Field Report

Awanish Kumar, Lalit Gautam, Bhanu Pratap, Anjali Maurya, Avani Saraswat, Drishti Baid, Aswath, Vikas Meghnathi, Prashant Helaiya

Field Report of Pirana Road Solid waste treatment plant

Site Detail: Ahmadabad is a metropolititan city having population of about 55 lakhs as per census report 2011. Due to rapid urbanisation and growing population leads to generation of large quantity of solid waste in day today life. This poses new problem in front of Ahmadabad Municipal Corporation how to dispose this large amount of waste in a sustainable and efficient manner. Pirana, solid waste dumping site which comes under Ahemedabad Municipal Corporation is an example of in that sense.

Presence of open truck and tractors carrying solid waste and pile of plastics near Pinara dumping site

Observation: We found that there was no proper pavement at land fill site and open heavy duty vehicles i.e. trucks, tractors filled with solid waste were running in streets without any cover over solid waste (Figure-1). Presence of solid waste in road leads to generation of fine particulate matter due to friction between tyres and road. Pirana site looks like mountain having more than 30 feet in height. By close observation it appears that there is no proper sorting method adopted by Municipal Corporation. This solid waste is growing day by day due to huge production and unavailabity of proper disposal mechanism at a same rate. There are various private companies are running in vicinity i.e. NEPRA Solid waste management private limited and Bharuch enviro infrastructure limited (BEIL) to prevent this growing menace but they have their own limitation in terms of their limited output. Also there is presence of various unorganised and unskilled workers who are doing manual sorting of this solid waste for their livelihood. We talked to a group of around 15 lady workers infront of Nepra Solid waste management pvt. Limited and tried to understabd their working style and problems faced by them during execution of solid waste sorting. Majority of women were migrant labourers from Jhabua district Madhya Pradesh and came here with the help of company appointed contractors. There were so kids around 2-5 years of age with them and there was no facility of

crèche/baby sitting for such minors. They told us that there is so much foul smell coming during sorting of solid waste. Hand injury is common due to presence of needles and glass. We observed that they have woollen gloves in their hand, head cover and cheap quality mask in their hand. Also there was large number of top predatory birds like kites, crows were present in trees which was quite noticeable. Also in street there was presence of large number of stray dogs. We have not seen others birds like squirrels, sparrow and other common birds seen in our day today life. On enquiring it was told by residents that it is due to meat products also dumped on site leading to increase in predatory species population in the area (Figure-2).

Presence of Top predatory species found in Pirana dumping site

One lady also said that “this work is like that where there is a possibility of piercing of hand by needles and glass and sometimes it is possible that it can even pierce my sandals”. We noticed that they have no shoes in their legs. We also visited BEIL and tried to understand their working method and their concern. The authority concern presented their working methodology and told us that they are in a lease agreement under public private partnership model with municipal corporation for 25 years. During initial treatment, they cover the heap of solid waste with culture for about 45 days for decomposition. This was followed by extraction of fine debris followed by again exposure to culture for about 45 days. This was followed by compost extraction and large particles and unwanted materials were manually and magnetically sorted in a conveyor belt. After that whole residue is go for hammer mill-2 leading to refuse derived fuels which they supply to various cement factories, power plants. Systemization: It is the need of the time to systemize the place as whole site is being used recklessly and wasted is being dumped at any place. There is no organization of labourers (in this case raggpickers) neither they have any records. This leads to a largely unrecorded workforce which are exploited by business men, etc.

Suggestion: Our suggestion comprises of segregating hired and daily wage /contractual labour forces and bringing them together under one roof to make them aware of the hierarchy at workplace and make them aware of the job they are doing and its consequences on their health. By assigning

respective areas to different task, a working environment can be improved and by that means we would be able to exploit site to its full potential.

Waste segregation: There prime purpose was to segregate the waste into plastic/ metals/ rubber etc. hint that came to our notice was unlike of composite matter rest of the waste consist of regular plastic things used like water bottle and door handles etc. we saw certain similarities in the sizes and type of waste, like all the plastic bottles fall under a size range; similarly, the oil bottles of glass falls under one size range. Taking this into account we thought of first segregating waste according to sizes and then they can be sorted manually. The reason behind this was to reduce the interaction of human and waste. Rag pickers will not have to search the mountains of garbage just to look up for the big plastic bottles and this can be easily done if a machine is segregating them. This process may have limitation that we haven't sorted yet and that is, the process would be efficient till the things ae being delt in large sizes but as the size decreases the small plastic may get mixed up with sand at the lowest of 'sieve' so that makes in unfit for making compost. So here we have another idea for that.

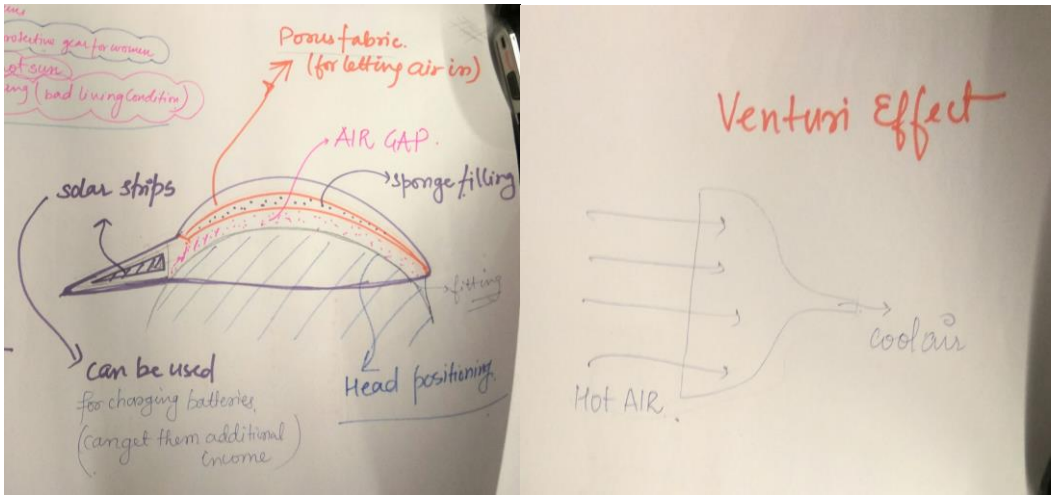
Plastic detection: While on the site, the workers showed us the compost that they make and they said it was biodegradable; but the reality was, it was not. Those people hire rag pickers and there job is just to sort the garbage on the basis of type of the material (plastic/ metal/ etc). Even after manual sorting small parts of plastic or micro plastic get into the biodegradable waste and through that path they enter the compost. When that compost is used in field, those plastic are likely to enter in food chain.

Suggestions: The solution to this is to design a device which could determine the presence of plastic and could even determine its percentage in a sample so that plastic degrading bacteria can be used to eliminate it. Uncomfortable protective gear for women: During our field visit we happen to talk to the women who were working on the dumping site. Despite of having all the required safety gear they never used it. On being asked they replied " didi pehnna pasand nahi he, kaam nahi kar paate". It is due to the illiteracy and unawareness which leads to such rampant practices at workplace.

Solution: To design a gear (mask, boot and gloves) for the women so that they wear it in workplace without facing any difficulties.

Working in open site in scorching heat conditions: The main and the most prominent problem, people over there faced was temperature and its consequence on their health. They said that they had problem in working in such hot conditions and it was unbearable in this peak of summer season. They continuously worked for long duration for about 12 h in a day despite getting lower sum of money in return.

Solution:



Providing them with a cap is the most basic solution that comes into our mind. Designing such things is quite difficult and costly affair. In order to circumvent such things, we tried to innovate a normal cap. Based on the principle of Venturi effect, we would be providing a porous fabric and for heat insulation a sponge filling. Our design also has an insulating air gap between head and sponge fabric. To maximize the cooling effect and allow the entry of air through a thin elastic fabric on the head while rest scaffold is stiff in nature. Cadmium Batteries present at distal tip of cap will be charged through solar strips attached on the top of the cap. They can use these batteries for daily chores or sell them in market. This leads to extra income and also motivation for them (Figure-3).

Questions: Solid waste which is supplied by Municipal Corporation after long time after its generation. Presence of plastic in a stored solid waste heap under sunlight (UV rays) leads to fragmentation of plastics and it is well known for the formation of plastic granules. Whether compost derived from such factories is free of plastic granules??? If not, then it has some serious consequences as it will enter into food chain.

Possible solution/Prototype designed: We will collect the compost from the company and analyse for plastic granules, plastic raw materials and other composite plastic component and ensure that the bio compost is suitable for its intended application. Using different spectroscopic, imaging and chemical means we will try to understand the presence of plastic polymer in biocompost.

Inference: This will help in quality control of bio compost supplied to Indian farmers.

Field Report of old age shelter home (Kailash Dham) near Gandhi nagar

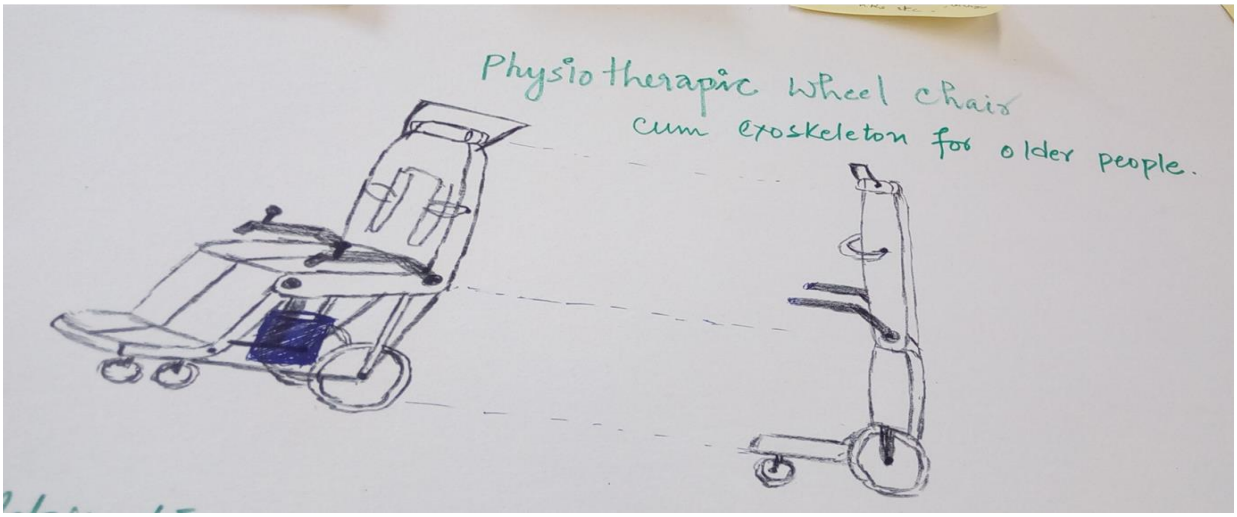
Site Detail: Kailash Dham an old age shelter home situated near Gandhinagar. We found that there were around 150 old people residing in a campus of 10 bighas. We talked to various old age people and found that these people are from effluent families and it is due to strained familial relations leads to avoidance of elderly persons by their children. There were ladies who were residing in this campus for more than 23 years. We found nice arrangements and accommodation set up and also there were satisfaction among old age residents.

Observation-1: we observed that there were construction barriers for disable people. We also observed that there was lady who was unable to walk for around 2 years.

Questions-1: How to make a disable person self dependent or minimize the immobility.

Possible solution/Prototype designed: We thought to design a novel chair with modern sophistication having provision to help in movement of various body parts and will ease day today life and also prevent further deteoriation of physiological function. Idea came to our mind by reading literature. In 2014 Olympic of football, a paraplegic person name Juliano Pinto kicked football symbolically using a designed robotically exoskeleton. In this case we will try to design a seat which has provision to enhance grip strength (finger), neck, ankle and other musculo-rotation as well as help in

Physiotherapic cum exoskeleton table for older people



generation of feeling of independence in disable people (Figure-4).

Carrying heavy buckets

The elderly had to fill their own water from a hand pump and carry it till their rooms. People who had their rooms on the first floor had to climb the stairs with the heavy weight.

Suggestion: Creating a trolley mechanism to transport heavy buckets of water till their rooms.

Quality of life: All the people living in the old age home were assigned chores. Women were responsible for cooking while the men were responsible for cleaning. Their typical schedule was cook, eat, sleep, repeat. They had no time for pursuing any hobbies.

Suggestion: Create a systematic assignment of duties and chores, so that nobody feels over burdened and the work gets done easier and quicker. Hold hobby workshops, like painting, knitting, gardening in the old age home to make their lives less monotonous.

Accessibility issues: Even though the old age home was built especially for the old people, yet we saw a lack of accessibility in terms of ramps, etc. Old age home for older person were full of structural constraint and poses a barrier for free movement.

Our suggestion: Building ramps near the stairs so that people on wheelchairs do not face issues of mobility.

Problem statement: During our visits to the dumping site (Pirana) and village Fatehpura, we found that people are using ground water for drinking. Ahmedabad is an industrial area and also the workers are living in the shelters very close to the factories. the water at these places may contain impurities, high amount of arsenic and fluoride content. it is not safe to use ground water specially in the areas close to industries or factories. also the issue with the workers is that they cannot afford a high cost water filter.

Solution: Although they are used to the same ground water and they don't even consider issues of potable water as a problem. But in reality it's a serious issue. Workers are backbone of industries and we could compromise with the health of workers. That's why we thought to design a Low cost water filter.

The filter would consist almost the similar layers that a Bio sand filter contains with little modification in design.

Diffuser: Protects the top of the sand and the bio-layer from being damaged when the water is poured into the filter.

Bio-layer: A community of micro-organisms that live in the top 1-2 cm of the sand. The micro-organisms eat some pathogens in the water, helping the filter treat the water better.

Activated charcoal: Used to remove impurities from water by the concept of adsorption. **Filtration sand:** Removes pathogens and suspended solid from water. The filtration sand is specially selected and prepared to treat the water well.

Separation gravel: Supports the filtration sand and prevent it going into the outlet tube.

Other than this we are searching on some other concepts to remove arsenic content from the water. Also it has been found in some research by MIT students that there are some trees that removes the dangerous bacteria E. coli from the water. Also we are thinking to add some cooling mechanism along with the filtration of water.

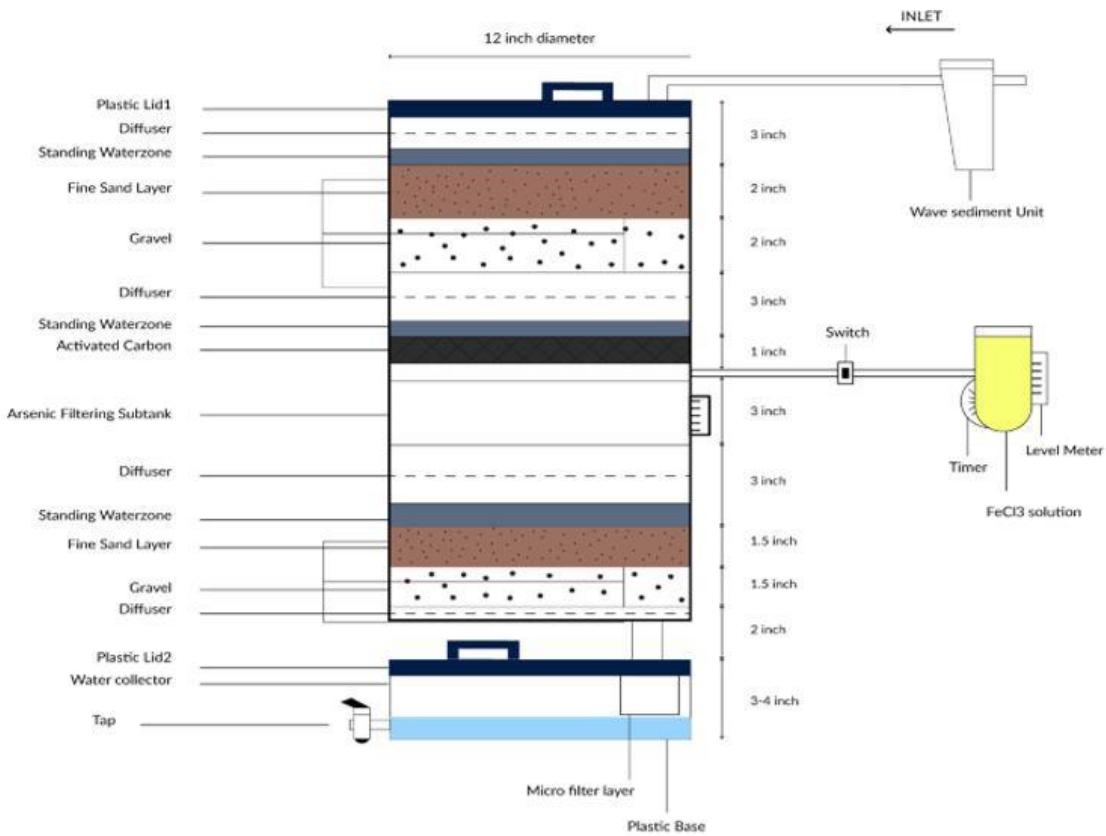


Figure-5: Diagram showing detail of different component of filter system (Photo courtesy: UBA team IITR in which one of our member Lalit Gautam was also part of that team during his dissertation)

Housing: The basic amenities of life 'roti, kapda and makaan' these three things are just a dream to the workers of pirana. They live at a place near dump site which is quite harsh and difficult with unhygienic conditions.

Solution: Plastic is available in abundance near their place of living and mud is available around them. That's why we proposed that by using these plastic bottles as a basic building unit for construction purpose with mud as a mortar and thatch roof. The design would be inspired from Bunga

architecture of Gujrat and the insulating material will keep the house cool during scorching heat. For additional cooling we could add a tin pipe along the outer edge and dig it in ground and provide one opening into the house. As tin heat up the hot air moves up while the air beneath the ground is cool and due to this it settles down and moves inside the house.

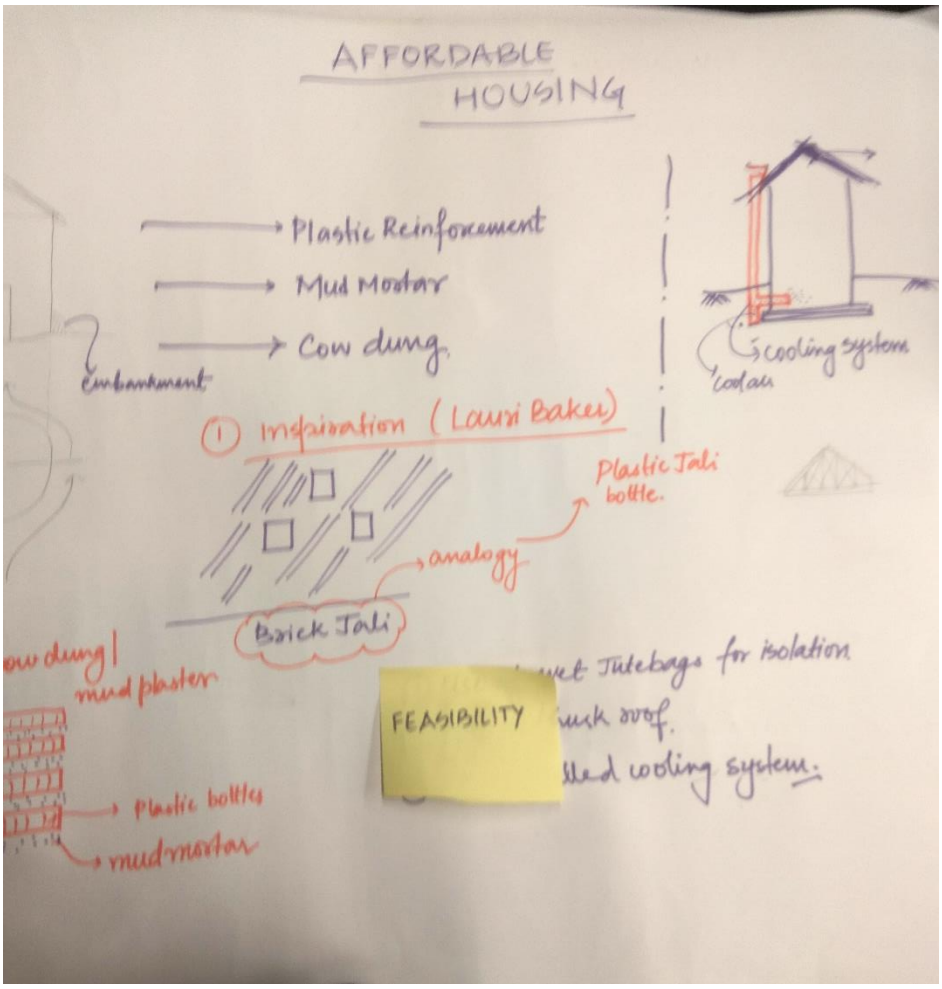


Figure-6: Schematic representation for affordable housing

Problem: Some workers who are not in industries and are working on their own to sell the waste for their livelihood cannot afford expensive and advance gloves, due to which most of the times their hands get pierced by sharp objects present in the garbage and also they have to bend to pick up the garbage.

Solution: In this problem instead of using the normal gloves we can design a cheap garbage pickup stick so that their hands will be safe as well as they don't have to bend again and

.again to pick the waste and it will help them to separate the waste easily (Figure-7; Courtesy: youtube.com). Basically the idea is to make a cheap garbage picker stick. Which can pick the garbage easily and also help to separate the waste. The image shown in above is just a prototype design which we can use in this device. In which we will add four legs due to which it will be easy to pick the garbage and it will also have the support for the hands as shown in the image above. Outside the four legs we will add blades opposite to each legs by using which it will be easy to separate the waste and pick the particular thing you want. We can also add mechanical rotation which will help for better waste segregation.

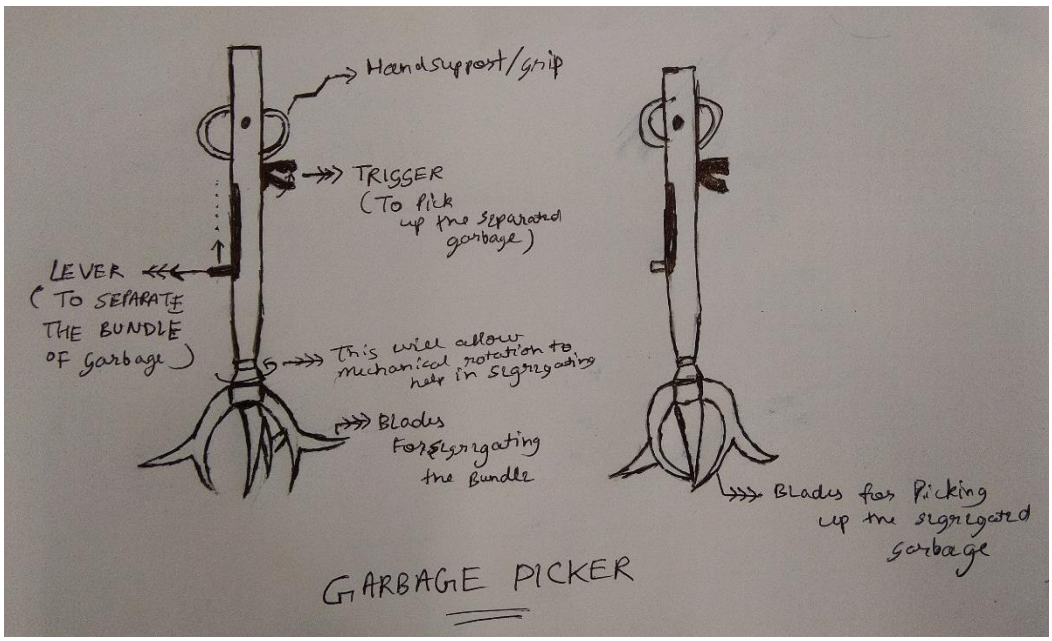


Figure-8: Schematic drawing showing garbage picker detail

Fatehpura village visit

Problem statement: The users of pesticides, famers and family members run the highest risks. they can easily come in contact with the pesticides, for example when mixing the chemicals or when applying them to crop. even sometimes it leads to death of individual applying the pesticides.

Solution: All the things starts when farmer comes in contact with the pesticides. Nowadays farmers used to spray the pesticides manually. They carry the tank filled with pesticides at the back and use a pipe – nozzle system to sprinkle the pesticides. When they breathe, the fumes of the pesticides enter through the nose and finally leads to a lot of problem. That's why we thought to design a Drone based Pesticide Sprayer. Designing a Drone based Pesticide sprayer would break the direct contact between the farmer and the fumes of pesticides. Other than this, we can control the flow of the pesticides and also the direction of flow. It would also reduce the time to a high extent.

Animal control: The villagers complained about Nilgai coming and ruining all their crops at night. Because of this, they had to stay awake at night and and watch over their crops.

Broken cots lying around: We saw a lot of broken cots which were made of nylon, which is extremely strong. These broken cots could be reused to make something useful for the villagers.