

# Impact Evaluation of the MCC-Funded Rural Water Supply Activity (RWSA) in Nampula, Mozambique

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# Rural Water Supply Activity (RWSA)

- Installation of 600 handpumps in rural communities across the provinces of Nampula (358) and Cabo Delgado (242)
- Installation of 10 small scale solar systems in Cabo Delgado





The objectives of the RWSA, as stated in the Compact, are to **increase beneficiary productivity and income** through:

- Time savings
- Reducing water-related illnesses (diarrhea, dysentery, etc.)

## **Demand Response Approach**

Communities submitted an application +  
Contributed 2,500 MZN (\$86 USD)











The **water committee** received training on:

- Handpump operation and maintenance
- Hygiene and sanitation (PHAST or CLTS)



PHAST = Participatory Hygiene And Sanitation Transformation

CLTS = Community Led Total Sanitation

# Research Approach

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# Principle Objective of Impact Evaluation

- Impact evaluations seek to provide confident causal inference about the link between an intervention and outcomes
- Difficulty is determining what would have happened to the individuals/communities of interest in absence of the project
- **Our Task:** Identify the impacts of the installation of handpumps in rural communities in Nampula from all other confounding factors

# Research Approach

- **Develop Panel Data:** Compare observed changes in the outcomes for a sample of participants and non-participants
- **Key Assumption:** In the absence of the program, communities selected into the participant and non-participant groups would be changing at the same rate

# Research Design for Phase 2 Communities

**Treatment**

**Comparison**

**Baseline**

$t_0$

$t_0$



**Handpumps  
Installed**



**Follow-up**

$t_1$

$t_1$

# Selection of Treatment Communities

- Treatment communities were randomly selected from the communities included in Phase 1 and 2 of the Rural Water Points Installation Program (RWPIP) in Nampula
  - Phase 1 Districts: Meconta, Mogovolas, and Nampula-Rapale
  - Phase 2 Districts: Moma, Mogincual, and Murrupula

# Selection of Comparison Communities

## Visited District Office

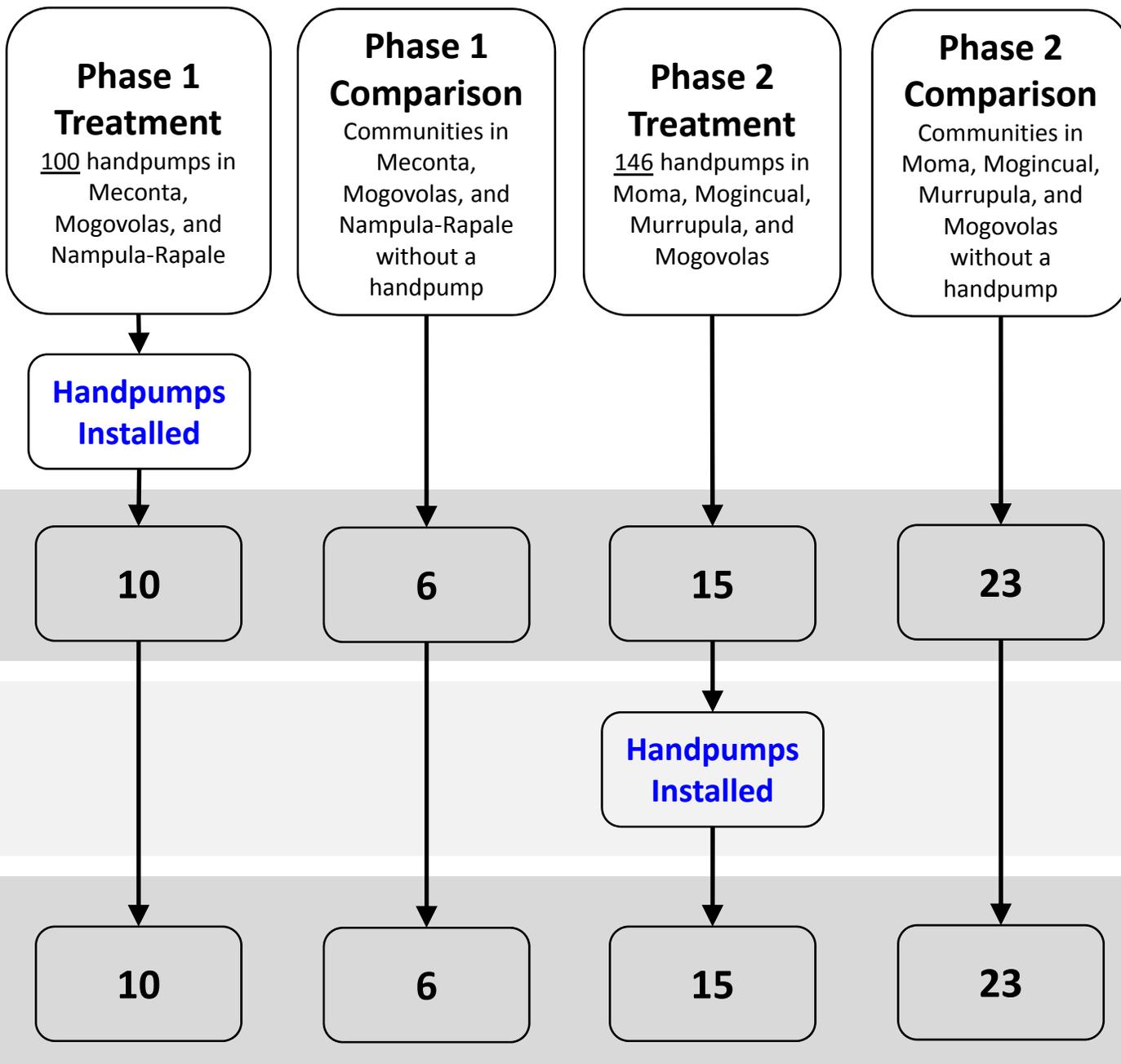
- Informed District Government of impact evaluation study
- Obtained permission to undertake the study

## Visited Localidade

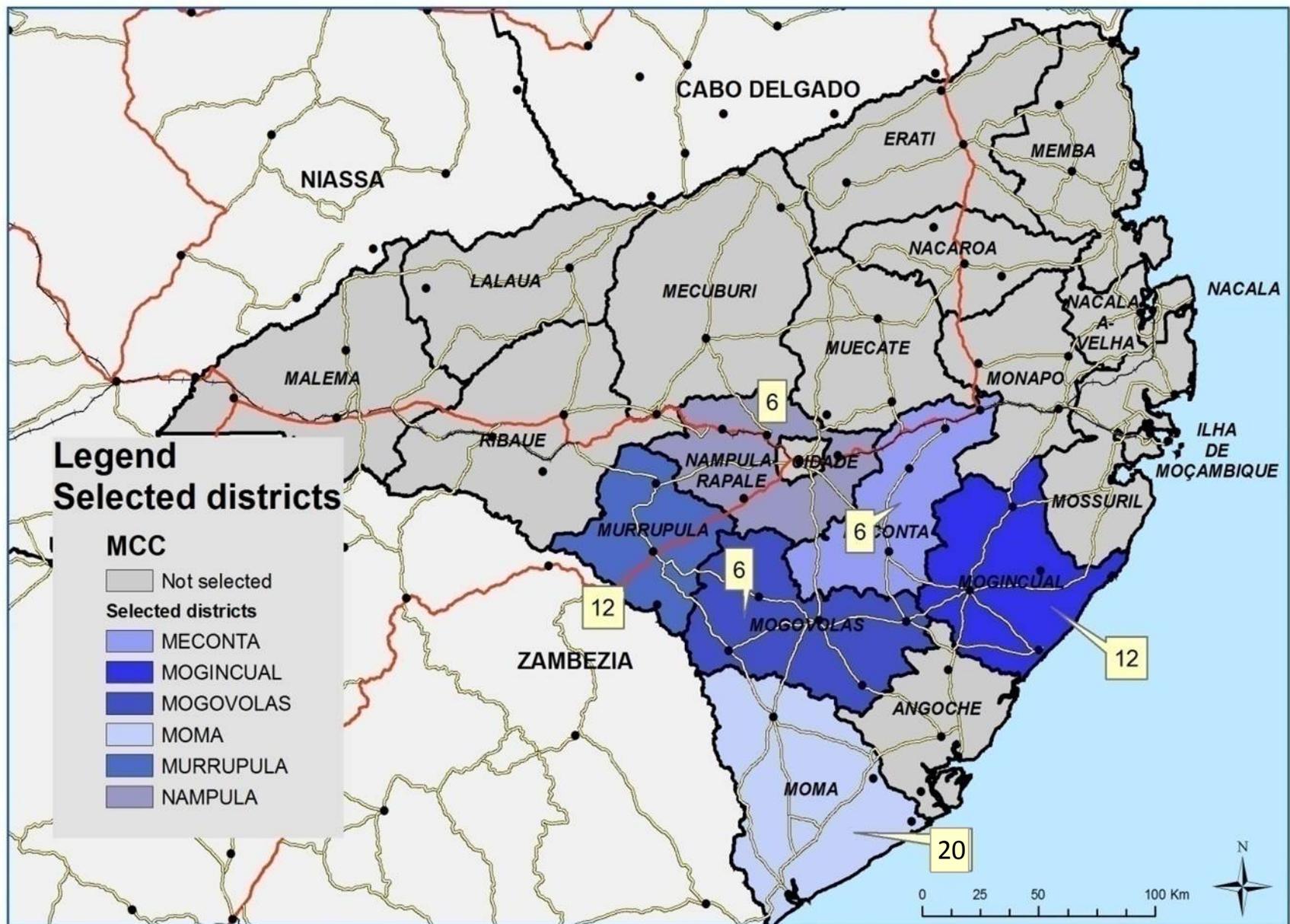
- Informed Localidade Authority of impact evaluation study
- Obtained permission to undertake the study
- Developed list of potential comparison communities with the *Chefe de Localidade*
  - Dry communities were excluded
- The *Chefe de Localidade* randomly selected the comparison communities (one for each treatment community in Localidade)



# Sample Frame at Follow-up (2013)







# Final Sample Frame

	Community Classification	Number of Communities in Group	Number of Communities by District
Phase 1	Treatment	10	4 Meconta 3 Mogovolas 3 Rapale
	Comparison	6	2 Meconta 1 Mogovolas 3 Rapale
Phase 2	Treatment	15	8 Mogincual 3 Murrupula 2 Mogovolas 2 Moma
	Comparison	23	4 Mogincual 8 Murrupula 1 Mogovolas 10 Moma

# Sample Validity

- Following the baseline study:
  - 9 treatment communities became comparison communities
  - 8 comparison communities became treatment communities
- ANOVA test comparing the overall difference in means between treatment and comparison communities **at baseline** showed that for 13 of 15 key variables, the differences were not statistically significant

# Data Collection

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# Data Collection Activities (RWSA)

Activity	2011 Baseline Study	2013 Follow-up Study
Household Surveys	<p style="text-align: center;"><b>1,579</b></p> <p style="text-align: center;">(54 communities: 27 treatment; 27 comparison)</p>	<p style="text-align: center;"><b>1,826</b></p> <p style="text-align: center;">(62 communities: 32 treatment; 30 comparison)</p>
Water Committee/ Leader Interviews	<p style="text-align: center;"><b>54</b></p>	<p style="text-align: center;"><b>31</b></p>
Water Sampling	<p style="text-align: center;"><b>11 communities</b></p> <p style="text-align: center;">(39 community water sources and 259 household containers)</p>	<p style="text-align: center;"><b>11 communities</b></p> <p style="text-align: center;">(32 community water sources and 873 household containers; water source variability tested in 4 communities)</p>
Handpump Observations	<p style="text-align: center;">NA</p>	<p style="text-align: center;"><b>17</b></p> <p style="text-align: center;">(17 communities)</p>

73% of the households interviewed during the baseline study were surveyed again in the follow-up study



# Fieldwork Preparation

- Household surveyors and water quality testing team members were trained for 2 weeks
- A pilot study was undertaken to test instruments and fieldwork protocols



# Fieldwork Preparation

- Following pilot – surveyors were retrained and instruments/ protocols were revised
- Three household surveying teams consisted of:
  - 1 team leader
  - 3 household surveyors
  - 1 driver



# Fieldwork Preparation

- Stanford-VT-WE Consult team supported the water sampling team (*consisting primarily of Universidade Lúrio students*) in the field and laboratory work



# Household Survey Teams (in field)



# Household Survey

- Household surveys undertaken using PDAs
- Data were cleaned during fieldwork
  - Enumerators were provided with feedback on their data entry errors and outliers were checked
  - Feedback dramatically reduced the number of recurring errors
- Summary data were sent to the MCA/MCC every two weeks during fieldwork



# Respondent/ Household Characteristics



	Baseline		Follow-up	
	Mean	Median	Mean	Median
Age of survey respondent	39.6	38	39.7	37
% female	38%	—	44%	—
% literate	32%	—	32%	—
Number in household	4.2	4	4.2	4
Number of children < 5	0.7	1	0.7	1

# Water Sources Used by Households

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78% of the households surveyed in the **treatment communities** reported using a handpump

**Phase 2 Treatment – Percent of Households Using Source and Percent of Total Water Collected from Source**

	<b>% of HHs Using Source</b>	
	Baseline	Follow-Up
<b>Handpump</b>	9%	<b>78%</b>
<b>Unprotected Well</b>	85%	<b>21%</b>
<b>River/Lake</b>	16%	9%

The water sources used by households in the **comparison communities** remained relatively unchanged from the baseline to follow-up study

**Phase 2 Comparison – Percent of Households Using Source and Percent of Total Water Collected from Source**

	<b>% of HHs Using Source</b>	
	Baseline	Follow-Up
<b>Handpump</b>	10%	2%
<b>Unprotected Well</b>	<b>78%</b>	<b>65%</b>
<b>River/Lake</b>	15%	35%

# Water Consumption

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All Sources and Improved Sources

The installation of the MCA handpumps are associated with an insignificant **2.5 LPCD** increase in **median water consumption** (from all sources) ( $p < 0.1$ )

**Phase 2 Median Total Liters per Capita per Day (LPCD) (All Sources)**

	Number of Communities	Baseline	Follow-Up	Difference
		Mean of Median LPCD	Mean of Median LPCD	LPCD
<b>Treatment</b>	15	17.2	19.5	2.3
<b>Comparison</b>	23	18.5	18.3	-0.2
			Difference in Differences	2.5

Significance codes: \*\*\*  $p < 0.001$  \*\*  $0.001 > p < 0.01$  \*  $0.01 > p < 0.05$  .  $0.05 > p < 0.10$

# Significance Key

Significance codes: \*\*\*  $p < 0.001$  \*\*  $0.001 > p < 0.01$  \*  $0.01 > p < 0.05$  .  $0.05 > p < 0.10$

$p < 0.001$  = **very strong evidence** that there is a difference between treatment and comparison

$0.001 < p < 0.01$  = **strong evidence** that there is a difference ...

$0.01 < p < 0.05$  = **evidence** that there is a difference ...

$0.05 < p < 0.1$  = **indication** that there is a difference ...

The installation of the MCA handpumps are associated with an **15.1 LPCD** increase in **median water consumption** (from improved sources) ( $p < 0.001$ )



### Phase 2 Median Total Liters per Capita per Day (LPCD) from *Improved Sources*

	Number of Communities	Baseline	Follow-Up	Difference
		Mean of Median LPCD	Mean of Median LPCD	LPCD
<b>Treatment</b>	15	0.0	15.1	15.1***
<b>Comparison</b>	23	1.8	0.2	-1.6
			Difference in Differences	16.7***

Significance codes: \*\*\*  $p < 0.001$  \*\*  $0.001 > p < 0.01$  \*  $0.01 > p < 0.05$  .  $0.05 > p < 0.10$

In treatment communities, 3 out of every 4 buckets of water collected are from an improved source

**Phase 2 Median Total Liters per Households per Day (LPD)**

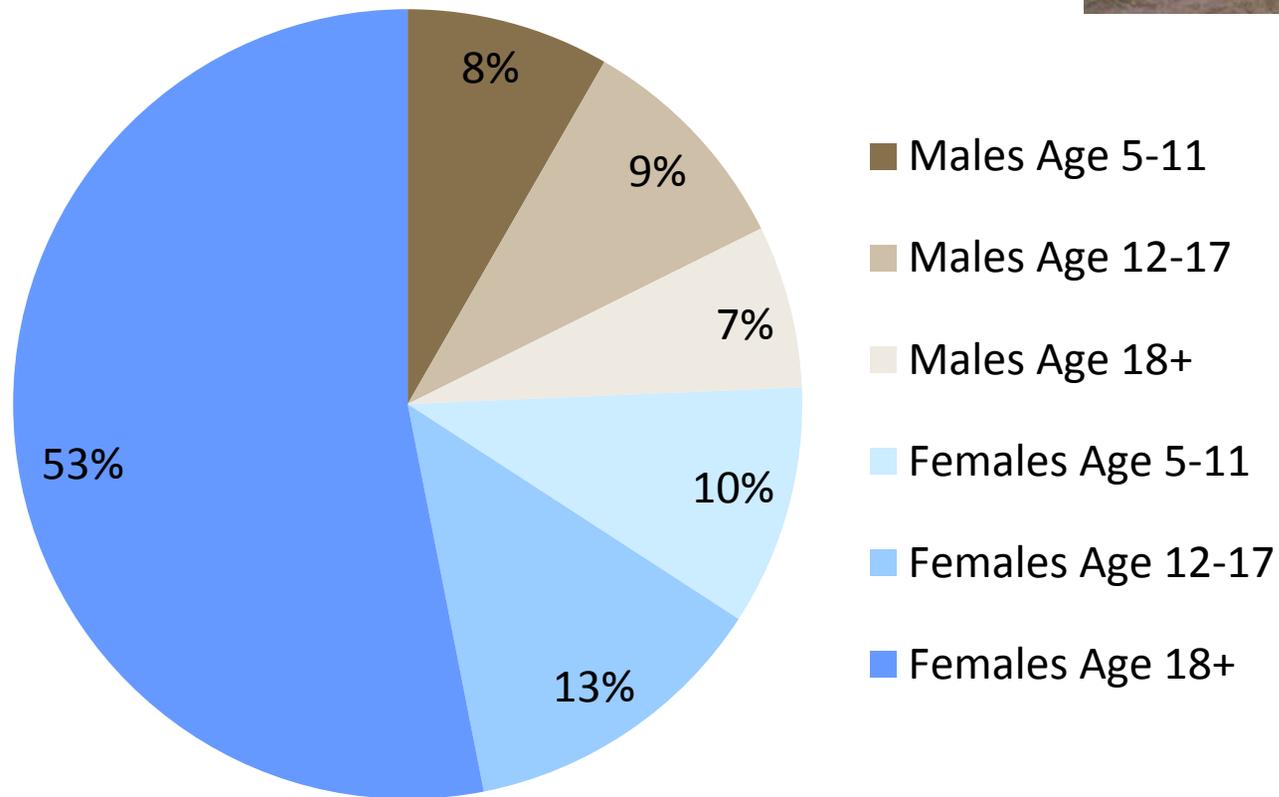
Phase/ Community	Number of Communities	Baseline	Follow-Up	Difference
		Mean of Median LPD	Mean of Median LPD	LPD
Treatment (all sources)	15	65.4	76.5	11.1*
Treatment (improved)	15	0.0	58.0	58.0***
Comparison (all sources)	23	75.6	68.5	-7.1
Comparison (improved)	23	7.5	1.3	-6.2

Significance codes: \*\*\* p<0.001 \*\* 0.001>p<0.01 \* 0.01>p<0.05 . 0.05>p<0.10

# Time Spent Collecting Water

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Females account for three quarters (76%) of the total time spent collecting water



Following the installation of the MCA handpumps there was an **88-minute decline** in the time households spent collecting water from all sources, but this decline was **statistically insignificant**

But...

The installation of the MCA handpumps can be associated with a 62-minute reduction in the median roundtrip time to the **‘primary’ source** ( $p < 0.05$ )

**Phase 2 Median Roundtrip Time to *Primary Source***

	Number of Communities	Baseline	Follow-Up	Difference
		Mean of Median Time (Minutes)	Mean of Median Time (Minutes)	Minutes
<b>Treatment</b>	15	161	76	-85**
<b>Comparison</b>	23	137	114	-23
			Difference in Differences	-62*

Significance codes: \*\*\*  $p < 0.001$  \*\*  $0.001 > p < 0.01$  \*  $0.01 > p < 0.05$  .  $0.05 > p < 0.10$

The wait time at the primary source in treatment communities **declined by 41 minutes** relative to comparison communities ( $p < 0.05$ )

No statistically significant change was found in the one-way walk times to the primary source

The installation of the MCA handpump can be associated with a 30% reduction in the total median time females (aged 12 and above) spend collecting water each day

There was no overall reduction in the time males spent collecting water



By comparing the **time** and **water volume** data by demographic groups, the installation of the MCA handpump can be associated with ...

an *increase* in the quantity of water collected by girls and boys aged 12-17 and women aged 18 and above, ...

but a *decline* in the time these groups spend collecting water

The installation of the MCA handpumps can be associated with a 55-minute reduction in the median **time to collect 20 liters of water** ( $p < 0.001$ )

### Phase 2 Median Time to Collect 20 Liters of Water

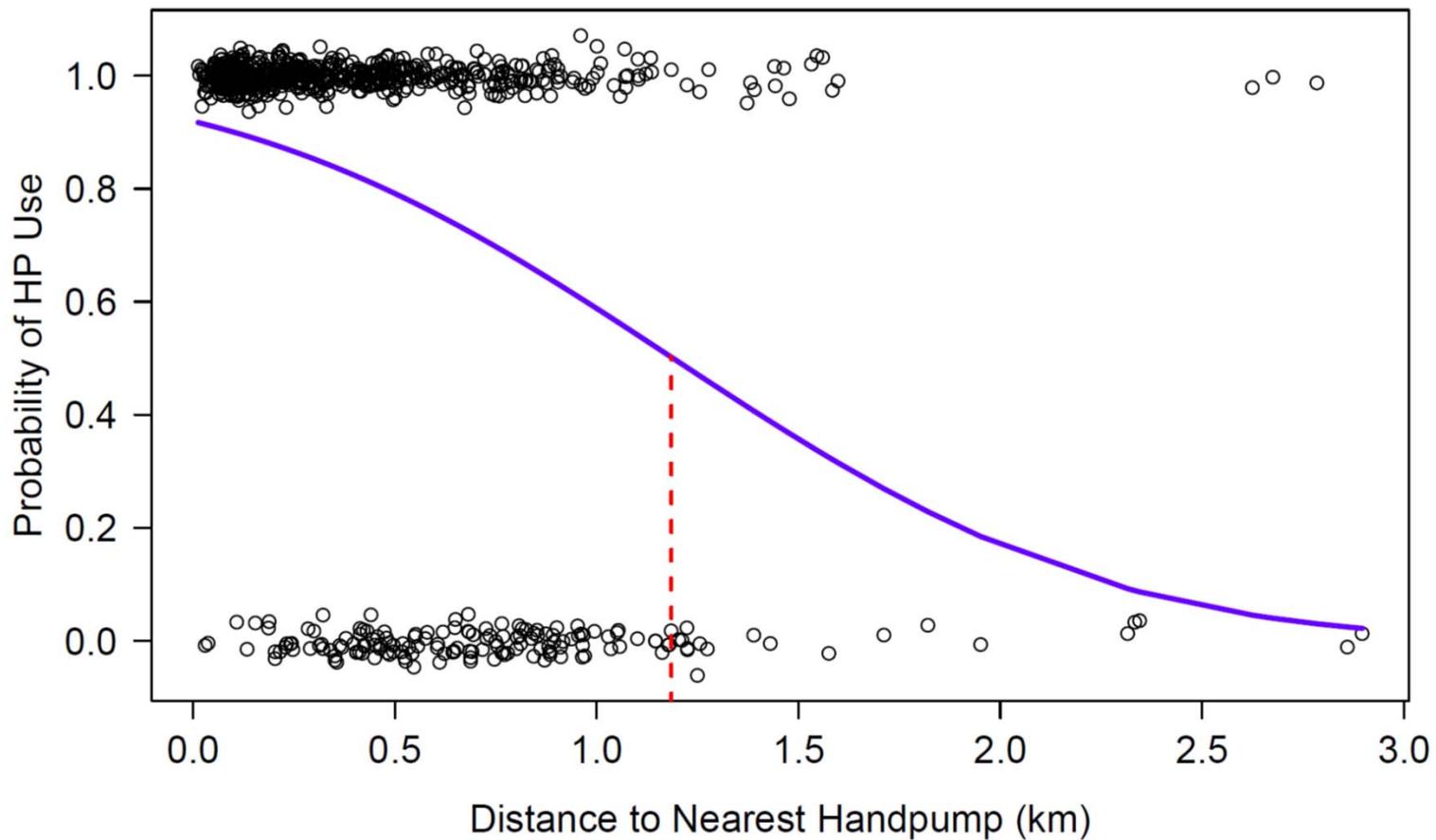
	Number of Communities	Baseline	Follow-Up	Difference
		Mean of Median Time (Minutes)	Mean of Median Time (Minutes)	Minutes
<b>Treatment</b>	15	104	62	-42*
<b>Comparison</b>	23	86	99	13
			Difference in Differences	-55***

Significance codes: \*\*\*  $p < 0.001$  \*\*  $0.001 > p < 0.01$  \*  $0.01 > p < 0.05$  .  $0.05 > p < 0.10$

# Probability of Using the Installed Handpumps

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As distance to the nearest handpump increases, the probability that a household will use the handpump decreases. The distance at which the probability of using a handpump drops below 0.5 is 1.2 km.



# Reasons for Not Using a Handpump

- 22% of households in the treatment communities do not use the handpump

Reason for Not Using Handpump	Percent of Households (n=170)
Distance	64.7%
Too expensive	28.8%
Don't like taste	14.1%
Closed or broken	7.1%
Too crowded	6.5%
Not permitted to use	5.9%
Conflicts	1.2%

# Impact on Schooling

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MCA handpumps are associated with a 17.5% reduction in the mean percentage of households stating that water fetching negatively affects the school attendance of their children ( $p < 0.01$ )

**Phase 2 Mean Percentage of Households (HHs) Stating that Water Fetching Affects School Attendance**

	Number of Communities	Baseline	Follow-Up	Difference
		Mean % HHs Stating that Water Fetching Affects School Attendance	Mean % HHs Stating that Water Fetching Affects School Attendance	Change in Percentage
Treatment	15	26.7%	7.1%	-19.6%**
Comparison	23	16.8%	14.7%	-2.1%
			Difference in Differences	-17.5%**

Significance codes: \*\*\*  $p < 0.001$  \*\*  $0.001 > p < 0.01$  \*  $0.01 > p < 0.05$  .  $0.05 > p < 0.10$

# Satisfaction with Water Supply

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MCA handpumps are associated with a 63% increase in respondent satisfaction with their water supply relative to comparison communities ( $p < 0.001$ )

### Phase 2 Percentage of HH Indicating Satisfaction with Water Supply Situation

	Number of Communities	Baseline	Follow-Up	Difference
		Mean Percent of HH Satisfied	Mean Percent of HH Satisfied	Change in Percentage
<b>Treatment</b>	15	22%	79%	57%***
<b>Comparison</b>	23	31%	26%	-6%
			Difference in Differences	63%***

Significance codes: \*\*\*  $p < 0.001$  \*\*  $0.001 > p < 0.01$  \*  $0.01 > p < 0.05$  .  $0.05 > p < 0.10$

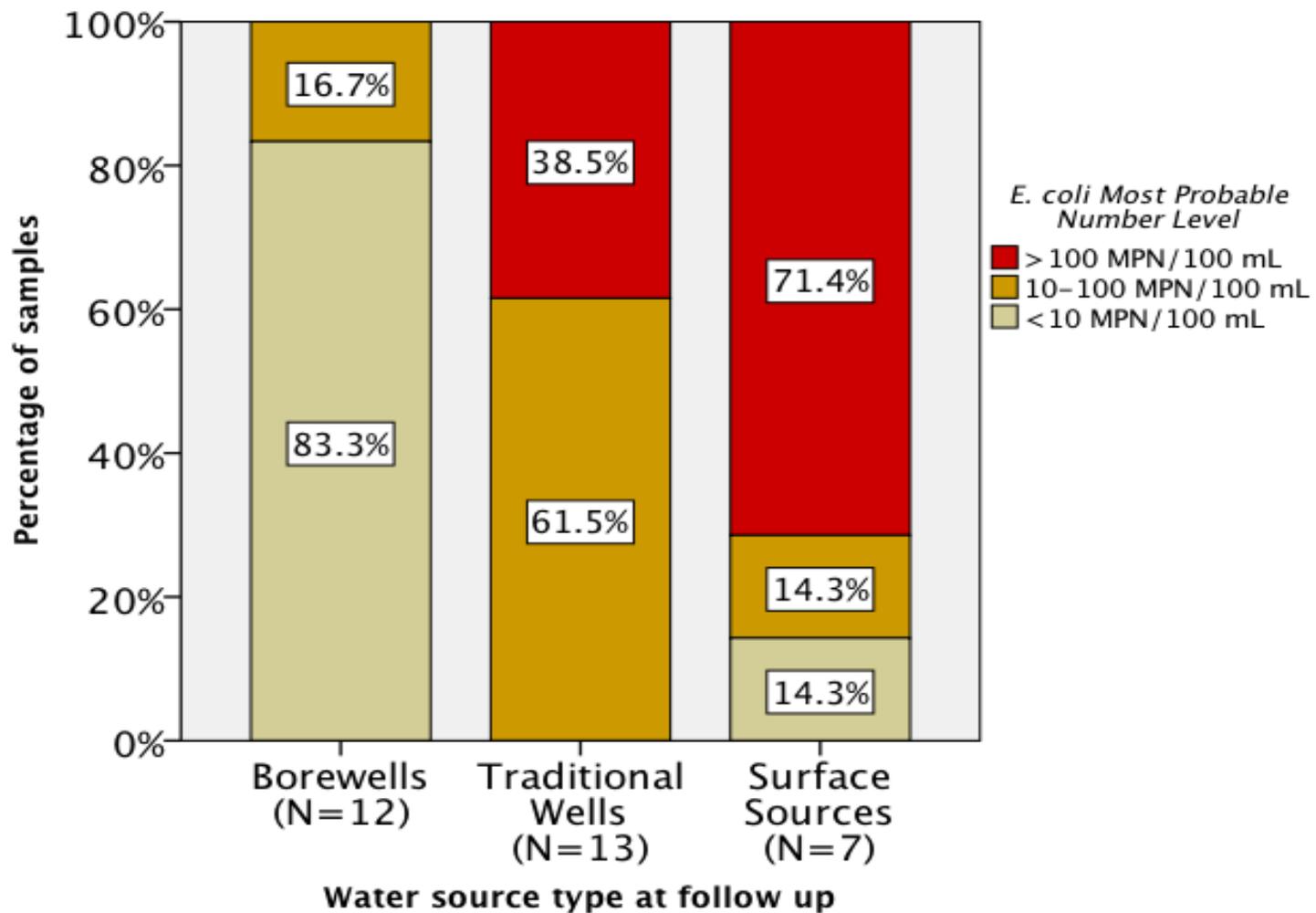
# Water Quality Testing

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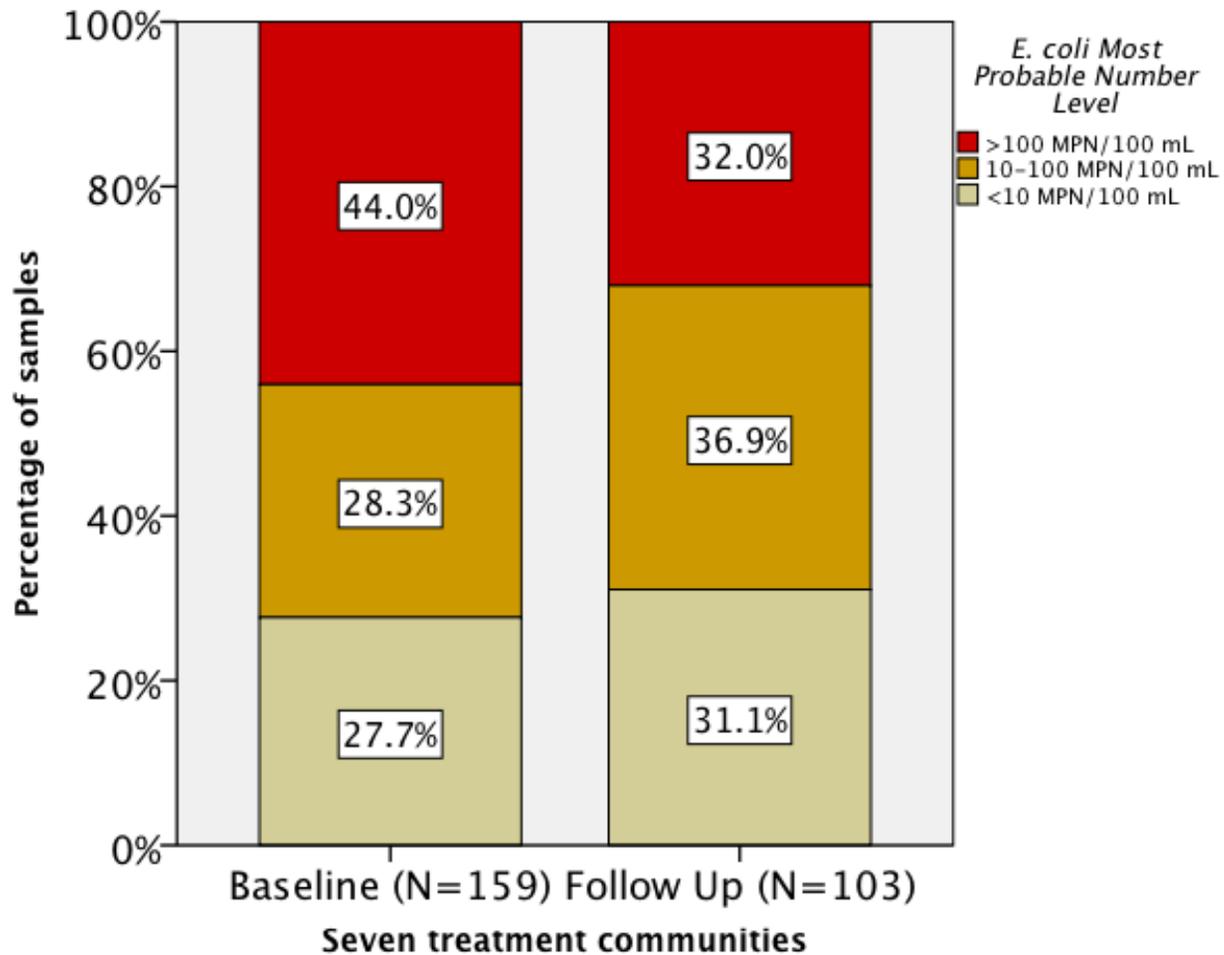
# Water Sampling Methodology

- Source and household stored water sampled in 11 communities during baseline and follow-up studies
- All samples processed tested for fecal indicator bacteria (*E. coli* results presented here)
- IDEXX protocol used to determine most probable number (MPN) of colony forming units (CFU) of *E. coli* in each sample
  - Results presented in terms of 0-10, 11-100, and >100 CFU/100mL (MPN) as per older WHO guidelines and current custom among WASH researchers

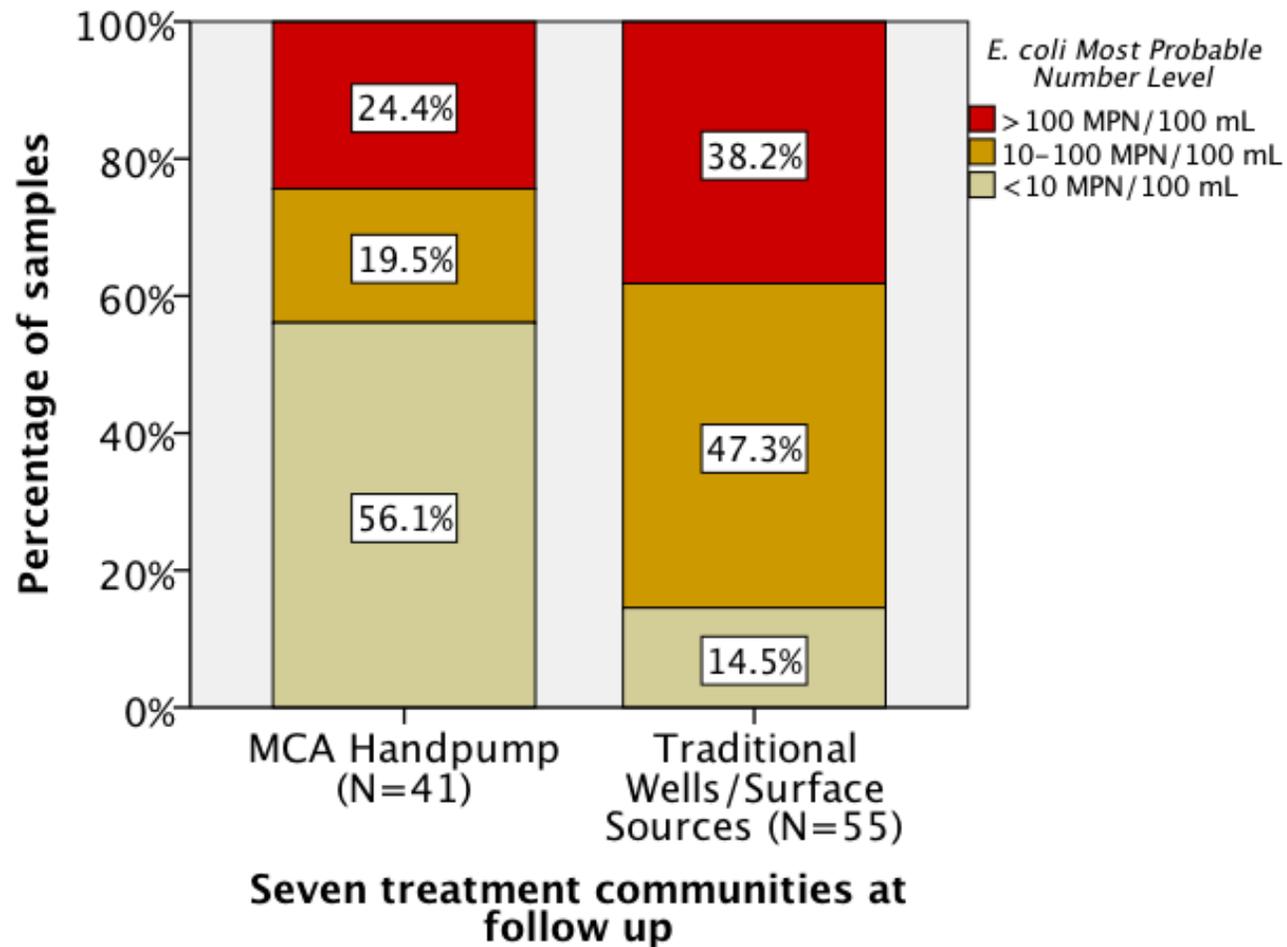
# Water Quality at Point of Collection



# Quality of Stored Household Water by Study Phase: Pooled data from 7 treatment communities



# Quality of Stored Household Water at Follow-up: Source-stratified data from 7 treatment communities



# Health, Hygiene, and Wealth

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The Installation of the MCA Handpump was *not* associated with significant changes in:

### **Health**

- Percentage of children with reported symptoms of gastrointestinal or respiratory illness in week prior to interview

### **Sanitation and Hygiene**

- Self-reported handwashing practices, latrine use, or satisfaction with household's sanitation situation

### **Wealth**

- Household income and expenditure

However, the percentage of households using a **latrine** did increase by 10% in the treatment communities ( $p < 0.01$ )

### Phase 2 Percentage of Households Using Latrines

	Number of Communities	Baseline	Follow-Up	Difference
		% HHs Using Latrine	% HHs Using Latrine	Change in Percentage
<b>Treatment</b>	15	23%	33%	10%**
<b>Comparison</b>	23	16%	18%	2%
			Difference in Differences	8%.

Significance codes: \*\*\*  $p < 0.001$  \*\*  $0.001 > p < 0.01$  \*  $0.01 > p < 0.05$  .  $0.05 > p < 0.10$

**Incomes and expenditures increased in both treatment and comparison communities** along with household engagement in agriculture and consumption of meat and fish, pointing to a **general trend of economic development in Nampula** (or a productive farming season)

# Are the Impacts Sustained?

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An analysis of Phase 1 treatment and comparison communities revealed no significant changes in the key variable of interest

This suggests that the various impacts observed due to the installation of the MCA handpumps have been sustained for at least two years

It also indicates that there has been no significant *increase* in benefits over time

# Policy Implications from RWSA

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# Policy Implications

- “Distance” was the number one reason households did not use the handpumps
- Given dispersed nature of housing in Nampula, it may be necessary to construct multiple handpumps per community or small piped water systems to provide adequate service levels
- Attention should be given to enhancing or rehabilitating traditional sources, since they continue to be important to households even after the installation of the handpumps
- Consider alternative approaches to sanitation and hygiene promotion that result in broader reach and better uptake of key messages

# Policy Implications

- Local governments may require additional financial support to cover major system repairs
- Follow-up trainings with the water committee may be required in the areas of financial management, and operation and maintenance
- A small stipend or incentive may also be necessary to ensure that the water committees continue to function at a high level over the life of the handpump
- Explore the use of new handpump maintenance models

# Impact Evaluation Team

- Co-Principal Investigators:
  - Dr. Jennifer Davis (Stanford University)
  - Dr. Ralph Hall (Virginia Tech)
- Core Team Members:
  - Dr. Eric Vance (Virginia Tech)
  - Dr. Emily Van Houweling (Virginia Tech)
  - Marcos Carzolio (Virginia Tech)
  - Mark Seiss (Virginia Tech)
  - Kory Russel (Stanford University)
  - Wouter Rhebergen (WE Consult)

# Questions?

