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## ABSTRACT

*Shidhulai Swanirvar Sangstha, a national research and development organization in Bangladesh, reaches poor, marginalized waterside communities by a fleet of 88 flat-bottomed boats, all made with locally available materials. The boats make their way through the hundreds of rivers and canals of northern Bangladesh to bring a range of educational services and renewable energy supplies to 87,000 families. All 88 boats use solar photovoltaic (PV) modules to generate all the electricity they need to provide daily classes in primary education for children, libraries, training in sustainable agriculture, health advice, mobile phone and Internet access, and battery-charging facilities. Shidhulai has also provided villagers with portable solar home systems and bicycle-operated pumps, each sufficient to irrigate half a hectare of land. The project protects bio-diversity, saves thousands of litres of fossil fuel each year, maximizes agricultural productivity and improves the quality of life for thousands of landless-marginal farmers. The project has been replicated by local community-based organizations elsewhere in Bangladesh and in India and West Africa. Certain steps need to be followed for successful replication of Shidhulai's model; if followed, the project is capable of being successfully extended amongst populations of other waterside communities, particularly in Southeast Asia.*

## INTRODUCTION

The remote Chalanbeel region of northern Bangladesh is difficult to access by road, and most travel is by boat. Many people have no land with which to support themselves and no access to education, training or modern energy supplies. Shidhulai Swanirvar Sangstha has overcome the challenge that the ecosystem of Bangladesh poses and has found an innovative way of delivering information technology to communities in this region. This has helped change their lives and has benefitted the environment. Shidhulai brings education, libraries, training in sustainable agriculture, health advice,

mobile phones and Internet access to the people by boat. Electrical equipment such as lights, computers and multimedia projectors are used to deliver these services, and the boats use onboard solar photovoltaic (PV) modules to generate all the electricity needed. On some boats the PV supply is mainly used to charge batteries for the portable solar home lighting systems that Shidhulai has supplied to families. To supplement the agricultural training, Shidhulai also provides bicycle water pumps, and makes micro-enterprise training available. Through the work of Shidhulai over 87,000 families benefit from improved education, a greater understanding of sustainable agriculture practices, clean solar-powered lighting and communication with the outside world.

## THE CHALLENGES

### *Basic Statistics on Bangladesh*

Population (2004)	139.2 million
Rural population (2004)	75.3%
GDP per capita USD\$ (2004)	\$ 406
Population living on less than USD\$1 a day (2004)	36%
Population living on less than USD\$2 a day (2004)	82.8%
Annual CO2 emissions per person (2003)	0.3 tons
Average daily per capita calorie supply (1999)	2201 kilocalories
Children underweight for age 5 (2004)	48 %

Bangladesh is 10 metres above sea level, located on the Bay of Bengal in the delta of Ganges, Brahmaputra and Meghna (GBM), and constitutes about eight percent of the combined catchment area forming the largest delta in the world. Over 92 percent of the annual runoff generated in the GBM catchment area flows through the country, which is the third highest in the world, after the Amazon and the Congo River systems. Bangladesh, with ninety percent of flood plain land, has the world's highest density of rivers per unit of area, and remains seasonally submerged. Climate change has increased the flooding in recent years, submerging one-fifth of the country during five months of monsoon every year.

### *Statistics on Communication in Bangladesh*

Paved roads	15,603 km
Earthen roads	1,89,679 km
Length of inland waterways	24,000 km
Passengers carried by waterways p.a.	87.80 million
Goods transported through rivers	50%
Passengers transported through rivers	21%

Bangladesh has the highest rural population density in the world - around 1,209 people per square kilometer. The 20 million people living in river basins lack basic facilities such as electricity and telephone service, as central planning of road construction did not consider the predominant river networks. Development initiatives are concentrated around paved roads, while riverside areas remain underdeveloped. The Bangladesh government and NGO's are not active in these areas because they are so hard to reach and are subjected to regular flooding. Rural people cannot use radio since batteries to run radios are expensive and sometimes not available in local market. People do not use mobile phones as they can not charge them due to lack of electricity. Only 20.4 percent of the population has access to grid electricity. People living in river basins therefore do not have any access to the information about developments in national laws, regulations and human rights policies and information, and also lack opportunities to partake in skill development training. The lack of these opportunities results in poverty, domestic abuse, early marriages, and poor access to education and learning opportunities--especially for children, girls and young women.

### *Statistics on Agriculture in Bangladesh*

Agricultural workers (1990)	65.2%
Female employment in agriculture (2003)	77%

Male employment in agriculture (2003)	53%
Average annual fertilizer use (1999)	1300,000 metric tons

Rivers are vital to local farming, but farming methods and agricultural runoff take their toll on the health of the rivers. In turn, the rivers make it difficult to reach farmers with information about environmentally sustainable agricultural methods. Therefore, most of the rivers have reached alarming levels of toxicity, aquatic ecosystems are being damaged, and chemicals entering the food chain create dangers to public health. River erosion grabs nearly 25,000 acres of land each year resulting in thousands more landless people in Bangladesh. The fish production has declined to about 50 percent due to the cropland runoff contaminants, the result of using pesticides more than the needed application rates, which finally reduce farmer's income and has a negative impact on the livelihoods of thousands of fishermen cum farmers.

*Statistics on Technology Use in Bangladesh*

Telephone mainlines per 1,000 people (2004)	6
Cellular subscribers per 1,000 people (2003)	31
Internet users per 1,000 people (2003)	2
Computer ownership per 100 people	0.782

Kerosene is used by poor families to provide lighting throughout the rural areas, which is also polluting and destroying the fragile environment. It is hard for children to study with the faint light of a kerosene lamp and often parents are unable to afford additional lamps for education. In a thatched house a heavy wind often blows out the lamp leaving people in darkness until the wind stops. It contributes to severe indoor air pollution which brings health hazards, particularly to women and children. And also there are risks of fire.

During the monsoon season, educational institutions located at many riverside areas remain under flood water for long periods, preventing students from attending classes for up to five months. This often results in children leaving the education system. With lack of practice, these neo-literates relapse into illiterates with in a year of leaving school. In Bangladesh 18 million children are eligible for primary education but 44 percent are still out of mainstream education. About 49 percent of children—or 12,000--in the age group one- to nine-years die due to drowning every year. This discourages rural parents from sending their children to distant schools.

Due to religious and cultural norms, girls are not allowed to move around freely, even at early stages of their life. This affects girls' enrolment in mainstream education. Furthermore, if poor parents can afford to send a child to school, it would most likely be a son, as a girl child is an important source of labor for a poor family. More than 40 percent of the parents are landless; therefore, they are unable to send their children to distant schools as it consumes valuable working hours. In Bangladesh the age of first marriage for females is 12-15 years; these mostly illiterate girls are more likely to become mothers during adolescence. About 22 percent of female deaths in the age group 10-45 years are due to domestic violence, half of which are suicide.

**TARGET POPULATION GROUP**

The pressure on land in Bangladesh is so overwhelming that it leaves little choice for the poorest segment of the population but to move to remote, inaccessible riverside areas to settle. These are mostly the poorest of the poor and the most disadvantaged, as they have to live and cultivate on flood-prone lands. They are usually classified either as landless (with no homestead land) or marginal (landless with only homestead, but 0.2 to 0.4 ha land) farmers. At least 30 percent of people cannot find paid work or are underemployed, mostly as agricultural laborers. More than 40 percent of the target group are considered landless by the Government, and at least 50 percent live below the poverty line, subsisting on less than a dollar a day. Most of our target groups are women because nowadays rural women are taking control over the key economic functions as male members have left villages in search of non-farm jobs and better income. Men's involvement in agriculture has been reduced by one-third and the increase in labor supply to non-agriculture has increased 42 percent from 1987 to

2000. At the same time, women have withdrawn labor from non-agriculture tasks and have increased the labor supply to agricultural activities. However, almost every working woman receives only half of the wage rate that their male counterpart receives. They are engaged in farming activity in their locality without any training and therefore do not meet the requirements of the local market. Statistics show that these women are most often poorly trained, and as a result unemployed or underpaid. This makes them one of the most vulnerable groups in the society, being women, mothers and heads of families.

## **THE ORGANIZATION**

Shidhulai initially established the first Waste Exchange Program in Bangladesh. This contributed to the income of the organization through a solid waste recycling process. The revolving funds of the community networks also contributed to the income of Shidhulai. The amount raised its income-generating projects is usually spent as start-up funds for pilot projects. In this way the boat school and library was started in 2002. Shidhulai aims to educate and mobilize poor people in remote areas so that they can plan, control and carry out activities independently for sustainable livelihoods. At the same time Shidhulai ensures the conservation of environmental resources through distance education, and the provision of resources and technologies. With 180 committed staff, 2,000 volunteers and thousands of grassroots networks, Shidhulai is using solar energy and cellular network to provide open learning, Internet access and training to thousands of families within its network of hundreds of rivers, streams, and wetlands in northern Bangladesh.

Shidhulai has additionally created local content in cooperation with the villagers and volunteers. These locally developed tutorials, training materials, presentations, and schoolbooks support education in technology, literacy, human rights, women's rights, child trafficking, domestic violence, organic farming, and the benefits of biodiversity, among other topics. The content is tailored to the needs of different audiences including literate and illiterate men, women, and children. Shidhulai also uses outside experts who are prepared to give advice where needed.

Shidhulai introduced the first Watershed project in Bangladesh aimed at saving rivers from pollution and raising awareness of the critical role of rivers in everyday life. The program educated farmers about environmentally friendly crop-production practices and methods of maintaining an ecological balance in the natural environment.

### **Shidhulai's key objectives are:**

- To increase agricultural productivity with sustainable agricultural practices that protect water quality, bio-diversity and the environment;
- To ensure self-reliance of the rural landless by introducing affordable technology;
- To ensure continuation of education in river basins throughout the year with availability of up-to-date information and the Internet, and improve computer skills and the status of women's rights;
- To improve livelihoods of fishermen and farmers and ensure ability to study at night in non-electrified, dark, villages.

## **INNOVATION IN DELIVERY OF TECHNOLOGY**

Shidhulai Swanirvar Sangstha has overcome the challenge that the ecosystem of Bangladesh poses and found an innovative way to deliver information technology to residents. Shidhulai brings solar power, Internet and cell phones on boats, and transforms the region's waterways into pathways for environmental education and technology. It is the only project in Bangladesh, and globally, which has a complete technology-equipped school, library, training facility and battery charging station on boats. The uniqueness of the project is simplicity: build a boat, equip it with books and computers, power it with solar energy, and bring it to communities through the waterways. Boats are built with local materials and labor, utilizing existing wireless networks for internet access. They provide practical

advice and education that teaches villagers how to help themselves. The boats are specially designed by Shidhulai to enable adjustment of any equipment configuration as well as to protect the electronic equipment from inclement weather, even during the height of the monsoon season. The boats provide maximum flexibility and can reach villagers that, for logistical, social, or cultural reasons, cannot access a permanent institution. The manufacturing cost of each portable solar home system is only US \$5, which is among the lowest in the world and its uniqueness is that it is portable and manufactured by villagers. Boat school is the only school in the world where children do not need to travel to school—instead, school travels to them.

## **TECHNOLOGY OFFERINGS**

Shidhulai uses photovoltaic (PV) systems and cellular technology in specifically designed boats. The boats have flat-plank floors to allow them to glide through the shallow canals. They are also outfitted with multi-layered waterproof roofs and side windows that can be opened for ventilation. In fact, they use the natural cooling system of the environment, as the side windows bring in sufficient air to cool the inner spaces, especially as the boats dock under the shade of large trees. A metal truss takes the weight off of the roof, so the interior is not obstructed by pillars, allowing the accommodation to be made spacious and comfortable. These entire features make inner space comfortable for the users and equipment. PV modules generate electricity from sunlight and the boats dock in such a way that its solar modules are faced towards bright sunlight in the south and are self-sufficient for a day. The boats are all built in the region, using locally available materials.

Introducing the Internet to the boats proved to be a daunting challenge. Initially, the project began using the telephone lines of its riverside project offices to connect to the Internet Service Provider in the city, and then a wireless network to distribute the signals to the boats. But the poor condition of the phone lines and limited coverage of the wireless network compelled Shidhulai to use data-fax enabled mobile systems along with high-gain antennae to transmit signals from the boats. Recently the system has been upgraded with high speed Edge/GPRS cards. These cards are used at PCMCIA or USB ports.

With rechargeable batteries to store electricity, the boats can provide an independent DC electricity supply system which can be used during both day and night. All boats have PV-powered lighting, using 10 W-compact fluorescent bulbs, and mobile phone services from the Grameen, Aktel and Citycell mobile phone networks. The mobile phone connection allows people to make personal phone calls, and also to talk to health experts and get agricultural advice. Most of the batteries are made in Bangladesh. PV modules are imported to Bangladesh and bought from local markets. The Shidhulai solar department installs the solar system on boats. The LEDs used in the Shidhulai's portable solar home system come from China and Japan. The portable solar home system (PSHS) is manufactured by both the Shidhulai and local youth in the project areas.

The bicycle-powered pump is designed for small-scale irrigation and is very cheap, so it brings particular benefits to landless farmers who cultivate on the land of others. The pump is cycle-operated, consisting of two pistons of an ordinary twin cylinder pump connected to a crankshaft. It has a flywheel on one end and a chain sprocket on the other end. The crankshaft is powered through a chain sprocket from the pedal of the bicycle, which is rotated by the foot of the operator sitting on the seat like pedaling a bicycle. The capacity of this pump is 60 to 100 litres/min with one laborer at a time. The pump can cover an area of 0.50 acre/day. The bicycle pumps are manufactured at the local workshops in the rural villages and the manufacturing cost is US \$45. About 70 percent of the pumps have been provided to farmers who had not previously been able to afford any irrigation pumps. The project has distributed 15,000 bicycle pumps and has created around 1,800 new jobs.

## **ACCESS TO INFORMATION AND EDUCATION: THE BOAT PROJECT**

Shidhulai Swanirvar Sangstha realized from the outset that the rivers do not have to be barriers to information; they can be communication channels. As a result, Shidhulai launched the boat library, which has all the facilities of a standing library, but moves to different riverside locations to cater for the educational and information needs of a community. Each boat library has four computers with

Internet access, mobile phones and a printer. There is also a digital projector and screen, and laptops are available for online training sessions that are offered on board. Each library contains 1,500 books on literature, economics, religion, and family law, among other topics. Additionally, 50 periodicals and educational materials on children's rights, healthcare and technology are available for the readers. Locally developed Web tutorials, PowerPoint presentations, documentaries and dramas, multimedia CD-ROM, digital still images, and hard copy printouts of locally customized learning materials downloaded and compiled from the Internet are available.

The library facilities are used by the students, school dropouts, unemployed youth, and particularly women. The main uses are computer skills development and access to relevant information on daily news, human rights, job opportunities, microenterprise, and effective healthcare. The boats use their solar energy to run the computers. A librarian and an assistant maintain the facility along with a computer trainer that helps the users develop technology skills and retrieve information off the Internet. The video conferencing in the libraries has facilitated conversations between scientists and farmers about effective agricultural practices, and university teachers and young women about human rights and the environment. Technology, through email and video, has allowed these conversations to occur and continue over time and distances. Shidhulai runs the library programs six days a week. On a typical day, the boat libraries make two stops and stay for four hours at each stop.

The Mobile Internet-Educational Units on Boats (MIEUB) are also equipped with laptops, multimedia equipment, educational presentations and a database. They make their way through the rivers, docking at villages to teach farmers techniques for preventing pollution and erosion, introducing affordable technologies like the bicycle pumps and portable solar home systems, and promoting environmentally sustainable agriculture, water rights, biodiversity, water quality monitoring, climate change, healthcare and human rights. MIEUB utilize locally-developed content, including web tutorials, animations and documentaries. During the day, MIEUB arranges onboard training programs for the farmers and women, and at night, educational programs are arranged on large screens so that many people can see from their own courtyards. Laptops are connected to the Internet via the cellular network using EDGE/GPRS data cards, allowing Skype or Yahoo Messenger plus Webcams to provide connection between users and solar/environmental/agricultural/healthcare experts at Shidhulai regional office/headquarters, research institutes, universities etc. Along with necessary training, farmers are also getting information on commodity and farm input prices. They can also send and receive e-mails, access the Internet and contact others using mobile phones.

Another program, the Boat School, brings education to children. The schools provide basic primary education with a focus on environment. Shidhulai has introduced the first river-based environmental curriculum in the country that teaches how to protect the environment and conserve water. The solar power enables the Boat School to provide night-time education to working children while they are free. Each Boat School consists of a classroom for 30 to 35 students, an Internet-linked computer, a mobile phone, 500 books, and electronic resources such as locally developed CDs on literacy and numeracy, animated drawings and dramas. Using the computer for writing and drawing, and exploring online content gives children the hope for higher education. Usually students are working children and come from landless families. Teachers are selected from local villages and are female. Boat School provides education six days a week. Educational materials are given free to the students. During the height of the monsoon season the riverside low-lying areas go under water. Students move to safer places with parents using Boat School, and later the school moves from door-to-door to ensure the continuation of education. In an exceptionally devastating flood, like in 2004, Boat School provided shelter to hundreds of flood-affected women and children.

Some 79.6 percent of the country's population of 139.2 million lack regular access to electricity. Therefore, Shidhulai distributes the portable solar home system (PSHS) amongst the families of fishermen cum farmers. PSHS consists of four Ah 6 V batteries, table and wall lamps (LED made), wiring and fixtures. The battery is also used to charge mobile phones. PSHS enables people to study, knit, sew, weave, catch fish, and more. These PSHS batteries are charged at charging stations on boats. These boat have a small manufacturing unit, service centre, battery charging spaces and an information centre consisting of a laptop and mobile phones. The laptop is used to train the beneficiary on the PSHS and get online information. People are using e-mail to place requests for

PSHS. These boats tour hundreds of rivers, canals and wetlands, and dock at riverside villages once a week, allowing the female members to bring their PSHS batteries to charge on the boats. The portable solar home systems are usually used at riverside thatched houses and fishing boats to provide light. Shidhulai has a strong sense of the need to lift people out of poverty first, therefore, PSHS is given free to the beneficiary. Around 35,000 PSHS have been distributed to landless and marginal farmers. The manufacturing cost of each portable solar home system is only US \$5, which is the lowest in the world, and the uniqueness is that it is portable, powered by solar energy and manufactured by villagers.

## **SUSTAINABILITY: COMMUNITY NETWORKS**

To sustain the project and bring long-term benefits to communities, Shidhulai establishes community networks in riverside villages. For example, the Water User Association (WUA) helps farmers identify their agrarian needs, understand related environmental issues and collect water samples. Shidhulai experts then analyze the data and propose solutions to identified problems. Environment and Energy Groups (EEGroups) decide which family should receive the PSHS, and then select people for the training. Once installations have been made, the group is responsible for ensuring that families are maintaining their solar systems correctly and bringing PSHS batteries to charge on boats in time. They also monitor the work of the solar engineers. The Girl Children's Rights Association (GCRA) is a distance-education program where girls and young women learn about domestic abuse, early marriages, child trafficking, prostitution, and the importance of independent media. Microenterprise Groups (MGroups) provide a monthly forum where villagers, particularly women, receive instruction on microenterprise development and explore ideas for small-scale income-generating activities. With the internet and mobile phones, the WUA, GCRA, EEGroups and MGroups are interacting with each other to address village problems more effectively. Shidhulai staff members regularly meet with members of these groups to monitor their progress, and identify and solve problems using boat resources.

## **HOW USERS OF SHIDHULAI SERVICES PAY**

The users of our resources and programs pay nothing for the services. The people that Shidhulai is working with are amongst the most disadvantaged in the country, and are often too poor to access the microfinance schemes that are available in many regions of Bangladesh. In particular, Shidhulai believes that everyone has a right to free education and information that helps improve sustainability. The only exception at present is payment for some mobile phone calls.

This approach may change for some products in the future. One example would be where PSHS are helping people set up a profitable business, and are creating an ability to those people to pay for our services. If people pay for technology and services where they can, this will allow more funds to be diverted to projects, thus helping more people who cannot afford to pay. Users might pay about BGT 20 to 40 (US\$ 0.30-0.60) per month for the battery charging service, but the BGT 400 (US \$6) per month savings on kerosene for lighting easily covers this. Our education and information will always be free.

## **PROGRAM TRAINING, SUPPORT AND QUALITY CONTROL**

The PV systems and other equipment on the boats are installed and maintained by Shidhulai's own trained technicians. For Shidhulai, training and support goes beyond the technology installed on the boats and distributed in the communities. Shidhulai's chief goal is education and training of children and adults, including primary education for children, computer education and library services for all ages, education on women's rights and training in sustainable agriculture. The manufacture, installation, repairs and maintenance of PSHS is being carried out entirely by unemployed village youth. These youth receive three months onboard training on how to install, maintain and repair portable solar home systems. Most of them have less than eight years of schooling and have never received any formal training in electronics or solar technology. Users of the PSHS are given some training, but as they are simply using a sealed battery and LED lights, this only needs to be at a basic

level. Users of the bicycle pumps are given training in the use of the pump, and the best way to apply the water to the land.

The success of boat project owes much to field oriented training of the staff. Shidhulai arranges orientation and technology training courses for officers that last for six month out of which twelve weeks are spent at Boat School, library and MIEUB. The staff training program reflects the guiding principles of the project. The components of orientation and technology trainings are:

- Orientation Training: job description and responsibility within Shidhulai, introduction to the policy and objectives of organization and projects, basic library skills, defining customer service in the library, information, resources and electronic contents of the boat library, monthly meetings of different network users, program coordination and supervision, financial management, liaison with local authorities, relevant learning opportunities within organization and other institutions, and hardware and software of library and MIEUB.
- Technology Training: computer fundamentals, Windows operating system, introduction to Microsoft Word Part I & II, introduction to Excel Part I & II, introduction to PowerPoint, introduction to Access Level I & II and introduction to the Internet.

Additionally, special training is arranged for the education and training officers on communication skills and staff management, multimedia educational materials and monitoring and project evaluation.

## **SHIDHULAI'S IMPACT ASSESSMENT**

Shidhulai Swanirvar Sangstha conducts needs analyses both before and after implementing a project and surveys are done at the beginning and end of each year. Shidhulai also commissions consultants' reports that document the improvements in daily lives and users' opinions on the project. Using tools such as surveys, interviews with beneficiaries, human rights monitoring reports, pesticide sale records and water quality monitoring reports, Shidhulai uses indicators to measure its impact. The indicators that are used to evaluate project impact include:

- school enrolment and dropout rates
- number of issues raised by girls and young women groups
- number of water user associations
- micro-enterprise groups and girl children rights associations formed and actively involved in Shidhulai programs
- water quality monitoring reports
- number of people receiving PSHS
- number of youth trained on solar system
- kerosene sale records
- amount of money saved for not using kerosene and additional income generated from it
- number of environment and energy groups formed and actively involved
- number of participants regularly attending MIEUB and libraries
- number of landless receiving lands

Consultants of Shidhulai, including university teachers, government officers and research institute scientists are engaged in the impact assessments of the project. Elected union council members, farmers, and government officials are invited to participate in the discussions on projects findings at the end of each year.

### **Benefits to Girls and Women :**

In a deeply conservative society such as Bangladesh, religious and cultural traditions restrict the mobility of women. This means they are often relegated to jobs with low economic returns. However, the unique approach of the boat project addresses these religious and cultural barriers. Women now take full advantage of the education and Internet facilities delivered

right to their doorsteps. The proximity of the facilities allays the concerns of their parents and guardians.

Before the boat program began, riverside communities had no way of coordinating their work on local issues. With the Internet and mobile phones, the community networks can interact with each other to address problems more effectively. Using PV electricity to charge batteries for off-boat use extends the range of services that Shidhulai can offer. Portable solar home systems provide families with high-quality light in the evening for children to study and women 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.

### **Key Project Impacts:**

As a result of MIEUB, 35 percent of trained farmers are now using mechanical means to control insects. This has reduced the usage of pesticides by 60 percent, which also controls fish kills. There have been improvements in water quality and health of frogs, snails, tortoises, and other species. Now there is less need to cut down trees to burn for light and reduced dependency on kerosene as people are using portable solar home systems. Therefore, carbon dioxide emissions and atmospheric pollution are reduced and people's income is substantially increased. PSHS have been particularly useful for night fishing. It helps fishermen spend more time in catching fish and surveys suggest that they have raised the average fisherman's income by BDT 300 (US \$4.34) per month--a significant increase in a region where earnings are typically only BDT 1,200-1,500 (US\$ 17.40-21.73) per month. PSHS also improves safety on boats, which are now having fewer accidents at night, and gives people the ability to signal to other boats in a way that they could not do with a kerosene lamp.

About 43 percent of the bicycle pumps are replacing the use of diesel pumps, which were either purchased or hired when needed. Therefore, it is saving thousands of litres of fuel and reduced carbon dioxide emission. Farmers can now cultivate a variety of crops outside the normal growing season. People now have a better diet, new houses, home improvements, better healthcare etc. The annual income of farmers has increased by 55 percent. The MIEUB has trained thousands of people on tree and grass filter strip establishment, and encouraged them to establish two hundred acres of trees and grasses at the river banks, which has slowed the soil erosion and polluted runoff. Children's enrolment in schools has increased by 35 percent, the dropout ratio has been reduced by 30 percent, and forced marriage has decreased by 70 percent. People are now involved in removing open latrines and a good number of the water quality monitoring stations are free from fecal contamination.

The informative price lists of the MIEUB have brought changes in the lives of landless-marginal farmers. It has helped them sell their products to the market at better prices. Therefore, the terms of negotiation between the middlemen and the farmers have improved significantly, and at least two steps in the marketing line have been eliminated. Due to the technology-mediated training, agricultural productivity has increased by 45 percent. About 65 percent of trained farmers have been liberated from the extra time spent in agricultural fields. Now they can engage themselves in other income-generating work, and thousands of landless farmers do not have to leave their villages in search of work. Thousands of microbusinesses have started through the revolving funds of the community networks. Parents are now self-reliant and able to take better care for their children.

The Boat School is taking education to children's doorsteps. This saves time for working children and has motivated parents to help their children continued their education. Also, Shidhulai has adapted the timing and content of courses to meet villagers' needs. For example, schooling is offered both during the day and at night to accommodate the schedules of working children.

## **TECHNICAL AND OPERATIONAL LESSONS LEARNED**

Shidhulai continues to craft innovative, relevant, and integrated solutions to address the manifold challenges and barriers related to rural development in waterbound areas. Key lessons learned from developing and implementing these solutions include:

- Introducing schools and libraries to the boats proved to be a daunting challenge. Therefore, boats are now designed for their particular configuration as well as to protect any electronic equipment, even during the height of the monsoon season. Boats have flat plank floors that allow them to glide even in shallow canals.
- Introducing the Internet on the boats was also challenging as boats continuously change directions. Earlier data-fax enabled mobile systems along with high gain antennae were connected to PCs to transmit signals from the boats, but data transfer rate was very slow (14.4 kbps) at that time. Now Shidhulai has introduced high-speed Internet on boats using GPRS and EDGE cards connected via USB or PCMCIA ports of a PC or laptop.
- Sometimes heavy rainfall during the monsoon season makes it difficult to stage ashore educational shows of MIEUB. Therefore, to select the program sites, preferences are given to places with large trees where plastic sheeting can be suspended between the trees to protect the people from the rain. Now people can easily sit and watch the program during the rainfall.
- There is strong community involvement in the project and boats return to a project office or boatman's place after the class or dock at a particular convenient place in crowded locality during night. Special considerations are therefore given to selecting the program sites and Shidhulai has been successful in safeguarding the boat and its equipment.
- It was difficult to ensure a clear view of the projection screen for a large number of people standing and sitting at different ends of the river bank during the ashore educational shows of MIEUB. Therefore, boats are now placed at right angles to the stream bank. The projector is placed at the covered space to allow back projection on to the sail-cloth placed at the end of the boat.
- Introducing solar energy on the boat to run computers was indeed a challenge. Earlier Shidhulai pilots had problems with the imported inverters. To solve the problem the inverters are now customized locally, and they work efficiently on boats.
- Boats always had surplus energy as the solar system was designed very cautiously, yet people could not study or read books during the night. To solve the problem, Shidhulai developed and distributed the portable solar home system amongst beneficiaries. Now library users and school students can study for three to four hours during the night.

## **REPLICATION OF SHIDHULAI**

With regard to client populations of about 20 million people in Bangladesh, the project has great potential for scaling within the country. About 17,000 villages are located at the river basins and are only accessible by boats. To date this project is the only development program which has shown the potential to reach these target groups. Therefore Shidhulai is trying to convince the Government and international community to scale up the project to reach the presently unreached at riverside villages. Government has already started developing policies of utilizing river networks for its citizens, especially public transportation, education and other usages.

As designed, boats, educational materials and strategies have already been developed under the project, only some equipment and a boat will be needed for others to replicate it. The operational costs of the boat school, library or MIEUB are substantially lower than the costs for a standing educational institution. The project model has already been replicated by local community-based organizations such as Daridra Bimochon Sangstha and Panchshisha Bahumukhi Somobay Somity. Also, the Boat

School has been replicated in Kakinada, Andhra Pradesh of India by Sarva Shiksha Abhiyan. A similar initiative has been replicated in Mali of West Africa by Sustainability Partnerships.

## **HOW TO FACILITATE FUTURE REPLICATIONS**

Shidhulai has been working with local community-based organizations since 2004 to replicate the boat project in other settings. The following challenges have been identified in relation to the replications:

- Local organizations have not been capable of constructing boats as per the design of Shidhulai. They need extensive training and a very experienced boat-maker. Also they need frequent advice on wood selection, construction methods, multi-layered boat roof, bottom floor construction, etc.
- Local organizational trainers have been found to be inexperienced and consistently need month-long technology training.
- It is very difficult for local organizations to find skilled solar technicians to install and maintain the system properly.
- Other organizations are interested in replication, but due to the lack of access to financial resources and technology training, they are as of now, unable to replicate it.

The following steps need to be taken for successful replications:

- Development of strategies, technologies and content in a way that can be easily used by local people or organizations in Bangladesh and other countries.
- Provision of financial assistance, intensive training, technology and technical assistance to other organizations on the Shidhulai approach.
- Development of a central training facility to offer training on the Shidhulai approach to other organizations interested in doing similar programs.
- Shidhulai must stay involved with the replication process long enough to be sure other organizations get off to a healthy start.
- Impact assessment of the replicated initiatives needs to be conducted.

It is expected that the generated revenues of replicated projects will be minimal during the first year. From year two onwards, it is anticipated that rural communities will be paying for recharging solar home batteries on boats. The amount raised from mobile phone services of boats will be accumulated in a fund to meet other expenses, such as printer cartridges, Internet bills, paper and supplies, and so on. Similarly community networks will be involved in mobilizing local resources. Thus, the generated revenue replications will be continued. To ensure sustainability of the projects it is necessary that operational costs, for example, the salary of teachers, trainers and boatmen must be supported by the NGO/CBOs themselves. Because the beneficiaries are mostly poor, in spite of their best intentions, they are not in a position to contribute to salaries.

## **CONCLUSION**

The project shows great potential for scaling up with regard to client populations of several millions of people in Bangladesh and in other waterside communities, particularly in Southeast Asia. There are thousands of villages located at these river basins which are only accessed by boats, and to date this project is the only integrated development approach which has demonstrated the potential to reach these target groups. Therefore, replications of Shidhulai's approach can reach those unserved at riverside villages across the world and benefit the communities' livelihoods and cultivation of the flood-prone lands.

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