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Measuring Technology Adoption in Bangladesh

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Issues in Measuring Adoption Rates

- Sometimes it may be sufficient simply to report on the proportion of farmers using the technology
- In other cases, the actual proportion of fields or crop area under the new technology will need to be estimated
- An important question for policy is who benefits from new technology. Adoption studies may be designed to document what kinds of farmers and what areas of the country have profited most from the development of a particular technology.
- Challenge of not only describing patterns of adoption but also understanding whether or not the technology and its institutional environment are adequate to the needs and resources of farmers.

Designing Survey to Assess Adoption

- Once a technology has been released, it is possible to study a random sample of farmers to analyze the degree of adoption
- The design of the questionnaire should be preceded by a good pretest that helps researchers identify key issues to be pursued in the questionnaire
- The results of a formal adoption study can be combined with other data on changes in farm production, farm incomes, or consumer gains to develop a more complete impact study
- If a new technology involves purchased inputs, for instance, surveys of input merchants may be useful for assessing the spread of the technology.

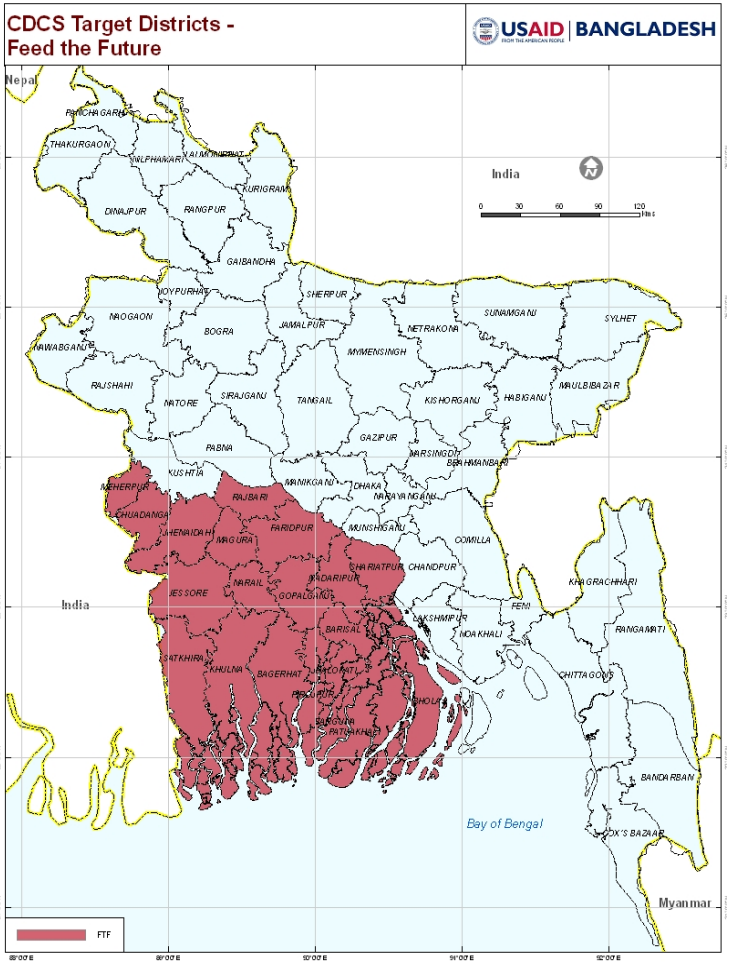
Bangladesh Survey Questionnaire

- The IFPRI-PRSSP team in Bangladesh prepared a draft questionnaire for the agricultural technology adoption survey, received comments on the draft questionnaire from USAID, and revised the questionnaire by addressing the comments.
- The questionnaire included eight modules:

1. sample household and identification
2. household composition, literacy, and education
3. roster of land owned or under operation
4. plot-level information on seeds, irrigation, and urea fertilizer usage
5. information on use of *Guti* (briquette) urea
6. information on usage of paddy varieties
7. information on use rate of paddy seed
8. access to credit

IFPRI Agricultural Technology Adoption Survey: Sampling of FTF Stratum

- The first survey is statistically representative of the FTF zone and its domain included all 120 FTF upazilas within the 20 FTF districts. The sampling process and survey administration included the following steps:
- List all villages in each of the 120 FTF upazilas from the 2011 National Population Census.
- Randomly select two villages in each upazila with probability proportional size (PPS) sampling, using the village-level population data from the 2011 National Population Census.
- Conduct complete census of each of the 240 selected villages.
- List all farm households that cultivated rice in the 12-month period prior to the survey, then randomly select 10 farm households from village census list.
- Conduct interviews of selected rice-farm households.



Timeline of Survey Activities

- **October 8, 2013:** IFPRI team leader (Chief of Party) met with USAID officials to plan the agricultural technology adoption survey in the FTF zone
- **October 10–18, 2013:** IFPRI researchers prepared a draft questionnaire for the survey, received comments from USAID, and pretested the questionnaire in the FTF zone
- **October 21–31, 2013:** IFPRI researchers and the survey firm (DATA) officials conducted the training of 120 survey enumerators and supervisors, finalized the questionnaire and printed it
- **November 1–19, 2013:** DATA conducted the survey under IFPRI supervision while simultaneously recording and cleaning the survey data. The survey team completed the survey of 3,400 farm households in only 16 working days
- **November 26, 2013:** DATA delivered the cleaned dataset to IFPRI
- **November 27, 2013:** IFPRI-PRSSP researchers started analyzing the survey data

Survey Data Analysis Plan: Example for UDP Technology

- Rates of adoption of urea deep placement (UDP) technology by farm size groups
- Percentage of farm area under UDP application
- Annual frequency of adoption, by percentage of farmers who used UDP in at least one out of four years (beginning in 2010)
- Source of UDP used
- Amount of UDP versus prilled urea applied for rice cultivation
- Effects of UDP on rice productivity
- Major reasons farmers reported for not using UDP

Describing Adoption Over Time

- It is useful to distinguish between adoption, which is measured at one point in time, and diffusion, which is the spread of a new technology across a population over time (Thirtle and Ruttan 1997)
- One problem with traditional analysis of diffusion, however, is that it assume cumulative adoption—that is, once a farmer begins using the technology, he or she will keep using it
- In many cases this is not correct, and many farmers may have one or more years of experience with the technology only to have subsequently abandoned it
- One way of investigating this phenomenon is to compare current use with past use

Duration Models to Analyze Technology Adoption

- Most of the past studies have focused on static scenarios and **do not consider the dynamics of adoption of new technologies**
  - Identification of factors which affect adoption decisions at a moment in time only (e.g, probit regressions)
  - Do not consider dynamics of adoption process that affect the diffusion and disadoption of technologies
- IFPRI study goes beyond an analysis of current practices and attempt to document adoption history**. In our survey, we collected year-by-year use of a technology**

The Model

- A household will decide to adopt a new technology choice if, at the optimal level of land allocation (A_1), the change in utility (ΔU_a), due to adoption, is positive.

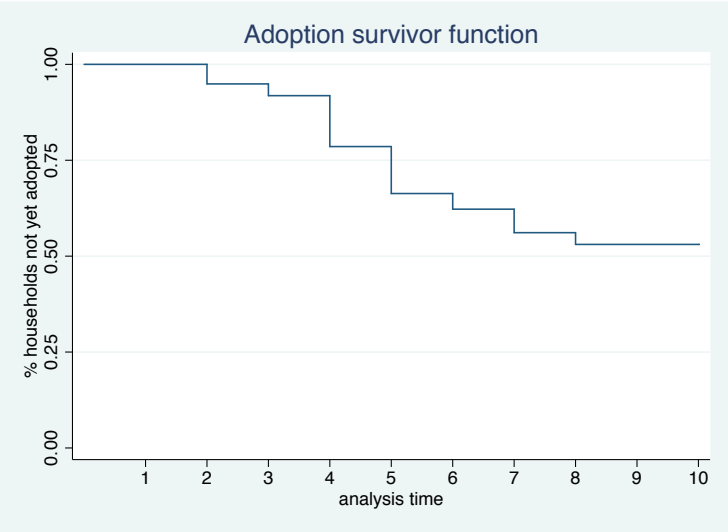
$$\Delta U_\alpha = \frac{1}{2\phi(\sigma_0^2+\sigma_1^2+2\rho_{01}\sigma_0\sigma_1)}[(\Pi_1-\Pi_0)-\phi(\rho_{01}\sigma_0\sigma_1-\sigma_0^2)]^2-c_1>0$$

- We analyze the decision by constructing a model that estimates time to adoption and duration as a user of the new technology. The estimation is done by using a parametric Hazard function with a Weibull distribution

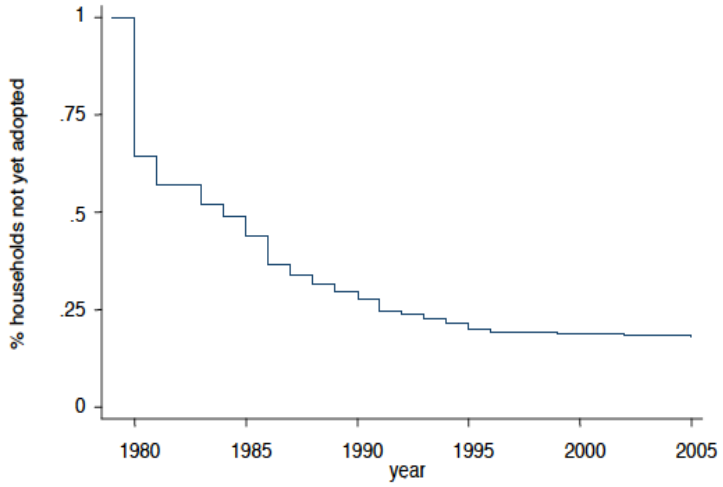
$$h(t)=\lambda(x)^\rho\,\rho t^{\rho-1}$$

Adoption Survivor Function: An Example

Technology A



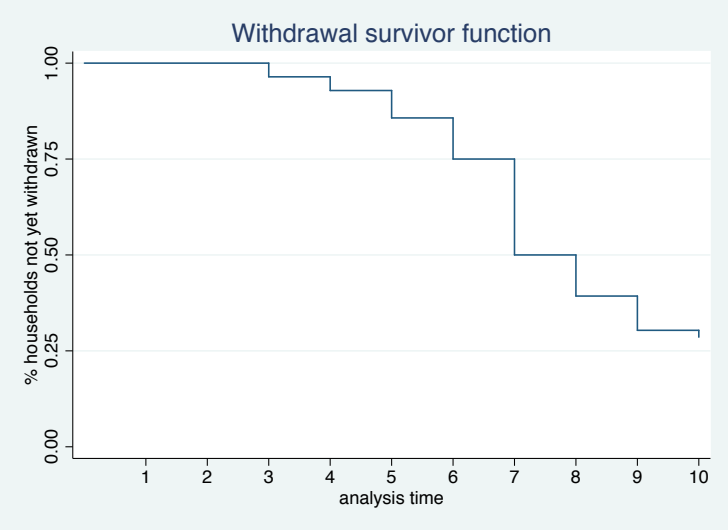
Technology B



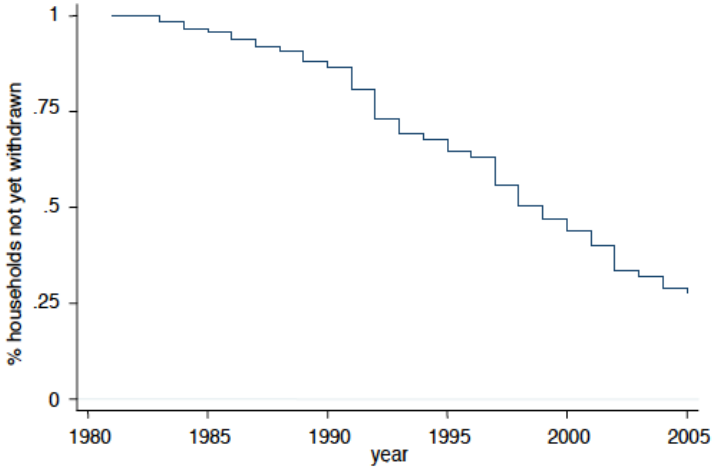
Non-adoption rate drops, meaning adoption increases. Adoption of technology B is faster than technology A. So, for technology A, non-adoption rate drops slowly, meaning adoption is slow. In year 10, non-adoption drops to about 55%, that is, adoption is 45%.

For technology B, non-adoption rate drops fast in the first couple of years, meaning adoption is faster. In 1990, non-adoption drops to only about 25%, meaning adoption is sustained around 75%.

Withdrawal Survivor Function: An Example



Technology B



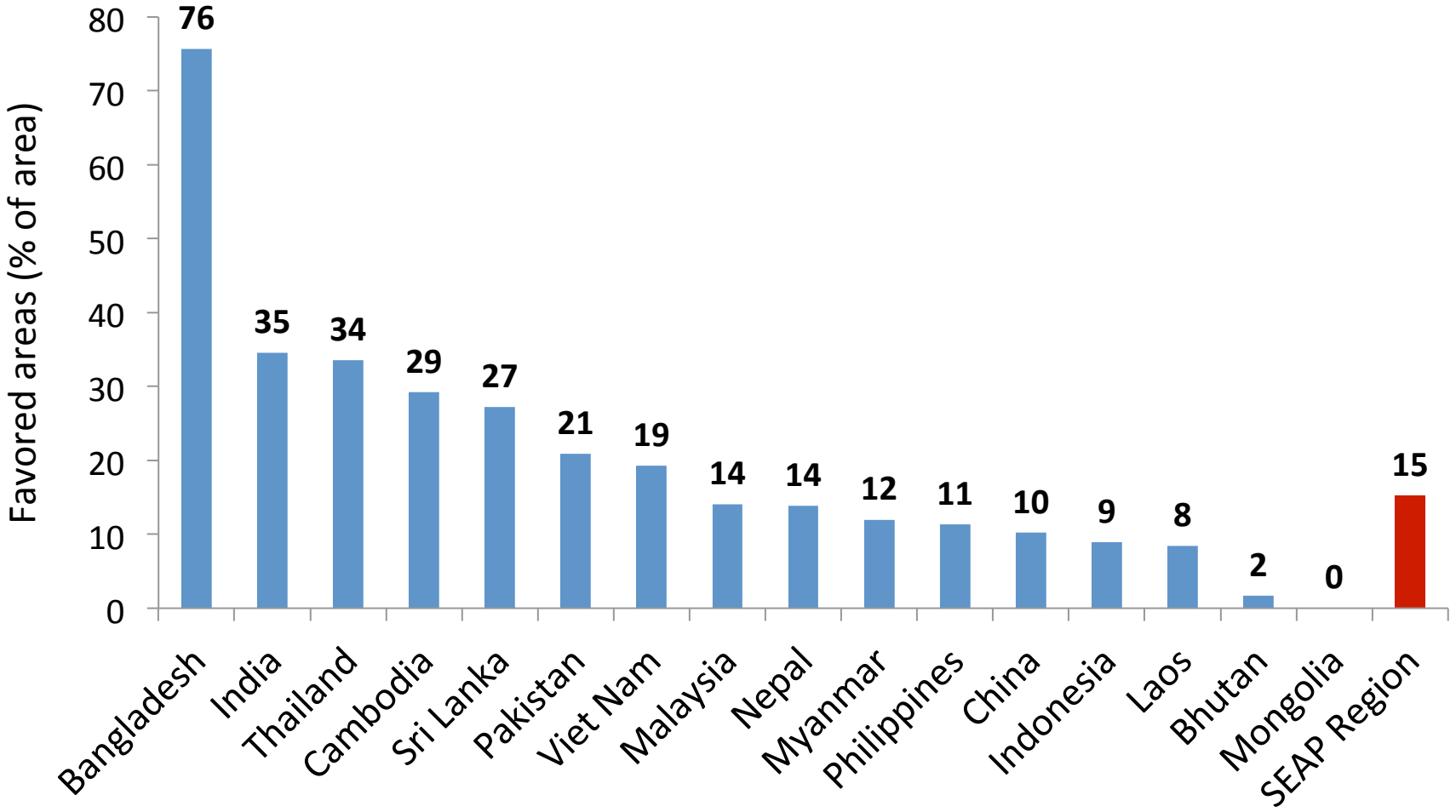
Among those who adopted, the duration of adoption of technology B is longer than technology A. After the first 3 years, farmers start withdrawing fast, in year 10, about 70% withdrawn.

In technology B, still about 80% have not withdrawn in 10 years from 1980 to 1990. But then they start withdrawing at a faster rate, because the technology might be getting obsolete after 10 years.

CONTEXTUAL FACTORS EXPLIANING WHY FARMERS ADOPT OR DO NOT ADOPT NEW TECHNOLOGY

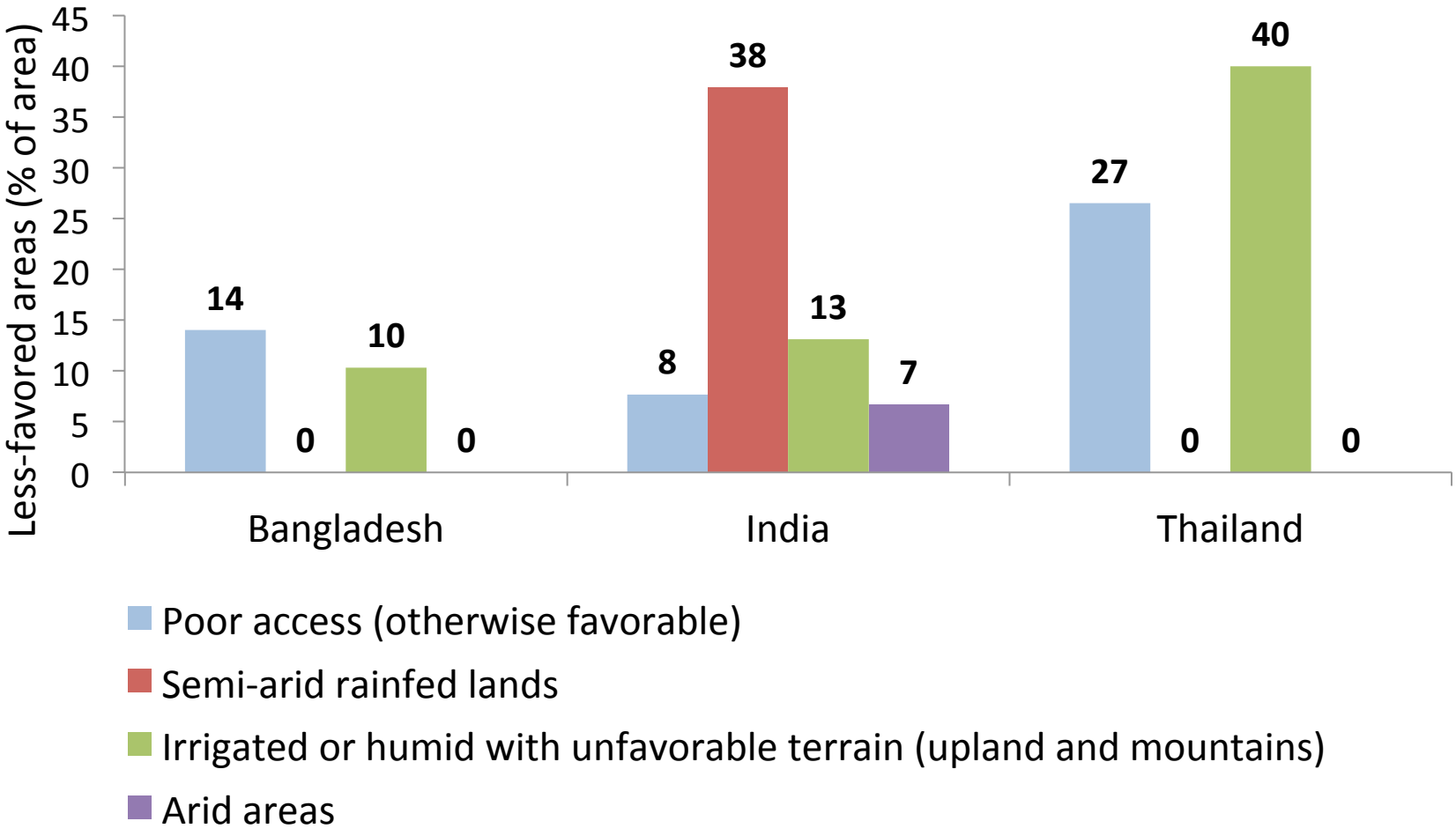
Bangladesh is the most "favored" area in South and East Asia and the Pacific countries

(Irrigated or humid/sub-humid with favorable terrain and market access)



Source: Pender, J. (2008) , IFPRI-IFAD

Comparing the components of "less-favored" areas: Bangladesh vs. India and Thailand

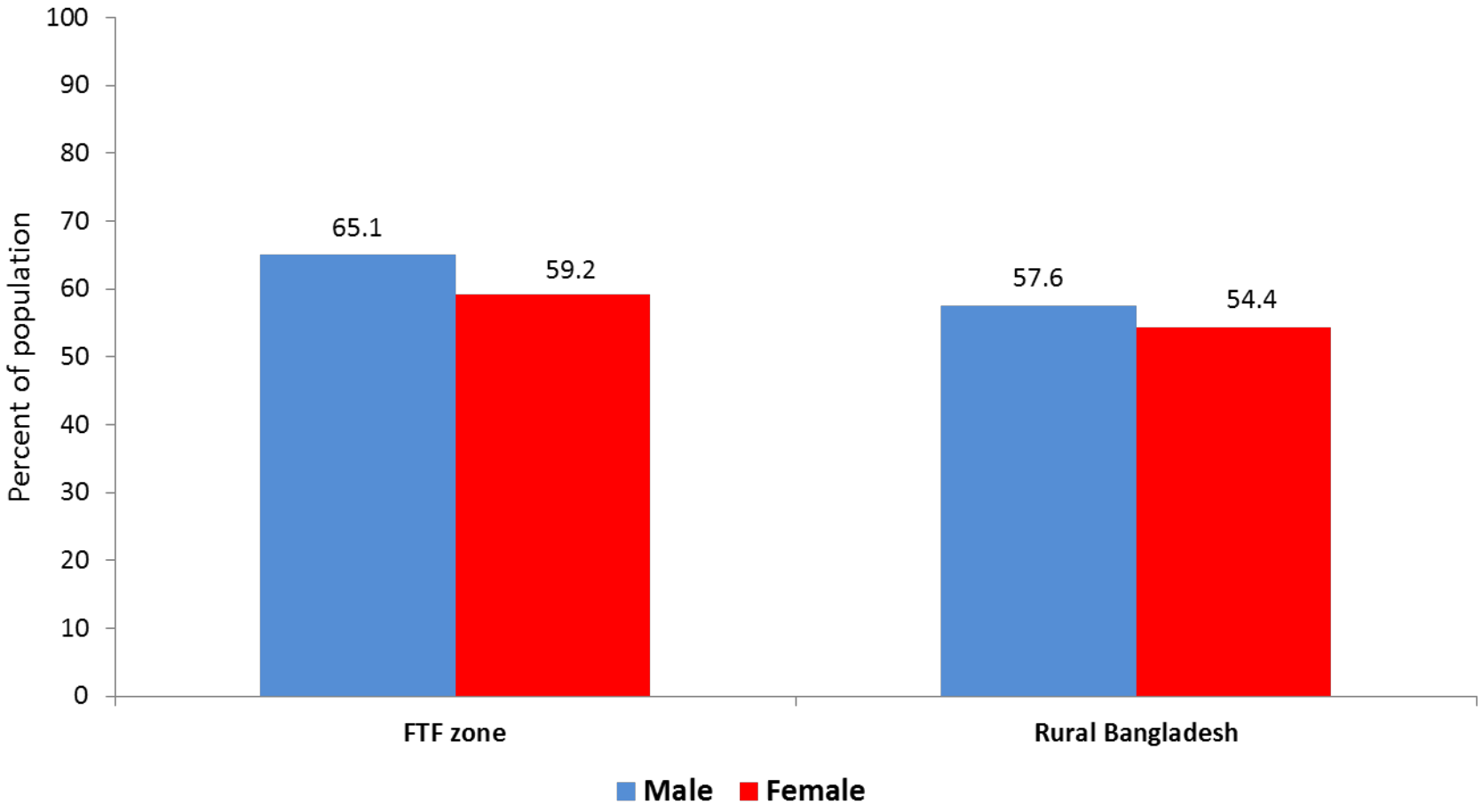


Source: Pender, J. (2008) , IFPRI-IFAD

Constraints to Adoption

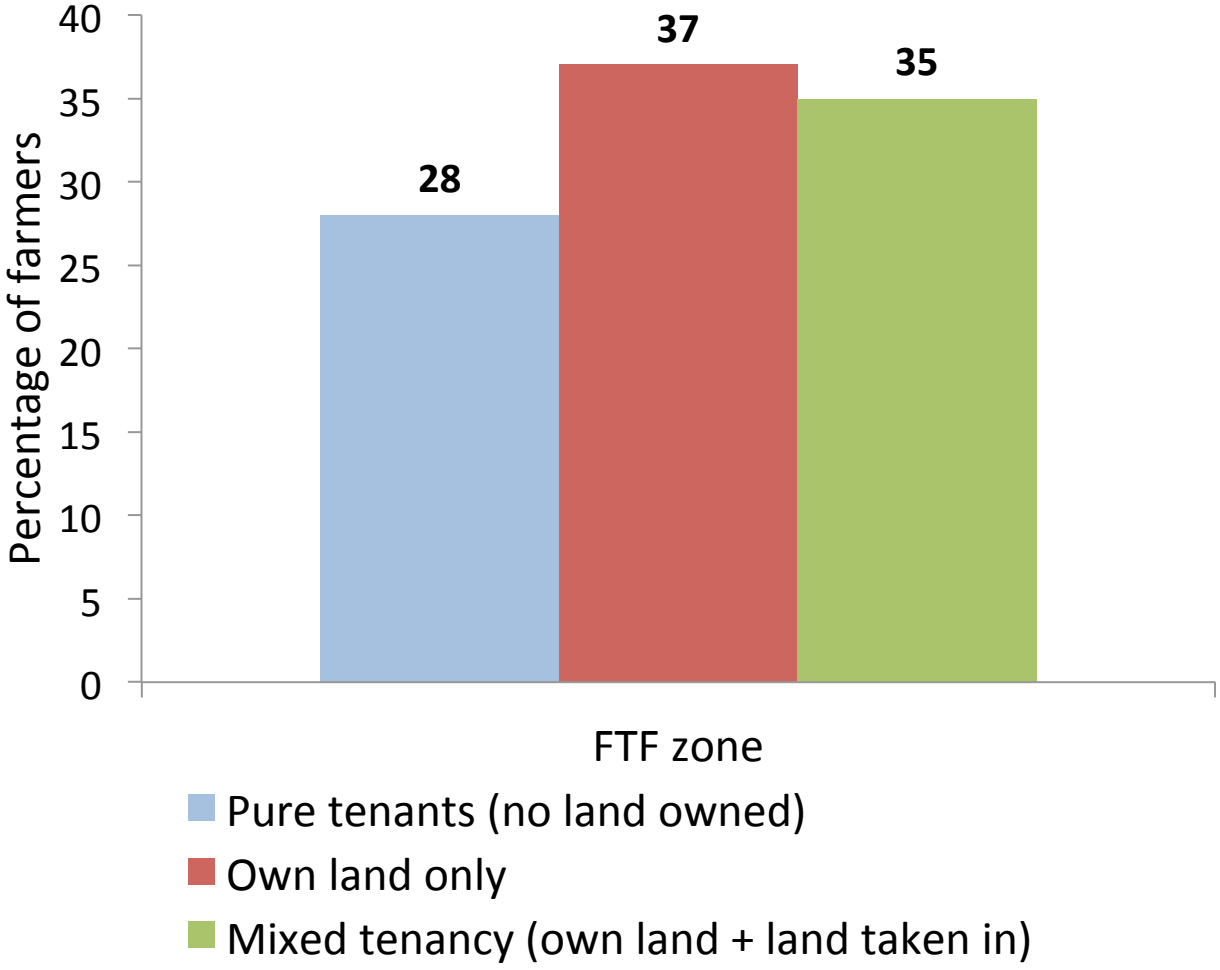
- Widespread poverty
- Illiteracy/low levels of education
- Undeveloped infrastructure
- Input fixity in the short run, such as access to credit, land, labor or other critical inputs limits production flexibility and conditions technology adoption decisions (Aikens et al., 1975; Smale et al., 1994; Shampine, 1998)

Adult Literacy Rate of People Aged 15 Years and Over in FTF Zone and Rural Bangladesh



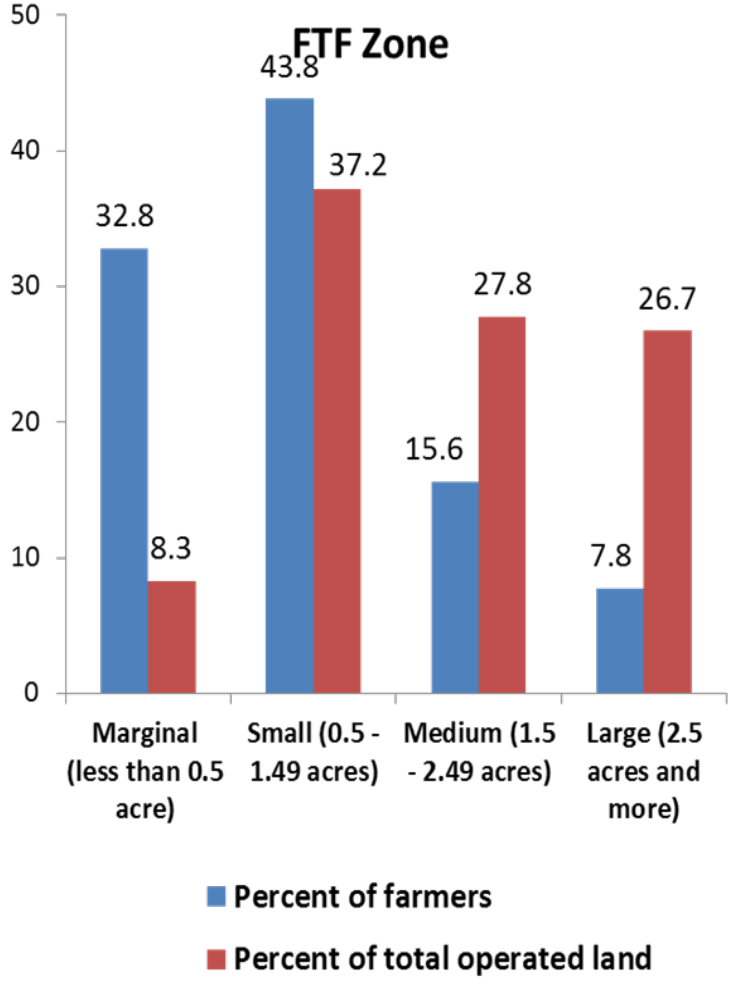
Source: IFPRI-USAID Bangladesh Integrated Household Survey, 2011-012

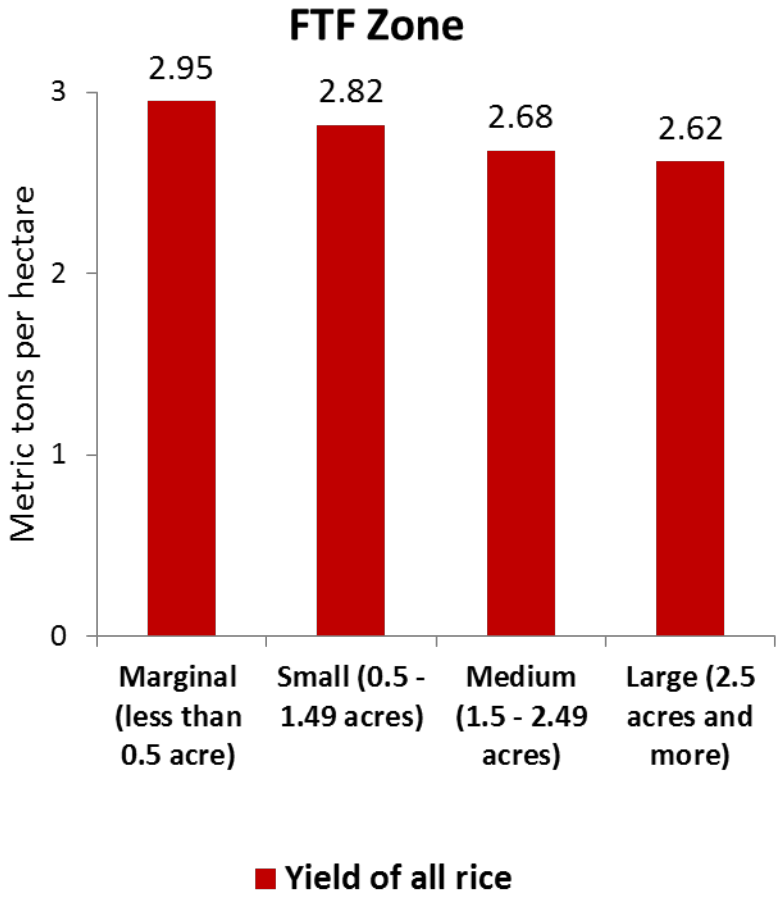
Tenancy Patterns in FTF Zone



Source: IFPRI-USAID Bangladesh Integrated Household Survey, 2011-012

Distribution of Farm Size Groups and Rice Yields in FTF Zone





Source: IFPRI-USAID Bangladesh Integrated Household Survey, 2011-012

Dolly Begum, a woman entrepreneur, produces briquette urea

"The machine costs 48,000 taka [$600]. I could not get bank loan, so I sold my two milk-cows," said Dolly Begum

IFPRI interview during pretest for the Agricultural Technology Adoption Survey, 2013

Kamrul Hassan, an early-adopter of urea deep placement technology

Kamrul Hasan, 33, is a landless tenant farmer. He has been using briquette urea for rice cultivation since 2008, the first farmer in his village to use the technology. "When I used *guti* (briqutte) urea for the first time, I got 4 maunds [160 kg] extra yield per bigha [1/3 acre] with almost half the fertilizer cost," said Kamrul. But he has to give half of the crop to the land owner, "he [the land owner] does not share any cost, not even irrigation cost," Kamrul said bitterly.

IFPRI interview during pretest for the Agricultural Technology Adoption Survey, 2013

Conclusions

- Improvement in food security can be enhanced by rapidly increasing the incomes of small commercial farmers. These farmers dominate agricultural production
- Providing smallholders with adequate access to institutional credit and effective agricultural extension services are critical for agricultural development in the FTF zone
- In rural Bangladesh, land tenure is a major constraint to technology adoption. About one-third of the farmers do not own the land that they work. These farmers must pay rent for the land they cultivate, which makes farming a low-profit enterprise for them. Greater investment in agricultural research for increased productivity will result in lower production cost per unit of output and higher profitability
- for these farmers This will mean developing new technologies and innovations through research to address production problems in flood, drought, and salinity induced stress conditions.