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Intrahousehold Preference Heterogeneity and Demand for Labor-Saving Agricultural Technology: The Case of Mechanical Rice Transplanting in India

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Abstract

Evaluations of agricultural technologies rarely consider how adoption may alter the labor allocation of different household members. We examine intrahousehold decision-making dynamics that shape smallholder agricultural households' decision to hire in mechanical rice transplanting (MRT), a technology that reduces demand for labor. To study the adoption decision, we employ an experimental approach to estimating the willingness-to-pay for MRT services, both at the level of individual men and women within the same households, as well as at the overall household level. We find that women value MRT more than men, but this difference in valuation is not driven by differences in their individual characteristics, but primarily by differences in preferences. Although women value MRT more than men, they have less influence over the ultimate technology adoption decision. In households with women working as outside hired laborers, the intrahousehold differences in MRT valuation disappear, suggesting that women value MRT as a means of reallocating on-farm labor to other unpaid family work. Labor-saving mechanization, such as MRT, may have important implications for rural labor markets and on the (gendered) division of labor within agricultural households.

(*JEL* D13, Q160, J43)

Keywords. Intrahousehold Bargaining, Mechanization, Labor Displacement, Market Valuation

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1 Introduction

Mechanization in agriculture can be both a cause and consequence of disruption in rural labor markets. Economic theory has long held that economic growth in high-productivity manufacturing sector tends to pull labor from the low-productivity agricultural sector, thereby increasing rural wages as part of the overall structural transformation process (Lewis, 1954). Higher wages and labor scarcities relative to other factors of production can, in turn, shift agricultural production towards more labor-saving technologies and practices (Binswanger and Ruttan, 1978; Hayami and Ruttan, 1970). This shift may include a relative increase in the use of capital, embodied in the adoption of agricultural machinery and equipment (Binswanger, 1986; Bigot et al., 1987). At the same time, the increased mechanization of farm operations reduces the demand for manual labor, thus displacing farm workers. These important dynamics are captured in models that integrate endogenous structural change with induced innovation, agricultural transformation, and mechanization, which have recently gained traction in empirical applications to smallholder production systems in developing countries (Binswanger and McIntire, 1987; Houssou et al., 2013; Takeshima et al., 2013, 2015; Takeshima, 2017).

These theoretical and empirical observations are increasingly relevant to India, where the share of agriculture in rural employment decreased by 10 percentage points from 1993 to 2010, while the annual growth rate in wages was 2.7 percent in agriculture compared to 1.8 percent in non-agricultural employment (Chand and Srivastava, 2014). These rural wage and employment changes are both causes and consequences of India's rural transformation as labor moves to urban areas and new machinery, equipment, and technology take their place on the farm. There is considerable popular concern about the effect that these changes might have on the production of rice and wheat, India's two most important food staples.

Indeed, national statistics reveal the rise in rural wages and the increase in agricultural labor productivity in India has led to a significant reshuffling of rural labor markets for both

women and men. From 2004-05 to 2009-10, 17.8 million male workers left agriculture and were primarily absorbed in other non-agricultural sectors such as construction. The effects in female rural labor markets, however, has followed a very different trajectory. During the same period, 36.4 million female workers left the agricultural sector (Raveendran and Kannan, 2012). Unlike their male counterparts, the majority of these women – many previously involved in unpaid family agricultural work or self-employment – were not absorbed into non-farm employment. The displacement of women’s labor from the agricultural sector has been a result of a complex set of factors including, but not limited to, rising household incomes and decreasing demand for farm unpaid labor.

When labor displacement arises as a consequence of technical change – specifically the adoption of labor-saving machinery and equipment – the distribution of economic welfare between men and women within a household or community depends crucially on the nature of the machinery (i.e., the embodiment of labor-saving technology) and the operations for which machinery is substituting for manual labor.¹ An unexplored dimension of this technical change is how intrahousehold preferences for the new technology and the division of bargaining power within the household affect agricultural technology adoption decisions. In many research settings, it is not possible to explore this dimension for lack of data since survey instruments typically assume a unitary household by asking only the male household head about farm management. And yet, even with a general division of labor within such households, significant agricultural decisions are often made in consultation with other household members, including female members. This aspect makes unobserved individual demand for agricultural technologies a potentially important empirical shortcoming.

This study attempts to explore this knowledge gap by assessing intrahousehold variation in demand for a new agricultural technology – mechanical rice transplanting (MRT)– along explicit gender dimensions. Each household member’s demand for the technology is assumed

¹Throughout this paper, we treat “machinery” as a labor-saving capital input to production that also embodies a change in technology, that is, a new way of organizing production factors to generate greater technical efficiency on the farm.

to be a function of, among other things, the household member’s gender as well as his or her participation in the agricultural operation for which labor is being substituted. As such, this study represents one of the first efforts to understand gendered differences for a labor-saving agricultural technology that has disproportionate gendered impacts, and how heterogeneous preferences might converge through some bargaining process to arrive at a household-level technology adoption decision.

Our focus on MRT is both timely and relevant to Indian agriculture. While women in rural India contribute to agricultural production in many different ways, one of the primary operations they undertake in India’s rice-producing regions is the laborious transplanting of rice seedlings in standing water. Consequently, there are important gender dimensions to consider when evaluating technologies that substitute for labor during this phase of rice production. Manual transplanting is the most labor-intensive activity undertaken during rice production in India, accounting for as much as 20 percent of all labor employed in rice production (Barker et al., 1985). On average, manual transplanting requires 10-12 labor days per acre, and hiring laborers for transplanting costs roughly INR 900-1,000 per acre.^{2,3} It is a grueling task that requires long hours working in a hunched over position in flood fields and stagnant water, accompanied by exposure to water-borne pests and diseases.

MRT was first introduced in the Indian rice cropping system in 2006, and was heralded as a way to significantly reduce labor costs and improve productivity (Kamboj et al., 2013). MRT equipment – typically custom-hired by smallholders rather than purchased outright – can transplant 3-4 acres per day, which is approximately 25 times the area that can be transplanted using only manual labor.⁴ Because mechanical transplanting potentially affects female laborers more than male laborers, women may be particularly vested in household

²These estimates are based on the sample data, described below in Section 3.

³INR = Indian Rupee. At the time this study was conducted, the exchange rate adjusted for purchasing power parity was 64.152 INR/USD.

⁴While mechanical transplanting is similar to manual techniques, the biggest shift in practice is in nursery cultivation. When rice is mechanically transplanted, the nursery for rice cultivation is prepared on special mats with much shallower root structures. Seedlings are transplanted using machines after two weeks, which is approximately half the time it takes to grow saplings in a traditional nursery for manual transplanting.

decisions to adopt this technology, especially when household members value women’s labor differently. This has implications for how we assess the potential impact of MRT as they become more common in India’s rice-producing areas, both in terms of their potential to reduce drudgery and their potential to displace female labor, particularly in the absence of other non-agricultural employment opportunities available for women.

To disentangle the unobserved individual valuation for custom-hire MRT services from the observed household valuation, we use a combination of stated preference and experimental valuation techniques. We capture MRT valuation from women and men belonging to same households using a stated valuation elicitation mechanism (a sequential, discretized contingent valuation method), and measure the household’s revealed demand for MRT custom-hire services using an incentive-compatible Becker-DeGroot-Marschak (BDM) experimental auction (Becker et al., 1964). Structurally, these valuation exercises are virtually identical, with the principal difference being the incentive compatibility of the binding BDM. These valuation exercises provide three comparable measures of willingness-to-pay (WTP): one for the female decisionmaker, one for the male decisionmaker, and one for the household as a unit, which is assumed to be a weighted average of the valuations for the two individual decisionmakers. Using the Oaxaca-Blinder decomposition, we separate the difference in stated WTP into endowment and preference differentials (Oaxaca, 1973). We combine the heterogeneity in valuation between women and men with the unobserved parameters of a woman’s “voice” in household decisions and her labor allocation to transplanting to assess women’s ability to influence the resulting household technology adoption decision in her preferred direction.

Our analysis suggests that women value MRT more than men, irrespective of their involvement in transplanting activities. The gap between women’s and men’s WTP is widest among households that use only family female labor for transplanting, and accounts for approximately 12 percent of the average WTP of households using only family female labor. We

believe this is primarily because these women are expected to experience the highest level of labor displacement as a result of MRT adoption. This stated WTP difference includes the differences arising from women’s and men’s individual observable characteristics (endowment differentials) and the differences due to their preferences (preference differentials). By and large, however, the majority of this intrahousehold WTP difference can be attributed to preference differentials, suggesting a demarcation in how male and female farmers view this technology, rather than innate differences in characteristics. Despite these differences in valuation and welfare outcomes between women and men, we find men have greater influence in the household’s MRT adoption decision as compared to women when women participate in transplanting, suggesting a significant imbalance in intrahousehold bargaining power.

2 Research Design

To better understand household valuation of MRT and the intrahousehold process that generates this valuation from individual demand for the new technology, we designed and conducted a study in 28 villages located in 13 districts in the northern Indian state of Bihar, which is one of the poorest states with a poverty headcount ratio of more than 30 percent (Reserve Bank of India, 2013). The study was rolled out in the months leading up to the *kharif* rice-growing season in 2015. A timeline for the study alongside the agricultural season calendar is shown in Appendix A. We designed our sampling strategy to be broadly representative of the rice-growing areas of Bihar. We randomly selected 965 rice-cultivating households with both an adult male and female residing in the household. The sample size was proportional to the population in each village: about a quarter of the village’s qualifying population were selected, with a maximum of 65 households chosen in any village.⁵

Beginning in March 2015, we conducted a survey to collect information on the household’s demographic and social characteristics, as well as agricultural data on the labor and capital

⁵A village’s qualifying population comprises all households that cultivate rice and have an adult male and female residing in the household.

used in each agricultural task. At the same time, we conducted a survey with each of the male and female household members jointly identified as co-heads to collect data on individual assets, human capital, employment and earnings, and social and familial backgrounds. For women, this survey also collected data on assets they brought to the household when they were married (including money paid as dowry and jewelry received as wedding gifts, among other assets considered) as these assets could be considered exogenous to household formation (Briere et al., 2003). We use this information to construct a measure of a woman’s “voice” or standing in household decisionmaking.

In April 2015, we revisited the male and female co-heads and introduced the individual-level preference and value elicitation exercises to assess the WTP of men and women in a household to access MRT services. The men and women were individually and separately introduced to the MRT technology through a brief verbal introduction, followed by a short informational video demonstrating MRT operating in the field and introducing them to the MRT service provider who would offer custom-hire services to village members. In all cases, the service provider was *not* a member of the same village as the study participants and was thus unknown to participants at the time we elicited their WTP for MRT services. Enumerators also read to each individual answers to frequently asked questions to clarify details associated with MRT service provision. We took care to provide complete, accurate, and uniform information to both individuals within a household. These individual interviews were conducted simultaneously but separately, with female enumerators interviewing female respondents and male enumerators interviewing male respondents.

For each rice plot the household intended to cultivate in 2015, we elicited WTP as a dichotomous “yes” or “no” statement in response to 14 discrete price points, ranging from INR 600 to INR 1,600 per acre (see Appendix E for the prices used in the exercise). Because some women do not participate in their household’s agricultural activities, we also provided participants with an approximate range of per acre manual transplanting costs as a point

of reference. Throughout the valuation exercise, we used three strategies to minimize hypothetical elicitation bias (Aadland and Caplan, 2003; Cummings and Taylor, 1999; Jacquemet et al., 2013). First, we employed honesty priming to inform the subjects that they would not gain anything by deviating from their true valuation in their responses (Jacquemet et al., 2013). Second, we used “cheap talk” measures and told both women and men to state their valuations as if they were the individual (i.e., household head) responsible for making the ultimate transplanting decision for their household (Cummings and Taylor, 1999). Finally, we elicited individual valuations and household WTP as a dichotomous choice question for each price point so individuals could decide if they wanted to pay each particular price for MRT services. At the end of the individual elicitations, participants were informed that the study team would return to discuss the opportunity to actually custom-hire MRT services, and that the participants should use this intervening period to interact with other household members and make their final decision about whether to hire MRT services.

Activities culminated in May 2015 with household-level BDM auctions. Those members from sampled households who self-identified as “household heads” in the initial survey were invited to participate in a village-level, collective exercise where they would have an opportunity to actually bid for custom-hired MRT services for their farms.⁶ On the day of the auction, the MRT service provider, tasked with providing MRT services in the particular sample village, visited the village along with the research team. After the research team informed the auction participants about the terms of the MRT services, we conducted the auction and elicited WTP for MRT services on each of the households’ plots using the same 14 price points as the individual elicitation. Because of the possibility that the farmers would actually hire MRT services if their WTP was greater than or equal to the village-drawn MRT price (i.e., because the BDM auction was incentive compatible), the WTP is a revealed measure of

⁶The household head is the principal decisionmaker among the co-heads, and typically the person making decisions about transplanting. Most households’ head in the study are men. This aspect of the study is designed to mimic the way MRT services would have been offered to the household, for example, by an MRT service provider.

the household demand.⁷ In sum, the BDMs and individual-level valuation activities provide us with comparable measures of women’s, men’s, and households’ WTP, with the caveat that the individual WTP is hypothetical and thus potentially biased upward, which we can control for on average in econometric specifications.

3 Data and Summary Statistics

Table 1 provides a snapshot of the sample households. The average farmer cultivated just 1.28 acres divided across less than three plots. Whereas 82 percent of our sample were owner-cultivators, 18 percent were landless and rented in the land they cultivated. The vast majority of households (97 percent) are headed by men who are, on average, just under 50 years of age. The female decisionmakers selected for the study are primarily the wives of these household heads. Women in sample households spend, on average, three labor days per acre on transplanting, whereas men spend approximately five labor days on transplanting. On average, sample households also hire seven female and two male laborers per acre for transplanting. The average cost of hiring labor for transplanting alone (i.e., excluding nursery cultivation costs) exceeds INR 600 per acre.

Across the sample, households differ based on the level of hired and family labor used for transplanting. Irrespective of whether the household uses hired or family labor, Table 2 suggests that MRT use can potentially displace more of women’s labor for transplanting as compared to men’s labor.⁸ The average cost per acre for transplanting increases as the household shifts away from using family labor to using higher levels of hired labor. As Table 2 also indicates, average transplanting costs are approximately INR 825 per acre if the

⁷Because the auctions were organized at the village-level (rather than on an individual basis), attrition during this phase of the study was high. From the original set of 965 sample households, only 608 households had a representative attend the auction. The vast majority (92 percent) of those attending the auctions were men. Sample attrition appears to be random on observable household and individual characteristics. There is no significant difference in individual hypothetical valuation or the wealth index between those who attended the auction and those who did not.

⁸MRT use has the potential to displace women’s labor especially if we consider that men’s labor would still be required on the farm for transplanting for supervising MRT service provision.

household uses both family and hired labor, and increases by INR 85 per acre if the household does not use any female family labor but relies only on hired labor. Households using hired labor also cultivate more plots as compared to those using only family labor. We construct a factor-analytic household wealth index as an indicator of a household’s asset level.⁹ Not surprisingly, households using more hired labor were also wealthier than households using only family labor. This is an important dimension for our analysis if we assume that MRT adoption has consequences for women in less wealthy households, i.e., households that are likely less able to afford the service.

Within the average household in our sample, women and men vary across several dimensions (Table 3). On average, men are about 4 years older and have 2 more years of education than women. Women and men do not appear to be significantly different in terms of their risk and uncertainty preferences, at least according to measures constructed from responses to subjective questions asked during the survey. Whereas 93 percent of the men in the sample are involved in agriculture, only 67 percent of women are similarly involved. Women seem to have less technical knowledge about agriculture than men in our sample based on a knowledge index, which is the sum of a respondent’s familiarity with a set of 18 widely used agricultural technologies in India. Although the overall access to agricultural extension is low for the entire sample, it is lower by 18 percentage points for women compared to men. Despite having access to the same household assets, women consider their ability to acquire INR 20,000 cash in an emergency situation to be less than men.

3.1 Intra- and Inter- Household Differences in Willingness-to-Pay

The distribution of men’s and women’s stated valuation provides the first evidence of potential heterogeneity in individual MRT demand. Figure 1 shows the distribution of plot-level WTP for MRT services after subtracting the actual, household-specific cost of manual

⁹The following variables were used in construction of the wealth index: ownership of cellphones, motorcycle, television units, cable television; expenditure on transport, education, and festival donations; ownership of diesel pump, rotavator, knapsack, and tractor; and the size of land owned (in acres).

transplanting. The figure shows two types of differences in relative MRT valuation. First, responses in the southeast and northwest quadrants suggest that men and women clearly disagreed about the value of MRT operations relative to manual transplanting. For example, in the southeast quadrant, women value MRT services in excess of the actual transplanting costs, while men value MRT services less than the actual transplanting costs. In the northwest quadrant, women value MRT services less than the actual transplanting costs, while men value MRT services in excess of the actual transplanting costs.

The second type of variation arises from the extent of deviation from the 45 degree line signifying perfect harmony in men’s and women’s valuations for MRT services relative to the manual transplanting costs. Since the actual manual transplanting costs are the same for both household members, perfect harmony implies that both women and men gave the exact same bid for a particular plot. While there were a surprising number of such occurrences (as indicated by the fairly distinct 45 degree line), the majority of observations deviated from perfect harmony. Even if both members stated bids that were either greater than or less than the actual manual transplanting cost (bids in the northeast and southwest quadrants), the further away their valuations are from the perfect harmony line, the greater is the difference in their individual valuation.

Table 4 reports the all-plot averages of male and female WTP for MRT services, with households classified based on the composition of their labor used during transplanting. For convenience, we describe these households as “family labor only” for those using only female family labor; “family and hired labor” for those using both female family and hired female labor; and “hired labor only” for those using only hired female labor. We observe that across all labor types of households, there are clear differences in MRT demand between men and women within the same household. Across the board, women value MRT more than men, irrespective of whether they actively participate in transplanting. The difference between women’s and men’s stated valuation is highest for households using only family labor for

transplanting. The difference in WTP (INR 89) between women and men in households using family labor only accounts for 12 percent of the mean WTP of this household group. Consistent with these findings, the household-level valuations elicited during the auctions show that households using family labor only have the mean WTP at INR 710. Households using both family and hired labor have a mean WTP of INR 785 and those using only female hired labor have the mean WTP at INR 797.¹⁰

3.2 Bargaining Power of Women

The degree of influence – bargaining power – represents the “voice” an individual member has in influencing joint household decisions, such as the household’s decision about whether to adopt a specific agricultural technology or practice (Carter and Katz, 1997). Yet, bargaining power is unobserved and difficult to identify within a household. Most studies on intra-household bargaining have relied on either a cooperative model or an exit (non-cooperative) model to measure bargaining (Manser and Brown, 1980; McElroy and Horney, 1981; Doss, 1996; Zepeda and Castillo, 1997; Kabeer, 1999; Quisumbing et al., 2003). In cooperative models, bargaining power specifies the sharing rule of an individual’s contribution to overall household welfare. Examples of proxies used in these models include whether a woman earns a cash income, the share of non-land assets and land area under the woman’s control, wage rates, and non-labor income (Smith, 2003; Briere et al., 2003; Gilligan et al., 2014). In non-cooperative models, bargaining power represents an individual’s options for exiting the household in the event that conflict arises. Most methods used to capture exit options rely on variables that are exogenous to the formation of the household, such as differences in age, education, or familial background between the woman and the man at the time of marriage, or the size of the dowry that the woman brings to the marriage (Briere et al., 2003).

Since the adoption of a gendered labor-saving technology like MRT may affect household members’ labor allocations disproportionately, the decision arguably embodies both cooper-

¹⁰These household WTP measures are not statistically different across the three household groups.

ation and conflict simultaneously. Specifically, both individuals may want to cooperate in order to maximize household welfare through the adoption decision, but each may independently decide on their individual allocations to transplanting labor to maximize individual welfare. Sen (1990) posits that bargaining power in such “cooperative conflicts” is a combination of an individual member’s (perceived) contributions to the household welfare, exit options, and (perceived) interest or participation in the household activity in question. Even if these measures are endogenous to household formation, the “perceived” individual role in decisionmaking plays a role in influencing the actual outcomes a household achieves. We use proxies for each of these aspects of bargaining to compute a bargaining power index using principle component analysis.

First, to capture the level of perceived contributions, we use variables based on whether a woman has a bank account jointly or alone; takes out a loan jointly or alone; is a part of group and the extent of her participation; and is satisfied with her leisure and work allocation.^{11,12} Second, we use demographic factors contributing to a woman’s household influence when she joined the household to capture her exit options. The variables include the woman’s age and education at the time of marriage, her father’s caste, and the value of silver, bedding, and cash that she brought as dowry. Third, we measure perceived interests with variables that capture a woman’s influence in household decisions related to agriculture, productive assets, and income spending. One of the proxy variables is the proportion of agricultural decisions she contributes to from a list of 15 agricultural decisions such as selecting crop variety, selling product to the market, and choosing farm inputs. Another variable captures the proportion of decisions she makes pertaining to making capital investments, buying

¹¹The variables ultimately selected to capture perceived contribution were heavily influenced by the variables used in constructing the Women’s Empowerment in Agriculture Index (WEAI; see Alkire et al., 2013), though the empirical approach is different. The WEAI is a composite index designed to measure the influence and the role of women in agriculture and comprises five components (or “domains of empowerment”): role in decisions regarding agricultural production, decisionmaking power in productive activities, decisionmaking on the use of income, participation and leadership in community, and labor and leisure allocation.

¹²A woman’s work satisfaction is a binary variable constructed using the actual hours she works and equals one if it is less than 1.5 times the median hours worked in the sample.

livestock, and spending remittances. We also use variables on woman's ownership of assets like land, livestock, house, and capital equipment and whether she feels she has the freedom to sell, rent, or buy any of these assets.

Figure 2 shows the distribution of the bargaining index for our three labor categories of households. The index value for women in households who do not participate in transplanting (hired labor only households) is higher than in households where women are involved in transplanting (family labor only and family and hired labor households). This difference may arise not only because women in these households may have better exit options but also because these women may *perceive* that their degree of contribution is greater in household activities.

4 Intrahousehold Preference Heterogeneity

As noted above, women value the technology more than men on average. It is quite possible, however, that the difference in valuation is due to differences in women's and men's individual endowments (or characteristics), rather than explicit differences in their preferences regarding the technology. To test whether these differences persist after controlling for these endowment differences, we decompose the stated difference in MRT valuation between women and men into an endowment differential and a preference differential.

Intuitively, the stated difference between women's and men's MRT valuation contains four differences: the difference due to the varying characteristics of women and men (endowment differential), the difference in valuation assuming women and men are alike in their characteristics but simply have different preferences (preference differential), the hypothetical decision bias if women do not participate in transplanting, and the hypothetical elicitation bias due to the lack of incentive compatibility in the stated valuation. Regarding hypothetical elicitation bias, we assume that cheap-talk and framing techniques discussed above reduced (or in the extreme case eliminated) the bias and further assume that the magnitude of the bias

is the same for women and men, thereby negating the effect of this bias in the stated WTP difference. In the following sections, we describe the conceptual and econometric framework for isolating the preference differential from the endowment differential and the hypothetical decision bias. Both the preference differential and the stated MRT valuation difference are relevant to understanding intrahousehold bargaining: the preference differential gives evidence of preference heterogeneity among women and men, whereas the household members negotiate over their actual differences in valuation to arrive at a valuation level for the household.

To isolate the preference differential from the endowment differential, we use the Oaxaca-Blinder decomposition (Oaxaca, 1973). When applied to these data, this method allows us to separate the stated WTP difference into preference and endowment differentials.

Suppose that WTP_n , $n \in \{m, f\}$ is assumed to be a linear and separable function in observable characteristics (X) and unobservable characteristics (ε). Then

$$WTP_n = X'_n \beta_n + \varepsilon_n \quad (1)$$

where β maps individual characteristics into WTP; and where X , β and ε are indexed by gender (n). For X , this merely reflects the possibility that men and women may differ in their individual observable characteristics. In the case of β , this permits these observable characteristics to have differential effects on WTP, while in the case of ε , unobservable characteristics have differential effects on WTP. We can write the difference in stated WTP as follows.

$$\begin{aligned} \Delta_{stated} &= E[WTP_f] - E[WTP_m] \\ \Delta_{stated} &= E[X_f \beta_f + \varepsilon_f] - E[X_m \beta_m + \varepsilon_m] \\ \Delta_{stated} &= (E[X_f] \beta_f + E[\varepsilon_f]) - (E[X_m] \beta_m + E[\varepsilon_m]) \end{aligned} \quad (2)$$

Assuming that the average unobservable characteristics $E[\varepsilon_f]$ and $E[\varepsilon_m]$ are constant and

equal in magnitude, and after adding and subtracting the average effect of women's observable characteristics under the men's β_m , $E[X_f]\beta_m$, the stated difference can be written as follows.

$$\begin{aligned}\Delta_{stated} &= (E[X_f]\beta_f - E[X_f]\beta_m) + (E[X_f]\beta_m - E[X_m]\beta_m) \\ \Delta_{stated} &= E[X_f](\beta_f - \beta_m) + (E[X_f] - E[X_m])\beta_m \\ \Delta_{stated} &= \Delta_{preference} + \Delta_{endowments}\end{aligned}\tag{3}$$

Equation 3 gives the proportion of the stated WTP difference resulting from a difference analogous to the unconditional difference in WTP ($\Delta_{preference}$) and a difference in observable characteristics ($\Delta_{endowments}$). The preference differential gives the difference in WTP assuming women and men are similar in their observable and unobservable characteristics. Intuitively, this approach is also similar to separating the true treatment effect and the selection bias in the observed stated difference using the potential outcomes framework (Fortin et al., 2011).

4.1 Results: Intrahousehold Preference Heterogeneity

As noted earlier, we observe that women value MRT more than men based on the difference between their stated WTP, irrespective of the household's use of hired and family labor, such that $\Delta_{stated} > 0$. To operationalize the decomposition, we need to specify the observable characteristics which may reflect the endowment differential. In this application, we use the demographic characteristics of women and men (age and education level), a binary measure of their respective involvement in agricultural activities and access to agricultural extension, reported measures of risk, agricultural technology index, and their reported level of credit access. Based on equation (3), we decompose this stated difference in WTP for each farm plot into the preference differential and the endowment differential. Women and men in the sample differ on the individual characteristics we use in the decomposition (see Table 3 and Section 3).

Table 5 reports the results from the decomposition of the stated WTP difference. Several insights can be drawn from this decomposition. First, the results suggest that after accounting for individual differences, the average stated difference in WTP for all households is roughly INR 54 per acre. This stated difference in WTP appears to be driven by the stated difference in WTP from households using family labor only for transplanting, which is roughly INR 90 per acre. After controlling for individual characteristics, the differences in stated WTP for households that use family and hired labor for transplanting are not statistically different from zero at conventional levels.

A second important result that emerges is that the preference differential for the full sample (approximately INR 80 per acre) is higher than the difference in stated WTP, implying women have strong preference-driven values for MRT that are significantly higher than men. The preference differential is highest for households using family labor only: based only on preferences, the value that women in households that employ only family labor place on MRT services is nearly INR 155 per acre more than men. The average individual valuation is INR 705 per acre, which implies that preference differential accounts for approximately 20 percent of the average WTP. Finally, the endowment differential shows that men value the MRT technology more than women by about INR 25 per acre, on average. However, under no circumstances, is the endowment effect statistically significant, implying that the differences in stated WTP cannot be explained by differences in individual characteristics.

Turning to the factors contributing to the preference and endowment differentials, we find that individual differences in education and access to extension contribute to the higher valuation of MRT by men. In households where both female family and hired laborers are involved in transplanting, differences in access to extension predict that men value MRT by INR 42 per acre more than women. However, the contribution of these factors differs in the estimates of preference differentials. Conditional on women and men being alike in their risk preferences, women value MRT by INR 140 per acre more than men. In households that

rely on family labor only and where women and men are of the same age, men value the technology by INR 420 per acre more than women, which is more than half the average WTP in this group. However, conditional on both women and men being involved in agricultural work, women value the technology more than men by more than INR 350 per acre.

5 Intrahousehold Bargaining and Household Demand

In this section, we use stated WTP values to assess the bargaining power of women and men when it comes to binding household decisions. We begin by assuming that the household's demand for the technology is influenced by information exchanges between the man (m) and woman (f) within the household, and with others (o) outside the household. Let WTP_f and WTP_m represent the woman's and the man's valuation, respectively, and let WTP_o capture the valuation of others outside the household. Let the function γ_f represent the weight of a woman's valuation – her “voice” or “standing” – in the household's demand for the technology. Similarly, γ_m denotes the weight of a man's valuation in the overall household demand, and γ_o denotes the weight of the valuation of others outside the household. When $\gamma_f = 0$ and $\gamma_m \neq 0$, only the man's valuation of the technology plays a dominant role in the household's demand for the technology, with the woman's valuation having no weight in the decision.

The overall household demand for the technology, as captured by the household's willingness-to-pay (WTP_h), is:

$$WTP_h = \gamma_f WTP_f + \gamma_m WTP_m + \gamma_o WTP_o \quad (4)$$

We assume that γ_f is a function of, among other things, the woman's bargaining power in the household. Suppose B_f represents the bargaining power of the woman. In a general household decision,

$$\gamma = \gamma_0 + \gamma_1 B_f \quad (5)$$

Here γ_0 represents the degree of a woman's influence on the decision based on whether the task falls within her sphere of influence, and $\gamma_1 B_f$ captures the additional influence on the decision attributable to her bargaining power. While γ is a function of the bargaining power of the woman in the decisions that the man and woman jointly make in the household, the role of bargaining power comes into play especially in the context of MRT because MRT adoption may significantly influence a woman's allocation of labor to transplanting. Depending on the level of a woman's involvement in the household's transplanting activities (denoted by T), she may be disproportionately vested in the household's decision to adopt the technology and exercise her bargaining power when she transplants.¹³ Therefore, we rewrite γ as a linear and separable function of these three components:

$$\gamma_f = \gamma_0 + \gamma_1 B_f + \gamma_2 B_f T \quad (6)$$

This composition of γ_f ties in closely with the bargaining concept described in Section 3.2, in which a woman's overall influence on household decisions comprises her exit options (analogous to γ_0), her perceived contributions capturing the weight of her opinion (analogous to γ_1), and her perceived interests capturing whether transplanting falls under her domain of interest (analogous to γ_2).

Because technology adoption decisions are presumably made by men regardless of the labor allocated to transplanting by women in the household, and because there is no reason to believe that the influence of outsiders' valuation is conditional on other characteristics,

¹³In the Indian context, agricultural technology adoption decisions fall predominantly under the man's sphere of influence in a male-headed household. Even when the woman has information about the transplanting technology (because of the information treatment given to the woman and the man in the household), if she does not participate in transplanting, she may not be inclined to participate in the adoption decision and exert her bargaining power in altering the household's demand for the technology.

we assume that γ_m and γ_o are simply scalar weighting parameters rather than functional weighting parameters. Equation 4 is then rewritten as follows.

$$WTP_h = (\gamma_0 + \gamma_1 B_f + \gamma_2 B_f T) WTP_f + \gamma_m WTP_m + \gamma_o WTP_o \quad (7)$$

Equation 7 shows the conduits through which information exchanges within a household and with others outside the household influence the household's demand for the technology. Specifically, the relative magnitude of γ_f allows us to test the degree of influence a woman has in household decisionmaking for MRT with respect to her bargaining power and labor allocation to transplanting.

Equation 7 forms the basis of our econometric estimation. Although we have measures of WTP_f and WTP_m , we do not have an exact measure of WTP_o . To address this, we construct a proxy of outside women's demand (measured as $WTP_{f,o}$) and outside men's demand ($WTP_{m,o}$) for each household, which is calculated as an inverse distance-weighted average of other women's and men's stated demand within the same village. The proxy assumes that sample outsiders living close to a given household exert a higher influence on the household's WTP than those living further away. However, it is likely that $WTP_{f,o}$ and $WTP_{m,o}$ are endogenous to WTP_f and WTP_m if household location is non-random and if individuals live within some distance of others due to non-random reasons. To avoid this endogeneity issue, we also estimate the model without any measure of WTP_o . We also estimate Equation 7 with and without an intercept. Equation 7 implicitly assumes no hypothetical bias in women's and men's individual demands. Although adding the intercept controls for the hypothetical bias, it slightly complicates the interpretation of the estimated women's and men's influence parameters.

In addition to the individual and outside demand variables, we consider whether the differences between the experimental auction and the stated valuation procedures may have also influenced household demand. As described earlier, individual and household demand

elicitation activities were conducted differently on three key fronts. First, the MRT service provider was present during the auctions and not during the individual elicitation. Second, the initial components of the auction exercise – the description of MRT custom-hired services and the question and answer session that followed – were held in the presence of other study participants in a village, even though we elicited the household demand privately in the same manner as the valuation exercise. Third, individual elicitation were hypothetical, so the members may have not fully internalized their household’s income constraints. In order to account for these differences, we include the following variables in the estimation: whether the household knows the service provider, whether the auction participant understood the auction procedure, whether a household is upper caste, and the household’s wealth index. We also included the plot’s area (in acres) as a control variable to account for plot size-specific factors affecting WTP, i.e., large plots may be more suitable to MRT use due to technical specifications of the machinery or due to economies of scale in mechanized transplanting.

We estimate the following equation.

$$WTP_h = [\gamma_0 + \gamma_1 B_f + \gamma_2 T + \gamma_3 B_f T] WTP_f + \gamma_m WTP_m + \gamma_{o,f} WTP_{o,f} + \gamma_{o,m} WTP_{o,m} + X' \alpha + \epsilon \quad (8)$$

where X represents the vector of methodological and control variables influencing household demand, α is the vector of coefficients we estimate for these controls, and ϵ captures the measurement error in the estimation.

5.1 Results: Intrahousehold Bargaining and Household Demand

Table 6 shows the estimation results of the basic household model in Equation 4. The influence of a woman’s WTP on household demand when she is involved in transplanting is estimated as $\hat{\gamma}_0 + \hat{\gamma}_1 E[B_f] + \hat{\gamma}_2 E[B_f]$, where $\hat{\gamma}_0$ is the parameter estimate of her WTP, $\hat{\gamma}_1$ is

her bargaining power's estimated influence, $E[B_f]$ is the mean bargaining power, and $\hat{\gamma}_2$ is the estimate of her bargaining power when she transplants. When she does not transplant, $\hat{\gamma}_2 = 0$. Table 8 shows the estimated weight parameters for women and men for different household groups, based on the source of their transplanting labor. Panel A in Table 8 shows the estimated influence parameters based on the estimation of Table 6, Specification (1). The difference between men's and women's influence is 0.16 when women transplant, but men's influence is even higher ($\gamma_m - \gamma_f = 0.22$) in households where women do not transplant. Both differences in men's and women's influence are statistically significant, irrespective of their transplanting status.

We next estimate the full model as shown in Equation 8. Due to potential endogeneity concerns between individual WTP and the inverse-distance weighted WTP of other women and men in the village, we estimate the model after dropping these two variables. For the full model, a woman's influence when she transplants is estimated as $\hat{\gamma}_0 + \hat{\gamma}_1 E[B_f] + \hat{\gamma}_2 + \hat{\gamma}_3 E[B_f]$. $\hat{\gamma}_2 = \hat{\gamma}_3 = 0$ when she does not transplant. Table 8, Panel A shows the influence parameters from the estimation of Table 7, Specification (1). Whereas women's influence is lower by 0.39 as compared to men's when she transplants and is statistically significant, the difference is 0.09 when she does not transplant and is not statistically significant. This result contrasts with the results obtained from the base model in which women who did not transplant exhibited a lower influence as compared to women who transplanted.

Next, we examine the differences based on the household's source of transplanting labor, i.e., whether households use female family labor only, both hired and family labor, or hired labor only. Women's influence on the household's MRT demand for each household group is estimated as follows.

$$\hat{\gamma}_f = \hat{\gamma}_0 + \hat{\gamma}_1 E[B_f] \quad (9)$$

Here $E[B_f]$ is the average bargaining index for each household group. The influence parameters estimated using Specifications (3), (4), and (5) in Table 6 are shown in Table 8, Panel B. The difference between men’s and women’s influence is highest in households using only family labor, and is statistically significant ($\gamma_m - \gamma_f = 0.81$). Recall that women in this household group were willing to pay more for MRT compared to the men among all the household groups based on the composition of transplanting labor. Men’s influence is about four times that of women’s influence in households using both family and hired labor. The difference between the weight of a man’s WTP and woman’s WTP is not statistically significant in households using only hired labor.

The influence parameters obtained from Specifications (2), (3), and (4) in the full model (Table 7) are also shown in Panel B, Table 8. Women’s weighting parameter in the full model for each household group is also estimated using Equation 9. Women’s influence in households using only family labor is not statistically significantly different from men’s influence. Women in households using hired transplanting labor only have an influence parameter of .25 and men have an influence parameter of .28, and this difference is again not statistically significant. The difference in influence is greatest among households using both hired and family labor. Here the difference in men’s and women’s influence is 0.22 and statistically significant. Because there are few observations in households using only family labor, when we combine households using any female family labor for transplanting, we find the difference between the influence of women’s and men’s WTP on household MRT demand to be statistically significant and increases to 0.24. Overall, these results show even though women’s WTP is higher as compared to the men, their influence is lower as compared to the men’s influence on household WTP.

We also run alternative specifications of the bargaining model to verify the robustness of these results. These robustness regressions are shown in Appendix B. We use different proxies of the bargaining index to capture exit options, *perceived interests*, and *perceived contributions*

separately. We also restrict the sample to men and women who are husband and wives. Our findings are robust to the use of these alternative restrictions and variables.

6 Intrahousehold Differences in Welfare

In this section, we analyze the welfare implications resulting from our estimates of women’s and men’s individual MRT demand. We examine two different welfare measures: (i) the reduction in production costs (and thus the increase in profits from rice cultivation) resulting from hiring fewer female laborers for transplanting, and (ii) the reduction in family female labor allocated to transplanting and potentially reallocated to other productive home or market activities.

As discussed in Section 4, the overall demand for MRT varies within households based on the source of labor used for transplanting. The heterogeneity in MRT demand both within and across households based on the source of labor for transplanting is also illustrated in Appendix C. Across these different types of households, adoption of MRT necessarily displaces labor, either family, hired, or both. For example, for households that use family labor only, MRT adoption would reduce the quantity of household labor used in transplanting. As we see in this figure, MRT demand increases progressively as households use a greater share of hired labor for transplanting.

Using these individual demand measures, we construct the amount of cash savings that households receive from custom-hiring MRT services at different prices as a substitute for hired labor for manual transplanting. Figure 3 shows the level of cash saving for households using both family and hired labor and hired labor exclusively. The cash savings from women’s and men’s MRT demand is statistically indistinguishable, especially when the MRT services are priced below INR 1,000 per acre.¹⁴ In addition to displacing hired labor, MRT adoption

¹⁴The average cost of transplanting using hired labor exclusively is INR 910 per acre based on our sample data estimates.

also reduces unpaid female family labor. Figure 4 depicts the reduction in the days of family labor resulting from MRT adoption for households using only family labor and those using both family and hired labor. There is no statistical difference in family labor-savings resulting from women’s and men’s MRT demand among households using family labor only for MRT services priced below INR 1,000 per acre. However, for the same price range, women in households using both hired and family labor tend to select plots that save 114 more labor-days, on average, than those chosen by men in our sample. Because this group of households uses about 4 family labor-days per acre, on average, this labor saving translates to a willingness-to-pay of roughly INR 190 per day more by women. The average female wage rate in the study area for transplanting is INR 133 (ranging from INR 80 – INR 200) and the average male wage rate is INR 175 (ranging from INR 100 – INR 250). This implies that women are willing to pay slightly more than their wage rate (approximately 8 percent higher) and about the same as the male wage rate, on average, to reallocate labor away from transplanting. Even though women and men in this group do not have a statistically different willingness-to-pay for MRT (after controlling for individual differences) or quantity of cash savings from hired labor displacement, women are selecting farm plots that tend to save significantly higher quantity of their unpaid family labor as compared to men.

6.1 Potential Drivers of Women’s MRT Valuation: Drudgery and Wages

As our analysis suggests, not only do women have a higher willingness-to-pay for custom-hired MRT services than men, they also tend to select plots that save their unpaid labor more as compared to those chosen by men. Women may choose to lower their labor in transplanting in order to reallocate it to other unpaid and, perhaps, less arduous family work or engage in other wage work. In order to examine the potential drivers of women’s valuation, we divide the sample of women working on their own farm into two groups: women working exclusively on their own farm and women working as hired farm laborers

also during transplanting. Women in 180 households work on other people’s farm and earn an average of INR 110 per day. Approximately 37 percent of women in households using only family labor also work on other people’s farm during transplanting, and about 38 percent of women in households using both family and hired labor also engage in paid farm work. The MRT valuation of women in these two groups is not statistically different among households that use only family labor for transplanting. However, women who work on other farms in households using both hired and family labor value MRT less by about INR 160 per acre as compared to those women who do not work outside. Moreover, the valuation of men is statistically indistinguishable from that of women who work outside during transplanting. The valuation of women working exclusively on their farm is higher by roughly INR 70 as compared to their male counterparts among these households, suggesting women’s shadow value of their own time is higher than the men’s valuation.

A comparison of the plots that the two groups of women would have chosen also suggests that women may value MRT more in order to avoid the drudgery of transplanting activities. Figure 5 shows the female family labor saving by women working as hired laborers versus women working exclusively on their family farm among households that use both family and hired labor.¹⁵ While there is no statistical difference in labor saving between women working outside and the men in those households, women not working outside choose plots that save 91 more labor-days as compared to their male counterparts for MRT prices below INR 1,000 per acre.

7 Conclusion

In this paper, we show that the potential labor displacement effects resulting from the mechanization of gendered on-farm labor activities is associated with both intra- and inter-household heterogeneity in willingness-to-pay among potential adopters of the machinery.

¹⁵The cash savings accruing to households when women work as hired laborers versus when women work exclusively on their family farm are shown in Appendix D.

These results have three broad welfare implications for mechanization decisions at the individual, household, and policy levels. First, the results highlight the role that women’s bargaining power and their earning potential outside of transplanting plays in the emerging market for custom-hired MRT services. Even if MRT adoption implies women losing wages, an overall improvement of women’s bargaining power allows them to have greater control over their unpaid and paid labor allocation decisions.

Second, the heterogeneity in intrahousehold demand suggests the importance of including both women and men in efforts to promote MRT through public extension services, non-governmental development projects, and commercial marketing strategies. This should be obvious not just because MRT have gendered effects on household labor allocation, but also because the differences in MRT valuation between women and men – as shown in this paper – suggest a keen recognition of these gendered effects among our participant households. Even though the analysis shows that men exert a greater influence than women in the household’s technology adoption decisions, we would suggest that this may change as MRT becomes more common in India’s rice-cultivating areas. We cannot yet reject the possibility that women’s valuation may eventually exert greater influence or guide household’s MRT adoption decisions in the future.

Finally, there is a possibility that, in the near future, higher rates of MRT adoption may push women into more traditional gendered labor roles, which may influence women’s wage rates and bargaining power in rural labor markets for transplanting and for other activities, both agricultural and non-agricultural. If households use MRT in order to reduce the drudgery of transplanting, then MRT adoption may limit women’s work to only unpaid family housework and, in turn, lower their voice, agency, and mobility. Alternatively, if households use MRT to reduce drudgery and open up new employment and enterprise opportunities for women, then MRT may increase voice, agency, and mobility. Future work on this topic may explore the linkages between women’s bargaining power and labor displacement. Al-

though the ability to engage in activities outside of transplanting may be associated with an improvement in bargaining, this displacement may also lower their bargaining power if it reduces women’s mobility and autonomy. Eswaran et al. (2013) find supporting evidence that when women withdraw from agricultural work to engage in “family status” production due to agricultural productivity gains, they lose their individual autonomy. These “family status” activities include providing greater attention to children, preparing nutritious meals, and improving the family’s social capital. Another extension of the present research can examine the interaction between female and male wage rates and women’s labor displacement, especially because women’s and men’s labor are not perfect substitutes in the Indian agricultural context. Mahajan and Ramaswami (2017) show that while women’s labor supply does not influence male wage rates, men’s labor supply has a significant effect on the female wage rates. If women’s displacement from labor-intensive agricultural tasks implies a greater proportion of men working on the farm, such a shift in farm production technologies can influence the relative wage rates of women and men. Ultimately, this massive exit of women from agricultural labor markets has long-run implications for women’s participation in remunerative employment, welfare, and empowerment.

References

- Aadland, D. and A. J. Caplan (2003). Willingness to pay for curbside recycling with detection and mitigation of hypothetical bias. *American Journal of Agricultural Economics* 85(2), 492–502.
- Alkire, S., R. Meinzen-Dick, A. Peterman, A. Quisumbing, G. Seymour, and A. Vaz (2013). The women’s empowerment in agriculture index. *World Development* 52, 71–91.
- Barker, R., R. W. Herdt, and B. Rose (1985). *The Rice Economy of Asia*, Volume 2. Los Banos, Philippines: IRRI.
- Becker, G. M., M. H. DeGroot, and J. Marschak (1964). Measuring utility by a single-response sequential method. *Behavioral Science* 9(3), 226–232.
- Bigot, Y., Y. Bigot, and H. P. Binswanger (1987). *Agricultural mechanization and the evolution of farming systems in Sub-Saharan Africa*. Baltimore: Johns Hopkins University Press.
- Binswanger, H. (1986). Agricultural mechanization: A comparative historical perspective. *The World Bank Research Observer* 1(1), 27–56.
- Binswanger, H. P. and J. McIntire (1987). Behavioral and material determinants of production relations in land-abundant tropical agriculture. *Economic Development and Cultural Change* 36(1), 73–99.
- Binswanger, H. P. and V. W. Ruttan (1978). *Induced innovation: technology, institutions, and development*. Baltimore, MD: The Johns Hopkins University Press.
- Briere, B., K. Hallman, A. R. Quisumbing, et al. (2003). Resource allocation and empowerment of women in rural Bangladesh. *Household Decisions, Gender, and Development: A Synthesis of Recent Research*.

- Carter, M. and E. Katz (1997). Separate spheres and the conjugal contract: Understanding the impact of gender-biased development. *Intrahousehold Resource Allocation in Developing Countries: Methods, Models and Policies*.
- Chand, R. and S. Srivastava (2014). Changes in the rural labour market and their implications for agriculture. *Economic and Political Weekly* 49(10), 47–54.
- Cummings, R. G. and L. O. Taylor (1999). Unbiased value estimates for environmental goods: A cheap talk design for the contingent valuation method. *American Economic Review* 89(3), 649–665.
- Doss, C. R. (1996). Women’s bargaining power in household economic decisions: Evidence from Ghana. Technical report, University of Minnesota, Department of Applied Economics.
- Eswaran, M., B. Ramaswami, and W. Wadhwa (2013). Status, caste, and the time allocation of women in rural India. *Economic Development and Cultural Change* 61(2), 311–333.
- Fortin, N., T. Lemieux, and S. Firpo (2011). Decomposition methods in economics. *Handbook of Labor Economics* 4, 1–102.
- Gilligan, D. O., N. Kumar, S. C. 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*.
- Hayami, Y. and V. W. Ruttan (1970). Agricultural productivity differences among countries. *American Economic Review* 60(5), 895–911.
- Houssou, N., X. Diao, F. Cossar, S. Kolavalli, K. Jimah, and P. O. Aboagye (2013). Agricultural mechanization in Ghana: Is specialized agricultural mechanization service provision a viable business model? *American Journal of Agricultural Economics* 95(5), 1237–1244.

- Jacquemet, N., R.-V. Joule, S. Luchini, and J. F. Shogren (2013). Preference elicitation under oath. *Journal of Environmental Economics and Management* 65(1), 110–132.
- Kabeer, N. (1999). Resources, agency, achievements: Reflections on the measurement of women’s empowerment. *Development and Change* 30(3), 435–464.
- Kamboj, B. R., D. B. Yadav, A. Yadav, N. K. Goel, G. Gill, R. K. Malik, and B. S. Chauhan (2013). Mechanized transplanting of rice (*Oryza sativa* L.) in nonpuddled and no-till conditions in the rice-wheat cropping system in Haryana, India. *American Journal of Plant Sciences* 4(12), 2409–2413.
- Lewis, W. A. (1954). Economic development with unlimited supplies of labour. *The Manchester School* 22(2), 139–191.
- Mahajan, K. and B. Ramaswami (2017). Caste, female labor supply, and the gender wage gap in India: Boserup revisited. *Economic Development and Cultural Change* 65(2), 339–378.
- Manser, M. and M. Brown (1980). Marriage and household decision-making: A bargaining analysis. *International Economic Review* 21(1), 31–44.
- McElroy, M. B. and M. J. Horney (1981). Nash-bargained household decisions: Toward a generalization of the theory of demand. *International Economic Review* 22(2), 333–349.
- Oaxaca, R. (1973). Male-female wage differentials in urban labor markets. *International Economic Review* 14(3), 693–709.
- Quisumbing, A. R. et al. (2003). *Household decisions, gender, and development: a synthesis of recent research*. Washington, D.C.: International Food Policy Research Institute.
- Raveendran, G. and K. P. Kannan (2012). Counting and profiling the missing labour force. *Economic & Political Weekly* 47(06), 77–80.

- Reserve Bank of India (2013). Handbook of statistics on Indian economy: Number and percentage of population below poverty line. Technical report, Mumbai: Reserve Bank of India.
- Sen, A. (1990). *Gender and Cooperative Conflicts*. New York: Oxford University Press.
- Smith, L. C. (2003). *The importance of women's status for child nutrition in developing countries*, Volume 131. Washington, D.C.: International Food Policy Research Institute.
- Takeshima, H. (2017). Custom-hired tractor services and returns to scale in smallholder agriculture: A production function approach. *Agricultural Economics* 48(3), 363–372.
- Takeshima, H., R. P. Adhikari, M. N. Poudel, and A. Kumar (2015). *Farm household typologies and mechanization patterns in Nepal Terai: Descriptive analysis of the Nepal living standards survey*, Volume 1488. Washington, D.C.: International Food Policy Research Institute.
- Takeshima, H., A. Nin—Pratt, and X. Diao (2013). Mechanization and agricultural technology evolution, agricultural intensification in sub-saharan africa: Typology of agricultural mechanization in nigeria. *American Journal of Agricultural Economics* 95(5), 1230–1236.
- Zepeda, L. and M. Castillo (1997). The role of husbands and wives in farm technology choice. *American Journal of Agricultural Economics* 79(2), 583–588.

Table 1: Summary Statistics: Household Characteristics

Variable	Mean	Std. Dev.
<i>Household Composition</i>		
Age of household head (years)	47.95	13.79
Household head is male (share)	0.97	0.16
Household size	6.08	2.95
Household is involved in agriculture (share)	0.44	0.24
Household is nuclear (share)	0.74	0.44
Share of husband-wife in sample	0.87	0.34
Household is upper caste (share)	0.25	0.43
Household has Below Poverty Line ration card (share)	0.44	0.5
<i>Agricultural Characteristics</i>		
Household owns agricultural land (share)	0.82	0.39
Area owned (acres)	1.64	3.89
Area cultivated (acres)	1.28	2.27
Number of plots	2.7	2.0
<i>Transplanting Cost and Labor-use</i>		
Transplanting cost per acre (INR) [†]	614.92	753.53
Female transplanting wage rate (INR)	134.41	48.49
Male transplanting wage rate (INR)	173.37	62.08
Female family labor per acre	3.15	6.04
Male family labor per acre	4.86	6.17
Female hired labor per acre	6.96	12.16
Male hired labor per acre	1.96	6.77
Observations	965	

[†] Transplanting cost per acre only includes cost of hiring laborers for transplanting. It does not include any nursery or family labor-use cost.

Table 2: Summary Statistics: Labor-use in Transplanting

	Family labor only	Family & hired labor	Hired labor only
Number of plots	2.33 (1.69)	2.71 (1.48)	4.03 (17.33)
Plot area (acres)	0.65 (1.75)	0.62 (0.53)	0.83 (1.17)
Wealth index	-0.37 (0.47)	-0.19 (0.63)	0.37 (1.17)
Transplanting cost per acre (INR)	- (-)	826.22 (712.62)	910.4 (759.61)
Family female labor per acre	9.1 (8.87)	3.89 (5.83)	- (-)
Family male labor per acre	8.02 (9.06)	4.28 (4.09)	3.3 (4.08)
Hired female labor per acre	- (-)	10.18 (15.4)	7.92 (10.41)
Hired male labor per acre	- (-)	2.03 (5.42)	2.79 (4.79)
Bargaining index	-0.64 (0.74)	-0.46 (0.93)	0.78 (1.34)
Observations	153	362	331
Standard deviation in parantheses			

Table 3: Summary Statistics: Individual Differences Within a Household

	Observations	Female	Male	Difference	<i>t</i> -Statistics
<i>Individual Characteristics</i>					
Age	1930	43.8	47.8	-4.0***	(6.54)
Education (years)	1930	2.6	4.6	-2.0***	(6.64)
Literacy (percent)	1930	36.3	70.8	-34.5***	(16.19)
Member of a group (percent)	1927	20.7	2.5	18.1***	(-12.94)
Uncertainty index	1927	.36	.32	0.04	(-1.80)
Risk	1900	5.3	5.3	0.08	(-0.90)
<i>Agricultural Involvement</i>					
Involved in agricultural work (percent)	1930	67.2	93.1	-25.9***	(15.09)
Involved in transplanting (percent)	1930	69.0	75.7	-6.7***	(3.32)
Agricultural technology index	1930	24.6	29.6	-5.1***	(14.01)
Accessed extension last year (percent)	1929	2.6	20.5	-17.8***	(12.71)
<i>Access to Credit</i>					
Have a bank account (percent)	1928	41.1	66.0	-24.9***	(11.31)
Have a loan (percent)	1928	6.9	4.9	1.9	(-1.84)
Credit worthiness (INR)	1930	13,145.1	33,015.5	-19,870.5***	(8.12)
<i>Time Allocation</i>					
Hours spent on household chores	1706	7.4	5.2	2.2***	(-19.77)
Hours spent on farm work	1706	1.9	3.3	-1.4***	(12.26)
Hours spent on leisure	1706	2.3	2.4	-0.08	(1.19)

t-statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4: Differences Between Women's and Men's Stated Willingness-to-pay

Composition of Transplanting Labor	Female (WTP _f)	Male (WTP _m)	WTP _f – WTP _m	Plot Observations
Family labor only	750 (582.37)	660.81 (647.06)	89.19** (40.02)	236
Family & hired labor	867.57 (524.79)	819.89 (632.02)	48.68* (25.51)	680
Hired labor only	966.25 (515.06)	915.14 (614.18)	51.11** (24.76)	720
Overall	891.77 (537.38)	841.64 (633.03)	50.12*** (15.95)	1700

Standard deviation shown in parentheses for columns (1) and (2), and standard errors shown in parentheses for column (3).

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Even though within household differences between female's and male's MRT valuation are statistically significant, these differences are not statistically significant across the three sub-groups of households.

Table 5: Oaxaca-Blinder Decomposition of Individual MRT Valuation

	(1) All	(2) Family only	(3) Family & hired	(4) Hired only
Equation 1 : Differential ($WTP_f - WTP_m$)				
Female Mean	890.39*** (19.36)	746.15*** (52.29)	867.26*** (30.24)	964.51*** (29.30)
Male Mean	836.34*** (22.50)	655.82*** (56.55)	818.98*** (35.94)	907.83*** (33.90)
Difference	54.05** (23.95)	90.33* (52.04)	48.28 (37.28)	56.69 (38.97)
Equation 2: Preference Differential				
Age (years)	-1.59 (88.61)	-420.59** (205.19)	27.28 (133.86)	82.48 (144.78)
Education (years)	9.58 (19.13)	-3.74 (27.12)	20.69 (23.34)	-2.61 (37.53)
Involved in agricultural work(=1)	45.39 (88.71)	351.25* (199.43)	-84.81 (185.18)	27.20 (103.08)
Accessed extension last year (=1)	-2.79 (5.67)	-3.75 (16.34)	-4.13 (11.24)	-7.45 (7.39)
Risk	140.09* (73.96)	262.86 (179.46)	100.17 (125.53)	250.81** (102.75)
Technology index	-63.07 (103.29)	-47.39 (264.11)	62.78 (159.19)	-253.77 (162.69)
Credit worthiness	7.86 (8.57)	-84.82 (57.08)	3.44 (26.73)	20.18 (12.81)
Intercept	-55.95 (181.90)	101.03 (489.57)	-59.50 (291.03)	-53.95 (255.74)
Total	79.51*** (30.67)	154.84* (84.45)	65.92 (43.72)	62.90 (49.58)
Equation 3: Endowment Differential				
Age	0.36 (4.75)	12.48 (12.72)	-5.43 (5.67)	5.15 (9.09)
Education (years)	-10.86** (5.41)	6.40 (16.65)	-0.40 (8.04)	-11.82 (7.53)
Involved in agricultural work(=1)	16.02 (11.06)	-14.92 (16.87)	2.03 (14.56)	15.88 (21.55)
Accessed extension last year (=1)	-29.72*** (9.85)	-42.17 (30.27)	-41.74*** (13.34)	-23.23 (16.79)
Risk	0.002 (0.07)	-7.06 (13.31)	1.98 (2.88)	0.66 (4.29)
Technology index	-0.55 (8.72)	-31.64 (31.76)	17.57* (9.63)	-1.97 (15.52)
Credit worthiness	-0.72 (5.90)	12.42 (19.39)	8.34 (9.24)	9.12 (10.59)
Total	-25.46 (18.79)	-64.50 (59.52)	-17.65 (24.64)	-6.21 (31.21)
Observations	3,250	466	1,355	1,429

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Standard errors clustered at household level in parentheses

Table 6: Intrahousehold Bargaining and MRT Demand: Base Model

Dependent Variable: Auction WTP	(1) All	(2) All	(3) Family only	(4) Family & hired	(5) Hired only
Male Individual WTP	0.44*** (0.08)	0.23*** (0.07)	0.89*** (0.07)	0.37*** (0.07)	0.32** (0.13)
Female Individual WTP	0.25*** (0.08)	-0.06 (0.09)	0.07 (0.15)	0.08 (0.09)	0.56*** (0.19)
$WTP_f \times$ Bargaining index	-0.05* (0.02)	-0.0008 (0.03)	0.01 (0.10)	-0.01 (0.03)	-0.06* (0.03)
$WTP_f \times$ Bargaining index $\times$ Women transplants (=1)	0.07 (0.06)	0.001 (0.07)			
Outside male WTP	0.17 (0.15)	0.23 (0.25)	0.17 (0.21)	0.32 (0.35)	0.04 (0.13)
Outside female WTP	0.31* (0.16)	0.23 (0.19)	0.07 (0.18)	0.36 (0.32)	0.21 (0.15)
Constant		306.34 (206.34)			
Observations	575	575	66	219	272

Standard errors in parentheses clustered at village-level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Intrahousehold Bargaining and MRT Demand: Full Model

Dependent Variable: Auction WTP	(1) All	(2) Family only	(3) Family & hired	(4) Hired only
Male individual WTP	0.25*** (0.04)	0.09* (0.05)	0.15*** (0.06)	0.28*** (0.05)
Female individual WTP	0.22** (0.10)	0.14 (0.17)	-0.07 (0.08)	0.35*** (0.13)
$WTP_f \times$ Bargaining index	-0.07** (0.04)	0.11 (0.18)	0.00 (0.04)	-0.11*** (0.04)
$WTP_f \times$ Women transplants (=1)	-0.27*** (0.10)			
$WTP_f \times$ Bargaining index $\times$ Women transplants (=1)	0.06 (0.05)			
Women transplants (=1)	255.94** (130.04)			
Bargaining index	24.20 (39.34)	-97.08 (219.09)	-15.98 (77.83)	90.07* (53.34)
Knows service provider	72.34 (54.59)	184.70 (253.91)	122.33 (105.10)	14.16 (69.24)
Understood auction	-10.27 (141.96)	-97.30 (128.24)	31.34 (84.53)	-58.22 (218.87)
Plot area (acres)	13.00 (10.30)	-30.60 (49.19)	39.25 (33.54)	16.38 (11.53)
Household is upper caste (=1)	81.17 (61.26)	68.01 (352.84)	306.98** (144.76)	6.82 (76.59)
Wealth index	-8.45 (21.44)	-204.67* (109.40)	11.75 (72.60)	-12.77 (22.39)
Constant	515.17** (232.43)	680.64 (614.25)	674.39*** (193.03)	496.57 (330.46)
Observations	575	66	219	272

Standard errors in parantheses clustered at village-level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Household-level random effects used

Table 8: Women's and Men's Degree of Influence in Household MRT Demand

PANEL A				
	Base Model		Full Model	
Men	.44		.25	
Women when she transplants	.28**		-.14***	
Women when she does not transplant	.22*		.16	
PANEL B				
	Base Model		Full Model	
	Female	Male	Female	Male
Family labor only	.07***	.89	.06	.09
Hired & family labor	.08***	.37	-.07***	.15
Hired labor only	.51	.32	.25	.28
Chi-squared test * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$				

Figure 1: Intrahousehold Heterogeneity in the Distribution of Individual Willingness-to-pay

Figure 2: Bargaining Index, by Household's Source of Labor Allocated to Transplanting

Figure 3: Cash Saving from Hired Labor Displacement from MRT Adoption

(a) MRT Displaces Family & Hired Labor

(b) MRT Displaces Hired Labor

Figure 4: Family Female Labor Saving from MRT Adoption

(a) MRT Displaces Family Labor

(b) MRT Displaces Family & Hired Labor

Figure 5: Family Female Labor Saving When Women Work as Family and Hired Labor

(a) MRT Displaces Female Family Labor Working as Hired Laborers

(b) MRT Displaces Female Family Labor Not Working as Hired Laborers

Appendix A. Timeline of Field Activities in 2015

Appendix B. Robustness Checks

Table B1: Intrahousehold Bargaining and MRT Demand Using Asset-Based Bargaining Index

Dependent Variable: Auction WTP	(1) All	(2) Family only	(3) Family & hired	(4) Hired only
Male Individual WTP	0.07 (0.05)	0.13** (0.06)	0.04 (0.05)	0.07 (0.09)
Female Individual WTP	-0.07 (0.05)	-0.20 (0.21)	-0.12 (0.10)	0.05 (0.06)
$WTP_f \times$ Asset bargaining index	-0.00 (0.03)	0.05 (0.21)	-0.05 (0.06)	-0.03 (0.04)
$WTP_f \times$ Women transplants (=1)	-0.09 (0.06)			
$WTP_f \times$ Asset bargaining index $\times$ Women transplants (=1)	0.13** (0.07)			
Asset bargaining index	-35.89 (34.19)	-168.17 (267.52)	59.21 (64.99)	4.47 (40.71)
Women transplants (=1)	-19.08 (71.26)			
Knows service provider	65.94 (73.73)	297.07 (240.66)	137.69 (129.78)	-36.94 (86.69)
Understood auction	-219.36* (117.08)	-183.32 (206.20)	40.45 (163.49)	-340.95* (174.57)
Plot area (acres)	32.65*** (12.43)	-25.22 (85.49)	103.81*** (37.48)	16.58 (11.42)
Household is upper caste (=1)	85.34 (84.40)	-99.91 (261.40)	250.10* (139.72)	52.19 (99.58)
Wealth index	-22.96 (23.81)	-48.97 (153.34)	-47.57 (81.15)	-14.33 (28.50)
Constant	993.12*** (177.38)	603.77 (601.83)	624.29** (284.86)	1172.62*** (268.31)
Observations	753	95	283	346

Standard errors in parantheses clustered at village-level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Household-level random effects used.

Bargaining index is constructed using principle component analysis and uses the following variables: age and education at marriage, father's caste, and value of silver, bedding and cash brought in as dowry at marriage.

Table B2: Intrahousehold Bargaining and MRT Demand Using Income-Based Bargaining Index

Dependent Variable: Auction WTP	(1) All	(2) Family only	(3) Family & hired	(4) Hired only
Male Individual WTP	0.07 (0.05)	0.16** (0.08)	0.04 (0.05)	0.06 (0.09)
Female Individual WTP	-0.10** (0.04)	-0.29*** (0.10)	-0.07 (0.09)	0.02 (0.08)
$WTP_f \times$ Income bargaining index	-0.05 (0.04)	0.19*** (0.07)	-0.04 (0.04)	-0.02 (0.03)
$WTP_f \times$ Women transplants (=1)	-0.04 (0.06)			
$WTP_f \times$ Income bargaining index $\times$ Women transplants (=1)	0.04 (0.06)			
Income bargaining index	-0.43 (37.75)	-55.50 (45.23)	35.11 (70.83)	-61.50 (47.71)
Women transplants (=1)	3.57 (74.43)			
Knows service provider	72.61 (73.69)	338.10 (238.93)	133.47 (131.67)	-52.34 (83.23)
Understood auction	-193.17* (111.93)	-117.91 (138.58)	52.07 (175.78)	-309.58* (177.90)
Plot area (acres)	32.59*** (12.13)	-57.01 (73.68)	107.87*** (36.39)	16.40 (11.22)
Household is upper caste (=1)	60.82 (84.30)	-73.35 (290.48)	228.32* (117.77)	0.87 (105.57)
Wealth index	-25.94 (23.40)	8.73 (136.28)	-38.13 (73.65)	-23.14 (31.40)
Constant	961.77*** (169.02)	637.90 (395.28)	569.22** (286.14)	1180.74*** (265.12)
Observations	753	95	283	346

Standard errors in parantheses clustered at village-level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Household-level random effects used.

Bargaining index is constructed using principle component analysis and uses the following variables: whether woman currently has a bank account, whether woman currently has a loan, whether woman is member of a group, woman's level of participation in a group, woman's level of satisfaction with the number of leisure hours, and woman's level of satisfaction with the number of work hours.

Table B3: Intrahousehold Bargaining and MRT Demand Using Sample of Spouses Only

Dependent Variable: Auction WTP	(1) All	(2) Family only	(3) Family & hired	(4) Hired only
Male Individual WTP	0.24*** (0.05)	0.05 (0.04)	0.16** (0.08)	0.29*** (0.06)
Female Individual WTP	0.08 (0.06)	0.14 (0.17)	-0.01 (0.09)	0.32*** (0.12)
$WTP_f \times$ Bargaining index	-0.01 (0.04)	0.13 (0.17)	0.04 (0.05)	-0.11** (0.06)
$WTP_f \times$ Women transplants (=1)	0.04 (0.06)			
$WTP_f \times$ Bargaining index $\times$ Women transplants (=1)	-0.02 (0.04)			
Women transplants (=1)	-12.88 (93.61)			
Bargaining index	-20.56 (45.76)	-123.99 (209.82)	-29.42 (93.92)	93.36 (79.13)
Knows service provider	77.88 (66.83)	194.02 (269.86)	112.52 (110.54)	36.80 (74.42)
Understood auction	102.16 (190.54)	-155.02 (139.59)	58.99 (88.47)	42.26 (341.62)
Plot area (acres)	4.38 (11.29)	-1.66 (26.85)	19.48 (41.26)	8.55 (12.54)
Household is upper caste (=1)	73.90 (75.50)	-10.34 (495.59)	226.45 (191.17)	44.15 (93.68)
Wealth index	-16.96 (24.87)	-215.06* (118.55)	16.41 (92.34)	-20.85 (26.70)
Constant	552.75* (301.61)	712.05 (658.15)	635.89*** (233.39)	378.11 (475.04)
Observations	483	59	191	217

Standard errors in parantheses clustered at village-level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Household-level random effects used

Appendix C. MRT Valuation by Household's Source of Labor Allocated to Transplanting

(a) Family Labor Only - MRT Displaces Family Labor

(b) Family & Hired Labor - MRT Displaces Family & Hired Labor

(c) Hired Labor Only - MRT Displaces Hired Labor

Appendix D. Cash Saving When Women Work as Family and Hired Labor

(a) MRT Displaces Female Family Labor Working as Hired Laborers

(b) MRT Displaces Female Family Not Working as Hired Laborers

APPENDIX E

Mechanical Rice Transplanting Individual Elicitation: PROTOCOL **“Mechanized Rice Transplanters and Female Labor in Bihar, India: How do Intrahousehold Valuation and Bargaining Shape Technology Adoption?”**

This document describes the structure and content of the individual elicitation and preference heterogeneity game we will use to elicit female’s and male’s individual valuation of MRT. We will involve females and males from the same household in this valuation exercise. These valuation exercises will be conducted after the project team has established their first contact with the sample households for conducting the baseline and individual survey.

Note to enumerators: Respect the respondent’s answers and do not promote the technology at any point. Our goal is to get data, not to promote the technology.

PHASE 1: Information session

- Soon after conducting baseline and individual female and male co-head surveys, the enumerator teams will visit the sample households again. One female and male enumerator will visit each sample household to interview female co-head (FCH) and male co-head (MCH) separately but simultaneously. The female and male enumerator will seek the **permission of the female co-head and male co-head to participate** in this phase of the study.
- After the female and male in the household have agreed to participate, each enumerator will conduct a **short survey** on the FCH’s and MCH’s prior knowledge of MRT and their involvement in transplanting activities as well as involvement in hired labor work.
- After the short survey, the enumerators will show a **video** of mechanical rice transplanting to the woman and man separately. The video will provide farmers with as much relevant information about MRT as we can without staging it as a promotion or advertisement for MRT. The video will also show a short **video clip of the service provider** for that village. These service providers live in a neighboring village, so the farmers may know these service providers. The content of the video will be such that farmers have some appreciation for important dimensions of heterogeneity of returns to MRT (e.g., based on labor availability, use of family and hired labor, and land area). Right after showing the video, the enumerators will read answers to few **frequently asked questions** on MRT service provision. This will ensure that all farmers are exposed to more or less homogeneous information about MRT service provision. The enumerator will be very clear upfront that we are a research team and NOT a sales team.

PHASE 2: MRT individual valuation

- “Before we begin, we just want to let you know that we are a research and not a sales team. Through this exercise, we just want to find out how you value this technology.”
- “As you just saw in this video, MRT may be more valuable for some farmers and less valuable for others. Differences in valuation of MRT may also exist between you and other members of your household depending on how involved each of you are in transplanting, availability and cost of hired labor in transplanting, and how your agricultural land is. For example, if you are directly involved in transplanting activities, you may really like or dislike this machine. If

you are not directly involved in any agricultural activities, but your household is involved in agricultural activities, you may think about the relevance of this machine for your household. We are interested in knowing **how you, and only you, value this machine for your household**, which may be different from other members of your household because everyone thinks differently. We only want you to focus on only your own likes and dislikes and how desirable you find different aspects of transplanting for your household's farming. It is possible that you may like one aspect of manual transplanting and another aspect of machine transplanting."

- "Before we begin the actual exercise for mechanical rice transplanting, we will use an example to demonstrate the game to you."

Enumerator now places the example box attribute sheet in front of the respondent and shows the 2 boxes to the respondent.

"Here, we have two boxes in front of you. You can keep same kinds of things in both these boxes. But, these two boxes are different. This box is red and the other is blue. For now, we want you to focus on only the color. We want you to think of only your likes and dislikes and tell us which color you prefer for this box."

Let the respondent make their selection for color.

"So, as you said, you like this _____ color for the box. Now, tell us how much more do you like the color of this box as compared to the other color? Do you like this color somewhat more, more, or a lot more as compared to the other color? We want you to think of only your likes and dislikes and tell us how much more do you like the color as compared to the other box."

Let the respondent state how much more they like the color of the box. Next, give them the 10 tokens.

"Now we want you to tell us how much you like the color of the box as compared to the other color using these 10 tokens. You just told us you like this color _____ (state somewhat more, more, a lot more) as compared to the other color. Now, if you had to put these tokens on both of these colors to show how much you like this color as compared to the other color, how many would you put on each color? For example, if you like the two colors almost the same, you may want to put 6 on this one and 4 on the other. If you like this color a lot more, then you may also put 10 on this color and nothing on the other one. So, using these tokens, tell us how much more you like this color as compared to the other one."

Enumerator works with the respondent to put tokens and makes sure that they only put tokens for how much they like the color of the box.

Enumerator: Now show them a round and a square box.

"Now we have these two boxes for you. The earlier box differed only on color. These two have different colors and a different shape. So, we will discuss about the two attributes now."

"Please focus only on the color and let us know which color of the box do you like?"

"Now, just as before, let us know how much more do you like the color of the box as compared to the other one?"

"Great, now just as before, let us know by putting tokens how much more do you like the color of the box as compared to the other one?"

"Now, we will focus on another aspect of the box. This box is round in shape. And this box is square-shaped. Just think of the shape of the box and tell us if you like a round box or a square-shaped box. It is possible that you like the color of one box and shape of another box.

So, we just want you to think of your likes and dislikes and think about only the shape of the box and let us know which shape of the box you like.”

Enumerator now works with the respondent to ask about which shape they like, how much, and how much more using tokens.

“So, for this example, we talked about two attributes of the box: shape and color. It is possible that you may like the shape of one and color of the other. We just want you to think of your likes and dislikes and let us know about which attribute you prefer. Imagine if you were thinking of buying this box. Would you give most importance to color or shape of this box or both when thinking of which one to buy?”

- “In the same way now, we will think about the comparison between traditional transplanting and mechanical rice transplanting. Both traditional and mechanical rice transplanting have different attributes. We want you to think of only your likes and dislikes for each of these aspects and let us know which method of transplanting you prefer for each attribute. Please focus on what you desire and not what you may have to do out of need. We will compare the different attributes of traditional transplanting and mechanical rice transplanting just as we compared the shape and color of the two boxes.”

Enumerator now places the attribute sheet in front of the respondent.

1. “Use of female family labor (point to the female family labor card): One attribute of transplanting is the use of female family labor.
 - If you traditionally transplant, your household may use female family labor to directly transplant, to supervise transplanting activities, help in nursery, and to prepare food for hired workers. You may be directly involved in transplanting, indirectly involved, or not involved at all.
 - If you transplant using a machine, you may just be using female family labor for supervision.”

“Now, think of only female family labor and let us know whether you like machine or manual transplanting when it comes to the use of female family labor. Remember, we only want you to answer according to your desires and your likes and dislikes.”

“Okay, you said you like _____ transplanting as compared to _____. Now, we want to know how much more do you like _____ transplanting as compared to _____ for the use of female family labor. Please only think of the use of female family labor for now. Do you like this method a little more, more, or a lot more?”

“Now, using tokens, let us know how much more you like _____ as compared to _____ for using female family labor. Are you sure of this allocation?”

Enumerator: Confirm the allocation of tokens with the respondent.

2. “Use of male family labor (point to the male family labor card): Another attribute of transplanting is the use of male family labor.
 - If you traditionally transplant, your household may use male family labor to directly transplant, to supervise transplanting activities, and to work in nursery cultivation.

You may be directly involved in transplanting, indirectly involved, or not involved at all.

- If you transplant using a machine, you may just be using male family labor for supervision and for assisting a little in nursery.”

“Now, think of only male family labor, and let us know whether you like machine or manual transplanting when it comes to the use of male family labor. Remember, we only want you to answer according to your desires and your likes and dislikes.”

“Okay, you said you like _____ transplanting as compared to _____. Now, we want to know how much more do you like _____ transplanting as compared to _____ for the use of male family labor. Please only think of the use of male family labor for now. Do you like this method almost the same, more, or a lot more?”

“Now, using tokens, let us know how much more you like _____ as compared to _____ for using male family labor. Are you sure of this allocation?”

Enumerator: Confirm the allocation of tokens with the respondent.

3. “Use of hired laborers (point to the hired laborer card): Another attribute of transplanting is the use of hired laborers.

- If you traditionally transplant, your household may use hired workers for directly transplanting or cultivating nursery. Your household may be using both female and male hired workers. This aspect may depend on how big your cultivated land is and the ease of labor availability in your area.
- If you transplant using a machine, you do not need hired laborers for transplanting activities.”

“Now, think of only hired workers, and let us know whether you like machine or manual transplanting when it comes to the use of hired workers. Remember, we only want you to answer according to your desires and your likes and dislikes.”

“Okay, you said you like _____ transplanting as compared to _____. Now, we want to know how much more do you like _____ transplanting as compared to _____ for the use of hired workers. Please only think of the use of hired workers for now. Do you like this method almost the same, more, or a lot more?”

“Now, using tokens, let us know how much more you like _____ as compared to _____ for using hired workers. Are you sure of this allocation?”

Enumerator: Confirm the allocation of tokens with the respondent.

4. “Nursery cultivation for transplanting (point to the nursery cultivation card):

- If you traditionally transplant, it takes about 28-30 days. You generally sow the seed after preparing the seed-bed and then water it, add chemicals and fertilizer as needed, and then after 28-30 days, you uproot that nursery and transplant it. You cover all the costs associated with doing your nursery.

- As you saw in the video, nursery for machine transplanting is done differently. It only takes 14-20 days, but you have to do it on a raised seedbed using a polythene mat. For this rice season, the service provider will do the nursery for you and you would need to pay the costs of doing nursery. So, you are giving the responsibility of doing nursery to him.”

“So, these are two different ways of doing nursery. You may like one more than the other. Now, think of only these two methods of doing nursery and let us know whether you like machine or manual transplanting when it comes to the method of doing nursery. Remember, we only want you to answer according to your desires and your likes and dislikes.”

“Okay, you said you like _____ transplanting as compared to _____. Now, we want to know how much more do you like _____ transplanting as compared to _____ for the method of nursery cultivation. Please only think of the method of nursery cultivation for now. Do you like this method almost the same, more, or a lot more?”

“Now, using tokens, let us know how much more you like _____ as compared to _____ for the method of nursery cultivation. Are you sure of this allocation?”

Enumerator: Confirm the allocation of tokens with the respondent.

5. “Delay in transplanting (point to the delay in transplanting card):
 - If you traditionally transplant, delay in your transplanting activities can happen if you do not get workers in time or you cannot get enough workers, which makes your transplanting delayed.
 - If you transplant using a machine, delay in your transplanting activities can happen if the service provider is not able to come to your farm when you want him to because he could be transplanting other people’s farms. This is just like a delay that may be caused when you custom-hire other machinery.”

“So, these are two different ways why your transplanting could be delayed. You may like one more than the other. Now, think of only these two ways of why your transplanting could get delayed and let us know whether you like machine or manual transplanting when it comes to delay in transplanting activities. Remember, we only want you to answer according to your desires and your likes and dislikes.”

“Okay, you said you like _____ transplanting as compared to _____. Now, we want to know how much more do you like _____ transplanting as compared to _____ for the delay in transplanting activities. Please only think of the delay in transplanting activities for now. Do you like this method almost the same, more, or a lot more?”

“Now, using tokens, let us know how much more you like _____ as compared to _____ for the delay in transplanting activities. Are you sure of this allocation?”

6. “Speed of transplanting activities (point to the speed of transplanting card):
 - If you traditionally transplant, your speed of transplanting depends on number of laborers working and how big your land is. For example, for transplanting 1 acre,

you may require around 10-12 people for one day. If, instead, you have only 2 people working, then number of days in transplanting will increase.

- If you transplant using a machine, the time taken will also depend on how big your land is. One transplanter can cover approximately 3-4 acres per day. So, for transplanting 1 acre, it will take less than a day.”

“So, these are two different speeds of transplanting. You may like one more than the other. Now, think of only these two speeds of transplanting and let us know whether you like machine or manual transplanting when it comes to the speed of transplanting. Remember, we only want you to answer according to your desires and your likes and dislikes.”

“Okay, you said you like _____ transplanting as compared to _____. Now, we want to know how much more do you like _____ transplanting as compared to _____ for the speed of transplanting. Please only think of the speed of transplanting activities for now. Do you like this method almost the same, more, or a lot more?”

“Now, using tokens, let us know how much more you like _____ as compared to _____ for the speed of transplanting. Are you sure of this allocation?”

Enumerator: Confirm the allocation of tokens with the respondent.

- Next, place the six picture attribute cards in front of the respondent.
“Thank you for letting us know about how desirable you find various aspects of transplanting. You saw the MRT video and we have also discussed about various aspects of transplanting with you. Now, we just want you to think of your likes and dislikes and what you have understood about the various dimensions of this technology. So, just think about if you alone are in-charge of making the decision of transplanting, then what attribute would you give most importance to? Pick one picture card that you would give most importance to while making your transplanting decision.”

Enumerator: Help the respondent pick one card and help them understand the question. After they have picked the card, place it aside.

“Now, pick up the next picture card that you would give most importance to while making your transplanting decision after this picture card_____.”

Enumerator: Continue asking this question till they cannot decide anymore.

“Now are there any cards (in the remaining cards) that you would not give any importance to while making your decision about transplanting? Again, just think of your likes and dislikes and think about what you would do if you were made in-charge of transplanting.”

- “Thank you for working with us in this exercise.”

- “Now that you have had a chance to think about the differences between manual and machine transplanting, we want to know how much is MRT worth to you in money terms. Before doing this exercise, we want you to remember 3 things:
 - We want you to think of yourself as in-charge of your household’s decisions for transplanting. We want you to make your decision just as your heart desires, after considering your own unique likes and dislikes. Ultimately, we want you to be happy and satisfied with whatever decision you take.
 - Also remember that your household is the same and has the same level of resource and money access for agriculture as now. So, you could be spending whatever money you have now for transplanting or could be spending less or more as agricultural expenditures vary from time to time. *If the spouse does not make the transplanting decision right now, constantly remind them that the household is the same and has the same level of resource access for agriculture;; we just want to know if they were in-charge and could do what their heart desired, what would they do.*
 - Treat this as giving your word to something, where you cannot go back to whatever you commit to. So, please speak the truth about what you really think.”

“Before we begin asking you about how much is machine transplanting worth to you, we want to inform you that when you manually transplant, costs may vary according to land size. For example, it may cost Rs. _____ if your land is under 1 acre, Rs. _____ if your land is between 1 acre and 5 acres, and Rs. _____ if your land is greater than 5 acres. These costs are just for your general knowledge. We are interested to know how much you value MRT at different prices, if you were in-charge of transplanting decision for your household and were following your heart’s desires.”

Enumerator: Ask the question in the following format - “For this plot, would you be willing to pay Rs. 1600 per acre for machine transplanting on this plot?” *Ask the highest price first and then go down the valuation chart for each plot. Continuously remind them to think of only their likes and dislikes and make the decision as if they are in-charge.*

Whenever they stop, confirm if that price is their final price. “Are you certain that you would be willing to pay Rs. _____ for machine transplanting on this plot and nothing more?”
Do not force any answers. Respect their answers and do not promote the technology at any point. Our goal is to get data, not to promote the technology.

Own valuation of MRT (Rs/acre)															
	Plot (‘name’)	Size (ac)	600	700	800	900	950	1000	1050	1100	1200	1300	1400	1500	1600
A			✓	✓	✓	✓	✓	✓							
B.			✓	✓	✓										
C.			✓	✓											

- *At the end of this elicitation, ask them if they would be able to change their spouse's decision about using MRT if it differed from theirs and if they will discuss about this technique after we leave.*
- Hand them the price card and tell them that right now they told us how valuable MRT is to them. "In May, we will be back and then your household will actually make a decision about whether you want MRT. Till then, we want you to think carefully about these attributes and the different prices at which MRT could be offered in your village and whether you want MRT for your household."

PHASE 3: Individual preferences for household expenditures

- "Thank you for letting us know about how much you value MRT services. Now, we will play a different game with you where you will be asked to allocate money to different items. Remember, this game is also hypothetical and we will be giving you fake currency bills to play this game."
- "Again, just as the MRT exercise, we want you to remember two things:
 - o We want you to think of yourself as in-charge of your household's decisions for spending all this money and no one else in your household is responsible for making this decision. We want you to make your spending decision just as your heart desires.
 - o You have your own unique likes and dislikes. Your spouse (or the _____ co-head) may have his or her own likes and dislikes. We only want you to consider your likes and dislikes and let us know how you would allocate this money on different items if you were in-charge. Ultimately, we want you to be happy and satisfied with your allocation."

Enumerator will now hand fake bills of Rs. 100 each and Rs. 50 equaling Rs. 3000. They will place a chart containing pictures of different household items that rural Indian families usually spend on: food, schooling, housing improvement, clothing, own savings, agriculture such as buying seed and fertilizer, tractor and other machines, children's marriage, jewelry, cigarette, kitchen appliance, festival, and emergency fund for family such as sickness.

- "If you received Rs. 3000 in addition to your current income every month, how would you spend it, if you were in-charge and you could spend it according to your heart's desires? Please allocate Rs. 3000 to the items that you prefer to do so from these 13 items.

Give the respondent a few minutes to look at the item chart and think about their allocation decision. After a few minutes, ask them to place the fake bills on different items. After they are done with placing the bills, make sure they have allocated the entire Rs. 3000 to various items. Emphasize that you want them to think as if they are in-charge of allocating this Rs. 3000 to these items. They should make an allocation that ultimately makes them happy and satisfied.

- Now, pick up money allocated to each item and confirm with the respondent, "Are you sure you want to allocate Rs. X to this item? Remember, you are free to allocate any amount to any item. We just want you to be happy with your allocation."

Record the money allocated to each item.

<i>Own allocation</i>		
	<i>Item</i>	<i>Allocation (Rs.)</i>
1.	Food	
2.	Schooling	
3.	Clothing	
4.	Housing improvement	
5.	Own savings	
6.	Agriculture such as buying seed and fertilizer	
7.	Tractor and other machinery	
8.	Children's marriage	
9.	Jewelry	
10.	Cigarette/Bidi	
11.	Kitchen appliance	
12.	Festival	
13.	Emergency fund for family such as sickness	

PHASE 4: Individual preferences for labor allocation

- "Thank you for answering these money allocation questions. Now, we will have a very similar exercise related to how you would want to spend your time."
- "Again, we want you to remember that we want you to make your decision just as your heart desires. Ultimately, we want you to be happy and satisfied with whatever decision you take. Treat this as giving your word to something, where you cannot go back to whatever you commit to. So, please speak the truth about what you really think."
- FCH: "Imagine that your household bought a washing machine, which saves you time. Now, in a month, all of a sudden, you have 2 extra days of time that you used to earlier spend in washing clothes. We want you to think of 1 day as 8 hours, which means you got 16 hours extra in a month because of purchasing a washing machine. How would you choose to spend this time?"

MCH: "Imagine that you decide to use combine harvester this year for harvesting instead of using workers. Now, in a month, all of a sudden, you have 2 extra days of time that you used to spend in harvesting activities. We want you to think of 1 day as 8 hours, which means you got 16 hours extra in a month because of using a combine harvester. How would you choose to spend this time?"

Enumerator: Give the respondent 16 tokens representing an hour.

<i>Own allocation</i>		
	<i>Item</i>	<i>Allocation (Hours)</i>
1.	Housework such as cooking, cleaning etc.	
2.	Taking care of children	
3.	Taking care of elderly or sick people in household	
4.	Work on farm	
5.	Work on other people's farm	
6.	Work elsewhere for a wage/business	
7.	Sleep and relax	

8.	Social activities such as hanging out with friends	
9.	Going out such as to the market	

- *After wrapping up this allocation exercise, thank the respondent for their participation.*
 “Thank you very much for participating in these exercises. We really appreciate your time and participation in our research study. Remember, we will be back in your village in May at which time your household will have an opportunity of actually getting MRT custom hire services. We are leaving this price card and this MRT brochure with you. Please think about this technology and discuss it with your spouse and others, if you like. When we are back in your village, you will once again have a chance to let us know if you are interested in getting this technology, which is when you will be actually making the decision about wanting MRT services from the service provider shown in the video. We thank you for your time.”

Mechanical Rice Transplanting Experimental Auction: PROTOCOL
“Mechanized Rice Transplanters and Female Labor in Bihar, India: How do Intrahousehold Valuation and Bargaining Shape Technology Adoption?”

This document describes the structure and content of the experimental auction we will use to elicit farmer household’s valuation of MRT and to randomize the delivery of MRT services to interested farmers. We will involve all of our surveyed farmers in these auctions. For many farmers, the baseline survey will provide the first contact with the project team. We will train enumerators to use this baseline survey as a chance to build rapport with the farmers and to officially invite them to participate in the research project.

PHASE 1: Information session and individual valuation of MRT

Soon after conducting baseline and individual female and male co-head surveys, the enumerator team will visit the sample households. One female and male enumerator will visit each sample household to interview female co-head and male co-head separately but simultaneously. During these individual interview sessions, the female co-head and male co-head will be shown an information video introducing them to mechanical rice transplanting. Each member will be asked to elicit his or her individual preferences regarding the adoption of mechanical rice transplanting (see individual valuation protocol). After this round of individual elicitations and in the month prior to when farmers actually begin transplanting activities, the household head of each household will be asked to participate in a village-level auction/activity through which they will have a chance to avail mechanical rice transplanting services on their farm plots.

PHASE 2: Village-level auction session (a few weeks after individual valuation exercise)

Welcome and Introduction: “Thank you for participating in this auction. As a token of our appreciation, we have given each of you Rs. 100 as you arrived today. This money is yours to keep. During this auction, you will work with a helper (enumerator). At any point, if you have questions, feel free to ask your helper.”

“A few days ago we discussed mechanical rice transplanting with you. In today’s session, we will give you an opportunity to custom hire MRT services for your own land. We hope you have had a chance in the past few weeks to think more about how valuable you think MRT would be on your own land. Before we continue, do you have any questions about MRT now that you have had time to think about the technology and, perhaps, discuss it with your spouse and others?”

“We will use a simple market exercise to give you a chance to hire MRT services for your own plots. Because you may actually purchase these services, it is important for you to understand how the market exercise will work. The market exercise is not a competitive auction. This means that ***you will never be competing against the other farmers in the market exercise.*** This makes your job easy: ***All you have to do is determine how much you think MRT services are worth to you*** – without regard to how much the same MRT services may be worth to other farmers.”

“Before we continue we would like to emphasize two points:

1. Each of you is different and has unique plots and transplanting labor needs. These differences may mean that, at a given price, you choose to purchase MRT services for your plots while another farmer may not. This is perfectly normal. ***Because we want to know what you think, we will keep conversations with your helper as private as possible.***

2. Your participation in this auction and the survey is part of a research project. As such, ***we are here as a research team, not a sales team.*** We are not here to promote MRT. We simply want to understand how beneficial you think MRT would be to you as a farming household. We provided you with accurate and complete information about MRT when we came to your house to discuss MRT with you.
3. The difference between when we met you last and today is just that today you will actually decide if you want to get machine transplanting on your farm plots. Last time, you and your spouse just expressed how valuable the machine is to you, but you did not actually get a chance to try the machine. The market exercise will help you decide today if you want machine rice transplanting.”

Practice auction: “Since these market exercises will eventually involve real money and real MRT services, we want to be certain that you understand the market process. To help you, we will conduct a practice candy auction to demonstrate how the auction will work.”

“We have candy X available for purchase. <Describe candy in detail.> Does anyone have any questions about this candy?”

“To demonstrate how the market exercise works, we will practice the exercise first. After the practice, we will proceed to a real market in which you can actually purchase the candy if you would like.”

“We would like to know if you would be willing to purchase candy X at different prices. Your helper will ask you this question for several different prices. Please talk with your helper privately. Each helper will take you to a private place in this area to ensure that your conversations remain private.”

Each worker will work separately and quietly with each farmer to complete the first pricing card. Start by asking, “If candy X cost 2 Rs, would you want to purchase it?” Put a checkmark in the box under 2 if he says “Yes”. Continue asking for 4 Rs, 6 Rs, etc. until he says “No”. At this point, say, “It sounds like you are not willing to pay more than [highest price with a checkmark] for candy X. Is this right?” Once he is satisfied, turn to the next farmer and conduct the same procedure.

NOTE: The farmer need not see or have his/her attention focused on the pricing card. As much as possible, this process should be oral. Showing the pricing card will confuse or intimidate some farmers.

Candy X, Practice	1	Price of each candy (Rs):	2	4	6	8	10
	2	Purchase Candy X?	✓	✓	✓		
	3	Price card drawn (circle)	2	4	6	8	10
	4	Total purchase price					

“Now that you’ve completed your purchase decision (row 2), we’ll describe how we will determine the price of the candy. We asked you whether you were willing to buy candy X at 5 different prices. We have prepared 5 cards with each of these prices.”

Show each card separately and announce the price as you hold up the card for everyone to see.

“To determine what the price will be, we will mix up these cards and ask one of you to choose one. The price card that is drawn will be the price. Let’s try drawing a price to complete this practice market.”

Have one of the farmers draw a price card. Hold up and announce the drawn card. Explain that if they said they would like to buy candy X at this price, this is the price they would pay. Each helper will circle the corresponding price on the pricing cards of the farmers they are helping.

EMPHASIZE that in this market exercise they must consider their decision at each price carefully because they do not know which price could be the real price in the exercise. As long as they make their decision at each price carefully, they will be happy no matter what price is drawn. That is, if the price is higher than their checkmarks, they will be happy that they didn’t get the candy because the price is too high. If the price is below their highest checkmark, they will be happy that they are able to purchase the candy at such a price.

Tell the participants to ask their helpers if they have any questions.

“Let’s start over with one more practice market exercise for candy. This market will be like the first, except we will also offer a second candy, candy Y, for purchase. <Describe candy Y.> Just like the first time, we will ask you about 5 potential prices. For each of these prices, your job is to decide whether you would like to buy candy X or candy Y or both. Just like before, remember: **it is important that you would be happy with any of your decisions because you don’t know what the price will be.**”

Each enumerator will work privately with his farmer to complete the next pricing card. We will always talk through the prices and purchasing decisions by column. This means that the conversation will start with something like this: **“If the price was 2 Rs, would you choose to purchase candy X or candy Y or both?”** Continue asking this question for each price and checking the appropriate boxes. Remind the farmer as needed that any of the prices could be drawn, so they need to make sure they would be happy with their purchase decision no matter what price is drawn.

Candy X / Y, Practice	1	Price of each candy (Rs):	2	4	6	8	10
	2i	Purchase Candy X?	✓	✓	✓	✓	✓
	2ii	Purchase Candy Y?	✓	✓			
	3	Price card drawn (circle)	2	4	6	8	10
	4	Total purchase price					

“Now that you’ve made your decisions, we will draw a price card.”

Hold up the card and announce the price. Explain that if they had decided to buy one of the two candies at that price, they would pay that price and get the candy. If they had

decided to buy both candies at that price, they would pay that price for each candy – meaning, they would pay a total of 2X the price and get both candies.

“If you have any final questions before we proceed with the real candy market, feel free to ask your helper.”

Give them time to ask questions and discuss with their enumerator.

“Now, we’ll conduct the real candy market. We will use the same 5 prices as before, but this time we drew the price card before and put it in this envelope. After you make all your purchase decisions, we will show you the card that is in this envelope. Just like before, you have to decide whether to purchase the candies at each price without knowing what the price will be. This means you must consider each price carefully so you happy with your decision no matter what price is in this envelope.”

“This is the real candy market. This means that those who wanted to purchase the candy at the price in this envelope will actually pay money to buy the candy. Your helper will now ask you for your final purchase decisions.”

Enumerators work privately with their farmers to complete the next pricing card, keeping their conversations as quiet and confidential as possible.

Candy X / Y, REAL	1	Price of each candy (Rs):	2	4	6	8	10
	2i	Purchase Candy X?	✓	✓	✓	✓	✓
	2ii	Purchase Candy Y?	✓	✓			
	3	Price card drawn (circle)	2	4	6	8	10
	4	Total purchase price					

“Now, let’s see what price card is in this envelope.”

Have a farmer pull out the card, hold it up and announce the price. Conduct transactions as necessary.

“Any questions about how this market exercise works?”

MRT services auction:

“Now that you understand how the market works and are familiar with MRT, we are ready to proceed to the market exercise for actual MRT services on your land. This market for MRT services will be similar to the candy auction. ***Just like before, your job is to decide which plots of your land, if any, you would like to have machine transplanted at different MRT prices. Just like before, the outcome of the real auction will be real: you will actually pay money to receive real MRT services on your land.***”

“While the MRT market exercise is very similar to the candy market, there is one important difference: You will neither receive nor pay for the MRT services today. Instead, for any MRT services you purchase today, we will schedule a convenient time in the near future to machine transplant your land. In your village, we plan to schedule MRT services during the week of _____. You will pay for the services at this time. A member of our research team will be

your contact and coordinator for these services. *<Introduce the monitor and MRT service provider for the village.* If you purchase MRT services in today's market, you will work with him so you can coordinate when exactly you would have the machine transplant on your farm and which crop variety you want to transplant because the service provider will be planting your nursery. You will bear the costs of nursery yourself. In today's market exercise, we will only be discussing actual transplanting and not discussing about nursery. Are there any questions about how we will arrange to schedule the transplanting of your land if you purchase the services today?"

"In the candy market, we asked you whether you would like to buy two different kinds of candy. In the MRT market, we will ask you whether you would like to purchase MRT services on different plots. Just like each type of candy is different, each plot is unique and has unique labor transplanting needs. In order to ask you about MRT for each of your plots, we will first record some information about each plot. Please work with your helper to confirm the size of your plots."

Enumerators will work with each farmer separately to confirm information about their plots.

"Just like in the candy market, your task is simply to decide whether or not you would like to machine transplant each of your plots at different prices. In the MRT market, we will ask you about each of the 10 different prices that were listed on the YELLOW price strip we gave you during the individual valuation session. ***In recent years, across different states in India from different MRT service providers, the price of custom hire MRT has ranged between about 800 and 1500 Rs/hour. But remember, past prices are not always a good way of predicting future prices. We have included prices on the YELLOW strip in this price range given to you at the earlier information session. Since most of the custom hire MRT prices we will ask you about have actually been paid by farmers somewhere in India, it is important that you consider each price as if it could be a real price.***

"Like the candy market, we will draw a price card to determine which price will count. ***Since you will not know which price will count, it is important to think carefully about each decision. Above all else, we want you to be happy with your decisions no matter which price card is drawn.***

"Your helper will now ask you whether you would like to purchase MRT services for each of your plots at each price level. Please remember to keep your conversations private."

Enumerators will work with their farmers to complete the first MRT pricing card. They should work down each price column, asking, "Would you like to custom hire MRT for plot A (name) at a price of Rs 500 per hour?" Check the corresponding box if the answer is "Yes". Proceed to the next plot, "For this 500 Rs/hour price, would you like to custom hire MRT for plot B (name)? For plot C (name)?" Then move to the next column, "For a price of 500 Rs/hour, would you like to custom hire MRT for plot A? plot B plot C?" Enumerators should ask each of their farmers to decide for each price and check the box accordingly. They should not skip around.

Price of MRT (Rs/acre)															
	Plot (name)	Size	60 0	70 0	80 0	90 0	95 0	100 0	105 0	110 0	120 0	130 0	140 0	150 0	160 0

		(ac)													
A			✓	✓	✓	✓	✓	✓							
B			✓	✓	✓										
C.			✓	✓											
Price card (circle)															
Total estimated price: Add (acres)X(price) for each checked plot															

“Now that you have completed your MRT custom hire decisions, we are ready to determine the price. We have one card for each price here. We will not be actually drawing a price card from these price cards. This is just for demonstration purposes.”

Show each card and read the price, then put them in a pile and shuffle them up. To emphasize the potential range of prices, say, “Suppose we drew this 1100 Rs/acre card.” Hold up the card. “For 10 acres of land, this would cost you Rs. 11000.” Move to a low card and say, “If instead we drew this 500 Rs/acre card, it would cost you Rs. 5000. For 10 acres of land, it could have cost you more than Rs. 11000 or less than Rs. 5000. So, it is very important that you take each of the prices very seriously.”

“Before this session began we drew one of these price cards and – just like the candy auction – put it in this envelope. Let’s pull this price card out to conclude this practice MRT market.”

Have a farmer draw a price card. Announce the drawn price and have the enumerators discuss the outcome. The enumerators should discuss an estimated total cost based on the drawn price and the farmer’s estimated plot acreage.

“In a moment, we will repeat this MRT market exercise for real. In that exercise, you may actually custom hire MRT on your land. If you do, you will pay the drawn price per acre of MRT service on each plot you want machine transplanted. **Based on your estimate of time required for MRT for each plot, you will know approximately how much the service will cost. When our provider actually transplants your plots, you will pay him then. We are committed to providing high quality of transplanting service and your coordinator () will accompany the provider to ensure excellent service.**”

“Are there any questions about how this MRT custom hire service will be arranged or provided or how the actual cost will be determined?”

“Let’s proceed with the real MRT market exercise. You’ve had a few weeks to think about MRT and how valuable you think it would be on the plots you cultivate. Based on everything you’ve learned about MRT and know about your plots, you will now finalize your decisions for each price.”

Enumerators will work with their farmers as above. Enumerators can copy over the plot details and then begin asking the questions as above.

Price of MRT (Rs/acre)															
	Plot (‘name’)	Size (ac)	60 0	70 0	80 0	90 0	95 0	100 0	105 0	110 0	120 0	130 0	140 0	150 0	160 0
A			✓	✓	✓	✓	✓	✓							
B			✓	✓	✓										
C			✓	✓											
Price card (circle)															
Total estimated price: Add (acres)X(price) for each checked plot															

“Now that you’ve made your final decisions we will determine the price. Again, we have pre-drawn a price card and put it in this envelope. Before showing you the price, it is important for you to understand one last thing. We are now distributing coupons randomly to you all. These coupons are for Rs. 0, Rs., 100, and Rs. 200. If the price drawn is at or greater than your willingness to pay and the amount of the coupon you receive, you will be allowed to enter a simple random lottery. For the candy market, we had enough candy on hand that anyone who wanted to could buy the candy. For the MRT market, we do not have enough MRT capacity to serve everyone who wants to custom hire MRT services. In order to be fair, we will use a simple random lottery to determine whose plots we will machine transplant. The lottery will consist of a few simple steps:

1. Each of you who would like to custom hire MRT at the drawn price on at least one of your plots will receive a red or white token. *<Show one of each token.>*
2. Next, we will put one red token and one white token in this bag. *<Demonstrate.>*

3. Finally, we will have one of you pick a token out of the bag. *<Demonstrate.>* If the red token is drawn, then all farmers holding red tokens will receive MRT custom hire at the drawn price. Those holding white tokens will not receive MRT custom hire at this time. If the white token is drawn, only farmers with white tokens will receive MRT. Of course, only those whose land is actually machine transplanted will pay for the per acre charge for MRT custom hire.”

“This simple lottery is the fairest way to determine whose land we machine transplant as part of this project. It shouldn’t change your decisions in any way. It will just help us allocate our limited MRT capacity as fairly as possible. Any questions?”

“Now, let’s pull out the price card. *<Pull out the card and announce the price.>*

Your helper now has a few questions for you while we prepare to conduct the lottery to determine who will custom hire MRT on their plots.”

At this point, the coordinator collects the pricing cards from the “winners” first, and then the “losers.” The “winners” pricing cards are stacked in order of the highest bid for MRT custom hire for any plot, based on what is marked on the real MRT market table. The coordinator then distributes the stack into two equal piles of 9 pricing cards each. This is done by alternating the placement of the pricing cards across the piles, i.e., placing the first pricing card of the stack into pile 1, the second pricing card into pile 2, the third pricing card into pile 1, the fourth pricing card into pile 2, and so on until all pricing cards are distributed. Pile 1 will then be assigned either to the red or white token, and pile 2 will be assigned to the other token.

“Winners” are now given either a red or white token based on which pile their card is assigned to. Conduct the lottery as described above.

Avoid making this into a big public spectacle out of consideration for the ‘losers’.

Enumerators should talk to the lottery “winners” and the MRT monitor to determine feasible dates for scheduling of MRT services and the rice variety they want. All should be cognizant of the village’s estimated date for completion of the wheat harvest, as MRT services can only be provided once harvest is complete.

“We thank you for your time and interest. We plan to contact you in the coming months to learn more about your crop production during this *kharif* rice season.”

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