



Centro Internacional de Agricultura Tropical
Desde 1967 *Ciencia para cultivar el cambio*

InfoNote

Use of discrete choice experiments in gendered participatory breeding and varietal selection.

**A case study of biofortified rice varietal selection in Bolivar,
Colombia**

Diksha Arora and María Alejandra García

1. Introduction

Biofortification is a process that improves the nutritional quality of food crops through conventional plant breeding and agronomic practices.¹ Breeders' principal selection criteria are often based on agronomic characteristics like higher yields, agro-climatic stability, and better nutrient content. However, these criteria may not fully account for farmers' preferences and needs, and such a mismatch may explain why, in some cases, farmers do not adopt a new variety (Almekinders and Elings, 2001; Najeeb et al., 2018). Within the agricultural development community and the CGIAR, through participatory research, scientists have been attempting to incorporate the needs of the local farmers in varietal development and selection. Several studies show the efficacy of participatory plant breeding and varietal selection in increasing adoption rates (Monyo et al. 2001, Morris and Bellon 2004).

From a gendered perspective, participatory plant breeding and varietal selection is not fully 'participatory' if some of the marginalized groups like women are not consulted for their needs and inputs. Oftentimes, women's criteria for crop processing and food preparation are disregarded in the process of plant breeding (Farnworth and Jiggins, 2003). Paris et al. (2008) argue that "failure to include gender-differentiated production and consumption traits and focusing on the wrong attributes leads to biased and inappropriate varietal promotions." Therefore, ignoring women's role in production and processing of crops may lead to slow adoption of new varieties. Some studies show that including women's inputs and needs in participatory plant breeding increases adoption potential (Paris et al. 2008; Dalton and Guei, 2003; Lilja and Dalton, 1997, Lilja and Erenstein 2002).

Women play an important role in production and processing of food crops and are primarily responsible for food preparation and care provision (Gammage 2010; Arora and Rada, 2017).² As a result, gender researchers within the CGIAR produced few guides for impact assessment of participatory research and gender analysis to ensure that poor women are not ignored in the varietal development and selection (Johnson et al., 2004; Lilja and Ashby, 1999; Lilja and Johnson, 2001).

This study presents an ex-ante methodology to examine gender differences in the preferences for different traits (yield, nutrient content, labor requirement, post-production activities) of biofortified rice varieties. We employ a choice experiment methodology to examine

preferences of men and women rice farmers who are also the consumers of the final product. We piloted the methodology in two focus group discussions (FGDs), separately with men and women small-scale farmers, in a community near Cartagena in Bolivar, Colombia, in May 2018.³ The experiment presented **hypothetical scenarios** to the participants to assess their preferences between higher yielding varieties (HYV) and more nutritious varieties, and their choice to adopt or not high-yielding varieties that increase labor demand in production and/or post-production activities. The FGDs further assessed the intra-household allocation of labor and decision-making dynamics in farm and household activities and in adoption of new varieties of rice.

2. Gender roles and intra-household dynamics among small-scale rice producers

2.1 Intra-household allocation of labor in farm activities

In the study site in Bolivar, rice is the staple crop. Almost all the households produce rice for own consumption, and few are able to attain the surplus for sale in the market.

The division of roles in rice production is clearly marked along gender lines. We present men's and women's participation in several rice production and processing activities in table 1. Although men and women jointly perform most of the tasks in production and post-production, the amount of labor supplied by each varies by activity. Women are more active in post-production activities and also support their husbands in several production-related tasks.

As indicated in table 1, men devote more time to traditional male tasks like land preparation, sowing, fertilizer application, commercialization or selling the surplus while women contribute more post-production activities like drying, pounding, and cleaning. However, it is important to note that in harvesting and other post-production activities (e.g., storing rice) both women and men seem to contribute in the same proportion.

¹ Definition of biofortification borrowed from <https://ciat.cgiar.org/what-we-do/breeding-better-crops/>

² Women's participation in these roles may differ across different countries.

³ The name of the community is not mentioned in this document to preserve the identity of the participants.



Table 1. Men’s and women’s participation and labor input variations in rice production in Bolivar.

Activity	Participation		Who devotes more labor?
	Man	Woman	
Land preparation	Yes	No	Men
Choice of crops	Yes	Yes	Men
Sowing	Yes	Yes	Men
Applying fertilizers	Yes	Yes	Men
Weeding	Yes	Yes	Men
Protecting the crops from animals	Yes	Yes	Both
Harvesting	Yes	Yes	Both
Drying the crop	Yes	Yes	Women
Pounding/dehusking rice	No	Yes	Women
Cleaning the rice	No	Yes	Women
Storing the rice	Yes	Yes	Both
Selling rice	Yes	Yes	Men

Source: FGDs with men and women in Bolivar, Colombia, May 2018.

2.2 Managing productive and reproductive tasks – Women in Bolivar

The variation in men’s and women’s labor input to different tasks in rice production and post-production is directly linked to women’s roles in unpaid care work. Evidence suggests that women choose to work closer to the home in order to manage household tasks and care work along with their roles in the agricultural sector (Benard et al., 2016). Their own leisure needs are often subverted under the pressure of the need to look after the family (Arora and Rada, 2017). The discussion with the focus groups of men and women suggests that household chores and child care is mainly the woman’s responsibility with very little input from the man. The only unpaid activity where men actively help is collecting firewood for household use.

2.3 Decision-making in farm and household management

Women and men agreed on who decides on agricultural production activities, and household responsibilities. Table 2 shows that both, women and men, affirm that the woman makes the decisions on post-production activities, household chores, and child-care, while the man on production, selling, and adoption of a new rice variety. However, there is a mismatch in women’s and men’s responses regarding the decisions on the control of household income and finance management. While women responded that both make those decisions, men answered that solely the man in the household makes the decisions over the uses of income from rice and off-farm sources.

Table 2. Men’s and women’s participation in decision-making.

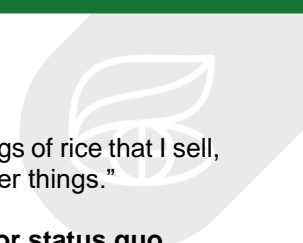
Activity	Who makes the decision?	
	Men’s responses	Women’s responses
Production	Man	Man
Post-production	Woman	Woman
Selling	Man	Man
Adoption of a new variety	Man	Man
Household chores	Woman	Woman
Child care	Woman	Woman
Control of household income and finance management		
Use of income from sale of rice	Man	Both
Use of income from sale of other crops	Both	Both
Use of income from off-farm sources	Man	Both
Managing household expenses	Man	Both

Source: FGDs with men and women in Bolivar, Colombia, May 2018.

Regarding the decision to adopt a new variety or implement a new agricultural management practice, both men and women agreed that the man in the household makes this decision. Men also indicated that they consult their wives when making big decisions related to farming and income generation activities. According to women, the consultation is a mere notification of what men wish to implement or adopt in agriculture. Some women voiced their contentment of not having to make the decisions regarding adoption of new varieties because they lack the knowledge to do so. However, the older women in the FGD argued that seeking knowledge and participating in trainings help them learn about new technology and management practices and that they can influence their husbands’ decisions related to agriculture. “However, ultimately, often the man’s decision prevails because this is our culture,” a woman said.

3. Choice experiment and participatory varietal selection

To integrate men’s and women’s needs and preferences in rice breeding and varietal selection, we implemented two discrete choice experiments during the FGDs with men and women in the study site. Mangham et al. (2009) define a discrete choice experiment (DCE) as “a quantitative technique for eliciting individual preferences. It allows researchers to uncover how individuals value selected attributes of a program, product or service by asking them to state their choice over different hypothetical alternatives.” We presented the participants with 3 scenarios in each experiment. The alternatives in the experiments were hypothetical outcomes, which helped us assess their preferences between different



traits or agronomic properties of rice varieties. The objective of the experiments was to examine what traits do men and women rice producers and consumers value more in a new variety of rice.

3.1 Better nutrition or higher incomes

The first experiment presented scenarios between a **hypothetical** biofortified rice variety and a **hypothetical** high yielding rice variety. In the first scenario, the participants made a choice between a high yielding variety of rice that increases incomes by 10% and a biofortified rice variety that has higher contents of zinc, which is good for their own and their children’s nutritional outcomes. In scenario 2, keeping the same option of biofortified variety of rice, we changed the outcome for the high-yielding rice variety to increased incomes by 20%, and in scenario 3, increased incomes up to 30%. The responses of men and women are summarized in table 3.

Table 3. Men’s and women’s responses to choice experiment 1 – better nutrition or higher incomes.

Scenarios	Men's responses		Women's responses	
	Percentage of total who made the choices for:			
	Variety 1	Variety 2	Variety 1	Variety 2
Scenario 1				
Variety 1: increases income by 10%	9%	91%	0%	100%
Variety 2: High contents of zinc and iron				
Scenario 2				
Variety 1: increases income by 20%	36.36%	63.63%	0%	100%
Variety 2: High contents of zinc and iron				
Scenario 3				
Variety 1: increases income by 30%	91%	9%	67.67%	33.33%
Variety 2: High contents of zinc and iron				

Source: FGDs with men and women in Bolivar, Colombia, May 2018.

A 10% increase in incomes, as presented in scenario 1, is not attractive enough to replace a promising and nutritive biofortified variety of rice. Both men and women preferred better nutrition to a 10% increase in income. In scenario 2, with a 20% increase in income, women’s choice remained the same, however, about 36% of men changed their choice from biofortified rice to high-yielding variety with a promise of 20% incremental income. A general consensus among men who changed their choice in scenario 2 suggests that the additional income will help them purchase other food items like meat. A similar opinion was seen in the choice experiment with women in scenario 3 when about two-thirds of women changed their choice to high-yielding variety with 30% increase in income from a nutritive rice variety. A woman in the FGD analyzed the alternatives and suggested, “one prefers the

nutrition of the children. With the 26 bags of rice that I sell, I buy meat for my children, among other things.”

3.2 More work and higher incomes or status quo

In this experiment, we gave the participants alternatives between adoption and no adoption of a **hypothetical** variety that increases productivity of rice crops, however, requires more work in the weeding activity. It is important to note that this hypothetical variety that might increase labor does not exist. It was presented in the workshop to test women and men’s preferences between yield and labor. In scenario 1, the participants decided whether or not to adopt a high-yielding variety of rice that can increase incomes by 10 percent but require an additional hour of work per day in weeding during the peak season. The question was reframed in the FGD with women to specifically focus on women’s activity – dehusking and cleaning rice. In scenario 2, keeping the same HYV of rice, we increase the requirements for labor to an additional 1.5 hours/day in the task of weeding for men and dehusking and cleaning rice for women. In the last scenario, the increase in labor demand goes up to 2 hours/day.

The results from this experiment shows that most of the women are not willing to increase their labor supply in rice post-production by more than 1 hour/day even if it increases their household income by 10% (Table 4). The arguments shared by women to support their choices indicate that their care work responsibilities will suffer if their workload in rice production increases. This is particularly true for women with infants and young children. For example, a woman who chose to not adopt the HYV of rice in any of the scenarios said, “I have two young kids, if I work more in rice production, who will take care of them.” She also added that her husband would not help in child-care because it’s a woman’s responsibility. Another women who chose not to increase their workload in rice production argued, “the body gets tired, one cannot keep on abusing the body.”

Men’s choices in this experiment show that most of them are willing to increase up to 1.5 hours/day in rice production to attain a 10% increase in incomes. However, the incremental income is not sufficient to induce them to work more than 1.5 hours/day.

Table 4. Men's and women's responses to choice experiment 2 – more work for higher incomes.

Scenarios	Men's responses		Women's responses	
	Percentage of total who made the choices for:			
	Adopt	Do not adopt	Adopt	Do not adopt
Scenario 1				
New variety: increases income by 10% and requires 1 extra hour/day of work in weeding	72.7%	27.3%	93.33%	6.67%
Scenario 2				
New variety: increases income by 10% and requires 1.5 extra hours/day of work in weeding	54.5%	45.5%	0%	100%
Scenario 3				
New variety: increases income by 10% and requires 2 extra hours/day of work in weeding	0%	100%	0%	100%

Source: FGDs with men and women in Bolivar, Colombia, May 2018.

3.2.1 Sub-experiment 2

We conducted an additional experiment with the group of male participants to assess their preferences between adoption and no-adoption of a high-yielding hypothetical variety that requires more work in a woman's activity like pounding or cleaning the rice. The objective of this experiment is to assess the choices of men, the principal decision-makers in the household, when the benefits of adoption accrue to them while the costs, as measured by increased labor demand, does not affect their workload.

The results show that most men are willing to adopt the high yielding variety of rice even if it increases the workload of women by 2 hours per day in post-production. As seen earlier in the study, usually, the man's decisions prevail in the household and agricultural activities. A decision to adopt a high yielding variety may increase household incomes, however, it will hurt women by increasing the competing claims on their time, to which they may respond by reducing their leisure or care work time. Such a trade-off is ultimately undesirable as it reduces the well being of members of the household. It is also possible that women, who can influence household's agricultural decisions, may assert to not use such a variety of rice, resulting in poor adoption and wasteful resources.

Table 5. Men's responses to choice experiment 2.1 – more work in the woman's activity for higher incomes.

Scenarios	Percentage of men who made the choices for:	
	Adopt	Do not adopt
Scenario 1		
New variety: increases income by 10% and requires 1 extra hour/day of work in pounding and cleaning the rice	100%	0%
Scenario 2		
New variety: increases income by 10% and requires 1.5 extra hours/day of work in pounding and cleaning the rice	81.8%	18.2%
Scenario 3		
New variety: increases income by 10% and requires 2 extra hours/day of work in pounding and cleaning the rice	81.8%	18.2%

Source: FGDs with men and women in Bolivar, Colombia, May 2018.

4. Conclusions and policy implications

Our work pilots a methodology to conduct gender analysis in participatory plant breeding and varietal selection. We conducted discrete choice experiments to assess men's and women's needs and preferences between different agronomic traits of biofortified rice. The first experiment, better nutrition or higher incomes, demonstrated that women in general prefer better nutritional outcomes to a possibility of higher household incomes, which is also evident from their statements, "one cannot do anything if one does not have good nutrition," "without good nutrition, kids would easily become sick" and "nutritive food would serve our kids for better growth and development." Nevertheless, if the incremental income is high enough, as in scenario 3 of this experiment, women are willing to select high yielding variety because they believe that with the additional income they can purchase and feed items in other food groups, which will provide the essential nutrition to their children. Nonetheless, this can work better in places with available markets. Men, however, chose the high yielding variety of rice over biofortified rice even with moderate increase in income. In this case, after considering the preferences of men and women, it would be worthwhile to consider the community wide nutritional outcomes among adults and children to make a final selection between the varieties.

The results also show that it is essential to consider the traits of new varieties that relate to demand for labor or workload. As shown by the experiment, most people, especially women, are not able to increase their labor supply in rice production and post-production unless they make trade-offs to meet the competing claims on their time. Without including women's needs and preferences in the participatory process, it is possible to implement a variety that may impact women's wellbeing negatively or

may not be widely adopted by the farmers. Overall, the idea of these experiments using hypothetical scenarios with hypothetical varieties and characteristics is to pilot a methodology, which is adaptable to real combination of traits present in the new varieties and can help facilitate a gendered participatory breeding and selection.

References

Almekinders, C.J.M., and Elings, A. (2001). "Collaboration of farmers and breeders: Participatory crop improvement in perspective." *Euphytica* 122: 425-438.

Arora, D. and Rada, C. (2017). "Gendered model of the peasant household: Time poverty and farm production in rural Mozambique." *Feminist Economics*. 23(2): 93-119.

Ashby, J. and Lilja, N. (2004). "Participatory research: does it work? Evidence from participatory plant breeding. Paper presented at the 4th International Crop Congress 'New Directions for a Diverse Planet', Brisbane, Queensland, Australia, 26th September to 1st October 2004.

Dalton, T. and Guei, R. (2003). "Productivity gains from rice genetic enhancement in West African ecologies." *World Development* 31:359-37.

Farnworth, C. R. and Jiggins, J. (2003). Participatory plant breeding and gender analysis. *Participatory plant breeding Monograph No. 4*. Cali, Colombia. CGIAR System Wide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation.

Gammage, S. (2010). Time pressed and time poor: Unpaid household work in Guatemala. *Feminist Economics* 16(3).

Johnson, N., Lilja, N., Ashby J. and Garcia, J. (2004). "The practice of participatory research and gender analysis in natural resource management." *Natural Resources Forum* 28(3): 189-200.

Lilja, N. and Dalton, T. (1997). Developing Africa public goods: rice – Varietal selection in Côte d'Ivoire. A discussion paper presented at the American Agricultural Economics meetings, Salt lake City, Utah.

Lilja, N. and Erenstein, O. (2002). Institutional process impacts of participatory rice improvement and gender analysis in West Africa. *PRGA Working Document No. 20*. Cali, Colombia. CGIAR System Wide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation.

Mangham, L. J., Hanson, K. and McPake B. (2009). "How to do (or not to do) Designing a discrete choice experiment for application in low-income country." *Health Policy and Planning* 24(2):151-158.

Monyo, E. S., Ipinge, S. A., Heinrich, G. M. and Chinhema E. (2001). Participatory breeding: does it make a difference? Lessons from Namibian pearl millet farmers. In *Assessing the Impact of Participatory Research and Gender Analysis*, Chapter 11 (Eds N. Lilja, J. Ashby and L. Sperling). Cali, Colombia. CGIAR System Wide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation.

Morris, M. L. and Bellon, M. R. (2004). Participatory plant breeding: opportunities and challenges for international crop improvement system. *Euphytica* 136:21-35.

Najeeb, S., Sheikh, F.A., Parray G.A., Shikari A.B., Zaffar G., Kashyp S.C., Ganie M.A., and Shah A.B. (2018). "Farmers' participatory selection of new rice varieties to boost production under temperate agro-ecosystems" *Journal of Integrative Agriculture* 17 (6): 1307-1314.

Paris, T. R., Singh, A., Cueno, A. D. and Singh, V. N. (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.

About the authors

Diksha Arora, PhD

Postdoctoral Research Associate at Colorado State University. She conducted this study when she was a gender economist at CIAT.
diksha.arora@colostate.edu

Maria Alejandra Garcia, MSc

PhD student in the Department of Community Sustainability at Michigan State University. She participated in this research when she was a research assistant at CIAT.
garcia425@msu.edu

Correct citation

Arora, D. and García, MA. (2019). Use of discrete choice experiments in gendered participatory varietal selection in Bolivar, Colombia. International Center for Tropical Agriculture (CIAT). HarvestPlus. Cali, Colombia.

Acknowledgments

We are thankful for the generous financial support from HarvestPlus and the CGIAR Research Program on Rice



to undertake the fieldwork for this work. We would also like to thank Cecile Grenier, Sonia Gallego, Daniel Alvaro and Maria Eugenia Rolon from Fundacion Canal del Dique for providing valuable feedback on the earlier versions of the info note. Last, we are grateful to the people of the community who participated in the workshops and provided the information needed for this research.

Disclaimer

CIAT Info Notes are brief reports on interim research results. They are not necessarily peer reviewed. As part of the HarvestPlus project, this info note summarizes the findings of a qualitative study conducted in Bolivar, Colombia in 2018. The study focused on gender, time use, rice production, and adoption of new varieties. The opinions expressed here belong to the authors, and do not necessarily reflect those of CIAT, HarvestPlus, CGIAR, or partner organizations.

