At ***BEZRAH***, we believe cities can become places where nature thrives, not just where concrete dominates. Urban farming gives us the tools to turn unused spaces like rooftops, small yards, or even balconies into areas that grow fresh, healthy food.

We aim to make farming in the city simple and sustainable, helping people connect with the environment while solving everyday problems like food shortages and pollution.

This report reflects our dedication to promoting urban farming as a practical and sustainable way forward. We will start by looking at the bigger picture—how urban agriculture can address global challenges like climate change and food shortages while improving the quality of life for city residents.

Next, we explore specific methods, such as aquaponics, hydroponics, and composting, to understand how they work and how they can be adapted to fit into urban spaces effectively.

Through our role At ***BEZRAH*** in advising and inspiring communities, we aim to shape the future of urban farming. we know that small changes can lead to big impacts. By helping more people understand and use these farming methods, we can build greener cities and stronger communities for the future ad healthier lives for generations to come

*Urban Farming* refers to cultivating, processing, and distributing food in and around urban areas. It involves innovative practices like rooftop gardening, vertical farming, and hydroponics, often integrated into urban landscapes to produce fresh, locally sourced food. Urban farming encompasses more than just food production—it includes related activities such as aquaculture, beekeeping, and small-scale livestock management.

*Urban farming* is much more than growing food in unconventional spaces; it's a movement aimed at addressing some of the most pressing challenges faced by modern cities.

By using rooftops, backyards, and other urban spaces, urban farming transforms underutilized areas into productive, green oases. This not only increases local food production but also:

- **Improves Food Security**: Especially in developing regions like Egypt, urban farming helps communities grow fresh, nutritious food in their vicinity, reducing reliance on long supply chains.
- **Promotes Environmental Benefits**: Urban farming contributes to cleaner air, reduced urban heat, and better waste management by using organic waste as compost.
- **Strengthens Community Resilience**: It encourages people to connect with one another, share knowledge, and collaborate on sustainable food systems.
- **Supports Local Economies**: By creating jobs and entrepreneurial opportunities, urban farming helps alleviate poverty and fosters small-scale economies.

Urban farming techniques range from traditional soil-based farming to innovative approaches that maximize limited urban space:

1. **Hydroponics and Aquaponics**: These systems allow plants to grow without soil, making them ideal for urban environments. Aquaponics combines hydroponics with fish farming, creating a circular, sustainable system.
2. **Vertical Farming**: Utilizing vertical spaces, such as walls and shelves, to grow crops increases yield without requiring extra land.
3. **Rooftop Farming**: Converting rooftops into green spaces not only produces food but also improves building insulation and reduces energy consumption.

4. **Composting and Bio-Fertilizers**: Using natural materials, such as yeast-based fertilizers, transforms organic waste into valuable nutrients for plants

While urban farming is promising, it comes with challenges like:

- **High Initial Costs**: Techniques like aquaponics and hydroponics require significant investment in equipment and training.
- **Space Limitations**: Urban areas often lack sufficient or accessible spaces for large-scale farming.
- **Technical Expertise**: The need for knowledge in managing advanced systems can deter widespread adoption.

***Egypt*** has seen notable efforts in urban agriculture, with initiatives like "***Your Roof Is Your Paradise***" and "***Greener Cairo***" promoting urban gardening. These projects are transforming rooftops and informal settlements into thriving green spaces. In Cairo, for example, simplified hydroponic systems are used to provide fresh vegetables in areas with polluted soil, addressing both health and environmental challenges.

- https://www.egypttoday.com/Article/1/102607/Your-rooftop-Your-Paradise-Initiative-to-plant-Egypt%E2%80%99s-rooftops

- https://cairoclimatetalks.net/event/greener-cairo-sustainability-through-urban-agriculture/

At ***BEZRAH***, we believe that urban farming has the potential to reshape communities. By advocating for sustainable practices and advising on the use of innovative techniques, we aim to empower people to create greener, healthier cities.

**Exploring Types of Urban Farming:**

Urban farming has evolved into a diverse set of practices, tailored to make the best use of limited urban spaces while addressing the growing need for fresh food and green environments. Each method not only transforms cities but also connects people to the essence of nurturing life. Here are the main types of urban farming that have been reshaping urban landscapes:

**1. Rooftop Gardens**

Imagine a bustling city where the tops of buildings bloom with vibrant gardens. Rooftop farming utilizes these often-overlooked spaces to grow vegetables, herbs, and even small fruit trees. Beyond providing fresh produce, they act as natural insulators, reducing building energy costs and mitigating urban heat.

**2. Vertical Farming**

This innovative technique stacks crops in layers, creating high yields on minimal land. Picture walls of lush greens in urban apartments or commercial spaces. Vertical farming is a game-changer in space-starved cities and allows fresh food to be produced close to consumers, reducing transportation emissions. Advanced systems even integrate LED lighting and automated watering for efficiency.

**3. Community Gardens**

These shared plots of land bring neighbors together, creating bonds over shared harvests and sustainable practices. Community gardens thrive on collective effort and are especially impactful in fostering food security and environmental stewardship in urban neighborhoods.

**4. Indoor Farming**

From basements to warehouses, indoor farming uses controlled environments to grow crops year-round. By managing light, temperature, and nutrients, indoor farming ensures consistent food supply regardless of external weather conditions. It’s a practical solution for dense cities, combining technology with sustainability.

Each of these farming methods contributes to a vision of cities that are more self-reliant and environmentally friendly. By embracing these techniques, urban farming creates not only greener cities but also fosters a deeper human connection with the environment. At ***BEZRAH***, we advocate for such sustainable methods, envisioning a future where urban agriculture becomes a cornerstone of community well-being.

Based on FAO:


**55%** of the world's population resides in urban areas


**800 million** people worldwide are involved in UPA (1996)


**79%** of all food produced is destined for consumption in cities


**266 million** urban households are involved in crop production in developing countries

Urban farming offers profound environmental, economic, and social benefits:

**Environmental Impact**

Urban farming turns gray cities green. By cultivating plants in urban areas, we reduce the carbon footprint associated with transporting food from distant farms to cities. These green spaces also improve air quality by absorbing pollutants and releasing oxygen, while mitigating urban heat through cooling effects. Additionally, it makes use of spaces that would otherwise remain idle, converting them into productive hubs of biodiversity.

**Economic Impact**

Urban farming contributes to local economies by creating jobs and reducing food costs. Whether it's rooftop farms or community gardens, these initiatives offer affordable, fresh produce while supporting small-scale entrepreneurs.

**Social Impact**

Urban farming strengthens the social fabric by bringing communities closer, offering spaces for collaboration, learning, and cultural exchange. It also encourages healthier lifestyles by promoting fresh food consumption and physical activity.

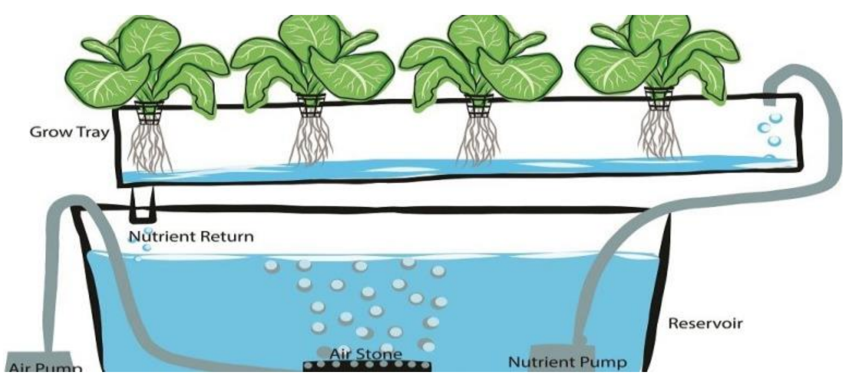
**Food Security**

Urban farming provides a lifeline. It ensures access to fresh, nutritious food, especially in underserved urban areas. By growing food locally, cities can reduce reliance on global supply chains and build resilience against disruptions.

At ***BEZRAH***, we believe that urban farming is more than a solution—it's a movement toward sustainable living. We hope to shape the future of urban farming and create greener, healthier cities for generations to come.

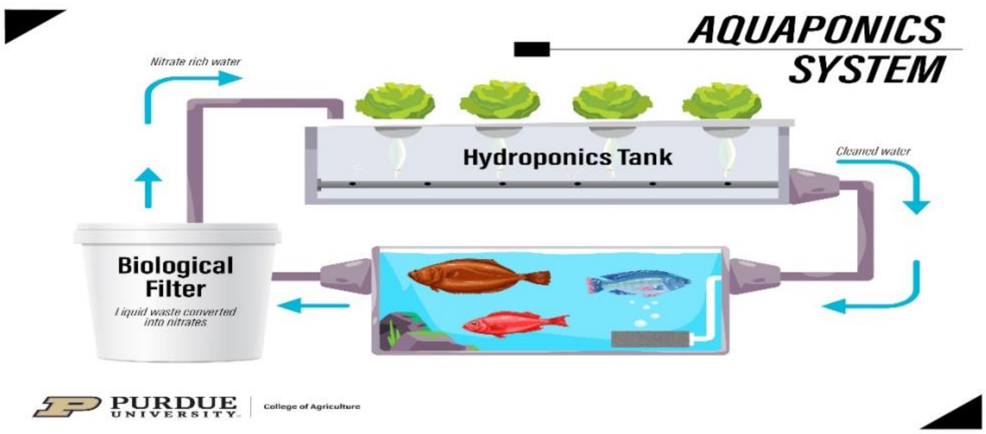
**Techniques Used in Urban Farming:**

**Hydroponics**



This method eliminates the need for soil by growing plants in a nutrient-rich water solution. It maximizes space and conserves water by recycling it within the system, making it an excellent choice for areas facing water scarcity. Hydroponics also enables year-round farming in controlled environments, ensuring high yields and minimal use of pesticides, as pest risks are reduced indoors. This technique is especially impactful in urban areas with limited land.

### Aquaponics




Aquaponics combines hydroponics with aquaculture, growing plants and fish together in a closed-loop system. The fish waste acts as a natural fertilizer for plants, while plants filter and clean the water for the fish. This sustainable approach uses 90% less water than traditional farming and supports biodiversity, including fish species like tilapia and vegetables like leafy greens or tomatoes. In urban settings, aquaponics can thrive in small spaces like rooftops, backyards, or community gardens.

### Bio-Farming

Emphasizing organic principles, bio-farming avoids synthetic fertilizers and pesticides. It relies on natural compost and techniques like crop rotation and companion planting to maintain soil health and ecosystem balance. Bio-farming fosters sustainable practices while offering nutrient-rich produce, making it a cornerstone of urban farming initiatives that prioritize environmental and human health.

## Composting

Composting involves recycling organic waste—such as food scraps and plant residues—into nutrient-rich fertilizer. Urban farming benefits greatly from this low-cost and eco-friendly technique. It reduces landfill waste, lowers greenhouse gas emissions, and enriches soil quality, creating a sustainable cycle for food production in cities.

## ***Urban Farming's Role in Sustainable Development Goals:***


***Urban farming*** plays a significant role in advancing the United Nations' Sustainable Development Goals (SDGs) by addressing critical global challenges through locally driven, sustainable solutions. We will explore its contributions in detail, showcasing how it touches the heart of sustainability and community well-being:


### 1. SDG 2: Zero Hunger

Urban farming directly addresses food security by growing fresh, nutritious produce in cities where access to affordable and healthy food may be limited. It's not only about providing immediate food sources but also about building long-term resilience in urban communities. Local food production reduces dependency on global supply chains, lowering food costs and environmental impacts. Furthermore, it allows for diverse crops suited to local needs, which can be particularly beneficial in areas facing food deserts.

**2. SDG 3: Good Health and Well-Being**

Urban farming is a powerful tool for improving health. It provides communities with access to fresh produce, which is essential for a balanced diet. In addition, gardening has well-documented mental health benefits: the act of growing plants reduces stress, promotes mindfulness, and strengthens community bonds. The time spent outdoors, tending to crops, has proven physical health benefits by encouraging exercise and reducing air pollution.

**3. SDG 11: Sustainable Cities and Communities**

Urban farming contributes to the development of sustainable cities by transforming underutilized or neglected spaces into green, productive areas. Whether it's rooftop gardens, community plots, or vertical farming systems, these initiatives enhance urban biodiversity and improve air quality. By integrating agriculture into the urban landscape, cities can become more self-sufficient, reducing dependence on external sources for food. The transformation of urban spaces into sustainable farming areas also increases green cover, contributing to improved urban resilience against climate change.

**4. SDG 12: Responsible Consumption and Production**

Urban farming aligns with the principles of circular economy by reducing food waste and utilizing resources more responsibly. Composting, a key aspect of many urban farms, helps recycle organic waste back into the soil, which can then be used to fertilize crops. This reduces the need for synthetic fertilizers, promoting organic farming practices. By making food production more local and waste management more efficient, urban farming helps reduce the carbon footprint associated with food production.

**5. SDG 13: Climate Action**

Urban farms have the potential to reduce carbon footprints in multiple ways. Local food production minimizes transportation emissions, as produce does not need to travel long distances to reach urban consumers. Furthermore, green roofs and community gardens help to mitigate the urban heat island effect by providing natural cooling and increasing green cover. As urban farming grows, it can also function as a carbon sink, absorbing $CO_2$ and supporting efforts to combat climate change.

**6. SDG 15: Life on Land**

Urban farming also plays a role in preserving biodiversity. By integrating farming into cities, these projects create habitats for pollinators, birds, and beneficial insects. Additionally, urban farms contribute to soil health and reduce urban sprawl, preventing the overexploitation of land and encouraging sustainable land use. Even in densely populated urban areas, farming methods such as vertical gardens or rooftop farms can support a wide variety of species, fostering a more biodiverse environment.

***Urban farming*** is not just a way to grow food—it is a powerful movement that has the potential to reshape cities into sustainable, resilient, and healthier places to live.

By addressing hunger, improving well-being, reducing waste, and supporting climate action, urban farming helps to make cities more self-reliant and environmentally conscious. By advancing these SDGs, urban farming offers a hopeful pathway toward a more sustainable future, one community garden at a time.

## 🌱Rooftop Farming Application 🌱

**There are two types of crops that can be used in rooftop farming, which are:.**

1- Traditional agriculture.

2- Modern agriculture such as (Hydroponic agriculture and Aeroponics).

- Traditional agriculture differs from modern agriculture, as traditional agriculture is considered a primitive method that relies on the use of simple tools, unlike modern agriculture, which uses modern methods and new agricultural technology. It is also possible to differentiate between them through simple points such as the following:

## 1- Traditional agriculture

expresses the agriculture practiced in the past and passed down through generations, using usual tools and methods. Traditional agriculture depends on the use and treatment of agricultural soil.

- *Types of plants that can be grown in the traditional way:*

  Usually most or all types of plants, and these are some of the types widely used in rooftop cultivation (tomatoes, cucumbers, peppers, spinach, green coriander, parsley, watercress, radishes, and others).

- *Characteristics of traditional agriculture:*

  1. Providing a source of food.
  2. Preserving the genetic genes of plants.
  3. Preserving environmental diversity and biological systems.
  4. Using traditional seeds in agriculture.
  5. Diversity of plants used in agriculture.
  6. It may take a long time to produce crops.
  7. Agricultural animal manure is often used as organic fertilizer for the soil.

- *Tools used in traditional agriculture:*

  1. Hand Sickle (for collecting and harvesting plants).
  2. Pickaxe (coordinating and cleaning the soil around the plant)
  3. Shovel (digging the soil)

4. Hoe (it has several uses such as organizing and cleaning the soil, getting rid of weeds and harmful materials).
5. Greenhouses, basins, or simple units made of plastic or any other material are used to place the plant in them.
6. The soil is also prepared, so that it is light in weight and its thickness is 10:5, and it may be more or less depending on the type of plant.

**2- Modern agriculture.**

- They are used as quick ways to produce crops and increase money earning.
- It relies on modern and effective methods of agriculture.
- It uses modern technology and tools.
- Some hybrid and new seeds are often used in agriculture.
- Modern agriculture encompasses a variety of methods and techniques aimed at improving crop production, reducing waste, and increasing resource efficiency. Below are some types of modern agriculture:

**A.** Protected Agriculture (Greenhouses)

1) Relies on cultivating crops within controlled environments (e.g., glass or plastic greenhouses).
2) Provides protection for crops from weather conditions and pests.
3) Enables the cultivation of crops outside their natural growing season.

**B.** Hydroponics

1) Involves growing plants without soil, using nutrient-rich water instead.
2) Suitable for areas with limited arable land or poor soil quality.
3) Consumes less water compared to traditional farming methods.

**C.** Aeroponics

1) Plants are suspended in the air and nourished with a mist containing nutrients.
2) Significantly reduces water consumption and allows precise monitoring of plant growth.

**D.** Vertical Farming

1) Focuses on growing crops in stacked layers within specialized facilities.
2) Utilizes artificial lighting and environmental control technologies.
3) Ideal for urban areas with limited agricultural spaces.

**E.** Organic Farming

1) Produces crops without using chemicals or synthetic fertilizers.
2) Aims to ensure environmental sustainability and maintain soil health.

**F.** Smart Farming

1) Employs advanced technologies like the Internet of Things (IoT) and Artificial Intelligence (AI) to boost productivity.
2) Includes using sensors to monitor soil, weather, and water conditions.

- **Benefits of Modern Agriculture:**

1. Increased productivity.
2. Reduced resource consumption.
3. Minimized environmental impact.
4. Enhanced quality of agricultural products.

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**Hydroponics (The Hydroponic Revolution)**

**Abstract**:

With the growing global population, increasing desertification, and the shrinking of vast areas of arable land, the issue of food shortages, especially basic food supplies, has emerged. In some areas, the land has become unsuitable for agricultural production, or there is insufficient space for farming. One of the modern solutions is hydroponics, which relies on environmental solutions as a

fundamental pillar to reduce water usage and overcome the lack of arable land. This study considers hydroponics as a sustainable solution and explores its various aspects.

**Keywords**: Hydroponics, nutrients, nutrient solutions.

## Introduction:

Although humanity has associated farming with the existence of humans on Earth, for thousands of years, it was widely believed that soil, water, and light were essential for agriculture. However, scientists discovered a new farming method that does not rely on soil, called hydroponics. This method involves the growth of plants and their roots in nutrient solutions. Hydroponics is a relatively modern term referring to the cultivation of plants without soil.

This method dates back to ancient times, such as the Hanging Gardens of Babylon and the agricultural practices in Mexico and China, which were considered early forms of hydroponics (Resh, 2013).

Hydroponics is both a science and an art within the field of botany. It offers unique advantages, including high-quality production, increased productivity, and flexible system designs. Moreover, hydroponic farming contributes to national economic stability, supporting sustainability, security, and sovereignty in societies and nations. Throughout history, it has been evident that adopting this method has had profound impacts, as noted by Jacob (2009).

Growing plants without soil (hydroponics) is a promising approach, as it involves cultivating plants in nutrient-rich solutions, providing extraordinary results. This system allows for combating nutrient deficiencies, offering both essential and supplementary nutrients effectively. In fact, plants grown through hydroponics often achieve better growth compared to traditional soil-based methods (Resh, 2013).

Additionally, plants grown hydroponically rely on photosynthesis, a process in which sunlight and a chemical compound in leaves called chlorophyll convert carbon dioxide and water into glucose and oxygen, eliminating the need for soil.

Soilless farming serves as evidence that plants can grow without soil, relying solely on water and the nutrients they require. This method facilitates easy access to essential nutrients without dependence on soil. If these elements are unavailable in the natural environment, they can be transported and provided to plants through a nutrient-rich solution. This technique eliminates the need for soil entirely, making it a flexible and straightforward approach.

Hydroponics is a method that involves placing plant roots in an aqueous environment enriched with a mixture of nutrients and minerals essential for growth. Various systems are based on this technique, but the core elements of any hydroponic system revolve around accurately and effectively supplying nutrient-rich water.

The term Hydroponics is derived from two words: the first, "Hydro," meaning water, and the second, "Ponics," referring to work or cultivation. This indicates that the system relies on water as the primary medium for delivering essential nutrients to plants (Jones, 2014).

This system is particularly effective in nourishing plant roots with diverse nutrients, significantly enhancing the efficiency of water and nutrient usage. These essential nutrients, ranging between 12 and 16 elements, are dissolved in a nutrient solution distributed to plant roots. The solution is specifically designed to nourish plants in a balanced manner without requiring traditional soil.

This technique offers a practical solution to challenges such as arid lands and desertification, providing an accessible and viable alternative to conventional farming. Hydroponics relies on nutrient solutions containing the vital elements necessary for rapid and sustainable plant growth. It also helps address many challenges faced by traditional agriculture, such as the scarcity of arable land or soil degradation.

Hydroponics is an effective method for ensuring food production, presenting an innovative solution to the scarcity of land and water. It opens new horizons for achieving food security and environmental sustainability.

**<u>Hydroponic Farming Techniques:</u>**

1. Nutrient Film Technique (NFT):

- This is a true hydroponic system where plant roots are directly exposed to a thin film of nutrient solution. The channels and pathways are made from flexible, bendable materials. The seedlings are placed with a small growth medium like rock wool, and the edges of the board are bent towards the base of the seedling to block light and evaporation. Surprisingly, as the plants grow, they form a mat-like structure at the bottom of the channel. The maximum length of the channel ranges between 5 to 10 meters, and it is placed at an incline.

2. Flow Technique:

- This is one of the main techniques used in hydroponics, where plants are grown without soil and rely on a nutrient solution to provide the necessary elements for growth. In the flow technique, a thin layer of nutrient-rich water continuously or periodically flows over the plant roots.

- <u>How the Flow Technique Works:</u>

  - The nutrient solution is pumped from the reservoir to the beginning of the channel, where it flows in a thin layer over the plant roots. The roots absorb the required nutrients, and any excess solution is returned to the reservoir for recirculation.
  - One of the advantages of this system is the good aeration of the roots, as the continuous flow improves oxygen delivery to the roots. Additionally, it has

low operating costs, requiring less water and fertilizer compared to traditional farming.

- The Flow Technique (NFT) is an ideal choice in modern hydroponic farming due to its efficiency and sustainability, especially in areas with water scarcity or infertile soil.
- One disadvantage of this system is that it can be difficult to remove individual plants, as the roots may intertwine with each other.
- Other hydroponic techniques used worldwide include drip and wick systems.

**Hydroponic Requirements:**

1) Light:
   Plants grow best when exposed to sunlight for at least 8 hours a day.

2) Temperature:
   Plants grow directly when exposed to an appropriate temperature.

3) Humidity:
   Plants that are adequately supplied with water will develop normally. However, if they are not given enough water, they will develop abnormally due to stress. Therefore, plants must have sufficient water at all times. Additionally, waterborne diseases can harm the plants.

## The Importance of Hydroponic Farming:

The importance of hydroponic farming lies in the fact that farmers can achieve yields several times greater when they abandon traditional methods. This is because plants grown in water are directly nourished with nutrient-rich solutions, allowing them to absorb what they need much more easily than plants growing in soil. As a result, they develop much shorter roots and dedicate more of their energy to promoting the growth of leaves and stems. With hydroponic systems, it is possible to grow more plants in the same space and achieve higher yields from the same amount of land.

Hydroponic plants also grow faster because many soil-related pests are eliminated. Therefore, eliminating the use of soil provides a healthier growing system with fewer disease-related problems, making hydroponic farming ideal for indoor cultivation. It can be used to grow plants year-round. Additionally, hydroponic farming can be conducted on rooftops to grow vegetables and herbs or inside homes to cultivate ornamental plants that are less dependent on sunlight, as well as on balconies.

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**Agriculture currently involves the use of natural organic fertilizers, resulting from several different processes, as there are a few different methods used in making organic fertilizer, below we will discuss some examples:**

# Utilization of food waste in production of bio fertilizer:

| **FW nature** | **microorganisms** | **Enzyme activity** | **Functional role** |
|---|---|---|---|
| Vegetable, fruit, and food waste compost | *Brevibacillus borstelensis* (thermophilic) | Cellulolytic, lipolytic, proteolytic, and amylolytic activities. | Microbial inoculation enhanced the degradation of FW, increased the total N and the germination rate of alfalfa seed, shortened the maturity period, and improved the quality of bio-fertilizer. |
| Agricultural and animal waste (chicken waste) | **Three bacteria:** *Bacillus coagulans, Bacillus licheniformis*, and *Bacillus smithii*; one actinomycete: *Streptomyces thermophilus*. **One fungus:** *Aspergillus fumigates* (thermo-tolerant P-solubilizing microbes) | Carboxy-methyl-cellulases, amylase, protease, chitinase, pectinase, lipase, and nitrogenase activities. | These thermo-tolerant microbes can convert agricultural, animal (poultry and livestock wastes), and food (vegetable and fruit wastes from markets and households) wastes into multi-functional bio-fertilizers for bioresource recycling and sustainable agriculture applications. |
| Organic waste and municipal vegetable waste | *Bacillus subtilis, B. licheniformis,* and *B. haynessi*; Fugal isolates: *Talaromyces pinophilus*, *Myrothecium verrucarria, Aspergillus terrus,* *Acremonium implicatum, Hanseniaspora guilliermondii*, and *Phanerochaete chrysosporium* | Cellulase, amylase, xylanase, protease, and pectinase producers | Bioconversion of organic and municipal vegetable waste into crude enzymes, animal feed, compost, and liquid bio-fertilizer (increased amount of K, phosphorus, and N that improve the soil fertility and also showed antagonistic activity so that it can be used in agriculture practices). |
| Organic waste | *Bacillus subtilis*, *Pseudomonas* sp | - | It increased the total N and P solubilizing activity. |
| Soil rhizosphere | *Bacillus* spp. *Azotobacter* spp | - | They can fix N, solubilize P and K, and protect from pathogen/insect attacks. |

| | | | |
|---|---|---|---|
| | | | And they were also used for the production of liquid bio-fertilizer in mixing with fruit waste. |
| Composting material (wooden cylinders, Sawdust, rice bran, and condensed molasses fermentation soluble) | *Bacillus licheniformis*, *Gordonia terrae*, and *Virgibacillus halophilus* (thermophilic) | Cellulase activity | Conversion of aquaculture FWs into bio-fertilizer. This bio-fertilizer efficacy was assessed based on the Chinese cabbage germination percentage. |
| FW and human excreta | **Bacteria:** *Escherichia, Citrobacter, Bacillus, Pseudomonas, Proteus, Klebsiella, Clostridium, Bacteroides, Enterobacter, Staphylococcus, Salmonella,* and *Streptococcus*; **Fungus:** *Aspergillus, Mucor, Rhizopus*, and *Penicillium* (mesophilic, thermophilic) | - | These can boost the digestive bio-fertilizers' efficiency through N fixation and nutrient solubility in soils. They also increase the digestion mechanisms of FWs via the AD pathway. |
| FW compost | *Bacillus subtilis, B. subtilis* and *Bacillus coagulans* | - | Anaerobically-fermented MKR (model kitchen refuse) compost with the bacterial isolates promoted the growth parameters of the *Brassica rapa* plant. |
| Liquid FW material | *Bacillus* spp | - | Liquid FW material amendment with PGPB isolate enhances the growth of *Brassica rapa* compared to chemical fertilizer. They showed indole acetic acid production activity, 1-aminocyclopropane-1-carboxylic acid deaminase activity, siderophore production, and P solubilization activity. |

| | | | |
|---|---|---|---|
| FW | *Bacillus mojavensis* | - | Showed antifungal properties against *Aspergillus terreus*, *A. fumagatus, A. flavus*, and *Fusarium redolense* and improved the growth of altari radish and lettuce. |
| Kitchen waste oil | *Pseudomonas aeruginosa* | Acyl-CoA synthetase, hexadecanoyl-CoA, acyl-CoA dehydrogenase, Enoyl-CoA hydratase, CoA-dehydrogenase and CoA-acyltransferase | Kitchen waste oil is composed of long-chain triglycerides, which the isolate degrades. And the isolate also converts the kitchen waste oil into bio-fertilizers that enhance cabbage growth |
| Vegetable waste | *Clostridium, Bacillus, Pseudomonas, Actinobacteria, and Micrococcus* | - | These N-fixers and P solubilizers confer bio-fertilizer potential to the digestate. |
| Vegetable waste | *Bacillus sp. and Pseudomonas sp* | - | The isolates are involved in composting by decomposing the waste and enhancing green gram plant growth. |
| Dairy manure | *-Bacillus subtilis, fluorescent pseudomonads, Pseudomonas putida (Mesophilic)*<br>*-Bacillus licheniformis, Pseudomonas spp., Pseudomonas aeruginosa (Thermophilic)* | - | All isolates significantly promoted wheat growth, and AD was a potential source of PGPB. "plant growth promoting microbes" |
| soil | *Aspergillus niger* | - | When combined with FW, it significantly inhibits Fusarium growth and enhances plant growth by P solubilizing activity. Through this fertilizer production procedure, FW recycling is possible. |
| Palm oil industry waste | *Bacillus tequilensis (biocontrolling and composting), Enterobacter* | Cellulase, xylanase, | Some bacteria play significant roles during |

| | | | |
|---|---|---|---|
| | *cloacae subsp. Dissolvens (plant growth promoting and bio-controlling agent), and Citrobactersedlakii (plant growth promoting and composting).* | chitinase, and lignin peroxidases | composting, promoting plant growth, protecting against *Ganoderma boninense* infection, and enhancing palm oil yield. |
| Food process waste | *Bacillus siamensis, Bacillus subtilis, Proteus cibi and Providencia hemibachae* | Proteolytic, cellulolytic, Ligninolytic, Lipase activity | These bacterial isolates exhibited beneficial traits, including indole acetic acid production and antifungal activity against *Phytophthora capsici, Rhizoctonia solani, Botrytis cinerea* |
| Organic waste materials | *Alphaproteobacteria, Actinobacteria, Bacilli, Betaproteobacteria, Cytophagia, Flavobacteriia and Gammaproteobacteria* | | Radish and Chinese cabbage growth were significantly improved by organic formulations with this bacterial diversity. |
| FW | *Knoellia subterranean, Sphingomonas sediminicola, and Funneliformis mosseae* | | These PGPMs are enhanced the plant canopy by increasing the biomass ratio of shoot/root in tomato and lettuce plants, enhancing the total yield capacity, and delaying fruit ripening in tomatoes. |
| Agricultural waste press mud | **Bacteria:** *Bacillus wiedmannii;* **Fungus:** *Aspergillus niger* | Cellulase, amylase, xylanase, and pectinase activity | These microbes are effectively speeding up the maturation of lignocellulosic waste and boosting nutrient contents compared to the noninoculated substrate; however, the consortium demonstrated its effectiveness by more remarkable development in waste degradation and increasing nutrient contents compared to individual microbial isolates |
| | *B. altitudinis* | Cellulase | |
| | *B. velezensis* | Cellulose and amylase activity | |
| | *Pseudomonas aeruginosa* | - | |

| | | | |
|---|---|---|---|
| Landfill extracts | *Actinomadura spp, Streptomyces spp, Rothia spp* | Cellulase, N reductase activity | Microbes break down the lignin and cellulose in organic waste (sewage sludge, vegetable waste, chicken litter, sawdust) during composting, and the bio-fertilizer can actively enhance Okra and Maize plants' growth-related parameters. However, the consortium of *Streptomycetes* spp and *Rothia* spp produced better results. |
| Limestone deposit sites | *Amycolatopsis sp.* | Keratinase | The keratinolytic enzyme-producing isolate showed antifungal and PGP properties through IAA production and P solubilization. This isolate also generated feather hydrolysate, which markedly improved rice plant growth in field trails. This investigation showed that this strain might lead to the synthesis of inexpensive fertilizers from used chicken feathers. |
| Chicken waste | *Alternaria tenuissima* | Keratinolytic enzymes | The study showed that the fungal isolate was effective at degrading feathers and improving the nutrient value of the soil by adding the proteins cysteine, lysine, methionine, and valine, which also enhanced the growth and health of the chickpea plant. The soil's nutrient quality depended on the isolate's keratin degradation capability. |

## A. Preparation and application of bokashi in production of bio-fertilizer:

1. 2cups of rice + 2cups of distilled water.
2. Stirring then leave for 15-20 min.
3. Filter them and place filtrate in a jar and close them with permeable cover “cloth or sponge”.
4. Leave jar for 2-3 days, liquid separated and starch is precipitated.
5. Filter them and take liquid.
6. Liquid is mixed with milk in 1:10 ratio respectively.
7. Stirring then cover with permeable cloth.
8. Added in warm place for 24 hours. “turned off oven”
9. Placed in refrigerator for 2 days.
10. Place the result in cloth and hang it vertically in order for liquid to be drained which contain starter. “can be used in this stage by diluting each ml to liter of water_ can be valid for 3 months in room temperature and 1 year in refrigeration”
11. Mix liquid with molasses “free from sulfate” or date deps or brown sugar in ratio 1:1 and seal with closed cover in case of refrigeration and permeable cover in case of storage at room temperature.
12. 10 kg egg cartoons or black and white magazines or coarse bran or barley bran + approximately 30 gm of dry yeast dissolved in 9 cups of distilled water and leave it to activate for 10-15 min + 3 cups resulted from step no.11 is mixed with 30 cups of distilled water.
13. Add one cup of yeast and one cup of distilled EM1 in bran till it hold together when squeezed but not release excess water and disaggregate when left.
14. Add in black plastic bag and press the air out then tightly close the bag.
15. Place the bag in container and close it tightly not letting any oxygen enters and leave it for a month.
16. Dry it in the air and can be used or stored in bags or containers covered or uncovered.
17. Add any type of solid food waste “not spoiled” after cutting it to increase surface area to container contain 2 levels the upper has a perforated bottom and the lower have tap.

**18.** Each 4-5 cm of food waste covered with handful of bokashi starter till the container is filled and leave it for two weeks.
**19.** Drain the liquid day on and day off and each ml of this liquid is diluted with 1 liter of water and can be applied.
**20.** After 2 weeks take the fermented food waste and burry it in 10 cm depth in soil then cultivate your crops.

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**B. Preparation steps for homemade fungicide:**

**1)** 100gm bitter lupine. “baladi”
**2)** Full spoon turmeric.
**3)** Full spoon cinnamon.
**4)** 1liter boiling water.
**5)** Covering and leave 2 hours.
**6)** Filtration and add the filtrate in sprayer.
**7)** Dilution by adding water till the 2 liter indicator.

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**C. Using the larvae of the black soldier fly to recycle organic waste**.

This is done by feeding the larvae on food scraps or any other organic waste.as the life cycle of the fly takes place as follows:

1- The life cycle of the black soldier fly begins with mating between the male and female, and then the female lays eggs. It ranges between 300 and 900 eggs.
2- The eggs hatch after a period of 4-5 days, where any food is placed in order for the eggs to hatch and the larvae to grow on it.
3- The larval stage begins, and this stage usually lasts for 15 days. The larvae are fed with food that contains a high percentage of moisture (it may reach 70%). Here, it is preferable to use the larvae as feed at the age of 10-12 days because they contain the largest percentage of protein.

4- The larvae are separated from the formed organic fertilizer (larval waste, which is called Ferass), and used directly in agricultural soil.
5- Then the pupal stage, after the larvae complete their growth, stops eating for about a week; In preparation for the dormant phase.
6- The dormant stage, the larvae prepare to transform into a fly and become a cocoon. At this stage, flies feed only on water.

**Notes**:

1- It is preferable to place the larvae at a temperature of 27 degrees, and it is not necessary to provide light; Because it doesn't like lighting.
2- In the dormant stage and when the larvae turn into flies, they are provided with a place with high lighting in order for the mating process to occur.
3- The larvae are used as a nutritional supplement and not as a complete food, so it is preferable to add them to food at a ratio of 25:50% while monitoring the reaction of animals or poultry.
4- The larvae are used as food for poultry and pets.
5- The larvae may be used alive or dried.
6- It is possible to use the waste of poultry or agricultural animals; As food for larvae, but it gives a lower percentage of protein than using plant waste.

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