



Food and Agriculture  
Organization of the  
United Nations



World Food  
Programme



COX'S BAZAR  
FOOD SECURITY  
SECTOR



# HOMESTEAD GARDENING GUIDELINES

VEGETABLE PRODUCTION FOR HOUSEHOLD CONSUMPTION USING  
MINIMAL SPACE IN ROHINGYA CAMPS AND HOST COMMUNITIES

# **HOMESTEAD GARDENING GUIDELINES**

Vegetable production for household consumption using minimal space in Rohingya camps and host communities

Food and Agriculture Organization of the United Nations (FAO), World Food Programme (WFP) and Food Security Sector (FSS), Cox's Bazar  
Cox's Bazar, 2022

Required citation:

FAO, WFP, and FSS. 2022. *Homestead gardening guidelines: Vegetable production for household consumption using minimal space in Rohingya camps and host communities*. Cox's Bazar.

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of FAO, WFP or FSS.

©FAO, 2022



Some rights reserved. This work is made available under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO licence (CC BY-NC-SA 3.0 IGO; <https://creativecommons.org/licenses/by-nc-sa/3.0/igo/legalcode>).

Under the terms of this licence, this work may be copied, redistributed and adapted for non-commercial purposes, provided that the work is appropriately cited. In any use of this work, there should be no suggestion that FAO endorses any specific organization, products or services. The use of the FAO logo is not permitted. If the work is adapted, then it must be licensed under the same or equivalent Creative Commons licence. If a translation of this work is created, it must include the following disclaimer along with the required citation: "This translation was not created by the Food and Agriculture Organization of the United Nations (FAO). FAO is not responsible for the content or accuracy of this translation. The original [Language] edition shall be the authoritative edition."

Disputes arising under the licence that cannot be settled amicably will be resolved by mediation and arbitration as described in Article 8 of the licence except as otherwise provided herein. The applicable mediation rules will be the mediation rules of the World Intellectual Property Organization <http://www.wipo.int/amc/en/mediation/rules> and any arbitration will be conducted in accordance with the Arbitration Rules of the United Nations Commission on International Trade Law (UNCITRAL).

**Third-party materials.** Users wishing to reuse material from this work that is attributed to a third party, such as tables, figures or images, are responsible for determining whether permission is needed for that reuse and for obtaining permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user.

**Sales, rights and licensing.** FAO information products are available on the FAO website ([www.fao.org/publications](http://www.fao.org/publications)) and can be purchased through [publications-sales@fao.org](mailto:publications-sales@fao.org). Requests for commercial use should be submitted via: [www.fao.org/contact-us/licence-request](http://www.fao.org/contact-us/licence-request). Queries regarding rights and licensing should be submitted to: [copyright@fao.org](mailto:copyright@fao.org).

Cover and back cover photo: A Rohingya women at community homestead garden in the camps in Cox's Bazar. ©FAO/MH Kawsar Rudro

## EDITORIAL TEAM

**Authors:** Bidyuth K. Mahalder, FAO; Md. Moksed Ali, FAO; Saimunnahar Ritu, FAO

**Technical review and editing:** Moin Us-Salam, Senior Agriculture Expert, FAO; Md. Abul Kashem, Deputy Director, DAE, Cox's Bazar

**Contribution in assessment of technologies:** Md. Mizanur Rahman, WFP; Subrata Chakrabarty, UNHCR; Md. Abdul Maleque, UNHCR; Karishma Tarannum, UNHCR; Md. Abdus Salam, BRAC; Zillur Rahman Chowdhury, Concern World Wide; MD. Alimul Islam, Concern World Wide

**Contribution in data collection and compilation:** Md. Syful Islam, BRAC; Md. Mojahidul Mostafa, BRAC; Nobadip Biswas, BRAC; Mehedi Hassan Faisal, BRAC; Ripon Kumar Shingh, Concern World Wide; Sirajul Islam, Concern World Wide, Ananada Bikash Chakma, FAO

**Overall coordination, design and publishing:** Food Security Sector (FSS) Team, Cox's Bazar and MH Kawsar Rudro, FAO

# CONTENTS

|                                                                                             |           |
|---------------------------------------------------------------------------------------------|-----------|
| <b>FOREWORD.....</b>                                                                        | <b>v</b>  |
| <b>OVERVIEW .....</b>                                                                       | <b>1</b>  |
| OBJECTIVES.....                                                                             | 2         |
| ENVIRONMENTAL/GEOGRAPHICAL CONTEXT .....                                                    | 2         |
| GUIDANCE FOR HOMESTEAD GARDENING.....                                                       | 3         |
| SEASONAL RISKS/NATURAL HAZARDS .....                                                        | 4         |
| <b>DIFFERENT PRODUCTION SYSTEMS.....</b>                                                    | <b>6</b>  |
| 1. BED PLANTING.....                                                                        | 7         |
| 2. PIT PLANTING .....                                                                       | 8         |
| 3. SACK PLANTING.....                                                                       | 9         |
| 4. TRELLIS GROWING .....                                                                    | 10        |
| 5. VERTICAL GROWING.....                                                                    | 11        |
| 6. MULTILAYER GROWING.....                                                                  | 12        |
| INPUTS .....                                                                                | 14        |
| PEST CONTROL AND DISEASE MANAGEMENT .....                                                   | 15        |
| CROP CALENDAR AND SEASONAL CONSIDERATIONS .....                                             | 15        |
| COST ANALYSIS .....                                                                         | 17        |
| <b>COMPARISON OF SIX HOMESTEAD VEGETABLE PRODUCTION SYSTEMS .....</b>                       | <b>18</b> |
| DATA COLLECTION AND ANALYSIS .....                                                          | 20        |
| RESOURCES.....                                                                              | 20        |
| <b>Annex 1: Sample questionnaire for data collection .....</b>                              | <b>21</b> |
| <b>Annex 2: Block level landslide susceptibility in Rohingya camps in Cox's Bazar .....</b> | <b>16</b> |

# FOREWORD

The development of this homestead gardening guidelines was coordinated by the Cox's Bazar Food Security Sector (FSS) and prepared by the two sector lead agencies: the Food and Agricultural Organization of the United Nations (FAO) and the United Nations World Food Programme (WFP) under the UN-UN agreement. The guidelines aim to identify the most productive and cost-efficient production models within the fragile ecosystem of Rohingya refugee camps in Cox's Bazar.

Inputs and lessons learned from the FSS implementing partners have been incorporated throughout; these inputs were collected via partners during FSS bi-weekly meetings, workshops, partner field visits, and partner reports. The guidelines benefited greatly from inputs provided by the United Nations High Commissioner for Refugees (UNHCR), the United Nations International Organization for Migration (IOM), the United Nations Entity for Gender Equality and the Empowerment of Women (UN Women), BRAC, HELVETAS, Solidar Suisse, Solidarités International, Concern Worldwide (CWW), Social Assistance and Rehabilitation for the Physically Vulnerable (SARPV), Shushilan, Center for Natural Resource Studies (CNRS), Danish Refugee Council (DRC), Friends In Village Development Bangladesh (FIVDB), Gana Unnayan Kendra (GUK), and Mukti Cox's Bazar.

We hope that the document will be a useful resource for FSS partners in promoting homestead gardening to support vegetable production for household consumption and increase dietary diversity for vulnerable Rohingya and host communities in Cox's Bazar.



**Marco De Gaetano**  
Head of Cox's Bazar Sub-Office,  
Food and Agriculture Organization of the  
United Nations (FAO), Cox's Bazar



**Sheila Grudem**  
Senior Emergency Coordinator  
United Nations World Food Programme (WFP),  
Cox's Bazar

# OVERVIEW

With more than 923,179<sup>1</sup> people spread across approximately 25 sq. km. of single-story buildings, the Rohingya Refugee Camps are both the biggest and the most densely populated refugee camps in the world.<sup>2</sup> The camps sit on previously forested, now landslide prone topography. The decreased greenery due to deforestation has resulted in higher ambient temperatures and slope destabilization. Since 2018, the humanitarian response has engaged in camp greening activities, including the reforestation of 470 ha of land and the engagement of nearly 60,000 HH annually in gardening initiatives. These camps greening efforts have both reduced the landslide risk within the camps and provided important disaster risk reduction programming and temperature control.<sup>3</sup> The gardening initiative is also providing the Rohingya with vegetable production capacity at the household level, which is supporting critical access to more nutritious and diverse diets. Furthermore, camp gardening supports greening efforts and decreases the demand for vegetables in the Cox's Bazar Market – a critical contribution given the anticipated 50-60 percent annual vegetable deficiency in the Cox's Bazar District.<sup>4</sup>

Over four years after their arrival, the Rohingya continue to show high levels of vulnerability and remain heavily dependent on food assistance.<sup>5</sup> The impact of COVID-19, and the subsequent lockdown efforts to quell the rate of transmission has further exacerbated levels of vulnerability in the camps. According to the Refugee Influx Emergency Vulnerability Assessment ([REVA 5](#)) report, the acceptable food consumption score in Rohingya households has improved in 2021, reaching 45 percent, compared to 50 percent in 2020, and without assistance, more than 51 percent of the households would not be able to afford the minimum expenditure basket (MEB). As access to nutritious foods remains an issue in the camps, distributing seeds and conducting training on vegetable gardening for household consumption can help to increase access to nutritious diets. Furthermore, this initiative is in line with rural Bangladeshi practices of subsistence from household vegetable production.<sup>6</sup>

Since 2018, more than 12 Food Security Sector (FSS) partners have been engaged in camp gardening initiatives. The existing initiative includes components such as agricultural training and input distribution (i.e., seeds, sacks), and most of the FSS partners have introduced and implemented gardening activities using modern techniques, overcoming challenges such as limited space and water access. Gardening in camps also provides positive mental health

---

<sup>1</sup> Joint Government of Bangladesh – UNHCR, 2022, *Population Factsheet as of 28 February 2022*, [URL](#)

<sup>2</sup> Médecins sans frontières, 2020, *COVID-19: Five challenges in Bangladesh and the Rohingya refugee camps*, Relief Web, [URL](#)

<sup>3</sup> UNHCR, IUCN, 2019, *The Greening of Cox's Bazar - The Positive Impact of Liquefied Petroleum Gas (LPG) distribution among the Refugee and Host communities – Bangladesh*, Relief Web, [URL](#)

<sup>4</sup> FAO, 2020, *Rapid Market Assessment on Vegetables, Fish and Livestock Value chain in Cox's Bazar*, [URL](#)

<sup>5</sup> World Food Programme, 2021, *Refugee influx emergency vulnerability assessment (REVA) - Cox's Bazar*, [URL](#)

<sup>6</sup> National Information Platform for Nutrition, 2020, *Policy Brief, Pathways to Nutritional Well-being: A Framework for Nutrition Intervention and Policy Action*

benefits to the Rohingya households involved, including the ultimate yield of fresh and healthy vegetables.<sup>7</sup> As this activity enters into the 4<sup>th</sup> year of implementation, FSS, in coordination with sector lead agencies, WFP, FAO, and relevant Government of Bangladesh line ministries, is striving to develop a ‘living’ harmonized guidance note on gardening activities in the camp for household consumption. This document builds upon three years of FSS partner experience and global recommendations in order to ensure the continued strengthening and positive progression of gardening in the camps. It is the aim of this document to be regularly updated in correlation with increased lessons learned and changing camp dynamics – with the overall goal being to strengthen resilience and access to nutritious diets in the camps.

## OBJECTIVES

1. **Increase household access to high-quality, nutritious food and dietary diversity in a densely populated and stressed refugee setting**, thereby increasing household resilience to meet their own nutritional needs.
2. **Enhance utilization of nutritious foods and support the health and well-being of beneficiaries within the camps** – Studies indicate that involvement in gardening activities results in increased vegetable consumption, thus improving behaviour change towards healthy eating. Further, studies show that observing nature and participating in physical activity in green spaces, play an important role in positively influencing health and wellbeing.<sup>8</sup>
3. **Provide opportunities for capacity building** – teach technical agricultural skills to boost production using minimal amounts of soil and water. Further, gardening activities maintain heritage skills – many Rohingya were engaged in agricultural practices in Arakan, the connection between community and nature is believed to be passed on from their ancestors. For further information see [IOM Rohingya Cultural Memory Centre](#).
4. **Increase local vegetable production to address an anticipated 50-60 percent annual vegetable deficit in Cox’s Bazar District (FAO, 2020)** – this will help [Bangladesh achieve Sustainable Development Goal 2](#) by promoting sustainable agriculture in the camp setting, which will alleviate the current district-wide food deficit. ([2020, Md. Abul Kashem, Deputy Director, Department of Agricultural Extension](#)).

## ENVIRONMENTAL/GEOGRAPHICAL CONTEXT

The Rohingya influx placed enormous pressure on the environment and available natural resources in Cox’s Bazar. Camps were established in protected forest areas, resulting in deforestation and disruptions to ecosystem services. In response, disaster risk reduction activities, including slope stabilization through reforestation, were implemented. To complement ongoing reforestation and slope stabilization activities, it is critical that homestead gardening efforts continue to work in parallel with such efforts. To this end, FSS and the Environment and Energy Technical Working Group (EETWG) recommend that partners include the following key messages in homestead gardening activities:

---

<sup>7</sup> Concern Worldwide, 2021, *Upwards, sideways, sloped: gardening in refugee camps*, [URL](#)

<sup>8</sup> Garden Organic and Sustain, 2014, *The benefits of gardening and food growing for health and wellbeing* *Health Growing Food growing for health and wellbeing*, [URL](#)



## **GUIDANCE FOR HOMESTEAD GARDENING**

*A Rohingya woman harvesting tomatoes. ©FAO/MH Kawsar Rudro*

### *Guidance around plantation sites:*

- ☐ Tree saplings are not to be removed, nor trees cut down, when cultivating vegetables.
- ☐ Avoid growing vegetables near plantation sites.
- ☐ Ground vegetation conserves moisture and adds nutrients to the soil, therefore avoid removing it during vegetable gardening.
- ☐ New bamboo shoots and other grasses should not be removed for any purpose, especially as edible items.
- ☐ Consider crown canopy and the subsequent shade trees give when selecting the crop variety.
- ☐ Shade or trellis should not be erected over existing plantation sites for vegetable gardening because it will filter the sunlight.

### *Guidance in sloped areas:*

- ☐ Consider pit and sack planting in landslide-prone areas to avoid destabilizing the slope.
- ☐ Vegetables with large leaves and vines should be considered as they can reduce splash erosion.
- ☐ Zero or minimal tillage is recommended for vegetable cultivation, especially in sloped areas, and avoid cutting or damaging any steep slopes as this will increase the risk of a landslide.

Furthermore, with the support of the REACH Initiative, please see ANNEX 2 for an overview of landslide vulnerability. These maps should support partners in identifying landslide-prone areas and identifying planting considerations accordingly. Landslide susceptibility is a higher priority consideration during the monsoon season than in the winter.

### SEASONAL RISKS/NATURAL HAZARDS

Homestead gardening is directly impacted by natural calamities such as the monsoon season or summer dry season and the availability of inputs with irrigation sources. Raising vegetable seedlings is difficult during the rainy season or continuous heavy rainfall. Additionally, high wind velocity damages the vegetative part of the plant, and fruits drop. Continuous rainfall (i.e., 3–7 days) can loosen surface soil and potentially lead to the shattering of plants. Further, continuous rainfall can lead to flash floods that wash out surface soil and damage bed plantation. All these risks decrease during winter cropping.

Some contagious pests and diseases (i.e., mosaic virus, aphids, fruit fly, etc.) may spread rapidly from one household to another in the dense plantation areas during the summer season. Further, due to the scarcity of irrigation water in the summer season, some seedlings may be damaged, or their growth may be slowed. Using HH grey water as a pest control (phosphate levels in soap can reduce some insects) and a water-related stress reliever during the dry season can be beneficial.

The physical structures for production methods (i.e., trellis, vertical, multilayer, sack, roof, etc) may be damaged during the high wind/cyclone season. Considerations for additional inputs to support and/or additional labour for the restoration of the damaged crops and repair of the structures may be advised.

Based on assessing the risk in the camps, the following details the risks of gardening activities:

- The risk of continued rainfall/heavy rainfall/storm/cyclone causing damage to gardening activities.
- Risk of landslides.
- Soil erosion from surface soil during the rainy season as a result of bed plantation.
- Pests and diseases attack and spread as a result of dense populations and plantations.
- Irrigation water crisis during severe drought – Kharif 1 season (March-May).

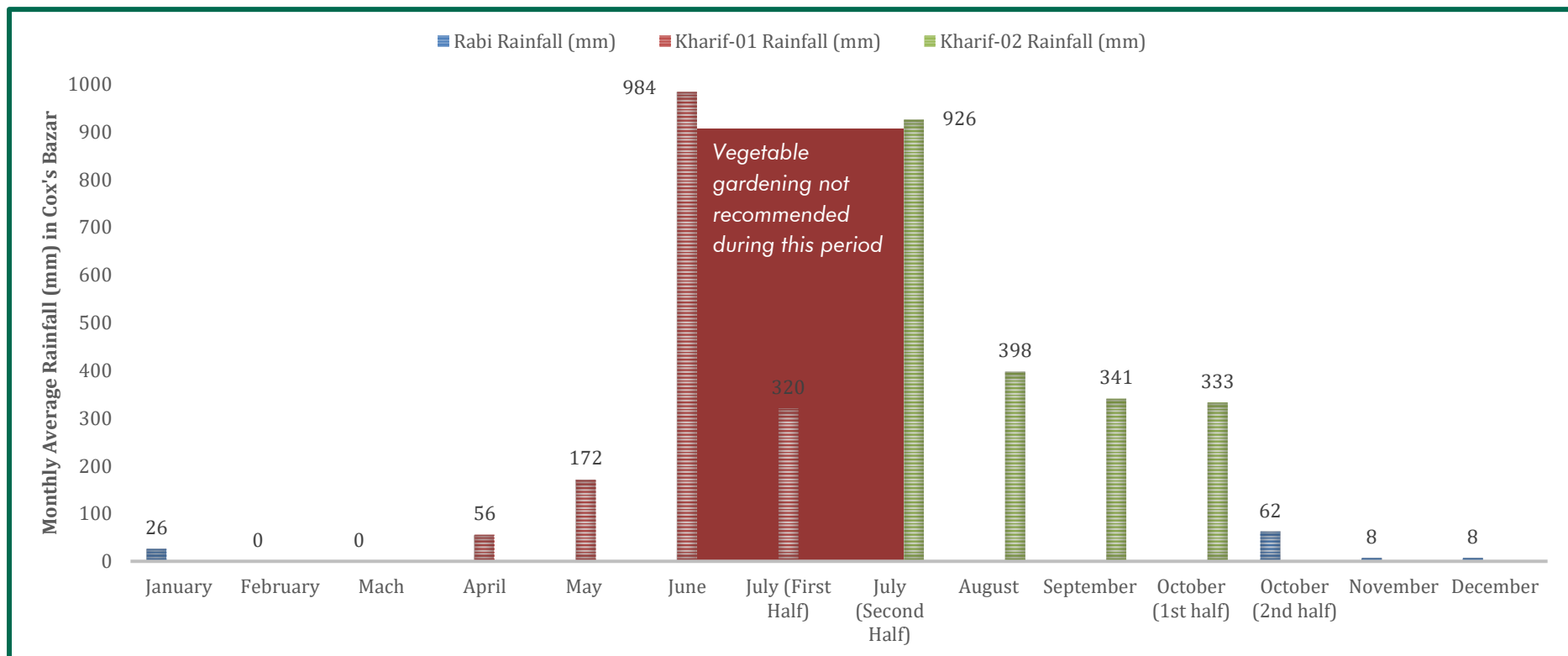


A Rohingya woman at a community homestead garden. ©FAO/MH Kawsar Rudro

# DIFFERENT PRODUCTION SYSTEMS

Based on FAO household gardening assessment in the Rohingya camps, six production systems have been identified considering the camp contexts (i.e., space availability, species suitability, soil disturbance and water requirements) and the overall environment of the topographic areas (FAO, 2021).

FIGURE 1: RAINFALL PATTERN WITH DIFFERENT CROPPING SEASONS IN COX'S BAZAR



Source: Bangladesh Agriculture Research Council Website (2020); [www.barc.gov.bd](http://www.barc.gov.bd)

## 1. BED PLANTING

- A piece of plain to mildly slopy natural land with no above-ground structure.
- At a higher elevation to facilitate drainage and good access to sunlight.
- Requires soil tilling depending on crop species selection.
- Mix compost and/or cow dung with soil and practice mulching for moisture conservation to reduce irrigation costs.
- Raised beds may be prepared and separated by a trench for proper drainage.
- Not suitable for highly stressed edaphic or non-edaphic environments.
- Recommended seeds per cropping season are listed in the [crop species with reference yield](#) section.
- This method is not recommended for Rohingya camps in Cox's Bazar due to limited flat open space and a high risk of soil erosion.



Bed planting. ©FAO/Moksed Ali





Pit planting. ©FAO/Saimunnahar Ritu

## 2. PIT PLANTING

- Enclosed smaller separate beds sitting on with a full or partial basal connection to the land surface. Pit sides may be enclosed with a bamboo frame and bio-degradable polythene sheets.
- Mix compost and/or cow dung with soil and practice mulching for moisture conservation to reduce irrigation costs.
- Suits stressed edaphic (such as soil salinity, hard and stony soil, and unfertile soil) and non-edaphic (such as waterlogging and water salinity) environments as it does not use natural land.
- Recommended seeds per cropping season are listed in the [crop species with reference yield](#) section.

### 3. SACK PLANTING

- Similar to pit planting, except sacks are used as enclosure material, which does not have a direct attachment to the land surface, and the system is moveable.
- Mix compost and/or cow dung with soil and practice mulching for moisture conservation to reduce irrigation costs.
- The seeds or seedlings should be planted on the soil surface, and the sack will be placed at the homestead in an area that is exposed to sunlight and not prone to flooding during the rainy season.
- Suits stressed edaphic and non-edaphic environments as they are not connected to natural land.
- Best usage for small, rooted crops. Recommended seeds per cropping season are listed in the [crop species with reference yield](#) section.



Sack planting. ©FAO/Saimunnahar Ritu



Sack planting. ©FAO/MH Kawsar Rudro



## 4. TRELLIS GROWING

- Similar to bed planting, except a horizontal bamboo structure or a bamboo framed structure will be erected around the pits or sacks that will later support the canopy of the creeping vegetables.
- Limits crop species choice as non-creeping crops experience various degrees of shadow from crops spread on the above-ground structure.
- Mix compost and/or cow dung with soil and practice mulching moisture conservation to reduce irrigation costs.
- The use of pit planting or sac planting at the base can be adjusted depending on surrounding soil conditions.
- Recommended seeds per cropping season are listed in the [crop species with reference yield](#) section.



Trellis growing. ©FAO/MH Kawsar Rudro

## 5. VERTICAL GROWING

- The vertical growing structure will be made with the support of bamboo poles and frames; the structure should be self-supported and secure and not rely on shelter structures.
- Structure placement and securement should consider wind direction and velocity.
- Mix compost and/or cow dung with soil and practice mulching for moisture conservation to reduce irrigation costs.
- The seeds or seedlings will be planted on the soil surface, and the sack will be placed at the homestead in an area that is exposed to sunlight and not prone to flooding during the rainy season.
- Limits crop species choice as non-creeping crops experience various degrees of shadow from crops spread on the above-ground structure.
- The use of pit planting or sac planting at the base can be adjusted depending on surrounding soil conditions.
- Recommended seeds per cropping season are listed in the [crop species with reference yield](#) section.

The vertical growing structure could be of different types:

- a) Self-supported vertical frame.
- b) Over the rooftop.
- c) Vertical frame on house wall.



Self-supported vertical frame. ©FAO/Ananda Chakma; Over the rooftop frame. ©UNHCR/Subrata Chakrabarty; Vertical frame on house wall. © FAO/Ananda Chakma; A Rohingya women Infront of her garden. ©FAO/MH Kawsar Rudro



Multilayer growing. ©FAO/Saimunnahar Ritu

## 6. MULTILAYER GROWING

- Combination of a soil bed at the bottom layer, a bamboo framed structure (i.e., trellis) at the middle layer, and a nylon net spread horizontally as the upper layer above the trellis.
- Raised beds may be prepared and separated by a trench for proper drainage. May require soil tilling, depending on crop species selection.
- Mix compost and/or cow dung with soil and practice mulching for moisture conservation to reduce irrigation costs.
- Framed bamboo structure will support the canopy of the creeping vegetables on the middle and top layers of the structure.
- A nylon net can be spread onto the middle and top layers of the bamboo structure. The net will be tightened with the bamboo poles of the trellis and rope to protect it from the wind and support the weight of the vegetables.
- Up to three or four species of vegetable seeds can be sown/seedlings will be planted considering vegetables that can grow in bed planting (bottom layer), creeping types of vegetable species on the trellis (middle layer) with heavy fruit weight, and light fruit weight on the upper layer.
- Recommended seeds per cropping season are listed in the [crop species with reference yield](#) section.

# CROP SPECIES WITH REFERENCE YIELD

The appropriate crop species and methods are important in growing homestead vegetables in the Rohingya camps. A recent study (FAO, 2021) explored the suitability of vegetable crop species with six production systems. The crop species are recommended considering both the fruit and leaf for the diversity of the households' food habits and consumption, nutrition value, productivity, potential risks, soil types (i.e., clay and clay loam), organic matter content, and landscape.

**TABLE 1: RECOMMENDED PRIORITIZED CROP SPECIES FOR THE SUMMER SEASON (OPEN-POLLINATED VARIETY)**

| Sl. | Vegetable Species | Scientific Name               | Production System                                 | Ref. Yield (kg/dec.) |
|-----|-------------------|-------------------------------|---------------------------------------------------|----------------------|
| 1   | Cucumber          | <i>Cucumis sativus</i>        | Sack, Pit, Trellis, Multilayer & Vertical growing | 263-283              |
| 2   | Bottle Gourd      | <i>Lagenaria siceraria</i>    | Sack, Pit, Trellis and Multilayer                 | 223-243              |
| 3   | Bitter Gourd      | <i>Momordica charantia</i>    | Sack, Pit, Trellis and Multilayer                 | 85-93                |
| 4   | Sweet Gourd       | <i>Cucurbita Maxima</i>       | Sack, Pit, Trellis and Multilayer                 | 142-162              |
| 5   | Ladies Finger     | <i>Abelmoschus esculentus</i> | Sack, Pit and bed planting                        | 69-85                |

Source: FAO field survey, 2021

**TABLE 2: RECOMMENDED OPTIONAL CROP SPECIES FOR THE SUMMER SEASON (OPEN-POLLINATED VARIETY)**

| Sl. | Vegetable Species | Scientific Name          | Production System                                 | Ref. Yield (kg/dec.) |
|-----|-------------------|--------------------------|---------------------------------------------------|----------------------|
| 1   | Yard-long Bean    | <i>Vigna unguiculata</i> | Sack, Pit, Trellis, Multilayer & Vertical growing | 61-81                |
| 2   | Eggplant          | <i>Solanum melongena</i> | Sack, Pit and bed planting                        | 162-182              |
| 3   | Ash Gourd         | <i>Benincasa hispida</i> | Sack, Pit, Trellis & Multilayer                   | 100-120              |
| 4   | Ridge Gourd       | <i>Luffa acutangula</i>  | Sack, Pit, Trellis & Multilayer                   | 90-100               |
| 5   | Indian Spinach    | <i>Basella alba</i>      | Sack, Pit, Trellis, Multilayer & Vertical growing | 202-304              |

Source: FAO field survey, 2021

**TABLE 3: RECOMMENDED PRIORITIZED CROP SPECIES FOR THE WINTER SEASON (OPEN-POLLINATED VARIETY)**

| Sl. | Vegetable Species | Scientific Name             | Production System                                   | Ref. Yield (kg/dec.) |
|-----|-------------------|-----------------------------|-----------------------------------------------------|----------------------|
| 1   | Country Bean      | <i>Phaseolus vulgaris</i>   | Sack, Pit, Trellis, Multilayer and Vertical growing | 61-69                |
| 2   | Bottle Gourd      | <i>Lagenaria siceraria</i>  | Sack, Pit, Trellis & Multilayer                     | 223-243              |
| 3   | Sweet Gourd       | <i>Cucurbita Maxima</i>     | Sack, Pit, Trellis & Multilayer                     | 142-162              |
| 4   | Tomato            | <i>Solanum lycopersicum</i> | Sack and Pit, bed planting                          | 324-344              |
| 5   | Eggplant          | <i>Solanum melongena</i>    | Sack and Pit, bed planting                          | 162-182              |

Source: FAO field survey, 2021

**TABLE 4: RECOMMENDED OPTIONAL CROP SPECIES FOR THE WINTER SEASON (OPEN-POLLINATED VARIETY)**

| Sl. | Vegetable Species | Scientific Name            | Production System          | Ref. Yield (kg/dec.) |
|-----|-------------------|----------------------------|----------------------------|----------------------|
| 1   | Radish            | <i>Raphanus sativus</i>    | Sack and Pit, bed planting | 263-283              |
| 2   | Red Amaranth      | <i>Amaranthus cruentus</i> | Sack and Pit, bed planting | 50-60                |

Source: FAO field survey, 2021

## INPUTS

The following is a general list of inputs based on partner feedback and recommended gardening types. This list should serve as guidance only—prioritization is given to the required inputs list. However, based on field observations, additional inputs may be strategically included depending on production models.

**TABLE 5: REQUIRED INPUTS FOR VEGETABLE GARDENING**

| Type              | Quantity                        | Size                   | Additional information                                                                                                                         |
|-------------------|---------------------------------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Buckets           | 2                               | 20L                    | Partners are encouraged to look into recycling or repurposing opportunities for buckets.                                                       |
| Sac               | 3                               | 20L                    | Sacs may disintegrate, however, further partner input on longevity is requested.                                                               |
| Bamboo            | 8 (depending on gardening type) | Small and large pieces | Bamboo inputs are durable, but regular maintenances should be considered                                                                       |
| Rope              | N/A                             | --                     | Rope may require regular replacement due to wear and tear.                                                                                     |
| Labour Cost       | N/A                             | --                     | Required for instalment of trellis and regular maintenance between seasons/storms, etc.                                                        |
| Additional Inputs |                                 |                        |                                                                                                                                                |
| Water can         | 1                               | 6L                     |                                                                                                                                                |
| Compost           | 10-20kg                         | --                     | Camp level composting can be linked with homestead gardening initiatives (e.g., through Material Recovery Facilities MRF and the WASH Sector). |
| Soil              | 10-20kg                         | --                     | Soil should be procured from flat areas, potential to connect with ongoing camp construction/ excavation projects.                             |
| Bug net           | N/A                             | --                     | Cost considerations to be assessed.                                                                                                            |
| Shovel            | N/A                             | --                     | Cost considerations to be assessed.                                                                                                            |

Source: FAO field survey, 2021

## PEST CONTROL AND DISEASE MANAGEMENT

**Pheromone traps:** Pheromones are chemicals insects use for communication. Insects send chemical signals to attract mates, warn others of predators, or find food. Pheromone traps can be used to monitor target pests. By monitoring for insects using these traps, early infestation detection may be possible—a critical step in lessening damage to agriculture or other plants.

Please see video here: [video training on "How to setup sex pheromone trap for insect control in vegetable garden" by HELVETAS Bangladesh and Shushilan.](#)

**Yellow Card:** Yellow sticky cards are used as a form of pest control – the yellow colour attracts insects while the adhesive causes them to stick to the cards rather than be able to attack the plants. Yellow cards, like pheromone traps, can be used to monitor insect type and prevalence and aid in early infestation detection.

Please see this helpful video: [video training on "How to use yellow card for insect control in vegetable gardens" by HELVETAS Bangladesh and Shushilan.](#)

## CROP CALENDAR AND SEASONAL CONSIDERATIONS

The crop calendar is an important hand tool for practitioners in practicing homestead gardening that provides the following guidelines for growing vegetables based on cropping seasons:

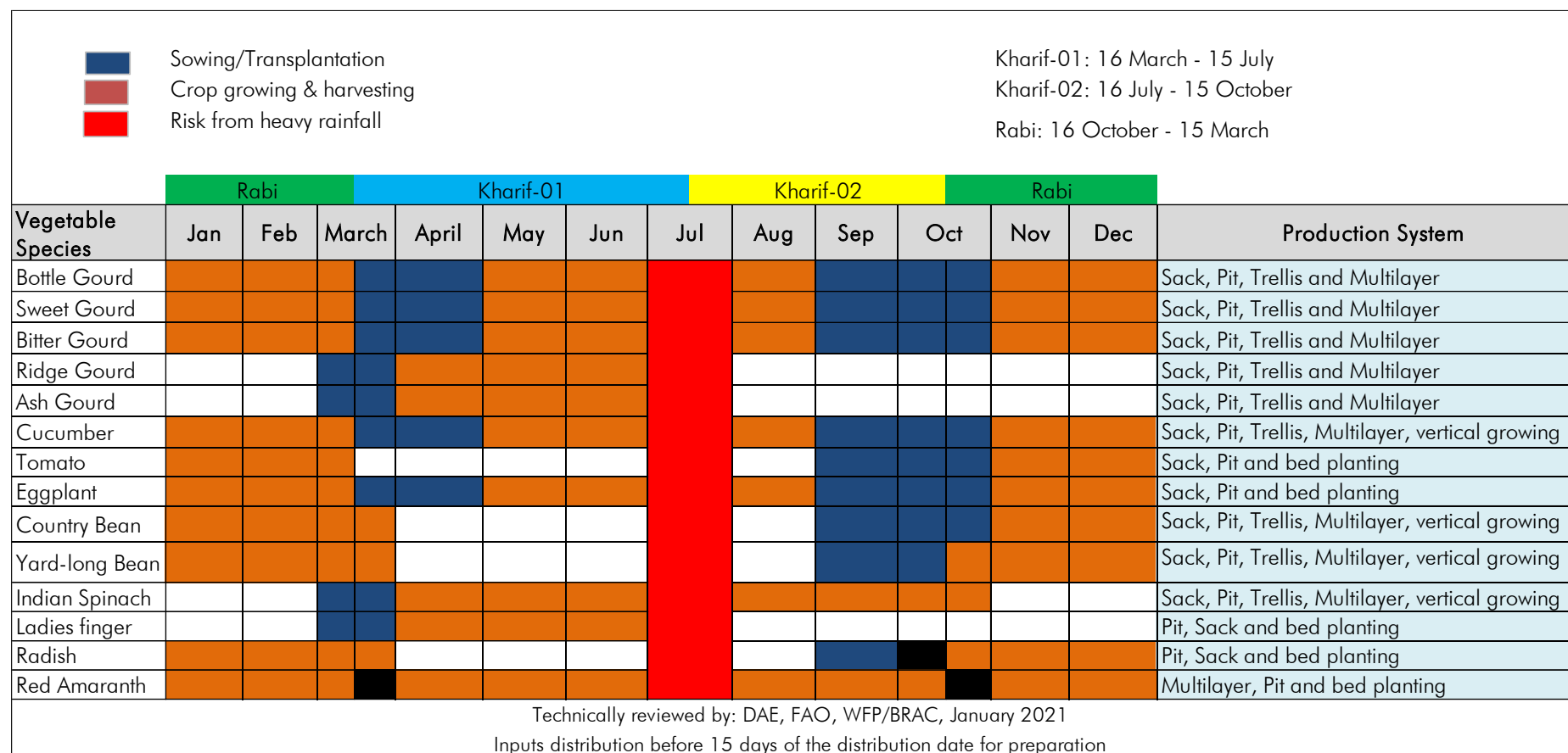
1. Indicate crop sowing and harvesting times in a crop calendar year.
2. Indicate production methods of homestead gardening.
3. Guide proper planning in the distribution of inputs (i.e., seeds and fertilizers).
4. Guide the field staff in growing year-round vegetables avoiding risks of damaging crops from heavy rainfall or cyclone.
5. Guide the field staff and practitioners in identifying lean periods and planning for early planting to mitigate natural disaster risks.

The following observations from the field may provide additional support:

**Germinating seeds – Mature plant:** Maintain protection from wind and high heat for newly planted seeds—this can be done by placing them close to the home, which may provide shading and wind protection. As the seeds grow, train them by attaching them to a trellis so they grow vertically. Eventually, once a mature plant, the vines can grow on top of the house. This rotation of protecting germinating seeds and training mature plants to grow vertically correlates nicely with seasonal distributions (i.e., winter plants are mature and growing on the roof while summer seeds are further mature; conversely, winter plants are likely dead by the time summer plants are mature enough to replace them on the roof).

**Summer season water access:** Water access may be more limited during the summer season. At this time, it is encouraged (and within current Rohingya gardening practices) to use 'second-use' water. If possible, gardeners can form greywater catchments within their homes to collect the water and recycle it by watering plants. Soapy water contains phosphate, which in moderation can be good for plants; it is recommended to prioritize watering plants in the early mornings and late evenings when it is cooler. Soapy water may also provide additional benefits, such as insect control.

**FIGURE 2: CROP CALENDAR FOR VEGETABLE PRODUCTION IN ROHINGYA CAMP**



Source: FAO field survey, 2021

## COST ANALYSIS

Below are details related to the input cost per household per activity. Please note that input costs should be considered indicative of total costs, but it is estimated that there will be variability across agencies due to several factors such as: operational costs, organization size, input variation, and retailer variation.

**TABLE 6: INPUTS COSTS PER HOUSEHOLD**

| Vegetable production method | Input Types                                                             | Input cost per household (BDT) | Average land space per household (square feet) * | Species diversity per household* |
|-----------------------------|-------------------------------------------------------------------------|--------------------------------|--------------------------------------------------|----------------------------------|
| Bed planting                | Seeds, compost, bamboo, watering can, fencing, rope, and labour         | 1,600                          | 61.3                                             | 3                                |
| Pit planting                | Seeds, compost, bamboo, watering can, rope and labour                   | 1,200                          | 67.3                                             | 7                                |
| Sack planting               | Seeds, sack, bamboo, compost, watering can, rope and labour             | 1,400                          | 115.6                                            | 4                                |
| Trellis growing             | Seeds, compost, bamboo (mul, borak), watering can, rope and labour      | 2,200                          | 120.0                                            | 4                                |
| Vertical growing            | Seeds, compost, bamboo (mul, borak), watering can, rope and labour      | 1,800                          | 120.0                                            | 2                                |
| Multilayer growing          | Seeds, compost, bamboo (mul, borak), watering can, net, rope and labour | 2,800                          | 166.8                                            | 4                                |
| <b>Average</b>              |                                                                         | <b>1,833</b>                   | <b>82.0</b>                                      | <b>4</b>                         |

Source: FAO field survey, 2021

# COMPARISON OF SIX HOMESTEAD VEGETABLE PRODUCTION SYSTEMS

FAO conducted a study having field level data collection support from the WFP, UNHCR, CWW, and BRAC to observe vegetable production systems meeting year-round household consumption and nutrition in the Rohingya Refugee camps in Cox's Bazar, Bangladesh (FAO, 2021). The comparison study results on the six homestead vegetable production systems (HVPs) are presented qualitatively in a 3 (system property class) x 3 (system property) matrix (Figure-1). Results indicate that greater variability occurred among the six HVPs due to varying responses in system properties under the 'situational context' class. For example, bed and pit planting systems perform excellently in 'space friendliness' property, whereas sack planting, trellis growing, and vertical growing are moderate, and multilayer growing is poor.

The system properties under the 'value for money' class are less variable among the six HVPs. Productivity is excellent under pit planting, sack planting, trellis growing, and multilayer growing systems. On economic value, the four systems, except for pit planting and sack planting, are excellent; the latter two are good.

The variability among the six HVPs on system properties under the management perspective class is lower than the situation context but higher than the value for money class. Bed planting is poor for water economics, whereas sack planting is excellent. The rest of the proposed systems are good for water economics. Vegetable species grown under the six systems are largely suitable.



FIGURE 3: PERFORMANCE MATRIX OF SIX HOMESTEAD GARDENING SYSTEMS CORRESPONDING TO THEIR PROPERTIES

| System property class   | System property          | Production system |              |               |                 |                  |                    |
|-------------------------|--------------------------|-------------------|--------------|---------------|-----------------|------------------|--------------------|
|                         |                          | Bed planting      | Pit planting | Sack planting | Trellis growing | Vertical growing | Multilayer growing |
| Situational context     | Space friendliness       | ●                 | ●            | ●             | ●               | ●                | ●                  |
|                         | Species diversity        | ●                 | ●            | ●             | ●               | ●                | ●                  |
|                         | Environment friendliness | ●                 | ●            | ●             | ●               | ●                | ●                  |
| Value for money         | Productivity             | ●                 | ●            | ●             | ●               | ●                | ●                  |
|                         | Cost effectiveness       | ●                 | ●            | ●             | ●               | ●                | ●                  |
|                         | Economic value           | ●                 | ●            | ●             | ●               | ●                | ●                  |
| Management perspectives | Water economics          | ●                 | ●            | ●             | ●               | ●                | ●                  |
|                         | Species suitability      | ●                 | ●            | ●             | ●               | ●                | ●                  |
|                         | Easiness of adoption     | ●                 | ●            | ●             | ●               | ●                | ●                  |

**Score point**  
(0 to 100 scale, relative to maximum performance of a system defined as 100)

● Excellent ( $\geq 80\%$ )

● Good ( $\geq 60 - <80\%$ )

● Moderate ( $\geq 40 - <60\%$ )

● Poor ( $\geq 20 - <40\%$ )

● Extreme Poor ( $< 20\%$ )

Source: FAO Homestead vegetable gardening assessment report 2021.

\* Value for money is defined by the following: productivity<sup>9</sup>, cost effectiveness<sup>10</sup>, and economic value/coefficient.<sup>11</sup>

<sup>9</sup> The productivity is defined as the 'bottle gourd equivalent yield (i.e., most commonly grown vegetable under almost all systems)' for a particular production system in a cropping season (i.e., summer or winter) in kilogram per square meter.

<sup>10</sup> The production cost property will be computed as all variable costs (in BDT) per decimal (i.e., 432 square meters) in growing vegetables in a cropping season (i.e., winter or summer) for a particular production system.

<sup>11</sup> (1) This is measured as the ratio between the observed yield to the break-even yield. (2) Observed yield will be the average yield of all crop species grown in a particular production system per square meter area. (3) The breakeven yield will be computed as the production cost of all crop species grown in a particular production system per decimal (i.e., 432 square meters) area.

## DATA COLLECTION AND ANALYSIS

FSS recommends that partners engage in harmonized data collection where possible. Provided in [Annex 1](#) is a sample questionnaire for post-harvest data collection. Below are further details on recommended data collection and analysis. These are not requirements for partners; however, harmonized data collection will support annual review and continued improvements.

- After seed and input distributions are completed, it is recommended that partners conduct a post-distribution monitoring (PDM) assessment. This assessment is recommended to be tailored to the specific implementing partner, taking into consideration their unique projects.
- After each cropping season, it is recommended that implementing partners collect information on post-harvest yield. In Annex 1, a sample tool that may be used is described. Door-to-door data collection of the households involved in this activity is recommended, with a supervisor verifying at least 10-15 percent of the data collection on site for quality assurance.
- Where possible, partners are requested to share the findings from the above two suggested assessments with FSS. This information will be compiled and analysed in order to inform future project implementation, such as cost analysis, seed types per season, and inputs.

## RESOURCES

- [Upwards, sideways, sloped: gardening in refugee camps – Concern Worldwide \(23 March 2021\)](#)
- [Video training on improved pit preparation by HELVETAS Bangladesh and Shushilan](#)
- [Video training on improved pit preparation using sack method by HELVETAS Bangladesh and Shushilan](#)
- [Video training on "How to use yellow card for insect control in vegetable garden" by HELVETAS Bangladesh and Shushilan](#)
- [Video training on "How to setup sex pheromone trap for insect control in vegetable garden" by HELVETAS Bangladesh and Shushilan](#)
- [Video training on 3G-4G technique to increase production by HELVETAS Bangladesh and Shushilan](#)
- [Sustainable Development Goals Tracker – Bangladesh's Development Mirror](#)

# Annex 1: Sample questionnaire for data collection

## Homestead gardening post-harvest data collection questionnaire

### A. Basic Household Information

|     |                      |      |                           |
|-----|----------------------|------|---------------------------|
| A.1 | HH/Beneficiary name: | A.2  | FCN/Registration no:      |
| A.3 | Father/Husband Name: | A.4  | Camp no.      Block name: |
| A.5 | Union:      Ward no: | A.6  | GPS Coordinate:           |
| A.7 | Sub-district:        | A.8  | District:                 |
| A.9 | Implementing org:    | A.10 | Supported org:            |

### B. Production

| Vegetable species | Fruit (kg/decimal) | Leaf (kg /decimal): | Cultivation Area (Decimal) |
|-------------------|--------------------|---------------------|----------------------------|
|                   |                    |                     |                            |
|                   |                    |                     |                            |
|                   |                    |                     |                            |
|                   |                    |                     |                            |
|                   |                    |                     |                            |

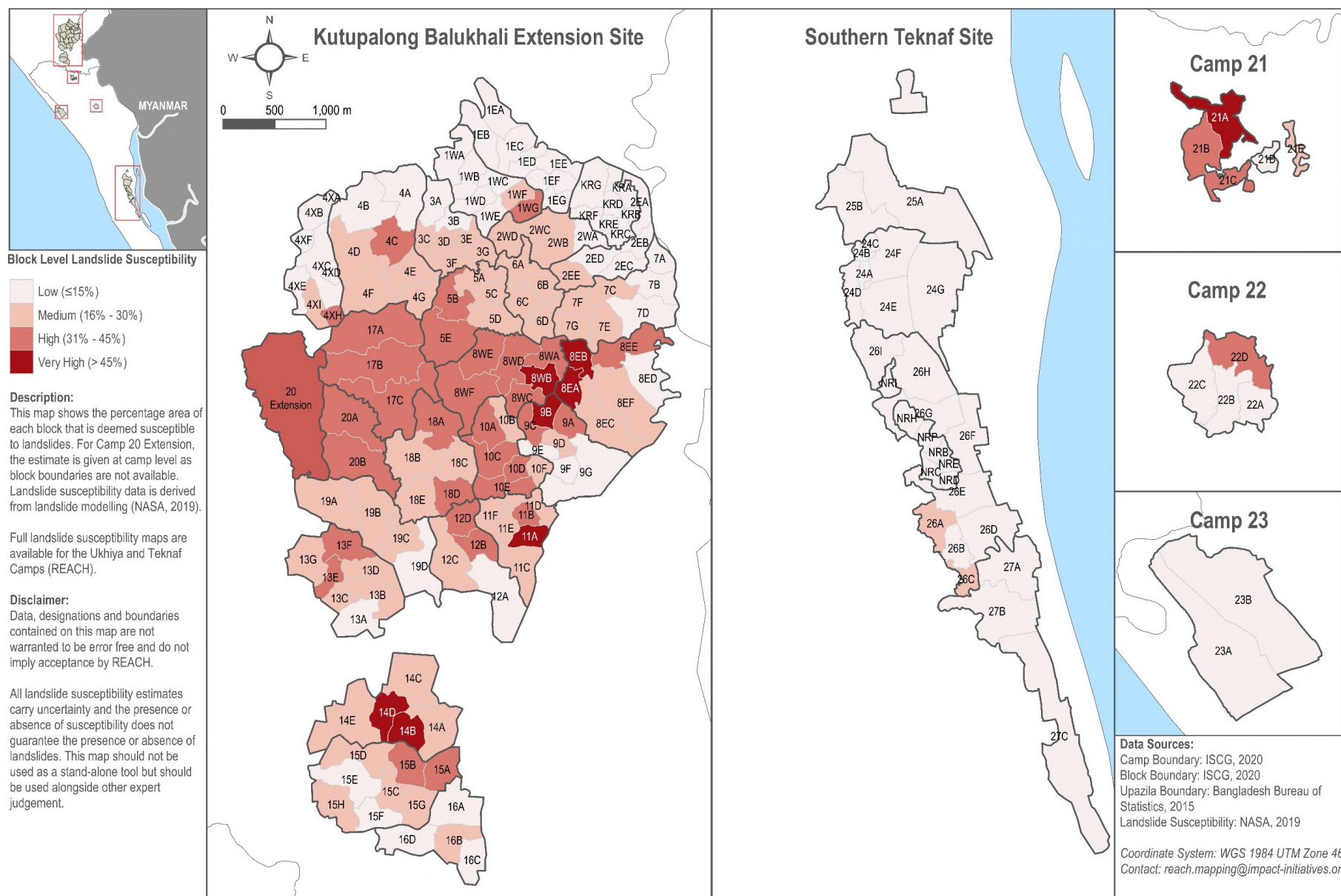
### C. Consumption

| Vegetable Species | The quantity consumed (kg) | Quantity distributed (kg) | Sold/other (kg) |
|-------------------|----------------------------|---------------------------|-----------------|
|                   |                            |                           |                 |
|                   |                            |                           |                 |
|                   |                            |                           |                 |
|                   |                            |                           |                 |
|                   |                            |                           |                 |

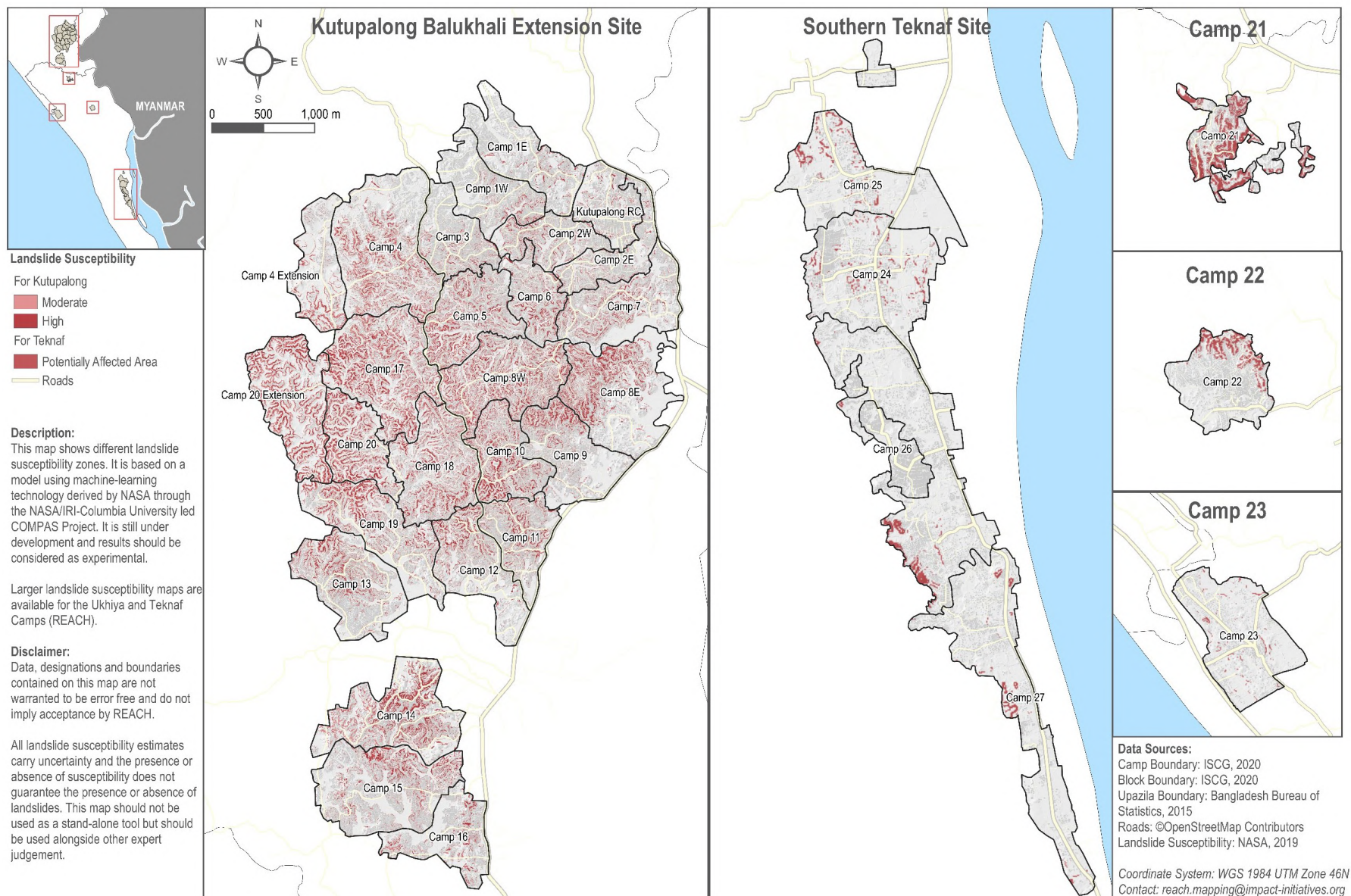
**D. Production Cost (Per decimal area for one cropping season) [Only variable cost]**

| Production cost                                       |                           |            | Total income<br>(Estimated income/earn/HH) |                           |            |
|-------------------------------------------------------|---------------------------|------------|--------------------------------------------|---------------------------|------------|
| Item                                                  |                           | Cost (BDT) | Item                                       |                           | Sell (BDT) |
| 1                                                     | Seeds                     |            | 1                                          | Leaf (-----kg x-----BDT)  |            |
| 2                                                     | Vermicompost/Compost/soil |            | 2                                          | Crop (-----kg x-----BDT)  |            |
| 3                                                     | Bamboo (Muli, borak)      |            | 3                                          | Other (-----kg x-----BDT) |            |
| 4                                                     | Watering can              |            |                                            |                           |            |
| 5                                                     | Plastic Balti/pot         |            |                                            |                           |            |
| 6                                                     | Rope                      |            |                                            |                           |            |
| 7                                                     | Net                       |            |                                            |                           |            |
| 8                                                     | Pheromone trap            |            |                                            |                           |            |
| 9                                                     | Sack bag                  |            |                                            |                           |            |
| 10                                                    | Labour                    |            |                                            |                           |            |
| 11                                                    | Other if any              |            |                                            |                           |            |
| Total production cost (BDT)                           |                           |            | Total income (BDT)                         |                           |            |
| Profit/decimal (Gross income – Total production cost) |                           |            |                                            |                           |            |

## Annex 2: Block level landslide susceptibility in Rohingya camps in Cox's Bazar



# Landslide hazard susceptibility in Rohingya camps in Cox's Bazar





### About the Food Security Sector

FSS is committed to saving lives through the coordination of appropriate, efficient, and well-resourced food security responses in major emergencies. The FSS in Cox's Bazar was established in 2017 in response to the Rohingya crisis. The sector is led by FAO and WFP and co-chaired by BRAC. Within the Inter-Sector Coordination Group (ISCG), the FSS is a platform to strengthen food security and livelihood response through operational coordination, information sharing, and identifying food security related priorities and solutions.