BEACON AHEAD

2022

Annual Report

Executive summary:

Worm composting toilets: Beacon AHEAD built 33 "**B**eacon **E**arthworm **S**ewage **T**reatment" Toilets (or simply the acronym "**BEST** Toilets") in economically disadvantaged areas of North Bihar. BEST toilets are appealing and have convenience of light, water, cubby shelf, grab bars and serve one and all, especially the elderly. It is odour free and easy to clean using ash from cook-stoves. Token cost of Rs. 5000 per toilet is contributed by the household to promote a sense of ownership towards better usability of the toilet. However, the total cost of the toilet is Rs. 40,000.

The BEST toilets provide for onsite-treatment of solid waste; effluents are 90% clean and safe to release into water bodies; within 12 hours' solid waste is transformed into usable compost. No external power is required and the overall health and hygiene is thereby improved. This is a great way of reducing the environmental impact of human waste and the system of maintenance is relatively simple.

BEST toilet is installed within 2 days as it is fully precast. The design and technology show the form and the function of a durable toilet.

2022 also marked a milestone in Beacon AHEAD's sanitation work as we were able to build the first innovative toilet for People with Special Needs **("Disability friendly toilet")**. The toilet was provided free of cost to a family with 3 people with special needs. Following the guidelines, a ramp was provided in place of stairs with a railing on both sides to aid the use of a western toilet for a seat. Vents allowing air flow; space management; lights; odor free nature of the toilet are among the added advantages. Training to use and flush the toilet has been imparted. The community feedback followed the experience of the users which built trust about the product.

Model ICDS Anganwadi Centers: Beacon AHEAD in its efforts in creating Model Anganwadi Centers endeavours to work with the Government to achieve Universal Access to quality health services and joyful learning. With the tremendous support and permissions given by the Government of Bihar, renovation in 5 selected ICDS Centers in Patepur Block of Vaishali district have been completed. Play area and play equipment was added in two centers as per space availability. The colourful model ICDS Centers are attractive for children which adds to the distinct appeal of Patepur block.

All round repairs and renovations were undertaken along with renovation of toilet, provision of water supply, hand washing stations; building cookstoves that are smokeless; painting the center to make it appealing and enhance education as per the BALA model criteria, providing TLM kits; storage box cum vaccination bed with

privacy screen; creation of vertical garden near the kitchen and provision of solar light inside the classrooms were all successfully completed and handed over.

Innovative Livelihood projects in the pipeline:

Braille – Progress in 2022: Developed educational booklet with mixed English print and Braille showing sample words in the Braille dots. Glued pairs of paper to make the required thickness of paper for printing. Used simple press to emboss the Braille dots on each sheet.

Translated educational book about Braille into Kannada and further improvised the available software for clarity. In our pursuit of really affordable Braille printing, we plan to recycle used copy paper to make thick Braille paper.

Sample of the Braille translation software: developed educational boards, with very large Braille alphabets. The aim was to create extra-large Braille letters to help to teach Braille to very small children or older adults with limited eyesight. Children and older people can feel the shape of the Braille letters, and learn the alphabet this way. The pegs can be removed and new letters and short words can be written in Braille. This can be repeated indefinitely thereby increasing the access of Braille to many people in need.

Bicycle Trailer: Designed and built bicycle trailer prototype. A low-cost, strong bicycle trailer can be useful to people in many ways: to allow people to carry much more goods with them, such as rice and wheat from the ration stores. A bicycle trailer in the form of a shopping cart will be useful to bring home groceries and supplies easily, even if they don't have a bicycle. The bicycle trailer should fold flat when not in use and stored in a small space. This could help provide a better livelihood, in terms of delivering or taking away goods and materials. The body of the trailer prototype is made from water-resistant plywood. Other design options using bamboo, pipes or plastic will also be considered.

Coconut Carving Machine: Second-generation coconut carving machine was developed in a simple way so that the carving machine turns the coconut and lifts and lowers the cutter into the coconut. The new Coconut carving machine is really promising as the cutter positioning and depth of cut are better controlled, so that the carving of the coconut shell can be stopped and restarted many times, for example when there are power outages, and so that the carved patterns will have a more consistent cutting depth and will therefore look neater and more accurate.

Pantograph Copy Carving Machine: A prototype was built by using locally available materials, such as a trimmer router, wood boards, nuts and bolts. Pantograph machine can carve repeated shapes with a trimmer router. As a livelihood project, we plan to train people in villages to make Panto-Routers and templates to sell to others. In this way, a good livelihood can be made by making useful machines that can help others in the community to create craft products and useful household items, etc., that they can sell and earn a living.

1. BACKGROUND:

Introduction: Beacon AHEAD Institute is a non-profit, Registered Trust in India which works for the social development of India by creating innovative products that help people in need and bridge the gap between low cost, eco-friendly technology and community development.

Our Institute follows the whole cycle of creating awareness and products, training, maintaining and ensuring constant use and applicability of low-cost products in order to solve issues among underprivileged communities such as open defecation, illnesses due to contaminated water, smoke from cookstoves, low agricultural yield, etc. In turn, our approach revolves around providing low-cost toilets, safe drinking water treatment devices, smokeless cookstoves that produce Bio-char, etc.

We aim to create access to better livelihoods and improve the quality of life for low-income communities. We work in close collaboration with the Government of India and other social development agencies for providing better hygiene, sanitation and self-employed livelihoods through innovative products for the people of India.

Beacon Ahead Institute was established in 2012 for creating sustainable impact.

1.1 OUR FOCUS AREAS:

The Institute works in five sectors namely Agriculture, Health, Education, Art and Design thus forming the acronym AHEAD. BAI focuses on innovations for rural development and tribal welfare for enhancing the economic opportunities while working in close collaboration with Government, NGO's, research and resource institutions.

Beacon Ahead Institute (BAI) is very particular to align its work with the Sustainable Development Goals of United Nations and Global Compact initiatives:

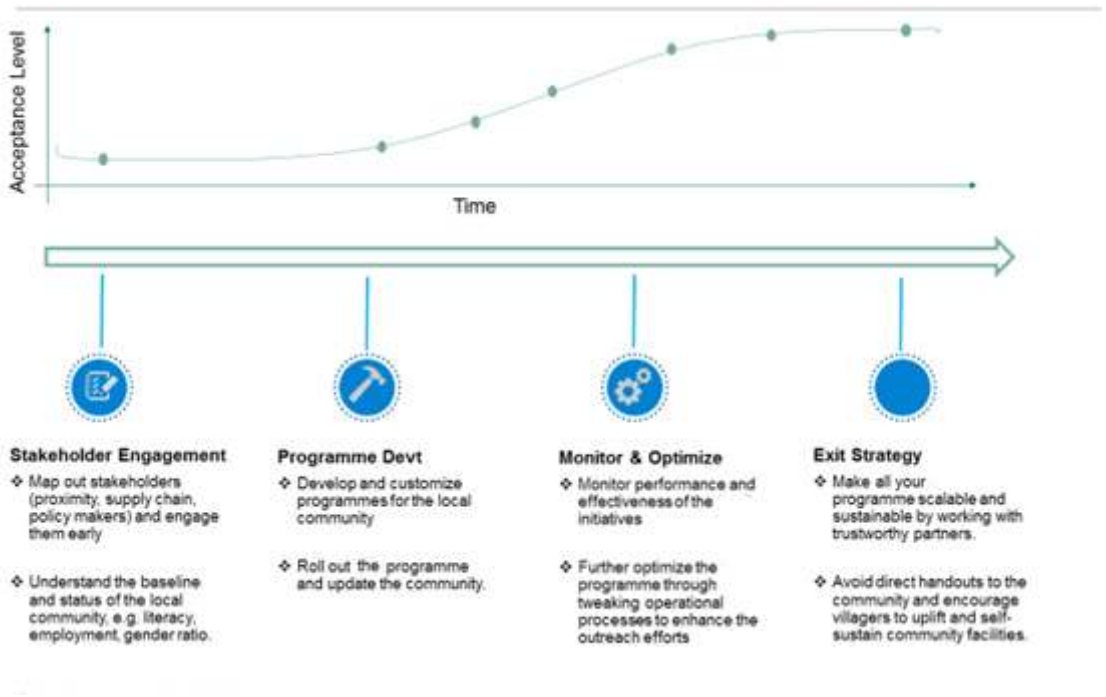
Alignment with Sustainable Development Goals:

"Meeting the needs of the present in tandem to enhanced abilities of future generations to meet their own needs"
BAI'S Focus areas are : 3,4,6 , 8 , 9 and 11

Human Development	Social Development	Environmental Development
1) No Poverty	10)Reduced Inequalities	**6) Clean water and Sanitation**
2) Zero Hunger	**11) Sustainable cities and communities**	7) Affordable and Clean energy
3) Good Health and Well Being		13) Climate Action
4) Quality Education		14) Life below water
5) Gender Equality		15) Life on Land

Economic Development	Good Governance
8) Decent work & Economic Growth	16) Peace, Justice and strong Institutions
9) Industry, Innovation and Infrastructure	17) Partnerships for the Goals
12) Responsible consumption and Production	

In line with the above framework, Beacon AHEAD Institute should focus its work on the above 5 focus areas to meet the communities needs and priorities and it is also particular about the exit strategy as well.



Our strength is in reaching out to people and working with them to develop products that they can make, use and create a sustainable impact.

We promote eco-friendly innovation and social entrepreneurship development programs.

1.2 HOW WE MAKE A DIFFERENCE:

- Development of innovative, eco-friendly, low-cost products.
- Creating access to better products and services that make a difference, to improve quality of life and health for people, communities and the environment.
- Creating improved opportunities for sustainable livelihoods.
- User Research, to find out what is needed, what works well and best ways to ensure user satisfaction throughout the development process.

1.3 CREATING SUSTAINABLE IMPACT:

We feel happy when we work with under-privileged communities, and observe improvements in their health, prosperity, neighbourhood and environment, etc., and create a long-term sustainable impact in the lives of the children, families and communities.

1.4 PROMOTING IMPROVED SANITATION TREATMENT, IN ALIGNMENT WITH SDG 6 – ENVIRONMENTAL DEVELOPMENT

Beacon Ahead Institute is a very strong proponent of on-site sewage treatment, especially treatment based on vermi-composting of human waste, which is aligned with SDG 6 - Clean Environment and sanitation for Environmental Development. This low-cost, low-maintenance technology converts sewage into a valuable fertilizer, with no smell or flies using no external power inputs.

1.5 DEVELOPING ECO-FRIENDLY ITEMS FOR ENHANCING ECONOMIC OPPORTUNITIES FOR WOMEN AND YOUTH ENTREPRENEURS, IN ALIGNMENT WITH SDG 8 (DECENT WORK AND ECONOMIC GROWTH) FOR ECONOMIC DEVELOPMENT

We work to develop products that can be made from environmentally friendly materials such as banana fibre, coconut shells, bamboo, and recycled materials, etc. We help people learn how to make these products, so that they can earn a good income and become more self-sufficient.

For example, last year, we designed low-cost, eco-friendly products made from coconut shells. When coconut shells are smoothed and polished, they have a beautiful dark wood pattern, like teak wood. Useful, strong items can be made from this attractive and nearly free raw material. For example:

i. Pen/pencil holders
ii. Phone or tablet stands
iii. Small storage boxes, etc.

We created a prototype of a low-cost, computer-controlled carving machine for automatically making nice-looking products from coconut shells. This photo (right) shows the most recent prototype design for which we have been writing computer programs to cut out different designs from coconut shells.

We also worked on creating a booklet to teach blind people about Braille, the international reading and writing system for people who are not able to read printed text. This booklet would be helpful for families who have a young blind family member, as well as older family members who are losing their eyesight.

We are working in parallel to develop a low-cost printer, to make these books locally, affordably and appropriately in the local language(s). These printers don't need any electricity, and they can print the Braille booklets using recycled paper, which is environmentally friendly, too.

The vermi-composting sewage treatment, mentioned above in Section 1.4, is also very environmentally friendly, as it diverts human waste away from the practice of being dumped into rivers and onto fields.

OUR PROJECTS

2. CONSTRUCTION OF 33 ECOFRIENDLY AND AFFORDABLE TOILETS IN BIHAR

2.1 OVERVIEW OF USER RESEARCH FINDINGS FROM END USERS:

Beacon AHEAD built 33 "**B**eacon **E**arthworm **S**ewage **T**reatment" Toilets (or simply the acronym "**BEST** Toilets") in North Bihar.

Swachh Bharat Abhiyan, or Clean India Mission (2014 - 2019 for Phase I), built millions of toilets in India. But there is no affordable way to gather and treat the human waste that accumulates in the leach pits and septic tanks of toilets in areas with no sewerage systems. Many of these toilets have become dysfunctional.

Training was imparted to local people to procure components and assemble the same. Using Reinforced Cement Concrete (**RCC**) - parts with which the wall, floor panels, roof, sub-structure and shelves were made to make it durable. Strong doors, hinges and locks were installed which suited local preferences. The design has proved: Safe and Private; Impact, water, fire, termite and weather resistant using ISI materials. It is also cost effective and provides excellent value.

Water: Most houses have tap connection in addition to using a handpump. Water from the same is used for hand washing after using a toilet or before cooking their food. The product used for handwashing is soap.

Issues: People have no other choice but to resort to open defecation. But the lands are mainly agricultural fields and privacy issues are embarrassing; rainy season; presence of snakes and other pests; lack of water and light; slippery soil; having to walk for about half a kilometre or more; waiting for hours to relieve oneself are among the several problems stated. To date people have been using cement ring toilets with brick super structure; few use septic tank sub-structure.

Constraints: Mainly financial issues, space and land fragmentation were stated for not being able to procure a toilet.

Diseases: Cough, cold, fever are common in addition to diarrhea. Children tend to fall sick often. Seasonal weather changes, extreme climatic conditions; unhygienic conditions and hunger were reported to be the causes.

Motivation: To stop open defecation and live a more hygienic life; respect for women; avoid danger from snakes.

How the toilet fits the requirements: Respondents found the design appealing and nice. While they are able to use it at all times, the features promote convenience of light, water, cubby shelf etc. The toilet serves as being most useful mainly for the sick and elderly people.

Usability: Rated as easy and convenient; *pacca* construction with a slab; durability was assessed to be from 2 to 15 years; enables privacy, safety and accessibility; can use at night and during all seasons; no water stagnation as it drains away easily; all the family members use it; there is no bad odour and is easy to clean using ash from cook-stove

Affordability: Cost of the toilet ranges from Rs. 5000 to 35000 as per user perceptions; each household contributed Rs. 4000 which was paid towards labour and transportation cost. The overall cost-effectiveness made it affordable.

Decision making at the household: The mother-in-law, the father or the husband take the decisions to purchase a toilet.

Promotion: Users will advocate the use of this toilet as it is good space saving model; portable with all facilities; an all-in-one design which is built using quality materials providing several features.

Loans: Microfinance agencies are not active in the selected areas. Few households procured private loans.

Feedback: Reported as the BEST toilet which had sufficient space; with no obstruction to height; the roof did not have any leakages; door and hinges being strong and made of thick material. The presence of the door enabled privacy; provision of cubby shelf to place soap or mobile phones seemed handy while the grab bar helped old and disabled for support; taps proved useful and the height of the foundation is easily accessible; the vents paved way for brightness; availability of light is useful; water tank provided sufficient water supply.

Top 3 features: Door, tap and light.

Recommendations: None

Impact: Mainly beneficial for ladies, the elderly, disabled and children; enhances social status; cost-effective; awareness regarding the importance of having a toilet is enhanced and its convenience was appreciated.

Overall benefits: Environmentally friendly; no odour (aerobic), municipalities have lesser load as onsite-treatment of solid waste is being done; effluents are 90% clean and safe to release into water bodies; within 12 hours solid waste is transformed into usable compost. No external power requisition; health and hygiene is greatly improved.

Conclusion:

This is a great way of reducing the environmental impact of human waste and the system of maintenance is relatively simple. The beauty of this system lies in its straightforward simplicity without compromising the ecological principles which govern its function.

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2.2 OVERVIEW OF RESEARCH FINDINGS FROM TECHNICAL PERSONNEL:

Background: Resorting to open defecation; waiting for the appropriate time and place to do so results in several diseases. Flood prone areas and poor sewage system call for improved sanitation and hygiene. Challenges are due to unclean water and poor sanitation. Generally, brick toilets are in usage with cement ring sub-structure of 7-8 feet depth. Monetary issues and space constraints stand out as the main problems. Even after the incorporation of the Swachh Bharat Mission scheme, 40% still resort to open defecation.

To address the health issues and social hazards, where women are particularly targeted, it becomes imperative for families to have a toilet. The BEST model sub-structure is 3 feet by 3 feet as the waste doesn't accumulate. Responses have been positive as the toilet is sturdy using less space and is installed in 2 days. Being an eco-friendly product, the resultant effect is the manure which can be used in the agricultural fields. It is a highly portable and a usable model. Once beneficiaries are convinced about the mechanism of the earthworm bio-filter system which is also odour free and serves a family of 6 people, they are able to take a decision to get this toilet. They opt for strong door; roof to safeguard from rains; walls for privacy; water tank that holds and releases adequate water; facility of tap; workable drains and a provision of light.

The feedback for the following features was analyzed as follows: Space: sufficient and just right to install to support the panels. The entire toilet occupies less space as it can be fitted in an overall space of 5 by 5 feet so it is really useful for households that have space constraints. **Height and foundation:** provision is 6 feet and the roof panel is rightly placed which has the right load. **Door and hinges:** strong quality doors are welded into the door frame. Exact angles are designed to add strength to the door frame and the rubber cord is attached to prevent the door from slamming shut too fast due to heavy winds. **Cubby shelf:** serves the purpose to place phones and other storage related to personal hygiene. **Taps:** adequate for water supply and use. Connected to water tank holding 30-40 litres. **Vents:** adequate as air passes through it well. Provides sufficient light inside the toilet. One inch (9 holes are made into each panels {3 panels}). **Handles:** serves as support and safety for the people. The infirm and disabled can use the toilets independently. **Light:** most useful provision, especially at night. If the toilet is located at a certain distance, the light is also provided outside the toilet to aid the beneficiaries along the pathway. Use of torch is not required and it ensures safety from snakes and pests. **Water tank:** has good capacity and placed at lower height. Easy to fill Nal Jal water. **Outlet drain pipe** is well incorporated as it separates the water that is used to clean the toilet or any

excess water (prevents it from entering into the bio-filter of the toilet thus preventing the flooding of the worm bed). **Tiles:** much appreciated by the people as it is highly aspirational. **Top three features:** Installation time is minimum; Concrete materials make it long lasting; it is eco-friendly as it prevents bad odour, water contamination and environmental pollution.

Disliked features or aspects about the toilet: People opt for twin pits and bigger sub-structure; the air vents for the foundation panels should be at the back or on the sides unlike the existing front and back positions; the roof panel should be clamped on at least two sides so that it is locked in place and prevents it from falling over due to strong winds and it should sustain; the floor notch of the door frame should be tilted to face the back wall of the toilet and it should be bolted in place into the foundation panel; the cubby shelf inside can obstruct or hurt them.

Manufacturability

Precast toilets are a great option and the need for plastering is absent. Masons find the uniformity of the materials and standard thickness of wall panels easy to work with and assemble the same in a systematic manner. Precast toilets are themselves a first-of-a-kind in rural areas. These are considered *pacca* as well. Different shapes and forms of the precast parts and components are made to fit together to create a toilet structure. Parts are transported and assembled easily. The design and technology show the form and the function of a durable toilet.

Distinctive design allows for easy manufacturing of various components; keeping the user-needs as the prerogative, the steps of the design was developed; the systematic approach to precast the panels paved ways to install the same without any issues though the concept is totally new; accuracy of dimensions cannot be compromised and the field staff monitored and guided the masons during the execution of the project. High quality raw materials, thoughtful design and in-depth

research ensure that the products are one of a kind and its replicability is easy. The toilet on the whole is aesthetically pleasing and highly functional. It was made with the belief that this design can make everyday lives better and meaningful.

It is easy to cast the water tank shelf and the cubby shelf. The cubby shelf new mould is easier and better with rounded corners; the water tank shelf is sturdy to support the tank.

Weight of the precast parts signifies the strength and durability of the panels that is acceptable to people. The panels are interlocked at various levels to make it strong. Transporting the panels is a heavy task and requires 7-8 labourers. Delays occur when labour is not regular. But on the whole there are no significant issues. Problems do occur when the path is narrow to the site where additional manpower is required. The team uses two bamboo poles that they place on the floor and put up to 3 pieces of slit bamboo on top of it with equal distance. Wall panel is placed on it to slide it reach the installation site more easily. The need is for a trolley to carry the wall panels[1].

Common technical issues Maximum technical issues were faced with the foundation of the toilet. Due to heavy rains, flood water would fill into the foundation pit as soon as labour would dig 2 feet into the ground to install the toilet. No sooner the labour would try to remove the water, more water would fill into the pit as it was rainy season and all the efforts were in vain as the soil is full of slippery clay. Sub-structure is the most crucial foundation for building any structure. So, additional precast foundation base panel (also called the Raft foundation panel) was added to provide a flat, solid floor footing on which the entire toilet structure would then be installed in a proper and durable way. The base panel would be able to handle the additional strain of slippery clay soil due to the rainwater. Issue is also with the iron rod frame that is tied together to provide strength to the concrete parts from within. The distance between the iron rod frame should be 4 to 5 inches as per the approved measurement in the design drawing. This is an issue since these toilet panels are made manually without using any moulds. The access panels cause issues with the holes not being in its proper place which does not set well with the access cover panel. This issue was overcome by drilling the holes or aligning the holes to match with the access cover so that the bio-filter is

[1] The product design team has developed a prototype of a new portable wall panel trolley that can be used easily to place and transport the wall panels to the installation site as the trolley will be on wheels. It was a design challenge to make the wall panel trolley as simple as possible to avoid theft and also make it portable enough that after installation it can be transported back to the pre-casting site on a two wheeler. Efforts are in progress to finalize this design and enable higher efficiency of transporting the wall panels despite challenges of narrow alleys.

kept safe and protected well. In addition, the access panel cover can be removed for supervising the health of the bio-filter by the technical team as and when deemed necessary.

Suggested improvements: Choice should be given to people: for a single pit or a twin pit vermi-filter depending on their family size and space availability. For the flood-prone areas, several changes and recommendations were listed. Toilet seat and foundation panel to be at ground level and connected to the sub-structure beside toilet. It helps to convert 2 to 4 chambered sub-structure. Floor panels, metal door frame, taps to be lower than the handles, lights to have proper fixture; roof height increase to 8 inches and be inter-locked. Galvanized (or "GI") rust resistant nuts and bolts to be in use for durability and painting will bring about a distinctive outdoor exhibit.

Improved hands-on training: for the masons to handle precast and installation independently. Multiple work sites can be simultaneously covered. **Solid concrete base platform for pre-casting:** 20 feet by 20 feet solid platform for pre-casting is required for making panels. It can be made of bricks and plastered. **Customization of wall panel holes as per household toilet location:** Holes can be reduced as per the need to keep the panels strong. If the wall panels are customized to the location site, the number of holes can be determined. **Moulds:** Following design specifications moulds to be made to enable greater numbers of panels to be ready in less time. Uniformity of the panels and elimination of air bubbles can be possible if the frames are made with nuts and bolts and the panels are cast into it and as this will reduce quality issues. If fiber sheets with pegs are attached, it can be placed accurately over the precast wall panel. Plastic pipes can be used as pegs. Use of iron is not recommended and the panels should not be too wet when the mould sheet is placed on top to reduce damage to the panels. **Vibrating table:** for removing air bubbles from pre-casted concrete parts and add to the quality of the panels. The panels can be made to have a further thickness of 3-4 inches. 10% increase in the amount of cement is foreseen as the vibrating table removes all the excess water from the panels. 6 to 7 labour will be required to lift and place panels onto the vibrating table and shift it to the location to cure. Additional space for curing will be required. When the

demand escalates to 100 toilets per month, the need is for a fully automated masonry system in place. To set it up also will mean meeting the high costs. To start with, a small vibrating machine with a needle can be set up. **Other tools:** If a better tile cutting machine is provided, then work will progress well.

Quality control: Higher demand requires time allocation. Process of manufacturing and adhering to precise design is crucial for not compromising on the quality; experienced and committed masons and supporting labour to execute the work; monitoring and material usage with minimum wastage to be ensured; the air bubbles to be removed from precast parts; sufficient manpower with adequate storage space for components to be looked into; provision of water curing tank is necessary to gain optimum strength; close monitoring and mid-course corrections to be carried out by the organization for systematic progress of the project.

Affordability:

Toilets range from Rs. 1 - 1.5 lakhs in general when it comes to septic tanks. Many people cannot afford to purchase a toilet. So, many of them choose leach pit toilets with a brick lining.

Cost: A BEST toilet cost can go up to Rs. 50,000/- if bought from a market. Overlooking the cost of the vendors or any other margin, its price is maintained within the range of Rs. 35,000 to 40,000. Ensuring the quality of the materials and the transparency of manufacture has promoted people's satisfaction of the product.

Contribution of beneficiaries: Low cost sanitation is the only option for the poor and they want a toilet for Rs. 25000-35000/-. The need is to raise the amounts to serve the deserving families. With awareness generation regarding the installation time and the eco-friendly aspects, the demand escalation is also expected. Rs. 5000/- is considered as a token amount from the beneficiary to ensure ownership. The token amount is directly paid as wages for the labour and the transportation of panels. There is transparency as per the cost of the materials and the beneficiaries interact with the labourers who belong to the local area. The people's trust with the implementing organization is enhanced.

Finance: Micro-finance options for purchasing toilets are not easily available in most areas excepting Samastipur. Percentage of people availing such loans are 20-30% only. SHGs and the NGO Jeevika provides loans for purchasing toilets. But the interest rates are generally not affordable. Beneficiaries require time to mobilize amounts for the BEST toilets.

Social marketing and Promotions:

Steps for social marketing include awareness generation; individual usage and people's experience. Once people understand the form and function of the design, people realize that it is a community managed product. The overall health and hygiene is better. Further propaganda can be addressed by use of banners highlighting its benefits. Local leaders can also convince people to opt for BEST

model. Service is ensured to the people in obtaining timely feedback for optimum usage and maintenance. Television advertisements showcasing the advantages of the BEST toilet to be taken forward. The ecological impact and water usage to be highlighted; Space, money and time saving aspects to be stressed; the many features can be listed along with the manure that is generated by the BEST model.

Challenges: Convincing the community members regarding the affordability, workability and the durability of the model is a major task. Motivating people to adopt better hygienic living is part of the on-going efforts of the field staff. The concept of treatment of human solid waste into compost using earthworms takes a while for the people to understand the process and to take into consideration all the aspects that are related to its functioning.

Issues During The Project Period: During the project period, the cost of the materials fluctuated considerably; water level due to floods increased drastically which caused considerable delay in the execution of the project. People also did not opt for building a toilet due to heavy rains during the monsoons; the fabricators could not work on the moulds due to the pandemic. The accuracy of assembling precast parts required carrying inverter back-ups for drilling purposes; Due to unavailability of GI nuts, the nuts and bolts used had to be covered using mortar to make them rust-proof and water-proof for durability. This reduced the outer appeal but the model is able to withstand wear and tear even in extreme climatic conditions.

Improvements: Based on the technical feedback, GI nuts and bolts of high grade quality are being now incorporated into the toilet assembly; the air vents that were originally placed towards the front of the toilet, are placed on the side panels of the sub-structure not to hinder the stairs and it also prevents additional water from flowing into the vermi-filter. There is a need for toilets in at least 500 households located in 350 wards in Sakra block of Muzaffarpur district.

Opportunity: To increase coverage, the need is to have separate teams for precast panel manufacturing and installation. Potential beneficiaries need to know the toilets are not provided by the Government and that the efforts are totally non-profit. The token amount of Rs. 5000 (earlier Rs. 4000/- was taken as the token amount, but due to material cost increases, the amount has been increased to Rs. 5000/-. It is to be noted that the token amount is charged to only those beneficiaries

who have an income or are able to mobilize this amount. If not, the toilet is further subsidized and in some cases of dire desperation, the token amount is not charged at all) paid by the households is to promote a sense of ownership towards the toilet facility so its usage is effective.

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2.3 OVERVIEW OF RESEARCH FINDINGS ABOUT THE DISABILITY FRIENDLY TOILET:

Rationale for building a disability toilet:

It is a big issue for differently abled people or those who are specially challenged to travel a little distance for their toilet needs. A suitable toilet with close proximity is the pressing need of the hour. About 5 to 10% of the families in the communities have need for a disability toilet. Financial constraints do not allow for such a facility. Fearing the inability to relieve themselves, the members also reduced the food and water intake. Taking all these into consideration, the toilet become one of the great assets for this most deserving household.

A ramp was preferred to the stairs. A railing on both sides is designed with the ease of the western toilet for a seat. For a disabled person, squatting for a long time is problematic. The western commode also accounts for better health. The vents are designed to allow proper air flow; space availability is better and the lights help the users to see clearly. The odour-free nature of the toilet is one of the added advantages along with many other features. The design team incorporated all the guidelines that are in place for building a disability toilet. Initially the beneficiaries have to be trained how to use the western commode model effectively as this type of a seat is not common in rural areas. They have to learn to also flush the waste after using the toilet.

Most liked features:

The western toilet seat: helps support the users like a chair on which they can sit and easily use the toilet. Currently, the three members of this family who are disabled have trouble with mobility. **The handles provided all the way on inside of the toilet:** for support for the disabled and the infirm. **Ramp and railing:** with every step, the railing helps as a support. **Bathroom:** is accommodated as part of

the toilet design. **Strengthening the joints** between the wall panels make it more spacious and stronger.

The cubby shelf was reported to obstruct the user and the recommendation was to install the same on a different wall.

Community feedback: For a new product brings with it several doubts and it takes time to convince them about its function and benefits. With the experience of the users gradually a trust is developed.

General Training and manufacturing: Since the design was totally different, manufacturing various components was a very new experience. The mason and the field staff were briefed about the methods to incorporate these changes at the ground level as they made the precast parts and to follow the guidelines specifically. The raft foundation that was earlier a simple square was modified to be much bigger to hold almost two toilets length of structure on it. The foundation seat panel had to accommodate a western toilet seat instead of an Indian one. Considering the space constraint inside the toilet, the distance had to be maintained so that the hole for setting the toilet is placed precisely without wasting too much back space. It is also not exactly right against the back wall (if there are any repairs, it can be easily addressed). The hole had to be big enough for the syphon to fit into it while ensuring that it is not too big for the air to leak out. Interlocking panels that were incorporated is a great feature as it makes the toilet strong and helps keep the panels bonded especially if there is a mild earthquake or if the panels get shifted.

Extention of labour and time: Making parts (every component, including bio-filter) for a disability friendly toilet required almost double quantity of all raw materials as opposed to the BEST model. The transportation and labour was also doubly challenging. It also took two full days to install this toilet when compared to the BEST model which can be installed in a day. Labour increased from 12 to 18 members and masons from 3 to 5. Being a new design, it was challenging for the team to install the same. Our Product Design Lead, Jane Verrall, was present during the entire assembly and installation of the toilet. At every step, she provided training and guidance in a meticulous manner. The raft foundation had to be joined together and the mason and team were told to set the two panels together beside the dug pit and then it was easy for them to lay them in and set it on a final basis. The wall panels not only needed angular iron clamps to secure these in place but since it was a double toilet, it also needed flat clamps between the straight panels to ensure the panels would not bend and fall over. This ensured a secure locking of the panels.

Quality control: If the demand for such toilets increases, then **increasing manpower** would be necessary to enable pre-casting, monitoring, shifting and transporting of panels efficiently. Training and monitoring of staff is equally important so that high levels of targets are achieved. **Coordination and support** between the mason and the field supervisors is crucial. The field staff require **sufficient time** to make the panels properly as it calls for concerted effort and care to make the same. Sufficient time has to be allotted for curing of the components. It is the priority focus of the staff that optimum care is ensured in using high quality materials (sand, gravel, cement, black wire, reinforced bars, etc.,) and the ratios of the mixtures are also maintained for strong and good quality panels. It results in better finishing and higher quality control. Water usage for curing purposes will also increase.

Recommended changes: People have to be trained to use a western commode and also flush the waste away. Western toilets tend to use more water to flush and this will impact not only the worm bed but will also require increasing the capacity of the water tank and including a flush tank for the toilet. The level of mobility, health condition and personal preferences are to be the deciding factors. Its user-friendliness determines the success of the product.

Affordability: The toilet provided was totally free of cost. Poorest families have no means even to pay a token amount to purchase a toilet. Beacon AHEAD offered the special service by designing and building a very convenient model to suit their requirements. This will add to their better standard of living adding quality and convenience. The cost of making this toilet was more than double the cost of making usual BEST toilets. The actual cost of this toilet was well over Rs. 90,000/-

Token amount that can be charged: If demand for such a toilet increases, depending on the family's income levels, up to Rs. 10,000 would be a reasonable

token amount. This amount will be paid directly for transport purposes and partly to meet the labour cost. Very poor families can contribute Rs. 2000/-. Token amount adds value to ownership.

Promotion of this kind of toilet: People get motivated when they see a working model in the community. This inspires others to avail the facility. These become the Model toilets for generating demand. Options can be provided regarding the regular 3 feet by 3 feet toilet and the same toilet attached with a bathroom facility whether or not the family has disabled persons or not. The overall cost of this kind of toilet can also be shared and it can be promoted. The token cost of Rs. 5000/- will be considered reasonable especially since this toilet comes with various disability friendly features that will relieve them from so much suffering and prevent them from accidental falls or any other mishap.

Construction of 33 Toilets in Muzaffarpur, Samastipur and Vaishali Districts, Bihar

Comprehensive Report Findings: User Feedback

3. BEST TOILETS USER RESEARCH FINDINGS FROM USERS

3.1 PURPOSE:

There is an urgent need in India for environmentally friendly Sewage Treatment.

Health and Hygiene are greatly improved when toilets, hand-washing and safe drinking water are available at home, and when sewage is treated so that pathogens are not spread in communities.

NEED:

Without a toilet at home, women and girls go for open defecation, where they are particularly vulnerable. Generally, they can relieve themselves only once, before daybreak or after it gets dark at night. For most of the day, they simply hold back their toilet needs. As a result, they choose to drink very little water, and tend to get digestive and urinary health problems. In hot weather, they can easily become dehydrated.

The Swachh Bharat Abhiyan, or Clean India Mission (2014 - 2019 for Phase I), built millions of toilets in India. However, there is no affordable way to gather and treat the human waste that accumulates in the leach pits and septic tanks of toilets in areas with no sewerage systems. As a result, men tend to go for open defecation and not use toilets at home, as the cost to empty leach pits and septic tanks is significant.

On-site treatment of human waste can solve this problem, if the treatment is low-cost. Then everyone in the family can feel comfortable using the toilet as per their need.

Earthworm bio-filters are an excellent, eco-friendly, fast and affordable way to treat human waste. This technology has been developed over the last decade, and simple, robust bio-filters can now be placed in toilets to provide effective, low-maintenance and low-cost sewage treatment.

Beacon AHEAD built 33 "**B**eacon **E**arthworm **S**ewage **T**reatment" Toilets (or simply the acronym "**BEST** Toilets") in North Bihar:

1. These 33 BEST toilets were built in Muzaffarpur, Samastipur and Vaishali districts in Bihar. These user-friendly toilets are serving as models. Other community members can see the BEST Toilets' usability and functionality.
2. We trained local people how to make or procure the components of the toilets, and then assemble the toilets in or beside people's homes.

There is great need for toilets in North Bihar. In some ways, North Bihar has not been a priority area in India, and many families there are not living at the same standard of living as in rest of the country. One toilet can have a huge impact on a family.

For this project, an on-site needs assessment was initiated in the districts to determine the most deserving and low-income families who need toilets. It is a privilege to be of service to these deserving communities, especially in flood prone areas.

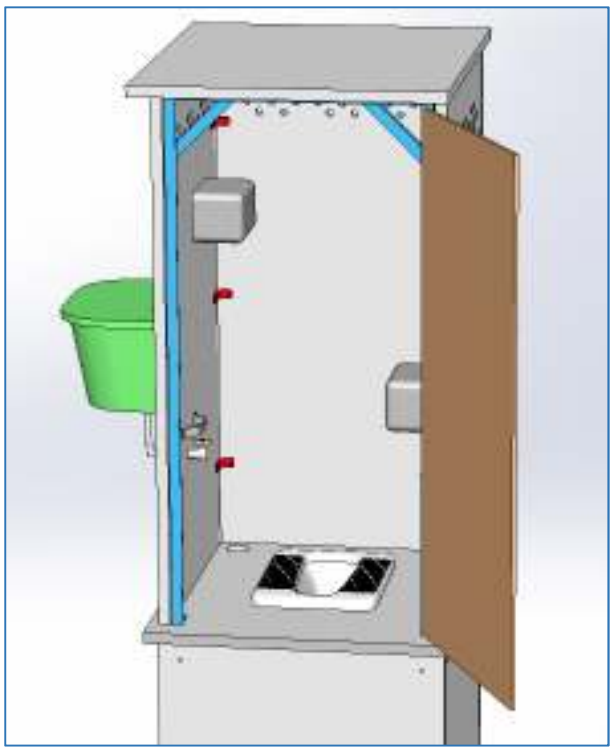
3.2 DESIGN AND ITS PURPOSE

The toilets are durable as they have been made using Reinforced Cement Concrete (**RCC**) - parts with which the wall, floor panels, roof, sub-structure and shelves were made. Strong doors, hinges and locks have been installed which are suited to local preferences.

The benefits of building with RCC modular parts of that the BEST Toilets are:

- Safe and Private
- Impact resistant
- Long lasting and weather resistant
- Modular Construction, with different features and options
- Better finish, with no sharp corners
- Water resistant
- Fire resistant
- Termite resistant
- Made from ISI materials
- Easier and faster to build, with a consistent, high-quality level
- Cost effective and excellent value

The RCC panel toilets can be built either inside people's homes or outdoors, near the home. People feel confident that concrete is pacca ("strong and long-lasting"), so they will trust that the toilet will survive normal abuse, such as a buffalo scratching her back on the corner of the toilet!



We install solar or mains electric lights in the toilets, so that people feel comfortable using the toilets at night. It is important to be able to see well at night, so one can check for any hazards inside before one enters the toilet.

Grab bars (or "handles") are installed on either side of the squat pan, to support people to balance themselves, and to stand up after using the toilet. Two concrete 'Cubby Shelves' are installed on the walls of each toilet. One shelf is outside, near the water tank, for soap, etc. The other shelf is higher up on an inside wall, near the back wall. Phones can be placed on top of this shelf. The inner space inside this rear shelf faces the back wall, so there is a lot of privacy for women and girls to keep menstrual products inside the shelf in the toilet.

A water tank, shown above in green on the outside wall of the toilet, provides water inside the toilet for washing and cleaning. The water tanks are small plastic "Sintex" tanks, that are supported on a reinforced concrete shelf.

A floor drain at the rear of the pan drains away water and soap used for cleaning and sanitizing the toilet interior. It is good to divert this water into a separate drain, away from the bio-filter, so that the earthworms do not get too much soap or cleaning chemicals flushed through their bed.

3.3 CONSTRUCTION:

Detailed step-by-step photo documentation of all the phases of construction of the precast parts as well as assembling the toilet is maintained by

Beacon AHEAD, for the purposes of quality control and training. The documentation is updated as our process is refined and improved.

3.4 FEEDBACK BEFORE RECEIVING AND USING BEST TOILET

3.4.1 Water Supply at Households:

Nal-Jal government tap connection was functioning in most households. Two households had only hand pumps. Iron content is higher in the water that is available in the communities. The water that is being supplied to the households through the Nal Jal scheme is not clean water.

50% of the people wash hands with the water from the hand pumps and the remaining 50% from the tap. The product(s) used for washing was mainly soap. One respondent used liquid soap. They washed their hands mainly after using the toilet or before cooking.

3.4.2 Problems before having a toilet:

It is very difficult for people to go for open defecation in rainy season as it is muddy clay soil and people tend to slip and fall frequently. There is danger of snakes, scorpions as it is surrounded by jungle area and it is scary.

During the day also there are difficulties as there are agricultural fields around the home and people are working in the fields that adds to the embarrassment of going for open defecation. Beyond that there is jungle area. It is also challenging to go out for toilet purposes especially when they suffer from ill health such as diarrhea. People face lots of issues as snakes move around a lot at nights and scorpions too. During rainy season the people feel helpless as they do not have a choice and lack a toilet. They have to resort to open defecation.

In detail, the responses given by users were as follows:

- All the respondents expressed difficulties related to open defecation.
- Fear of snakes, scorpions and other insects and pests were reported by all.
- Rainy season was one of the main issues for respondents.
- Finding the right spot for open defecation and waiting for the right time to ease oneself was mentioned by one respondent.
- The slippery nature of the wet and filthy soil was reported by 2 respondents.
- The issue of carrying water was reported by 2 of them.
- The issue of carrying light was reported by 3 respondents.
- Having to walk a distance of half a kilometre for open defecation was one issue.

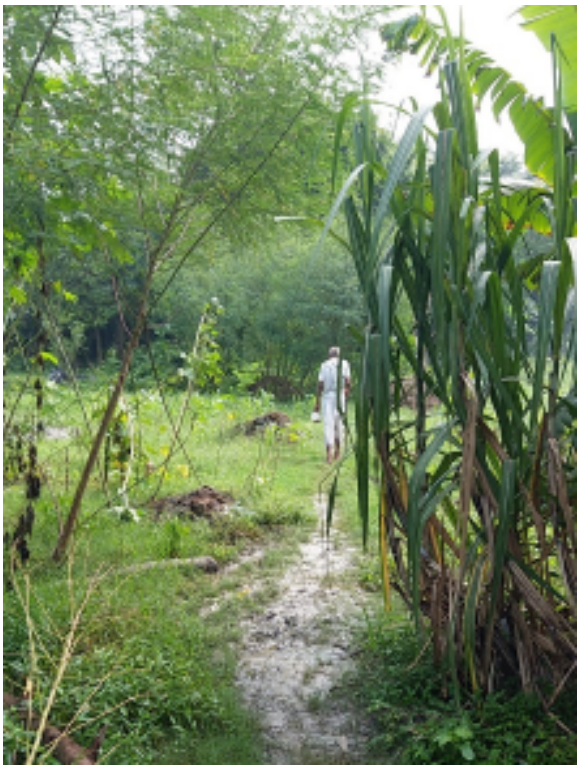
Other problems mentioned in relation to open defecation were:

- Resorting to open defecation with little kids

- Prone to other health problems
- Privacy issues and possibility of loss of respect in the community
- People suffering from leg pain and other health issues

3.4.3 Means in which people addressed the problems:

There was no other choice or way to address the issues that they were facing. They carried a torch or a bulb. One respondent attempted to build a thatched toilet for her daughter with a provision of a stone in the middle.



Others tried to opt for clear and dry areas and wait for the time when they could relieve themselves.

3.4.4 Reasons for not having a toilet:

Financial constraints were the main reasons for many families for not having a toilet.

The detailed responses were as follows:

- 8 respondents mentioned financial constraints for not having a toilet.
- Two respondents mentioned lack of space for a toilet. Among them one of them mentioned the fragmentation of land within household.
- Open defecation has also become a habit for the people; septic tanks are expensive and not affordable.

Other reasons mentioned were:

- Securing employment to live a better life was difficult.
- Two households mentioned that supporting habits of alcohol made the families poor.

3.4.5 Diseases before having a toilet:

The common diseases in the communities are cold, cough, fever, headaches, diarrhea and paralysis. Problems are also associated to age, stress, hunger, overworking, consuming unhealthy food, unhygienic living conditions and seasonal changes of extreme heat or cold climate. Children tend to fall sick easily. While cough, cold and fever are the common ailments reported by all the respondents, stomach pain and pneumonia were reported by two respondents.

Lots of digestive diseases are attributed to not being able to defecate and use a toilet on a regular basis.

3.4.6 As to what would improve the situation the responses were as follows:

- ✓ Eating clean food and maintaining cleanliness would improve health.
- ✓ Good education will promote better life was reported by 2 respondents

Other beneficial options suggested were:

- ✓ Getting proper medical treatment when necessary is crucial (if financial issues are present, nothing can be done about it).
- ✓ Better hygiene and healthy good habits.

3.4.7. Motivation to build a toilet:

- ❖ To stop open defecation and have more hygienic and clean practices.
- ❖ Protect the respect of especially women by preventing them from going for open defecation.
- ❖ Avoid dangers from snakes and other pests.
- ❖ Issues related to rainy season and privacy concerns motivate them to use a toilet.
- ❖ Interest among the community members is growing to use a toilet as they also see the various features that are provided. The entry and exit is easy and it is serving as an all-in-one model.
- ❖ People are developing trust in its durability and some are also requesting for an additional toilet for the house.

3.4.8 Present scenario of toilets in Communities:

Many people got toilets made through the subsidy of Rs. 12,000/- that was offered under the Swacch Bharat Abhiyan. Those that spent additional amount of their own money got a toilet that is still functional and good to use. However, others who built the toilet using only the subsidy amount got a cement ring toilet in which either the substructure filled up within one to one and half years and the toilet is now not usable or many of the toilet parts are broken and fell out of use.

40% of the people go for open defecation. In many households with a toilet, only the women use it and the men go out for defecation as they are of the opinion that this way it will prevent the toilet sub-structure from filling up as the depth of the sub-structure is only 3 feet.

People build brick latrines with cement rings. Most have leach pits while others who have money (around 10% of the population) have septic tank toilets.

It depends largely on people's affordability to get a toilet built.

3.5 FEEDBACK AFTER RECEIVING AND USING BEST TOILET:

Overall it is appealing and the seat is nice. The users are able to use it at all times especially when they are unwell. The design is liked by all. It has all the facilities and helps the users from not having to go for open defecation.

One of the respondents stated that it safeguards the respect of the household as taking a *lota (small container)* and going for open defecation is disrespectful. "Even if one eats less, they should have a toilet." was the response from the user. Another respondent stated that, "without this toilet our daughter's respect is at stake".

The BEST toilet has a lot of features of convenience and it looks nice. It is built with less money.

The toilet is a big safety feature be it night or day. It is also seen as a provision of protection. It is weather-proof and overall it is safe to use in all seasons.

The provision of water is one of the assets along with the cubby shelf and lights.

3.5.1 Impact:

BEST Toilet recipients stated the following, when asked about their experience with their new toilet:

- Beneficial mainly for ladies and children. It is a respectful thing for the daughter. Benefits grandchildren. Senior citizens also benefitted a great deal. Disabled and unhealthy people found this toilet most useful.
- Community considers toilet as being useful and it helps improve social status. The family with the new toilet got a lot of praise as they now have a toilet. A family stated that "It is a miracle from God, and other people feel jealous also".
- In less cost the toilet was built. People in the neighbourhood are also very interested in having such a toilet built in their homes. In a way awareness about the importance of having a toilet has also increased.
- Highly convenient.
- In many low-income households that live in thatched houses, the precast toilet is the first step of transforming their home into becoming pacca.

- Among a few extended families, the siblings had their land divided amongst themselves and then decided to get a toilet built on their land so that the construction of their new home would be either beside the toilet and they would include the toilet inside the walls of their home in the future.

3.5.2 Usability table:

The following table highlights the qualitative responses from the users that are assessed with the most crucial parameters that determine the usability of the BEST toilet:

Easy to use rating	Very easy and convenient
Pacca/kuchcha	Pacca. Better than a brick toilet as it is stronger and is held up on a slab, gravel and sand. It has tiles and also light fixture; one respondent reported that it is neither pacca nor kachcha – it is portable – which can be disassembled and installed elsewhere too.
Durability	2 to 15 years and depends on use. The sub-structure will not fill up till 3 years.

Privacy	Enables privacy and accessibility - and can use it at any time.
Safe to use at night	No issues as light is present; no fear of snakes.
Usable in all seasons	There is no water stagnation and chances of slipping is less; the water drains away easily. It is placed higher up from the ground level so it will not flood inside the toilet. It is much better than going for open defecation as the toilet is located at home. One user stated that since the area is prone to flooding, the toilet also may flood in rainy season and become difficult to use.
All family members will use	Most households reported that all members would use the toilet. One respondent said that the grandfather in his home is very old and is unable to use it. Another respondent stated that the father will not use this toilet as he is habituated to go for open defecation.
Easy to clean	There is no bad odour and it is easy to clean using ash from the cook-stove. Palm leaves are also used as a broom. People also use a brush. Households are told not to use detergent for cleaning as it will harm the bio-filter.
Toilet promotes safety and privacy	Yes

3.6 FEEDBACK ON THE OVERALL FEATURES OF THE BEST TOILET BY THE USERS:

This table summarizes the feedback about the toilets and its many features from the households:

Best toilet	This toilet is better than fully plastered latrines as it is airier. In a small space the toilet was set very well. Better than pacca toilet. Insects will not bite inside the toilet. One household stated that they need to keep the worms alive only then this toilet will function.
Space	Sufficient and fine
Height	Bihari people are short so it is fine. No obstruction. It is good.
Roof	There are no leaks or any other issues; it is appealing. Just sufficient for this toilet. Roof should be wider so that rain water will not fall on walls but would fall outward. Should be 6 inches wider on all four sides.
Door and hinges	It is strong and it is easy to close and open; the presence of a door makes a lot of difference. It has a latch; door is of good quality and made of thick material. Door is much better than what most people generally use in toilets.
Cubby shelves	Very apt and useful to place a bar of soap or to place shampoo. Good feature for women as they can use it and also store things as per their need. For four toilets the shelves were installed a little later since there were manufacturing delays.
Taps	Provision of tap is very useful; some respondents mentioned that they need an extra tap outside the toilet.
Height of foundation slab	New design. It will not fill up soon. It is similar to a leach pit system as it is 4 by 4 and a half feet deep. Mainly there were no issues; easily accessible for disabled people and even children could go into the toilet easily; it is good once mud is put all around it.

Vents	Airy; provides brightness; prevents rain from entering into the toilet especially during stormy weather.		
Handles	It is good for old and unhealthy people. Easy to sit and stand up using the handles and especially useful during ill health conditions. Even children use these handles.		
Light	Bulb inside the toilet is useful.		
Water tank	Sufficient. If need be the households will get a bigger Sintex tank. 40 litres are enough for one whole day. One household requested for a pipe to fill water in the tank; otherwise water is adequate and mostly people fill it once in 2-3 days; children sometimes tend to waste a lot of water. Some also carry a bucket of water for use.		
Top three features	Door	Tap	Light

3.6.1 Concerns of Users:

Due to the filling up of the bio filter materials, one respondent was of the opinion that the sub-structure is already half full and there would not be adequate space for the waste to accumulate. However, the respondent was briefed about the worm composting system and he hoped it will serve well even after constant use.

Another respondent wanted the toilet inside her courtyard. But the *aangan* (courtyard)will be used for religious purposes for her son's marriage. So got it built right by the road. She stated that her family needs one more toilet behind her house for her daughter-in-law.

3.7 AFFORDABILITY

BEST Toilet recipients stated the following, when asked about toilet prices and the affordability of their new BEST toilet:

- Cost for toilet construction ranges between Rs. 5000 to 35000/-.
- Cement ring toilets costs between Rs. 10000 – 12000/- for six concrete rings leach pit and has a tin roof on top of the super-structure.

- Cost would be between Rs. 12,000 (if it is a subsidy toilet) to Rs. 50,000, depending on people's needs. Some people also make toilets in a simple way.
- Septic tank toilets cost Rs. 1 lakh whereas cement ring toilets costs Rs. 30,000 to Rs. 35,000.
- Households expressed their gratitude, stating that they would not be able build a toilet for Rs. 4000. (Each household contributed Rs. 4000 which was directly given to workers for labour costs to build their toilet as well as transportation costs for shifting the RCC panels to the household site for installation. This amount given creates a sense of ownership and contribution, which makes it more likely that the household will respect, appreciate and use their toilet.)

3.7.1 Loans for procuring a toilet:

Microfinance agencies are not active in the areas where the toilets were constructed and the households did not receive any loans for getting their toilets built.

One respondent availed a private loan on the basis of her petty shop. She also runs an auto.

3.8 DECISION MAKING AUTHORITY: AND REASONS:

In two instances the son decided these matters; in two other households, the mother-in-laws took the decisions; one instance where the husband or the father mainly decided and only one respondent said that she is the head of the household and had to take all the decisions.

Seeing similar toilets being constructed helps the users to arrive at a decision to purchase a latrine. The mason and his staff also convinced some of the households about the benefits of such a toilet.

3.9 PROMOTIONS/MARKETING

Users stated they will advocate the use of this toilet as it is:

- ✓ Space saving
- ✓ Good model
- ✓ Portable and can be disassembled and shifted if need be
- ✓ Includes tiles
- ✓ All the facilities are good
- ✓ All features are found in one toilet
- ✓ Built well
- ✓ Good quality
- ✓ Overall good toilet

3.10 CONCLUSION:

The BEST Toilets were well received by the household members. There was significant interest from the Mukhiya and the community for more toilets to be built. We are excited to improve the toilet design, based on the feedback we received, and to build many more toilets in the years to come.

These toilets are the best sites for waste management. They prove to be far superior in mass reduction, pathogen destruction, compost quality and operational cost. The usage of less water is an added advantage.

This is a great way of reducing the environmental impact of human waste and the system of maintenance is relatively simple. Needing no external energy input or machinery, the beauty of this system lies in its straightforward simplicity without compromising the ecological principles which govern its function.

Our gratitude and appreciation to all the people and the users who helped to make this project a success.

Comprehensive Report Findings: Technical Inputs

4. BEST TOILETS TECHNICAL INPUTS FROM FIELD LEVEL PERSONNEL

4.1 BACKGROUND - PRIMARY HEALTH PROBLEMS RELATED TO SANITATION:

Due to absence of toilets, people go for open defecation only at night time or early morning before sunrise. As a result, people suffer from a lot of digestive problems and many other diseases are invited. Floods also cause a lot of issues as many people struggled to go for open defecation which in turn increased the demand for having a toilet.

Due to open drains and no proper sewage system, there is are problems related to water stagnation that gathers in potholes and in the drains. For those with proper immunity, diseases don't tend to affect them. Since rural areas are not equipped with good sewage system, most people are habituated to living with the existing conditions. But if there are health problems that occurs suddenly from an open

drain or from filthy water flowing out of the drains then people want these to be repaired so that hygiene is maintained.

4.1.1 Challenges due to water and sanitation:

Lots of toilets that have been built in communities earlier face problems related to hygiene as these toilets are not washed after usage due to which the toilets become unusable after a while. Unavailability of water is also an issue. So there is a lot of need to work on providing clean toilets that have proper water supply.

There are plenty of issues related to water supply too. Since there is power supply shortage extensively in Bihar, people are not able to pump water into tanks all the time. However, when they do fill up their tanks, people misuse and waste huge quantities of water that later becomes unavailable for them to use for more necessary activities such as using it in a toilet. Then people have to wait for a long time before they can use it for toilet purposes. Water scarcity is more during summer season as water levels are low. So people need to be made aware that they should use only the required amounts of water so that additional water will be available during summer season.

Iron content in water is also high as water that is kept in storage and not treated at the municipal level. This same water is being supplied through the Nal Jal taps. This may result in health hazards.

4.1.2 Types of toilets built:

Majority of the toilets made in communities are brick toilets. In Muzaffarpur and Samastipur districts, cement ring substructures with 7 to 8 feet depth are common and are considered satisfactory for regular use. This is one of the reasons that most people want a 7 to 10 feet depth sub-structure in the BEST toilets too and are unsatisfied with its existing depth being only 3 feet.

Only 10% of the population who are considerably rich use brick septic tanks.

People have requirements in a toilet based upon their budget. In general people require a toilet that lasts a lifetime, and is space saving especially for poor people. Most of the toilets other than the BEST toilets occupy a lot of space.

4.1.3 The reasons why people do not have a toilet at home are:

- **Monetary issues**

- **Space** is another restricting factor as most people know that they require 10 by 20 square feet of space to install a septic tank toilet along with the toilet room. Many people do not have this much space to fit a toilet.
- **Sub-structure issues and capacity** - Cement ring toilets get filled up or it gets dysfunctional and broken over time which results in non-usage. Those who spent their hard-earned money and used the Subsidy amount of Rs. 12,000/-, got good toilets built. But others have issues with dysfunctional toilets or toilets that have smaller capacity of 3 feet. If the sub-structure capacity is lower, then only the women use the toilet while the men go outdoors for their toilet needs.
- **Government schemes:** Lots of people are awaiting schemes from the Government to take initiative and built toilets at their home. Until then people keep going out for open defecation. They are of the opinion that when the time is ripe, then the Government will come forward to make a toilet for them, as was the case with the Swachh Bharat Mission. 40% of the population still goes for open defecation.

4.1.4 The reasons that motivate people to have a toilet in their homes are:

They deem it is necessary and useful for them and their families. When there is real need then people tend to put forth effort to get it even if it is by saving money to have a toilet at home so that it will save them from a lot of problems that arise out open defecation. It is difficult for the women to go long distances for open defecation and family members express and emphasize the need for a toilet. Such people do get a toilet built at their homes.

Most people who have money, do get a toilet made in their home.

4.1.5 Features required in a toilet:

The most important features that are needed in a toilet are:

- ✓ A good quality door.
- ✓ Roof that prevents rainwater from entering into the toilet
- ✓ Walls should provide privacy so that people cannot peak inside
- ✓ Water tank should not have any leakages. Should have adequate water supply or else people stop using the toilet as they are unable to keep it clean and eventually the toilet gets clogged. Tap is most useful.
- ✓ Toilet itself should not get clogged.
- ✓ Light inside the toilet is useful even in daytime as when the door is closed, the toilet can get dark inside and the light makes it convenient to use during the day and night.

4.2 TECHNICAL FEEDBACK

4.2.1 Customer perceptions:

People's response towards the toilet has been highly positive as during installation a lot of other people liked that the toilet takes up less space, is installed in less time and is sturdy. When people saw panels being placed near the households, they were of the opinion that the toilet might be built in one or two months, but people were highly impressed when the toilet was fully erected in the next day or two. People themselves checked the sturdiness of the toilet and also liked its look. Hence, people's demand for this type of toilet is already increasing as they also have the need for it and have similar problems pertaining to space, time and finances. This kind of toilet will fulfil people's needs as it has a good super-structure, strong walls, tiles are inside the toilet, it looks nice and it has a roof.

Earlier people wanted toilets to be made only behind their homes. But with this toilet as it is good looking and is highly user-friendly due to its many features, people want to make this toilet in front of their homes too. But well-off people will not like this kind of toilet as it can only be built outside the house. Middle class and poor people will prefer this kind of toilet.

This toilet does satisfy customer needs due to the presence of its many features and people like it for the following reasons:

- It is an eco-friendly worm composting toilet
- It provides manure (Sonakhaadh)
- Toilet can be used all the time without the need to empty it.
- It has a unique appearance and all its features are also unique
- It is portable as it can be disassembled and reassembled if people move from one house to another.
- It is a highly useable model.

Many people in the communities need toilets as these toilets only cost Rs. 5000/- and provides great value as it has worms and a bio-filter in it that converts waste into compost. So there is a lot of demand for this kind of toilets as the compost will be useful even in people's agricultural fields.

Women will benefit the most from this kind of toilet as they can use it whenever they want and they need not wait for night time to relieve themselves. This toilet will be long lasting provided people use this toilet properly.

4.2.2 Community feedback:

At the rural level, communities do like this model of toilet as it has tiles in it which is a highly aspirational feature that not everybody can afford and get. They also like the many features that it offers.

The only concern they express about the sub-structure filling up really fast as it is only 3 by 3 feet and are concerned that it may fill up in 1 to 2 months upon use. In most cases while the installation happens, community feedback revolves around the depth of the 3 and a half feet substructure and that it may fill up as it is so small and will fill up soon upon regular usage. This is one of the major concerns among most people who get the BEST toilet built at their homes. However, once the toilet is installed and the briefing about the earthworm bio-filter system and details are shared with people, then they tend to become more aware and also understand the mechanism of vermi-compost since the communities are predominantly agriculturally oriented. Hence they know the use and importance of compost and accept this type of system more easily when compared to urban communities. It is also shared among the new households that there are other households with up to 6 people that are using similar toilets daily for the past one and a half years and this toilet is working well for them. After listening to all this, people do get convinced and feel more confident about these kinds of toilet systems.

People will be most interested in the community towards this toilet due to the following reasons:

- It is a new kind of toilet that is space saving, affordable, good looking, has several good features, is eco-friendly as there is no pollution due to this toilet nor is there extra water usage in it so people will like this toilet.
- There is no smell in this toilet.

- People will have to bear only Rs. 4000 to 5000/- to get this kind of toilet if it is a funded project or else people will be given the right pricing of toilet based on the current cost of materials which will still be an economical option for those in need.
- It will be highly beneficial for any family to have this toilet due to the reasons listed in the following section.

The benefits of worm-composting toilets are:

In rural areas, fertilizer is required in large quantities which can be expensive. A lot of the amount that is spent on generating the yield is equally spent on the fertilizer. For the farming community, the worm composting toilet is a great way to get nutrient rich fertilizer that is also free of cost. Due to their agricultural background, they are also familiar about the process of generating vermi-compost from cow-dung. So when they see that the bio-filter also contains layers of cow-dung in it and the worms will also be put in it, they tend to understand that this toilet will also follow the same process and will be able to successfully generate vermi-compost. Hence the BEST toilet is a two in one option that provides a toilet and fertilizer that is very useful in their agricultural fields.

The fact that this is a worm composting toilet that will last will be an interesting reason for people to choose this type of toilet.

People question about the gases that will spread inside the sub-structure and have concerns that the worms might not be able to survive the amount of gases that is generated from the waste. Then it is explained to them that there are air filters that are installed in the sub-structure that enable good air flow due to which the worms will not have any issues and they can continuously work their way through the waste, decompose it and convert it into compost. The bio-filter also enables the worms to work well and multiply over time.

A lot of households were concerned that this toilet has only one 3 X 3 feet sub-structure and in that also there are other materials of the bio-filter that occupies a lot of the space. This might result in the sub-structure filling up too soon. Since this technology and model are new, people doubt the system a lot. But when people come to know that this toilet uses the technology of worms that decomposes the waste and converts it into compost, it is an aerobic system due to which there will be no smell, and awareness about the benefits and long life of this system are explained to them, then they stop worrying about the tank getting filled too fast.

However, this takes many rounds of creating awareness among neighbouring people in the communities who come to find out more about this toilet while it is being installed at any household.

4.2.3 Feedback on specific features:

The table below states the feedback given by the technical personnel on each of the different features of the BEST toilets:

Space	It is enough and convenient to use the toilet even after placing a bucket and mug inside it. If the toilet space is wider then it will be a problem to fix all the panels together as the weight of panels will increase and it will cause increase in labour and may also result in labour getting hurt if one of the panels fall on them by mistake. More space will be required if a bathroom is also attached to the toilet for free movement.
Height	It has 6 feet height which is sufficient as most people in Bihar are of 5.5 feet height. If height is increased, then it will be hard to place the roof panel on top of the toilet and will result in labour difficulties.
Roof	The roof is quite strong and has a lot of load to it.
Door and hinges	Door is strong as it is welded into the door frame and set well into the toilet. Everybody who has seen the toilet have stated that "such a nice quality door was not used even in their homes, but it is used in this toilet" so it is a good thing. The angle provided to add strength to the door frame is good. The rubber cord that is attached to prevent the door from slamming shut too fast due to heavy winds is the best idea and solution.
Cubby shelves	It is a good feature as people can use it to place their mobile phones and it is useful for storing small things in the toilet (i.e., tobacco, etc). People can use this feature to place utility items inside and outside the toilet.
Taps	It is good and useful to have one tap only. If multiple taps are provided, then it will result in increased water usage and it will take up more space.

	Single tap on the inside is sufficient bearing in mind the capacity of the water tank which is of 30 to 40 litres.
Height of foundation slab	It is 3 feet by 3 feet and it is ideal as it prevents ground water contamination. It is also Government's guidelines that one cannot dig deeper than 1 meter for leach pit toilets so for Bihar the depth of the foundation slab is perfect. Initially, there was doubt if the air vent holes in the foundation would be adequate or would it cause any bad odour. But after building the toilets and seeing the earthworms work so well, it is sufficient and there is no bad odour. 95% of the households are of the opinion that the foundation should be bigger up to 4 and a half to 5 feet depth so that it will not fill up fast.
Vents	It is adequate as air passes through it well. In addition, the vents do provide sufficient light inside the toilet. Earlier the vent holes were half an inch but later one inch holes were made into the panels. Each panel has 9 holes multiplied by three panels so 27 holes are good and provide enough air flow and brightness. There is no need to have more vent holes as it may impact the strength of the wall panels and cause damages to it during transportation.
Handles	It is a very nice feature that is new and not found in most toilets. It is a very useful supporting feature for those people who have a lot of leg and knee pains and suffer while squatting and standing up. It prevents them from falling over. It is also equally useful to old people or anyone who is ill. People really like this feature and say that it is a safety feature for children too.
Light	Light is very useful especially at night. Only at households where the toilet is located at a distance, the pathway might not have any light, then at such sites light can be provided outside the toilet too.
Water tank	It is of sufficient capacity of 40 to 50 liters and is convenient for people to fill it. For people who find it difficult to fetch water to the toilet or if someone is

	suffering from a fracture, it is a useful feature. The capacity is ideal for a small family of 2 to 3 members. If the water tank is bigger then it becomes difficult for people to fill it as it is placed at a height and people would need to fill it using their Nal Jal connection which doesn't have a lot of water flow. Water (Nal Jal) connection into the toilet can be provided through a motor that fills the tank as then there will not be any need to fill the tank manually using a bucket. If people of the households fill the tank in the morning and in the evening, then there will be 24 hours of water supply in the toilet. People have liked the look and sturdiness of the water tank. It is quite strong as it has adequate amount of thickness and is rust free. The tank can also be placed upon the roof of the toilet.
Top three features	1. Less time toilet is installed and made usable. 2. Long lasting as it is made of concrete 3. Eco-friendly as it prevents bad odour, water contamination and environmental pollution.

4.2.4 Most liked features according to technical personnel:

- The most liked feature in this toilet is the **cubby shelf** as it is useful to everyone and they can place articles on it. It is also a really useful feature for women as it prevents them from throwing their used sanitary pads into the toilet and flushing these as it further goes on to jam the entire toilet. It is really useful for women to store their sanitary rags or pads in it and also dispose these off in a proper way while others do not watch or impose on them.
- It has sufficient amount of **space** inside and the whole superstructure is built upon the sub-structure tank itself. The entire toilet occupies less space as it can be fitted in an overall space of 5 by 5 feet so it is really useful for households that do have space constraints.

- ❖ The **outlet drain pipe** is well incorporated as it separates the water that is used to clean the toilet or any excess water (i.e., someone leaving the tap open by mistake) from flowing inside and prevents it from entering into the bio-filter of the toilet thus preventing the flooding of the worm bed.
- ❖ The toilet has **tiles** included in it which is very popular among people.
- ❖ **Light** is also considered very useful. People do not need to carry a torch. Presence of light also ensures that people can feel safe and not fear snakes and other pests.
- ❖ A good water facility system in the form of a **water tank and tap**. The water tank is placed at a lower height that is easy to fill. People do not need to carry water into the toilet as there is provision for it inside the toilet.

- ✓ The accessibility **handles** are useful as lots of women and old people who suffer from calcium deficiency and thus face a lot of aches and pains which in turn makes it hard for them to squat to use the toilet. Hence, the handle provides a lot of support for people to use the toilet independently. Handles that are provided in the BEST toilets are one of the most liked features.

4.2.5 Disliked features or aspects about the toilet:

Following were the disliked aspects about the BEST toilet according to the technical team:

- ▪ People should be given options to choose **one or twin pits for the sub-structure** so that 3 X 3 feet pits of double the amount of capaicity can be made. This will help prevent it from filling up too fast. Most people really like the various user-friendly features that are being incorporated into the toilet but only recommend that the size of the sub-structure should be bigger so that it will last longer.

- The **air vents** for the foundation panels should be at the back unlike the existing front and back positions.
- The roof panel is heavy and simply placed on top of the wall panels. The **roof panel should be clamped** on at least two sides so that it is locked in place and prevents it from falling over due to strong winds.

- The **floor notch of the door frame** should be tilted to face the back wall of the toilet and it should be bolted in place into the foundation panel.
- A lot of people have remarked that having the **cubby shelf inside can hurt** them if they are not mindful about its presence. Men in general do not see the need for two cubby shelves and would prefer having only one on the outside wall.

4.3 MANUFACTURABILITY

4.3.1 BEST precast toilet perceptions:

Precast toilets are a great option for those who do not have lakhs of rupees to spend on a toilet. It is the best option for families who have space problems; who need a toilet to be built in less time (2 to 3 days) and which can be used soon after installation unlike septic tank toilets which have a complicated mechanism and takes weeks to build and cure. Precast toilets are built very quickly and take up less space. Such toilets are also stronger and easier to build when compared to brick toilets that take a long time to not only build it part by part but also plaster these to prevent insects from entering. BEST toilets need not be plastered.

Even for masons, building this design of precast toilet is uniform and fixed as the thickness of wall panels remains standardized otherwise customers tend to demand wall thickness of 5" to 10" in brick toilets.

This is the first time that most of people in rural areas are seeing precast toilets being made in their communities and it is a completely new kind of toilet. Customers initially wondered how a toilet can be built without the use of bricks. But after seeing this type of toilet, everyone has found a new way of making pacca toilets. Due to its many features and systematic assembly, everyone understands its process and benefits that it provides.

Field staff remarked that at first when they saw the different shapes and forms of the precast parts and components being made, they did not understand how it will

all fit together to create a toilet structure. But after they gained experience of how these panels are carried and transported and a few installations were completed then they fully understood how it all goes together. It is being manufactured and assembled in the best possible way. It is quite a successful and strong model of toilet and there are no issues in it.

This toilet option as an affordable and best option as it will last a lifetime and this toilet design incorporation taught the mason a lot especially about the technology of the sub-structure.

BEST toilet is likeable model as people can find all the features in the toilet and it is self-sufficient.

4.3.2 Training and design drawings:

This toilet design is completely different from other toilets that are usually made. Initially it took time for all the staff to understand the various components and structure of this toilet. But each component has a role to play and has a different name due to which the field technical staff got accustomed to this design, its dimensions and shapes.

It was also hard to understand and incorporate the design drawings at the field level. But once they gained experience doing the panels and following the drawings step wise, then they understood that it has been made keeping all the technical and user needs in mind. It provides a highly systematic approach to manufacturing the precast panels. Following the drawings also results in a non-problematic way of installing toilets. Design drawings are really useful for all the members who are technically engaged in this project.

Initially the training of the masons was slightly challenging as communities here are used to only

building brick latrines and precast toilets were totally new to them.

Due to the absence of moulds, all the panels had to be made precisely using manual means providing measurements of the lengths, breadths and widths of the different panels. Regarding the shape of the panels also a lot of care was taken to ensure that the rectangular or square shape of the panels is made well. The mason was strictly instructed to follow that he could not change the measurements even by half an inch as per his will as that would have a negative impact on the overall design and assembly would not be done accurately. The dimensions of the holes and its location also has to be precise. In order to ensure all of the above, it was essential for the field staff to supervise the work of the mason and his team by being present in person and guiding him and his team at every step so that all the holes and panels align perfectly. This type of monitoring presence and training is a constant requirement and this results in higher quality of manufacturing.

In addition, the ratio of materials that are used in construction are different while making these precast panels. In the precast parts that we get made, the ratio of the cement/sand/gravel materials mixture is 1:2:2 which is of higher grade and quality. The mason also stated that initially it was difficult for him to adapt to the design drawings and the ratios of mortar mix but with a lot of guidance and step by step systematic support from Vikash Kumar, he was able to adapt and understand the process and its importance. Awadhesh Kumar and Raushan Kumar were also equally supportive and helped ensure that the manufacturing got done well.

Once the mason made precast panels and installed the first toilet, he saw the strength and quality finish of the toilet. It was then that he was also convinced that it is a good product that will be durable. Now the mason and his team realize and value the design and the process that we follow.

4.3.3. Panels manufacturing:

There are no issues in manufacturing the BEST toilet. It is a new design and even the mason liked working on this toilet. The best aspect of this toilet design is that any additional waste water does not go into the vermi-filter and instead goes out through a separate outlet pipe.

4.3.4 Precast features manufacturing feedback:

When compared to the bigger panels, it is easy to cast the water tank shelf and the cubby shelf. The new cubby shelf mould is easier and much better as it has better shape with rounded corners. It is much more convenient to adjust it and make it now.

All the precast parts are appealing. All the precast parts have been made well, such as the water tank shelf is sturdy so as to bear the load of 40 to 50 liters of water.

4.3.5 Labour issues:

Now and then there are delays due to labour taking unexpected leave but most of the times they are all actively working and such delays are normal and to be expected in any construction work.

4.3.6 Weight of the precast parts:

The precast parts do have a lot of weight but the weight signifies the strength and durability of the panels that is acceptable to people. The weight of the panels ensures that the toilet will withstand strong winds and heavy rains of a typhoon that sometimes hits Bihar. This kind of toilet is also interlocked at various levels so that also makes it strong.

Usually 7 to 8 labour are needed to shift the panels and for the installation process. The weight of the precast components does add to labour issues and it makes it hard to transport these to a distance, but it is necessary for the strength of the toilet. If the thickness of the panels is reduced, then it will make the panels weak and it might crack easily. So, the existing weight of the components is proper and quality of the product is more important. Labour can be increased to deal with any weight issues that arises.

Problems due arise at some of the household sites where the path to the toilet installation site is too narrow and more manpower is necessary. Due to the weight of these panels it becomes harder to take these panels to the installation site. In such instances, the team uses two bamboo poles that they place on the floor and put up to 3 pieces of slit bamboo on top of it with equal distance. Then they place the wall panel on it and slide the wall panel so that it can reach the installation site more easily. There is an urgent need for a wall panel trolley that can bear the load of the panel and help shift the wall panel easily to the installation site without causing any damages.

Due to this issue and the preliminary idea of using bamboo, the product design team has developed a prototype of a new portable wall panel trolley that can be used easily to place and transport the wall panels to the installation site as the trolley will be on wheels. It was a design challenge to make the wall panel trolley as simple as possible to avoid theft but also make it portable enough that after installation it can be transported back to the pre-casting site on a two-wheeler. Efforts are in progress to finalize this design and enable higher efficiency of transporting the wall panels despite challenges of narrow alleys, including development of trolleys for shifting the RCC wall panels.

4.3.7 Transporting the precast parts:

The only minor transportation issue was with loading and unloading of panels as the height of the vehicle is 2.5 to 3 feet so lifting these panels and placing these especially the wall panels which were quite big, heavy and long into the vehicle was challenging. However, the labour managed to load and unload well.

Material transport is also challenging in monsoon season.

4.3.8 Common technical issues faced while pre-casting BEST toilet:

1. Maximum technical issues were faced with the foundation of the toilet. Due to heavy rains, flood water would fill into the foundation pit as soon as labour would dig 2 feet into the ground to install the toilet. No sooner the labour would try to remove the water, more water would fill into the pit as it was rainy season and all the efforts were in vain as the soil is full of slippery clay. Sub-structure is the most crucial foundation for building any structure so after facing lots of similar issues at multiple locations, all the members of the technical and design team came up with the idea of adding another precast foundation base panel (also called the Raft foundation panel) to provide a flat, solid floor footing on which the entire toilet structure would then be installed in a proper and durable way. The base panel would be able to handle the additional strain of slippery clay soil full of rainwater.

2. The other issue that comes about is with the iron rod frame that is tied together so that it provides strength to the concrete parts from within. The most common technical issue is to make the holes inside the precast panel (3" holes for the air vents and the drain in the foundation panels and the holes in the wall panels that had to 9" apart) as often the iron rebar comes in the way. The distance between the iron rod frame should be 4 to 5 inches as is the approved measurement in the design drawing. This is an issue since these toilet panels are made manually without using any moulds.

3. The access panel sometimes causes issues with the holes not being in its proper place which then creates problems in setting it well with the access cover panel. This issue is overcome by drilling the holes or aligning the holes to match with the access cover so that the bio-filter is kept safe and protected well.

4.3.9 Suggested improvements:

- People can be given options to choose if they want a **single pit or a twin pit vermi-filter** depending on their family size and also the available space for the toilet.
    - The foundation slab should be 2 feet into the ground and 1.5 feet above the ground so that it is more secure and prevents the worms from being flooded. If the foundation slab is 3 feet into the ground, then there will be problems with flooding.

- In addition, if households have abundant space and request for **the sub-structure to be made beside the toilet**, then this option should also be made available to people. It can be made like a soak pit using 200- 250 bricks and the cost of this feature may result in an increase of the overall cost by Rs. 2000 to 3000. But it will be beneficial for some families in whose toilets the system gets overloaded with too much water usage in which case it might be easier for Beacon AHEAD to reinstall a failed system due to wrong usage if the sub-structure is beside and not underneath the toilet. The toilet seat and foundation panel can be at ground level and it can be connected to the sub-structure beside the toilet. With this option it will also be a possibility that people can convert it into 2 to 4 chambered sub-structure depending on the need and space available at the household.
- The **foundation floor panel** could also **be fixed** in place so that it is stronger and better.
- **In the metal door frame, the strap metal piece** at the bottom **should face the front** rather than be on an angle so that it can be bolted into the foundation floor panel and not cause any hindrance to the people walking into the toilet. This would also ensure better strength and add to the overall sturdiness of the toilet.

- The **tap should be placed lower** and there should be distance between the handle and the tap or else people can hurt their hand in trying to open the tap.
- **Handle should be** placed **higher** up from the tap.
- **Cubby shelf hole** should be **deeper**. Regarding the cubby shelf, most people are not utilizing it well. People need to be **made more aware about its importance** and the convenience to menstrual hygiene and storage feature that it provides for women. It would also be better if **only one cubby shelf** is provided to each household toilet **on the outside**. The inside cubby shelf sometimes hurts people in the shoulders especially for those who are taller than the others or those whose eyesight is not good. Or **if the cubby shelf is provided on the inside** of the toilet then maybe **it could be** placed **on the back wall**. Most people use it to place their mobile phones on it.
- Providing light inside the toilet is correct but the light should not be hanging on a wire. Instead, **a holder should be fixed** to the wall of the toilet.
- The **Roof extends** 6 inches out above the door. This can be **increased** to 8 inches.
    - This way the door will be more secure. Roof should be wider so that rain water will not fall on walls but would fall outward. Should be 6 inches wider on the front and back, 3 inches wider on the sides. This would ensure that the roof looks more appealing and provides better shade.
    - The roof is quite strong and has a lot of load to it. But in the same way as the wall panels are all inter-connected and stable, if the **roof** is also **inter-locked** with the rest of the structure then it would enable people to be rest assured that the roof would not fall due to any reason. Clamps should be put to secure the roof so that it stays in place and is better able to support the overall strength of the toilet.

- In order to make the nuts and bolts waterproof, a lot of mortar was put as lumps on it. If a design can be made on these lumps or if **GI nuts and bolts can be used** instead then the overall appeal of the toilet would enhance.

  Using high quality GI nuts and bolts will be most important because the entire toilet structure is held together on the basis of the nuts and bolts system and its durability depends fully on it. Extra care needs to be taken to ensure the usage and constant supply of these materials so that the toilet stays rust proof and lasts long. This is as important as the other good quality cement and materials that are being used in manufacturing this toilet.

- Beneficiaries are told that if they get their toilets painted then it will look more appealing. In the future, if budget permits then painting of the toilet could also be included. It will cost an additional Rs. 3000/- to get it painted.

4.3.10 Resources needed for improved manufacturing:

- ✓ **Improved training:**

If more number of BEST toilets need to be made, then there is a need to provide further training to masons. As of now, a lot of on-going monitoring with each and every aspect of pre-casting (such as quantities of cement, sand, gravel, etc. needed to mix mortar, rods sizes, location of holes and so on) had to be continually ensured. Masons would require two more rounds of training so that they can then work independently and more effectively. With further training and monitoring, masons can work at multiple sites if the demand increases.

- ✓ **Solid concrete base platform for precasting:**

  There is a need for 20 feet by 20 feet solid platform for pre-casting that can be allotted and used just for making of the panels. This platform need not be

made fully using concrete base. Even if the foundation level is made of bricks and plastered then the panels can be made well and the finishing will be better guaranteed. Right now, fine sand is being used as the base for the panels to be pre-casted on but the finishing still needs to be better and the surface finish of the panels needs to look finer.

- ✓ **Customization of wall panel holes as per household toilet location**

  Holes can be reduced and only as many holes as is deemed necessary can be included in the wall panels. The more the number of holes, the weaker the panels get. The number of holes can only be reduced if the wall panels are customized to the selected household location, the direction that is decided for the door opening and for the overall installation of the toilet.

- ✓ **Moulds:**

  Moulds as per the design drawing measurements could be made for future panel work as it would result in more work completion in lesser time.

  It was difficult to press the panels while casting these to ensure air bubbles were removed. Bricks were used to ensure that the panels were made in a straight way and this resulted in a few panels not being made uniformly. In the future a frame should be made with nuts and bolts so that the panels are cast into it and it reduces the chances for any mistakes or quality issues.

Presently, the wall panels need a lot of holes that are inserted to attach the various features and for attaching the wall panels too. Usually the wall panels are pre-casted and then the mason measures the location between the holes and then manually inserts pegs made out of PVC pipes to create the holes. At times if the PVC pipe pegs get stuck then the holes are drilled and the plastic is removed. If there was a fiber sheet with the pegs attached to it at exact locations or if there are holes in exact locations, then this sheet could be placed accurately over the pre-casted wall panel and this could be left in place for 20 minutes and then removed in order to create the required number of holes in the wall panels either through the pegs attached or by inserting plastic pipes as pegs. Then panels can be made in lesser amount of time as one does not need to measure as much as is done presently. But the moulds should not be made of iron because if the pegs or rods get stuck then it will be hard to remove these.

However, it is important to supervise that the panels are not too wet when the mould sheet is placed on top of it as the chances of damage to the panels may increase.

- ✓ **Vibrating table:**

  It is useful for removing air bubbles from pre-casted concrete parts and add to the quality of the panels. But the panels that are used in the toilet have the thickness of one and a half inches only. The vibrating table or machine might be a useful feature for concrete components that are 3 to 4 inches thick, so the mason would need to determine whether it would work with the panels of lesser thickness.

  In order to use a vibrating table, it should be borne in mind that 6 to 7 labour are required to lift and place panels onto the vibrating table and likewise remove it and place it on the area where it can dry. As the number of panels being manufactured increases, the distance of carrying the panels to place for curing would also increase. There could be chances of accidents if by mistake the panel slips and damages other panels. This would also entail that there should be additional space provided for panels to dry after using the vibrating table. There will also be a 10% increase in the amount of cement that will be used as vibrating table removes all the excess water from the panels.

  So, considering use of vibrating table would be useful and effective provided there is a fully automated masonry system in place. This kind of establishment will be needed only when the demand is of 100 toilets per month. It should be taken into consideration that the setup costs of such a unit will be very high.

  Currently the mason and his team work hard and ensure the air bubbles are removed and use bricks to ensure the panels are made in a proper size and shape and as per the measurements of the design drawings. If vibrating table is used, then it is a must to use interlocking clamps to hold the panels in place or else the dimensions of the panel can change and would cause a lot of issues in installation and setting of the various panels. For the existing demand, there is no need for a vibrating table and the mason is willing to remove air bubbles manually.

  For the current levels of demand, usage of a small vibrating machine with a needle can be looked into so that air bubbles are removed more easily.

- ✓ **Other tools:**

  If a better tile cutting machine is provided, then work will progress in a better way.

4.3.11 Quality control:

In order to ensure quality of toilets when the number of toilet components are made several a day, the following aspects need to be of prime importance:

- If production demand is higher, then sufficient time should also be given to be able to meet the demand as quality cannot be compromised. The same process of manufacturing and following the steps of the design drawings is crucial whether the demand is for one toilet or ten toilets.
- Knowledgeable and experienced mason should be there who are committed and involved to execute work.
- Monitoring is most crucial so as to check the materials usage, its quantities and expiry dates of materials such as cement, etc.
- It is also important to ensure that the mason is working properly and is compressing the precast parts so as to remove air bubbles.
- Managing personnel is key and a trained mason should guide the other labour and masons so that they understand the process of manufacturing quality parts as per requirement.
- Based on increased quantity of manufacturing, manpower should also increase and there should be sufficient space to make and store all components.
- Provision of water curing tank is also necessary as precast parts need to cure for 15 days to 3 weeks in order to gain optimum strength.
- In terms of ensuring project progress and proper management of manufacturability, it is important for periodic visits of the head office team of Beacon AHEAD so that issues can be tackled, quality checks can be done and monitoring continues to be done systematically.

4.4 AFFORDABILITY:

Conventional brick toilets with septic tanks can cost between 1 to 1.5 lakhs. Leach pit toilets need a brick slab and these fill up after 5 to 10 years of use. Since the septic tank toilet costs are high, lots of people cannot make a toilet in their homes. Hence a lot of poor people choose leach pit toilets with a brick lining.

4.4.1 Cost:

If the BEST toilet were to be bought from a market, then it would cost Rs. 40,000 – 50,000/- inclusive of the profit margin that vendors would add to it. Just the manufacturing charges of this toilet is Rs. 35,000 to 40,000/-, so that will be the minimum price if you want to sell the toilet without any margin.

In addition, this toilet is made up of all good quality materials and all the components of this toilet have been made in the open where everyone could see that all the components were made with high quality methods which is also one of the reasons for the increase demand in having such a toilet. Many people have commented that they have not used such good quality materials to build their own homes as has been used to build this toilet.

4.4.2 Amount customers are willing to pay:

People will want the toilet at an affordable and discounted rate. Most people will want this type of toilet for Rs. 25,000 to 35,000/-. Middle class families and poor families can afford to pay anywhere between Rs. 15,000 to 40,000 for the precast toilets. This is so as most people cannot even pay more than this amount as most people earn Rs. 15,000 to 20,000 a month. So people will want to spend a maximum of their two months' salary on a toilet.

Septic tank toilets cost Rs. 1 lakh and only the rich can afford such toilets.

Furthermore, if donations are given, then several toilets can be built for the people who are in real need and cannot afford having a toilet.

Vendors will be able to sell this type of toilet as people need such toilets. It is possible that initially there might be fewer people who want this toilet. But as awareness increases about this type of toilet that can be made faster, then more people will want to buy this kind of toilet. Until such awareness increases among the people, it is necessary to support this type of toilet manufacturing. Sales supported on a large scale through donor funding is needed as lots of low income people and those who cannot afford to buy a toilet will benefit from it. This will also motivate the families who do have money to purchase such a toilet.

4.4.3 Percentage of customer's interest in having this type of toilet:

Maximum people (nearly 35 to 50%) who are getting leach pit toilets made will show interest in this kind of toilet. Small families will show greater interest as it is a good quality toilet with many features.

4.4.4 Token cost and cost concerns:

I. **Background related to the token cost charged:** While the overall cost of making one BEST toilet amounts to Rs. 35,000 to 40,000/-, currently Rs. 5000/- is being taken as a token amount from the beneficiary household so that they value having a toilet as their hard-earned money is used to get this toilet. This is motivated by the survey conducted in the past which justified that free products are not valued by people no matter how good quality a product it might be. It is also to be noted that the token amount is NOT taken by our organization and is given directly to pay the wages of labours and the cost of the transport vehicle on the day of installation.

Due to the Rs. 5000 amount that the families contributed towards the toilet, there is more value that is attributed to the toilet because of their investment and also as it provided them with a good quality toilet for a very reasonable cost. Most people felt safe and happy to invest this amount in the toilet as they were to give this money directly to the labour and/or mason upon the completion of the toilet and not beforehand. This increased their sense of trust in the team and towards Beacon AHEAD.

II. Addressing token cost concerns of beneficiaries:

Since this type of toilet is being installed for families that are low income and really in need, they have concerns about giving Rs. 5000/- as they often think that this amount is taken as a bribe and they bargain that Rs. 500 to 1000/- should be reduced for them. But the staff share that Beacon AHEAD is a non-profit and the amount contributed by the household is taken so that the household does not misuse or not value the toilet if it is given free of cost. It is also shared that the Rs. 5000/- should be given directly by the household to the transport vehicle person and to the mason and labour who do the installation of the toilet as they are working hard and none of these services come free of cost. Not a rupee of the amount contributed is taken by our organization and we would only appreciate if the household values the toilet and keeps using and maintaining it well.

If potential consumers are concerned about the cost of toilet, then it is best for them to talk to the mason as people trust the mason's word more as they are known to people locally. Mason will say the truth about the materials and the costing that resulted in the price of the toilet and then people will be rest assured that the price

is reasonable. Otherwise only option left for people is to make brick toilets which are very expensive.

4.4.5 Finance:

Micro-finance options for purchasing toilets are not easily available in most areas except Samastipur.

20-30% people in communities do have access to micro-finance options to build toilets. Such people get micro-finance loans for Rs. 15,000-20,000 and repay this amount regularly on an instalment basis. Self-Help Groups (SHGs), chit fund agencies and the NGO Jeevika also provide loans for building toilets. People access these loans depending on their individual capabilities of repayment as per due dates and knowing well that the interest rates of such loans are not low.

Most people will be able to mobilize Rs. 10,000 to 20,000 for the BEST toilets. However, people should be given sufficient amount of time to mobilize the money for such toilets.

4.5 SOCIAL MARKETING AND PROMOTIONS:

4.5.1 Best ways to social market this product:

The best means to do social marketing of a product is based on individual usage and positive experience. It takes time to promote a product this way but it is the sincerest form of promotion based on community usage that results in trust and goodwill. It is important to create awareness about the benefits that this toilet offers in terms of it being space saving, cost effective, long lasting, installed without any hassle and that it provides the convenience of a 1 lakh rupees' toilet.

The best ways to do social marketing of this toilet will be to do the following:

- ✓ The eco-friendly factor of earthworms converting waste into fertilizer is the best aspect of this toilet.
- ✓ The main advantage of having such a toilet made at the household level is that it is time saving as it gets installed very soon. In addition, the people at the households can spend their time earning money rather than waiting for days to monitor a toilet being built as is the case with brick toilets. People can also benefit as they will be saved from any kind of loss, as through this toilet, they will get a product made of quality materials by a proper mason, and people in turn get a good durable structure made at their home.
- ✓ It will be great to have a model toilet built at a prime location such as by the road side along with a banner that highlights all the benefits of such a toilet so that many people, including illiterate people, can see and get a toilet made at their homes.

- ✓ Banners in all prime locations such as the Mukhiya's home and other important social gathering spots will be ideal.
- ✓ If the word is spread by the main community leaders, such as the Mukhiya, then people tend to believe their word and follow what they recommend. This is so because people in the community trust their leaders and if you are a newcomer and you build a new kind of toilet, then they need to trust that if something goes wrong then they have someone to help them.
- ✓ Service and monitoring is also important aspects that, if provided, result in greater community acceptance and trust.

4.5.2 Promotional messages:

Television advertisements should be made about the advantages of the BEST toilet.

The best promotional message for this type of toilet will be to tell people that the BEST toilet is:

- ✓ Space saving
- ✓ Money saving as it can be made using Rs. 25,000 to 30,000 and it will last long.
- ✓ It looks very appealing due to the tiles and if it is painted
- ✓ It is sturdy when compared to brick toilets especially the ones that are made using low grade bricks that fall apart after one or two years of use.
- ✓ Eco-friendly and prevents water contamination
- ✓ In less time, fertilizer/golden manure ("Sona Khad") will be generated from the waste
- ✓ The toilet can be used on a long-term basis as the sub-structure will not fill up fast due to the worm-composting technology.

4.5.3 Challenges in promoting this kind of toilet:

Every person in the community will have their individual opinions regarding this toilet. Initially there might be issues with promoting this type of toilet as people will have many doubts. But when they see that this toilet is standing strong even after 6 months or one year of use, then automatically people will get faith in it.

However, the field team will do their best to motivate people and clarify all the doubts that arise in the minds of the people.

Vermi-filter technology that uses earthworms to filter and treat the waste was initially very intriguing and caused many doubts about the survival of the worms and their ability to stay within the vermi-filter. But as the work progressed, then all the doubts about its efficacy became clear. It is a very unique sewage treatment solution and many people do come forward to know more about its process.

4.6 ISSUES DURING THE PROJECT PERIOD:

- During the course of this project, the cost of materials increased substantially.
- Water level due to floods increased drastically which made the work stall on many days and delayed the project completion by weeks.

- Many selected households backed out from having a toilet installed during the rainy season as they were of the opinion that the structure could probably get damaged due to the floods.
- Lack of moulds (due to Covid-19 lockdown, moulds could not be made as fabricators were unavailable to work) for accurate pre-casting of toilet components meant that several holes that are needed to fit together using nuts and bolts had to be drilled manually on-site at the household level. This meant that the field team carried heavy inverter power back-ups with them so that they could drill into the precast panels and make all the parts interlock.
- Unavailability of GI nuts and bolts in any of the local hardware market meant that the available nuts and bolts had to be covered using mortar to make these rustproof and waterproof to ensure durability of the toilet. Though this caused the outer appeal of the toilet to seem as though the panels were covered in blobs, it ensured that the toilet would withstand wear and tear even in extreme climatic conditions.

4.7 ACKNOWLEDGMENTS:

Beacon AHEAD acknowledges the technical team who had the power to rise above any situation and deliver the best results irrespective of the circumstances. The efforts of the following members are highly appreciated for their dedication and commitment:

1. Jane Verrall, Product Design Lead, Beacon AHEAD (Honorary)
2. Vikash Kumar, Project Manager, Beacon AHEAD
3. Raushan Kumar, Field Supervisor, Beacon AHEAD
4. Awadhesh Kumar, Field Executive, Beacon AHEAD
5. Vidyanand Rai, Volunteer (School Improvement Program), AKRSP(I)
6. Devender Ram, Head Mason, Beacon AHEAD

5. Comprehensive feedback on Disability toilet:

5.1 EXPERIENCE WITH BUILDING THIS TYPE OF TOILET:

When people need to go for open defecation, it generally takes time for them to find a suitable place for that. It becomes even more challenging for a disabled person to travel a certain distance to find such a suitable place. The need for having a toilet in close proximity is a far greater need for this section of community.

On an average, 5 to 10% of the families in the communities have need for the disability toilet. Out of which only 4% of such families would be able to get this toilet made at their home due to financial constraints.

In a disability toilet, stair cannot be provided as it will be problematic for the

affected people to climb it. So a ramp has been provided for them, with railing on both sides and the seat is also a western one so that they can easily sit and use the toilet. The main problem is that they cannot squat on an Indian toilet pan as their legs do not support them well enough. A lot of the times, because of mobility problems, it may take them a while to go up to the toilet during which time it is difficult for them to control themselves or by the time they get to the toilet, they may not need to go anymore. For a disabled person squatting for a long time is really difficult. Keeping this in mind, the western toilet seat is really useful as they can take their time and use the toilet properly which in turn will also help them be heathier. It helps that there are vents for proper air flow, lots of space and light to keep the toilet bright. The biggest advantage is that this toilet does not have any smell. So this design and all its features are really nice.

The only issue is that they are not habituated to using a western commode and they need to be trained about how to use such a toilet effectively. Even after all the conveniences of a disability toilet that are provided to the family, due to their previous habits they are unable to use it properly as they do not know how. So they need to learn and adapt to it.

This toilet has been made very well keeping in mind their needs and considering all the other toilets. This toilet was built specifically for this family because the majority of the people in this household are disabled and hence they are a really

deserving family. Most importantly, all the guidelines for building a disability toilet were well incorporated in this toilet.

5.1.2 Most liked and useful features:

- **The western toilet seat** is most useful and it is also provided based on government guidelines for differently abled people. The toilet seat helps support the users like a chair on which they can sit and easily use the toilet. Currently, the three members of this family who are disabled have trouble with walking and living. In the future, their mobility may get hampered even more, so the toilet seat will be most useful for them.
    - It is true that this type of toilet seat is not common in rural areas, but this is most useful for this particular family as it will not only be useful now but will prove to be useful even in the future. This is not a temporary solution and they may need to learn how to use, sit on and flush this type of toilet. But once they learn all this then it will be a long lasting and effective solution for the family's needs for many years to come.
- **The handles provided all the way on the inside of the toilet** is also very useful especially in times of illness as it will provide a lot of support to those who are already weak and feeling unstable and prevent falling in the toilet. It enables the people using the toilet to have better accessibility and increases their ability to use the toilet effectively.
- The **ramp and the railing** are very useful and helps support a disabled person at every step of going into the toilet. The family also liked it very much.
- When compared to the design of the usual BEST toilets, this toilet design is even nicer as with a little bit of space increase, this type of toilet is able to **accommodate both a toilet and a bathroom** which is quite good. It also looks different from the usual toilets as it has been made with a lot of care and attention to detail whether it was the ways to attach and strengthen the joints between the wall panels or making it more spacious. A lot of people have worked hard to build this toilet and it has been made very well.

5.1.3 Disliked features:

The cubby shelf in this particular toilet should have been in installed on a different wall on a side as it may hurt the shoulders of the people who stand up after using the toilet also considering the fact that they are already a bit unstable due to their disability.

5.1.4 Community feedback while making this type of toilet:

As this was the first precast toilet that was built in that area, a lot of people were curious about the mechanism of precast panels and had a lot of questions about how can a toilet be possibly built in a day. Any new product that is introduced in communities, creates a lot of doubts and questions in people's minds. While initially the negative feedback is high, overtime with experience and use, people start trusting products and their efficiency. Same was the case even with this toilet.

The various features and the conveniences of this toilet was much appreciated and liked.

The people in the community also shared that particularly with this model it would be a great help for the family as they used to suffer a lot to go for open defecation especially in rainy season. Due to inability to go for toilet needs outside they were not able to eat properly as they couldn't relieve themselves timely. So considering

all this, it is a great asset for this family and the community was also highly supportive in accepting as well as encouraging the installation of this toilet.

5.2 MANUFACTURING OF THE VARIOUS NEW DESIGN PANELS:

5.2.1 General Training and manufacturing:

The design of lots of the components changed for this type of toilet. The mason and the field staff had been briefed about the methods to incorporate these changes at the ground level while making the precast parts with a lot of care and effort so that the result is as desired and as per the good design drawings that were provided to them by the product design team. It also helped that the team is already aware of and has experience about the general manufacturing of panels and its procedure that they have with the BEST toilets being made.

Firstly, the raft foundation that was earlier a simple square got changed into being bigger so that it could hold almost two toilets length of structure on it.

The foundation seat panel also changed as it had a western toilet seat instead of an Indian one. Keeping in mind the limited space availability inside the toilet, the distance had to be maintained so that the hole for setting the toilet is placed rightly without wasting too much back space and at the same time it is not right against the back wall so that in future if there are any repairs then there is scope to do the same. So the hole had to be big enough for the syphon to fit into it while also ensuring that it is not too big for the air to leak out.

Interlocking panels that were incorporated in this toilet is also a great feature as it makes the toilet strong and helps keep the panels bonded especially if there is a mild earthquake or the panels get shifted, even then the toilet stays locked in place due to the interlocking mechanism.

However, interlocking panels were harder to precast as it involved more cutting, it had to be made precisely and it had to be set perfectly.

The design was done very well and the because of the interlocking panels, it was easy to install and set this toilet. Starting from the training of the mason to make the components of this toilet up until the complete installation, there were no issues encountered.

5.2.2 Transportation issues:

For this particular model, all the parts were of double quantity. Materials used for the bio-filter as well as for making the ramp were also double than usual and hence the transportation weight was also doubled. But the usual mode of transport was only chosen because choosing a heavy vehicle would entail lifting the panels to a greater height for transporting these and that would be difficult for the labour.

Initially there were issues with the transport people wanting to take all the panels in two loads. But that would result in slower installation and would increase the cost

of transport, too. So, it was done in one load but with the help of double the amount of labour. The parts were also heavy.

However, there were no breakages while transporting the parts as the vehicle driver was instructed to drive carefully.

5.2.3 Installation time and labour:

It also took two full days to install this toilet when compared to other usual toilet that take only one day.

Usual toilet pre-casting and installation takes 10 to 12 labour and 3 masons. For this toilet it took 17 to 18 labour and 4 to 5 masons to complete it.

5.2.4 Installation challenges:

Initially there were a few challenges as the design for this toilet was different and since this type of toilet was being assembled for the first time. All members of the team tried to do their best in ensuring various ways in which the best possible result could be achieved. Jane Verrall was present during the entire assembly and installation of the toilet and so her guidance and monitoring really helped the team a lot as she was the one who fully knew the means through which this toilet could

be installed well and taught the rest of the technical team to do the installation as meticulously as was possible.

A few challenges encountered during the installation were as follows:

- The raft foundation had to be joined together and this needed guidance and supervision. The mason and team were told to set the two panels together beside the dug up pit and then it was easy for them to lay them in and set it on a final basis.
- The wall panels not only needed angular iron clamps to secure these in place but since it was a double toilet, it also needed flat clamps between the straight panels to ensure the panels would not bend and fall over. This meant that it would also provide even better locking of the panels in place. As a lot of the wall panels needed to be set in a line, it was also a bit challenging.
- The floor panels and the roof panels had to be set carefully so it took time as all the panels had to fit into place. It also entailed the services of extra number of labour.

5.2.5 Quality control:

1. If the demand for such toilets increases, then **increasing manpower** would be necessary so that pre-casting, monitoring, shifting and transporting of panels can all be done efficiently. Training and monitoring of staff is also equally important so that high levels of targets are achieved.
2. **Coordination and support** between the mason and the field supervisors is very essential.
3. Time is the main factor and the field staff would need **sufficient time** to make the panels properly as it takes a lot of effort and care to make these panels. Sufficient time is also required for the curing of the components and the amount of water used for curing also enables the parts to be strong. A lot of care needs to be taken. It is the priority focus of all the staff that optimum care is ensured in using high quality materials (sand, gravel, cement, black wire, reinforced bars, etc.) and the ratios of the

mixtures are also maintained well to ensure strong and good quality panels. This results in better finishing and higher quality control.

If the demand for more toilets rises, then there will be a **need for one additional labour** just **to focus on** water application, so that water for **the concrete curing** gets added well, two to three times a day. This results in increased strength of the panels.

5.2.6 Any recommended changes:

Technically there are no changes required.

1. However, a lot of people with no disabilities also would like the option of **including a bathroom** with their toilet especially in households that have many female members. But the provision to include a bathroom or not will depend if the household site is:
    - If the toilet would be at the front of the house or will be located behind the house. This is particularly an issue because of the space availability.
    - Vaastu preferences, with regard to the seat direction and the opening direction of the door.
2. In terms of the toilet seat, an **option** can be given to households with disabled members **to choose from western or Indian toilet seats**. In rural areas, most people would prefer an Indian pan and if the family itself chooses this option based upon their habit, then it may be better for Beacon AHEAD to provide the squat pan as per the convenience of people's needs. Most people are not aware about how to use a western toilet and since a flush tank is not included, people say that the solid waste is not passing through the toilet.

    It is also important to teach people who choose this type of toilet seat to be trained to use less water as this is one of the most important factors while using a worm composting toilet to use very less amounts of water or else it would result in the drowning of the worm bed. Usually western toilets tend to use more water to flush and this will impact not only the worm bed but will also require increasing the capacity of the water tank and including a flush tank for the toilet. Due to these issues, it may be more suitable to provide an Indian toilet pan only for the effective functioning of the BEST toilet. Or there is a need to find a commode toilet that only uses 3 to 4 liters of water per flush and in spite of flushing if there is any waste remaining then it can be flushed using a bucket of water.

    In many cases, people tend to sit with their feet on top of the western commode and then try to use it. Considering all these aspects, it is equally important that people are taught how to use this type of toilet effectively and then they are given the choice depending upon their health condition, level

of mobility and personal preferences. If people are able to go for open defecation, then they tend to develop a habit of squatting so if that is their habit then it will be easier for them to use an Indian pan rather than to develop a new habit of using and flushing a western commode toilet. More than the cost of a toilet or the number of features, the level of usability determines the success of any given product.

5.3 AFFORDABILITY:

5.3.1 Reason for making this toilet available to the respective beneficiary free of cost and its importance:

Families with disabled people usually have financial constraints and there is a great need for this type of toilet. If such toilets can be made available to people in need through Beacon AHEAD, then it will be really useful for them to get such a toilet especially by contributing a small and affordable amount. In the case of the present beneficiary, the token amount of Rs. 5000/- was also not charged bearing in mind that they are really desperate and cannot pay any amount. Providing a toilet to them without taking any money is a great boon for them and people in dire need will really appreciate and value this kind of help of Beacon AHEAD. In a way they consider getting this toilet as getting a new life as they can now eat properly and use the toilet at their convenience.

5.3.2 Actual Cost:

The cost of making this toilet was more than double the cost of making usual BEST toilets. The actual cost of this toilet was well over Rs. 90,000/-.

5.3.4 . Token amount that can be charged to beneficiaries and why:

In the future, if there is more demand for such a toilet and depending on the family's income levels, up to Rs. 10,000 would be reasonable for the family to contribute to have such a toilet built in their homes. This amount will be given directly to the transport person who may end up taking parts to the chosen site of installation twice and the remainder amount will be given to the labour and mason even though it does not fully cover their labour costs.

However, the amount that families in need can pay for such a toilet depends largely on the income levels of the families. In most cases people can pay about Rs. 5000/- for a toilet to be built at their home. This amount is thus ascertained taking into consideration that even if there are two people working as labourers in a family and each earns Rs. 350/- per day, this amount per month would add up to Rs. 21,000/-. So, if such a family decides they need a toilet, then contributing Rs. 5000/- would be fairly easy for them and would create value for them. For families with disabled members and those having constraints or not proper family backup, Rs. 2000/- could be taken as the token amount.

As mentioned above, when people are given anything free of cost they tend not to value it as much. But if the same thing is made available to them using some amount of their hard-earned money then they tend to use it and care for it more. With this idea, the token amount is charged to the beneficiary.

5.4 PROMOTION OF THIS KIND OF TOILET:

- ✓ People get motivated the most upon seeing a model that works well in their community. So, once model toilets are built and used, maximum people will get inspired to have their toilets built this way as it provides so many features of convenience. Model toilets in use are not only being seen by people of the same village, but people from neighbouring villages also come and see it. Seeing is believing and this will be the best and most trustworthy means of promoting this kind of toilet.
- ✓ For promoting this kind of toilet, it will be best to show pictures of both the regular 3 feet by 3 feet toilet and the same toilet attached with a bathroom facility whether or not the family has disabled persons or not. This facility of a bath attached to the toilet will be very useful for families who have higher number of females at their household.
- ✓ The overall cost of this kind of toilet can also be shared and it can be promoted by saying that families need to invest only Rs. 5000/- for such a good quality toilet with so many disability-friendly features that will relieve them from so much suffering and prevent them from accidental falls and getting hurt.

5.5. WAY FORWARD:

- Based on the technical feedback, GI nuts and bolts of high-grade quality are being now incorporated into the toilet assembly.
- In addition, air vents that were originally placed towards the front of the toilet, are now being placed on the side panels of the sub-structure so that it does not hinder the stair construction as well as it prevents any additional water on the stairs from flowing into the vermi-filter.

There is a need for toilets in at least 500 households located in 350 wards in Sakra Block of Muzaffarpur district. In order to increase coverage, it is important to have separate teams for precast panel manufacturing and for installation.

- It is also important to let potential customers know that the amount of Rs. 5000 being paid by the households towards each of the toilet construction is not being taken by any middlemen and these toilets are not being provided by the Government. Instead that amount is being given by the people so that their valued contribution is also part of the funded toilet being provided to the households. This is necessary so that people use the toilets more effectively.

6. Renovating and remodeling Integrated Child Development Scheme (ICDS) ANGANWADI Centers into Model Anganwadi Centers:

6.1 BACKGROUND: (Source: ICDS Government website)

Anganwadi (Courtyard Shelter) Centers are a form of Rural child care centers in India. ICDS (Integrated Child Development Scheme) began in India in 1975 with the aim to combat child hunger and malnutrition.

Pre-school education (PSE) is the most crucial component of the ICDS Scheme which aims at development of school readiness and inculcating a positive attitude towards school education among children between the age group of 3 to 6 years through non-formal and joyful play way methods and activities. Fostering better health, hygiene and literacy in a nurturing preschool environment is the foundation of the Anganwadi Centers.

Anganwadi Centers (AWCs) provide meals each day to children under 6 years of age as proper nutrition is critical for the development of healthy brains and bodies during the formative years of children.

Direct intervention mechanism is used to benefit nearly 27.6 million beneficiaries across India. Anganwadi Centers and their related personnel are the backbone of rural child care and health care services in India.

The scheme of ICDS has performed considerably well in our socio-cultural system to ensure children's right for survival, growth, protection and development as well as their active participation in the environment where they live, grow and develop.

6.1.2 Aims and Objectives of ICDS Centers:

Six components that form the core of the aims and objectives of the ICDS scheme under the Ministry of Women and Child Development are:

1. Supplementary nutrition
2. Pre-school non formal education
3. Nutrition and health education
4. Immunization
5. Health check-ups and
6. Referral services.

In addition, these Centers also aim to enhance the ability of the mother to look after the normal health and nutritional needs of the child.

6.1.3 Challenges of Anganwadi Centers are:

- Infrastructure related
- Logistic supply related
- Inadequate honorarium
- Lack of help from community
- At times - inadequate supervision

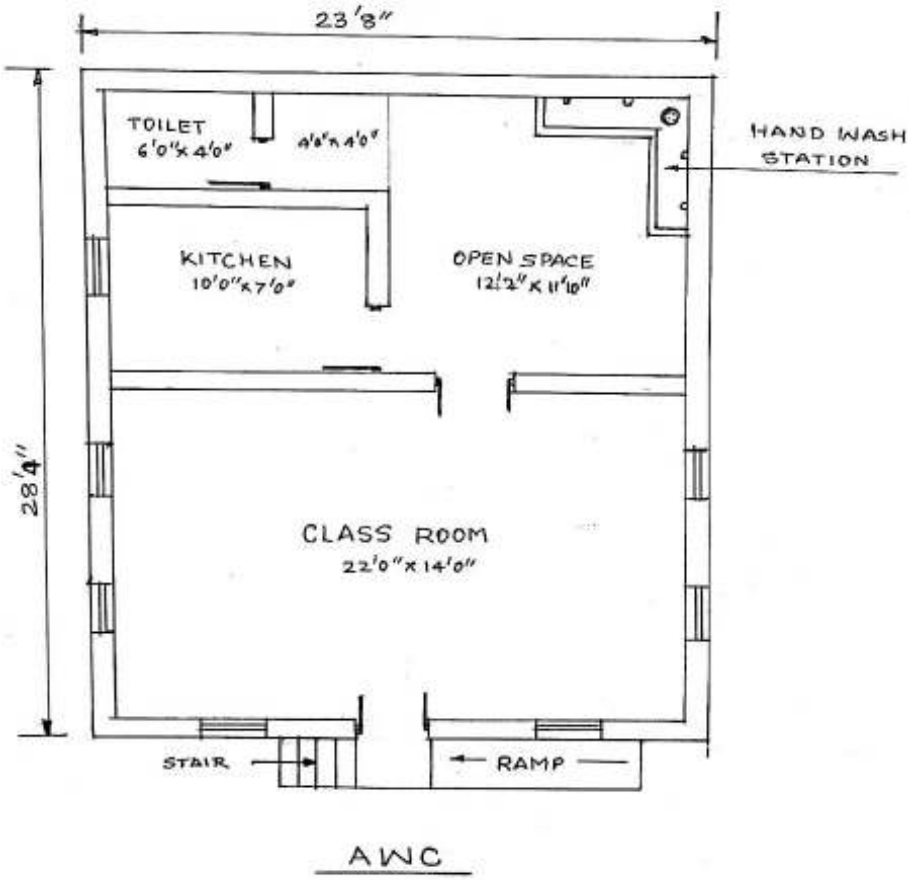
6.2 TRANSFORMING ICDS ANGANWADI CENTERS INTO MODEL ANGANWADI CENTERS

6.2.1 Purpose:

There is an immense need to renovate and create model ICDS Anganwadi Centers in Vaishali District of North Bihar.

Need:

ICDS ANGANWADI Centers are part of the Government of India program through which pre-school education, nutritional meals, primary healthcare, immunization, health check-up and referral services are provided to children (under 6 years of age). Under this program, the Government of every state has built various ICDS ANGANWADI Centers to provide these services to the mothers and children at each ward.



Typical Layout of an Anganwadi Center

However, these Centers were either built many years ago or have been built using low quality materials, due to which many to most of these Centers are under the threat of collapse or are becoming close to being unused. The major issues at the ICDS ANGANWADI Centers are as follows:

- Seepage and cracks in the roof and walls
- Lack of appeal, due to old, damaged looking structure
- Many Centers have damaged windows and doors
- Absence of proper "Teaching Learning Materials" (TLM) kits and storage options
- Lack of seating arrangement for the children
- Dysfunctional toilet due to lack of water supply and unhygienic past usage. (A few Anganwadi Centers have only an empty room in place of the toilet, with no toilet seat or water connection.)
- Lack of handwashing system
- No means of cooking on proper cook stoves that work effectively
- Dearth of kitchen garden
- Lack of drinking water supply
- Absence of light within the classroom, etc.

Due to the above-mentioned issues, children are facing challenges and are unable to have access to adequate learning and hygienic healthcare.

Government also lacks sufficient funds to renovate these Centers and thereby children and mothers in communities are facing innumerable problems.

6.2.2 Means of transforming ICDS Centers into Model Anganwadi Centers:

In order to support the Government in their efforts to provide pre-primary education and quality healthcare to children below 6 years of age and better healthcare to the mothers of these children, Beacon AHEAD Institute aimed to bring about the following developments at the ICDS ANGANWADI Centers, without causing any structural changes to the Centers:

- Renovations of the roof and walls to prevent seepage and make these waterproof

- Repair all the windows and doors
- Completely renovate the toilet, add tiles along with provision of water supply. The toilet also includes a handle to enable better support for the children.
- Build a handwashing station
- Provide a water storage unit so that there is abundant water supply for sanitation and cooking purposes.
- Build smokeless cook stoves that work without electricity
- Painting the entire Center for better appeal and adding colourful images and/or matter that encourage and motivate children to learn as per the BALA (**B**uilding **A**s **L**earning **A**id) model criteria so as to holistically incorporate activity based learning, child friendliness and inclusive education by using the school infrastructure.
- Provide proper TLM kits
- Affix a storage box cum vaccination bed made out of recycled plastic panels and waterproof plywood. This storage box has four chambers out of which three are used by the Anganwadi Sevika to store the TLM materials and the fourth chamber is used by the ANMs (**A**uxiliary **N**urse and **M**idwife) or ASHA (**A**ccredited **S**ocial **H**ealth **A**ctivist) workers for storing their healthcare related materials. All the chambers can be securely locked when not in use. The storage box also has in-built pneumatic supports that prevent the lids from falling on the person reaching into the box. In addition, a privacy screen is also provided to ensure privacy during vaccination programs.
- Organize satisfactory and useful seating arrangement for children
- Create a vertical vegetable garden on the walls near the kitchen
- Include solar lights inside the classroom and toilet

These developments have enabled the ICDS ANGANWADI Centers to become models for change and help children and mothers in those respective communities. Thereby children have higher and better-quality education and health which in turn would result in creating awareness and leadership in reinventing existing programs to achieve their goal. Likewise, it also helps prevent issues such as illiteracy, malnutrition, and pre-mature deaths among children and widespread diseases among mothers.

AWC - Before Renovation

AWC - After Renovation

Many new features in these ICDS ANGANWADI Centers are environmentally friendly products that add to the spin-off benefits of executing this project.

6.2.3 Outcome:

With the tremendous support and permissions given by the Government of Bihar, Beacon AHEAD team started renovating ICDS Anganwadi Centers in Patepur Block of Vaishali district, Bihar since November, 2021.

During the current year of 2022, the following work was successfully implemented:

- ✓ Five model ICDS ANGANWADI Centers (with Center codes 169, 255, 414, 128 and 157) were renovated in Vaishali district, Bihar in 2022.
- ✓ Based on the successful implementation of the renovations, the CDPO of Patepur Block provided a television, battery and power supply provision at the Model Center 255.

- ✓ The TV, Battery and Power Supply are shown at right:

In two of the above Centers (with Center codes 255 and 414) that had adequate space and by seeking separate Governmental approvals, play areas were added with the following features:

- ✓ Boundary wall was constructed along with a gate to ensure added security of the Anganwadi children and the Center.

- ✓ The Play area was fully painted on the inside and outside with colourful pictures of joyful learning and sceneries with stories or animals to encourage joyous and fun environment of learning for the children.

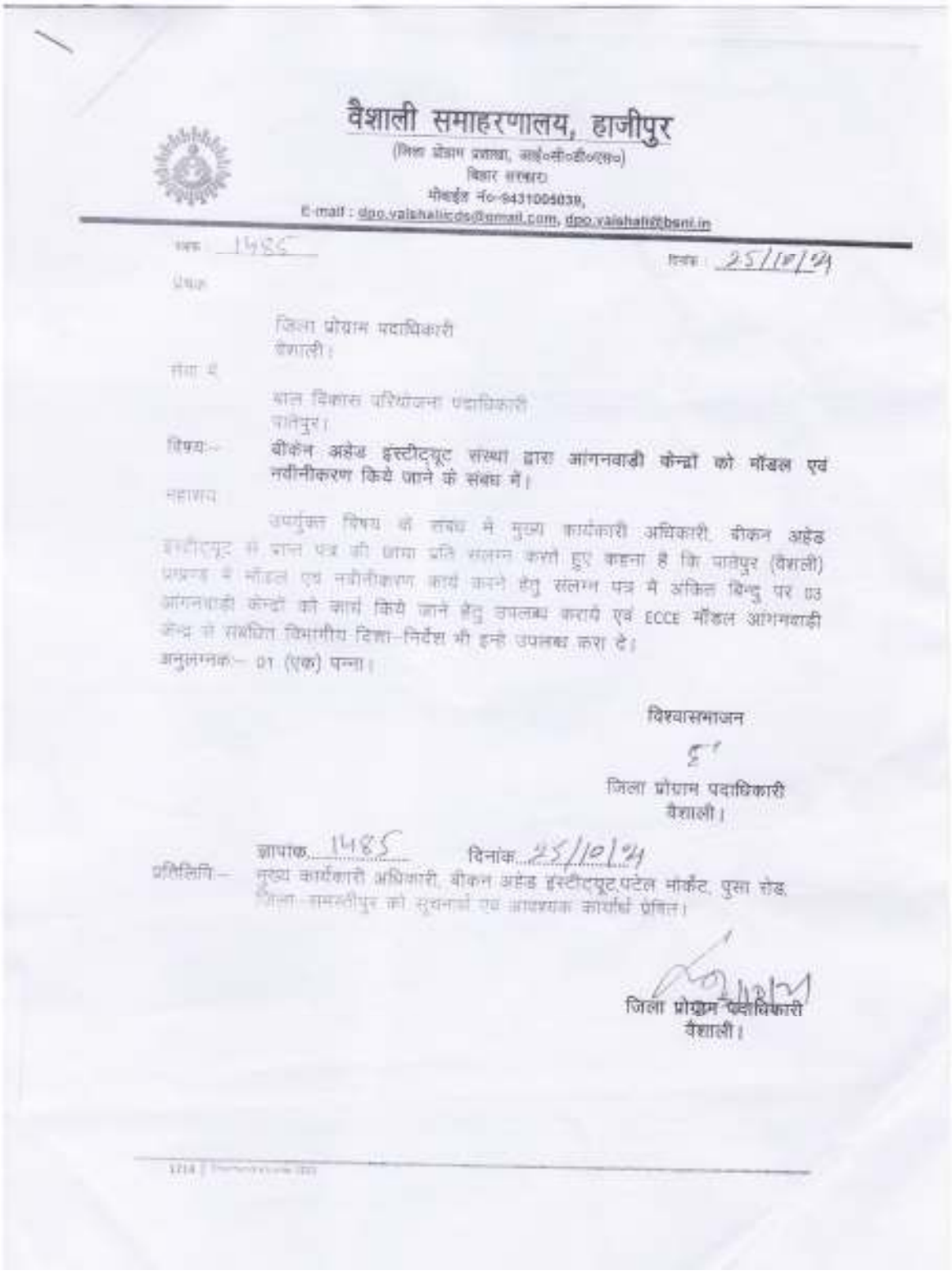
- ✓ Playing equipment such as two swings, slide and seesaw were fixed within the available space of the play area.

- ✓ Small stools pre-cast in the form of Mushrooms were also fixed in the play area so that children would have some where to sit and interact with one another

- ✓ A Garden has been provided by constructing a 3 feet wall half way up the boundary wall on the inside to include greenery so that children have better access to clean air and play in a flourishing environment.

- ✓ Efforts to transform two additional ICDS Centers into Model ICDS Anganwadi Centers are in the offing and it is aimed to be completed by early 2023. Governmental permission to do the same have been sought.

6.3 PERMISSION LETTER FOR RENOVATING ICDS ANGANWADI CENTERS AND ADDING TWO PLAY ZONE AREAS:



वैशाली समाहरणालय, हाजीपुर

(जिला प्रोग्राम प्रशासन, आई०सी०डी०एस०)

बिहार सरकार

मोबाईल नं०-9431004039,

E-mail : dpo.vaishaliicds@gmail.com, dpo.vaishali@bsnl.in

ज्ञापांक 1485 दिनांक 25/10/24

प्रेषक

जिला प्रोग्राम पदाधिकारी
वैशाली।

सेवा में

बाल विकास परियोजना पदाधिकारी
पातेपुर।

विषयः— बीकन अहेड इंस्टीट्यूट संस्था द्वारा आंगनवाड़ी केन्द्रों को मॉडल एवं नवीनीकरण किये जाने के संबंध में।

महाशय

उपर्युक्त विषय के संबंध में मुझे कार्यकारी अधिकारी, बीकन अहेड इंस्टीट्यूट से प्राप्त पत्र की छाया प्रति संलग्न करते हुए कहना है कि पातेपुर (वैशाली) प्रखण्ड में मॉडल एवं नवीनीकरण कार्य करने हेतु संलग्न पत्र में अंकित बिन्दु पर 03 आंगनवाड़ी केन्द्रों को चार्ज किये जाने हेतु उपलब्ध कराये एवं ECCE मॉडल आंगनवाड़ी केन्द्र से संबंधित विभागीय दिशा-निर्देश भी इन्हें उपलब्ध करा दें।

अनुलग्नक— 01 (एक) पन्ना।

विश्वासभाजन

जिला प्रोग्राम पदाधिकारी
वैशाली।

ज्ञापांक 1485 दिनांक 25/10/24

प्रतिलिपि— मुख्य कार्यकारी अधिकारी, बीकन अहेड इंस्टीट्यूट,पटेल मार्केट, पुसा रोड, जिला-समस्तीपुर को सूचनार्थ एवं आवश्यक कार्यार्थ प्रेषित।

जिला प्रोग्राम पदाधिकारी
वैशाली।

6.4 LETTERS OF APPRECIATION GIVEN TO BEACON AHEAD FOR THE SUCCESSFUL IMPLEMENTATION OF TRANSFORMING ICDS CENTERS INTO MODEL ICDS ANGANWADI CENTERS

समेकित बाल विकास सेवा परियोजना, पातेपुर, वैशाली

Mobile No-9431008368, Email: icdspatepur@gmail.com

पत्रांक 274 /दिनांक :- 20 / 07 /2022

To:
Beacon Ahead Institute
Bihar

(Sub: Letter stating the completion of transforming three ICDS Centers into Model Anganwadi Centers)

We are pleased to state that the work done by Beacon AHEAD Institute towards the transforming of the three ICDS Centers (169, 255 and 414) into Model Anganwadi Centers have been highly successful and praiseworthy.

In particular we would like to extend our heartfelt appreciation to Beacon Ahead for including unique and eco-friendly features such as the vertical garden, smokeless chulha, TLM Kit cum vaccination bed with privacy screen made of recycled plastic panels and very interactive teaching learning materials at the ICDS centers. The play area at ICDS Center255 has been done very beautifully and promotes joyful learning as well as a colorful garden space for the children who will study there. The Bala model paintings too have been done well.

Wishing the entire team at Beacon AHEAD, all the best for all their future endeavours.

With best regards,

CDPO
Patepur Block Office
District Vaishali
Bihar

समेकित बाल विकास सेवा परियोजना, पातेपुर, वैशाली

Mobile No-9431005368, Email ID - cdpo.patepur@icdsbih.gov.in, (icdspatepur@gmail.com)

पत्रांक-415 /दिनांक – 02/12/2022

प्रेषक,

बाल विकास परियोजना पदाधिकारी
पातेपुर, वैशाली ।

To:
Beacon Ahead Institute
Bihar

Date: December, 2022

(Sub: Letter stating the completion of transforming two ICDS Centers into Model AnganwadiCenters and adding a play area to ICDS Center 414)

We are pleased to state that the work done by Beacon AHEAD Institute towards the transforming of the two ICDS Centers (138 and 157) into Model AnganwadiCenters have been highly successful and praiseworthy.

In particular we would like to extend our heartfelt appreciation to Beacon Ahead for including unique and eco-friendly features such as the vertical garden, smokeless chulha, TLM Kit cum vaccination bed with privacy screen made of recycled plastic panels and very interactive teaching learning materials at the ICDS centers. The play area at ICDS Center414 has been done very beautifully and promotes joyful learning as well as a colorful garden space for the children who will study there. The Bala model paintings too have been done well.

Wishing the entire team at Beacon AHEAD, all the best for all their future endeavours.

With best regards,

CDPO
Patepur Block Office,
District Vaishali, Bihar

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6.5 FEEDBACK FROM SEVIKAS OF ICDS CENTERS AND TECHNICAL PERSONNEL

6.5.1 Likes:

Based on the feedback derived from the Anganwadi Sevikas (Head of the respective Aanganwadi Center) and the Sahayakas (Helper to the Sevika at each Center) as well as Beacon AHEAD's field staff, the following aspects were features that were most liked at the Anganwadi Centers:

1. The TLM (Teaching Learning Materials) Box is considered to be highly useful as it created a new space provision to not only store the TLM kit but also keep these items safe due to the locking facility of the box when compared to earlier as there was no separate space available exclusively for the Sevika. The Sevikas also really like that there is demarcated space in the box for the requirements of the TLM kit as well as for the ANM's vaccination drives. In addition, the vaccination bed can be used in a multipurpose way as the Sevikas can also use it for resting purposes in case of ill health of the children or herself.

2. Many ICDS centers are in a damaged state. Especially in the Center 157, the entire floor of the Anganwadi center was damaged and it was not possible to continue using this center and there was no seating provision. After the renovations were completed, the Center looks brand new and the children

are now able to study and utilize the center in a much better way. Hence the repairs to the Centers and the carpets provided for seating are considered to be of good quality and help in fostering education to the children in a better and more comfortable way.

3. Initially only Nal Jal connections were available at the Centers and these have timings for water supply. Due to this, there was no water supply available all the time at the Center. But now the Sintex tank has been installed at the Center to store water for 24 hours of usage and this enables continuous water facility available in the toilet and at the handwashing station for the on demand needs of the children.

4. The vertical vegetable and flower garden that has been included in the Aangan (courtyard) of the Center is the most liked feature by the Government Officials as it is useful, the Sevika can grow vegetables for the nutritional meals being prepared for the children at the Center, looks simple but has an intricate installation mechanism to control water flow as well as ensure enough water supply to the plants in the vertical garden. The functionality of water supply that goes step by step in a top down approach and the outlet that drains out excess

water has been designed for a high efficiency of the vertical garden performance and yield.

5. The overall painting of the Centers that has been done as per the BALA model looks unique and very attractive even when seen from a distance. Inside the Centers, the paintings fill up the entire walls and feels like one is entering into a colorful textbook.

6. The play zone are that has been included in Centers 255 and 414 are gaining popularity as many people consider these to be a mini park of their area and come to see it. The swing and the play equipment are so popular among kids that even the students of the neighbouring Government school come and play on these.

On the whole, each and every feature of the Anganwadi Centers are distinct and have in turn made Patepur Block a unique one.

6.5.2 Dislikes:

The preliminary smokeless chulha that was pre-cast on site in the Aangan of the Center was not liked and changes were recommended to it by the Sevikas which were as mentioned below:

- The provision to cook on two burner cookstoves was not always utilized and it occupied too much space.

The direction of the cookstoves often created issues as the Sevikas and the Masons preferred it to be placed or built in a specific direction which was not always convenient in terms of available space utilization and made it inconvenient to use it. In case the Chulha was built to be used in any other direction that was not as per their preference, then such a chulha also would not be used by the Sevikas as it was considered to be a bad omen.

- Height of the Chulha was too high and was difficult for them to sit on the floor and cook or stir the pot.
- Pot support that was provided in the double burner cookstove was meant for flat pots but most of the pots being used were circular which did not fit well on the pot support.

Based on the above mentioned issues, a new chulha was designed and installed at the Centers that:

- ✓ Occupied less space
- ✓ Since the overall size of the chulha was made to be smaller it could fit into any place of choice or placed in any direction as per the needs and preferences of the Sevika be it in the Aangan area or even inside the kitchen. Earlier Chulhas were not built inside the kitchen as there were smoke issues. But in the Centers remodeled by Beacon AHEAD, only smokeless Chulhas that use any wood, garbage waste materials, corn cobs or rice husks can be used as fuel thereby making it more ecologically sustainable.
- ✓ Height was made to be at a convenient lower level
- ✓ Pot support was made to fit pots of flat and circular bases so that it would not be an issue for the Sevikas and the Sahayakas.

6.5.3 Challenges:

At the ICDS Center 255, upon the completion of the pictorial painting for the play zone area and right before the handing over of the Center to the Government, a tractor drove accidentally into the one of the walls of the completed play zone area and damaged it. However, due to the active involvement of the Sevika and the willingness of the tractor driver who agreed and paid for the full repair and repainting of the damaged wall, this challenge was overcome within a short span of time.

At the same center mentioned above, there were instances of theft issues in the community in the past. To overcome these issues, the Sevika with her own determination and dedication, got barbed wire installed covering the whole area of the Aangan, so that thieves could no longer enter into the Center and cause any potential damage to the renovated and remodeled Center.

6.5.4 Needs and improvements:

- ✓ Include a flag post at the Centers that can be useful for flag hoisting on days of National Importance.
- ✓ Provide a fan in Centers where there is a valid electric connection
- ✓ If sufficient funding is available in the future, then means to digitalize Anganwadi Centers can be highly promoted. For digitalization of any Center, the following can be included:
    - ➢ Solar power supply by adding solar panels to the roof of the Anganwadi Centers. But these solar panels should be highly secure to prevent theft that often is a major issue at the Centers
    - ➢ Inverter power backups so that the Center has uninterrupted power supply
    - ➢ Television and Television protection box
    - ➢ Tablet and adequate capacity building of the Sevika
    - ➢ Light and fan provision at the Center
- ✓ According to our technical team, if there was another staff member to help monitor the work at the Anganwadi centers then it will be hugely beneficial. This new person could help monitor better quality of renovation and remodelling work that is taking place at the Anganwadi Centers so that targets of completion can be achieved in a better way.
- ✓ The painter needs a solid base support that he can stand on to do pictorial painting on the full length of the Anganwadi Centers. If you observe the roof of all the Centers, the height in the middle is 11 feet and as it slopes down it gets to be 9 feet by the side walls. The main challenge is that the painter currently uses a table of 3 feet width so that he can do pictorial painting on

3 to 4 feet of the wall at a time. But this table does not have an adequate height which then delays the work of the painter and hinders his efficiency in completing the work fast. He cannot use a ladder because though the ladder would give them the adequate height it would not provide a safe platform for him to stand on and he would not be able to do pictorial painting well enough. It is also hard for the painter and his team to transport this 10 feet long ladder to and from the Centers as they all commute on two wheelers. So there is a need to provide some kind of innovative, foldable platform that the painter can use but it should also be portable enough for them to carry it on a two wheeler.

6.6 WAY FORWARD:

A lot of the ICDS Centers have been adopted by the Mukhiyas in Patepur Block, so these Centers can only be renovated with the fund under Mukhiya or Ward member of the respective areas. Beacon AHEAD cannot renovate these Centers that have been adopted by the Mukhiyas. This has caused a dearth of ICDS Centers in which Beacon AHEAD can choose and transform these into Model Anganwadi Centers. Hence, there is a need to increase coverage and remodel more ICDS Centers in areas such as:

1. Mahua block
2. Samastipur district
3. Nalanda district
4. Patna district

Further funding is also required to do lot of good work in creating many more ICDS Anganwadi Centers.

6.7 CONCLUSION:

Beacon AHEAD endeavours to achieve the following through its efforts in creating Model Anganwadi Centers:

1. Providing Universal Access to quality health services and joyful learning.

2. Giving children best possible chance to survive and thrive.
3. Investing in features and services to enhance health and well-being for children as a basic foundation for better communities.
4. On the whole, the Model Anganwadi Centers signify taking steps towards ensuring better nutrition, health, education as well as Mother and child welfare. Thereby, community development is given a boost combining a four in one sectoral approach.
5. All the above are in alignment with Sustainable Development Goals under Human Development of SDG 3 (Good Health and Well-being), and SDG 4 (Quality Education).

6.8 REPRESENTATION OF BEACON AHEAD'S WORK RELATED TO REMODELING OF ICDS AANGANWADI CENTERS WITH DISTINGUISHED PERSONNEL FROM THE GOVERNMENT OF BIHAR

Meeting with Additional District Magistrate and DPO, Vaishali district, Bihar

ICDS Aanganwadi Center visit by Deputy Collector, Vaishali District, Bihar:

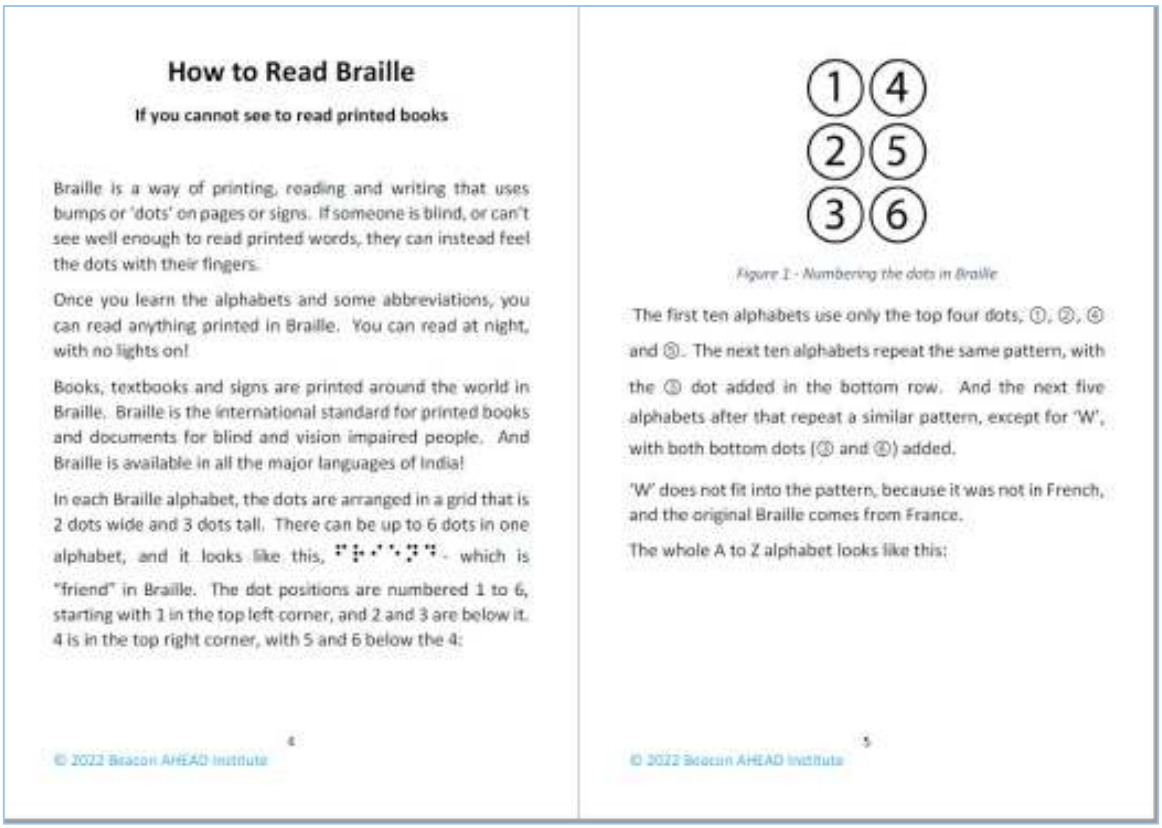
ICDS Aanganwadi Center visit by CDPO, Patepur Block, Vaishali District, Bihar:

7. Innovations for Livelihood opportunities

7.1 BRAILLE – PROGRESS IN 2022:

This year, explored five new areas in Braille education and printing:

1. We edited our educational booklet with mixed English print and Braille. This booklet tells people about Braille, and shows the alphabet and some sample words that are written in Braille dots. We glued together pairs of paper sheets, to make pages of the required thickness for printing Braille. We used a simple press to emboss the Braille dots on each sheet:



How to Read Braille

If you cannot see to read printed books

Braille is a way of printing, reading and writing that uses bumps or 'dots' on pages or signs. If someone is blind, or can't see well enough to read printed words, they can instead feel the dots with their fingers.

Once you learn the alphabets and some abbreviations, you can read anything printed in Braille. You can read at night, with no lights on!

Books, textbooks and signs are printed around the world in Braille. Braille is the international standard for printed books and documents for blind and vision impaired people. And Braille is available in all the major languages of India!

In each Braille alphabet, the dots are arranged in a grid that is 2 dots wide and 3 dots tall. There can be up to 6 dots in one alphabet, and it looks like this, ⠋ - which is "friend" in Braille. The dot positions are numbered 1 to 6, starting with 1 in the top left corner, and 2 and 3 are below it. 4 is in the top right corner, with 5 and 6 below the 4:

4

1 4
2 5
3 6

Figure 1 - Numbering the dots in Braille

The first ten alphabets use only the top four dots, ①, ②, ④ and ⑤. The next ten alphabets repeat the same pattern, with the ③ dot added in the bottom row. And the next five alphabets after that repeat a similar pattern, except for 'W', with both bottom dots (③ and ⑥) added.

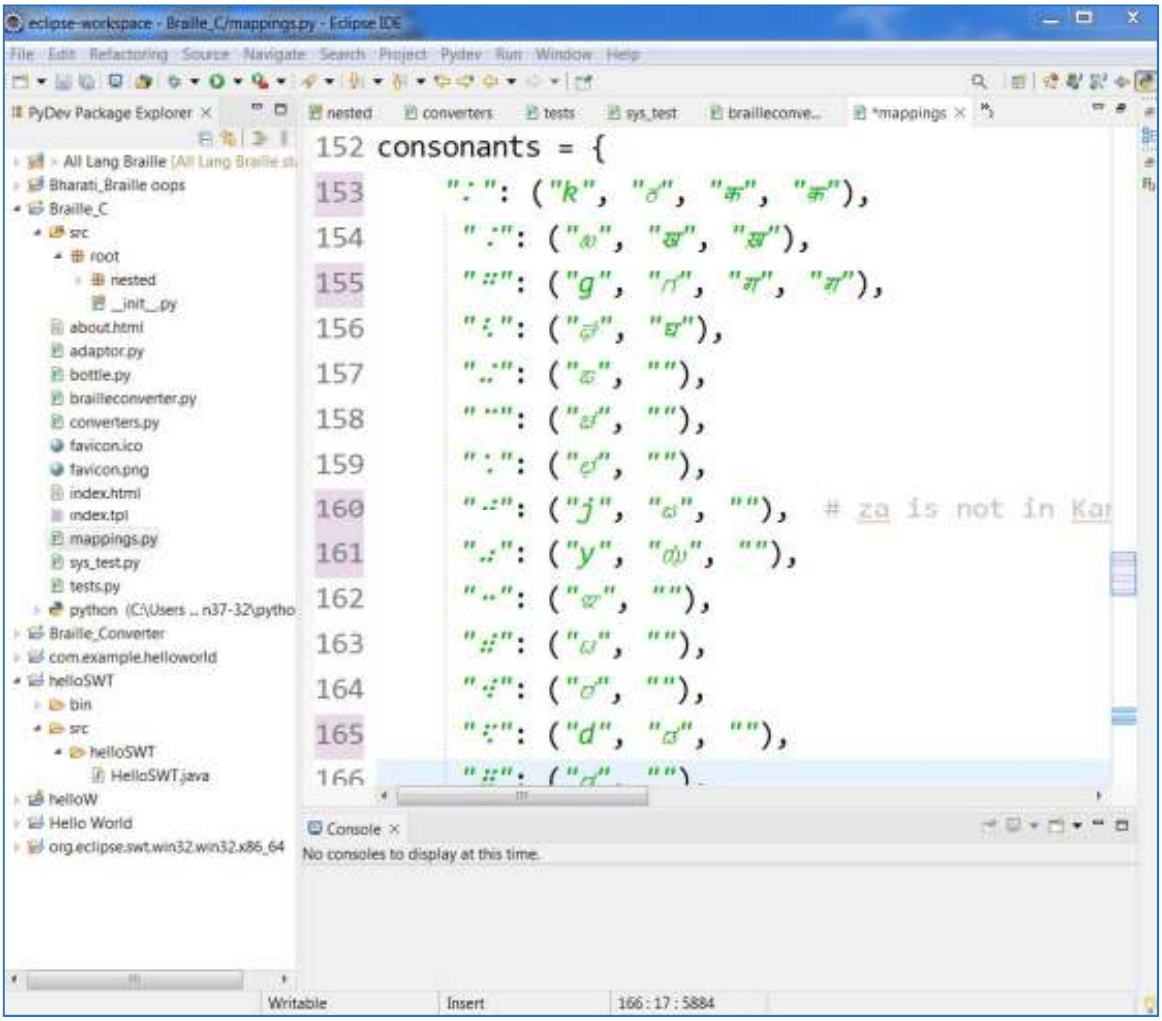
'W' does not fit into the pattern, because it was not in French, and the original Braille comes from France.

The whole A to Z alphabet looks like this:

5

Sample pages from Beacon AHEAD's Braille educational booklet

2. We translated the above educational book about Braille into Kannada. We also developed software for converting Kannada text into Braille in Kannada. There are websites that convert Kannada into Braille, but we found that they had several errors, especially for correctly converting words like ki and kai into Braille correctly. Our Braille software looks promising, as it can convert a document that includes many languages (Hindi, Kannada, English, etc.) as well as numbers in many Indian language scripts, into Braille all at once. This is particularly useful for converting books that contain mainly one language, such as Kannada, but also contain the occasional word written in another language, such as Hindi or English.



Sample of the Braille translation software

3. We developed educational boards, with very large Braille alphabets. The aim of this project was to create extra-large Braille letters to help to teach Braille to very small children or older adults with limited eyesight. There are holes spaced proportionately to Braille alphabets/letters, but 10 times further apart, and we used wooden pegs that are also 10 times larger than Braille dots. When the wooden pegs are placed in the holes, then any of the different Braille letters can be created. Children and older people can feel the shape of the Braille letters, and learn the alphabet this way. The pegs can be removed and new letters and short words can be written in Braille. This can be repeated indefinitely.

4. Similarly, we made educational boards with 10 times larger Braille characters, but this time, we wanted to design the boards for schools and public situations where the wooden pegs might be frequently misplaced. Instead of putting custom-made wooden pegs into the Braille boards, we wanted to use a small round object that could be found easily in any town or village. The ideal hard, smooth round object that we found was dried peas. Dried peas are reasonably round, and very smooth. They have the added

benefit of being digestible, if accidentally swallowed. There is some variation in the sizes of dried peas, so it may be necessary to sieve the peas, to sort out any peas that are too large or too small. Such a sieve could be supplied with the Braille boards, or simply built into the Braille board itself.

Braille Educational board, with dried peas representing large Braille dots
The 8 mm and 9 mm are the diameters of the drilled holes

5. In our pursuit of really affordable Braille printing, we plan to recycle used copy paper to make thick Braille paper. In previous years, we found that we could emboss Braille dots on 'Braille paper' that we made by gluing together two pieces of copy paper. Since it doesn't matter if anything is printed on the paper, as Braille is simply a language made of dots pressed into the page, we look forward to recycling free misprinted pages from printers and copy shops. In our research with printers, we asked about the best glues and pastes to use for joining two pages together. The best paste that we tested was Binding Paste, used in the bindings of books. This paste, if spread thinly and smoothly on the papers, works very well for joining the pages without wrinkles, lumps or stiffness. Binding paste is extremely affordable, readily available, and made from starch.

6. Braille Printer Costs and Impact:
    a. Direction and Cost estimate for improving the machines and products:
        i. Collaborate with Blind schools, Government and organizations that help blind people to have better access to Braille textbooks and storybooks. This Pilot project would be Rs 4 – 5 lakhs Rupees.
        ii. Tie up with entrepreneurs and manufacturers to build these printing machines, and to print books, to further increase jobs and livelihoods.
        iii. We also would like to make the Braille printer an open-source project, so that others can design and make better printing machines. In this way, the project can grow in many ways.
    b. Benefits for the community:
        i. Income generation for household members in the range of Rs. 200 to 1000 per day, by printing Braille on recycled copy paper and gluing together pairs of copy paper to form thicker paper for Braille printing.
        ii. Income generation for manufacturers and maintenance workers in the range of Rs. 1 to 2 lakhs per year, making and servicing these Braille printers in India.
    c. Costing:
        i. Link up with Micro-finance and other groups to help low-income people and/or entrepreneurs to purchase the printing machines from local manufacturers for Rs. 4000 or less.
        ii. This would include training, support, and machine maintenance.
    d. Impact:
        i. Improved literacy and education for blind and vision impaired children.
        ii. Enable blind children to have access to inclusive and quality education and inspire them to have creative imagination.
        iii. Providing better and affordable means for Schools and Anganwadi Centers to have Braille education textbooks for the blind children.
        iv. Income enhancement for poorest of the poor families
        v. Effective utilization of recycled paper products;

vi. Improving social status for the poor families;

vii. Avoiding migration to the cities, etc.

All the above are in alignment with Sustainable Development Goals under Human Development – SDG 4 (Quality Education).

7.2 BICYCLE TRAILER

Another new project for 2022 was to design and build bicycle trailer prototypes. A low-cost, strong bicycle trailer can be useful to people in many ways:

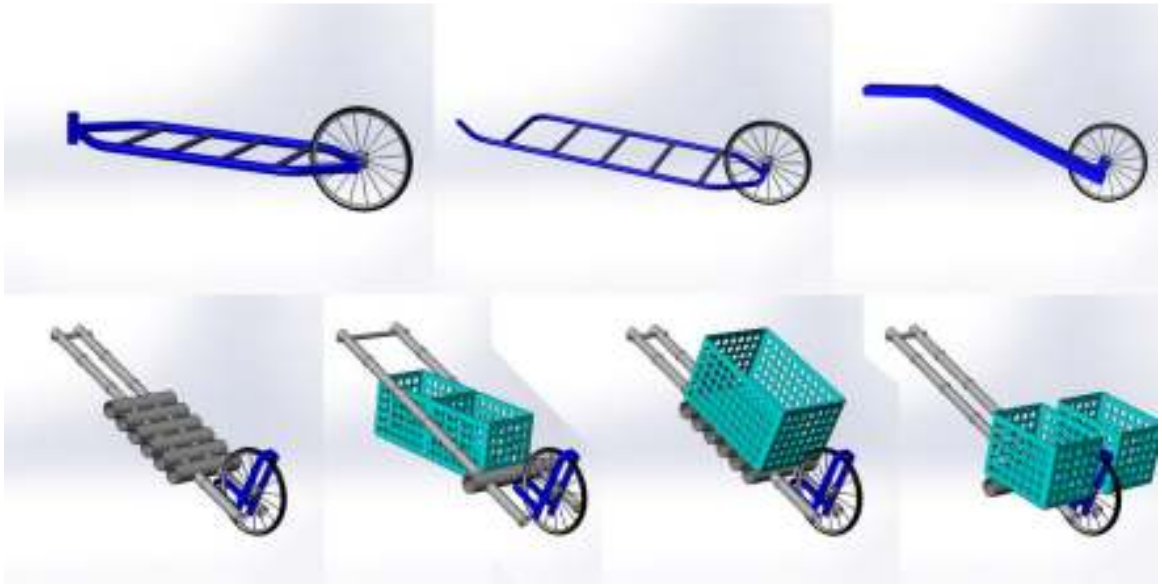
1. Many people are able to afford to buy a bicycle, and a trailer would allow them to carry much more goods with them, such as rice and wheat from the ration stores.
2. Several ladies commented that they would like the bicycle trailer in the form of a shopping cart, so that they could bring home their groceries and supplies easily, even if they don't have a bicycle.
3. The bicycle trailer should fold flat when not in use, so it can be stored in a small place or hung on the wall, out of the way. Many people have less space at home, so having the benefits of a trailer or shopping cart, plus the advantage of less storage space required would be very useful.

Beacon's first folding trailer prototype for bicycles

4. A bicycle trailer could help to provide a better livelihood, in terms of delivering or taking away goods and materials. Cycle rickshaws can be used for these purposes, too, but rickshaws are more expensive and take up more space for parking.
5. In terms of the design and materials, we selected 16 inch diameter bicycle wheels for the first bicycle trailer prototype. These wheels are a readily

available common size, so they will be easy to repair, and they are small enough to help to keep the trailer affordable and foldable, but large enough diameter to go over most bumps in the road. The body of the trailer prototype is made from water-resistant plywood that has been painted with Touchwood polish to help seal all the edges.

6. We also looked at other design options, such as bamboo (incredibly strong and resilient), pipes and plastic boxes for making bicycle trailers. As time permits, we will make more trailer prototypes, to explore which designs would be best for livelihood projects (making trailers, as well as delivering goods in trailers), and which trailer prototypes perform the best in real world conditions (rough roads, rainy weather, etc.) Since space and cost are always big concerns, and the bicycle wheels are one of the costly parts of the trailers, we looked at one-wheel trailer designs, too. With one-wheel trailers, we don't want the trailer to tip over, so we would connect the trailer securely to the bicycle at the seat post or at the rear frame, so that the trailer can move up and down and side to side, and it is always vertical relative to the bicycle. Below are several Bicycle Trailer designs that we are developing:



Designs of Bicycle trailers with one wheel, with metal (dark blue), bamboo (grey) and plastic (light blue) parts

7. Bicycle Trailer Costs and Impact:
    a. Direction and Cost estimate for improving the Bicycle Trailers:
        i. Collaborate with bicycle shops, Government and organizations that help people to have better livelihoods (through delivering goods). This Pilot project would be Rs 2 – 4 lakhs Rupees.

ii. Tie up with entrepreneurs and manufacturers to build these bicycle trailers, to further increase jobs and livelihoods.

b. Costing:

i. Link up with Micro-finance and other groups to help low-income people and/or entrepreneurs to purchase the bicycle trailers from local manufacturers for Rs. 4000 or less.

ii. This would include training, support, and maintenance.

c. Impact:

i. Improved ease of transporting goods and taking home groceries and other shopping.

ii. Enable people to have access to a delivery livelihood.

iii. Income enhancement for poorest of the poor families

iv. Improving social status for the poor families;

v. Avoiding migration to the cities, etc.

d. Benefits for the community:

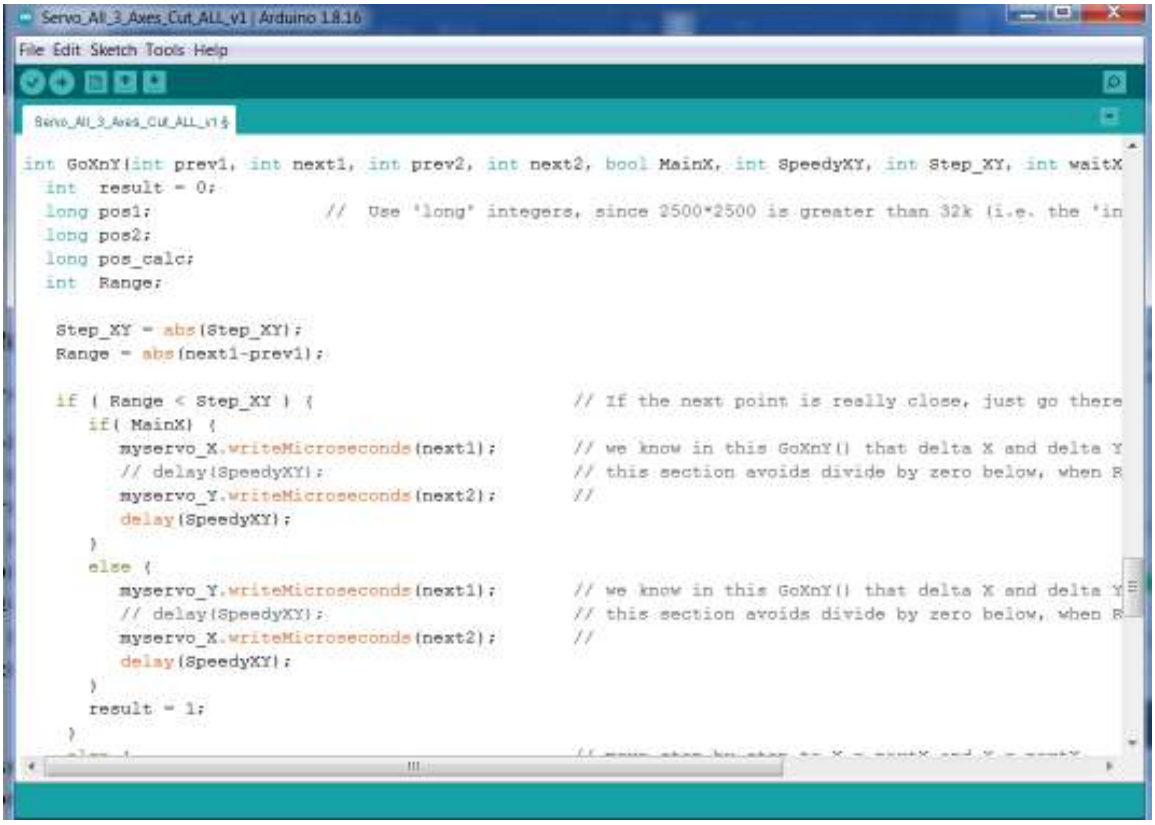
i. Income generation for household members in the range of Rs. 500 to 1000 per day, by delivering materials and goods in the community.

ii. Income generation for local small manufacturers and maintenance workers in the range of Rs. 1 to 10 lakhs per year, making and servicing these bicycle trailers in India.

7.3 CARVING MACHINE for COCONUT SHELLS

In 2022, we made several improvements to our second-generation coconut carving machine:

1. We developed a simple way to program the way the carving machine turns the coconut and lifts and lowers the cutter into the coconut. To avoid expensive laptops for each coconut carving machine, we are using tiny computers, such as a single-board computer, also known as an 'SBC'. These SBC's, such as Arduinos, keep these carving machines simple to use and affordable. We wrote software for the SBC that moves the machine to successive positions in a data array. This way the program is very small, basically a loop of moving the machine back and forth, as it steps through the data array. By separating the software into data and control sections, the program is compact enough to fit into the memory of the smallest and least expensive SBC.



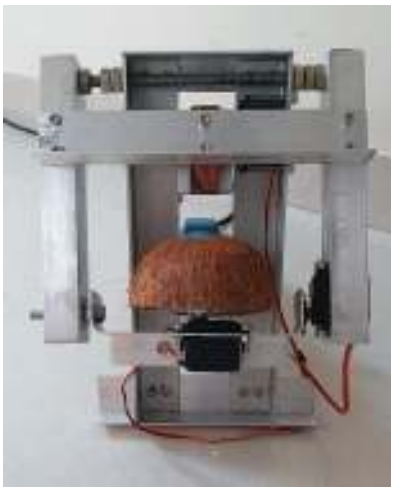
Sample of the software that runs in the SBC

2. We sourced several other SBC's, to ensure that we develop the Coconut Carving machine to be independent of one kind of SBC, such asArduinos, so that we are not dependent on the availability or price of that SBC. Both the NodeMCU and the Raspberry Pi Pico (below) are very affordable SBC, and they have considerably more memory (RAM) than Arduinos, which is helpful for storing longer and more complicated carving patterns. Therefore, these SBC alternatives look really promising:

3. The new Coconut carving machine is really promising, too. We are designing a depth stop, so that the carving of the coconut shell can be stopped and restarted many times, for example when there are power

outages, and so that the carved patterns will have a more consistent cutting depth and will therefore look neater and more accurate:

Side view of Coconut Carving machine



Front view of Coconut machine

4. Cost Estimates for potential projects related to coconut carving machines:
    i. Cost estimate for developing coconut carving machines for replication: Rs. 4 to 5 Lakhs for product refinement and user-satisfaction testing, in partnership with community-based organizations in Bangalore, Hyderabad and Bihar.
5. Benefits for the community:
    i. Income generation for household members in the range of Rs. 500 to 3000 per day, by making beautiful carved coconut shell products.
    ii. Income generation for manufacturers and maintenance workers in the range of Rs. 1 to 2 lakhs per year, making and servicing these computerized carving machines in India.
6. Cost estimate for improving the machines and products:
    i. Tie up with entrepreneurs and manufacturers to build these machines, to further increase jobs and livelihoods.
    ii. Link up with Micro-finance groups to help low-income people and/or entrepreneurs to purchase the carving machines from local manufacturers for Rs. 11,000 or less.
    iii. This would include training, support, and machine maintenance.
    iv. We also would like to make the machine and programming it, an open-source project, so that others can design better machines and interesting new products that can be made with these machines. In this way, the project can grow organically.

7. The Impact of this coconut shell carving project is:
    i. Income enhancement for poorest of the poor families
    ii. Effective utilization of natural products. Instead of wasting the coconut shells, transforming them into an income generating product.
    iii. Improving social status for the poor families;
    iv. Avoiding migration to the cities, etc.

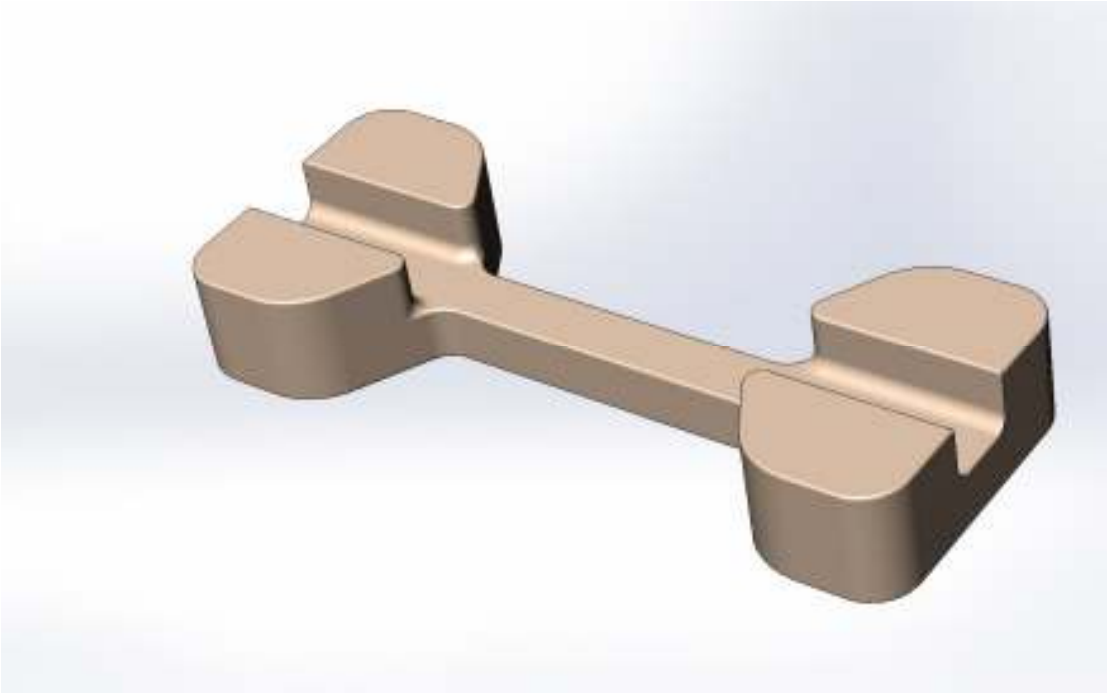
7.4 PANTOGRAPH COPY CARVING MACHINE

1. We also built a prototype of a simpler carving machine, using locally available materials, such as a trimmer router, wood boards and nuts and bolts. Like the coconut carving machine, this Pantograph machine can carve repeated shapes with a trimmer router. However, in this case, the machine is much simpler, without any computer or motors. In this 'Panto-Router', a template is provided, at double the scale of the desired carved piece. With a very small amount of training, anyone can trace the Panto-Router's indicator around the template, while the router carves a piece of wood, bamboo, coconut shell, etc. The advantages of this machine over the CNC Coconut Carving machine is that the Panto-Router is simple to maintain, and easy to restart if the power goes out in the middle of cutting one piece. It's also easy to switch templates, so the person using the machine can decide how many of which parts to cut, and change the templates independently. In the photos below, the blue piece is the Trimmer Router, a motorized cutter that spins different shaped cutting bits. In the second photo (below right), a sample cut is shown: an etching of two letter 'J's and an oval:

Top View of Panto-Router

Front View of Panto-Router

2. As a livelihood project, we plan to train people in villages to make Panto-Routers and templates to sell to others. In this way, a good livelihood can be made by making useful machines that can help others in the community to create craft products and useful household items, etc. As an example, a three-dimensional phone holder can be carved from wood:



3. Cost Estimates for potential projects related to Panto-Routers:
    i. Cost estimate for developing Panto-Router machines for replication: Rs. 1.5 to 2 Lakhs for product refinement and user-satisfaction testing, in partnership with community-based organizations in Bangalore, Hyderabad and Bihar.
4. Benefits for the community:
    i. Income generation for household members in the range of Rs. 500 to 2000 per day, by making beautiful carved wooden and bamboo products.
    ii. Income generation for manufacturers and maintenance workers in the range of Rs. 1 to 1.5 lakhs per year, making and servicing these computerized carving machines in India.
5. Cost estimate for improving the machines and products:
    i. Tie up with entrepreneurs and manufacturers to build these machines, to further increase jobs and livelihoods.

ii. Link up with Micro-finance groups to help low-income people and/or entrepreneurs to purchase the Panto-Router machines from local manufacturers for Rs. 5000 or less.

iii. This would include training, support, and machine maintenance.

iv. We also would like to make the Panto-Router an open-source project, so that others can design better machines and interesting new products that can be made with these machines. In this way, the project can grow organically.

6. The Impact of this Panto-Router carving project is:

i. Income enhancement for poorest of the poor families

ii. Effective utilization of natural products. Instead of wasting small wooden and bamboo pieces, transforming them into an income generating product.

iii. Improving social status for the poor families;

iv. Avoiding migration to the cities, etc.

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