

# INDIA MICRO-IRRIGATION PROGRAM SURVEY

## SUMMARY OF FINDINGS



### Overview<sup>1</sup>

As part of the final evaluation of the India Micro-Irrigation Program, IDE India conducted a household survey to measure improvements in production and income among users of the technology. As summarized in this report, the survey found significant improvements in a range of production and income variables, comparing users and non-users of IDEI-marketed treadle pumps and drip irrigation systems.

### Methods

The research firm IMRB conducted the survey in February 2012, covering four states: two in which the primary focus was on drip irrigation customers (Maharashtra and Tamil Nadu) and two in which the primary focus was on treadle pump customers (Bihar and Orissa). Interviewers spoke to 520 respondents in each state (200 users and 320 non-users of IDEI micro-irrigation technology) for a total of 2,080 interviews. Respondents had all purchased their technology in 2010 and reported on their 2011 crop production and marketing, covering the three main seasons of Rabi (winter), Zaid (summer), and Kharif (monsoon) crops. Figure 1 shows the eligibility period (red box) – selecting customers who purchased treadle pumps in 2010 – and the recall period (blue box) for production outcomes in 2011, relative to treadle pump sales and the timing of the main seasons in that state.

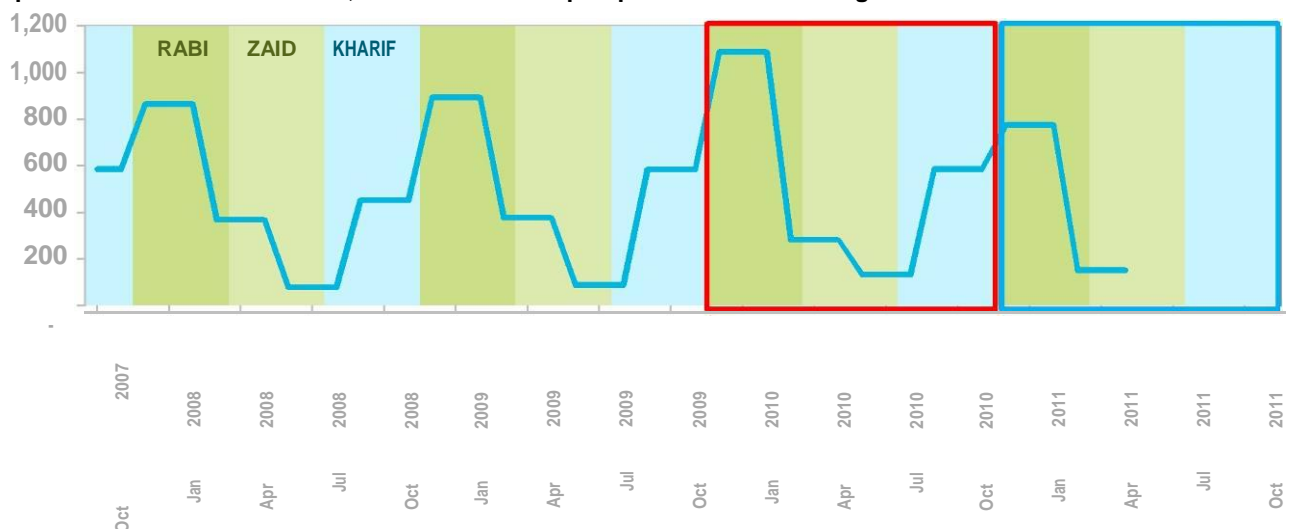


Figure 1. IDEI sales of treadle pumps in Orissa relative to seasons: Rabi, Zaid and Kharif (red box indicates eligibility period for respondents; blue box represents recall period for production outcomes)

### Sample Selection

IDEI provided sales totals for business associates (BAs) in each of the four states during the eligibility period. The number of BAs ranged from 30 to 61. IMRB used these data to select five BAs in each state, using probability proportional to size. IDEI provided physical warranty cards for sales by each of the selected BAs from which IMRB selected eight per BA. IMRB then worked with IDEI to identify the four closest customers to each of those selected sales, to form eight clusters of five (40 per BA). BAs traveled to the field with IMRB research teams to help them locate the respondents. In the field, the teams then selected non-user respondents by taking the closest neighbour who was not using a comparable improved irrigation system (mechanized pumping in the case of treadle pump areas and drip or sprinklers in drip irrigation areas). The field teams also sampled an additional three non-users in each cluster area to provide a larger control population for the matched analysis.

The overall sample consisted of 5 users and 8 non-users per cluster X 8 clusters per BA X 5 BAs per state = 520 (200 users and 320 non-users) per state.

<sup>1</sup> This report is an excerpt from the final draft report. India Micro Irrigation Programme was funded by the Gates Foundation (November 2007- October 2011)

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### Analysis

The analysis used propensity score matching<sup>1</sup> to match users and non-users on a set of pre-purchase characteristics. These included land-holding, family size, and a set of questions that form part of the Progress out of Poverty Index.<sup>2</sup> The matching algorithms included nearest neighbour, caliper (radius = 0.05) and kernel methods. Due to some inconsistencies with kernel results, we have focused on the consistent findings of nearest neighbour and caliper methods.<sup>3</sup>

### Findings

#### Both technologies reach significant numbers of poor farmers

The survey included a module that measured the likelihood that households fell below the poverty line, using the Progress out of Poverty Index.<sup>4</sup> Using this measure, Figure 2 presents the proportion of technology customers who were living on less than \$1 per capita per day and \$2/cap/day at baseline (i.e. prior to purchasing the technology) by state. It is clear from this graph that users of treadle pumps were overwhelmingly poor (96% and 97% below \$2/day in Bihar and Orissa respectively) whereas drip irrigation reached substantial numbers of poor households (77% and 62% below \$2/day in Maharashtra and Tamil Nadu respectively), but not exclusively. Treadle pumps also reached a much higher proportion of households living on less than \$1/day.

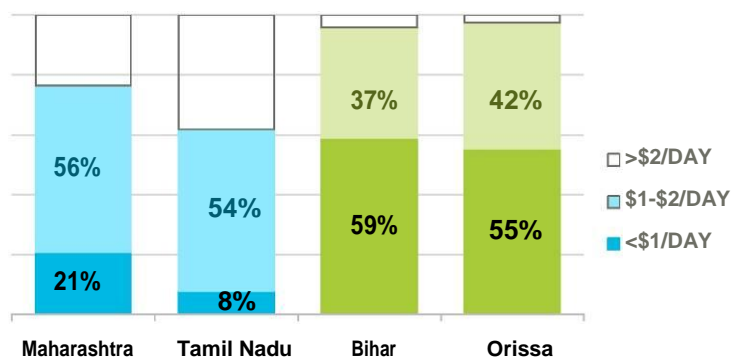


Figure 2. % of customers below \$1/cap/day and \$2/cap/day at baseline, by state (drip states in blue, treadle pump states in green)

#### Farmers in drip irrigation areas cultivate more land with more market-oriented crops

Farmers in the drip irrigation areas in Tamil Nadu and Maharashtra tend to grow fewer crops – focused on commercial crops such as turmeric, tapioca, sugar cane and coconut (which also have longer production cycles) – and have substantially larger areas than farmers in the treadle pump areas of Orissa and Bihar, where production is typically more oriented toward small-scale mixed vegetables for home consumption and staple crops. As

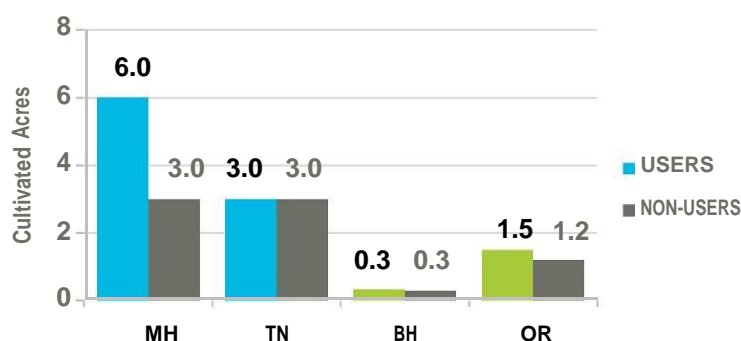


Figure 3. Median land cultivated, by state, comparing users and non-users (drip states in blue, treadle pump states in green)

<sup>1</sup> Propensity score matching is a quasi-experimental design that approximates the results of a randomized experiment by comparing households considered equally likely to adopt the technology based on a set of predictive variables in a probit model.

<sup>2</sup> The Progress out of Poverty Index was designed by the Grameen Foundation. It consists of a battery of 10 questions that correlate with the likelihood that a household falls below the poverty line.

<sup>3</sup> Kernel estimates tended to be higher (i.e. indicating a higher level of attributable change) but not always consistent with nearest neighbour and caliper estimates. Kernel matching is considered less robust to smaller sample sizes and so was dropped for the purposes of this analysis.

<sup>4</sup> The Progress out of Poverty Index (PPI) was developed by the Grameen Foundation. It uses a battery of 10 questions, probing easily observable characteristics, to estimate the likelihood that a family falls below a set of nationally and internationally established poverty lines.

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shown in Figure 3, users and non-users were cultivating similar areas, except in Maharashtra, where drip users were cultivating twice the area of non-users.<sup>5</sup>

### Customer satisfaction highest among treadle pump users

The survey asked respondents to rate their satisfaction with the technology after the first year of use. Satisfaction rates were very high in Bihar and Orissa, as shown in Figure 5. 100% of users in Bihar and 99% in Orissa said that they recommended the technology to others.

In Maharashtra and Tamil Nadu, some farmers did express dissatisfaction with their purchase.

Frequent repairs was a common complaint in both states (13% in Maharashtra and 15% in Tamil Nadu). Interestingly, despite the complaints, high numbers of farmers in both states still recommended the technology to others (93% in Maharashtra and 91% in Tamil Nadu).

Some farmers (3% in Maharashtra and 7% in Tamil Nadu) indicated that they would not continue using the technology.

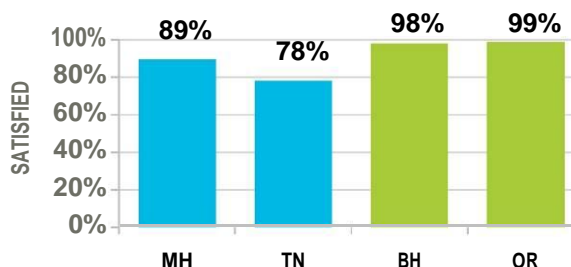


Figure 5. % of micro-irrigation users 'satisfied' with their technology, by state (drip states in blue, treadle pump states in green)

<sup>5</sup> Note that landholding was a factor in the PSM model, ensuring that the matching model took into account differing land size when calculating income and production results.

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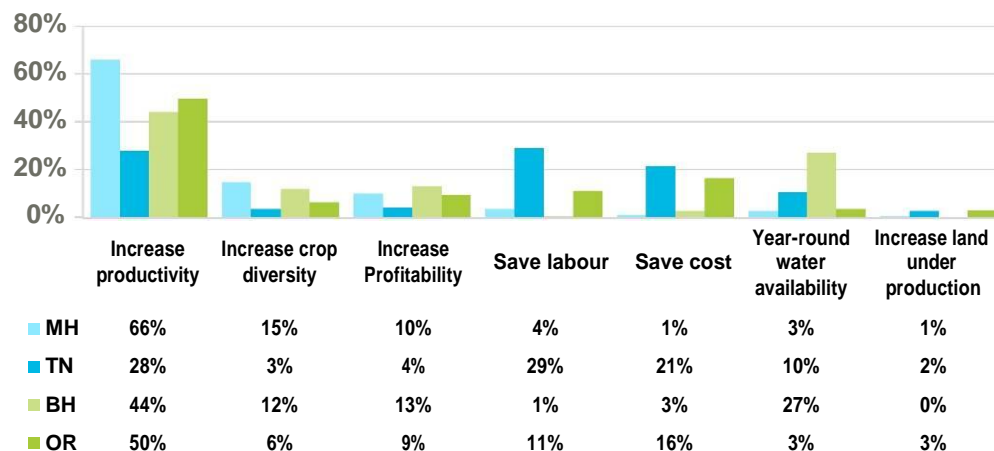


Figure 6. Main reason for purchasing micro-irrigation technology, by state

When asked about their main motivation for purchasing micro-irrigation technology, the majority indicated that they desired increased productivity. Far fewer farmers indicated that their purchase decisions were primarily focused on increasing the profitability of their production.<sup>6</sup> Labour saving was a stronger motivator in Tamil Nadu and cost saving figured highly in Tamil Nadu and Orissa.

### Micro-irrigation users more likely to report improved finances – especially treadle pump owners

The survey asked farmers whether their overall financial status had improved, stayed the same or deteriorated (Figure 7). Micro-irrigation users were far more likely to report that their finances had improved. This trend was much more pronounced among treadle pump users. Very few non-users in Bihar and Orissa (8% in both states) reported an improvement in their overall financial status, compared with the vast majority (90% and 83%, respectively) of users.

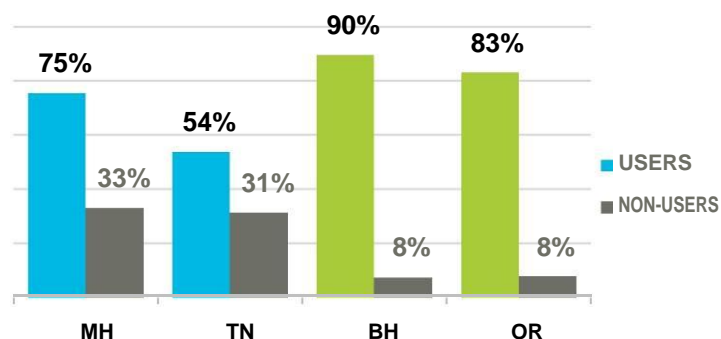


Figure 7. % of farmers reporting that their overall financial status has improved over the past year, by state

Improved productivity was the most common reason given for improvements in financial status. Farmers also cited improved prices, but only half as often as productivity (see Figure 8).

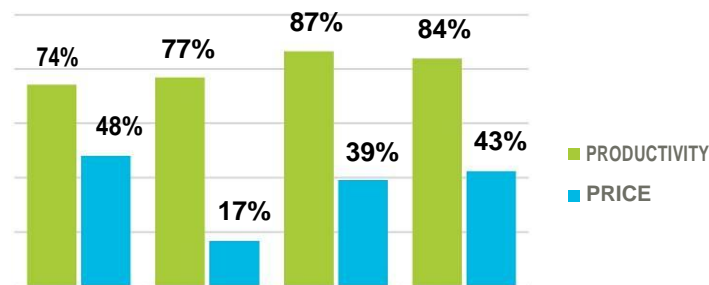


Figure 8. Main reasons for improved financial status, by state (% of farmers reporting)

<sup>6</sup> Of course, productivity is closely linked with profitability. Thus, we are not suggesting that profitability is not a major consideration. However, productivity takes in a broader range of benefits, including food for home consumption.

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#### Micro-irrigation users have significantly higher crop incomes than non-users

Across all states, the analysis found significantly higher crop incomes among micro-irrigation users, compared with matched non-user controls. As shown in Figure 9, crop incomes were much higher in the drip states, and higher in Tamil Nadu than in Maharashtra.

As previously noted, there is significant market activity in general in drip states. Thus, even non-users in Maharashtra and Tamil Nadu are earning substantially more than farmers in Bihar and Orissa. However, in treadle pump states, farmers are moving from little or no market involvement (essentially subsistence production) to growing vegetables and other crops for market, facilitated by the introduction of irrigation technology.

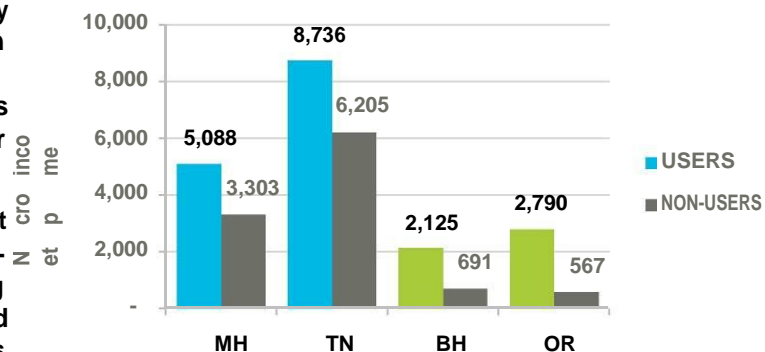


Figure 9. Net crop income of users and non-users, by state (\$PPP)

Table 1 illustrates the significantly higher relative difference in income between users and non-users in the treadle pump states.

Table 1. Net crop income difference between users and non-users, by state

	INR	USD	PPP User : Non-User Ratio
Maharashtra	34,915	744	1.784
Tamil Nadu	49,527	1,055	2.531
Bihar	28,068	598	1.435
Orissa	43,508	927	2.224

NOTE: Results for Maharashtra and Tamil Nadu are significant at 90% confidence; results for Bihar and Orissa at 99%.

Figure 10 presents the return to land area in \$PPP/m<sup>2</sup>. Maharashtra has the lowest return per unit land area. As shown previously, farmers in Maharashtra are cultivating on average much larger areas than farmers in other states. This reflects more extensive / less intensive production in Maharashtra, where farmers are cultivating field crops such as cereals and pulses that are offering lower per-acre returns than more intensive horticultural products. Note that the estimates of per-land unit returns for Bihar were not reliable due to the margin of error relative to the miniscule land sizes reported.

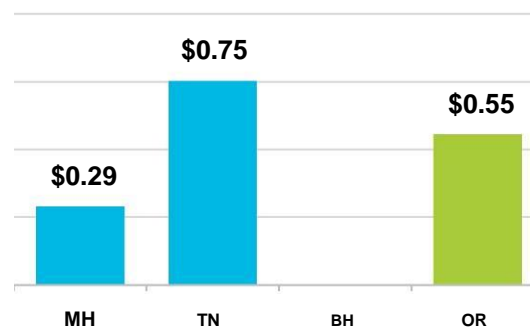


Figure 10. Gross crop revenue (\$PPP) per m<sup>2</sup>, by state

We should note that some of the major crops in drip areas are longer-cycle crops such as turmeric, sugar cane and tapioca. It is possible that some of the estimates of crop income are biased lower due to the fact that not all farmers had harvested their 2011-planted crop by the time of the survey in February 2012. As shown in Table 2, farmers in drip states tend to focus on fewer, market-oriented crops. In TP states, there is a much more pronounced increase in crop diversity among treadle pump users.

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Table 2. Mean number of crops grown, comparing users and non-users, by state

	Users	Non-Users
Maharashtra	3.2	2.0
Tamil Nadu	1.9	1.7
Bihar	5.1	2.8
Orissa	9.0	3.0

Vegetables contributed significantly to income gains in all states except Bihar, as shown in Table 3. Paddy yields and income were a significant contributor to income gains in Bihar. And, while Bihar did not show significant difference for vegetables as a category, users did have significantly higher yields and returns on potato. Also, users had high returns on cauliflower in Bihar, but there were not enough non-users growing cauliflower to permit a statistically significant comparison of yield or return.

In Orissa, treadle pump users had significantly higher returns per unit area on onion, tomato and brinjal (eggplant).

Table 3. Gross income per acre by crop category showing user returns and difference between users and non-users, by state (\$PPP/m<sup>2</sup>)

	Maharashtra		Tamil Nadu		Bihar		Orissa	
	Users	Difference	Users	Difference	Users	Difference	Users	Difference
Cereals	0.17	0.08	0.29	n.s.	0.29	0.18	0.27	n.s.
Pulses					0.87	0.63	1.11	n.s.
Cash Crops	0.36	n.s.	0.72	0.32			0.56	n.s.
Spices			1.73	n.s.	1.02	n.s.	0.95	n.s.
Vegetables	1.35	1.00	0.54	0.20	1.01	n.s.	1.87	1.34
Fruit			1.74	1.11				

Colour denotes significance level:  $\text{\textcircled{SS}}$  = 90%  $\text{\textcircled{SS}}$  = 95%  $\text{\textcircled{SS}}$  = 99% n.s. = not significant

## Conclusion

The 2012 household survey indicates a significant impact of micro-irrigation technology on a range of production and income indicators for farmers across four states included in the India Micro-Irrigation Program. While drip users experienced significantly better outcomes compared to non-users (and some impacts may not yet be realized as some farmers had not yet harvested long-cycle crops), the impact of treadle pumps in Bihar and Orissa appears to be much more profound. Treadle pumps are reaching significantly poorer farmers, who are hardly engaged in any market production, and enabling them to produce for local markets, dramatically increasing their incomes in relative terms.