Vietnam - SDC
2016 Evaluation Report

Contents
Tables ........................................................................................................................................... 1
Figures .......................................................................................................................................... 1
Introduction ..................................................................................................................................... 1
Purpose ......................................................................................................................................... 1
Study Design ................................................................................................................................. 1
Implementation ............................................................................................................................. 2
Limitations ..................................................................................................................................... 2
Sample Demographics ................................................................................................................ 3
Household Characteristics .......................................................................................................... 3
Land and Water Use .................................................................................................................... 6
Customer Satisfaction ................................................................................................................. 7
Crop Productivity and Water Use ............................................................................................... 9
Crop Production ........................................................................................................................ 9
Methods of Estimating Water Use ............................................................................................. 11
Water Use .................................................................................................................................... 12
Crop Per Drop ............................................................................................................................ 13
Conclusion .................................................................................................................................... 14
Appendix 1: Crop Level Analysis ............................................................................................... 16
Appendix 2: Crop Stages ............................................................................................................ 17
Appendix 3: Crop Production and Water-Use Survey Instrument ............................................. 18
Vietnam - SDC
2016 Evaluation Report

Tables
Table 1: Sample Sizes for iDE Vietnam Evaluation................................................................. 2
Table 2: Percent of Female Respondents and Female Heads of Household ................................... 2
Table 3: Average Age of Head of Household ......................................................................... 3
Table 4: Level of Education Obtained by Head of Household ...................................................... 4
Table 5: Average Number of Household Members, By Gender .................................................. 4
Table 6: Ethnicity of Household ........................................................................................... 4
Table 7: Household Classification .......................................................................................... 5
Table 8: PPI Poverty Rates, by various thresholds .................................................................... 5
Table 9: Average Land Holdings in Sao, by Crop Category ......................................................... 6
Table 10: Pump and Well Characteristics ............................................................................... 7
Table 11: Method of Learning about MIT ................................................................................ 8
Table 12: Services Received from Supplier ............................................................................. 8
Table 13: Satisfaction with MIT Product and Services ............................................................... 8
Table 14: Recommended MIT Product and Supplier ................................................................. 9
Table 15: Average Crop Margins per Square Meter, VND ......................................................... 9
Table 16: Average Crop Margins per Square Meter, $USD PPP ............................................. 10
Table 17: Average Total Crop Margins, $USD PPP ................................................................. 10
Table 18: Average Water Usage (Liters) Per Square Meter, By Crop Stage ................................ 13
Table 19: Crop Per Drop (Currency / Liter) .......................................................................... 13
Table 20: Crop Count, by Household ...................................................................................... 14

Figures
Figure 1: Average Land Distribution for Control and Treatment Households ............................ 6
Figure 2: Average Input Cost Components per Square Meter ($PPP), by Treatment Group ........ 10
Figure 3: Average Household Crop Harvest and Sales Volume in Kgs ...................................... 11
Figure 4: Average Water Use (l/m^3), by Crop Stage ............................................................... 13
Introduction

Purpose

“Introducing Low-cost Micro Irrigation Technology (MIT) for Poor Farmers in South Central Vietnam” (referred to as the MIT project) seeks to increase smallholder farmers’ income through water and labor saving technology. Started in 2009, iDE employed a market-based approach to introduce MIT to smallholder farmers who are typically outside of conventional irrigation markets. iDE Vietnam is now at a turning point to scale-up their efforts to achieve greater market penetration and expand into new provinces. There are two ultimate goals when scaling-up: to increase farmer income and alleviate environmental impacts of agriculture.

Key activities of the project are: (1) to promote MIT to smallholder farmers; (2) establish a flexible MIT supply chain network; (3) engage farmers and retailers in MIT product research and development. Additionally, market research was conducted to identify high-value crops ideal for regional-specific MIT production.

iDE Vietnam is currently receiving funding from the Scaling Up Productive Water Phase II program funded by the Swiss Agency for Development and Cooperation (SDC) for the MIT project. Under this program, iDE is responsible for reporting differences between treatment and control households on the following metrics:

- Smallholder income of our clients
- Water-use productivity (crop-per-drop)
- Production costs associated with agri-food production

The most important evaluation outcome at this point is to obtain credible evidence around the effectiveness of the approach iDE has taken in Vietnam and to provide iDE Vietnam with a set of meaningful learnings that can be used to improve their programs, be used by field technicians to market improved irrigation technologies/practices to potential clients and be used to fulfill accountability requirements to SDC.

Study Design

EXPERIMENTAL GROUPS

The evaluation will follow two cohorts:

- Treatment Group – a random sample of older clients, defined as farmers who have directly purchased a MIT in 2014 and have received agronomic support through iDE since MIT installation (they have completed at least 3 crop cycles with MIT and agronomic support).

- Control Group - a sample of non-clients, defined as those who did not purchase an MIT and use flood-furrow irrigation with comparable socio-demographic, agricultural and water access characteristics.

SAMPLE DESIGN

According to the sales tracking system used by iDE Vietnam, over the course of the project, approximately 2,100 households invested in MITs, and the direct clients (Treatment Group) were randomly selected from this cohort of MIT clients.
Implementation

We collected one-crop season production and income data by recall at endline. In the past, iDE has attempted to collect both baseline and one-year follow-up data in the same interview (i.e. by interviewing farmers at least one year post-adoption and attempting to get 24-month recall data to estimate baseline conditions). Due to resource limitations and time constraints to complete the evaluation, as well as concerns about the reliability of the longer recall period, we are conducting a post-post analysis that does not control for fixed time effects but does seek to control for self-selection biases.

The data was collected over the period February – March, 2016. An iDE staff member collected endline data from a sample of existing clients, using the MIT client registry collected over the course of the MIT project. In addition, the iDE staff collected a similar control group observation by identifying neighboring households without MIT systems in the same village. In some communes finding control households proved difficult as there were few non-users. The survey instrument closely aligns with the survey instrument that has been used in other evaluations carried out by iDE and the Global iQ team and on average took 60-90 minutes, including time for onsite flow rate and pump pressure measurements.

Table 1 presents the proposed sample plan and the actual collected sample composition. The percentage of female respondents for our sample are presented in Table 2. There is a statistically significant difference between treatment and control groups for percentage of female respondents. It is also worth noting that iDE has historically stratified analyses based on head-of-household gender to detect any differences between female and male headed households. In the present case, however, only 5% of respondents were female-headed households in our sample, and thus stratification along these lines would not be feasible.

<table>
<thead>
<tr>
<th>Table 1: Sample Sizes for iDE Vietnam Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Control Group</td>
</tr>
<tr>
<td>Treatment Group</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Percent of Female Respondents and Female Heads of Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female Respondents</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Control</td>
</tr>
<tr>
<td>26% (6)</td>
</tr>
<tr>
<td>Treatment</td>
</tr>
<tr>
<td>11% (4)</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
</tr>
<tr>
<td><strong>18% (4)</strong></td>
</tr>
</tbody>
</table>

*Standard errors in parentheses*

Limitations

This evaluation faces several limitations that should be taken into consideration. First, this is an ex-post evaluation that compares non-randomized treatment and control groups. As treatment assignment is

---

1 T-test is significant at the 10% level of significance
non-random, observed differences between the two may be due to other factors that predict their likelihood of participating in the first place. We conduct robust hypothesis testing on household socio-economic characteristics that are not likely to change as a result of the treatment to determine if there are any statistically significant differences between the two groups that could predict program take-up. If we find significant differences, we can address some of the biases through a matching method along those predictive characteristics.

In addition, given time and resource constraints we have a small sample size (n = 107) that is stratified into treatment and control groups. The size of a small sample limits the generalizability of this study. Findings of non-significant results in differences between treatment groups are probably due to a Type II error because of the small sample size.

Field enumerators also faced some difficulty following the sample plan due to high saturation rates of treatment activities. In some villages it was difficult to find control households as most of the community had adopted MIT technology. This could result in selection bias where the control households within a community share underlying characteristics that distinguish them from treatment households.

Finally, this study relied on respondent recall and self-reporting for crop production data and time spent watering which can be susceptible to inaccurate recall and misrepresentation of actual productivity. Cleaning of the data included checks for outliers that could skew the results.

Sample Demographics
This section describes the demographic and socio-economic composition of the target population. We define “household” as a group of persons who lived together and shared common feeding arrangements or were economically supported by one agricultural enterprise during the survey period. For the purpose of our evaluation, our unit of analysis and reporting is at the household level.

Household Characteristics
Overall, there are very few significant differences between the treatment and control groups in terms of basic socioeconomic characteristics as presented in Tables 3 through 8 below, as well as considering female headed households in Table 2. Establishing close to similar treatment and control groups is advantageous as we will not need to account for differences in our ex-post evaluation through a quasi-experimental method such as propensity score matching.

HEAD OF HOUSEHOLD
Summary statistics on the average age of the head of household and the level of education obtained are presented in Tables 3 and 4, respectively. We find that, on average, the household head is 46 years old in our sample. In addition, the majority of our sample (77%) have obtained elementary or secondary levels of education, with 42% obtaining elementary education, and 35% obtaining secondary education. There are no significant differences between treatment and control groups for either age or education statistics.

<table>
<thead>
<tr>
<th>Table 3: Average Age of Head of Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
</tr>
<tr>
<td>48</td>
</tr>
<tr>
<td>(1.7)</td>
</tr>
<tr>
<td>Treatment</td>
</tr>
<tr>
<td>44</td>
</tr>
<tr>
<td>(1.4)</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
<tr>
<td>46</td>
</tr>
<tr>
<td>(1.1)</td>
</tr>
</tbody>
</table>
Table 4: Level of Education Obtained by Head of Household

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Treatment</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>11%</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>(5)</td>
<td>(4)</td>
<td>(3)</td>
</tr>
<tr>
<td>Elementary</td>
<td>48%</td>
<td>38%</td>
<td>42%</td>
</tr>
<tr>
<td></td>
<td>(7)</td>
<td>(6)</td>
<td>(5)</td>
</tr>
<tr>
<td>Secondary</td>
<td>28%</td>
<td>39%</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>(7)</td>
<td>(6)</td>
<td>(5)</td>
</tr>
<tr>
<td>High School</td>
<td>11%</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>(5)</td>
<td>(3)</td>
<td>(3)</td>
</tr>
<tr>
<td>College</td>
<td>2%</td>
<td>8%</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>(4)</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

HOUSEHOLD SIZE

Table 5 presents the average number of household members by gender as well as the average household size. Household size is evenly distributed with an average size of 4.5 members and composition of 2.3 males and 2.2 females. We find no statistically significant differences between treatment and control groups.

Table 5: Average Number of Household Members, By Gender

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Treatment</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>2.2</td>
<td>2.4</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>(.2)</td>
<td>(.2)</td>
<td>(.1)</td>
</tr>
<tr>
<td>Females</td>
<td>2.4</td>
<td>2.1</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>(.2)</td>
<td>(.1)</td>
<td>(.1)</td>
</tr>
<tr>
<td>Total</td>
<td>4.6</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>(.2)</td>
<td>(.2)</td>
<td>(.1)</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

ETHNICITY

Respondents were asked to identify their ethnicity as Kinh or other. Sample results are reported in Table 6 where we see 93% selected Kinh and 7% selected other. There is a significant difference between our treatment and control groups as all respondents in the control sample selected Kinh ethnicity; however, given the small proportion that responded as other in the treatment group stratifying based on ethnicity will not be pursued.

Table 6: Ethnicity of Household

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Treatment</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinh</td>
<td>100%</td>
<td>87%</td>
<td>93%</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>(4)</td>
<td>(2)</td>
</tr>
<tr>
<td>Other</td>
<td>0%</td>
<td>13%</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>(4)</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
Table 7 presents household classification proportions of poverty designation as assigned by the Government of Vietnam. The vast majority of our sample (93%) classified as non poor, while only 3% identified as near poor and 5% as poor. There are no statistically significant differences between our treatment and control groups when comparing their respective levels of classification.

Table 7: Household Classification

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Treatment</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>9%</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>(4)</td>
<td>(2)</td>
<td>(2)</td>
</tr>
<tr>
<td>Near Poor</td>
<td>2%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>(2)</td>
<td>(2)</td>
</tr>
<tr>
<td>Non Poor</td>
<td>90%</td>
<td>95%</td>
<td>93%</td>
</tr>
<tr>
<td></td>
<td>(5)</td>
<td>(3)</td>
<td>(3)</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

POVERTY INCIDENCE - PROGRESS OUT OF POVERTY INDEX

The Progress Out of Poverty Index (PPI) was developed by the Grameen Foundation and is a valuable tool that iDE uses in as many of its country programs as possible to measure the incidence of poverty among iDE customers. The PPI score is obtained by adding together the scores from ten simple, and verifiable, questions pertaining to household size, building materials, education, energy use, etc. Each set of questions has been specifically chosen and weighted for the country in which it is to be implemented. The resulting PPI score is then used to estimate the probability that the household is in poverty using a PPI Scorecard. The PPI scorecard provides probabilities for each possible PPI score, and may be used to estimate the household’s likelihood of falling below a number of poverty thresholds, including for the purposes of this analysis the $1.25, $1.75 and $2.50 PPP daily thresholds.

Using the various PPI thresholds, we find overall that poverty rates are low for our sample. Only 2% of the sample are poor according to the $1.25 PPP threshold. That is, 2% of our total sample are living on less than $1.25 a day. It appears that the $1.75 PPP daily threshold is comparable to the poor and near-poor classifications presented in Table 7. Approximately 8% of our sample are poor according to the $1.75 PPP threshold and we likewise found that 8% of our sample are classified as poor or near-poor using the Government of Vietnam’s classification. It is worth noting that while we did not find significant differences between our treatment groups using the poor classification system in Table 7 we do find significant differences between our treatment and control groups using the PPI measure of poverty.

Table 8: PPI Poverty Rates, by various thresholds

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Treatment</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPI $1.25</td>
<td>4%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(.3)</td>
<td>(1)</td>
</tr>
<tr>
<td>PPI $1.75</td>
<td>12%</td>
<td>5%</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>(3)</td>
<td>(1)</td>
<td>(1)</td>
</tr>
<tr>
<td>PPI $2.50</td>
<td>28%</td>
<td>19%</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>(5)</td>
<td>(3)</td>
<td>(3)</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

2 As defined by Vietnam’s 2011-2015 classifications. Poor = a household with per capita income ≤VND 400,000/month ($18). Near Poor = per capita income between VND 401,000 – 500,000/month ($18 – $22).

3 The ten questions are extracted from the respective country’s income/expenditure survey and must match the translation and content exactly. The 2006 Vietnam PPI version was used in our survey and was noted by field staff as outdated.
Vietnam – SDC
2016 Evaluation Report

Land and Water Use

LAND HOLDINGS

Households from our sample have on average 6.7 saos of land holdings. Overall, there is no statistically significant difference in total land holdings between treatment and control households. However, when comparing average land holdings within various crop categories, significant differences were identified. Treatment households’ average land holdings of rice (0.9 saos) and fruit trees (2.6 saos) are significantly greater than control households’ (0.3 and 1.3 saos respectively). While the total land holdings are statistically similar in summation, the profiles of control households are heavier in vegetable holdings while treatment households have greater rice and fruit tree holdings as demonstrated in Table 9 and Figure 1 below. This could be due in part to iDE program activities which including promotion of fruit tree production.

Table 9: Average Land Holdings in Sao, by Crop Category

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Treatment</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>0.3</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>(.1)</td>
<td>(.3)</td>
<td>(.2)</td>
</tr>
<tr>
<td>Vegetables</td>
<td>3.1</td>
<td>2.2</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>(.4)</td>
<td>(.4)</td>
<td>(.3)</td>
</tr>
<tr>
<td>Fruit Trees</td>
<td>1.3</td>
<td>2.6</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>(.3)</td>
<td>(.3)</td>
<td>(.2)</td>
</tr>
<tr>
<td>Other</td>
<td>2.0</td>
<td>1.1</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>(.7)</td>
<td>(.3)</td>
<td>(.3)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6.6</td>
<td>6.8</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>(.8)</td>
<td>(.6)</td>
<td>(.5)</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

In addition, we consider the average share of land holding across the different crop categories for household plots as presented in Figure 1. For the average control plot, 60% of the land is allocated to vegetable production and 18% is allocated to fruit production. Conversely, an average plot from the treatment group allocates 28% of the land to vegetable production and 53% to fruit production. Treatment and control households have significant differences between their vegetable and fruit land allocation.

Figure 1: Average Land Distribution for Control and Treatment Households

4 T-tests are significant at the 10% and 1% levels of significance, respectively.
5 T-tests are significant at the 1% level of significance.
Respondents were asked a series of questions regarding the type of pump used to draw water from their well. For most of the questions there was an overwhelming consensus on one answer, in which detailed breakdown of the distribution among treatment groups would not provide additional insight. For example, when asked what is the primary type of pump used to withdraw water, 98% of respondents use electric while 2% use an engine diesel pump. These results are as we would expect given Vietnam’s high rates of access to electricity, 99% coverage according to recent World Bank data.\(^6\) We find that diesel pumps are used in instances when households cannot connect to the main grid.

Results of all pump and well characteristics are presented in Table 10 below.

<table>
<thead>
<tr>
<th>Table 10: Pump and Well Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pump type</strong></td>
</tr>
<tr>
<td>Electric</td>
</tr>
<tr>
<td>Engine/Diesel</td>
</tr>
<tr>
<td><strong>Size of Pump Inlet</strong></td>
</tr>
<tr>
<td>&lt; 60 mm</td>
</tr>
<tr>
<td>60 mm</td>
</tr>
<tr>
<td>&gt; 60 mm</td>
</tr>
<tr>
<td><strong>Pump Power</strong></td>
</tr>
<tr>
<td>1 horsepower</td>
</tr>
<tr>
<td>1.5 horsepower</td>
</tr>
<tr>
<td>2 horsepower</td>
</tr>
<tr>
<td>&gt; 2 horsepower</td>
</tr>
<tr>
<td><strong>Well Depth</strong></td>
</tr>
<tr>
<td>0 – 5 meters</td>
</tr>
<tr>
<td>5 – 10 meters</td>
</tr>
<tr>
<td>11 - 15</td>
</tr>
<tr>
<td>&gt; 15 meters</td>
</tr>
<tr>
<td><strong>Lift to Elevated Tank?</strong></td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

**Customer Satisfaction**

Treatment households were provided an additional module in the survey instrument requesting feedback on their experience with MIT products and service provision. Only 61 of the treatment households answered this module and thus the sample size for Tables 11-14 is \(n = 61\).

Table 11 shows that the majority of treatment households heard about MIT through word of mouth (80%) with print literature being the second most common method of awareness (13%).

\(^6\) http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS
Roughly 23% of treatment households said they received no services from the supplier while 21% received credit services and 14% received installation guidance. Almost no households, only 3%, received actual installation services, and only 2% received guarantees. These figures follow a shift in program design. Initially, installation services were established at the start of the project; however, the project adapted as staff learned that farmers preferred to install the systems themselves after receiving training or guidance. The project then developed installation guidance (a printed leaflet) to encourage materials suppliers to provide installation guidance as an embedded service along with materials.

Table 13 presents level of satisfaction with both MIT products and services. Respondents were provided with the option to select dissatisfaction; however, all answered within the range of very satisfied to neutral. While 90% of households report being very satisfied with the product, only 78% are very satisfied with the services provided. Overall 98% and 97% report some level of satisfaction with the MIT product and services, respectively.
Similarly, we see in Table 14 that while 70% of treatment households have recommend the MIT product, only 43% have also recommend their MIT supplier.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>70%</td>
<td>43%</td>
</tr>
<tr>
<td></td>
<td>(6)</td>
<td>(6)</td>
</tr>
<tr>
<td>No</td>
<td>30%</td>
<td>57%</td>
</tr>
<tr>
<td></td>
<td>(6)</td>
<td>(6)</td>
</tr>
</tbody>
</table>

*Standard errors in parentheses*

**Crop Productivity and Water Use**

**Crop Production**

Respondents were asked a series of questions regarding their crop production and harvests as well as irrigation practices and water usage for the 2014/2015 season. Based on the self-reported figures we calculated average seeding costs, crop revenue, and input costs per square meter of land, from which we derived crop profit per square meter estimates as presented in Tables 15 (local currency VND) and 16 ($USD PPP) below.

We find the differences between treatment and control groups are statistically significant for all crop production indicators: seed costs, crop revenue, input costs, and crop profit. The results are very promising demonstrating that MIT users earned, on average, more than double per square meter of cultivated land than control households. Specifically, treatment households earned $17 PPP of crop profit per square meter of land in comparison to control households who earned $8 PPP profit per square meter of land. Statistically significant results of this magnitude, particularly given the small sample size, demonstrate the effectiveness of MIT.

<table>
<thead>
<tr>
<th></th>
<th>Seed Costs</th>
<th>Crop Revenue</th>
<th>Input Costs</th>
<th>Crop Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>18,268</td>
<td>119,161</td>
<td>34,627</td>
<td>66,273</td>
</tr>
<tr>
<td></td>
<td>(5,484)</td>
<td>(24,263)</td>
<td>(4,428)</td>
<td>(19,125)</td>
</tr>
<tr>
<td>Treatment</td>
<td>6,293</td>
<td>221,478</td>
<td>64,575</td>
<td>150,626</td>
</tr>
<tr>
<td></td>
<td>(3,958)</td>
<td>(44,260)</td>
<td>(6,016)</td>
<td>(43,135)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>11,441</td>
<td>177,491</td>
<td>51,700</td>
<td>114,362</td>
</tr>
<tr>
<td></td>
<td>(3,264)</td>
<td>(27,303)</td>
<td>(3,923)</td>
<td>(25,929)</td>
</tr>
</tbody>
</table>

*Standard errors are in parentheses.*

---

7 Local VND were converted to $USD PPP using the World Bank PPP Vietnam conversion factor for private consumption (PPP factor = 8,769.16) http://data.worldbank.org/indicator/PA.NUS.PRVT.PP

8 Seed costs t-test is significant at the 10% level. Crop revenue t-test is significant at the 5% level. Input costs t-test is significant at the 1% level. Crop profit t-test is significant at the 10% level.
We standardized per unit of land (square meter) for equal comparison of costs and profit productivity on a standard plot size. However, it is also helpful to consider aggregate costs, revenue, and profit to compare if treatment households are also earning and spending more overall. Total crop margins are presented in Table 17 ($USD PPP). While we do see higher aggregate crop profits, revenues, and input costs for treatment households, none of these differences are statistically significant.

Interestingly, there is a significant difference in spending on input costs between groups where treatment households spend more on input costs than control households. Figure 2 provides a detailed picture of the various components that comprise total input costs. On average, treatment households spent 29,948 VND (3.50 $USD PPP) more on input costs per square meter than control households.9

### Table 16: Average Crop Margins per Square Meter, $USD PPP

<table>
<thead>
<tr>
<th></th>
<th>Seed Costs</th>
<th>Crop Revenue</th>
<th>Input Costs</th>
<th>Crop Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.1 (0.6)</td>
<td>14 (3)</td>
<td>3.9 (0.5)</td>
<td>7.6 (2.2)</td>
</tr>
<tr>
<td>Treatment</td>
<td>0.7 (0.5)</td>
<td>25 (5)</td>
<td>7.4 (0.7)</td>
<td>17.2 (5)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1.3 (0.4)</td>
<td>20 (3)</td>
<td>5.9 (0.4)</td>
<td>13.0 (3)</td>
</tr>
</tbody>
</table>

*Standard errors are in parentheses.*

**Table 17: Average Total Crop Margins, $USD PPP**

<table>
<thead>
<tr>
<th></th>
<th>Seed Costs</th>
<th>Crop Revenue</th>
<th>Input Costs</th>
<th>Crop Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>3,902 (1,2424)</td>
<td>22,381 (5,826)</td>
<td>6,470 (807)</td>
<td>12,009 (4,981)</td>
</tr>
<tr>
<td>Treatment</td>
<td>1,755 (1,137)</td>
<td>33,712 (6,203)</td>
<td>9,827 (868)</td>
<td>22,138 (6,088)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,678 (839)</td>
<td>28,841 (4,334)</td>
<td>8,384 (604)</td>
<td>17,784 (4,078)</td>
</tr>
</tbody>
</table>

9 T-test is significant at the 1% level.
When considering each individual input, we find there is no significant difference on average spending between treatment and control households for chemical, electricity, and other input costs. We do find that treatment households spend more on fertilizer, labor, and fuel inputs than control households.\textsuperscript{10}

It is worth considering how greater spending on production inputs by treatment households may influence any differences in productivity and water efficiency between treatment and control, outside the scope of the MIT program. One potential explanation is the increase in “plot productivity” by treatment households. Farmers using MIT technology are estimated to increase their yield for three primary reasons; one, MIT’s narrow pipes allow for denser cropping pattern than furrow irrigation; two, MIT enables more crop cycles per year; and three, MIT enables farmer to expand planting to a larger portion of their land. Each of these activities could be attributed to an increased use of production inputs and costs.

HARVEST AND SALES PRODUCTION

Next we consider average productivity in terms of crop harvest and sales, volume measured in kilograms. Total volume of crops harvested and sold is highly contextual depending upon which crops households decided to produce. For example, a household will produce less in volume of coriander than say watermelon, however may earn more per kilogram. Figure 3 shows us the difference between aggregate harvest and crops sales within treatment and control households. On average, control households sell a greater percentage of their harvested crops. However, the differences between harvest and sales are not statistically significant.

\textit{Figure 3: Average Household Crop Harvest and Sales Volume in Kgs}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure3.png}
\end{figure}

Methods of Estimating Water Use

Included in the survey instrument was a module that collected self-reported farm-level water use across three distinct crop stages (seedling, growth, and fruiting). Measurements were taken on-site to calculate flowrates for irrigation systems accounting for both micro-sprinkler and flood furrow or hosepipe methods. Water use estimates were calculated using the method presented below:

1) Flow rates (liters/second) were determined by measuring length of time required to fill a 45-liter tank.

\[
\text{Flow rate} \frac{\text{liters}}{\text{second}} = \frac{\text{tank size (liters)}}{\text{fill time (seconds)}}
\]

\textsuperscript{10} T-tests are significant at 5%, 1%, and 1% levels of significance, respectively.
2) For treatment households using microsprinkler systems, flow rates were corrected to account for the system’s operating pressure.

\[
\text{% reduction in flow rate} = 0.004x^2 + 0.0055x + 0.02887
\]

where \(x\) = pressure in meter of water

3) In order to calculate the total amount of water used for an average week, within a given crop cycle per household and crop, we multiplied the corrected flow rate by the duration of a single irrigation event (in seconds) by the frequency of irrigation events per week.

\[
\text{Weekly Water Use}_{ijk} = \text{duration of single irrigation event}_{ijk} \times \text{flow rate}_{ij} \times \text{frequency of events per week}_{ijk}
\]

Where:
- \(i\) = crop cycle (i.e. seedling, growth, and fruiting)
- \(j\) = household
- \(k\) = crop

4) Once we estimated the household’s average weekly water use per crop stage, we estimated the number of crop stage weeks as a function of the household’s specific crop portfolio. To do this we obtained the average crop stage lengths from Food and Agriculture Organization and country staff provided appropriate corrections relevant to the program area.\(^{11}\) We multiplied the weekly water estimates per crop and household by the average length of crop stage to obtain total water use estimates per crop stage.

\[
\text{Total Water Use}_{ijk} = \text{Weekly Water Use}_{ijk} \times \# \text{ of Crop Stages Weeks Per Crop}_{ijk}
\]

5) Finally, to calculate total water used by the household, per crop, during the season we sum the total water used across the three crop stages. This provides us with a detailed analysis of water usage per crop per household. This data was collapsed into crop level averages to provide descriptive statistics along crop type and is presented in Appendix 1. For the purposes of our analysis at the household level, the data was then reshaped and summed to provide water usage estimates at the household level.

\[
\text{Total Water Use for Season}_j = \sum_{i=\text{seedling}}^{\text{fruiting}} \text{Total Water Use}_{ij}
\]

Water Use

Following the method as previously described, average water usage estimates (in liters per square meter) are presented in Table 18. We find that treatment households use significantly less water for seeding and fruiting stages of the crop cycle, as well as in total summation, in comparison to control households per square meter of cultivation.\(^{12}\) In total, treatment households use 32% less water than

---

\(^{11}\) Crop stage length information is presented in Appendix 2.

\(^{12}\) T-test for seeding usage is significant at the 1% level of significance; t-test for fruiting usage is significant at the 5% level of significance; and t-test for total usage is significant at the 10% level of significance.
control households. Figure 4 presents treatment and control household water use for each crop stage side-by-side for visual comparison.

**Table 18: Average Water Usage (Liters) Per Square Meter, By Crop Stage**

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Treatment</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeding</td>
<td>1,005</td>
<td>412</td>
<td>59%</td>
</tr>
<tr>
<td>(151)</td>
<td>(39)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth</td>
<td>2,948</td>
<td>2,571</td>
<td>13%</td>
</tr>
<tr>
<td>(430)</td>
<td>(534)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruiting</td>
<td>1,551</td>
<td>776</td>
<td>50%</td>
</tr>
<tr>
<td>(367)</td>
<td>(119)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>5,504</td>
<td>3,759</td>
<td>32%</td>
</tr>
<tr>
<td>(850)</td>
<td>(580)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Standard errors in parentheses*

**Figure 4: Average Water Use (l/m²), by Crop Stage**

**Crop Per Drop**

Using average water usage and crop profit figures as presented in Tables 16 and 18, we calculated a “crop per drop” efficiency estimate as present the results in Table 19. Crop per drop refers to the estimated earnings from crop production per liter of water applied. Although treatment households earned more money from each liter of water applied, the differences in our crop per drop estimates for control and treatment households are not statistically significant.\(^{13}\) This is due in part to variable construction and the associated high standard errors for our small sample. However, recalling that differences in average crop profit and water usage are statistically significant we find supporting evidence that treatment households have relatively greater water-use productivity than control households.

**Table 19: Crop Per Drop (Currency / Liter)**

<table>
<thead>
<tr>
<th></th>
<th>VND</th>
<th>$USD, PPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>22</td>
<td>.002</td>
</tr>
<tr>
<td>(8)</td>
<td>(.001)</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>44</td>
<td>.005</td>
</tr>
<tr>
<td>(23)</td>
<td>(.003)</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>35</td>
<td>.004</td>
</tr>
<tr>
<td>(14)</td>
<td>(.002)</td>
<td></td>
</tr>
</tbody>
</table>

\(^{13}\) P-value = 0.37
In addition to analyzing crop per drop at the household level, crop level analysis was conducted to determine if there are any significant differences between treatment groups among various crops. Among the 23 different crops grown by households in this study, only 14 were grown by both treatment and control households. Table 20 presents the distribution of crops produced by treatment and control households.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Control</th>
<th>Treatment</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grapes</td>
<td>14</td>
<td>45</td>
<td>59</td>
</tr>
<tr>
<td>Onion Root</td>
<td>16</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>Turnip</td>
<td>13</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td>Carrot*</td>
<td>8</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Chili</td>
<td>7</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Garlic*</td>
<td>9</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Peanut</td>
<td>2</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Onion Leaves</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Asparagus</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Coriander</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Tomato</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Watermelon</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Jicama</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Chinese Cozla</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Corn</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Green Melon</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Basil</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Custard Apple</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Eggplant</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Green Dragon</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Radish</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Vietnamese Apple</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

When analyzing crop per drop statistics for the 14 crops produced by both treatment and control households, we find only a significant difference for carrots and garlic.\(^{14}\) For both carrot and garlic production treatment households earned on average $0.009, PPP per liter in comparison to control households’ earnings of $0.001, PPP per liter. Appendix 1 has the full crop analysis for all crops, stratified by treatment and control groups, including statistics on land allocation, water usage, and crop revenue. Interestingly, while some crops were more profitable for control households than treatment in terms of crop revenue per square meter, after conducting crop pre drop analysis we see those signs reversed and that treatment households fared better in terms of revenue per liter of water used. This also suggests that treatment households have relatively greater water-use productivity than control households and gains are due in part to improved water-efficiency with the use of MIT.

\(^{14}\) T-tests are significant at 5% and 1% significance levels, respectively.
Conclusion

In summary, we find statistically significant evidence of increased profitability and water-efficiency for farmers using MIT in comparison to traditional flood and furrow households in our ex-post study. Specifically, MIT farmers earned, on average, $17 of crop profit per square meter of land in comparison to non-users who earned $8 profit per square meter of land.\textsuperscript{15} In addition, the evaluation found that, on average, MIT farmers consume 32\% less water than control households across all stages of crop production.\textsuperscript{16}

Further, while the results are not statistically significant due to a small sample size and variable construction, we do see support for the claim that MIT farmers have increased water-productivity when measured using “crop per drop” ratio, that is the crop profit per liter of water used. Each of the variables used to construct the crop per drop estimate (crop profit per square meter and water usage per square meter) had statistically significant differences between treatment groups. In addition, when conducting crop level analysis we found that while non-users earned more than MIT farmers for specific crops in terms of revenue per square meter, MIT farmers had higher profit comparing water-productivity in terms of crop-per-drop. The magnitudes of the differences were not statistically significant, but the change in sign also supports MIT farmers benefitting from improved water productivity.

\textsuperscript{15} Crop profit t-test is significant at the 10\% level and USD values are adjusted for Purchasing Power Parity.

\textsuperscript{16} T-tests is significant at the 1\% level.
### Appendix 1: Crop Level Analysis

<table>
<thead>
<tr>
<th>Crop</th>
<th>Treatment</th>
<th>Land Holding (m²)</th>
<th>Water Use Seeding (l/m²)</th>
<th>Water Use Growth (l/m²)</th>
<th>Water Use Fruiting (l/m²)</th>
<th>Total Water Use (l/m²)</th>
<th>Crop Revenue per m² ($USD, PPP)</th>
<th>% Difference</th>
<th>Crop per Drop ($USD, PPP)</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>0</td>
<td>630</td>
<td>3,015</td>
<td>14,220</td>
<td>14,510</td>
<td>31,745</td>
<td>$9.71</td>
<td>-35%</td>
<td>$0.001</td>
<td>14%</td>
</tr>
<tr>
<td>Asparagus</td>
<td>1</td>
<td>675</td>
<td>620</td>
<td>4,218</td>
<td>4,304</td>
<td>9,142</td>
<td>$6.33</td>
<td>-</td>
<td>$0.001</td>
<td>-</td>
</tr>
<tr>
<td>Basil</td>
<td>0</td>
<td>252</td>
<td>2,857</td>
<td>3,571</td>
<td>4,464</td>
<td>10,893</td>
<td>$9.40</td>
<td>-</td>
<td>$0.001</td>
<td>-</td>
</tr>
<tr>
<td>Carrot</td>
<td>0</td>
<td>720</td>
<td>2,097</td>
<td>4,665</td>
<td>432</td>
<td>7,193</td>
<td>$6.48</td>
<td>6%</td>
<td>$0.001</td>
<td>830%</td>
</tr>
<tr>
<td>Carrot</td>
<td>1</td>
<td>1,080</td>
<td>1,543</td>
<td>2,477</td>
<td>3,803</td>
<td>7,256</td>
<td>$13.03</td>
<td>-36%</td>
<td>$0.003</td>
<td>2%</td>
</tr>
<tr>
<td>Chili</td>
<td>0</td>
<td>694</td>
<td>977</td>
<td>2,477</td>
<td>3,803</td>
<td>7,256</td>
<td>$8.30</td>
<td>-</td>
<td>$0.003</td>
<td>-</td>
</tr>
<tr>
<td>Chili</td>
<td>1</td>
<td>756</td>
<td>515</td>
<td>679</td>
<td>1,169</td>
<td>2,363</td>
<td>$15.33</td>
<td>-27%</td>
<td>$0.006</td>
<td>553%</td>
</tr>
<tr>
<td>Chinese Coza</td>
<td>0</td>
<td>360</td>
<td>27</td>
<td>746</td>
<td>124</td>
<td>897</td>
<td>$11.25</td>
<td>-</td>
<td>$0.041</td>
<td>-</td>
</tr>
<tr>
<td>Chinese Coza</td>
<td>1</td>
<td>720</td>
<td>29</td>
<td>244</td>
<td>0</td>
<td>273</td>
<td>$12.86</td>
<td>-109%</td>
<td>$0.000</td>
<td>-141%</td>
</tr>
<tr>
<td>Coriander</td>
<td>0</td>
<td>641</td>
<td>2,666</td>
<td>3,555</td>
<td>3,110</td>
<td>9,331</td>
<td>$2.86</td>
<td>-</td>
<td>$0.000</td>
<td>-</td>
</tr>
<tr>
<td>Coriander</td>
<td>1</td>
<td>972</td>
<td>626</td>
<td>835</td>
<td>731</td>
<td>2,192</td>
<td>-$0.27</td>
<td>-</td>
<td>$0.000</td>
<td>-</td>
</tr>
<tr>
<td>Corn</td>
<td>0</td>
<td>1,260</td>
<td>405</td>
<td>506</td>
<td>409</td>
<td>1,321</td>
<td>$0.64</td>
<td>-</td>
<td>$0.001</td>
<td>-</td>
</tr>
<tr>
<td>Custard Apple</td>
<td>0</td>
<td>2,880</td>
<td>281</td>
<td>1,313</td>
<td>963</td>
<td>2,556</td>
<td>$0.28</td>
<td>-</td>
<td>$0.000</td>
<td>-</td>
</tr>
<tr>
<td>Eggplant</td>
<td>1</td>
<td>1,440</td>
<td>51</td>
<td>846</td>
<td>829</td>
<td>1,725</td>
<td>$0.62</td>
<td>-</td>
<td>$0.000</td>
<td>-</td>
</tr>
<tr>
<td>Garlic</td>
<td>0</td>
<td>620</td>
<td>1,975</td>
<td>3,650</td>
<td>429</td>
<td>6,055</td>
<td>$3.24</td>
<td>-</td>
<td>$0.001</td>
<td>-</td>
</tr>
<tr>
<td>Garlic</td>
<td>1</td>
<td>840</td>
<td>882</td>
<td>955</td>
<td>87</td>
<td>1,924</td>
<td>$16.00</td>
<td>-19%</td>
<td>$0.012</td>
<td>5%</td>
</tr>
<tr>
<td>Grape</td>
<td>0</td>
<td>987</td>
<td>448</td>
<td>5,340</td>
<td>974</td>
<td>6,762</td>
<td>$44.20</td>
<td>-</td>
<td>$0.013</td>
<td>-</td>
</tr>
<tr>
<td>Grape</td>
<td>1</td>
<td>1,034</td>
<td>474</td>
<td>3,869</td>
<td>809</td>
<td>5,153</td>
<td>$35.60</td>
<td>-</td>
<td>$0.009</td>
<td>-</td>
</tr>
<tr>
<td>Green Dragon</td>
<td>1</td>
<td>3,600</td>
<td>754</td>
<td>1,218</td>
<td>754</td>
<td>2,727</td>
<td>$1.39</td>
<td>-</td>
<td>$0.011</td>
<td>-</td>
</tr>
<tr>
<td>Green Melon</td>
<td>0</td>
<td>540</td>
<td>804</td>
<td>4,620</td>
<td>420</td>
<td>5,844</td>
<td>$4.81</td>
<td>-</td>
<td>$0.000</td>
<td>-</td>
</tr>
<tr>
<td>Jicama</td>
<td>1</td>
<td>1,224</td>
<td>99</td>
<td>924</td>
<td>87</td>
<td>1,111</td>
<td>$2.54</td>
<td>-</td>
<td>$0.006</td>
<td>-</td>
</tr>
<tr>
<td>Onion Leaves</td>
<td>0</td>
<td>1,140</td>
<td>133</td>
<td>798</td>
<td>38</td>
<td>968</td>
<td>$21.31</td>
<td>-170%</td>
<td>$0.010</td>
<td>-1041%</td>
</tr>
<tr>
<td>Onion Leaves</td>
<td>1</td>
<td>744</td>
<td>56</td>
<td>380</td>
<td>58</td>
<td>495</td>
<td>-$14.83</td>
<td>-</td>
<td>$0.018</td>
<td>-85%</td>
</tr>
<tr>
<td>Onion Root</td>
<td>0</td>
<td>924</td>
<td>1,282</td>
<td>1,963</td>
<td>281</td>
<td>3,527</td>
<td>$22.21</td>
<td>79%</td>
<td>$0.018</td>
<td>-</td>
</tr>
<tr>
<td>Onion Root</td>
<td>1</td>
<td>1,140</td>
<td>714</td>
<td>1,369</td>
<td>1,53</td>
<td>2,236</td>
<td>$4.74</td>
<td>-3%</td>
<td>$0.003</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>2,700</td>
<td>1,186</td>
<td>2,739</td>
<td>1,519</td>
<td>5,444</td>
<td>$3.83</td>
<td>-67%</td>
<td>$0.001</td>
<td>10%</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1,080</td>
<td>240</td>
<td>370</td>
<td>215</td>
<td>825</td>
<td>$1.26</td>
<td>-</td>
<td>$0.002</td>
<td>-</td>
</tr>
<tr>
<td>Peanut</td>
<td>0</td>
<td>720</td>
<td>770</td>
<td>4,425</td>
<td>381</td>
<td>5,577</td>
<td>$4.33</td>
<td>63%</td>
<td>$0.006</td>
<td>-37%</td>
</tr>
<tr>
<td>Peanut</td>
<td>1</td>
<td>1,035</td>
<td>531</td>
<td>1,176</td>
<td>92</td>
<td>1,799</td>
<td>$7.07</td>
<td>-</td>
<td>$0.004</td>
<td>-</td>
</tr>
<tr>
<td>Radish</td>
<td>1</td>
<td>720</td>
<td>189</td>
<td>813</td>
<td>95</td>
<td>1,097</td>
<td>$1.44</td>
<td>-</td>
<td>$0.001</td>
<td>-</td>
</tr>
<tr>
<td>Tomato</td>
<td>0</td>
<td>630</td>
<td>335</td>
<td>2,326</td>
<td>3,889</td>
<td>6,550</td>
<td>$6.45</td>
<td>-23%</td>
<td>$0.001</td>
<td>826%</td>
</tr>
<tr>
<td>Tomato</td>
<td>1</td>
<td>1,026</td>
<td>388</td>
<td>589</td>
<td>830</td>
<td>1,808</td>
<td>$4.96</td>
<td>-34%</td>
<td>$0.002</td>
<td>1623%</td>
</tr>
<tr>
<td>Turnip</td>
<td>0</td>
<td>900</td>
<td>154</td>
<td>504</td>
<td>1,166</td>
<td>1,825</td>
<td>$2.84</td>
<td>-</td>
<td>$0.026</td>
<td>-</td>
</tr>
<tr>
<td>Turnip</td>
<td>1</td>
<td>1,560</td>
<td>37</td>
<td>135</td>
<td>282</td>
<td>453</td>
<td>$1.88</td>
<td>-</td>
<td>$0.002</td>
<td>-</td>
</tr>
<tr>
<td>Vietnamese Apple</td>
<td>1</td>
<td>1,080</td>
<td>477</td>
<td>3,337</td>
<td>1,087</td>
<td>4,901</td>
<td>$20.96</td>
<td>-</td>
<td>$0.004</td>
<td>-</td>
</tr>
<tr>
<td>Watermelon</td>
<td>0</td>
<td>1,140</td>
<td>646</td>
<td>3,504</td>
<td>456</td>
<td>4,607</td>
<td>$0.92</td>
<td>41%</td>
<td>$0.000</td>
<td>561%</td>
</tr>
<tr>
<td>Watermelon</td>
<td>1</td>
<td>1,080</td>
<td>376</td>
<td>960</td>
<td>112</td>
<td>1,448</td>
<td>$1.29</td>
<td>-</td>
<td>$0.002</td>
<td>-</td>
</tr>
</tbody>
</table>

17 T-test significant at the 1% level of significance.  
18 T-test significant at the 1% level of significance.  
19 T-test significant at the 1% level of significance.
Appendix 2: Crop Stages

<table>
<thead>
<tr>
<th>Crop</th>
<th>Seedling Stage (weeks)</th>
<th>Growth Stage (weeks)</th>
<th>Fruiting Stage (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>12.9</td>
<td>34.3</td>
<td>300.0</td>
</tr>
<tr>
<td>Basil</td>
<td>2.9</td>
<td>2.9</td>
<td>3.6</td>
</tr>
<tr>
<td>Carrot</td>
<td>4.3</td>
<td>11.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Chilli</td>
<td>3.6</td>
<td>7.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Chinese Cozla</td>
<td>0.5</td>
<td>3.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Coriander</td>
<td>4.3</td>
<td>5.7</td>
<td>5.0</td>
</tr>
<tr>
<td>Corn</td>
<td>2.9</td>
<td>3.6</td>
<td>5.0</td>
</tr>
<tr>
<td>Custard Apple (new)</td>
<td>4.3</td>
<td>30.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Custard Apple (repeated)</td>
<td>4.3</td>
<td>15.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Eggplant</td>
<td>4.3</td>
<td>6.4</td>
<td>21.0</td>
</tr>
<tr>
<td>Garlic</td>
<td>4.0</td>
<td>8.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Grapes (new)</td>
<td>2.9</td>
<td>30.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Grapes (repeated)</td>
<td>2.9</td>
<td>5.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Green Dragon</td>
<td>13.0</td>
<td>21.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Green Melons</td>
<td>3.6</td>
<td>11.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Jicama</td>
<td>1.0</td>
<td>15.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Onion Leaves</td>
<td>0.5</td>
<td>3.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Onion Roots</td>
<td>4.0</td>
<td>8.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Peanut</td>
<td>5.0</td>
<td>12.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Radish</td>
<td>1.0</td>
<td>4.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Tomato</td>
<td>4.3</td>
<td>6.4</td>
<td>10.7</td>
</tr>
<tr>
<td>Turnip</td>
<td>0.7</td>
<td>1.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Vietnamese Apple (new)</td>
<td>4.3</td>
<td>30.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Vietnamese Apple (repeated)</td>
<td>4.3</td>
<td>15.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Water Melons</td>
<td>2.9</td>
<td>13.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Other</td>
<td>3.9</td>
<td>12.1</td>
<td>17.6</td>
</tr>
</tbody>
</table>

Notes: 1) Crop cycle lengths taken from [http://www.fao.org/docrep/x0490e/x0490e0b.htm](http://www.fao.org/docrep/x0490e/x0490e0b.htm) 2) FAO Crop cycle lengths are presented in four stages, for the table above we have combined the 3rd and 4th cycle as both of these correspond to what we are calling the “fruited” stage. 3) Crop cycles lengths “other” are estimated as the average of all the other crops reported in the FAO statistics. 4) iDE staff provided updates to FAO estimates to better reflect the country context.
# Appendix 3: Crop Production and Water-Use Survey Instrument

## INTERVIEW DATA

<table>
<thead>
<tr>
<th>1.1 INTERVIEWER NAME</th>
<th>1.5 IDENTIFICATION # OF RESPONDENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2 INTERVIEW DATE</td>
<td></td>
</tr>
<tr>
<td>1.3 SUPERVISOR NAME</td>
<td></td>
</tr>
<tr>
<td>1.4 SUPERVISOR SIGNATURE</td>
<td></td>
</tr>
</tbody>
</table>

## LOCATION

<table>
<thead>
<tr>
<th>1.6 DISTRICT</th>
<th>1.10 LATITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7 COMMUNE</td>
<td>1.11 LONGITUDE</td>
</tr>
<tr>
<td>1.8 VILLAGE</td>
<td>1.12 ADDRESS</td>
</tr>
</tbody>
</table>

## 1. BASIC HOUSEHOLD DATA

### RESPONDENT DETAILS

<table>
<thead>
<tr>
<th>2.1 RESPONDENT’S FULL NAME</th>
<th>2.6 SEX OF RESPONDENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>Female</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.2 IS RESPONDENT THE HEAD OF HOUSEHOLD?</th>
<th>2.7 RESPONDENT PHONE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>___</td>
</tr>
<tr>
<td>NO</td>
<td>___</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.3 HEAD OF HOUSEHOLD’S FULL NAME</th>
<th>2.8 SEX OF HOUSEHOLD HEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.4 AGE OF HOUSEHOLD HEAD (in years)</th>
<th>2.9 HH Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Poor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.5 EDUCATION OF HOUSEHOLD HEAD</th>
<th>2.10 Ethnicity of HH</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUCATION CODES</td>
<td>Kinh</td>
</tr>
<tr>
<td>00: None</td>
<td></td>
</tr>
<tr>
<td>01: Elementary</td>
<td>03: High School</td>
</tr>
<tr>
<td>02: Secondary</td>
<td>04: College/Univ.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.11 Number of Household Members</th>
<th>2.12 Number of Household Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>Females</td>
</tr>
</tbody>
</table>

## 3. LAND AND WATER USE
<table>
<thead>
<tr>
<th>Questions</th>
<th>Response Options</th>
<th>2014/2015 SEASON*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Land holding in sao?</td>
<td>RICE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VEGETABLES</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FRUIT TREES</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other (grazing, fallow, rented land, etc)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
</tr>
</tbody>
</table>

**TYPE OF PUMP**

<table>
<thead>
<tr>
<th>Type of Pump</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2</td>
<td>What type of pump do you use to withdraw water from your well?</td>
</tr>
<tr>
<td></td>
<td>ENGINE/DIESEL PUMP</td>
</tr>
<tr>
<td></td>
<td>ELECTRIC PUMP</td>
</tr>
<tr>
<td></td>
<td>OTHER</td>
</tr>
<tr>
<td></td>
<td>DO NOT USE A PUMP → Skip</td>
</tr>
<tr>
<td></td>
<td>DO NOT KNOW → Skip</td>
</tr>
<tr>
<td>3.3</td>
<td>Size of the pump inlet?</td>
</tr>
<tr>
<td></td>
<td>Smaller than 42mm</td>
</tr>
<tr>
<td></td>
<td>42mm</td>
</tr>
<tr>
<td></td>
<td>60mm</td>
</tr>
<tr>
<td></td>
<td>60mm</td>
</tr>
<tr>
<td></td>
<td>Larger than 75mm</td>
</tr>
<tr>
<td></td>
<td>Do not know</td>
</tr>
<tr>
<td>3.4</td>
<td>How large is the pump that you use most often?</td>
</tr>
<tr>
<td></td>
<td>1 horsepower</td>
</tr>
<tr>
<td></td>
<td>1.5 horsepower</td>
</tr>
<tr>
<td></td>
<td>2 horsepower</td>
</tr>
<tr>
<td></td>
<td>2.5 horsepower</td>
</tr>
<tr>
<td></td>
<td>3.5 horsepower</td>
</tr>
<tr>
<td></td>
<td>5 horsepower</td>
</tr>
<tr>
<td></td>
<td>Larger than 5 horsepower</td>
</tr>
<tr>
<td></td>
<td>Do not know</td>
</tr>
<tr>
<td>3.5</td>
<td>How deep is the well that you are withdrawing water from?</td>
</tr>
<tr>
<td>3.6</td>
<td>Do you lift water into a tank that is elevated above the plot or field?</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

**FLOW RATE CALCULATION**

<table>
<thead>
<tr>
<th>Flow Rate Calculation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.7</td>
<td>Size of tank/bucket being used in flow rate test?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>3.8</td>
<td>Amount of time to fill the tank?</td>
</tr>
<tr>
<td></td>
<td>[BE SURE TO FILL THE TANK WITH THE PUMP OPERATING AT THE SETTING THAT THE FARMER MOST COMMONLY USES]</td>
</tr>
<tr>
<td></td>
<td>[IF THE TANK IS VERY LARGE, RECORD THE HEIGHT OF WATER IN THE TANK BEFORE AND AFTER THE TEST.]</td>
</tr>
<tr>
<td>3.9</td>
<td>Do you ever use micro sprinklers to apply water to any of your crops?</td>
</tr>
<tr>
<td></td>
<td>No → SKIP</td>
</tr>
<tr>
<td>3.10</td>
<td>What is the irrigation system’s operating pressure?</td>
</tr>
<tr>
<td></td>
<td>[USE PRESSURE GAUGE TO MEASURE THE SYSTEMS PRESSURE WHILE THE SPRINKLERS ARE RUNNING]</td>
</tr>
</tbody>
</table>

19
4. KEY CROP PRODUCTION

Please provide details for the crops you harvested in **2014/2015 SEASON**.

<table>
<thead>
<tr>
<th>Crop Code</th>
<th>Month planted [USE 1-12 for months]</th>
<th>Area planted (In sao)</th>
<th>How many times per year do you grow this crop?</th>
<th>Seed/seedlings Cost</th>
<th>Harvest quantity</th>
<th>Sold quantity</th>
<th>Seedling Stage</th>
<th>Growth Stage</th>
<th>Fruiting Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Micro sprinkler or Flood Furrow/ Hosepipe?</td>
<td>How much time in minutes do you spend irrigating during a single irrigation event?</td>
<td>How many times do you irrigate per week?</td>
</tr>
</tbody>
</table>

IRRIGATED CROPS (2015 SEASON)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
</table>

RAINFED CROPS (2014/2015 SEASON)

<table>
<thead>
<tr>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
</table>

SEED UNIT CODES: 1: Grams 2: KG 3: Plant/piece

UNIT CODES: 1: KG 2: 100KG 3: TON
### 5. OTHER INPUT AND PRODUCTION COSTS

<table>
<thead>
<tr>
<th>INPUT TYPE</th>
<th>TOTAL COST FOR RAINFED PRODUCTION IN 2014/2015 SEASON*</th>
<th>TOTAL COST FOR IRRIGATED PRODUCTION IN 2014/2015 SEASON*</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 CHEMICALS (pesticides- herbicides, acaricides, fungicides, etc)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2 FERTILIZERS (inorganic and purchased organic fertilizers)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3 Labor/services (hired labor, machinery/tool rent, land rent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4 Fuel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5 Electricity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.6 Other inputs (plastics, transport, etc.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 6. CUSTOMER SATISFACTION

FOR THE 2014/2015 SEASON PLEASE ANSWER THE FOLLOWING QUESTIONS:

#### INPUT SUPPLIERS

6.1 How did you hear about MIT?

[Read options; select all that apply]

- WORD-OF-MOUTH (NEIGHBOURS, FRIENDS, FAMILY) 1
- LOCAL BUSINESS (SHOP / TRADER) 2
- MEDIA (RADIO, TV, NEWSPAPER) 3
- VILLAGE DEMONSTRATION 4
- PRINT LITERATURE 5
- OTHER _________________________ 6

6.2 How would you rate your satisfaction with the product?

[Read options; select one]

- VERY SATISIFIED 1
- SOMEWHAT SATISFIED 2
- NEITHER SATISFIED NOR DISSATISFIED 3
- SOMEWHAT DISSATISFIED 4
| 6.3 | Have you recommended this product to someone else? | YES | 1 |
|     | [Read options; select one] | NO  | 2 |
|     |                                      | DON'T KNOW | 3 |

| 6.4 | What kind of services you received from the material suppliers? | NONE | 1 |
|     | [Read options; select all that apply] | CREDIT/PAYMENT ON INSTALLMENTS | 2 |
|     |                                      | GUARANTEE | 3 |
|     |                                      | INSTALLATION GUIDANCE/ADVICE | 4 |
|     |                                      | INSTALLATION | 5 |
|     |                                      | OTHER ____________ | 6 |

| 6.5 | How satisfied are you with the service you received from the material supplier where you got MIT materials (i.e., pipes, sprinkler head, etc.)? | VERY SATISFIED | 1 |
|     | [Read options; select one] | SOMEWHAT SATISFIED | 2 |
|     |                                      | NEITHER SATISFIED NOR DISSATISFIED | 3 |
|     |                                      | SOMEWHAT DISSATISFIED | 4 |
|     |                                      | VERY DISSATISFIED | 5 |
|     |                                      | DON'T KNOW | 6 |

| 6.6 | Have you recommended this supplier to anyone else? | NO | 0 |
|     |                                      | YES | 1 |

### 7. PROGRESS OUT OF POVERTY INDEX

| 7.1 | How many household members are 14 years old or younger? | TICK |
|     | | A. Three or more |
|     | | B. Two |
|     | | C. One |
|     | | D. None |

| 7.2 | In the past 12 months, how many household members were self-employed in agriculture, forestry, or aquaculture? | TICK |
|     | | A. Four or more |
|     | | B. Two or more |
|     | | C. One or none |
|     | | A. Makeshift or other |
### 7.3 What type is the household’s main residence?

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Semi-permanent house</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Strong house with a shared kitchen or shared bathroom / toilet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Villa or strong house with private kitchen and private bathroom / toilet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 7.4 What type of toilet arrangement does the household have?

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>None or other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Double-vault compost latrine or toilet directly over water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Suilabh or flush toilet with septic tank or sewage pipes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 7.5 What is the household’s main source of water for drinking and cooking?

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Public tap, deep drilled wells, hand-dug and reinforced/no reinforced wells, covered wells, protected/unprotected springs, rain, small water tank, water tank, river, lake, pond, or other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Private tap water inside/outside the house or purchased water (in tank or bottle)</td>
<td></td>
<td></td>
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</tbody>
</table>

### 7.6 What kind of cooker does the household have?

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Electric cooker, rice cooker or pressurized cooker (no gas cooker)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Gas cooker</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 7.7 Does the household have a motorcycle?

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YES</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 7.8 Does the household have a video/DVD player?

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
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<td>NO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YES</td>
<td></td>
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<td></td>
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</tbody>
</table>

### 7.9 Does the household have a wardrobe of any kind?

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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<tbody>
<tr>
<td>NO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YES</td>
<td></td>
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</tbody>
</table>

### 7.10 Does the household have a refrigerator or freezer?

<p>| | | | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YES</td>
<td></td>
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</table>

**END INTERVIEW.**

[Ask the respondent if he/she has anything to add or any questions to iDE]

### 8. DATA ENTRY RECORD

<table>
<thead>
<tr>
<th>9.1</th>
<th>DATA ENTRY CLERK NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.2</td>
<td>DATA ENTRY CLERK SIGNATURE</td>
</tr>
<tr>
<td>9.3</td>
<td>DATA ENTRY DATE</td>
</tr>
<tr>
<td></td>
<td>Y Y Y Y M M D D</td>
</tr>
</tbody>
</table>

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23