



## Annexure 5 Report I

### “Construction of Water Treatment Plant in the Adopted villages” National Institute of Technology Manipur

#### ACTION PLAN:

A core committee has been formed comprising of Faculties, Staffs and Students headed by the Co-ordinator Dr .P. Albino Kumar (Head, Civil Engg. Dept).

#### Details of the Team including Coordinator:

<u>Dr. P. Albino Kumar</u>	Head of Department(Co-ordinator)
<u>Dr. Thiyam David Singh</u>	Assistant Professor (Chemistry)
<u>Dr. Sangeeta Laishram</u>	Assistant Professor (Basic Science & Humanities)
Dr. Waikhom Victory	Lecturer
Ms. S. Pipileima	Lecturer
Kh. Sachidananda	Lecturer
Mr. M. Nongthouba	Lecturer
Mr. I. Bigyananda	Technical Assistant
Ms. N. Bidyamani	Technical Assistant
Ms. P. Jesiada	Technical Assistant
Mrs. Kh. Jayalalita	Technical Assistant
S. Saroja	M.Tech Student
Sumenri Thongam	B.Tech Student
N. Bishwajit	B.Tech Student
Somorjit Yumnam	B.Tech Student

UBA NIT Manipur has adopted **5 (five) villages** at Nambol, Bishnupur District of Manipur.

Namely-

- 1. Nambol Makha**
- 2. Kongkham awang**
- 3. Maibam Chingmang**
- 4. Nambol Bazar &**
- 5. Koriphaba.**

## **Introduction**

The villagers of Nambol face acute crisis of water scarcity. UBA NIT Manipur has adopted 5 (five) villages at Nambol, Bishnupur District of Manipur namely- Nambol Makha, Kongkham Awang, Maibam Chingmang, Nambol Bazar & Koriphaba. The team of UBA-NIT Manipur had carried out Participatory rural appraisal (PRA) of these villages in 2015 and identified the most priority issue - Clean & Safe water for drinking. The villages have ponds and it's their main source of water. NIT Manipur adopt the villages through UBA and firstly surveyed and select few ponds for treatment. A lab- scale and a pilot plant filtration unit has been set at NIT Manipur, and studied for designing of large scale plant to be implemented at the villages site using biosand filter concept. A low cost 9000 L water treatment plant based on roughing and biosand filter was designed and constructed by NIT Manipur and finally inaugurated on 27 August 2016 along with awareness programme. The treated water were odourless, colourless and health effects were found to be almost nil. The treatment plant serves the villagers within 3 km radius. Another 2 water treatment plant was constructed and handed over to villagers of Maibam Chingmang in April 2018. Impact/ positive change of the project on the community: Treatment of water from nearby ponds using indigenous techniques (combination of Roughing Filter and Slow Sand Filter) with low cost and easily available materials. The 9000 L water treatment plant based on roughing and biosand filter treats the water from the Pond and provided drinking water (Potable water) to the villagers of Nambol. The treated water were tested for all the parameters and observed within permissible limit for potable water and hence these treated water were abundantly used by all the villagers in the vicinity. More than 2000 villagers of Nambol depend on this filter for their drinking water. Villagers within 2- 3 km(farthest) radius of the treatment plant comes and collect water, the mode of conveyance being trolleys and bicycles. Regular surveys were carried out to identify effect due to the plant water if any. For the last three years the water treatment plant fulfill the needs to safe and healthy water for consumption without any cost and minimum maintenance. Also programs related to sanitation of the villages through introduction and installation of Dust Bins (Different solid waste) to optimise Solid Waste Management provide a very effective awareness and practice to the villagers in the vicinity regarding importance of sanitation.

## **Outreach**

After completion of the construction, the inauguration of the biosand filter on 28th August 2016 was attended by more than 200 local peoples. The awareness & demonstration lectures were delivered by Dr. P. Albino Kumar, UBA Coordinator, NIT Manipur. This whole project with the awareness programmes on importance and methodology for sanitation also benefited a lot to the local villagers in the vicinity and hence the project was extended and another 2 water treatment plant was constructed and handed over to the villagers of Maibam Chingmang in April 2018.

## **Participatory Planning Process adopted/ Methodology:**

The base survey has been completed for all the study areas and the survey formats were prepared. Base line survey has been done in order to know the present situations of the model village adopted. The population is 1985 according to the census 2011. The socio economic characteristics of the study area are discussed in the following sub headings.

### **i. Livelihood:**

The main occupation and source of livelihood of people in the area are farming, fishery and agriculture. Women are mainly engaged in weaving, and other handloom related works. Most of the people are unemployed and unskilled labour and are not well-educated which resulted into economically backwardness of the villages.

### **ii. Water:**

As the main river is far away from the village, the local peoples are facing a hurdle for the daily use of water. For drinking and other purposes, the villagers are using underground water and from the village pond. The main problem is the scarcity of water due to the lack of proper water supply.

### **iii. Roads and Communication:**

Most of the roads running through inter-villages are kuccha roads. Whereas few bituminous pavements are seen but not all.

### **iv. Health and Sanitation:**

The village has no any public sanitary toilet facilities. However, public health centre is properly function. There is also abandoned and dysfunction sewage treatment plan in the area.

### **v. Education:**

The Nambol High School has an enrolment of about 360 students. The school has classes of 9 - 12 standard and offer different streams i.e. science, arts and commerce from 11th standard onwards. However, the enrolment in the commerce stream is nil. Perhaps, the declining familiarity of the stream could be a reason. As most of the villagers are economically backward and they cannot afford private school. Thus, their ultimate resort for schooling is only the government school.



**Meeting with the Local Bodies**



**Dumping Site at Nambol**



**No Proper Drainage System**



**Iron in Water Hand Pump**

**The extent and nature of interaction with rural areas, field functionaries, voluntary organisations and Govt. developmental bodies**

About 200 individuals and few local organisations in the area were interviewed. Most of them address the issues of potable water. Implementation and induction of new innovative methods and technology are almost absent. For instance, the traditional method of conserving water with ponds at the household level is no more viable. A modern approach, research and technology which can be beneficial for the conservation of water in the individual pond would be indispensable. In general, the local organisation took important part in bringing various developmental work in block or local level. Community water tanks or ponds, community sanitary complex, community and lighting of street are few of the common initiative. However, major developmental work are funded by government agencies through municipal councils or gram panchayats in few cases. The interaction shows that a collective effort both from villagers, local organisation and government agencies would be required while implementing development work.



**TURBID RIVER  
WITH  
SUSPENDED  
SOLIDS**

**A VILLAGE POND**

**A DRY RIVER**

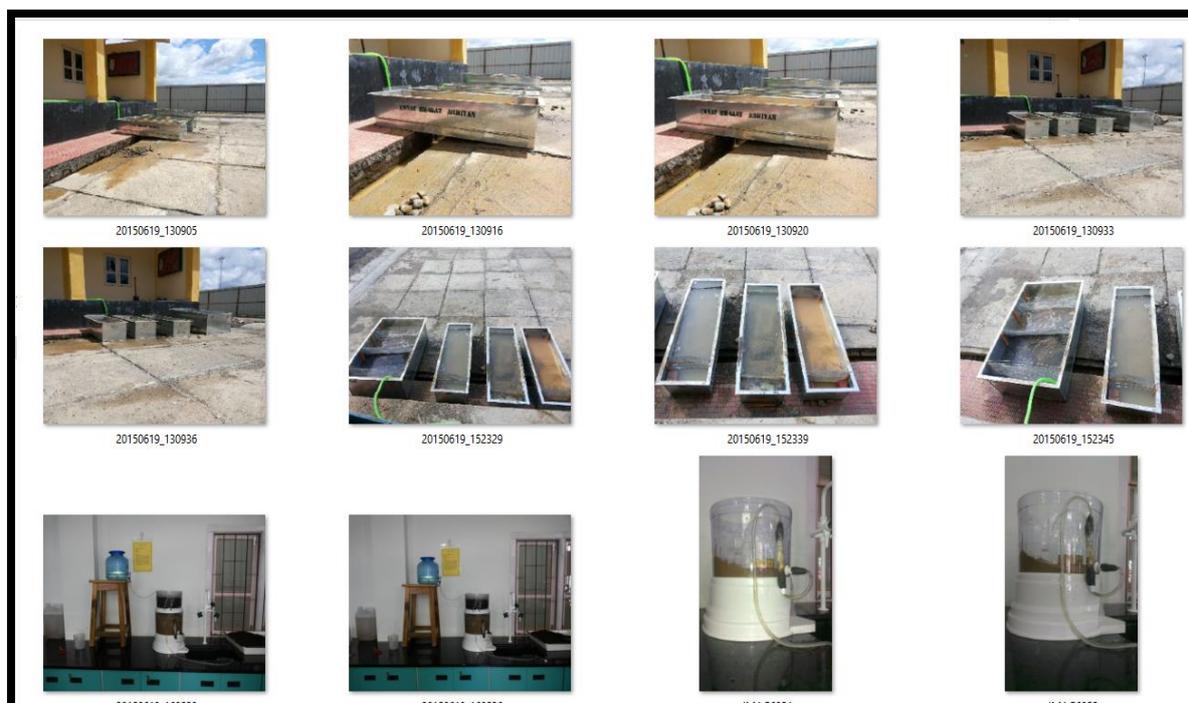
**Survey of Village water source: Ponds and Rivers by UBA NIT Manipur team**

**Table: Parameters analysis carried out in the ponds ‘water available in the adopted villages.**

Sl. no .	Location of collection	Turbidity (NTU)	Conductivity (µS)	Dissolved Solids (mg/L)	pH	Dissolved Oxygen (mg/L)
1	Nambol River near Nambol Bazar	155	68.2	33.8	7.43	5.4
2	Lainingthou Khoriphaba pong	1.27	126.3	62.64	7.23	5.63
3	Nambol Sabal Leikai pond	35.1	157.7	78.35	7.24	6.8
4	Nambol maibam Chingmang pond near Club	6.23	215.1	105.9	8.24	7.64
5	Nambol Maibam near Tiddim road	4.07	190.6	93.88	7.93	6.84
6.	Keinou mamang Leikai Pukhri Achouba	9	115.8	75.2	7.2	6.62



**Lab and field data Analysis**



**Lab scale studies of water treatment plant**

## Construction of water Treatment Plant in the villages:

A lab- scale and a pilot plant filtration unit has been set at NIT Manipur, and studied for designing of large scale plant to be implemented at the village's site. The treatment plant was based on indigenous techniques (combination of Roughing Filter and Slow Sand Filter), low cost and easily available materials.

### How does The Biosand Filter work?

The biosand filter has five distinct zones: 1) inlet reservoir zone, 2) standing water zone, 3) biological zone, 4) non-biological zone, and 5) gravel zone.

Pathogens and suspended solids are removed through a combination of biological and physical processes that takes place in the biolayer and within the sand layer. These processes include: mechanical trapping, predation, adsorption, and natural death.

- **Mechanical trapping.** Suspended solids and pathogens are physically trapped in the spaces between the sand grains.
- **Predation.** Pathogens are consumed by other microorganisms in the biolayer.
- **Adsorption.** Pathogens become attached to each other, suspended solids in the water, and the sand grains.
- **Natural death.** Pathogens finish their life cycle or die because there is not enough food or oxygen for them to survive.

Contaminated water is poured into the reservoir on an intermittent basis. The water slowly passes through the diffuser and percolates down through the biolayer, sand and gravel. Treated water naturally flows from the outlet tube.

The following table shows the efficiency of Biosand filter in removing pathogens in percentages and turbidity (NTU).

	<b>Bacteria</b>	<b>Viruses</b>	<b>Protozoa</b>	<b>Helminths</b>	<b>Turbidity</b>	<b>Iron</b>
<b>Labo-ratory</b>	Up to 96.5	70 to >99	>99.9	Up to 100	95% <1	NA
<b>Field</b>	87.9 to 98.5	NA	NA	Up to 100	85	90-95

The following sections describe how to properly use the biosand filter to ensure the highest level of treatment efficiency.

### Water Source

The biosand filter can be used with any cleanest water source (turbidity less than 50NTU) available such as rainwater, deep groundwater, shallow groundwater, rivers, lakes or other surface water

It is recommended to use a sedimentation method if the source water turbidity is greater than 50 NTU.

### **Establishing the Biolayer**

The biolayer is the key component of the filter that removes pathogens. Without it, the filter removes about 30-70% of the pathogens through mechanical trapping and adsorption. The ideal biolayer will increase the treatment efficiency up to 99% removal of pathogens.

It may take up to 30 days for the biolayer to fully form. The biolayer is NOT visible – it is NOT a green slimy coating on top of the sand.

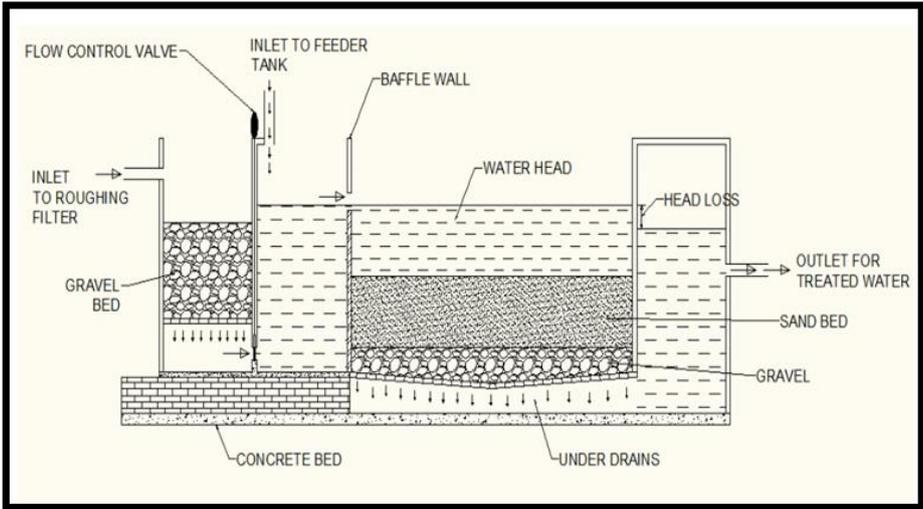
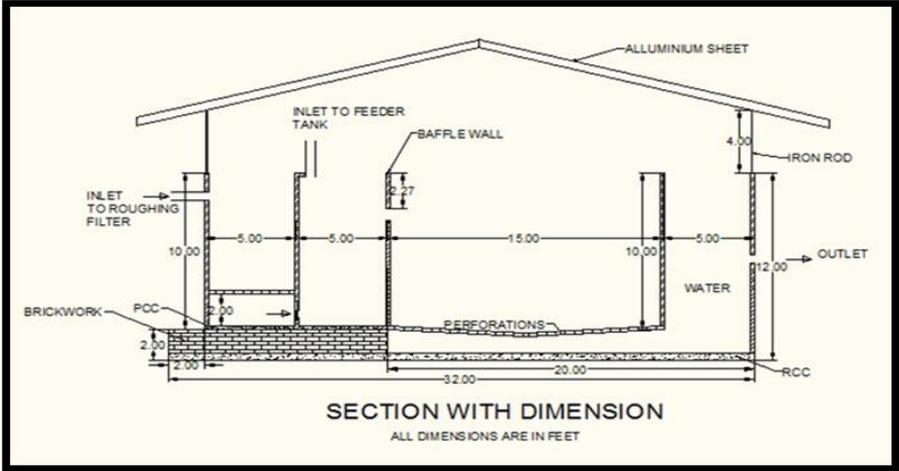
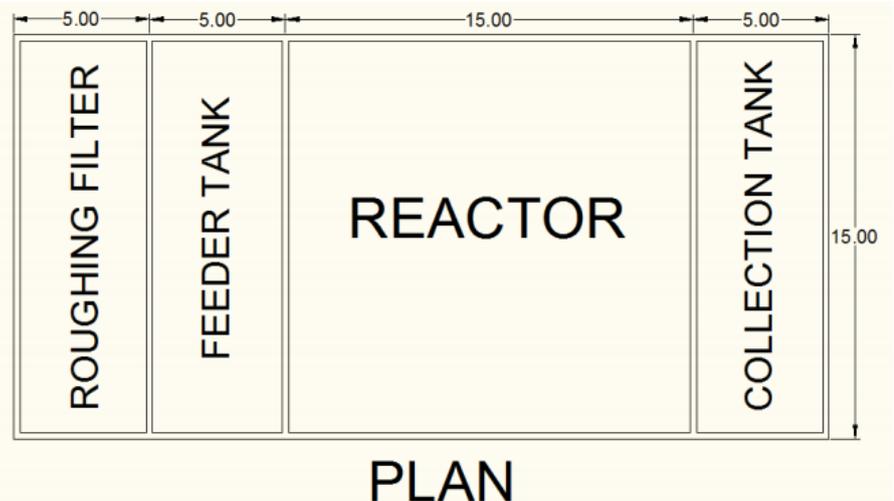
### **Standing Water Layer**

A biosand filter requires a standing water depth of approximately 5 cm (2”) above the sand during the pause period. A water depth of greater than 5 cm (2”) results in lower oxygen diffusion and consequently a thinner biolayer. A water depth less than 5 cm (2”) may evaporate quickly in hot climates and cause the biolayer to dry out.

With the above technique based, a designed plant was approached and conducted for both household and community based requirements (Reactor top view, sectional front view and side sectional view are shown in figures). The high water level pushes the water through the diffuser and filter (also called the hydraulic head. The water level in the reservoir goes down as it flows evenly through the sand. The flow rate will slow down over time due to less pressure to force the water through the filter. The inlet water contains dissolved oxygen, nutrients and contaminants and provides the oxygen required by the microorganisms in the biolayer.

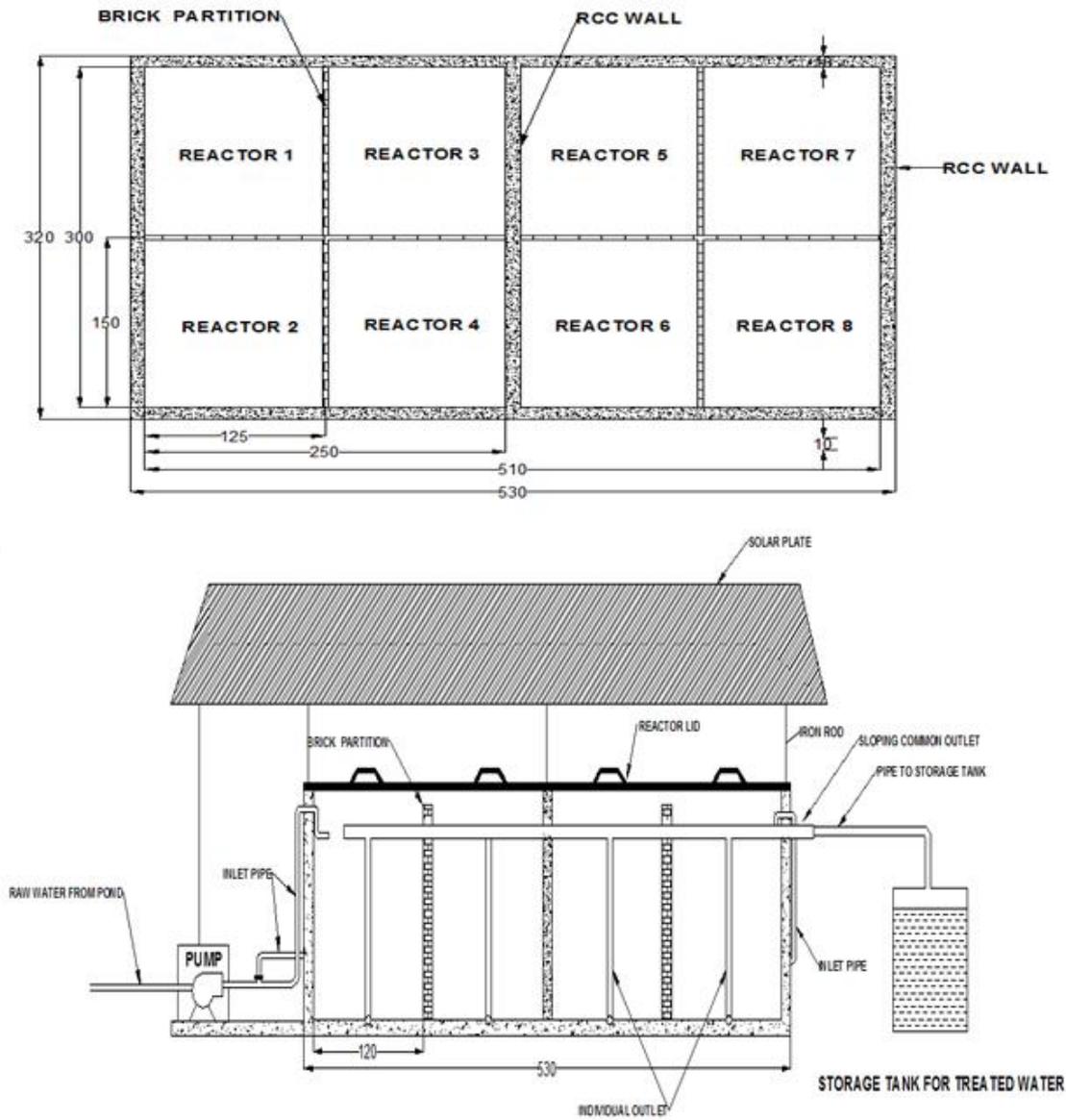
Larger suspended particles and pathogens are trapped in the top of the sand and they partially plugged the pore spaces between the sand grains. This also causes the flow rate to slow down. Slow sand filter are design for continuous water supply with development of Schmutzdecke layer or dirty skin on filter bed to remove the pathogens. However, during survey, the villagers practised intermittent supply and also the pond water won't be sufficient for continuous supply. For intermittent supply, biosand sand filter are widely practised in household scale (maximum 30 cm diameter). Therefore, NIT Manipur designed and study a prototype reactor to enhance the reactor size using biosand filter concept. The detail design of the modified biosand filter is as follows. The media used are sand and gravels from local markets.

**PROPOSED FILTER FOR NAMBOL WATER PURIFICATION:**



**HOUSEHOLD BIOSAND FILTER CONSTRUCTED AT NIT MANIPUR**

A 9000 L capacity Treatment plant based on roughing and Biosand filter was designed and constructed. The Plant treats the water from the Pond and provided drinking water (Potable water) to the villagers. The treated water were tested for all the parameters and observed within permissible limit for potable water. After completion of the construction, the biosand filter was inaugurated on 28th August 2017. The inauguration was attended by more than 200 local peoples and awareness & demonstration lecturer were delivered by Dr. P. Albino Kumar, UBA Coordinator, NIT Manipur with emphasis on the following points:



**Fig: Untreated water and treated water by BIOSAND Filter**

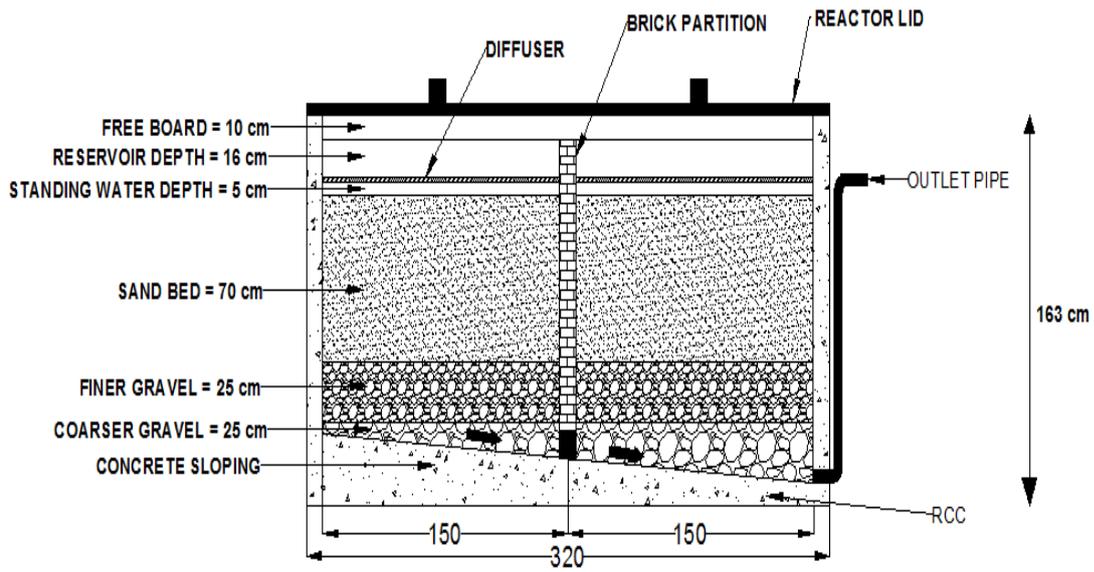


Fig:

Untreated water and treated water by BIOSAND Filter



Local Pond used for Bio Sand Filtration

Bio Sand Filter Water Tank at Nambol Makha



### **Maintenance:**

- Use the filter at least once every 1-2 days, preferably 2-4 times each day
- Use the same source of water every day to improve the treatment efficiency
- Use the best source of water (least contaminated) that is available – the better the source water, the better the treated water will be.
- The turbidity of the source water should be less than 50 NTU. If it is more turbid, then sediment or strain the water before using the biosand filters.
- The diffuser must always be in place when pouring water into the filter – never pour water directly onto the sand layer. Slowly pour the water into the filter.
- The lid should always be kept on the filter
- Use a separate container for collecting the source water
- Water must always be allowed to flow freely from the filter.
- The filtered water should always be disinfected to ensure the highest quality
- Add chlorine to water in the storage container – let it sit for 30 minutes – if chlorine is not available, let the container air dry frequently cleaning out the storage container with soap or chlorine.
- The spaces between the sand grains will become plugged with suspended solids over time. As a result, the flow rate will slow down. When the flow rate becomes much slower than the recommended flow rate, the user will need to do basic maintenance (known as “swirl and dump”) to restore it. As well the user will need to clean the outlet tube, safe storage container, diffuser, lid and outside surfaces of the filter on a regular basis.

**Meeting/ workshop:**

Besides the construction of water tanks, there is a need to rejuvenate our common property resources such as community wells, ponds, rivers and lakes etc. This will also help in recharging ground water. In addition, basic skill for water treatment is indispensable. Also for a mass reach out, an awareness on water harvesting is essential.



**মাতৃশত্রেণ পোর্কফর্ম**

**বাতর তেজ হোংগী খৌরম পাঙথোকথ্রে**

শেত্রফর্ম নিউজ সার্ভিস

ইশ্বল, অগষ্ট ২৮: উন্নত ভারত অভিযান প্রোগ্রামগী মখাশ বাতর ক্রিমেন্টে প্রান্ত (মিতর দীর্ঘ মাগনগী ফেপাসিতি), রাফিন এন্ড বাইওসেন্দ ফিল্টর ১১x২৫ পাক চাউবা অম নঙ্গেল লৈকায়গী পুত্রি মফাজ নেসনেল ইলতিতুং ওফ তেত্রেলোজি (এন আই তি) মনিপুরনা শাশা বাতর তেজ অম হোংগী খৌরম জসি পাঙথোকথ্রে হয়না এন্ডজবেসনেল এন্ড দিবেলপমেন্টে র্লব, নঙ্গেল মখা লৈকায়গী ত্রেবাল অমনা হয়রি।

খৌরম অল্লা নঙ্গেল মুনিসিপাল কর্তৃকলগী জোবপার্সন সক্রিয় বিবামনি ফুম্মা স্রিক পেস্ত, নেসনেল ইলতিতুং ওফ তেত্রেলোজি (এন আই তি) মনিপুরগী দিক্তর দাং সারথবম বিবেশনা প্রসিন্তে অমসং এন্ডজবেসনেল এন্ড দিবেলপমেন্টে র্লব নঙ্গেল মখা লৈকায়গী প্রসিন্তে পুত্রয় মখিত্রা অমদি যুথ এন্ড সেশার্তাল দিবেলপমেন্টে র্লব, নঙ্গেল মখা লৈকায়গী প্রসিন্তে আর কে নোরজিৎ মৈতেনা সেপ্ত ওফ ওনর ওইনা শরক রাবি।

বাতর তেজ হোংগী খৌরম অল্লা দাঃ পি অলবিলা ফুম্মার, হে এন্ড এসোসিয়ে এং দিন একাদেমিক্স সিবিল এঞ্জিনিয়ারিং দিপার্তমেন্ট, নেসনেল ইলতিতুং ওফ তেত্রেলোজি (এন আই তি) মনিপুরনা নিজাইন এন্ড মেঞ্জেনক ওফ লোকেল বাতর ক্রিমেন্টে প্রান্ত হায়না হীরবলা এংখোংগী অমেয়বাবা ফক সিবা ঈশিবেশিং অসি অহবা থকলা চাবা যাবা ঈশিং ফুম-ফুমদা শেভজনবগী মতঃপ্রা বাকমশিং থমবি হয়রি।

**Dr P Albino Kumar giving awareness on operation and maintenance of the Treatment plant community based BIOSAND Filter & also the awarrence programme in Local Newspaper Awareness:**

- Protection of Pond against cattle and human intervention to preserve the quality of pond water.
- The mechanism of the reactor
- Dos & Don'ts on the reactor (wasting of treated water by kids for bathing- a common sight always)
- Design of house hold filters with easily available low cost material.



**Villagers depending on water treatment plant constructed by NIT Manipur**

## Monitoring & survey

The assessment of water parameters were evaluated on site & lab and is shown in Table and showed that all the treated effluent were within the permissible limit.

### Water parameters of the untreated and treated during last 2016-17

Months	Untreated				Treated			
	Total Solids (ppm)	Turbidity (NTU)	pH	NO <sub>3</sub> <sup>-</sup> (ppm)	Total Solids (ppm)	Turbidity (NTU)	pH	NO <sub>3</sub> <sup>-</sup> (ppm)
September	102.9	9	6.7	55	0.05	0.0	6.6	10
October	101.5	10	6.6	55	0.05	0.0	6.6	11
November	99.2	8.5	6.9	57	0.04	0.0	6.8	10
December	100.4	8.0	6.7	51	0.02	0.0	6.6	9
January	100.8	8.2	6.7	53	0.02	0.05	6.7	10
February	105.1	8.2	6.7	51	0.03	0.08	6.8	10
March	102.3	7.5	6.8	52	0.01	0.21	6.7	10
April	101.6	6.4	6.9	51	0.01	0.32	7.0	10

During the survey with the villagers, the following conclusions were also drawn.

- Monitoring of the biosand filter plant & survey of the water consumption has been carried out since inauguration and the following observations are made.
- No of people depending on this biosand filter: more than 2000 nos
- Farthest distance of villagers collecting water from the filter: 2-3 km
- Mode of conveyance for collection: Trolleys, cycles. (Fig. 7)
- Frequency of pumping for feeding: 1-2 hours every alternate day
- Decrease in output flow rate: Insignificant (suggesting higher capacity of filtration)
- Smell or colour in water: Nil
- Any health effects due to this treated water: Nil

### Technologies developed and transferred/ disseminated, tangible field interventions and their impact:

Some of the issues related with water scarcity in the area have been solved with the construction of the Bio sand filter water tank mentioned above. Many people from neighbouring villages have also come to draw water from the tank. They (neighbouring villagers) also have been raised a proposal to construct the water tank.

### Outreach

This whole project with the awareness programmes on importance and methodology for sanitation also benefited a lot to the local villagers in the vicinity and hence the project was extended and another 2<sup>nd</sup> water treatment plant was constructed and handed over to the villagers of Maibam Chingmang in April 2018.



**Fig: 2<sup>nd</sup> Water Treatment plant constructed in Maibam Chingmang and**

#### **Potential Area of Future Intervention:**

There are various areas which can be intervened in terms of future prospect. Firstly, the economy of the villages can be enhanced without the affecting their occupational and economic pattern but by inducting suitable technology and innovative methods. Secondly, as they have pond at the household level, the water issues can be solved by sensitizing the locals with basic water conservation techniques or advanced techniques wherever required. As the new prepaid system of electricity had been introduced in the state, the street lighting became an apparent responsibility of the villages. Intervention can be made in the areas through affordable engineering.