POLICY BRIEF PREPARED FOR THE AGRICULTURAL BIOTECHNOLOGY SUPPORT PROJECT II

INDIAN FARMERS' VALUATION OF CROP YIELD DISTRIBUTIONS: IMPLICATIONS FOR BT BRINJAL

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Background

Farmers constantly deal with uncertainty. With few options for effectively managing risk, poor farmers in poor countries are particularly vulnerable to this uncertainty and are often only a bad harvest away from not meeting their basic needs. Crop losses due to severe drought or pest infestation can spell disaster for these vulnerable farmers.

Advances in agricultural biotechnology offer new options for addressing farmers' vulnerability to volatile growing conditions. Crops that tolerate drought and extreme temperatures or that resist biotic stresses such as disease, viruses, bacteria and insects will soon be available to farmers. The Agricultural Biotechnology Support Project II (ABSP II) recognizes the value of such crops and actively supports their development and delivery to farmers. Will poor farmers who could benefit most from less vulnerability choose to purchase such risk-reducing seeds? The objective of this research is to evaluate whether Indian farmers value risk-reducing seeds and to draw implications for the work of ABSP II.

Seeds that reduce farmers' vulnerability – often called 'pro-poor' seeds[1] – might seem naturally to attract poor farmers who stand to benefit most from reduced risk, but uptake may not be so natural in practice. The relative benefits conferred by these seeds are a function of the stochastic stress targeted by seed traits (e.g., weather, pests, etc.). These benefits are thus themselves stochastic. This implies that their relative advantage will not be apparent every season and that farmers may only gradually learn to value these seeds.

Additionally, the private sector will likely play a key role in the development and, particularly, the delivery of these seeds, implying that the diffusion of these seeds will hinge on farmers' valuation of the seeds on one hand and the pricing and marketing strategies chosen by the private sector on the other. Most poor farmers will purchase 'pro-poor' seeds from local agro-input dealers just like other seeds and inputs. Some farmers may even face a price premium for these seeds. In seasons when the output gains are negligible or non-existent, a price premium would render the new seeds' net returns inferior to competing unimproved varieties. Given these complexities, ABSP II must carefully understand how farmers will value risk-reducing, 'pro-poor' seeds in order to ensure the delivery of these seeds to a broad range of farmers.

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[1] My working definition of 'pro-poor' seeds consists of two parts. First, 'pro-poor' seeds must be relevant to the poor. Poor farmers must presently or potentially grow the crop. This implies low initial investment, low fixed costs of production and relatively simple (albeit possibly labor-intensive) management practices. In the case of a food crop, poor consumers should consume the crop. Second, 'pro-poor' seeds must confer some benefit relative to other seeds that addresses problems commonly faced by the poor. To date, these 'pro-poor' benefits have been of three sorts: (a) higher expected yield to address poor farmer problems such as macro-nutrient deficiency, lack of market entitlements, and chronic abiotic stresses such as soil salinity and low soil fertility, (b) lower yield risk via better yield stability (i.e., lower variance) or lower downside yield fluctuation (i.e., higher skewness) to address problems such as food security and income stability, and (c) higher micro-nutrient content to address micro-nutrient deficiency problems.

Research Methodology

To assess farmers' valuation of stabilized and truncated crop yield distributions, I use data from the Salem and Perambalur districts of Tamil Nadu state, India. Tamil Nadu state was selected because Tamil Nadu Agricultural University agreed to provide the necessary administrative and logistical support as a partner in ABSP II. Ten enumerators surveyed 290 households in three Perambalur villages and three Salem villages.

The research team collected data from selected farmers in two parts. In the first part, enumerators administered a detailed household questionnaire focused on farmers' management decisions, valuation of seed traits, risk exposure and wealth. In the second part, the team conducted experiments with farmers to elicit their valuation of hypothetical yield distributions. Farmers earned money (Rupees) according to their performance in the experiment.

The experiment consisted of a series of hypothetical farming seasons. At the beginning of each season, farmers were offered a 'seed' with a known Rupee-payoff distribution. This distribution was explained carefully and displayed graphically to facilitate farmers' understanding of the payoff distribution implied by a given 'seed.' The distribution of a particular 'seed' was represented by 10 chips in a small black bag. There were three colors of chips, each representing a 'harvest' payoff: blue (high), white (average), and red (low). The distribution was modified by changing the proportion of blue, white and red chips in the bag.

Summary of Findings

The analysis of this data suggests that farmers are generally more responsive to changes in the expected value of a yield distribution than in the higher moments of the distribution. Surprisingly, the farmers appeared to value neither lower variance nor lower downside risk even though both are presumably favorable for any risk-averse farmer.

There are some loose patterns in farmers' valuation. For example, wealthy farmers appear to value increases in expected value, but poor farmers may value a decrease in variance more than the wealthy. Likewise, farmers who consider their sources of income to be quite risky seem to value higher skewness in a payoff distribution, which implies lower downside risk, more than other farmers. But these findings are statistically weak and the results do not yield any strong conclusions about the effect of farmers' traits on their valuation of yield distribution properties.

In short, most farmers – whether rich or poor, large or small – seem to value an increase in a mean payoff of a distribution, but appear essentially indifferent about changes in payoff stability or downside risk.

Implications for ABSP II

There are several practical implications of these findings related to ABSP II's efforts to develop and deliver 'pro-poor' seeds. One such 'pro-poor' seed is *Bt* brinjal – a priority crop for ABSP II – which resists boring pests and protects farmers from catastrophic crop losses in high pest load years.

This research suggests that farmers' willingness-to-pay for the reduced downside risk associated with *Bt* brinjal may be modest or even trivial. Given this possibility, ABSP II should not rely on reduced downside risk alone to incent farmers to adopt *Bt* brinjal. ABSP II should instead ensure that the *Bt* brinjal varieties it supports are superior to comparable non-*Bt* varieties – especially in expected yield – or marketed based on traits other than reduced downside risk. For example, the success of Bollguard™ *Bt* cotton seed among farmers in India seems attributable to successful

marketing based on pesticide savings since Bollguard™ is not genetically superior to comparable non-*Bt* cotton seed.

If neither breeding nor marketing can increase farmers' valuation of *Bt* brinjal, then farmers may only purchase *Bt* brinjal seeds if the price premium relative to benchmark varieties is low or even zero. This implies that profit margins throughout the supply chain should be low.

Marketing considerations may be particularly important for ABSP II for additional reasons. Farmers – especially poor farmers – may learn about the advantages of *Bt* brinjal only gradually since benefits may be substantial during high pest seasons but negligible during low pest seasons. For ABSP II to succeed in delivering agricultural biotechnology to a broad range of farmers, ABSP II should ensure that the marketing of 'pro-poor' seeds purposely targets poor farmers who are normally slow to adopt new technologies.

The broad motivation behind this research is to understand how farmers will value 'pro-poor' seeds like *Bt* brinjal in order to inform the development and delivery of these seeds. This project specifically highlights farmers' valuation of the lower downside risk implied by *Bt* brinjal and other 'pro-poor' crops. There are other features of 'pro-poor' seeds that farmers may value. Thus, the finding that farmers do not seem to value yield stability and lower downside risk independent of expected yield does not indicate that farmers will not value these seeds at all. ABSP II should continue to support research efforts focusing on farmers' valuation of these seeds. Only with an accurate understanding of how farmers value these new seeds, will ABSP II be able effectively to orchestrate the development and delivery of agricultural biotechnology to a broad range of farmers.