

# IMPACT REPORT FOR THE BHUNGROO PROJECT:

Highlights and Lessons Learned from Three Farming Villages in  
Gujarat, India



Peggy Spitzer Christoff, PhD  
Stony Brook University, USA

Jamie M. Sommer, PhD  
University of South Florida, USA

Jasmeet Kaur, MA  
Stony Brook University, USA

# TABLE OF CONTENTS

Meet our Team.....	3
Introduction.....	4
Overview.....	5
Project Design.....	6
Demographics.....	7
Findings.....	9
Future Challenges.....	14
Appendix.....	19
Supplementary Table .....	31





# MEET OUR TEAM

Field research on women's roles in the **Gujarat villages of Nani Chandoori, Dudhkha, and Aritha** required commitment on many levels. Even as we developed and pre-tested the interview questions, Jamie and I needed program coordinators and interpreters in Gujarat as well as transcribers back in the United States. To prepare this report, Jasmeet Kaur joined our team, providing research assistance and coordinating the transcribing effort. [Please refer to the Appendix for more information about the principal investigators (PI).]

- Jamie M. Sommer, University of South Florida (PI)
- Hetshee Kangad, Naireeta Services (Interpreter)
- Peggy (Peg) Spitzer Christoff, Stony Brook University (PI)
- Lilaben Chaganbhai, village of Nani Chandoori (Interviewee)
- Dhruvi Thakar, Independent Volunteer (Interpreter)
- Jasmeet Kaur, Stony Brook University (Program Manager, not pictured)



# INTRODUCTION

With the support of local farmers, Biplab Paul invented the *Bhungroo* irrigation technology in Sami-Harij, a small town of the Patan district in the Indian state of Gujarat. Through an NGO, Lokviaks, he aimed to answer the demands of farmers with small landholdings. Partnering with Trupti Jain, Biplab expanded the mission to empower poor women, improve food security, prepare for disasters, and generate income through the *Bhungroo* water technology usage. Subsequently, the technology was housed under a for-profit company having social impact –Naireeta Services Private Limited (NSPL). As a social enterprise, Naireeta Services was registered in 2011 and actively began its irrigation technology program in 2013. The *Bhungroo* program implementation involves four phases: 1) conducting feasibility studies to determine whether the *Bhungroo* would work on the given farm and detailing of the catchment area (i.e. location, size, volume, duration, type etc); 2) conducting a geo-hydro survey to understand the subsoil structure and estimate the storage capacity of the *Bhungroo* within the given area as well as recovery options of the stored water; 3) drilling, depending on depth and other factors; and 4) installing the filtration chamber. (For more information, see [www.naireetaservices.com](http://www.naireetaservices.com))

The *Bhungroo* irrigation technology also was developed to respond to the 2001 earthquake, which had resulted in water scarcity that was followed by a monsoon. Over time, Biplab improved the *Bhungroo* irrigation technology as a sustainable solution to steady farming in both dry and wet seasons—which both harvests and stores water for irrigation. In simple terms, the technology helps mimic part of the natural hydrological cycle whereby water is gathered in the ground (or recharged) and then used to water crops, as well as keep the soil moist.

This entirely sustainable solution is paired with the need to improve the livelihoods of poor and semi-illiterate rural women. Naireeta Services and their partner organizations train women to use the technology and teach others, which widens their skillsets. Additionally, women are responsible for managing the technology, which helps improve their social power, especially because the majority of women do not have land rights in Gujarat.



# OVERVIEW

Our research team's main goal was to evaluate the *Bhungroo* project to determine how it has impacted the lives and natural environment of its users. We aimed to capture the voices and experiences of individuals across three villages, Nani Chandoori, Dudhkha, and Aritha. When we conducted our field research, neither Dudhkha nor Aritha had the technology: Our goal in the field research was to compare their experiences to those in Nani Chandoori who had the *Bhungroo* irrigation technology.

Naireeta Services provides the technology to those most in need when funding permits. This impact report will first describe our project design, sample, and demographics of respondents, report major findings from our research, and finally, articulate tools for expansion of the project, provide strategies for overcoming challenges, and present potential solutions going forward.

# PROJECT DESIGN

We interviewed 48 people in three different villages in need of water due to climate change-related issues. In Gujarat, which borders Pakistan, over the last several years, climate change has made land less and less arable. It is difficult for farmers to harvest spices and other crops to make money and offer other related services. Due to climate change, the monsoon season became more unpredictable, wet seasons became shorter, and dry seasons became longer. In order to understand how the *Bhungroo* technology impacted people within these villages, we interviewed farmers who had and those who had not received the *Bhungroo* technology.

Half of the sample, 24 people, had the *Bhungroo* irrigation technology in their households while the other 24 did not. Half of the sample was female and the other half of the sample was male. Interviews were carried out over a two-day period in the villages. The main investigators, Peg Christoff and Jamie Sommer, split into two teams to carry out the interviews; and each had a local translator. Naireeta Services helped us navigate the field and establish connections with the communities.

Our team spent a few months developing the survey and then translating it into the local language (Gujarati) with the help of Stony Brook University students back in New York. Jasmeet Kaur coordinated the interview transcriptions, which took about two months to complete. All study participants were informed of the study and the goals verbally in order to give consent. Participants either signed their name on the consent form or used a fingerprint stamp.

Our volunteers, Dhruvi Thakar and Hetsree Kangad, translated the English version of our questionnaire to Gujarati. They aimed to make the questions more relevant for those in the villages, while also shortening and combining the questions when appropriate. The questionnaire in both English and Gujarati can be found in Appendix 1 and 2, respectively. Each of the two teams separated and carried out interviews in the villages. Interviews were done with each participant individually, unless they expressed interest in being interviewed in a group (groups were segregated by sex). Those interviewed were between the ages of 21 and 60.



# DEMOGRAPHICS

## *Education*

In terms of background information (not gained from the interviews), we knew that the education level in rural India is comparably lower than in urban India and also lower than the national average. [According to the Indian Census of 2011, only 67.8% of rural India is literate. This number is especially lower for females in rural India (58.75%) as compared to men (78.57%).] In the state of Gujarat, where we conducted the interviews, the female literacy rate in rural areas is 57.78%, while the male literacy rate is 81.61%. Many of the people we interviewed were undereducated.

Our interviewees were dependent on farming, manual labor, and selling milk or toys in their villages for their livelihoods. Many expressed their desire to let their children study and attend school. About half our sample have children who are studying at various levels, from pre-k to a few college graduates. Unfortunately, several of the children who are educated and have completed high school or college degrees did not find proper jobs. As a result, they end up working at the farms with their parents as manual laborers. For example, one of our respondents, Somabhai, mentioned that both of his daughters recently graduated from college, but they are unable to find jobs, which is why they are working at the farm alongside him.



## ***Family Structures***

Many people in rural villages in Gujarat live in joint families. They consist of multiple generations: grandparents, mother, father, brothers and their wives and their children. Joint families are the norm in Indian culture, but that is changing in urban India. In a joint family in rural India, everyone in the household who works contributes to the household expenditure. They all work collectively to provide food and shelter for the family. A lot of the interviewees indicated this in our interviews. Most of them live in joint families and more than one person in the family is working as an agricultural laborer. They work together on the farm so they don't have to hire anyone else. Each respondent had between 3 to 12 total household members.

When we asked the interviewees about who makes the decisions in the household, several women indicated that their husbands do and that they sometimes advise them. The men generally indicated that their father or the eldest male in the household makes the decisions. They give their income to their father and whenever anyone in the house needs something, they ask the father. It is a common cultural practice that the oldest male in the family makes the decisions for everyone. This practice has changed considerably in urban India but is still relatively common in rural India. Some of the women interviewees indicated that, if they don't live with their in-laws, they are able to make the decisions. For example, Bhagwatiben said her mother-in-law and father-in-law passed away, so she makes the decision with her husband about their children's future. Out of our respondents, ten reported that they make decisions together, or at least consult the adults in the family, including women.

## ***Income***

About 13 of our participants had animals, ranging from one goat, cow or buffalo, to up to eight. Those who wished to disclose their income reported they make around 100 rupees per day depending on water availability, crop outcomes, and work available inside and outside of the villages.

In Indian society, being able to afford gold is considered to be a sign of prosperity. Gold is seen as an object of social security, which people can buy when they are doing well financially and sell during times of economic hardships in exchange for money, Suryaben, who didn't have *Bhungroo*, indicated that she had to sell some of her jewelry during the floods in order to buy food for her family. In contrast, Premilaben said she is able to buy gold and more sarees by saving her own money with the help of *Bhungroo*. Therefore, being able to afford gold provides these women with some financial security.

The villagers we interviewed have lived their whole lives farming on their own small pieces of land or doing manual labor at someone else's land or outside the village. They mostly plant crops such as cumin, castor, wheat, alfalfa, or sapodilla. Most of these crops require a large water supply in order to grow. During the monsoon season, these workers sow the seeds and cultivate their land. In the end, they sell their products in vegetable markets or in the village, which becomes a major source of income.



# FINDINGS

Generally, we found that those who received the *Bhungroo* technology are doing substantially better economically, physically, and emotionally than those who did not receive the technology. Below we briefly describe the major differences between the communities that received the technology and those who have not. After this, we review specific findings that emerge from the interviews including climate change and environmental issues, labor and migration, and women's roles.

## **Before and After *Bhungroo***

### *Non-Bhungroo*

Villagers who did not have the *Bhungroo* irrigation technology are highly dependent on the rain for water resources. They do the majority of their cultivation during the monsoon season and try to store some of the water for drinking purposes and to cultivate crops on their land. If they do not have water, they are not able to farm. Nine of the 24 *Non-Bhungroo* interviewees indicated that water shortage and scarcity is a major problem for them, the rest reporting that lack of food and work were major issues. Lack of water leads to many other issues. One female respondent, Bhagwatiben, reported she had to walk 3 km to find and fetch water for her crops and her cattle. Another respondent, Shilapen said that because of the lack of water she doesn't have enough food in the house to feed her family, which is why she has to do manual labor work to be able to survive. Similarly, Meghiben said she is not able to grow anything due to lack of water. These are just a few examples that indicate how the villagers are unable to plant or sell anything, which leads to low or zero income for the families. In essence, when they do not have an income, they are not able to buy food for the house. Several of the interviewees disclosed that their farm animals died because of the lack of water (for example, see Manabhai). One of them even mentioned how people have started to rob each other because they don't have enough food or money (Amthabhai, Jilaji, and Kanthibhai).

### *Bhungroo*

The *Bhungroo* technology was introduced to farmers in various villages in Gujarat by Naireeta Services. Due to limited funding, Naireeta Services created an application system whereby they use their funds to install and teach the technology in the most vulnerable households. According to our respondents, *Bhungroo* helped lift many out of poverty. People with *Bhungroo* do not have to

travel to other villages or areas in search of work or water. *Bhungroo* has not only provided the farmers with water, but it also has provided them with better financial conditions, as they are able to farm and grow crops in multiple seasons a year and sell them to make more profit. They use this extra income to buy bikes, tractors, and gold or save it for educating their children. They do not have to do manual labor anymore because they are able to plant on their own land. For some people, it has also helped them lower their debt and pay off their loans. *Bhungroo* has also helped to improve their natural surroundings, as these farmers are able to plant trees, such as neem and berries around their houses and farms. They are able to use the trees for shade during hot weather. Even the animals and birds are benefitting from *Bhungroo*, as it provides them water to drink.



## Climate Change and Environmental Issues

The floods in the monsoon season of 2017 caused damage in 20 states of India, but Gujarat was significantly damaged, with a death toll of around 200 people while affecting near 450,000 people. It affected many villages and cities in Gujarat, which led to the relocation of more than 130,000 people to shelter homes.

In our interviews, **19 out of our 48 respondents** informed us about the devastation and problems they encountered during the floods. Many people became homeless, as the water flooded in their houses. Savitben said,



“everything was submerged so we went to the nearby high school to seek shelter.” In some places, the water stayed for around 1-3 months, especially in places where they did not have *Bhungroo*. People like Rameshbhai who had *Bhungroo* said “My house was flooded with water. But because of *Bhungroo*, the water went down in 2-3 days.”

Due to the floods, all the crops and cultivation were destroyed, as the fertile top soil was washed away. People did not have money to buy food for their families, as they did not have any work to do on this barren land. Shilpaben said that during the floods, her house fell and she had to rebuild it herself, which cost her 6,000-7,000 rupees. Although the government promised to help, Amthabhai said that the government did not help at all.



## Labor, Migration and Debt

From our interviews, we learned that **12 out of our 48 respondents** report that they have to do manual labor or work on someone else’s farm in order to make ends meet from crop failure due to water issues. Others reported making money in other ways including selling toys in the city, selling vegetables, or renting their farmland and freelancing. Respondents who had received *Bhungroo* discussed how they used to have to work on the dairy farm (Tinaben), in cotton fields (Premilaben), or do manual labor (Naranbhai and Rameshbhai)

before the technology. Due to *Bhungroo*, they no longer have to migrate for work.

*Bhungroo* also greatly reduced migration for water. Bhagwatiben reports: “We used to walk 3 kms to get water. Now, we don’t have to walk so much to get water. We stay here.” Similarly, Rameshbhai said: “(Before *Bhungroo*) We didn’t have enough food. Even for the animals, we had to go to other places to get grass/plants for them to eat.” Virubhai also reports that they “had to walk 3 km to the next village to get water. We didn’t have any water before. I didn’t have work and other people in the village too.” The technology has also helped improve sanitation. Premilaben says that “Before I used to take animals to the lake to drink water which was very far and also we have bathrooms now because now we have water.”

Many respondents reported that they are struggling to provide food for their families. As a result, eight respondents reported they have taken out loans, either from the government, private lenders, or relatives. The loan amounts in our interview sample range from 10,000 (\$145) rupees to 4.5 lakhs (\$6,000). However, the interest rates on these loans are comparably high. Somabhai and Savitaben mentioned they had taken a loan from the government and private lender at the interest rate of 3% every month, which is 36% annually.

Maheshbhai mentioned he was in debt and needed to pay off his loans at a grocery store where he buys food for his family. The farmers took these loans believing that they would be able to pay them off in the next season when they could cultivate and sell their crops. It is harder for non-*Bhungroo* farmers to pay off their debt because they can only plant crops in one season a year. *Bhungroo* farmers were able to pay their loans after installing *Bhungroo* because they were able to plant and make a profit in 2 -3 seasons in one year by using the water they stored.

## **Women’s Roles**

Female recipients report a new sense of purpose and belonging in their communities and households because they no longer spend the majority of their time fetching water or working in the farm. Instead, the women report getting to focus more on the activities they enjoy and feel a sense of empowerment. Tinaben noted that she is able to take knitting classes because she has more time, and she hopes to start a small business of her own. It is important to understand that “women’s empowerment” in the Western context is different from rural villages in India. The empowerment we noticed in our interviews is more focused on the “personal empowerment” of women. Lilaben said she feels more empowered now because of her better financial situation. Being able to buy food and have a steady income for their families makes these women feel



content. In this sense, empowerment from the project comes through acceptance from family members of women's presence as well as awareness that their work is important. Before *Bhungroo*, they did not have self-respect or dignity.



### **Management and Oversight**

In our interviews, there was one major concern shown about the depth of *Bhungroo* – that if it had been installed deeper, it would have been more beneficial to the farmers. Also, there was one user who has installed *Bhungroo* recently who reported that he is not yet able to see any difference in terms of access to water to grow crops. We believe that the technology should be monitored and evaluated at regular intervals. As Biplab explained, (see the “Future Challenges” section), follow up and better management practices must be better addressed. In fact, most of the lead farmers are illiterate and their training is designed to be minimal. Thus, having evaluators and monitors on the ground would be enormously helpful.

# FUTURE CHALLENGES

Food insecurity and inadequate loan structures provided by the government and local moneylenders are ongoing problems that *Bhungroo* can continue to address. Furthermore, young people in rural communities are unable to find sustainable employment, which heightens anxiety. Naireeta Services addresses this by, for example, training local farmers to use the *Bhungroo* irrigation system. Biplab explains:

“I am always learning to work with multiple aspects to design a solution and cater to every farmer’s needs. My strategy is very micro-oriented and yet India is huge. Most importantly, we must provide opportunities for younger minds so that we can hand over the technology to local partners.”

State-of-the-art computer programs now enable Biplab to track and record soil conditions from remote locations. To support this, he employs a cadre of “climate leaders” – local field workers and managers who are able to work independently without supervision.

As previously mentioned in the findings section of this impact report, farmers with the *Bhungroo* system no longer travel long distances in search of work or water. The irrigation technology provides them with water and better financial conditions. With a successful program in Gujarat, Naireeta Services is now considering ways to expand the *Bhungroo* system to other regions. Trupti recognizes the challenges in terms of understanding how family structures – and even whole communities – could be affected with the introduction of new technology:

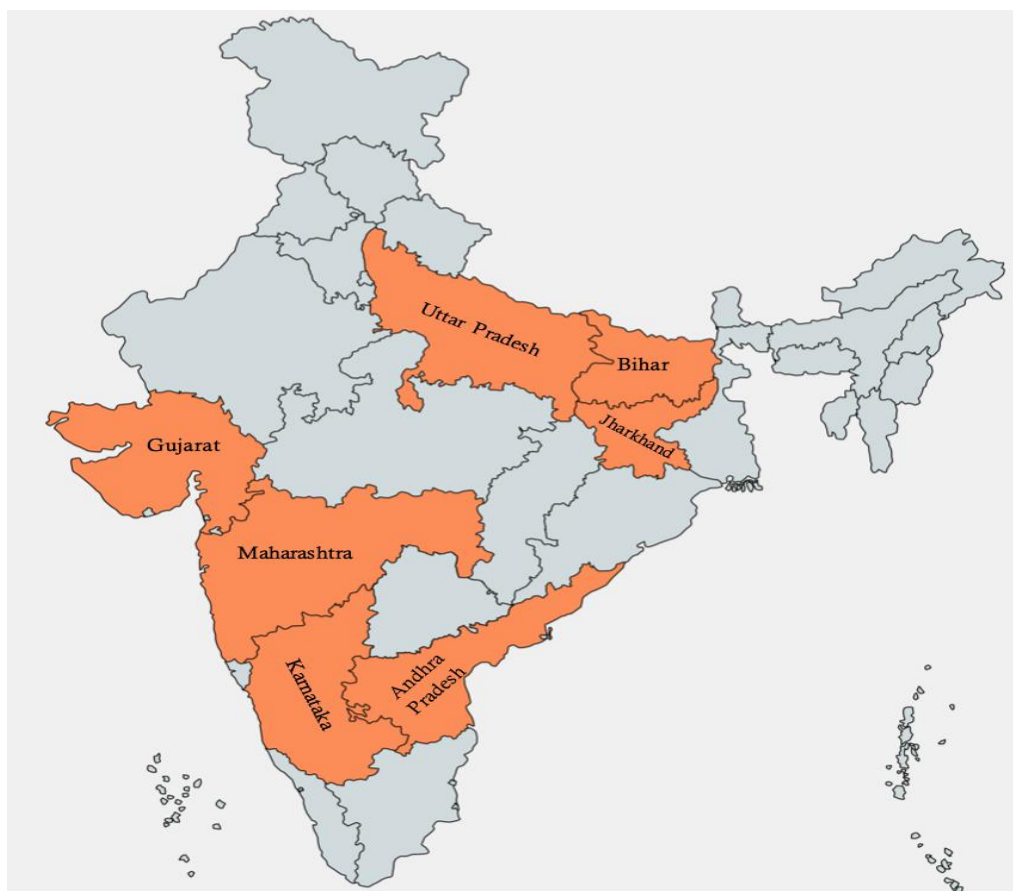
“Every state and every caste is different, especially in terms of the status of women. While there is more potential for women farmers, empowerment is hugely difficult because it requires acceptance from all other family members. Introducing *Bhungroo* changes behavior patterns and reformulates families. We need to raise the representative compensations.”



## Plans to Expand Services

Presently, the villages with *Bhungroo* in Gujarat serve as test cases for Naireeta Services to expand their territory and offer *Bhungroo* in other Indian states where farmers struggle. Naireeta Services identified Maharashtra, Andhra Pradesh, Bihar, Karnataka, Jharkhand, and Uttar Pradesh as potential states that could benefit from adopting the *Bhungroo* program in the future, once the oversight and management problems are address. These states have diverse ecological zones and unique social environments. According to Biplab:

“Because we are external to the states, we need to figure out which partnerships will be the most effective. In addition, we have to learn how to work across districts even within one state.”



Depending on the region, Biplab forms partnerships through self-help groups, educational institutions, and individual private entrepreneurs. In **Maharashtra**, for example, Naireeta Services focuses on working directly with local farmers because of the large number of families who are below the poverty line. While Maharashtra has the second highest population in India, in rural areas, people’s living standards are particularly vulnerable to droughts. And, with the high suicide rates among men, a larger proportion of female farmers’ livelihoods are difficult and time consuming. Struggling to survive, women farmers have no time to occupy leadership positions in their communities and,

instead, focus on taking care of children and the elderly. Compounding this problem, while it is against the law in India for moneylenders to seek retribution from the family members of those who are deceased, this is not enforced and moneylenders use widows and their children as bonded laborers. On the ground, Naireeta Services discovered a sugar cane industry that exploits the poorest farmers who cannot migrate to the cities to work as laborers. [In contrast to rural areas, Maharashtra's economy thrives in the cities, which has manufacturing, international trade, mass media (in particular, Bollywood), aerospace, technology, petroleum, fashion, apparel, and tourism.] Clearly, establishing *Bhungroo* would provide a lifeline.

**Andra Pradesh** has a completely different social environment that does encourage women's empowerment. As a result, women are actively engaged in the labor force. (In 2014, 74% of the women in Andra Pradesh voted in the national elections.) The pressing issues – of high temperatures, as well as heat waves – are expected to increase in magnitude as climate change continues, emphasizing the need for *Bhungroo* technology. It is likely that Andra Pradesh will experience increases in floods, landslides, earthquakes, and cyclones. These events will continue to disrupt agriculture and make household work more difficult and time consuming for many rural women.

Another paradigm is the state of **Bihar**, which is one of the poorest and most backward states in India. It has abundant natural resources – providing low-level labor employment in mining. Agriculture supports the employment of 80% of the population. There is a large aboriginal population, which until recently, the government ignored. Bihar is changing, though the mass media does not report on the many positive changes. Biplab believes that the state holds great promise in introducing the *Bhungroo* irrigation technology for three reasons: First, it is possible to develop partnerships with educational institutions to train climate leaders; second, the region is woman-oriented and has a stable leadership pool and; third, the desire to change the present situation is very strong. It is likely that flooding will increase in magnitude, given current and future predictions; and women, who lack access to financial and agricultural resources, are particularly at risk.

Yet another paradigm is **Karnataka**, where political leaders are sensitive to the needs of the people and the government is “pro-poor.” Karnataka has a rich history in traditional and classical languages, as well as prominent natural beauty and culture. While female literacy is among the highest in India, women are not allowed to become involved in politics. Even in rural areas, women have less power than men in making decisions for the family and do not have access to resources and training. Still, they are affected by climate change, especially given their responsibilities in water collection, cooking, and agriculture. Farmers have been able to maintain control over their land and would likely be



climate leaders for *Bhungroo*. Women remain in a low social position and are unlikely to become empowered but they would benefit from their husbands' initiatives.

Agricultural conditions in **Jharkand** also are poor because it is situated in 35 different ecological conditions. Rural female literacy is amongst the lowest in India and women are prevented from garnering support and vocalizing their environmental knowledge. Known as the “belly of Indian politics,” with vibrant oppositional political parties, there are high levels of mobility among its residents including a large number of migrant workers. Jharkhand's reliance on agriculture, and limited access to rights and basic education, leave women unprepared to deal with current and increasing climate issues. For instance, many women are malnourished, which is likely to intensify as climate change increases. Installing *Bhungroo* would help decrease food insecurity. Jharkhand also has large forested areas, which can help aid in flooding reduction and serve as a resource for rural people. However, while some tree species have increased in area, many have decreased due to heightened demand, overuse, and changes in weather patterns.

Biplab realized that, in Jharkhand, and also in **Uttar Pradesh**, he needs to develop a network of climate leaders to train and manage the *Bhungroo* irrigation system. Uttar Pradesh has the highest population in India and a very low GDP per capita. Agriculture (i.e., rice, maize, wheat, cotton, and sugar) is the main source of income. However, the high population rate leads to low economic growth in this state; and employment opportunities for women are sparse. Uttar Pradesh experiences inequalities in rights and resources and, in many cases, women are more at risk for climate-related issues than males. Generally, flooding, drought, and related climate issues translates into agricultural problems and food scarcity. Agricultural issues in this state are more devastating to those in poorer areas, and due to its large output of agricultural products, will lead to food security issues throughout India.

In conclusion, success in villages in **Gujarat** provides great hope for other regions. Naireeta Services assesses the impact of the irrigation technology in Gujarat by calculating the numbers of farmers and the extensive network of family members who have benefited from *Bhungroo*. Within the framework of increasing food security, climate change, and women's empowerment, it is clear that climate leaders must consider farming/agricultural factors as well as the psychological factors. In order to sensitize people to the need for a stable irrigation system, Naireeta Services aims to deeply understand and work within each region's social, political, and economic environments.

The *Bhungroo* technology is open sourced to honor the belief in *Antyodaya Gandhyan* – “to serve the poorest first.” This includes working with

the younger generation, especially those boys and girls who cannot continue their education. According to Biplab, high school and college dropouts should not be made to feel “unworthy.” He states: “The government and the mass media tend to blame the victim. I feel sorry for their limitations because they only look at the project and not the community.”

He sees great potential in training disenfranchised youths to become social entrepreneurs in their communities. This requires a team approach to divide the work among different districts and work across local boundaries. Accordingly, Biplab emphasizes: “Trupti and I don’t need money: We need guidance, which is why the local networks are crucial.”



# APPENDIX

## About the Authors:

Peggy (Peg) Spitzer Christoff, Stony Brook University (PI), is a Senior Lecturer in the Program for Writing and Rhetoric, specializing in international relations and Asian and Asian American Studies. Her research on transnational advocacy networks and Asian women's leadership has been published in book chapters and special editions, including *Sustainability, Gender and Practice: Insights from the Field*, *Women and Political Participation in Asia*, and *Asian Women Entrepreneurship*.

Jamie M. Sommer, University of South Florida (PI) is an Assistant Professor of Sociology, specializing in climate change and community resilience. Her research on the environment and development has been published in several acclaimed peer-reviewed academic journals including the *Journal of Development Studies*, *Sociological Inquiry*, *Environmental Sociology*, *The Social Science Journal*, *International Sociology*, and *Sociology of Development* among others.

Jasmeet Kaur, Stony Brook University (Program Manager) is currently working towards receiving her Master's degree. She is a specialist in the Indian region, especially in regards to women's rights and wellbeing.





## **1. English Questionnaire**

### Interview Schedule for Field Research

#### **Questions for All**

1. *What environmental/climate change related issues (water shortages, drought, floods) have you experienced?* This question should help us establish the level of concern and motivation for participating in climate change related programs.
2. *Can you tell me about what you usually do every day (schedule, work, etc.)?* We want to know what the women's lives are mostly like so we can see if their involvement in the project changed their day-to day lives.
3. *Can you tell me a little about your family (husband, kids, etc.)?* We want to know what their husband and kids do (like what he does for work, or if the kids go to school (daughters etc.).
4. *What is your job at home? What decisions do you make?* We seek to assess the balance between menial tasks and management of household expenses.
5. *What is your husband's job at home (if applicable)?* This would enable us to identify the level of gender equity.

#### **Following Questions for Those Who Participated in Project**

6. *Around what date and year did you join the project?* We may be able to compare length of involvement with the knowledge gained.
7. *How did you hear about the project?* We are looking for established communication practices in the community.
8. *Have you encountered difficulties in implementing the technology? Please explain.* We seek to understand the level of complexity and the learning curve trajectory or if they received any backlash from males in the community.

9. *How have these experiences impacted your decision making power or other types of power in the home?* We want to know what things they can do now that they couldn't before, like perhaps decide where the money goes with or instead of their husband. Put differently, do they have more money, the ability to make more decisions, or time now to do something different? We are interested in the economic and empowerment benefits, which we think would be a strong incentive for continuing in the program.
10. *What psychological benefits has the project given you?* We want them to reflect on if their involvement in the project has made them feel differently about themselves, changed their confidence levels, or the way they view themselves.
11. *What do you have in your life now that you did not have before the project?* This particular question, purposely open-ended, will reveal personal reflections and growth as a leader.
12. *As a result of this project, have you (or anyone you know) participated in your local or regional government? To what extent have you or others been involved in negotiating with the local government to improve conditions in your community as a result of the project?* We seek to assess the level of awareness in terms of how women become vocal in their community and/or if they have held an elected office, what activities they have participated in.
13. *Have you had the opportunity to teach your friends or family (in particular, other women) how to use the related technology? If so, how did this make you feel?* Their answers would indicate a hierarchy of knowledge and experience gained and passed on to others. The second answer would help us understand how the project impacted their views on themselves as leaders.
14. *How has your involvement in this program impacted your community economically and environmentally?* This can shift the focus to what they see as benefits to the community rather than personal benefits.

15. *What environmental benefits (ability to adapt to floods, dry periods, and less predictable weather patterns) has the project given you?* Given the dire conditions experienced by whole communities and states, we want to see if there have been observable changes.

16. *Has there been an improvement in environmental issues since you started working with the project?* The answer to this would provide a broader context and sophisticated understanding of technological advances.

17. *Are you aware of other initiatives led by local women to support the environment?* This would establish the existence of networks and a desire to connect to other members of the community.





## 2. Gujarati Questionnaire

### પ્રશ્નોત્તરી

૧. તમારા કુટુંબ વિશે જણાવો. તમારા પરિવારમાં કોણ કોણ છે? તમારા પતિનો વ્યવસાય શું છે? તમારા સંતાનો ભણે છે?
૨. તમારી દિનચર્યા જણાવો. તમારા રોજિંદા જીવનમાં તમે ક્યાં ક્યાં નિર્ણયો લો છો?
૩. તમારા પતિ ઘરમાં તમને કઈ રીતે મદદરૂપ થાય છે?
૪. ભૂંગરૂ પેહલા તમે કઈ કઈ સમસ્યાઓ નો સામનો કરતા હતા?
૫. તમને ભૂંગરૂ વિશે માહિતિ ક્યારે અને કઈ રીતે મળી? માહિતિ મળ્યા પછી થી લઈ ને અત્યાર સુધી માં શું શું કામગીરી થઈ છે?
૬. શું ભૂંગરૂ સ્થાપિત કરવા દરમિયાન તમને કઈ તકલીફ પડી? તમારા ભૂંગરૂ સ્થાપિત કરવા દરમિયાન સામનો કરેલ પડકારો જણાવો.
૭. ભૂંગરૂ માં જોડાયા પછી તમારા રોજિંદા જીવન માં શું તફાવત આવ્યો? ભૂંગરૂ માં જોડાયા પછી તમારી નાણાકીય પરિસ્થિતિમાં શું ફેરફાર આવ્યા?
૮. ભૂંગરૂની તમારા જીવન પર શું સકારાત્મક અસર પડી? શું ભૂંગરૂ પછી તમારા જીવન ધોરણમાં કઈ ફેરફાર થયો? વિસ્તારથી જણાવો.
૯. ભૂંગરૂ સ્થાપિત કાર્ય પછી શું તમે કોઈ પંચાયતી ચૂંટણીમાં ભાગ લીધો છે? ચૂંટણીમાં ભાગ લેવાનું કારણ જણાવો.
૧૦. શું તમે ભૂંગરૂનો પ્રચાર પ્રસાર કરો છો? જો હા તો કઈ રીતે અને જો ના તો કેમ?
૧૧. ભૂંગરૂ તમને કઈ રીતે ખેતી માં મદદરૂપ થયું છે? ભૂંગરૂના લીધે પર્યાવરણ પાર થતી અસરો જણાવો.

### 3. Interview Summaries

In the present day, through open scholarship initiatives, researchers attempt to address ethnocentric attitudes toward the Global South by providing free access to the “data” collected in the region. In our article, *Open Scholarship and Climate Change in The Asian World*, we state:

The basic assumption that research always is incomplete and “in process” and needs to be disseminated is especially salient in the field of CCA [Climate Change Adaptation], which requires different areas of specialized interdisciplinary comprehension (social, environmental, political etc.) to translate into actionable knowledge. Thus far, the focus of open scholarship has been on the allocation of resources to develop e-research through national-based institutions such as the National Science Foundation (Hesse, Moser, and Riley 2015). However, we address the importance of open scholarship in sharing and opening pathways of knowledge for broad impact, so that more groups have access to data and resources necessary to adapt to climate changes, especially in at risk areas like Asia (Borgman, C. L. 2010, Palmer, D. 2013).

Thus, in our field research in Gujarat, we sought and gained permission from all of our interviewees to use their names; and we will provide free access to all of our research materials (audio interviews, transcriptions, photos, etc) in the public domain, through a digital platform that is being developed by Stony Brook University Libraries. This platform will be launched in the spring of 2020. For this impact report, we provide summaries of our personal interviews. We believe that acknowledging the personal experiences of the interviewees’ moves away from the ethnocentric attitudes of treating the Global South as raw material.

**Savitaben** is a middle-aged married woman with six grown children, none of whom ever went to school. As day laborers, they live a hand-to-mouth existence, hoping for two or three days of work a week. When the floods came two years ago, their crops of grains were washed away and their home was destroyed so they relocated to a nearby high school. Her family borrowed money from a private moneylender who charged them 36% annual interest. With no work and huge debts, Savitaben summarized their lives, simply: “If we have food, we eat otherwise we don’t eat.”

**Somabhai** is a middle-aged farmer with a wife and two daughters. Both daughters received a college education and also married farmers. They used to grow cotton, wheat, and cumin, but water scarcity has made farming difficult. Then, when the floods came, they suffered great losses. All the grains were destroyed. They, too, took out loans – 50% from the government and 50% from the private moneylenders, also at an annual rate of 36%. Now they depend on getting one harvest of black gram lentils during the rainy season. For the other six months, they all work on someone else’s land. He says: “If we don’t get work, we have to starve.”

**Sonubhai** Thakur has two sons and five daughters. While the older girls did not go to school, the younger sons and daughters do. Because they have the *Bhungroo* irrigation technology, they can grow cotton and cumin (and the sapodilla plant for the cattle). Also,

through a canal unrelated to the *Bhungroo* system, they have access to drinking water. Their dependence on rainfall has been reduced but they still have government loans to pay off. While Sonubhai is not involved in local politics, he is connected to his community: “As drinking water increased, it was beneficial to all.”

**Surayaben** is in her early twenties with three children ages 4, 5, and 9. They are all in school and she works on someone else’s farm 15 days a month. “I would never ask for money from anyone,” she said. “During the flood, I had to sell some of my personal belongings, like jewelry, and even one small sheep. I used the money for household items, for medicine for the kids when they get sick, and for groceries, little by little.”

**Tinaben**, also a young mother with a preschool daughter, is fortunate to live in a relatively stable family with enough money to survive. With the *Bhungroo* technology, their lives dramatically improved. She used to work on a dairy farm and her husband had to migrate to find work. Now they farm their own land, and she decides how to use the money. Maybe they will get electricity next year but, for now, she says: “We get enough water for bathing; our bucket is full. We don’t need bathrooms and we have enough money. Before I used to walk miles to get water but now I have more time to do my work and help others.” She has a hopeful existence and plans to start her own small business to knit clothes and sell them in the village. “I feel proud because I can contribute to the family’s income.”

**Alkaben** is not sure how old she is – maybe around 30 – she has three children, all in school, and a husband who respects her opinions. As farmers, they too are faced with challenges due to the lack of water and must abandon the land to migrate to get work as manual laborers. Two years ago the fields flooded and washed away all the nutrients. The family’s income comes from 15-20 days of labor work a month. “Before the water problem, we migrated from one place to another to find fertile land. That is gone now.”

**Shantaben** also is not sure of her age. Maybe she is in her late 40s. Six people live in her household – including two sons and their wives – and they all make decisions together. She says, “If there is water, we work on other people’s farms. Everyone is struggling.” Still, there is work in the city for the men, who have work about 6 months out of the year. Of the floods, she says “All the crops were destroyed in the fields. There was no money in the house and everyone was sad. Then, in the winter, we got water from the canals. But it’s getting worse as the days go by. Water is getting less and less.”

**Daliben** is around 40 years old. She spends her days doing housework and on the farm with her two children and husband. Both of her children are studying in the 10<sup>th</sup> and 12<sup>th</sup> grade and if they decide will continue with their education. They will make that decision, as well as others, as a family. Daliben says that “Everything is a problem,” then laughs. “We don’t have money, or water, or job.” She and her family cannot grow anything on the farm without water; if there is rain, they plant crops. Her family has to do manual labor, about 10-20 days a month to makes ends meet, but also take out loans.



**Arvindbhai** is 30 years old and lives with his mother, father, two kids (five and two), and wife. He says, “There is no water, therefore, I don’t do anything.” His farm is useless because he has no water, so he sells toys in Ahmedabad at fairs (the nearest major city). They have to go to the lake ½ km away to water their cattle. His wife does manual labor, and his mother and father help other farm owners to collect lemons and fruits in others fields to make money.

**Rekhaben** is 30 years old and sells vegetables, making about 100 rupees a day. Her 2 husband and two daughters-in-law also sell vegetables, and her son does labor on farms in villages outside of their own that have water. Her family owns no property, so she must buy vegetables from the market than upsell them to others. She says, “There are a lot of financial difficulties. We earn and spend money. There is barely any savings.”

**Premilaben** is about 26 or 27 and studied up until the 6<sup>th</sup> grade, but she did not educate her daughter beyond that. She said, “Because of love affairs as they grow up and we’re scared. We sent our daughter to school in the village which was up to 6<sup>th</sup> grade as well. After that, the grandfather said no to go outside of the village to study.” Before Bhungroo she said she “used to take animals to the lake to drink water which was very far and also, we have bathrooms now because now we have water.” Now she walks less to get water and gets buffalo from the milk to make ghee. When she sells it, she gets to keep her money, though all other money goes to grandfather, who makes all of the decisions.

**Ramilaben** is between 25 and 26. She has two sons and a husband. She does labor work because they do not have enough water to plant crops or must get water from other farms. She says, “We get bore water from nearby from someone else and give them one part of the crops to them.” They must do freelancing work in and outside of the village to make money. During a recent thunderstorm, they lost their entire house because it was made of mud.

**Naranbhai** is 51 years old and lives as part of a joint family with ten other people, with four grandchildren who attend pre-kindergarten. Before the Bhungroo initiative, he said “we didn’t have anything. Now, I have a tractor and 2 vehicles (bikes) and also have some gold and money saved.” He benefited greatly from Bhungroo and is now able to plant four crops in three different seasons while having ample access to clean drinking water for himself and his cattle.

**Shilpaben** is a 21-year-old mother of two daughters. Because she doesn’t own land, she is confined to manual labor at other people’s farms for six days a week to make 100 rupees a day. She stated that “We don’t have enough food in the house. That’s why we have to go outside to do manual labor.” Her financial situation turned bleaker during the recent floods, in which her house was destroyed and she needed to take a 6,000 rupee loan from relatives to rebuild her house.

**Udaysingh** is a 38 years old farmer who lives with twelve people in his house. His land holdings have afforded him a sizeable income of 1.5 lakhs. He initially heard about Bhungroo from neighboring farmers and installed it at his farm 4 years ago. He was

initially hesitant, stating that “we were scared that the water will remain sour and that the land might not adapt to Bhungroo. But these fears soon changed into confidence and Bhungroo proved to be beneficial.” Bhungroo has helped him to expand his business to other fields and villages.

**Virubhai** is a 24-year-old farmer and has two daughters. He owns 30 bhigas of land and recently made the decision seven months ago to install Bhungroo. Before Bhungroo, he would have to walk 3km to the next village to get water for the house and farmland. He said, “We didn’t have any water before Bhungroo. I didn’t have work and many other people in the village too. Now everyone is able to use Bhungroo and they know I have money, so they all talk to me nicely and respect me.” He had 4-5 lakhs of loans that have since been paid off.

**Arvindbhai** sells toys in a village fair and also does freelancing and odd jobs whenever work is available. He spends his entire day working on other people’s land because he doesn’t own any land.

**Ashokabhai** works and operates his own farm. He is a member of the local milk cooperative and has a decent annual income of 1 lakh. Installing Bhungroo has allowed him to plan a broader variety of crops, such as cotton, castor, cumin, and grass for the cattle, while affording him the chance to make improvements to his livelihood. He said, “After Bhungroo I bought a tractor, bike, renovated my house and also constructed a sanitation facility at home.”

**Chanaja** has two sons who are attending school. He does farming work with his brother. They grow wheat, alfalfa, and cumin seeds. Chanaja has been less impressed with the Bhungroo technology, stating that “I didn’t notice a significant change” after implementing it.

**Chandubhai** sells vegetables with his wife in the village. He has two sons who are in school, and a daughter who dropped out because there were no higher education facilities provided in the village. He has a stock of cattle that includes twenty goats and two buffaloes. He also owns a small piece of land. He is unable to grow crops, however, due in large part to the lack of water resources available.

**Ganpathbhai** works with his wife at someone else’s farm. He has a son and daughter, both of whom attend school. He doesn’t own any land, and as such, gathers his income by doing manual labor on that farm.

**Lalabhai** used to migrate from one village to another with 3 daughters and an infant son before installing Bhungroo. Now with Bhungroo, not only he is able to grow various types of crop such as cotton, castor, gram lentils, Indian Plantago, cumin, etc, he said “My basket size has increased 8 times. Also as the family’s financial situation got better, my father stood for village election and he is head of the village right now.”

**Lilaben Changanbhai** has two sons, both of whom work in Ahmedabad City. She grows wheat on her own piece of land. She also does labor work for 15 days a month on her neighbors' properties to make some extra money. She stated her and her family often have to move to different locations to find available work.

**Lilaben Naranbhai** helps her husband take care of cattle and agricultural activities. She has three grandchildren who are attending school. Bhungroo technology has greatly helped her, as she's now able to grow crops in different seasons. She stated that "I feel more empowered now because of the better financial situation after installation of Bhungroo and my husband even gifted me gold." Unfortunately, her son and daughter-in-law still migrate in search of work.

**Shaileshbhai** doesn't own land, and must, therefore, work on other people's land. His only source of income is through this type of labor work.

**Meghiben** is 40 years old and has two children in school. She works at a farm where she sows and waters the crops. She initially had a partner with whom she shared water well, but he moved away, so she didn't have access to water until she installed Bhungroo. With the help of Bhungroo, she said "we are able to further agricultural activity. We are waiting for them to install more Bhungroo now."

**Chaganbhai** is a freelancer who works in other people's fields and travels to different villages in search of work. He has one daughter and two sons. One of his sons is in college and the other two children recently finished high school, and assist him as manual laborers.

**Rameshbhai** is a 32 years old who worked as a manual laborer for 5-6 years. He has a large family that he wasn't able to take care of before Bhungroo. He said "We didn't have enough food. Even for the animals, we had to go to other places to get grass/plants for them to eat." Bhungroo has made his life much easier, as he said "I don't have to do manual work. I save a lot of money and lead a better life." He was able to pay off a pre-existing tractor loan after installing Bhungroo and was able to cultivate crops for two seasons.

**Nitiben and Kamabhai** are a husband and wife who have seven daughters and two sons. Five of their daughters are married. They do manual labor and farming when work is available, sell toys to make a living when work is absent. They said "we only sell it in the village when there is a festival. It's not our permanent business. Just on the side."

**Manabhai** is 60 years old. Everyone in his family helps him at his farm. He sits at the vegetable market to sell what he sows for 9 months and, and farms for the remaining 3 months. He took a government loan of 1.5 lakhs, which he's still paying off. With Bhungroo technology, he said, "now we have water, so we are able to grow more crops." However, there has been little added variety to his crops, as he still only grows wheat.



**Amthabhai, Jilaji, and Kanthibhai** are all farmers who do manual labor in their village. They have a few acres of land, but don't cultivate it because they don't have enough water for sustained farming. During the floods two years ago, they said, "The government didn't help us at all. Because of that people have started robbing each other." They spoke of the unfortunate conditions of people who don't have enough water and food, and that in desperation, people have started to raid the houses of people who are assumed to have money.

**Bhagwatiben** is 33 years old who has an infant son and lives with her three brothers and their wives. Her family installed Bhungroo technology at their farm 2.5 years ago and everyone has reaped the benefits. It cost her 20,000 rupees to install Bhungroo. She used to have to walk 3 km to get water, but after installing Bhungroo, "Now, we don't have to walk so much to get water. We stay here."

**Maheshbhai** has two daughters and two sons. He has taken out loans from the grocery store to buy food for his family. He doesn't have his own land, so he said "We rent the land of other people to farm and crop plants. They pay us 4000-5000 rupees, so we just work for them." During the floods, much of the property was ruined, and he moved to a shelter with family.

**Navanganbhai** is a 40 years old who does farming and also sells milk. His wife and daughters-in-law stay at home to do house chores while he goes to work at the farm with his two sons. Surprisingly, the floods that occurred two years ago were actually helpful to him because he owns a lot of land in partnership with other villagers. He said "There was too much water. But it was good for us because we have 25 vegas of land that were watered, and we were able to plant on it after the flood."

**Jiviben** is around 40 years old. She is involved in the village women organization which she started, in which they all collect money and save it. While her husband works at the farm, she stays home and does household chores and provides fodder to the cattle. After installing Bhungroo technology, they are able to work on their own farm. Earlier they used to do manual labor. She said that with the help of Bhungroo, they have "become financially strong. We now donate money to the temple," where she prays for her family's wealth and happiness.

**Kamuben** has three sons and two daughters. Everyone in her family does labor work because they don't have enough water for farming. She said "When someone that has water borewell calls us, we go to work. And if we get work, we eat otherwise we sit at home." She has two grandchildren who she takes with her to the farms when she has manual labor work to do.

**Gitaben** has a six-year-old daughter who recently started going to school. She installed Bhungroo at her farm nine months ago and paid 10,000 rupees for the technology. She said, "To install the *Bhungroo*, we had to make a hole in the ground ourselves which was

very hard.” Even after installing *Bhungroo*, she said “I don’t notice that many benefits of it” as it costs more to install it than the money that it brings in.

# SUPPLEMENTARY TABLE

We did not directly ask about whether or not the respondents did manual labor, collected water, or struggled to feed their families before and after the Bhungroo. However, we did ask what hardships they faced, what they do when there is no farming work, and how Bhungroo has helped them. Therefore, the below table is skewed in terms of total respondents because we did not ask respondents these questions directly, as we were interested in their perceptions and challenges from their own perspectives without giving them words or our ideas.

	Manual Labor	Traveled for Water/ Water scarcity	Food Insecurity
Number of people who have these issues and do not have Bhungroo	10	9	12
%	41.67%	37.5%	50%
Number of people who no longer have these issues citing Bhungroo	6	9	6
%	25%	37.5%	25%
Total Respondents = 24 for each (48)			