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Dear reader,

The wet season is here and as the crops thrive in the farm, we must be prepared to take care of them through timely scouting for any occurring pests and applying techniques that effectively manage them without contaminating the crops or the environment.

In this edition we feature a comprehensive article on Integrated Pest Management (IPM) approaches that you can adopt to minimize pest damage on crops.

What technologies are you practicing to take advantage of the rains to harvest water and ensure moisture retention. Remember conserving water for the dry season, will save you resources and keep your farm productive despite water scarcity in months to come. Read on for ideas on how to harvest and conserve water for farm and household use.

Are you a livestock keeper wondering how to maximize yields through controlled breeding? An expert on animal genetics outlines various service providers in Kenya who support farmers in rearing breeds of preferred traits through advanced technologies.

With the changing agricultural landscape, farmers need to be dynamic in diversifying their income streams. This edition features an article on the business of sweet potato vine multiplication and the market opportunities among farmers.

Read on for these and much more in this edition of TOF Magazine.

PEST MANAGEMENT

Using IPM to manage pests and grow healthy crops

IPM combines different practices to reduce pest damage, keep crops healthy, minimize human health risks and reduce negative impact on the environment

By Grace Kinyanjui

IT IS THE onset of long rains and farmers are busy in their fields sowing their seeds with the hope of growing healthy crops and getting a good harvest. Among the challenges facing modern organic farming are pests and diseases and this planting season is no exception.

Despite these problems, it is important for organic farmers to consider good agricultural practices for the production of safe and healthy food. Pest control in organic farming is best achieved with an integrated pest management (IPM) approach. IPM combines different practices to reduce pest damage, keep crops healthy, minimize human health risks and reduce negative impact on the environment. The crucial IPM practices to adopt include monitoring, cultural, mechanical and biological pest control methods.

Snails and slugs are the common pests during the rainy season. Others include caterpillars, cutworms, thrips, stem borers, African armyworm, leaf beetles, burrowing insects and plant-parasitic nematodes. Insect pests such as leaf mining flies, cabbage moths and loopers, diamondback moth, sap sucking insects such as aphids, white flies, spider mites, and mealy bugs have slowed growth rates and thus are less abundant during the rainy season. But farmers should be cautious because even short periods of warm weather could rapidly increase the growth rates of these insects and result in significant crop damage. Most crops are also susceptible to plant pathogens such as fungi, viruses and bacteria, which cause diseases and related plant health problems. Successful implementation of an IPM approach requires monitoring as a basic component.

Regular monitoring enables early detection of pests and correct timing of a suitable pest control method. Monitoring requires proper identification of pests and their damage symptoms. Thus, it is important for farmers to recognize the pests on their crops and look out for feeding injuries such as irregular holes,

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Growing more food in less space

A multi-storey kitchen garden can be set up in fields, on balconies, or in house yards. They are essential in reducing poverty among households in both urban and rural settings PAGE 11

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yellowing, curled and distorted leaves, and malformed fruits. Cultural control are practices that disrupt the environment and make it less favorable to the pest's survival or reproduction. Cultural practices include soil health management, crop rotation, sanitation, intercropping, weed management.

- Investing in soil health guarantees production of strong and healthy plants that are less vulnerable to pests and diseases. Practices such as crop rotations, use of cover crops, conservation tillage, composting and vermi-composting promotes healthy soils that are rich in organic matter, microorganisms and nutrients.
- Crop rotation disrupts the life cycle of insect pests, reduces occurrences of soil-borne diseases and increases soil fertility. For example, good crop rotation of potatoes with non-host crops reduces the population and infestation of root knot nematodes and potato cyst nematodes.
- Field sanitation minimizes pests by removing or destroying their breeding sites. It involves removing crop residues, and diseased and infected plants. Slugs and snails can be controlled by removal of excess plant litter, weedy plants, and other refuges.
- Intercropping aims at reducing pests by diversifying the crops in a farm. For example, a maize-legume intercrop reduces impacts of maize pests such as fall armyworm and stem borers.
- Trap cropping is the planting of an attractive plant that protects the main crop from certain pests. Trap crops such as sunflower and sorghum can lure pests away from vegetables.
- Other cultural practices include proper weed management and use of cover crops. Mechanical and physical control are practices that destroy pests or put a barrier to pest infestation by creating unsuitable conditions for their entry or survival. Examples include mass-trapping, hand picking of pests (e.g. caterpillars, beetles, snails, slugs), soil solarization and fruit bagging.
- Light traps target night flying insects and moths such as armyworms, cutworms and stem borers. Yellow sticky traps control leaf mining flies, aphids and whiteflies. Others include blue sticky traps that target thrips, pheromone and water traps.

Several beneficial insects including predators (e.g. predatory mites) and parasitoids (e.g. Diglyphus isaea) from Dudutech Ltd and Koppert Biological Systems (K) Ltd are commercially available to manage various pests. Farmers can also manipulate their farms (habitat diversification) to increase these beneficials. For example, flower strips in a farm provide food resources such as pollen, nectar and shelter for natural enemies and pollinators.

Other biological controls include:

- Microbial biopesticides are formulations of microorganisms such as bacteria, fungi or viruses with pesticidal effects. For instance, commercial products with bacterium Bacillus thuringiensis (Bt) are used against a wide range of leaf chewing caterpillars. Biopesticides with Beauveria bassiana (e.g. BEAUVITECH WP) or Metarhizium anisopliae (e.g. Mazao ACHIEVE) and other fungal species are also commercially available to control crop pests. Products such as MYTECH WP and BIO NEMATON are biological nematicides that are used to control plant-parasitic nematodes.
- Commercial botanical biopesticides are comprised of neem (Azadirachtin) and pyrethrin active ingredients. NIMBECIDINE is an example of a botanical insecticide from Osho Chemical Industries Ltd that protect crops from leaf chewing caterpillars and sap sucking insects.
- Home-made biopesticides are components of pest management in organic farming. These include extracts of plants such as neem, pyrethrum, garlic, tobacco, chilli pepper or marigold. Usually, two (2) or more plant extracts are mixed together in soapy water for improved efficacy against target pests.

Cultural control are practices that disrupt the environment and make it less favorable to the pest's survival or reproduction

In addition to IPM, plant disease management is very important in maintaining healthy crops. A range of biological and copper fungicides that are compatible with IPM are available in the agrovets and can be applied as preventive treatments to protect crops from fungal and bacterial diseases.

https://www.infonet-biovision.org/natural-pest-control/biopesticides-kenya

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Water Harvesting Techniques

Water scarcity has significant impact on agricultural productivity, especially in arid regions. Erratic rainfall due to climate change has awakened farmers to practice water harvesting to sustain their farms

By Maurice Barasa

MAJORITY OF SMALL-SCALE farmers in Africa rely on the rainfed agriculture for food production. Research shows that water scarcity has significant impact on agricultural productivity, especially in arid and semi-arid regions. Erratic rainfall patterns due to climate change have awakened farmers to practice water harvesting to sustain their farms.

The topographic features of region; type of soil, geological patterns, climatic condition of a region and proximity to water bodies plays key role in selection of water harvesting techniques employed by farmers. The approaches used in water harvesting directly affect the soil moisture and water retention ability, hence influencing the productivity of the farm.

Water Harvesting and Soil-Moisture Conservation Techniques

Dams and Ponds

Dams are often constructed along the river, streams, waterways or dry valleys that experience runoff during rain seasons. Farmers therefore construct a barrier across the water cannels to collect large volumes of water that are used during dry seasons for irrigation and watering animals.

More developed dams have larger water volume that is equivalent to lakes, hence may support hundreds of farms for a longer period. Ponds are fairly small depressions formed either along the streams or inside the farm to collect runoff. Ponds exist both naturally and artificially. It may be communally or individually owned by the farmer. In mountainous areas, ponds are used to control soil erosion and help proper water penetration in the soil.

Half-Moon/ Demi lunes Approach

This approach is commonly used in ASAL and mountainous regions. Farmers sink excavations on the surface, which take the shape of a moon. The excavations are meant to trap water during rain season and nutrients curried by the runoff.

They also slow down the speed of surface runoff hence controlling soil erosion. Demi lunes improve soil-water holding capacity, which is critical in crop production. In ASAL regions, half-moon approach is used to support cover crops where initially no vegetations survived.

Trenching

Most of the roads in rural areas, especially Africa were previously waterways and experience high volume of runoff during rainy season.

Farmers construct the trenches from the roads to redirect the runoff to their farms where they either use the water directly to get to crops or store them in ponds for future use. Trenching is vital in reducing erosion and conserving soil moisture.

Bunds

Bunds are semi-circular raised structures on a slanting land to slow down the speed of runoff. During construction, farmers should ensure that the tips of bunds are on the same level with the contour and face upslope. Water collected may be used later to water crops. However, some farmers grow trees, shrubs and crops once the bunds are filled up with soil sediments and silts. Bunding helps to improve water retention and infiltration capacity of the soil, hence high productivity.

Wells

These are deep holes sunk below the water table to allow collection of underground seepage. This is the best approach to recover water lost from the surface through seepage/ infiltration. Wells are often suitable in ASAL regions, especially where the top soils are sandy. In the recent technology, farmers fit solar-panel pumps in wells to pump up water into their farms.

Roof Harvesting

This involves simple and standard harvesting methods. Simple roof harvesting is where farmers use small barrens ranging from 20 liters to 100 litres to collect water from their roofs. Farmers often tie the rope or use a long stick connected from the gutters to the collecting can to reduce water wastage. This is often used to collect water for domestic and livestock use. Standard roof water harvesting involves the use of large tanks holding more than 1000 litres of water. The tanks are well installed on a raised flat surface, where the mouth of the tank is at the same level with the gutters. During high rainfall, farmers with more tanks may harvest enough water to irrigate their kitchen gardens during dry season. Farmers may choose to use plastic, concrete or metal tanks depending on the availability of resources.

Rock Catchment

Farmers living in rocky areas have had challenges in water management. During rain season, most of the runoff is wasted to the lower side, with some of it penetrating the soil. Farmers however, have learned to practise rock outcrop methods to harvest water. The lower side of the rock is well cut and furnished to form a large depression around the rock that collects every drop landing on the rock. A tap or an outlet is fitted to allow collection and redirection of water into the farm.

Sand Dams

This involves the construction of structures across the seasonal river beds to collect water and store it in different sand layers. The dams replenish groundwater during dry season, making them more reliable throughout the

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year. Sand dams also promote soil-moisture conservation through recharge of aquifers and support of vegetation growth.

Fog Nets

Farmers might use fog nets to collect falling water droplets in areas that are frequently foggy. The water that is gathered might be used for irrigation or directed toward storage tanks. This provides a supplemental water source during dry periods and contributes to soil moisture conservation by augmenting natural precipitation.

Micro Catchment Systems

Involves techniques to channel rainfall into tiny basins or depressions where it can seep in and help plants, micro catchment systems sculpt the terrain. Through the capture of runoff and reduction of evaporation, this approach enhances soil moisture retention and is appropriate for water-stressed settings.

Mulching

Applying organic mulch such as crop residues, straw, or grass clippings on the soil surface helps trap moisture and conserve soil moisture by reducing evaporation. Mulching reduces weed growth and enhances soil structure.

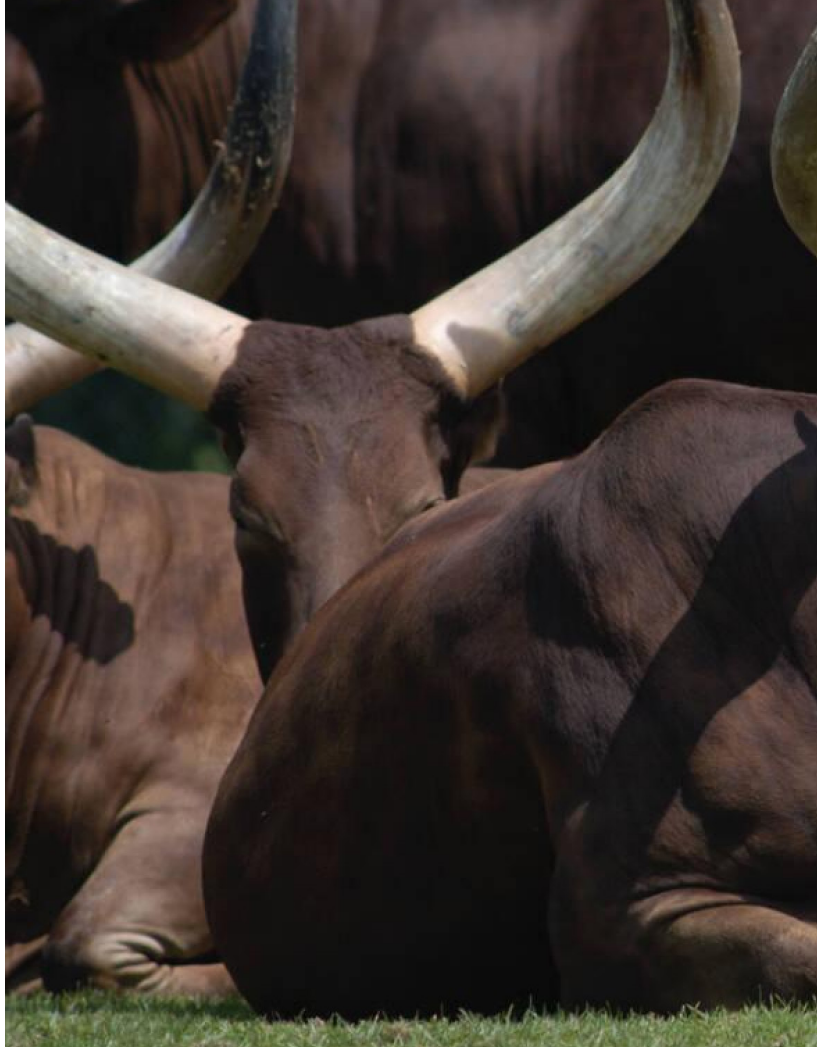
Reduced Tillage

Reducing tillage minimizes soil disturbance and surface evaporation, preserving soil moisture levels. Conservation tillage practices such as no-till or minimum tillage help maintain soil structure. They also increase water infiltration and reduce water loss, supporting soil moisture conservation and improving crop resilience to drought.

Conclusion

Water harvesting techniques and soil moisture conservation practices are integral components of sustainable agriculture, especially in water-stressed regions like Kenya. By implementing these strategies, farmers can enhance water availability, optimize crop production, and mitigate the impacts of climate variability on agricultural livelihoods.

https://www.infonet-biovision.org/water-management/rainwater-harvesting



LIVESTOCK PRODUCTION

Advancing Livestock Production: The Role of Controlled Breeding

Controlled breeding is a technology that is reshaping the landscape of cattle farming, bolstering productivity, and paving the way for a sustainable future

By Eliud Nkunja

KENYA'S NATIONAL CATTLE population stands at around 18 million, comprising various indigenous and exotic breeds. The livestock sector, including cattle farming, contributes approximately 40% to Kenya's agricultural GDP.

Cattle farming in Kenya is not just a source of livelihood—it is a dynamic force driving economic growth and nourishing communities. At the heart of this agricultural tapestry lies controlled breeding, a technology that is reshaping the landscape of cattle farming, bolstering productivity, and paving the way for a sustainable future.

Artificial insemination (AI) coverage in Kenya has increased from 10% in 2010 to approximately 30% in 2023 (Kenya Dairy Board). Embryo transfer programs have led to a 20% increase in the population of endangered indigenous cattle breeds over the last decade (Kenya Agricultural and Livestock Research Organization).

The Importance of Controlled Breeding

Controlled breeding enables farmers to selectively breed cattle for desirable traits like milk production, meat quality, and disease resistance. By harnessing the power of genetics, farmers can amplify the strengths of their herds while preserving the genetic diversity essential for long-term sustainability.

Current breeding technologies

Backed with advanced data management technologies, farmers and breeders are currently employing the following technologies to improve breeding.

- **Genomic Selection:** Genomic selection is an innovative breeding technique that utilizes DNA analysis to predict the breeding value of animals accurately. By analysing specific genetic markers associated with desirable traits, such as milk production, fertility, and disease resistance, breeders can make informed decisions about which animals to breed, leading to faster genetic improvement within herds. Genomic selection has the potential to revolutionize cattle breeding in Kenya by enabling farmers to enhance the genetic potential of their herds more rapidly and efficiently.

- **Artificial Insemination (AI):** AI involves the use of high-quality semen from superior bulls to breed cows without the need for natural mating. This technique allows farmers to access elite genetics and improve the genetic diversity of their herds.

  AI has become increasingly popular in Kenya due to its cost-effectiveness, convenience, and ability to overcome logistical challenges associated with natural mating. By using AI, farmers can improve the overall genetic merit of their herds and achieve higher levels of productivity and profitability.

- **Sexed semen:** This involves physical separation of Y chromosome-bearing sperm from X chromosome-bearing sperm. X chromosome bearing sperms have shown to produce up to 95% female embryo after fertilization.

Controlled breeding enables farmers to selectively breed cattle for desirable traits. By harnessing the power of genetics, farmers can amplify the strengths of their herds while preserving genetic diversity for long-term sustainability

Organizations supporting farmers in controlled breeding in Kenya

There are many organisations that work together to promote breeding in Kenya. The organisations represent government agencies, civil society organizations, private sector partners, and research institutions. Here are a few examples.

1. **Kenya Agricultural and Livestock Research Organization (KALRO):** KALRO plays a significant role in conducting research and providing technical expertise in livestock breeding and management practices. They collaborate with farmers, breed associations, and other stakeholders to develop and promote advanced breeding technologies tailored to the needs of Kenya's diverse cattle farming systems. (www.kalro.org)

2. **Kenya Livestock Breeders Organization (KLBO):** KLBO is a membership-based organization that promotes selective breeding programs and facilitates access to elite genetics for livestock farmers in Kenya. They collaborate with breed associations, research institutions, and private sector partners to improve the genetic merit of cattle herds and enhance overall productivity. (www.klbo.org)

3. **East African Animal Genetics Network (EAAGN):** EAAGN is a regional network of private sector organizations, research institutions, and government agencies involved in livestock genetics and breeding. They collaborate closely with farmers to provide access to high-quality semen, breeding services, and technical support to enhance genetic improvement in cattle herds. (www.eaagn.org)

4. **Kenya Animal Genetic Resources Centre (KAGRC):** KAGRC is a state corporation mandated to conserve and promote the utilization of indigenous animal genetic resources in Kenya. They maintain a national gene bank and provide breeding services, including artificial insemination and embryo transfer, to support livestock farmers in improving their herds' genetic potential. (www.kagrc.co.ke)

5. **Kenya Livestock Producers Association (KLPA):** KLPA advocates for the interests of livestock producers in Kenya and supports initiatives aimed at improving livestock breeding and management practices. They collaborate with government agencies, research institutions, and private sector partners to address challenges facing the livestock sector and promote sustainable development. (www.klpa.org)

6. **International Livestock Research Institute (ILRI):** ILRI conducts research on livestock genetics, breeding, and animal health in collaboration with national and international partners. They work to develop innovative breeding technologies and strategies that address the needs of smallholder farmers and contribute to food security and poverty reduction in Kenya and beyond. (www.ilri.org)

The Road Ahead:

As Kenya charts a course towards agricultural transformation, the future of cattle farming shines brighter than ever before. With continued research, collaboration, and innovation, farmers have access to an expanding toolkit of breeding technologies and practices to drive productivity, sustainability, and resilience.

https://www.infonet-biovision.org/animal-species/cattle-breeds-and-breeding

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VINE MULTIPLICATION

Discover the profitable business of sweet potato vine

Sweet potato vine multiplication involves the propagation of sweet potato plants using vine cuttings rather than traditional seedlings

By Kelvin Allan

SWEET POTATOES ARE preferred for their delicious taste and nutritional benefits. However, beyond their culinary appeal, sweet potatoes offer other benefits to farmers, especially in agribusiness. Whereas most farmers focus on the tubers for consumption or selling, there lies an even more profitable business opportunity in vine multiplication. Sweet potato vine multiplication involves the propagation of sweet potato plants using vine cuttings rather than traditional seedlings. This method offers several advantages over conventional seed propagation, including faster growth, higher yields, and increased resistance to pests and diseases.

The Process of vine multiplication

The process of sweet potato vine multiplication begins with the selection of healthy and disease-free sweet potato plants. Once identified, these plants are carefully pruned to produce vine cuttings, typically 20-30cm in length, each containing at least 2-3 nodes. These cuttings are then planted directly into the soil in beds or placed in a rooting medium to stimulate root development, 2 of the three nodes should be immersed in the rooting medium. The beds ought to be 1m wide and 5m long for ease of management. Also spacing between beds should be 50cm or 5m in case the varieties are different. Rooting medium options include moist sand, vermiculite, or water. By providing optimal conditions such as adequate moisture and sunlight, the vine cuttings will develop roots within a few weeks, signalling their readiness for transplanting into the field.

Things to consider when doing vine multiplication: While sweet potato vine multiplication offers numerous benefits, organic farmers must consider several factors to ensure successful implementation:

Variety Selection: Choose sweet potato varieties that are well suited to local growing conditions and market preferences. Consider factors such as drought tolerance, pest resistance, and culinary attributes when selecting varieties for vine multiplication.

Site Preparation: Prepare the planting site by ensuring proper soil fertility, drainage, and

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Benefits of Sweet Potato Vine Multiplication

Rapid Multiplication: Unlike traditional seed purchase or germination, which can be time-consuming, sweet potato vine multiplication allows for rapid multiplication of planting material. This enables farmers to quickly expand their sweet potato cultivation areas and meet growing market demands.

Cost Effectiveness: By eliminating the need for seed purchase or germination, sweet potato vine multiplication significantly reduces production costs for farmers. Additionally, the use of vine cuttings reduces the risk of seed-borne diseases, minimizing the need for chemical inputs and promoting organic farming practices.

Improved Yield and Quality: Sweet potato vine multiplication produces robust and healthy plants with well-established root systems. As a result, farmers can expect higher yields and superior crop quality compared to conventional seed propagation methods. Furthermore, the enhanced vigour of plants propagated through vine multiplication increases their resilience to environmental stressors and pest attacks.

Resilience in the face of climate change: Sweet potatoes are inherently resilient to adverse environmental conditions such as drought, heat, and poor soil fertility, making them well-suited to climate-affected regions. Additionally, by utilizing vine multiplication, farmers can quickly recover from crop losses and adapt their production systems to changing climatic conditions. Furthermore, sweet potato vine multiplication promotes soil health and conservation by enhancing soil structure, organic matter content, and nutrient cycling. The extensive root system of sweet potato plants helps prevent soil erosion, improve water infiltration, and suppress weeds, thereby mitigating the impacts of climate-induced soil degradation.

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weed management. Incorporating organic amendments such as compost or aged manure can improve the soil structure and nutrient availability, promoting healthy vine growth and root development. Also, think about access to water for irrigation. This is because vines should be ready by the onset of the rainy season, hence vine multiplication should happen during the dry season and thus the need to consider availability of water.

Vine Cutting Preparation: Handle vine cuttings with care to prevent damage to nodes and stems. Use sharp, sterilized cutting tools to make clean cuts, and remove any leaves from the lower portion of the cutting to promote root formation.

Rooting Medium: Choose a suitable rooting medium based on local availability and environmental conditions. Maintain consistent moisture levels and avoid water logging to prevent rotting of vine cuttings.

Transplanting and Care: Transplant rooted vine cuttings into the field at the onset of the rainy season or during periods of optimal soil moisture. Provide adequate spacing between plants to facilitate air circulation and minimize competition for resources. Scout plants regularly for signs of pests, diseases, or nutrient deficiencies and take appropriate measures to address any issues promptly. Also, something to note, farmers should ensure that vines are used for only three growing cycles. Further use of the vines past the three cycles will lead to diminished yields both in quality and quantity.

The vine selling business

The recommended seed rate for sweet potato is 11-13bags of vines per acre. A bag carries 1,000 pieces of vines that measure 30cm in length with 2-3 nodes. By multiplying 2-3 bags of vines on a small piece of land, a vine multiplier harvests about 10 bags of cuttings hence earning between Ksh11,000 and Ksh13,000 from a seed capital of between Ksh2000 and Ksh3000. The vine multiplier should source the starter material/vines from institutions such as KALRO and KEPHIS that guarantee clean, virus free vines and only needs a bag or two and then multiplies the vines. Therefore, the only cost that the multiplier incurs is costs to procure the starter seed for multiplication and maybe, fuel costs if they are not using solar powered irrigation kits.

Please note: The above case is premised on the assumption that this vine multiplier only received one customer intending to put just one acre of their land under sweet potato production. More customers means more profits. For steady markets, multipliers should establish and market themselves as suppliers of clean and disease-free vines that guarantee sweet potato producers of good quality and quantity yields.

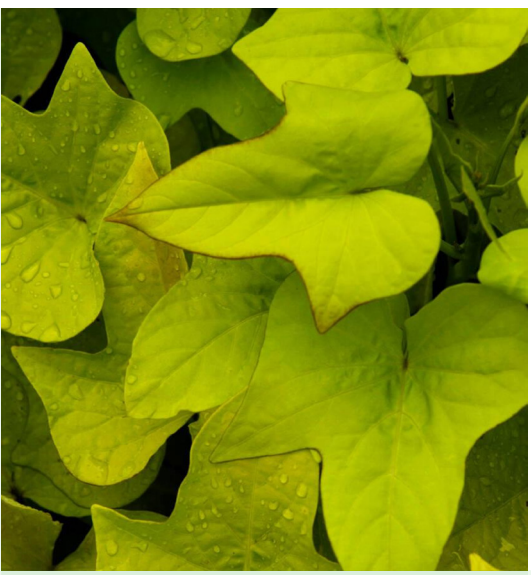
Market Demand: Kenya has a high demand for sweet potatoes due to their nutritional value and culinary versatility. Consumers in both urban and rural areas seek sweet potatoes for various purposes, including consumption, processing into value-added products, and livestock feed. As a result, there is a constant need for high-quality planting materials to meet this demand, presenting a significant market opportunity for sweet potato vine multiplication.

Target Market:

Smallholder Farmers: Small-scale farmers form the backbone of agriculture in Kenya. By offering affordable, accessible clean planting materials through vine multiplication, these farmers can enhance their productivity and income levels.

Agro-Processors: Agro-processing companies in the region require a steady supply of high-quality sweet potatoes for processing into products such as chips, flour, and snacks. Vine multiplication ensures a reliable source of raw materials, fostering partnerships between farmers and agro-processors.

Livestock Farmers: Sweet potato vines serve as nutritious fodder for livestock, particularly dairy cattle and pigs. By promoting vine multiplication, livestock farmers can access a sustainable source of feed, thereby improving animal health and productivity.



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https://www.infonet-biovision.org/crops-fruits-vegetables/sweet-potato

INTERCROPPING

Trees to grow on cropland

When planning your farm, it is important to know which trees will offer the required benefits since different trees give different benefits

By Bramwel Soita

TREES ARE KNOWN to be beneficial to the farmer and the environment. When planning your farm, it is important to know which trees will offer the required benefits and which ones are to avoid. Different trees give different benefits. This article analyses common trees, their characteristics and benefits or disadvantages.

Cassia Senna spectabilis (Cassia, Yellow Shower, Calceolaria Shower)

Cassia is a fast-growing, deciduous, nitrogen-fixing tree, growing to 10 m in height that has showy yellow flowers. It is useful for shade, as a landscape plant, for fuelwood, green manure, bee forage and light construction.

Calliandra calothyrsus (Calliandra, Caliendra)

Calliandra is a vigorous, nitrogen-fixing, bushy tree that can be fast-growing on poor soils. The tree responds well to coppicing, is a good fuelwood source and the leaves provide excellent fodder. Calliandra is used to enrich soil and provide stability on steep slopes.

Gliricidia sepium- Quick Stick, Rat Killer

Is a fast-growing nitrogen-fixing tree that grows up to 15m in height. It is used for living fences, green manure, fodder, honey production, wind breaks, and fuelwood. This tree tolerates dry, acid, alkaline, and salty soils and was traditionally grown to shade cocoa trees.

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Neem Azadirachta indica
Neem trees are medium to large sized, drought resistant, multi-purpose trees, that can be up to 30 m tall. All parts of the plant produce azadirachtin, a powerful antibiotic and antimicrobial. Seeds and leaves often have the highest concentrations and may be used to make insecticides.

Silver Terminalia, Silver Clusterleaf Terminalia sericea
Silver terminalia is a small tree or shrub, valued for its strong wood, and growing to 23 m in height. This tree provides good fuelwood and is valuable for land reclamation and erosion control.

Silk Tree Albizia lucida and lebbeck,
Albizia lucida is a nitrogen-fixing reforestation tree that grows quickly and tolerates poor soil and waterlogging and a very good soil binder and recommended for erosion control on eroded lands especially along river embarkments. Timber from this tree is used for furniture, construction, and pulp. It can also be used as high protein fodder and a shade tree. As it is nitrogen fixing, the leaves provide rich mulch and green manure.

Silk Oak - Grevillea robusta
Silk Oak is medium sized to large tree up to 40 m tall, with dense branches projecting upwards. It is an excellent timber tree and has been used for shade in coffee plantations. Its flowers providing good bee forage. The wood can be used for timber, poles, firewood and the growth pattern is ideal as windbreak. The abundant quantity of leaves also makes it good for mulching purposes.

Sesbania Sesban (Egyptian Pea)
Sesbania is a fast-growing, nitrogen-fixing perennial, growing to 7 m in height. It is typically found in wet locations and can withstand water logging and flooded conditions. Sesbania is used as a cover crop or green manure, coppices readily, provides light fuelwood, and good forage for livestock.

Tamarindus indica - Tamarind
Tamarind is an attractive, evergreen, nitrogen fixing tree, growing to 30 m in height, and best adapted to semi-arid conditions. The sweet-tart pulp from the pod is eaten fresh, used as an ingredient in cooking, or made into a refreshing drink. Tamarind wood is used for lumber and firewood.

Markhamia lutea - Nile Tulip
Markhamia lutea is an upright, evergreen tree, growing to 15 m in height. It is valued for timber, shade, bee forage, fuelwood, and landscaping use.

Moringa oleifera
Moringa, Drumstick tree, Ben Tree, Benzolive, Horseradish Tree,

Drumstick Tree
Moringa is a very popular tropical fast-growing tree up to 15 m in height. The young pods can be eaten, and the leaves are an excellent source of calcium, vitamins, minerals, and protein. The tree has a loose crown and can also be used for a hedge, living fence or windbreak. It coppices well for regeneration.

Acacia nilotica
Grows in many types of soils but does not grow big. Leaves and pods can be used as food, fodder and flowers serve as bee forage. The wood is hard, tough and termite resistant with many different uses. They are nitrogen fixing, and good use for firewood. Can also be used as medicine for multiple health problems.

Carica papaya (pawpaw)
Is a fast-growing tree which comes into fruiting within 5 months and lives for 4-5 years. Usually male and female flowers come on different trees, which makes it necessary to have a number of trees on a farm. The ripe fruit is a very popular breakfast and dessert fruit and is available during the whole year. Even the green fruit is used as a vegetable for cooking.

Benefits of trees on the farm
Trees build soil carbon and soil organic matter. Trees help provide a framework for both below and above-ground diversity to flourish. They help innovate diversified farm enterprises, provide shelter and fodder for all livestock.

Trees hold the soil, increase fertility through nitrogen fixation, or through bringing minerals from deep in the soil and depositing them by leaf-fall, provide shade, construction materials, foods, and fuel and store carbon.

Environmental benefits of trees on the farm – trees reduce pressure on natural forests and provide potential to mitigate the climate change effects through microclimate moderation and natural resources conservation in the long run.In terms of Carbon sequestration: trees sequester as much carbon in below-ground biomass as the primary forests and are far greater than the crop and grass systems. Also enables agricultural land to withstand extreme weather events, such as floods and droughts, and climate change. Trees increases the nutrient content of soil and prevents soil erosion as well.

Economically, tree products and tree services also contribute robustly to rural livelihoods. Fruit, fodder, fuel, fiber, fertilizer, and timber add to food and nutritional security, income generation, and work as insurance against crop failure and drought.

Trees that should not be planted on cropland
Eucalyptus – Eucalyptus trees have a terrible reputation as extensive water users and significant contributors to soil depletion. While they do need copious quantities of water, their colossal taproot can find moisture even in the most barren areas. This voracious appetite helps maintain their incredibly rapid growth.

Toxicity – Some homeowners place eucalyptus leaves around their homes for their aroma or will plant eucalyptus in their landscapes. However, eucalyptus plant foliage is toxic to animals and humans if ingested.

Toppling – Eucalyptus trees are prone to falling because of their shallow spreading roots that don't do an efficient job of anchoring or steadying the tree in loose soil or when an external force places overwhelming pressure against the trunk and branches.

Exploding – Eucalyptus oil gives off flammable fumes, and these fumes can be ignited by lightning, flying sparks, and cinders, causing the tree to explode.

Pine tree – Is among trees that should not be planted on farms. While most pine trees will grow in poor soils with low levels of nutrients, they need an acidic soil pH below 7.0 to thrive. Alkaline soils can cause chlorosis, or yellowing of the needles, as well as poor growth rates and stunted growth.

Trees reduce pressure on natural forests, potential to mitigate the climate change effects through microclimate moderation and natural resources conservation in the short run

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https://www.infonet-bio-vision.org/agroforestry/agroforestry

FOOD WASTE

Stop food loss and waste, it takes so much to produce it!

For many people, food waste has become a habit; buying more food than we need at markets, letting fruits and vegetables spoil at home, overeating or serving larger portions than we can eat is what we do daily

By Elias Biwott

The UNEP Food Waste Index Report 2021 revealed that around 931 million tonnes of food waste was generated in 2019, 61% of which came from households, 26% from food service and 13% from retail.

According to a recent FAO report, in Kenya 40% of food is lost from the farm gate to the family table. This scale of food waste contributes to more Kenyans continuing to lack access to nourishment, with the prevalence of food insecurity 10% higher for women than men.

Despite the huge wastes, an estimated 3.1 billion people worldwide do not have a healthy diet, and some 828 million people go hungry. Since 2019, the number of people experiencing hunger as a result of the pandemic has increased by more than 100 million. Between 691 and 783 million people faced hunger in 2022.

How does food loss and food waste occur?

Food loss and waste occurs at every stage of the supply chain but it is concentrated on the farm and in the home. This can be attributed to many reasons; poor production plans (not matching production and consumption), late deliveries to the market, broken contracts between producer and wholesale buyers, lack of adequate food storage and transportation facilities, the demand by buyers at the retail level to only buy fresh produce rendering the previous stock a waste, poor storage methods, lack of market information and poor food consumption/utilization plans at households. The middle of the supply chain generates comparatively small volumes of food waste but has resounding influence over how food is grown, purchased and eaten.

For many people, food waste has become a habit; buying more food than we need at markets, letting fruits and vegetables spoil at home, overeating or serving larger portions than we can eat is what we do daily. These habits can and need to change.

We all have a part to play in saving food. It's up to us to change our habits to make not wasting food a way of life. Food loss and waste undermine the sustainability of our food systems. When food is lost or wasted, all the resources that were used to produce this food - including water, land, energy, labour, effort, time, capital and investment - go to waste, not to mention the resources that go into transporting and processing it.

The waste also puts extra strain on our natural resources and damage our environment. In addition, the disposal of food loss and waste in landfills, leads to greenhouse gas emissions, contributing to climate change.

Food that is lost and wasted accounts for 38 percent of total energy usage in the global food system and is responsible for a staggering 8-10 per cent of global greenhouse emissions.

Food loss and waste can also negatively

> **When food is lost or wasted, all the resources that were used to produce this food - including water, land, energy, labour, effort, time, capital and investment - go to waste, not to mention the resources that go into transporting and processing it**

impact food security and food availability, and contribute to increasing the cost of food. Below are some simple ways to reduce food losses and wastes:

(a) Farm solutions

Consumers/farmers can help reduce the amount of food lost in transport by:

- Analyzing markets and consumption needs in line with production seasons, having proper production plans and preparations for markets.
- Buying locally grown produce, especially at farmers' markets.
- Supporting local farms that also fosters food security and can help domestic agriculturalists adapt to climate change.
- Growing your own food can help you enjoy produce at peak ripeness.
- Support local food producers by buying local produce. This help fight pollution by reducing delivery distances for trucks and other vehicles.
- Investing in markets and market linkages before producing any food to reduce farm losses.
- Improving and addressing distribution challenges.
- Value addition.
- Use less water, it is food. Use less water to grow food, reducing food waste also saves all the water resources that went into producing it.
- Keep our soils and water clean to reduce soil-water- crop contamination that leads to waste or losses.
- Sharing is caring. Donate food that would otherwise be wasted.

(b) Urban solutions

- Create circular food systems by raising awareness about food loss.
- Promoting urban agriculture.
- Providing free food waste recycling services, and
- Banning organic waste from landfills.

c) Quick tips for reducing food waste at ready for consumption household level

Here are some easy actions you can take to re-connect to food and what it stands for:

- Adopt a healthier, more sustainable diet.
- Buy only what you need and plan your meals well to waste less food and save money.
- Don't judge food by its appearance- they taste the same!
- Store food wisely by moving older products to the front of your cupboard or fridge and new ones to the back. Use airtight and closed to top containers.
- Understand food labeling to know when it is best to use and safe for consumption as a guide when purchasing food products.
- Start small; take smaller portions at home or share large dishes at restaurants.
- Love your leftovers, buy and cook the right amount, if you don't eat everything you make, freeze it for later or use the leftovers as an ingredient in another meal.
- Buying fruits and vegetables that have stayed longer on the shelves or using leftovers for other meals are two good habits to avoid food loss and waste.
- Put your food waste to use by composting and recycling them back to soil thus reducing your carbon footprint.
- Respect food and know the process that goes into making it, get to know your farmers too.

With increasing population, reducing arable lands for food production and food prices getting higher than before, consumers also have a powerful incentive to reduce food waste. Alongside reducing energy and water usage and rethinking transportation, cutting food waste is an important way we can all cut our costs.

KITCHEN GARDENS

Embracing multi-storey Kitchen gardens to grow more food in less space

A multi-storey kitchen garden can be set up in fields, on balconies, or in house yards. They are essential in reducing poverty and hunger among households in both urban and rural settings

By Vincent Kipyegon

A MULTI-STOREY KITCHEN garden is a type of vertical farming technique used for growing fruits and vegetables in limited spaces. It entails building multi-level farms using stacked gardens in vertical models. A multi-storey kitchen garden can be set up in fields, on balconies, or in house yards. They are essential in reducing poverty and hunger among households in both urban and rural settings.

Vertical farming is an innovative technique for sustainable food production to increase food security and produce income regardless of location in Kenya", according to Silas Kipruto, a multi-storey garden specialist from Kericho. "Multi-storey gardens on a piece of land can yield 10 times what a typical open field of the same size can yield," adds Kipruto.

The following crops can be grown in multi-storey gardens:

Vegetables: Kales (Sukuma wiki), coriander (dhania), carrots, lettuce, black night shade(managu), amaranth (terere), spinach, spring onions, leeks, cow peas, beans, open field tomatoes and chilies.

Fruits: Strawberries, passion fruits, gooseberries.

Herbs: Aloe vera and rosemary.

Other types of vertical farming

Sack gardens: This is a type of garden created using sacks and plastic bags filled with soil and manure and crops are planted on the sides. The sacks have uniformly distributed tiny openings for planting vegetable seedlings.

Hanging gardens: A hanging garden is a garden suspended on a vertical structure such as a wall, a shade or other suspension mechanism. It is an ingenious garden structure that may be utilised to grow vegetables and fruits.

Recycled clothes gardens: A recycled clothes garden is created by repurposing old clothes to create a space for growing food. Unwanted and used synthetic fabrics such as jeans can be recycled and turned into gardens by filling soil and manure and punching planting holes. The top open area and the side holes are filled with seedlings.

Benefits of multi-storey kitchen gardens

Increased food production: This gardening technique allows for maximum production of fresh vegetables and fruits for household consumption.

Source of income: Surplus food crop production can be sold in the market providing a supplementary income source for the farmer.

Minimum labour required – Multi-storey gardens eliminate the need for backbreaking labour, it only requires minimum maintenance on weeding and watering.

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TOF Radio

Through weekly Kiswahili and local languages radio programmes, TOF Radio helps to improve awareness and knowledge of sound agroecological practices, strengthen the link between researchers and farmers to enhance food security, reduce poverty and increase household incomes among farmers in Kenya.

TOF Radio Stations

Emuria FM	Monday and Friday -10-11AM
Getembe FM	Monday 8PM
Milele FM	Tuesday 11-12AM
Mutongoi FM	Wednesday 10-11AM
Coro FM	Thursday 8.20-9PM
Ingo FM	Friday 8-9PM

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Economical: A multi-storey garden can be created using locally available materials and affordable materials. Once installed, the garden has a lifespan of over 5 years.

Aesthetic value: Multi-storey gardens create visual appeal and beauty to the environment.

Constructing a multi-storey garden

A multi-storey structure consists of six circular layers stacked on top of one another, each layer ring having a height of 20cm. The base layer of the multi-storey garden has a diameter of 2 metres (6 feet), the diameters of the subsequent 5 ring terraces decrease by 1 feet creating a staircase with terrace space for cultivating crops.

The material for creating ring layers is a high density polythene dam liner which ranges in price of ksh1200 - ksh2500 depending on the thickness (0.5mm -1mm). Each layer is filled with a mixture of well drained fertile soil free from pathogens and soil-borne diseases and compost or animal manure at a ratio of 1:1.

The soil should be rich in organic matter and soil PH between 5 and 6. Addition of lime during preparation is recommended. Next, dig seed holes that are 25 cm high, the seeds or seedlings can be sown on the terrace's sides.

A single multi-storey garden can support 100-150 plants depending on the crop planted, 50 strawberry plants can be planted in a single garden. Multi-story gardens can be manually irrigated with watering cans or sprinklers installed around the farm.

Pre-perforated drip lines can be laid across gardens with multiple stories. Irrigation can be done twice or three times per week depending on the weather.

Challenges of multi-storey garden farming

1. Pest and diseases can quickly invade and spread throughout the garden causing significant losses. It's ideal to carry out frequent garden inspection and best farming practices. Insect and pest attacks can be avoided by implementing integrated pest management strategies.
2. Irrigation systems for vertical farming system can be costly but the benefits are substantial.

Best practices of a multi-storey garden farming

1. Practice inter cropping; growing pest repellent crops such as onions, spinach, leeks and coriander with other vegetables.
2. Practice crop rotation to preserve healthy soil structure and break the life cycle of insects and pests.
2. Mulching of the gardens to prevent moisture loss and formation of weeds.
3. Observing proper farm hygiene practices to prevent introduction and spread crop diseases.
4. Use organic manure (animal manure and compost manure) to enrich soil nutrients.

In conclusion, maximising the limited space available with a multi-storey garden is a beneficial technology for increasing food production and generating revenue for farmers in both urban and rural areas. It is a smart farming technique that can alleviate extreme hunger and poverty for vulnerable households in Kenya.

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Partner organizations

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