Solar-powered floating schools in flood-prone Bangladesh: An inclusive and sustainable solution towards greater equality

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Abstract: One fifth of Bangladesh floods annually during the monsoon season, but extreme floods cover up to two thirds. In recent years, the flooding has become more severe. During the monsoon period, thousands of schools are forced to close, and many children miss school days. Due to socio-cultural norms, the majority of rural adolescent girls are faced with the reality of early marriage that restricts their access to schooling. Shidhulai Swanirvar Sangstha came up with a creative solution to these problems and introduced 'floating schools' to the students in 2002. The idea was to 'combine a school bus with the schoolhouse, and use the local boat to create a floating space' to ensure access to basic education at doorsteps. The school-boat first serves as a school bus, collecting children from riverside stops; then it docks and class begins. The boat is solar powered, allowing the school to have an internet-linked computer, which makes learning more interactive and easier for children from disadvantaged backgrounds. The organization also runs a fleet of boats that serve as libraries and adult education centers, where parents and villagers receive training nutrition, health and hygiene, sustainable farming and adaptation to climate change. The boats use a blended approach of face-to-face and technology integrated learning. To combat discrimination and unequal opportunities for women, boats teach girls on additional skills and their rights to education, choices and opportunities, prevention of child, early and forced marriage. The project encourages parents to send girls to schools, while raising awareness on women's decision making power and mobility, and increases capabilities of disadvantaged young women for better livelihoods and economic opportunities. This paper is discussing the floating school case study, sharing the origin, concept, achievement, challenges and replications in other flood-prone regions where they are having a transformative impact upon education and communities.

1. Introduction

Almost 80 percent of the total area of Bangladesh is prone to flooding (NCDO, 2012). Experts say that by 2050, the country could lose 16 percent of its land to floods, and as many as 20 million people could be left with nowhere to live (IPCC, 1990). Not only do floods cause the loss of lives and livelihoods, it also severely interrupts children's education. In 2007, about 1.5 million children or 10 percent of the primary schools were affected by floods (IRIN, 2007). This worsens the already high number of out-of-school children in the country, now at 4 million (UNICEF, 2015). Schooling opportunities are very limited for the extreme poor, children with disability, and for those living in hard to reach areas, particularly in the flood-prone areas. Here land based schools struggle against floods and riverbank erosion. River is known as the 'destroyer of establishments' in the local community and the school buildings hit by the river have to relocate to safer ground (IRIN, 2007). Dr. Pascal Villeneuve, the UNICEF representative for Bangladesh, said, "Making sure that schools are resilient against natural disasters should be a priority for any disaster risk reduction preparedness and planning. We know from experience, getting children back into a school environment as soon as possible is the best way to help them recover from the shock and destruction of a natural disaster" (NYT, 2013). The floating school reduces the demand on school infrastructure such as buildings in flood-prone areas and ensures education during the monsoon season.

Barriers to education for girls are particularly high due to socio-cultural norms. Bangladesh has the second-highest rate of child marriage in the world (HRW, 2014). Majority of rural adolescent girls are faced with the reality of early marriage and dowry. It restricts their access to schooling, social and cultural participation. Roughly 10 million primary school aged girls (6 to 10) are in the country, but still 1.5 million girls are out of school (UNICEF, 2012). Girls' school dropouts are common, with girl's primary school completion rates at 37 percent (UNICEF, 2003). Over one third of girls are married before the age of 15, and 66 percent of girls are married before the age of 18 (UNICEF, 2015). One third of teenage girls aged 15 to 19 are mothers or are already pregnant (UNICEF, 2015). Adolescent mothers are more likely to suffer from birthing complications than adult women. The floating library and training centers develop the skills of those who are currently married (victims of child marriage) and unmarried women (at risk of early marriage), so that they become empowered and productive citizens in adulthood.

2. The study

2.1 Situation in flood-prone Chalanbeeel

Shidhulai Swanirvar Sangstha targets landless people in the flood-prone Chalanbeel regions of Natore, Pabna and Sirajganj districts in the northwestern Bangladesh. Road access is very limited in most parts of the project areas and boats are the only means of transport. These villages have no electricity, no telephone lines, limited access to education and information, and have very basic sanitation. Here many people have no land with which to support themselves. People only get one crop in a year and depend on fishing to supplement income and food supply. Communities live along rivers or canals are mostly the landless, and work as day laborers. The school is far away from these villages and does not have the capacity to accommodate the students from neighboring villages. As it is a low-lying area, roads to schools get flooded in the monsoon, when rivers rise as much as 4 meters, or 12 feet (NYT, 2013). Also some schools remain under floodwater for months. The flood prevents students from attending classes. This often results in school dropouts.

2.2 Project genesis

Mohammed Rezwan, the organization's founder and executive director, grew up in the country's northwest, where his organization operates. He seldom missed school days as a child - he used to go to school on a family boat during the flooding. But many of his friends were denied education. He wanted to do something about this and came up with a creative solution to the problem of extreme flooding and designed 'floating schools'. He thought if children couldn't come to school, then the school should come to them. He founded Shidhulai Swanirvar Sangstha in 1998, when flooding inundated two-thirds of the country, killing 700 people and leaving 21 million homeless (NYT, 2013). Only 22 at the time, he had no experience in fund-raising. But he searched the Internet for organizations that could help him and submitted proposals. His first floating school was introduced in 2002.

2.3 The concept - indigenous innovation

Rezwan's idea was to 'combine a school bus with the schoolhouse, and use the traditional wooden boat to create a floating space' to bring primary education at the doorsteps. The school-boat has an open space, classroom and book library. It is about 15 meters long and 3 meters wide - or about 50 feet by 10 feet - with main cabins that can fit 30 children and a teacher. Weatherproof roofs can withstand heavy monsoon rains and are supported by arched metal beams instead of columns, which would obstruct the classroom. Large roof overhangs in the front shelter the sitting area from sun and rain. The wall inclines to the exterior that holds the curved roof gives the boat a sculptural form. Viewed from the riverbank, the community members see the school-boat as 'river turtle' (Rezwan, 2014). The boat is built with environmentally friendly materials including wood and bamboo. The school-boats' performance and durability were considered for selecting the woods. Sal or Shala tree (Shorea Robusta) is used for the hull construction. The construction details are based on the wooden boat-building heritage of the northwestern Bangladesh.

2.4 The floating schools

The school-boat collects students from different riverside villages and finally docking at last destination the boat arranges onboard class. After the class the boat drops students at their places and then move forward to pick other groups, again it arranges an onboard class and after the class it drops students in their villages, and boat moves forward for other groups. This is the way the school works throughout the day and arrange 3 classes. It has a classroom for 30 students, an internet-linked laptop/computer, book library and electronic resources.

Solar power enables school to provide late evening class to the working children. So when school is done, many students take home the recharged Surya-hurricane solar lanterns (an innovative low-cost solar lantern made from recycled parts of the conventional and much used kerosene hurricane lantern) to provide hours of light in their homes at night. The students having good exam results are only eligible to receive the Surya-hurricane solar lanterns as scholarships. It is re-charged twice a week at the re-charging station on the boat or at home by 10 Wp solar panel.

Floating schools provide basic primary education up to grade IV. It introduces the first river-based environmental curriculum in the country that teaches how to protect the environment and conserve water. The school provides education six days a week. Educational materials are given free to the students. About 1,810 students are now studying on 22 school boats (SOWC, 2015).

Library boat has complete facility of a standing library, for example, 1,500 books, 2-4 computers with Internet access, printer and mobile phones. Children, youths, senior citizens, and particularly women learn computer skills, send receive emails, and get information on job opportunities, exam results, government process and services. There are two-tier boats that have a classroom and library in the lower deck. A circular bench is designed for the classroom considering the teacher and student bonding. The upper-deck provides the training space for the community, and also used as informal gathering space for the school. Therefore, on these boats, it is common to see children getting lessons on the lower deck and parents are learning sustainable farming techniques on the upper deck at the same time.

The solar powered training boats are equipped with laptops, multimedia equipment and educational presentations, and make their ways through the rivers, docking at villages the boats teach farmers nutrition, health and hygiene, women rights, sustainable farming and adaptation to climate change. The boats utilize in-house developed content, including web tutorials, presentations and documentaries. The video conferencing on the boats facilitate a conversation between scientists and farmers about effective agricultural practices and climate change. 30 people are trained during each training session. In the evening educational programs are arranged on large sail cloth, so that many people can see from their own courtyards. About 300 people attend each evening show at the riverbank.

Also the fleets of solar-powered library and training boats train girls and young women on additional skills to increase their capabilities, and end the cycle of child, early and forced marriage in the remote communities. The Commonwealth of Learning (COL) has partnered with Shidhulai Swanirvar Sangstha to provide skills development to some of the country's most vulnerable and hard-to-reach girls (COL, 2016).

2.5 Methodology

A comprehensive but mixed checklist was developed to evaluate the impact of floating schools for creating access to education in flood-prone areas. The study methodology was developed including following steps:

- All necessary documents and project tools were reviewed by the author. The documents include study reports, project proposals, survey reports, household profiles, monitoring reports, policy documents and training manuals.
- A detailed field study plan was developed.
- To gather information a list of research questions were formulated in the form of checklist.
- Ten floating schools, five floating libraries and three floating training centers were selected at random.
- The community members, service providers and other stakeholders were consulted using focus group discussions (FGD), key informant interview (KII), direct observation method, in-depth interview (IDI), formal and informal discussions.
- Discussion sessions with project staffs were conducted to understand the staff skills, capacity, strengths, weakness, and role of staffs.

The data was collected in July 2016 and August 2016 in Natore and Pabna districts, Bangladesh by the author and his four colleagues at the Shidhulai Swanirvar Sangstha. Interviews were conducted in Bangla. All the participants gave their verbal consent for using it for research purposes.

3. Findings

3.1 Social and economic impacts

During the visit to the school-boats, it was found 97 percent students were present in each class. The waterproofing roof helps that school to ensure the continuation of education during the monsoon season. The curriculum encourages children to come to school – it is student focused, interactive, and interesting. According to attendance register 97 percent students attend class regularly. 96 percent of students interviewed seem to be feel proud as they were students of floating school, because they learnt many new things including operating computer and drawing picture, watching educational cartoon show (for example Meena), using solar lanterns, also the school came to their home and they didn't have to go far to study, and teachers were very caring etc. The schooling schedule is flexible because of solar lighting and sometimes schooling is arranged in the evening. 33 percent of students interviewed reported that the school-boat saved valuable time for them as it offered schooling as per their work schedules.

Teachers are oriented on learner centered method or child centric approach. At present 66 teachers are involved with teaching on school-boats and all of them are female. In terms of educational qualification among the interviewed teachers 74 percent up to SSC level, 20 percent up to HSC level and 6 percent up to BA level. All of them received foundation training after joining, and then monthly trainings on curriculum and teaching.

In a deeply conservative society such as Bangladesh, culture restricts the mobility of girls and women. The unique approach of the project addresses these barriers. Boats provide maximum flexibility and reach villagers that, for logistical, social, or cultural reasons, cannot access a permanent institution. Girls and women now take full advantage of the education and information facilities delivered right to their doorsteps. The proximity of the facilities allays the concerns of their parents and guardians. Students now can borrow the books from the book library of the boats, which inspires them for higher education. The neo-literates who used to relapse in to illiterates are now in touch with education using the educational resources of book library. 93 percent people are informed about reproductive rights, prevention of domestic violence and early marriage. Because of onboard human rights training and rights reporters' meetings early marriage is stopped in the villages the boat operate.

The PowerPoint and videos provided visual presentations of information that helped illiterate parents, girls and women to easily understand the topics. Women participation in the trainings was remarkable. About 86 percent participants were women. They said that, they shared the lessons with their parent/ husband/ neighbors and also practiced the knowledge. Participants were well oriented on sustainable agriculture issues like flood resistant sugarcane and rice variety, floating farming, carpentry and boat building, sewing and embroidery, etc. 53 percent of the respondents received agricultural inputs, solar system, duck and fish with feed support from the organization. 85 percent of women interviewed reported involvement in family and community decision-making process.

Villagers are self-organized to address local problems such sanitation and clean drinking water. The sanitary latrine usage is increased by 90 percent among the respondents. The project has provided practical advice and education that is helping the villagers learn to help them. 79 percent of the respondents reported an increase in knowledge on the flood adaptations including growing the flood resistant crops. 70 percent of the respondents reported an increase of agricultural productivity and annual income. The trained parents and farmers have been liberated from the extra time spent in agricultural fields. Now they can engage themselves in other income generating works during the monsoon. 71 percent of the respondents reported that their family heads did not migrate during the monsoon. 100 percent of the respondents reported that they could afford 3-meals per day. 57 percent of the respondents reported that they had home improvements etc.

Using solar energy to re-charge SuryaHurricane lanterns for off-boat use extends the range of services that school-boats can offer. 10 percent of floating school students interviewed reported that the solar lantern provided their families with high-quality light in the evening for them to study and their mother to do craftwork to earn extra income. They also save the cost of kerosene, and eliminate the pollution and fire risk of using a kerosene lamp.

The floating training center works as a help line for farmers. 53 percent of the respondents reported that they consulted with trainer by mobile phone or in person visit on boat in case they faced any field problems. 9 percent of the respondents reported that they consulted with agriculture expert through onboard video conferencing in case the trainer failed to give solution.

3.2 Lessons learnt

- The project reduces the demand on school infrastructure such as buildings in flood-prone communities.
- Traditional country boat is not spacious to accommodate the space required for a school, library or training facility, therefore, only designed boat can offer onboard education/training.
- The school-boats are built with the Sal or Shala tree (Shorea Robusta), which is durable and has the natural chemicals to prevent rot. The interview with organization's boat builders suggested that it would give the boat a life span over 50 to 100 years.
- Only 40 percent of rural households have access to grid electricity (World Bank, 2013). The organization used generators to run the onboard computers that were costly, noisy and polluted the air. Since 2006 the boats have been using solar photovoltaic modules to generate all the electricity needed for the lights, computers and multimedia projectors. The project also introduced the Surya-hurricane solar lanterns so that the children can study at night.
- Introducing Internet on the boats proved to be a daunting challenge. Initially, the organization used the data-fax enabled mobile systems along with high-gain antennae to transmit signals from the boats. Later the system was upgraded with high-speed data cards that use the wireless network. These cards are used at the USB ports.

3.3 Recommendations

There is an overwhelming education and training need among the people living in the flood-prone communities. They deserve more and continued assistance from Shidhulai Swanirvar Sangstha. Considering the present and future needs, it is recommended that the organization should introduce more school-boats, provide more training and agriculture inputs to the landless and poor families. The recommendations are:

- On average 1,307 people live in each village, the average size of household is 4.11, about 39 percent are children (age 0-17 years) and 13 percent of total population is school-aged children. Therefore many parents want their children to get enrolled in the floating school. Following the student selection criteria and discussions with the villagers, the staff finalized a list of 90 students per school-boat. Therefore the organization should consider scaling up its' floating school program, to reach more target groups.
- Some school-boats were developed under 1-year project, later the project activities were sustained from organizational own funds. The organization should explore developing 3 to 5 years school-boat project for creating sustainable impacts.
- More agriculture inputs should be provided to the parents and farmers, so that they can practice the knowledge received. At the same time the strategy for creating effective market access should be considered.
- The girls and women receiving skills training should receive small grants from the organization to start their own business.

3.4 How to replicate a floating school

The floating school is very easy to start - build a boat, equip it with books and computers, power it with solar energy, and bring it to communities through the waterways. The work can be replicated not only in any river-based community, but there are aspects of it - solar lamps, solar system, locally developed contents and integrated floating farming - that are applicable anywhere. Gordon (2006) describes crucial initial steps in a successful school-boat replication are:

- First and most important, one has to find the right person to direct the program - someone who has the right combination of technical skills and people skills, and who knows the replication site well.
- Second, the replication should emphasize on the use of local materials and personnel (for example, wooden boats should be built by trees that are native to the area).
- Third, Shidhulai Swanirvar Sangstha should stay involved with the replication long enough to be sure they get off to a healthy start.

Conclusions

The lives of more than 2.8 billion people worldwide were disrupted by flooding between 1980 and 2009 (Patz, 2014). Ten percent of people worldwide live less than ten meters above the sea level and in a high-risk zone for floods – about 75 percent of them live in Asia (WV, 2008). By bringing school to the children even when the monsoon rains have drowned all the earthen roads, the floating school greatly increases access to education, particularly for the girls, who may not have been allowed to travel distances to school. With many more coastal areas facing rising water levels, school-boat is a compelling idea - a leap into a sustainable future (Gelfand, 2010). The 'floating school' model has spread across the world including Nigeria, Zambia, Cambodia, Philippines, Vietnam, Pakistan and India, and having transformative impact upon education and communities in flood-prone regions (BDRC, 2012 and Mashable, 2015).

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