Farmer's preferences for abiotic stress tolerant rice seeds in India: Evidence from Odisha

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Summary

Rice is the main staple crop in India and is grown under extremely diverse environments. Abiotic stresses such as droughts and floods significantly constrain rice production in India. The frequency of these stresses is likely to increase with climate change. Extreme drought and floods may lead to huge income and consumption losses for the rice growing farmers, which could increase incidences of poverty. Improved rice seed varieties that are better able to tolerate drought and floods could be effective in reducing yield loss and income loss for farmers and could ensure food security in India. Many scientists in public and private sector institutes in India and globally are engaged in rice biotechnology research and are attempting to develop drought tolerant (DT) and submergence tolerant (ST) rice seeds that have potential to increase rice production and reduce its variability. Moettlab (2012) demonstrates that successful development and delivery of DT varieties will produce significant benefits across South Asia, well in excess of the investment necessary to develop the technology. Dar et al. (2013) find that flood-tolerant rice can deliver both efficiency gains, through reduced yield variability and higher expected yields, and equity gains in disproportionately benefitting the most marginal groups of farmers.

However, once developed, adoption of these improved seeds may not be a straightforward process. Many studies find slow adoption of new agricultural technologies in developing countries. Lybbert and Bell (2010) argue that development of DT cultivars does not necessarily imply that DT varieties will be as widely adopted as Bt technology due to non-monotonic benefits. For agricultural technologies to be successful, their attributes should address farmers concerns.

This study aims to provide insights into farmers' crop variety attribute preferences and the driving socio-economic forces behind crop variety choices. We examine farmers' preferences for various characteristics of rice seeds in the state of Odisha, India. In particular, we focus on farmers' valuation for drought tolerant (DT) and submergence tolerant (ST) traits in rice seeds in India. The regions have been carefully chosen to include both flood prone as well as drought prone regions. Our study combines a discrete choice experiment and a field experiment. Primary data has been collected from these two sets of experiments from rural Odisha. To complement the experiment data, a separate survey was employed to collect data on socioeconomic characteristics.

In a choice experiment, individuals are presented with a choice set containing several alternatives in a hypothetical setting, and then asked to choose their preferred alternative. Each alternative comprises of different levels of the selected attributes. Each individual is presented with multiple choice sets. The attributes in this study include submergence tolerance, drought tolerance, duration of crop, whether seeds can be stored and reused in the next season, and price. We determine farmers' valuation for these attributes using choice experiment methodology. We then compute

their willingness to pay (WTP) for the various attributes in rice seed.

Choice experiment methodology is widely used in environmental and agricultural economics literature. A concern with the technology is that consumers make choices in a hypothetical setting without real trade-offs but the advantage is that it allows the researcher to estimate marginal values for various attributes embodied in goods and services by providing necessary variation in their levels, which may not be present in the historical data. Statistical analysis of the responses, using discrete choice models, provides estimates of the willingness to pay.

Several studies in the literature have documented the role of farmers' risk preferences on the adoption of new farming technologies. We also attempt to elicit behavioral information viz., risk aversion and loss aversion of farmers by using a series of lottery based field experiments, and relate them to the technology choice. We designed two experiments to estimate two parameters central of prospect theory: the probability weighing parameter and the parameter describing value function curvature. A third experiment is designed to estimate the loss aversion parameter.

Finally, we explore heterogeneity in these preferences using a random parameter logit (mixed logit) model and identify the socio-economic forces behind these preferences.

Results

We find farmers in Odisha have positive and statistically significant valuation for yield variability reducing attributes. The two other attributes highly valued by farmers are short duration, and seed re-usability. We also analyze these valuations for the drought prone and the flood prone regions separately and find that the mean WTP for the productivity increasing and yield variability reducing attributes to be higher in the flood prone regions. Further while farmers in the drought prone regions do not value submergence tolerance for 10-15 days, farmers in the flood prone regions have positive and statistically significant valuation for this trait.

The mean values for the estimated behavioral parameters differed across drought prone and submergence prone regions. We find that farmers are significantly more risk averse as well as loss averse than farmers in drought prone regions.

 The WTP for various attributes exhibited considerable heterogeneity across farmers. We explore socio-economic and behavioral factors driving farmers choices. The WTP is positively related to income; higher income farmers are willing to pay more for the productivity increasing and yield variability reducing attribute. We also find that farmers belonging to backward castes, namely SC and ST have lower and statistically significant WTP for these attributes. This is due to their higher marginal utility of income. In terms of risk preferences, we find that more risk verse farmers are willing to pay less for the improved varieties. Our findings provide support to poverty trap hypothesis: even if new and improved technologies become available, not all sections of the society would adopt and benefit from them; the vulnerable and marginalized sections of the society may not benefit from them as they do not adopt them due to their lower WTP and continue to suffer from economic losses when exposed to abiotic stresses.

The results of the study would be useful for the researchers engaged in developing improved varieties, and would also inform the government/policy makers if any compensation or subsidy needs to be paid to certain targeted population to encourage adoption of the new and improved varieties.

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Variables	Mean WTP Estimates	Confidence Interval	
		Lower	Upper
FSD	402***	391.4	412.3
SSD	418***	416.8	419.1
TSD	356***	347.4	364.5
Short duration	317***	281.0	352.9
Medium duration	44.4	24.2	64.5
Grain cannot be saved and reused	-187***	-207.5	-166.4
Submergence Tolerance (5-10 days)	92.2***	86.6	97.7
Submergence Tolerance (10-15 days)	8.41	-4.08	20.9