

PAULA	349	749	1	1	347	746	1	2	368	381
VAHVANI	500	1030	0	0	497	1027	3	3	529	501
Total	5561	11502	18	28	5503	1140 1	40	73	5542	5960

4.2 Jal Jiwan Mission (JJM)

4.2.1 Background

The Ministry of Jal Shakti, Department of Drinking Water and Sanitation, Government of India, initiated a significant national program called the Jal Jeevan Mission (JJM) in 2019-2020. This program was established by merging the National Rural Drinking Water Programme (NRDWP) and aims to provide functional family tap connections (FHTCs) to every rural household in India by 2024, ensuring a minimum water supply of 55 liters per person per day.

The announcement of the Jal Jeevan Mission was made by Prime Minister Narendra Modi on the occasion of India's 73rd Independence Day in 2019. The program, which commenced on August 15, 2019, is being implemented in partnership with the respective states. The objective is to deliver adequate quantities of tap water of recommended quality, maintaining acceptable pressure, on a regular and sustainable basis to every rural household by 2024.

Before the launch of the Jal Jeevan Mission, only 3.23 crore (17 percent) of rural households had access to tap water connections. This meant that the remaining 15.70 crore families had to rely on external sources of drinking water, depriving them of this essential requirement. Remarkably, within a span of less than two and a half years since its inception, the Jal Jeevan Mission has successfully provided an additional 6.4 crore tap water connections. This achievement has expanded the coverage of potable tap water supply to over half of the total rural households in the country.

4.2.2 Objective

The Mission's primary objectives are;

- To deliver Functional Household Tap Connection to every rural household.
- To give priority in the distribution of Functional Household Tap Connection to Sansad Adarsh Gram Yojana (SAGY) villages in drought prone areas and desert areas of the country, and everywhere else.
- To supply tap connections to Schools, Anganwadi centers, GP offices, health facilities, wellness centers and community buildings.
- To monitor the functionality of tap connections.
- To promote and ensure voluntary ownership amongst local communities of financial, service, and/or labor (shramdaan) contributions.

4.2.3 Progress

In JJM, the construction of the tank, pipe distribution and well construction, three works are being done in Katri.

The circular RCC (Reinforced Cement Concrete) tank. The approximate capacity of the tank is around 1.1 lakh litres to 1.13 lakh litres, aiming to provide piped water connections to every household in the area. The project, which is a part of the Jal Jeevan Mission, involves the installation of a water supply network and the distribution of water to households. However, JJM started six years ago, due to the slow implementation of the schemes, the work of JJM is still ongoing; its pipeline distribution work has not been accomplished, nor has every household received tap water at their door.



Figure 61: RCC tank with JJM board, katri (source: author)

Pipe installation and distribution to each house is under construction for the Patilpad and Hanipada. They have not installed and networked throughout the village.



Figure 62: public tank



Figure 63: Uninstalled Pipe

Well construction, there are two well constructions under the JJM, as discussed with the Villages last year, the constructed well has no water in it. Therefore, this year, the construction of a new well near the river in Patilpada. When visiting and checking in the summer, it has been noted that the well has water. However, the well is still under construction.



Figure 64: Social map of the village



Figure 65: Social map of the village

4.2.4 JJM Water Tank Distribution Analysis



Figure 66: Two tanks laid down without installation



Figure 67: public tank

Distribution of 9 Black and White water tank of 5000 liters by JJM in Patil Pada. This water stored in this tank is used when unavailability of water in the hand pump, especially in the morning. The distribution of water tank by JJM is 23, but till today only 9 water tanks are installed.

The one of the water tank was privately used by the family as it was being allotted to group of 15 families, unaware of the usage of the tank, by nearby family, the 1st family used it more predominantly. Additionally Overlaying of 2 water tank, that could be used by villagers kept at sarpanch FPO Company

Adivasi Vikas Vibhag Paani Purta Yojna 2007-08

The Water Tank as shown in the image was built in 2008-09 by the Adivasi Vikas Vibhag Paani Purta Yojna, as per this scheme the 50,000 litre Over Head Water Tank was built, the construction work was completed, but as the Gram sevak, approval authority got changed, the documents work could not get completed, and after 2 years, the scheme got lapsed and the handing over process of this water tank, was not given to villagers, leading to potential water

tank, standing still in good condition, but still of no use to villagers. The Villagers have encroached the space below the tank, and are being used for their selling of tea and kirana store.



Figure 68: RRC tank build under Adivasi Vikas Vibhag Paani Purna Yojna (2007-08) (Source: Author)

When discuss with the houses near by, we came to know, the yojna was successful, but due to delay from grampanchayat office for paper documents, they had to suffer and now they have to travel 1.2 km for filling of water.

Problems that are to be addressed

- Villagers only receive water every 5 to 6 days in the heat, which leaves them without enough to drink. They have to travel more than 200 metres from their homes to a handpump to obtain water.
- People have to use hand pumps to get their water in summer, increasing the likelihood that a heatwave may affect them.
- The current water tank is not able to cater to the demand of the villagers. Recently one lakh liter water tank was sanctioned which is also enough to complete the requirement of the village.
- There is no technological water treatment method in the village because of which there are various waterborne diseases in the village such as kidney stones.
- Due to electricity problems, use of motors is less so people have to manually fetch water to their homes.

Chapter 05

DIRECTED RESEARCH

"Field Technology Demonstration of a Sustainable Bamboo bridge for Tribal Resilience with Community-Driven Approach for Bridging 14 Isolated Hamlets in the Terrain-Sensitive Katri Region of Nandurbar through Eco-sensitive approach and Indigenous Materials"

"We build too many walls and not enough bridges."

— Isaac Newton

This research provides an overview of Field Technology Demonstration of a Sustainable Bamboo bridge for Tribal Rural population located at Katri Gram panchayat project site Naldapada Hamlet, Dhadgaon taluka, Nandurbar District, Maharashtra.

The proposed project is a joint work by the PWD Department of Nandurbar District, and IIT Bombay. Katri is having a terrain Sensitivity having 14 padas with each other and also from Talukas, it is difficult to get even the basic requirements like PHC, Schools, Market Govt Offices etc., The project will also have discussing & interacting with tribal population & PWD department for citing their connectivity issues followed by site selection so that access population needs to satisfy their minimum needs.

Further, the study will attempt to document and study at Naldapada Hamlet in katri village, the possible long-term impact for the Bamboo Bridge and additional social influences.

5.1. Introduction

Bamboo has frequently been known in the 21st century as the “green steel” and has played important roles in historically traditional construction principles in many areas of Asia, Africa, and South America (van der Lugt et al., 2006). One of the most remarkable uses for bamboo is in the construction of bamboo bridges, which reflect the values of creativity and innovation, sustainability, and adaptability of local communities and cultures. This study goes deeper than generalizations about the eco-friendliness of bamboo; it shows the role of engineering, the importance of local culture, and its role in present-day infrastructure.

The northeastern states of Assam and Arunachal Pradesh have established a great historical tradition of constructing bamboo bridges. In this context, bamboo transcends being merely a fixture of construction. It becomes a cultural symbol in the everyday lives of local usage. The making and upkeep of the bamboo bridges in these parts are community activities that habitually involve the participation of most community members, as well as knowledge passed down to them from generations of bamboo bridge builders before them.

Moving away from the northeastern context, this report outlines the recent efforts in Katri village, Maharashtra to build a bamboo bridge to suit specific needs. In contrast to Assam and Arunachal Pradesh, where there are traditions of bamboo bridge construction, the work in Katri village is an attempt to build an appropriate bridge design using local bamboo as the context is different environmentally and socially than that of the traditions of bamboo bridge building in northeast India and Katri is making a unique attempt to consider the conditions in central India. The need to build a bridge stemmed from the need to provide dependable access during the monsoon rains across an otherwise seasonal stream that isolates parts of the village.

The Katri bamboo bridge project featured a comprehensive assessment of the main bamboo species, load testing and hydrology. Community members, supported by technical advisors, were involved at all points, from initial assessment of materials and treatment, to design and construction. Maintaining durability was important during the construction process. Treatments were applied to the bamboo culms to protect it from decay and insects. The modular aspect of the bridge design allows for easy replacement of damaged bamboo pieces to make sure the bridge can be kept usable for as long as possible.

In many rural tribal communities throughout India, conventional infrastructure solutions are impractical due to geographical, ecological, and socio-economic factors for those groups who are to develop. During the monsoon season, isolation from floods on rivers limits access to basic services- Hospital, school, market, and Government. At this time, constructing community growth bamboo bridges provides an accessible, environmentally friendly, and culturally appropriate option. These bridges help to facilitate physical connectivity, build a sense of local ownership, and strengthen ties - bridging both literal and social divides (Dhangar, 2025).

Bamboo bridges are more than just structures—they connect people, improve daily life, and protect the environment. The experiences from Assam, Arunachal Pradesh, and Katri village show how local knowledge and teamwork can create safe, strong, and eco-friendly bridges. With ongoing care and community involvement, bamboo bridges can continue to bring positive change and hope to rural areas, making life easier and more connected for everyone.

5.2. Objectives

The aims of the study are:

To design and construct bamboo bridge which is affordable and moreover it improves the connectivity of the 14 hamlets of tribal village, saving distance and time for access to basic amenities such as School, PHC, PDS Centre

To empower sustainable indigenous practices and use of bamboo for the various purposes, such as Arch bamboo bridge as best practical example

To encourage the tribal village people to intensely take part in planning, construction and maintenance of project, thereby implementing a good sense of ownership by using modern tools and improving project efficiency and generating tribal professionals, thereby deploying skilled workers and encouraging self-employment opportunities.

To increase awareness for bamboo construction as climate friendly rural infrastructure model for sustainable development, by praising and supporting local nature and advocating social economic upliftment.

5.3 Study Area

The study is conducted in the hamlets of Katri village, specifically among the Bhill community residing in Patil pada, Makakund, Naldapada which are located approximately 12 kilometers from the main village habitation covering other 14 padas.

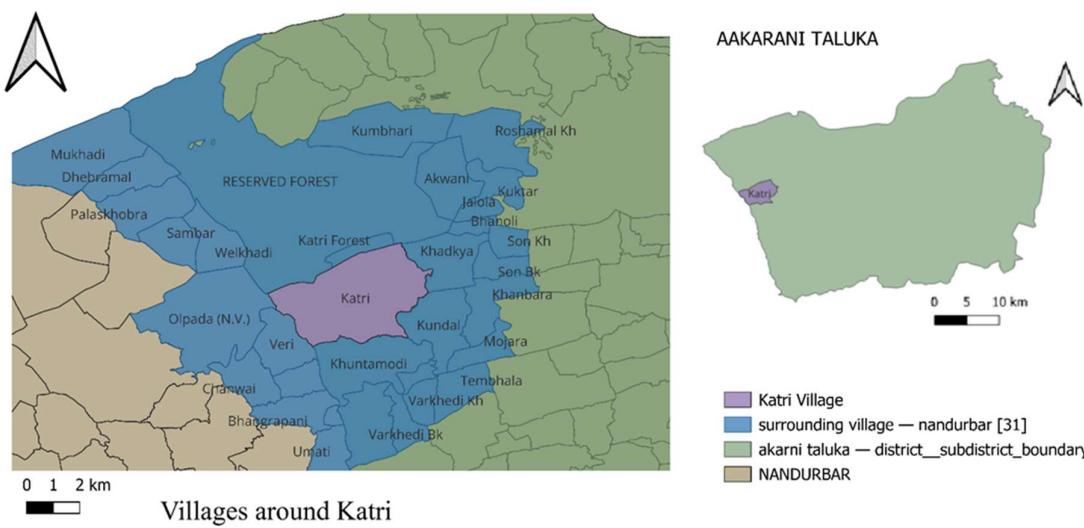


Figure 1 Village key Map of Katri, Source Author

The Houses in Naldapada Village, are significantly located far away from each other, and are mainly located in Terrain region.

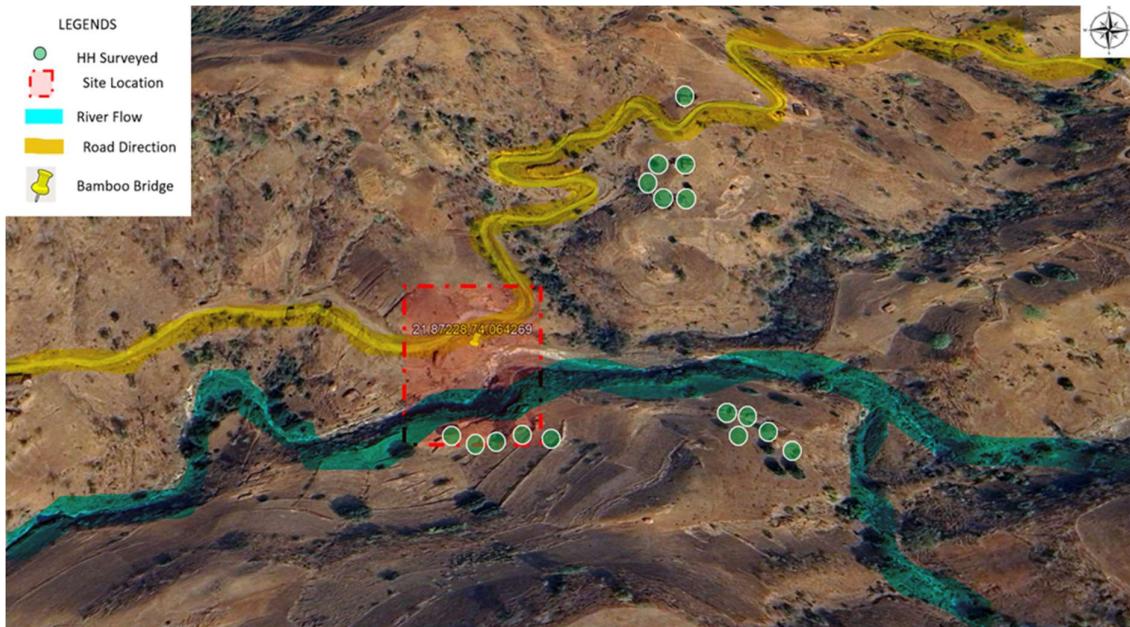


Figure 2 Site study Map, Source Author

5.4.Methodology

Detail Research Design for Naldapda, Katri Village, Nandurbar District, Maharashtra This segment shows the methodology taken to understand the feasibility, structural requirement, and socio-economic assessment of building bamboo bridge in katri village, which is especially featured by heavy Monsson. There by understanding the loss of connectivity of 14 hamlets also, the present RCC bridge, at other village are often covered by floods in monsoon, losing and cutting of the access to other villages.

The methodology research includes various stages, thereby adding 9-week field stay in the village itself. This are inclusive of Architectural Design, PRA Activities, Bamboo distribution, field demonstration tests, considering view points of tribal villagers by making sure the eco-sensitiveness and as per design for structural stability balancing out with nature.

5.5Motivation For the Directive Research

The fundamental objective of this DR is to understand the tribal rural patterns of the 14 hamlets and mapping out their daily activities of the villagers along with their travel distance to PHC, Govt Offices, PDS and other activities, which would later help for calculating the foot falls ratio as well as vehicular connectivity to other padas and then creating the design parameters as per vehicles traffic to estimate the load and strength of bamboo bridge.

The solution driven scope extends by solving connectivity issues and to develop a Field Technology Demonstration model for tribal communities, especially development rooted in context specific to bamboo material and engineering To start with, we had an in-depth knowledge for the terrain geographic region of village, their hydrology and intersection of flow of rivers system, along with GIS Maps and village flood history.

This research helped us to finalize the Naldapada as site for bamboo construction as the households surrounding the bridge are prone to seasonal floods, thereby giving best location for constructing of bamboo bridge.

To begin, we had an in-depth understanding of the physiographic regions, their hydrology, and river systems intersecting the areas, which, along with GIS Maps and village flood history, helped finalize Naldapada as a site. Since river flow direction ends at Naldapada it would make the households more vulnerable to flood.

To increase better chances for construction and village wide support, we conducted a bamboo workshop with the motive of increasing the villagers' understanding of bamboo as building material for the upcoming bridge.

As on-site pilot model of bamboo arch was built on scale to the required size. Also, the deflection test and 2-ton load test were performed to evaluate the structural stability and security check points.



Figure 3 Load Testing of Arches with sarpanch Sitting, Source Author

5.6.Data Collection Method

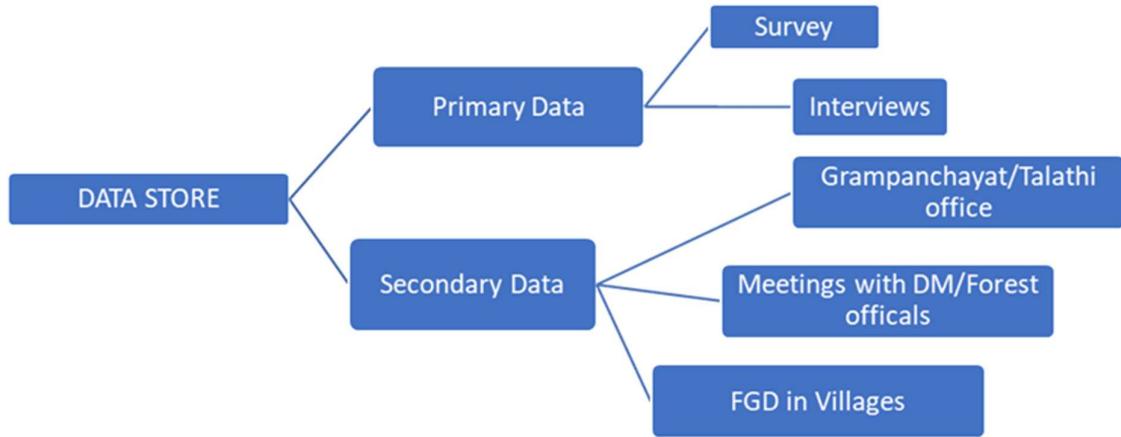


Figure 4 Data flow map Source Author

5.7.Discussions with Team Experts

In order to thoroughly grasp the potential and practicality of bamboo as a construction material, we spoke with specialists in bamboo construction, sustainable architecture, and rural infrastructure development. These specialists provided us with vital information that guided us in defining the construction details of the Bamboo bridge. With the bamboo and its chemical treatments, along with the joint connectors being renewable and locally available, the specialists provided us with valuable information in the cultivation of bamboo, current research in the field, and practical ways to empower rural citizens. Further, the specialists provided us with information on the cultural significance, environmental impacts, and economic advantages of bamboo in the village context. Their insights were valuable in addressing the problems of the material's source, durability, and the acceptance of the local community in its execution.



Figure 5 Discussion with Engineers at site, Source Author

5.8. Household (HH) Survey

We performed Household survey in Naldapada, where the bridge would be installed, to understand the issues, needs and expected outcomes. FGD with different age group on Pre-monsoon migration patterns and their struggles for livelihood

Meetings with surrounding artisans, craftsmen and officers from the forest department to explore sustainable bamboo sources and treatment methods.

A site-based supervision of the foundation and anchoring works included the construction of bunds and methods of water diversion, and methods for casting of columns and piers.

The data collected generates a comprehensive socio-technical study impacts report including architecture and structural drawings alongside maintenance manuals. These results produce a cohesive roadmap for localized execution, multi-stakeholder collaboration, and further development in other ecologically sensitive tribal areas.



Figure 6 Household Survey Near Bamboo Site, Source: Author

To assess these and to study the socio-economic and demographic profile of the population, results form a household survey; ranging in 16 houses near the Site of Bamboo Bridge, Naldapada. This method provided a notion that the observations were generalizable data, where it illustrated some of the situations of the Bhil settlement and how they faced tribulations. It provided data driven decision making and basic understanding of ideas for assessing subsequent versions.

The findings have informed the creation of targeted interventions for the village. This basic necessity of life is meant to be understood by a household survey that must incorporate both issues, whether it is before rain or after rain in order that the design is made keeping them in view.

5.9.Sampling Criteria

The Hamlets gives the singularity of the rural pattern and the fact that the entire population has the majority of Scheduled Tribes (ST), we have done sampling based on the house types such as Pucca, Kutcha and Semi-pucca. The data collected ourselves by calculating the houses during the visits, identifying total 172 households across the three padas

Hamlet	Total no. of HH (observation)	No. of Pucca houses	No. of Semi Pucca houses	No. of Kutcha houses	HH Surveyed (sample)
Patil Pada	69	10	40	19	30
Honi pada	60	8	40	12	14
Naldapada	43	3	15	25	16
Total no. of population (GP Office)	598				Total HH in village 172

The Patil pada was chosen, as this was the residents of Sarpanch, and the facilities and amenities had much more different than other padas.

The Honi Pada was chosen because it was junction point, connecting other major 6 padas, including kamodapada, padavpada, shelkadi pada, kundal,patil pada, thorkapada, shelkadipada

The Naldapada was chosen, after heavy discussion with Sarpanch and Gram panchayat officials for the Construction of Bamboo Bridge

5.10.Two Day Workshops for Understanding the Concept of Bamboo Bridge Design In with Villagers

A one-day workshop with people from Katri village was organized to make the community become more actively involved in the programme and also, they will be able to sustain the bridge itself in longer terms. These workshops became a means of dissemination of information, while bamboo was shared as an indigenous material and its sustainability, affordability, cost-effectiveness and abundance in nature were discussed, it further highlighted the disaster-prone terrains and the changing climate situation.



Figure 7 Bamboo Workshop at Katri village, Source: Author

Villagers were demonstrated different types of bamboo samples, their Mechanical & Load bearing Properties and various traditional treatment methods to strengthen, have long term benefit or any fungal damages could be avoided.

Experiments were also made for making bamboo arches, how they can be joined with either lashing or mechanical fasteners and how the structure stability is maintained with proper anchoring and bracing.

Also the workshop covered an adding bamboo, with RCC piers cap and foundation details. The construction stages with hand drawn models and working drawings were communicated to the villagers

Starting from creating bunds and site clearance are few footnote points. Rainfall, which we experienced while working on the bamboo construction, was a hamper for the work.

As a result, villagers were actively involved in building too, even by skilled, semi-skilled involvement of the direct labor base at village level itself during execution.



Figure 8 Bamboo Workshop Day 2, Source Author

It helped us to understand the Participatory construction model, and how sharing of information had empowered local communities to demonstrate successful repairs & maintenance, and replicate designs in other padas.

This created an ownership and pride with the project to link to the vibrant community.

Feedback:

- Farmers ask for yearlong connectivity
- Safety and durability concern
- Attraction for labor/material work during bamboo bridge (employment generate)
- How to Maintain the bridge
- Equal opportunity for using of bridges to all Hamlets
- The need for government support for future more bridges and planning
- Artisans, handicraft employment generating from other source of bamboo material

5.11. Meeting and Discussion for the Bamboo Bridge with Sarpanch, Up sarpanch and Gram panchayat officials



Figure 9 Meeting with Panchayat Committee, Source Author,

For better understanding the Site location and major connectivity of the villages and for identification of Potential sites we had a meeting with Sarpanch, Up Sarpanch and Gram Panchayat officials.

The Head of Hamlets, along with their team, were too invited for discussion; after scrutinizing the major catchment point of river flow and with heavy discussion, we had finalized the Naldapada Site.

The reason for finalizing the site, is because the naldpada ends at the tip of katri village, and major accumulation of river water is being there, during monsoons later disconnecting with other padas, majorly during rain.

Also, the residents residing there are being isolated and major facilities are been not provided to them, creating a sense of isolation among Villagers, therefore leading to more dropouts of children, mortality rate during monsoon and un availability of Food Grains

This decision was unanimously decided among the villagers of 14 padas along with sarpanch, therefore giving them major power for the Naldapada site.

5.12.Understanding the Local Community

The Naldapada has existed for a very long time in katri village. During our interactions with the oldest person of hamlet, age 92, he shared that her ancestor had been living in the area of

generation, The mountains had more trees and multiple biodiversity existed. But now as the coming generations' population increases, the forest has been cut down, for farming and the local species, reduced drastically. The livelihood majorly depended on forest, but as untoward rain and increased animal husbandry and grazing, there has been times, there has been shortage of grains, and lack of connectivity of roads, they have to starve many times.

Demography of Naldapada

There are 43 Households at Naldapada, with 149 population with 75 males, 50 Females and 25 Children. More of the Population engaged in Agriculture, Goat Farming, and 8 males migrated to Gujarat as construction labor, with average income of 12,000 Rs to 15,000 Rs



Figure 10 House hold survey, Source : Author

5.13.Cultural Context

In the cultural context of Tribal Community, Education, Health, Infrastructure, Food security, Employment opportunities are majorly influenced by transportation, connectivity of roads and accessibility to various parts of their surroundings to meet their needs. As connectivity is lost, the celebration of yearly cultural festivals has been decreased. This loss of connectivity has also led to stagnant growth, increase of dropout of children from school as they are later made to work in fields and forest, thereby creating immediate economic needs over long term educational benefits and later the increase in mortality rate due to non-availability of PHC.



Figure 11 Wedding Program at Village, Source: Author