Climate-smart house: Housing that is cyclone resistant and food, energy and water efficient in Bangladesh

CGIAR RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security CCAFS

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WorldFish

ABOUT THE CLIMATE-SMART HOUSE

Since cyclones Sidr (2007) and Aila (2009), communities in southern Bangladesh have increasingly needed to protect their homes and livelihoods from destructive natural disasters. WorldFish embarked on a climate-resilient housing project in 2013, building a prototype climate-smart house that is resilient to cyclones and is also water, food, energy and space efficient.

Photo Credit: Sm Nurun Nabi/PIM/CCAFS

Fish tank along with vertical vegetable-growing options at the climate-smart house.

BENEFITS OF THE CLIMATE-SMART HOUSE

Long-term changes in climate will likely result in an increase in the frequency of intense cyclones, rains and droughts.[1] Changes in climate will affect local weather patterns and impact many people's livelihoods. The climate-smart house provides protection against cyclones and flooding and supports efficient use of water and energy. Many features of the house are aimed at increasing food production and helping families become more self-sufficient and better able to cope with extreme weather events.

Photo Credit: Sm Nurun Nabi/PIM/CCAFS

Climate-smart house owner Mehrunnesa caring for her vegetables.

FEATURES OF THE CLIMATE-SMART HOUSE

A prototype climate-smart house was built by WorldFish, in partnership with Practical Action. The house is located in the area of Shatkira, near the Sunderbans in Bangladesh.

The prototype house cost approximately USD 6000 to build. Making a house more resilient to cyclones and flooding requires the house to be lifted above the flood line on an elevated platform of wood or concrete. To do this, the house is built on top of a one-story foundation consisting of six concrete columns. The full set of concrete columns cost approximately USD 850. Lifting the house is the greatest expense when building a climate-smart house in this region.

There are many technologies within the house that are affordable and make a household more food, water and energy efficient and resilient to changes in climate.

Some of the unique features of the climate-smart house are the following:

- a rainwater harvesting system with filter
- rainwater-fed multipurpose fish tanks
- drip irrigation
- vertical agriculture system
- barrel composting system
- improved cook stove
- twin pit sanitary toilet.

Rainwater harvesting system with filter

Rainwater harvesting is an extremely effective and important practice in high-saline areas. The harvested water can be used for drinking and irrigation of plants. Rainwater is collected from the roof of the house and diverted via drains into water tanks. Water tanks are more resilient if they are built of concrete and stored in the shade under the house. A tank holding approximately 6000 liters can sustain a family of four for around 4–5 months.

Photo Credit: Sm Nurun Nabi/PM/CCAFS

View of a water reservoir used for drip irrigation.

Rainwater-fed multipurpose fish tanks

Tanks made from concrete can be used to store rainwater and culture fish species, such as tilapia, *shing* and *magur*. Locating these tanks under the house utilizes the shade and limited space. In the event of a flood, the tank opening can be covered with nets to prevent the fish from escaping.

Water from the fish tank becomes enriched with nitrogen and can be used to irrigate red amaranth, spinach and other vegetables. In WorldFish experiments, 86% more Indian spinach plants germinated when watered from a fish tank compared to crops that were not watered from the fish tank. Similarly, red amaranth showed a 16% improvement in plants' germination rate compared to those not watered from the fish tank. Not only can these multipurpose fish tanks increase crop production, they make more fresh rainwater available for drinking and sanitary purposes by providing water for vegetable irrigation that would otherwise need to be sourced from fresh rainwater.

Vertical agriculture system

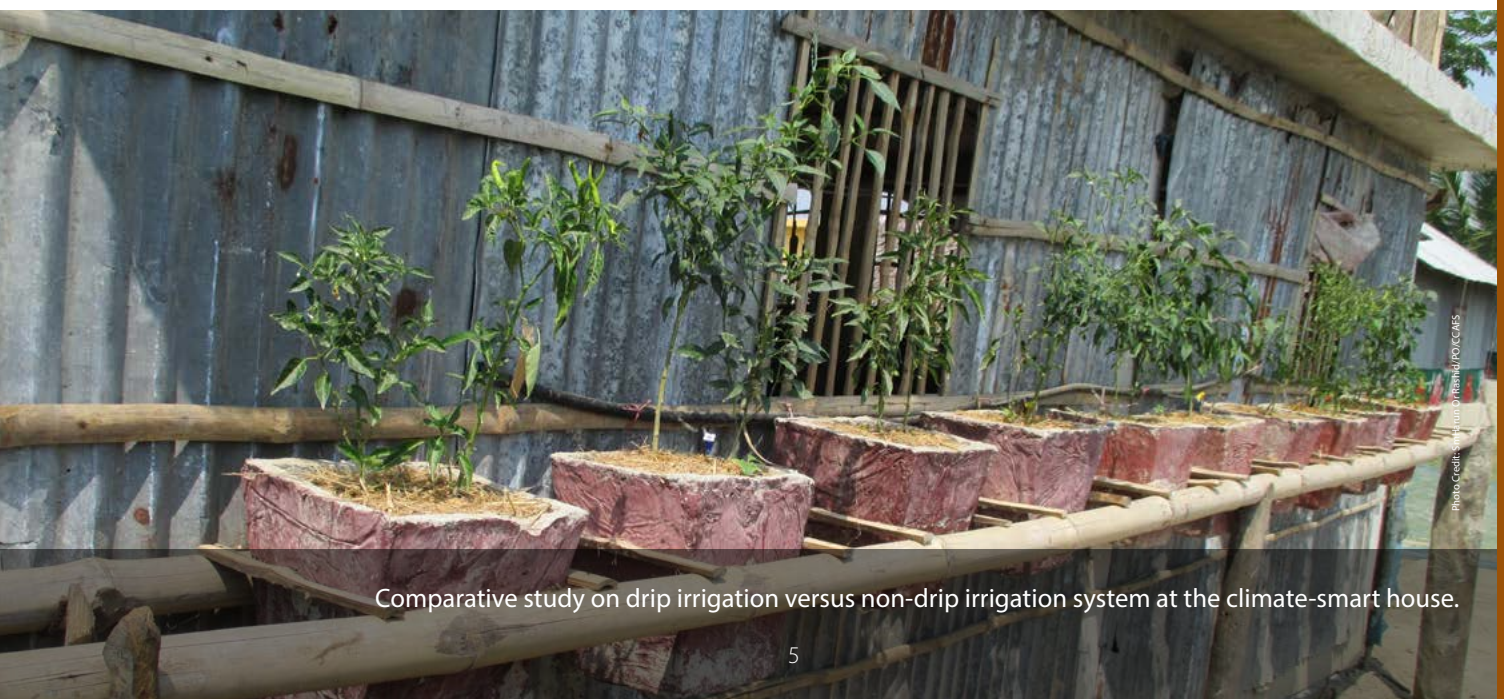
Growing vegetables on the raised platform of the house or in cement pots alongside the walls of the house can increase food production and protect plants from the harmful effects of flooding and saline water intrusion. Cultivation of *brinjal*, chili, tomato, cabbage, beet, okra and other vegetables has proven to be very successful in the cement pots, particularly when combined with drip irrigation and the use of water from a fish tank.

The vertical agriculture system can provide vegetables year-round, which is particularly important in times when there are water shortages. When combined with organic compost, fish water, drip irrigation, and protection from saline soils and waterlogging, the vertical agriculture system is an integrated and extremely efficient labor, food and water-use system.

Drip irrigation

Hanging vegetable pots can be watered effectively using a piped water distribution system connected to a 500-liter plastic drum that is installed above the roof. A gate valve installed in each pot helps maintain the water flow. Preliminary results from WorldFish research suggest that the drip irrigation system can reduce waste of water by 17.5% and provide 28.4% higher production of chili compared to plants grown in pots and watered by hand.

Low-cost handmade drip irrigation solutions can also be made from discarded plastic bottles. This is done by boring a hole in each bottle cap, attaching drip nozzles to them and suspending the bottles upside down above plant pots.



Comparative study on drip irrigation versus non-drip irrigation system at the climate-smart house.

Barrel composting system

A 100-liter plastic drum can be modified into a barrel composting system. Kitchen and other organic waste is dumped into the drum, and after a few months, the waste decomposes into a rich compost for fertilizing the vertical agriculture system. A hatch system built into the barrel makes it possible for the compost to be extracted from the bottom and new waste to be placed on top.

Improved cook stove

A double-burner improved cook stove (ICS) system can be installed at ground level. The ICS system is portable and can be shifted in the event of a flood. The ICS installed in the climate-smart house is a Grameen Shakti model and is made out of clay or cement. Cooking smoke is a health risk, so the stove has a chimney to channel smoke away from the house. According to the findings of the Institute of Fuel Research and Development (IFRD) of the Bangladesh Council of Scientific and Industrial Research and the inventors of the ICS system, the stove also requires 50% less wood for cooking than regular cook stoves.

Twin pit sanitary toilet

A twin pit sanitary toilet can be constructed using a total of 10 cement rings (5 in each hole). A lid placed on top of each pit helps to protect it from floodwater intrusion. Compared to single pit toilets operating without a water seal, the twin pit sanitary toilet significantly reduces flies and odors and also reduces pathogens. The twin pit sanitary toilets can also be used for a much longer period of time.[2]

View of an improved cook stove at the climate-smart house (left); view of a twin pit sanitary toilet at the climate-smart house (right).

FUTURE CHALLENGES

It is important for people living in areas at risk of natural disaster and high salinity to think about ways to suspend their living spaces, water storage and vegetable production above the storm water line.

While investments in concrete pillars may be too costly for some families, it is still possible to achieve efficiency gains using affordable technologies such as vertical agriculture, handmade drip irrigation or portable cookers. The key innovation in all of these technologies is the ability to suspend essential livelihood activities above the water line. Communities should work with government representatives to encourage the building of climate-smart housing in vulnerable areas.

Photo Credit: Sm Nurun Nabi/PM/CCAFS

Climate-smart house owner Mehrunnesa harvesting green chili from vertical growing system.

NOTES

[1] http://practicalaction.org/energy/advocacy/docs/advocacy/Adaptation_to_climate_change_Bangladesh.pdf; http://www.metoffice.gov.uk/media/pdf/1/q/Bangladesh.pdf

[2] http://www.sswm.info/content/twin-pits-pour-flush

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Contact Details:
WorldFish, PO Box 500 GPO,
10670 Penang, MALAYSIA
www.worldfishcenter.org

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