

## Vertical agriculture: Homestead horticulture suspended in sacks



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# ABOUT VERTICAL AGRICULTURE AND SACKS

Suspending horticulture in sacks above the ground can result in higher levels of productivity for vegetables when the challenges of unfertile or saline soil, flooding, waterlogging, and land and water constraints are regularly encountered.

Previously used feed and fertilizer sacks are filled with a high-productivity soil mixture. Vegetables are grown on the top and/or in holes cut into the sides of the sacks. While growing vegetables in sacks has existed for many years in Bangladesh, the technique has been modified by WorldFish in collaboration with farmer researchers. This new approach is highly effective in helping families adapt to salinity intrusion and waterlogging by suspending agriculture production 60 centimeters (cm) off the ground.



Different vertical techniques were established in a study plot at Hatsala village for educating farmers.

# BENEFITS OF VERTICAL AGRICULTURE

The farmers of Bangladesh face many challenges associated with a changing climate and increases in population. Rising salinity, waterlogging, flooding and storm surges, coupled with a growing population that is expected to reach 250 million by the year 2050, have resulted in a decrease in the amount of cultivable land for vegetable production. Vertical agriculture can address the loss of cultivable land by maximizing the space around households by suspending horticulture production in sacks along trees, houses and bamboo structures. Vertical agriculture results in higher production rates and the use of less land and water. It also allows women to better manage their own food security, nutrition and consumption of fresh vegetables.



View of a study plot at Gabgachia village.

# CONSTRUCTING VEGETABLE SACKS

Two types of sack techniques are described below: new sack technique and old sack technique. A homestead area that has a small amount of space and is exposed to 4–5 hours of sunlight daily can utilize either of these technologies.

The new sack technique uses a soil mixture along with a central column of brick chips for better water circulation and drainage. The design allows for planting on both the top and the sides of the sack.

The old sack technique contains only a soil mixture and allows for planting only on the top.

Both sack methods have benefits for farmers:

- increased surface area compared to soil beds (depending on the size of the sacks)
- portability and easy handling
- lower levels of salinity through the use of irrigation
- increased protection from flooding
- decreased water evaporation during periods of drought.

Results from WorldFish research show that plants grown using the sack technique have a greater level of productivity compared to the same plants grown in soil beds positioned next to the sacks.

## New sack preparation technique

First, identify the place where the sacks will be installed and create a pile of soil and/or bricks to raise the sacks 0.10–0.15 meters off the ground. This will protect the sacks from waterlogging during times of flooding. A piece of polyethylene sheet can be placed over the bricks before the sack is positioned to further protect the sack from salinity intrusion.



Growing different vegetables using the old sack technique at Hatsala village.

Next, prepare the planting medium and put it into the sack. The planting medium is made up of 40% dried water hyacinth, 30% good-quality soil, 30% coconut husk and about 10% cow manure.

After filling the sack to about 10 cm, place a PVC pipe (12 cm in diameter) in the sack and place brick chips in the pipe. Gradually raise the pipe up as you fill around the pipe with the planting medium. When the sack is full, remove the pipe, leaving only a column of brick chips running vertically down the center of the soil. This design allows for aeration and better irrigation.

## Old sack preparation technique

Prepare the base used to support the sack as in the new sack technique. Then, fill the sack with soil and a composted mixture (but no brick chips are added to this design).



View of a sack prepared with the new sack technique at Gita Ranis' home in Chandipur village.

# SOWING AND TRANSPLANTING ON THE SACK

Prepare small rectangular holes in the sides of the sack. By cutting only three sides of the rectangle and keeping one side (the top) attached, you can fold the flap upward and inward and sow seed or plant seedlings underneath the sack cover. The polythene barrier at the top of the hole directs the growth of the plant outward rather than upward.

Vegetables such as tomato, *brinjal*, chili, Indian spinach, okra, *knolkhol*, radish and beet can be grown on the top of the sack (maximum of two plants). Long-rooted vegetables such as sweet gourd, bottle gourd, ash gourd, ridge gourd, *dhondol*, bitter gourd, cucumber and snake gourd can also be grown on the top of the sack.

Plants that are short rooted and strong enough to stand upright unsupported are suitable for planting on the sides of the sack. Four to six seedlings of chili, Indian spinach, okra, *kholkhol*, beet or sweet potato can be grown on the sides of a sack.

## Pit preparation

For long-rooted vegetables such as bottle gourd, sweet gourd, ash gourd, bitter gourd, snake gourd, *dhondol* and cucumber, a pit should be prepared on the top of the sack and fertilizer should be added. Plant one or two seeds or seedlings on the top of the sack. After a few days, weed out smaller or weaker plants to allow maximum spacing and better production.

## Planting of seedlings

When seedlings are approximately 1 month old, they are suitable for planting in the rectangular holes on the sides of the sack. The spacing of the seedlings depends on the type of vegetable. However, spacing can be 20–25 cm (line to line) and 20–25 cm (plant to plant). If the plants are planted densely, production could be reduced.

## Fertilization

In addition to organic fertilization, chemical fertilizers such as urea, triple super phosphate (TSP) and muriate of potash (MoP) can be used for better growth and production of the vegetables. Doses depend on the type of vegetable and its nutrient requirements, but a standard amount is 15 grams (g) of urea, 20 g of TSP and 15 g of MoP.

## Irrigation

To maintain healthy plants, 1–2 liters of water can be applied on the top of the sack in the evening. Using a layer of straw or water hyacinth mulch on the top of the sack reduces evaporation of water and allows the soil to remain moist for longer periods of time. This means that less water is required to grow each plant.

# PRODUCTIVITY AND PROFIT FROM SACKS

The total investment required to establish a suspended vegetable sack is about BDT 100–150 (USD 1.30–1.90) or around BDT 40–50 (USD 0.50–0.60) per cycle. More than 7–8 kilograms of vegetables, valued at BDT 250–275 (USD 3.20–3.50), can be harvested per sack. The net profit per sack averages around BDT 200 (USD 2.70), which can be earned in a cycle. (There are three cycles in a year: summer, inter and winter.)



Tomato cultivated with the old sack technique at a study plot in Chandipur village.



**This publication should be cited as:**

Hossain E, Nurun Nabi SM and Kaminski A. 2015. Vertical agriculture: Homestead horticulture suspended in sacks. Penang, Malaysia: WorldFish. Program Brief: 2015-30.

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