson, P. Qin, and M. Sutter. 2013. "The Influence of Spouses on Household Decision Making under Risk: An Experiment in Rural China." *Experimental Economics* 16:383-401.

Collantes, C.F. 2016. "Reproductive Dilemmas, Labour and Remittances: Gender and Intimacies in Cavite, Philippines." *South East Asia Research* 24:77-97.

Courtois, B., B. Bartholome, D. Chaudhary, G. McLaren, C.H. Misra, N.P. Mandal, S. Pandey, T. Paris, C. Piggin, K. Prasad, A.T. Roy, R.K. Sahu, V.N. Sahu, S. Sarkarung, S.K. Sharma, A. Singh, H.N. Singh, O.N. Singh, N.K. Singh, R.K. Singh, R.K. Singh, S. Singh, P.K. Sinha, B.V.S. Sisodia, and R. Takhur. 2001. "Comparing Farmers and Breeders Rankings in Varietal Selection for Low-Input Environments: A Case Study of Rainfed Rice in Eastern India." *Euphytica* 122:537-550.

Dalton, T.J., M. Yesuf, and L. Muhammad. 2011. Demand for Drought Tolerance in Africa: Selection of Drought Tolerant Maize Seed Using Framed Field Experiments. Selected paper presented at the 2011 AAEA & NAREA Joint Annual Meeting, July 24-26, 2011, Pittsburgh, Pennsylvania.

David, F.P. 1994. "The Roles of Husbands and Wives in Household Decision-Making." *Philippine Sociological Review* 42:78-93.

de Palma, A., N. Picard, and A. Ziegelmeyer. 2011. "Individual and Couple Decision Behavior under Risk: Evidence on the Dynamics of Power Balance." *Theory and Decision* 70:45-64.

Demont, M., C. Custodio, D. Villanueva, and J. Ynion. 2015. *Investment Game Application (IGA): A New App for Prioritizing Rice Farmers' Preferences for Varietal Trait Improvements - Report on the IGA Pre-Test Conducted in Banca-Banca, Victoria, Laguna, Philippines*. Laguna, Philippines: International Rice Research Institute,.

Dosman, D., and W. Adamowicz. 2006. "Combining Stated and Revealed Preference Data to Construct an Empirical Examination of Intrahousehold Bargaining." *Review of Economics of the Household* 4:15-34.

Doss, C. 2006. "The Effects of Intrahousehold Property Ownership on Expenditure Patterns in Ghana." *Journal of African Economies* 15:149-180.

Doss, C., R. Meinzen-Dick, and A. Bomuhangi. 2014. "Who Owns the Land? Perspectives from Rural Ugandans and Implications for Large-Scale Land Acquisitions." *Feminist Economics* 20:76-100.

Doss, C. 2013. "Intrahousehold Bargaining and Resource Allocation in Developing Countries." *World Bank Research Observer* 28:52-78.

Doss, C., S.M. Kim, J. Njuki, E. Hillenbrand, and M. Miruka. 2014. Women's Individual and Joint Property Ownership: Effects on Household Decisionmaking. *IFPRI Discussion Paper 01347*, International Food Policy Research Institue, Washington, DC.

Doss, C., and R. Meinzen-Dick. 2015. "Collective Action within the Household: Insights from Natural Resource Management." *World Development* 74:171-183.

Duflo, E., and C. Udry (2004) "Intrahousehold Resource Allocation in Cote D'ivoire: Social Norms, Separate Accounts and Consumption Choices." Working Paper No. 10498, National Bureau of Economic Research, Cambridge, MA.

Eder, J.F. 2006. "Gender Relations and Household Economic Planning in the Rural Philippines." *Journal of Southeast Asian Studies* 37:397-413.

Eviota, E.U., ed. 1994. *Sex and Gender in Philippine Society: A Discussion of Issues on the Relations between Women and Men*. Manila, Philippines: National Commission on the Role of Filipino Women.

FAO. 2011. *The State of Food and Agriculture 2010-11. Women in Agriculture: Closing the Gender Gap for Development*. Rome, Italy: Food and Agriculture Organization of the United Nations.

Ghimire, R., H. Wen-chi, and R.B. Shrestha. 2015. "Factors Affecting Adoption of Improved Rice Varieties among Rural Farm Households in Central Nepal." *Rice Science* 22:35-43.

Gilligan, D.O., N. Kumar, S. McNiven, J. Meenakshi, and A.R. Quisumbing. 2014 Bargaining Power and Biofortification: The Role of Gender in Adoption of Orange Sweet Potato in Uganda. *IFPRI Discussion Paper 01353.* International Food Policy Research Institute, Washington, DC.

Grossbard-Shechtman, S.A., and S. Neuman. 1988. "Women's Labor Supply and Marital Choice." *Journal Of Political Economy* 96:1294-1302.

Haddad, L., J. Hoddinott, and H. Alderman. 1997. *Intrahousehold Resource Allocation in Developing Countries: Models, Methods, and Policy*: Johns Hopkins University Press.

Hensher, D.A. 2010. "Hypothetical Bias, Choice Experiments and Willingness to Pay." *Transportation Research Part B: Methodological* 44:735-752.

Hindin, M.J., and L.S. Adair. 2002. "Who's at Risk? Factors Associated with Intimate Partner Violence in the Philippines." *Social Science & Medicine* 55:1385-1399.

Hintze, L.H., M. Renkow, and G. Sain. 2003. "Variety Characteristics and Maize Adoption in Honduras." *Agricultural Economics* 29:307-317.

Hoddinott, J., and L. Haddad. 1995. "Does Female Income Share Influence Household Expenditures? Evidence from Côte D'ivoire." *Oxford Bulletin of Economics and Statistics* 57:77-96.

Horna, J.D., M. Smale, and M.V. Oppen. 2007. "Farmer Willingness to Pay for Seed-Related Information: Rice Varieties in Nigeria and Benin." *Environment and Development Economics* 12:799-825.

Hwang, J.-I., T.R. Paris, E. Cabrera, and Y.-j. Choi. 2011. "A Comparative Study on Women's Role in Intrahousehold Decision-Making in Korean and the Philippine Rice Farming Households." *Journal of Rural Development* 34:117-136.

Joshi, G., and S. Bauer. 2006. "Farmers' Choice of the Modern Rice Varieties in the Rainfed Ecosystem of Nepal." *Journal of Agriculture and Rural Development in the Tropics and Subtropics* 107:129-138.

Kshirsagar, K.G., S. Pandey, and M.R. Bellon. 2002. "Farmer Perceptions, Varietal Characteristics and Technology Adoption: A Rainfed Rice Village in Orissa." *Economic and Political Weekly* 37:1239-1246.

Lambrecht, I., B. Vanlauwe, and M. Maertens. 2016. "Agricultural Extension in Eastern Democratic Republic of Congo: Does Gender Matter?" *European Review of Agricultural Economics* 43:841-874.

Lépine, A., and E. Strobl. 2013. "The Effect of Women's Bargaining Power on Child Nutrition in Rural Senegal." *World Development* 45:17-30.

List, J.A., and C.A. Gallet. 2001. "What Experimental Protocol Influence Disparities between Actual and Hypothetical Stated Values?" *Environmental and Resource Economics* 20:241-254.

Little, J., and R. Berrens. 2004. "Explaining Disparities between Actual and Hypothetical Stated Values: Further Investigation Using Meta-Analysis." *Economics Bulletin* 3:1-13.

Lundberg, S.J., R.A. Pollak, and T.J. Wales. 1997. "Do Husbands and Wives Pool Their Resources? Evidence from the United Kingdom Child Benefit." *The Journal of Human Resources* 32:463-480.

Mabsout, R., and I. van Staveren. 2010. "Disentangling Bargaining Power from Individual and Household Level to Institutions: Evidence on Women's Position in Ethiopia." *World Development* 38:783-796.

Mahadevan, R., and J. Asafu-Adjaye. 2015. "Exploring the Potential for Green Revolution: A Choice Experiment on Maize Farmers in Northern Ghana." *African Journal of Agricultural and Resource Economics* 10:207-221.

Manser, M., and M. Brown. 1980. "Marriage and Household Decision-Making: A Bargaining Analysis." *International Economic Review* 21:31-44.

Marenya, P., M. Kassie, and E. Tostao. 2015. "Fertilizer Use on Individually and Jointly Managed Crop Plots in Mozambique." *Journal of Gender, Agriculture and Food Security* 1:62-83.

McElroy, M.B. 1990. "The Empirical Content of Nash-Bargained Household Behavior." *The Journal of Human Resources* 25:559-583.

McElroy, M.B., and M.J. Horney. 1981. "Nash-Bargained Household Decisions: Toward a Generalization of the Theory of Demand." *International Economic Review* 22:333-349.

Meinzen-Dick, R., J.A. Behrman, L. Pandolfelli, A. Peterman, and A.R. Quisumbing (2014) "Gender and Social Capital for Agricultural Development." In A.R. Quisumbing,R. Meinzen-Dick,T.L. Raney,A. Croppenstedt,J.A. Behrman, and A. Peterman eds. *Gender in Agriculture: Closing the Knowledge Gap.* Dordrecht, Springer Netherlands, pp. 235-266.

Munro, A., I.J. Bateman, and T. McNally. 2008. The Family under the Microscope: An Experiment Testing Economic Models of Household Choice. Available at SSRN: https://ssrn.com/abstract=1138969 or http://dx.doi.org/10.2139/ssrn.1138969

Murphy, J.J., P.G. Allen, T.H. Stevens, and D. Weatherhead. 2005. "A Meta-Analysis of Hypothetical Bias in Stated Preference Valuation." *Environmental and Resource Economics* 30:313-325.

Orr, A., T. Tsusaka, S.H. Kee-Tui, and H. Msere. 2016. "What Do We Mean by 'Women's Crops'? Commercialisation, Gender and the Power to Name." *Journal of International Development* 28:919-937.

Ortega, D.L., and P.S. Ward. 2016. "Information Processing Strategies and Framing Effects in Developing Country Choice Experiments: Results from Rice Farmers in India." *Agricultural Economics* 47:493-504.

Pant, K.P., J.C. Gautam, and E. Wale (2011) "Valuation of Rice Diversity in Nepal: A Trait-Based Approach." In E. Wale,A. Drucker, and K. Zander eds. *The Economics of Managing Crop Diversity on-Farm: Case Studies from the Genetic Resources Policy Initiative.* London, Earthscan, pp. 45-64.

Paris, T.R., A. Singh, A.D. Cueno, and V.N. Singh. 2008. "Assessing the Impact of Participatory Research in Rice Breeding on Women Farmers: A Case Study in Eastern Uttar Pradesh, India." *Experimental Agriculture* 44:97-112.

Paris, T.R., A. Singh, J. Luis, M. Hossain, H.N. Singh, S. Singh, and O.N. Singh (2001) "Incorporating Gender Concerns in Participatory Rice Plant Breeding and Varietal Selection: Preliminary Results from Eastern India." In N. Lilja,J.A. Ashby, and L. Sperling eds. *Assesing the Impact of Participatory Research and Gender Analysis.* Cali, Colombia, International Center for Tropical Agriculture, pp. 109-121.

Philippine Statistics Authority. 2016. *2016 Gender Statistics on Labor and Employment*. Manila, Philippines.

Pingali, P.L., S.D. Rozelle, and R.V. Gerpacio. 2001. "The Farmer's Voice in Priority Setting: A Cross-Country Experiment in Eliciting Technological Preferences." *Economic Development and Cultural Change* 49:591-609.

Quisumbing, A.R. 2003. *Household Decisions, Gender, and Development: A Synthesis of Recent Research*. Washington, DC: International Food Policy Research Institute.

Quisumbing, A.R. 1994. "Intergenerational Transfers in Philippine Rice Villages: Gender Differences in Traditional Inheritance Customs." *Journal of Development Economics* 43:167-195.

Quisumbing, A.R., and J.A. Maluccio. 2003. "Resources at Marriage and Intrahousehold Allocation: Evidence from Bangladesh, Ethiopia, Indonesia, and South Africa*." *Oxford Bulletin of Economics and Statistics* 65:283-327.

Reggio, I. 2011. "The Influence of the Mother's Power on Her Child's Labor in Mexico." *Journal of Development Economics* 96:95-105.

Sall, S., D. Norman, and A.M. Featherstone. 2000. "Quantitative Assessment of Improved Rice Variety Adoption: The Farmer's Perspective." *Agricultural Systems* 66:129-144.

Smith, L.C., U. Ramakrishnan, A. Ndiaye, L. Haddad, and R. Martorell. 2003. The Importance of Women's Status for Child Nutrition in Developing Countries. *Research Report 131,* International Food Policy Institute, Washington, DC.

Sraboni, E., H.J. Malapit, A.R. Quisumbing, and A.U. Ahmed. 2014. "Women's Empowerment in Agriculture: What Role for Food Security in Bangladesh?" *World Development* 61:11-52.

Sumner, D., M.E. Christie, and S. Boulakia. 2016. "Conservation Agriculture and Gendered Livelihoods in Northwestern Cambodia: Decision-Making, Space and Access." *Agriculture and Human Values*:1-16.

Swaminathan, H., R. Lahoti, and J.Y. Suchita. 2012. Women's Property, Mobility, and Decisionmaking: Evidence from Rural Karnataka, India. *IFPRI Discussion Paper 01188,* International Food Policy Research Institute, Washington, DC.

Thomas, D., and C.-L. Chen. 1994. Income Shares and Shares of Income: Empirical Tests of Models of Household Resource Allocations. RAND Labor and Population Working Paper Series No. 94-08, RAND, Santa Monica, CA.

Tiruneh, A., T. Tesfaye, W. Mwangi, and H. Verkuijl. 2001. *Gender Differentials in Agricultural Production and Decision-Making among Smallholders in Ada, Lume, and Gimbichu Woredas of the Central Highlands of Ethiopia*. Mexico, D.F.: International Maize and Wheat Improvement Center (CIMMYT) and Ethiopian Agricultural Research Organization (EARO).

Twyman, J., P. Useche, and C.D. Deere. 2015. "Gendered Perceptions of Land Ownership and Agricultural Decision-Making in Ecuador: Who Are the Farm Managers?" *Land Economics* 91:479-500.

Table 1. Traits and trait-specific metrics on which the IGA is calibrated

Trait	Metric	Baseline	Target
Slenderness	Length/width ratio	2.4	3.2
Stickiness	Amylose content (%)	27%	22%
Aroma	Price premium (%) (market benchmark = 100%)	0%	100%
Head rice recovery	% head rice obtained from a sample of paddy	45%	60%
Lodging tolerance	Crop losses eliminated (%)	20%	80%
Disease resistance	Crop losses eliminated (%)	50%	90%
Insect resistance	Crop losses eliminated (%)	80%	95%
Abiotic stress tolerance	Crop losses eliminated (%)	0%	90%
Reduction in shattering	Crop losses eliminated (%)	80%	95%
Earliness	Number of days the duration is shortened	0	14

Source: Demont, et al., 2015

Table 2. Summary statistics of the dependent and independent variables for the multinomial logit model

Variable	Definition	Freq.	Percent		
Dependent variables					
Total agreement	Joint replacement variety is exactly the same with the couple's individual replacement variety	175	71.72		
Joint decision same with one of the spouses	Joint replacement variety is same with either husband or wife replacement variety	47	19.26		
Joint decision not same with either spouse	Joint replacement variety is not same with either husband or wife replacement variety	22	9.02		
Independent variables		Mean	Std. Dev.	Min	Max
Difference in age	Gap in age (age of wife – age of husband)	-3.06	4.97	-20	13
Difference in education	Gap in education (years in school of wife – years in school of husband)	-0.26	2.87	-6	9
Difference in farming experience	Gap in rice farming experience (experience of wife – experience of husband)	-8.59	13.47	-50	24
Difference in attendance to training	-1 – only husband attended training, 0 – either both attended or both did not attend, 1 – only wife attended training	-0.52	0.58	-1	1
Difference in membership in organization	-1 – only husband is a member, 0 – either both are members or both are not members, 1 – only wife is a member	-0.12	0.66	-1	1
Difference in time preference	Gap in discount rate (wife discount rate – husband discount rate)	-0.22	4.88	-48	8.5
Difference in willingness to invest in farming*	Gap in willingness to invest in farming (willingness of wife – willingness of husband)	-0.15	0.54	-2	3
Difference in future perspective	-1 – only husband considered the future, 0 – either both considered the past or both considered the future, 1 – only wife considered the future	0.16	0.70	-1	1
Husband's primary occupation is farming	1 – primary occupation of husband is farming, 0 – otherwise	0.93	0.26	0	1
Wife's primary occupation is farming	1 – primary occupation of wife is farming, 0 – otherwise	0.09	0.29	0	1
Farm size	Total farm size in hectares (own + leased area)	1.30	1.04	0.18	6
Proportion of production sold	Proportion of rice production that is sold	0.63	0.22	0	1
Buyer requirement	1 – buyers require certain quality standards, 0 – otherwise	0.61	0.49	0	1
Who decides on amount of rice to sell or store	1 – only wife decides or wife dominates, 0 – otherwise	0.11	0.32	0	1
Who decides how to spend income from crop sale	1 – only wife decides or wife dominates, 0 – otherwise	0.82	0.39	0	1

* Willingness to invest in farming measured on a Likert scale: 1 - extremely unlikely; 2 - unlikely; 3 - neutral; 4 - likely; 5 - extremely likely

Table 3. Participation in crop choice and post-harvest decision making

Variable	Mean	Std. Dev.	Min	Max
Crop choice				
What crop to grow in the field	0.01	0.09	0	1
What rice variety to plant	0.02	0.13	0	1
Post-harvest operations				
Amount of rice to store or sell	0.11	0.32	0	1
Where to sell rice or other crops	0.09	0.29	0	1
When to sell rice or other crops	0.07	0.26	0	1
Selecting crop types and seed for the next growing season	0.02	0.16	0	1
Who decides how to spend income from crop sale	0.82	0.39	0	1
Where to store seeds	0.02	0.13	0	1

Who decides: 1 – wife only or wife dominates, 0 – otherwise

Table 4. Summary statistics of the dependent and independent variables for the fractional regression model

Variable	Definition	Mean	Std. Dev.	Min	Max
Dependent variable					
Wife's influence	Relative influence of the wife on the selected VTIs for the joint replacement variety	0.48	0.20	0	1
Independent variables					
Age of wife	Age of wife in years	47.65	10.75	22	73
Education of wife	Number of years in school of wife	8.17	2.30	2	14
Farming experience of wife	Years of rice farming experience of wife	19.35	13.66	0	50
Wife with off-farm work	1 – wife's primary occupation is in services or commerce, 0 – otherwise	0.30	0.46	0	1
Attendance to training of wife	1 – attended agricultural training in the past, 0 – otherwise	0.17	0.38	0	1
Membership in organization of wife	1 – member of an organization, 0 – otherwise	0.39	0.49	0	1
Time preference of wife	Preference for present values as measured by a discount rate	1.46	2.07	-0.5	9
Willingness of wife to invest in farming	1 – extremely unlikely, 2 – unlikely, 3 – neutral, 4 – likely, 5 – extremely likely	4.80	0.42	3	5
Wife future perspective	1 – investment preference for VTIs based on the future, 0 – otherwise	0.56	0.50	0	1
Couple has same religion	1 – couple has same religion, 0 – otherwise	0.95	0.21	0	1
Wife is older	1 – wife is older than the husband, 0 – otherwise	0.22	0.41	0	1
Wife is more educated	1 – wife is more educated than the husband, 0 – otherwise	0.27	0.45	0	1
Wife more experienced in farming	1 – wife has more rice farming experience than the husband, 0 – otherwise	0.07	0.25	0	1
Difference in attendance to training	-1 – only husband attended training, 0 – either both attended or both did not attend, 1 – only wife attended training	-0.53	0.58	-1	1
Difference in membership in organization	-1 – only husband is a member, 0 – either both are members or both are not members, 1 – only wife is a member	-0.06	0.67	-1	1
Difference in time preference	Gap in discount rate (wife discount rate – husband discount rate)	-0.30	5.69	-48	8.5
Difference in willingness to invest in farming	Gap in willingness to invest in farming (willingness of wife – willingness of husband)	-0.14	0.52	-2	3
Difference in future perspective	-1 – only husband considered the future, 0 – either both considered the past or both considered the future, 1 – only wife considered the future	0.18	0.68	-1	1
Proportion of production sold	Proportion of production sold	0.63	0.23	0	1
Buyer requirement	1 – buyers require certain quality standards, 0 – otherwise	0.63	0.48	0	1

Table 5. Replacement varieties selected

Season	Variety	Husband		Wife		Joint	
		Freq.	Percent	Freq.	Percent	Freq.	Percent
Wet season	NSIC Rc 222	95	77.87	96	78.69	100	81.97
	Rc 216	17	13.93	14	11.48	16	13.11
	Others	10	8.20	12	9.84	6	4.92
Dry season	SL-8	71	58.20	67	54.92	79	64.75
	NSIC Rc 222	34	27.87	34	27.87	23	18.85
	Others	17	13.93	21	17.21	20	16.39

Table 6. Investments allocated to the VTIs by husband and wife individually and jointly by season

VTI	Wet Season						Dry Season					
	Husband		Wife		Joint		Husband		Wife		Joint	
	Mean	Std. Dev	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Slenderness	0.09	0.17	0.06	0.13	0.07	0.14	0.09	0.16	0.09	0.19	0.11	0.17
Stickiness	0.05	0.13	0.03	0.09	0.04	0.11	0.02	0.09	0.03	0.09	0.04	0.11
Aroma	0.03	0.09	0.06	0.13	0.03	0.09	0.04	0.11	0.06	0.15	0.05	0.12
Head rice recovery	0.05	0.13	0.04	0.13	0.05	0.13	0.08	0.16	0.12	0.2	0.1	0.18
Lodging tolerance	0.24	0.23	0.22	0.21	0.21	0.21	0.13	0.2	0.1	0.18	0.06	0.13
Disease resistance	0.16	0.2	0.19	0.21	0.15	0.2	0.15	0.19	0.17	0.22	0.17	0.21
Insect resistance	0.14	0.21	0.15	0.19	0.19	0.2	0.17	0.23	0.15	0.18	0.23	0.2
Abiotic stress tolerance	0.11	0.18	0.13	0.19	0.11	0.2	0.16	0.24	0.13	0.21	0.08	0.17
Reduction in shattering	0.08	0.12	0.08	0.12	0.1	0.12	0.12	0.15	0.12	0.15	0.12	0.14
Earliness	0.04	0.09	0.03	0.08	0.04	0.1	0.03	0.1	0.03	0.08	0.04	0.1
Uninvested	0.01	0.02	0.01	0.02	0.00	0.00	0.01	0.04	0.01	0.02	0.00	0.00

Table 7. Marginal effect estimates on the joint replacement variety decision

Variable	Total agreement	Joint same with one of the spouses	Joint not same with either spouse
Difference in age	0.0023	0.0011	-0.0034
	(0.0060)	(0.0054)	(0.0034)
Difference in education	0.0024	-0.0009	-0.0016
	(0.0111)	(0.0097)	(0.0069)
Difference in farming experience	0.0011	-0.0028	0.0017
	(0.0025)	(0.0021)	(0.0017)
Difference in attendance to training	-0.0364	0.0257	0.0107
	(0.0568)	(0.0490)	(0.0287)
Difference in membership in organization	0.1447***	-0.0922**	-0.0525*
	(0.0495)	(0.0439)	(0.0294)
Difference in time preference	-0.0027	0.0047	-0.0021
	(0.0056)	(0.0045)	(0.0023)
Difference in willingness to invest in farming	0.0098	-0.0486	0.0387*
	(0.0469)	(0.0464)	(0.0221)
Difference in future perspective	-0.0006	-0.0119	0.0124
	(0.0431)	(0.0366)	(0.0283)
Husband's primary occupation is farming	-0.0503	-0.0473	0.0976***
	(0.0993)	(0.0976)	(0.0207)
Wife's primary occupation is farming	0.2179***	-0.1704***	-0.0475
	(0.0698)	(0.0447)	(0.0541)
Farm size	-0.0255	0.0162	0.0093
	(0.0325)	(0.0233)	(0.0192)
Proportion of production sold	-0.0393	0.0107	0.0286
	(0.1250)	(0.1068)	(0.0689)
Buyer requirement	0.0520	-0.0488	-0.0032
	(0.0659)	(0.0602)	(0.0359)
Who decides on amount of rice to sell or store	-0.2652*	0.1758	0.0894
	(0.1394)	(0.1158)	(0.1082)
Who decides how to spend income from crop sale	0.0986	-0.0652	-0.0334
	(0.0751)	(0.0724)	(0.0573)
Number of observations	244		
Wald chi2 (30)	1456.83		
Prob > chi2	0.0000		
Pseudo R2	0.0884		
Log pseudolikelihood	-171.84208		

Table 8. Results of the regression on the wife's relative influence on the joint VTIs

Variable	Coefficient	Cluster-robust SE	Marginal effect	SE
Age of wife	-0.0077	0.0082	-0.0019	0.0020
Education of wife	-0.0565*	0.0306	-0.0137*	0.0074
Farming experience of wife	-0.0139**	0.0063	-0.0034**	0.0015
Wife with off-farm work	0.2834*	0.1519	0.0686*	0.0365
Attendance to training of wife	-0.1934	0.2165	-0.0466	0.0518
Membership in organization of wife	0.0209	0.2227	0.0051	0.0539
Time preference of wife	0.0353	0.0270	0.0085	0.0065
Willingness of wife to invest in farming	0.2281	0.2436	0.0552	0.0588
Wife future perspective	0.5602**	0.2470	0.1343**	0.0574
Couple has same religion	-0.9180***	0.2526	-0.2221***	0.0605
Wife is older	-0.1510	0.1443	-0.0365	0.0349
Wife is more educated	0.0080	0.1620	0.0019	0.0392
Wife more experienced in farming	0.1428	0.2839	0.0346	0.0688
Difference in attendance to training	-0.0827	0.1588	-0.0200	0.0384
Difference in membership in organization	-0.0078	0.1382	-0.0019	0.0335
Difference in time preference	-0.0093	0.0071	-0.0023	0.0017
Difference in willingness to invest in farming	0.0458	0.1680	0.0111	0.0406
Difference in future perspective	-0.1803	0.1772	-0.0436	0.0427
Proportion of production sold	-0.0451	0.2653	-0.0109	0.0642
Buyer requirement	0.0360	0.1503	0.0087	0.0363
Constant	0.3862	1.4356		
Observations	174			
Wald chi2 (20)	57.1294			
Prob > chi2	0.0000			
Log pseudolikelihood	-117.7563			

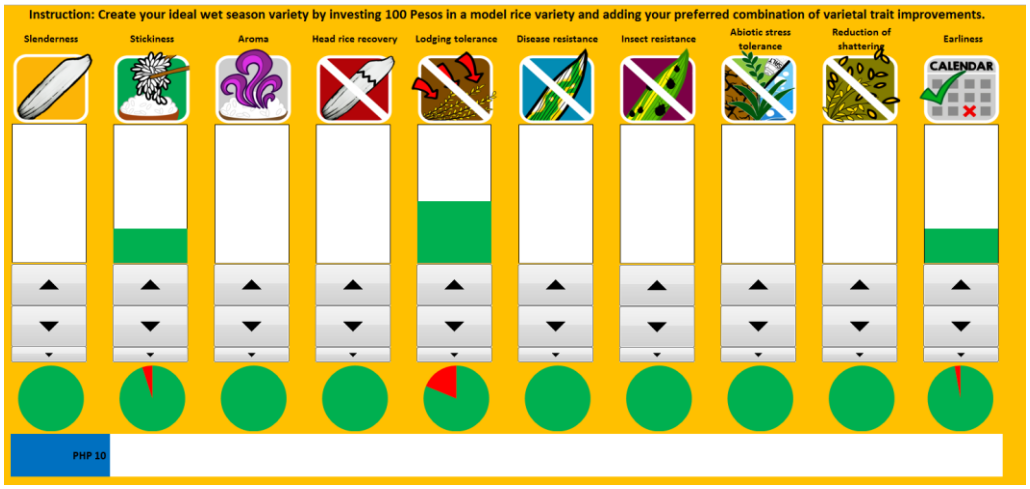

Fig. 1. Investment Game Application (IGA) with example allocations in stickiness, lodging tolerance, and earliness. The blue horizontal bar at the bottom shows the status of the endowment fund, while the pie charts below the VTI bars indicate the riskiness of each investment – green segments represent the probability that the target VTI will be achieved; the red segments represent the odds of achieving a random VTI somewhere between zero and the target VTI.

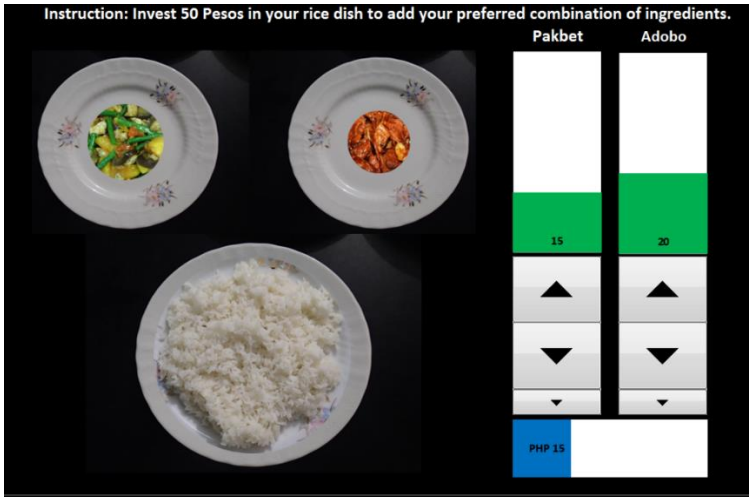

Fig. 2. Training on Investment Game Application (TIGA) with example allocation of PHP15 to Pakbet (vegetable dish) and PHP20 to adobo (meat dish). The blue horizontal bar at the bottom shows the remaining budget.