

**Dear reader,**

THIS BEING THE harvesting season, this month's edition of TOF Magazine features informational articles on techniques to use in storing your harvest to manage post-harvest losses.

Did you know that you can reduce the risk of aflatoxin in your farm produce by applying aflasafe in the early stages of the crop development? Find out more about this technology that is affordable and easily accessible to farmers across the country in this edition's main story.

We also feature a young innovator from Makueni County who has recently launched a hybrid dryer that is saving farmers' gains in preventing post-harvest losses.

As you prepare to plant for the next season, read on to discover new ideas such as use of biochar as soil fertilizing agent, and the effectiveness of integrating chicken manure in the soil for high productivity.

Are you looking for an opportunity to interact with other farmers, organisations and companies that could be the answer to your farming queries? Do not miss this year's National World Food Day to be held in Bukura Agricultural Technical College in Kakamega on 15th and 16th October.

Come and learn from fellow farmers, organisations, and private companies on new innovations to help improve efficiency in the farm as well as new income generating ideas. More details of the event are featured on page 8.

Enjoy the read!

IN SEASON

## Use *Aflasafe* to keep aflatoxins away

**Aflasafe is a new technology that prevents aflatoxin contamination in food right from production to consumption**

By **Samuel Monene**

FOR A LONG TIME, aflatoxin has been a snare for food producers, traders, and consumers. Previously, focus has been on safe food storage in controlling aflatoxin post-harvest, but did you know the occurrence of aflatoxins in food begins with the prevalence of bad fungi in the soil? Scientists have proven that if food producers can manage the bad fungi primarily *Aspergillus flavus* in the soil, by introducing the good fungi to multiply and prevail over the bad fungi, then crops would take up more of the good fungi and hence the food that is eventually harvested would have very low amounts of aflatoxin, that is within the acceptable amount of 10ppb according to the East African Standards.

This is because, aflatoxin is one of the many toxins produced by the bad fungi in the soil. It mostly occurs in high levels in the Arid and semi-arid areas or areas experiencing intermittent dry weather. In instances where crops are grown in soils infested by the bad fungi, they absorb the fungi which produce high levels of aflatoxins into the crop and consequently into the produce.

When poorly stored especially when not adequately dried before storage, these fungi find the environment highly conducive for breeding and more aflatoxin builds up in the produce. It is therefore critical that farmers observe measures to reduce aflatoxin occurrence when producing, after harvesting and when storing the food.

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**Aflatoxin mostly occurs in high levels in the Arid and semi-arid areas or areas experiencing intermittent dry weather**



## Controlling fruit flies

Learn how to control fruit flies, which provide entry for pathogens and increase the fruit decay, making fruits unsuitable for human consumption. PAGE 11

IN SEASON

# Use aflasafe to keep aflatoxins away

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Aflatoxin contamination commonly occurs in crops such as maize, groundnuts, sorghum, peanuts and various other grains. Warm and humid climates provide the perfect breeding ground for the bad fungi, making various regions in Kenya susceptible to aflatoxin contamination. The effects of aflatoxins are borne by both humans and animals.

## Impact on Food Safety, Public Health, and the Economy

Aflatoxins cast a dark shadow over food safety, threatening the health and well-being of consumers. Contaminated food items, such as maize, peanuts, and various grains, become silent carriers of these toxins, posing a grave risk to consumers. When ingested, aflatoxins accumulate in the body over time, leading to chronic health issues. Prolonged exposure to aflatoxins can lead to liver cancer, immune system suppression, growth impairment in children, and adverse reproductive outcomes.

Individuals with weak immune systems face elevated risks. Aflatoxins worsen malnutrition and hinder proper nutrient absorption, leading to stunted growth in children and increased susceptibility to other diseases. Additionally, aflatoxin-contaminated food not only affects human health but also harms livestock, leading to reduced productivity, increased mortality rates, and decreased quality of animal-derived products.

The economic impact of aflatoxins is equally distressing. Food and feed contamination result in significant financial losses due to unwanted crops, trade restrictions due to contaminated food, and decreased market opportunities. Governments often resort to costly measures like destroying contaminated food to safeguard public health. Agricultural productivity also takes a hit as farmers face reduced yields and diminished incomes. Furthermore, healthcare costs escalate as aflatoxin-related illnesses burden already strained healthcare systems.

Addressing the prevalence of aflatoxin-related issues necessitates research, education, and safe agricultural practices. Collaborative efforts between governments, research institutions, and international organizations are crucial in combating the menace of aflatoxins in affected regions and communities, and Aflasafe plays a crucial role.

## Aflasafe

In the battle against aflatoxin contamination, a groundbreaking solution has emerged – Aflasafe. This innovative biocontrol technology offers the means to fight to safeguard crops and protect public health from aflatoxins. Developed through collaborative efforts between research institutions, government agencies, and international organizations, Aflasafe presents a big step towards combating aflatoxin contamination.



**Aflatoxins worsen malnutrition and hinders proper nutrient absorption, leading to stunted growth in children and increased susceptibility to other diseases**



## How it is Made

Aflasafe stands out as a natural and safe product that is not chemical-based. Rather than resorting to harmful pesticides, Aflasafe harnesses the power of beneficial microorganisms to counteract aflatoxin risks. The key component of Aflasafe comprises four harmless strains of the fungus *Aspergillus flavus*, incapable of producing aflatoxin. These strains are cultivated and transformed into a liquid suspension. Subsequently, a seed treater is used to coat ordinary sorghum grains after they have been cleaned and roasted, rendering them sterile and unable to sprout or host other fungi.

The sorghum serves as both a carrier and a nutrient source for the friendly strains' spores. To differentiate Aflasafe from other sorghum intended for food or feed, blue food coloring is added. Additionally, a small amount of maize starch acts as a polymer, helping the spores adhere to the grain. Once the Aflasafe is packaged into bags, samples are taken for quality control testing before distribution to farmers and distributors.

## How Aflasafe Works

The science behind Aflasafe's efficacy lies in its impeccable timing and strategic application. When farmers apply Aflasafe early in the cropping season, the friendly microorganisms colonize the growing crops before the dangerous aflatoxin-producing fungi can take hold. As the plants develop, Aflasafe's microorganisms occupy the flowers and seeds, leaving no space for the toxin producers to thrive. This defensive approach significantly reduces the chances of aflatoxin contamination during crop growth.

Notably, Aflasafe's protective shield extends beyond the field. The microorganisms continue to ward off aflatoxin-producing fungi during harvest, storage, and transportation, providing an extra layer of defense against contamination.

By preventing contamination at each stage of the agricultural supply chain, Aflasafe ensures that food remains safe and aflatoxin-free until it reaches the consumers. Its one-time application each growing season is not only convenient for farmers but also cost-effective. Below is the process of how to use Aflasafe;



As the crops mature, the beneficial microorganisms continue to defend against any attempts by aflatoxin-producing fungi to establish themselves throughout the crop's growth.

- 1. Introduction and Establishment-** The process begins with the introduction of Aflasafe, which contains selected strains of *Aspergillus flavus* that are unable to produce aflatoxins. Aflasafe is applied to the crops, typically maize or peanuts, during the early stages of their growth. One acre requires 4kg of aflasafe which is applied by hand broadcasting onto the fields 2-3 weeks before crop flowering. At this stage, the maize is at waist length that is 6th to 7th leaf stage. For groundnuts, aflasafe is applied 30 days after planting, while in sorghum, it is applied when the crop is about to bud. Application should be done when it has rained or when rain or irrigation is anticipated. Do not apply before weeding, it is advisable to weed 2 weeks before application for proper multiplication and uptake. Poultry farmers are also advised to keep the chickens from the farm for 2 weeks once they have applied aflasafe as they can feed on the sorghum, which is the aflasafe carrier. Note, the chicken will not be harmed but the intended effect on the soil will not be achieved.
- 2. Competition and Suppression-** Once introduced, the friendly microorganisms from Aflasafe rapidly multiply and produce spores. These spores are spread throughout the field, colonizing the crops thus replacing the harmful fungi that would have established. By outcompeting and displacing the harmful fungi, the Aflasafe strains prevent them from gaining a foothold on the crops, effectively suppressing their growth.
- 3. Flower and Seed Colonization-** As the crop plants develop and produce flowers and seeds, the friendly microorganisms from Aflasafe move in to occupy these reproductive structures. This colonization of flowers and seeds is particularly crucial, as aflatoxin contamination tends to peak during this stage. By taking up residence in these plant parts, the beneficial microorganisms further reduce the chances of aflatoxin-producing fungi infecting the crops.
- 4. Pre-Harvest Protection-** Aflasafe's presence in the crops provides continuous protection during the pre-harvest stage.

**5. Post-Harvest Defense-** The presence of good fungi minimizes production of aflatoxin post harvest. Whether the crops are stored or transported, the friendly microorganisms remain active, preventing aflatoxin-producing fungi from growing. Farmers are advised to observe good practice post-harvest to ensure safety by adequately drying the grains; avoiding drying them on bare soil, but rather using canvas surfaces to dry grains in the sun (this protects the grains from acquiring aflatoxin-producing fungi from the soil); and ensuring that the storage room is well aerated and without leakage.

A 2kg pack of aflasafe costs Ksh402 and it is enough to serve a half an acre. Aflasafe is mainly distributed through agrovet, and the certified distributor is Koppert Biological Systems (K) Ltd (+254 731 202191). The product is registered for use in maize, sorghum, and groundnuts by the Pest Control Products Board, with KALRO as the registrant. Aflasafe is purely biological and even when a farmer has intercropped maize with vegetables, he/ she can apply it and still harvest the vegetables for use immediately, as it does not contain any synthetic chemicals.

#### Testimonials

- Farmers targeting export markets are aware that the acceptable limit for aflatoxin levels in products being exported for EU market is 4 ppb and so this product has come in handy to shield them from likelihood of missing out in the market.
- Some county governments are purchasing aflasafe for their constituents to sell to them at subsidized prices in order to minimize aflatoxin risks in food production.
- Farmers growing sorghum in Tharaka Nithi County are given aflasafe free of charge by East African Breweries Limited, the main buyer of sorghum, and are required to grow sorghum using aflasafe as a measure to mitigate aflatoxin occurrence in their production.
- The product has been used in Galana Kulalu farm successfully for three years now. (This is a project established in the Coastal region by the Kenyan government).

#### Conclusion

By embracing Aflasafe, aflatoxin levels are reduced by up to 98%, and by advocating for its adoption, we can protect millions of lives, ensure safer food supplies, and create a sustainable future for agriculture and the environment. Together, let us work towards a world where aflatoxin threats are minimized, and communities thrive on healthy and aflatoxin-free crops. KALRO Katumani Machakos County is open to train farmers on the use of this technology. Their contacts are provided below:

#### Where to buy Aflasafe

1. Kenya Agricultural & Livestock Research Organization (KALRO) Location: Aflasafe Factory, Katumani, Machakos County Distribution & Sales points
2. Koppert Biological Systems (K) Ltd. Apex Business Park, Unit 6, Mombasa Road. +254 731 202191 info@koppert.co.ke
3. Arysta Lifescience (K) Ltd (UPL) 4th Floor, Goodman Tower, Waiyaki Way, Westlands. Tel: +254 772 958 602 www.upl-ltd.com/ke
4. Latia Agribusiness Solutions Ltd. Off Pipeline Road, Isinya. Tel: +254 716 431 0054, E: info@latiaagribusinesssolutions.com www.latiaagribusinesssolutions.com



## ORGANIC NUTRIENTS

# Use of chicken waste manure integrated with compost to grow vegetables in the farm

**Also known as chicken litter or bedding, this manure is composed of chicken droppings, feathers, chicken water, and feed. When applied to the farm they add on to the nutrients and organic matter of the farm**

**By Mellen Nyabuto**

STEPHEN NJEHIA AN expert vegetable farmer in Kiambu County has quite a successful story in growing cabbages and spinach while incorporating both compost and chicken manure. Stephen regularly applies this kind of organic manure to his farm. He likes the results that he gets often and highly discourages using of chemicals and inorganic fertilizers. "I prefer using chicken manure because it is clean." he says. Chicken manure refers to chicken waste materials collected from reared chickens that are either for meat or eggs. Also known as chicken litter or bedding, this manure is composed of chicken droppings, feathers, chicken water, and feed. It contains high levels of nitrogen, phosphorous, and potassium which are essential in plant growth. When applied to the farm they add on to the nutrients and organic matter of the farm.

However, if not well applied, Mr. Njehia points out that one could suffer a loss in yields because of their high nitrogen content and salt content. He advises farmers to compost the chicken manure together with other compost materials before using it on the farm. Composting helps in reducing the nitrogen content. He does this to avoid the burning effect of the manure on seedlings.

Below is a step-by-step procedure that one can use to integrate chicken manure with compost and how to apply it on your vegetable farm.

1. Collect chicken manure from your chicken coop or cages. Gather other compost materials such as dry leaves, grass, vegetable scraps, and other organic matter. You'll also need a compost bin or pile to contain the composting process.
2. To create a compost pile, choose an appropriate compost location or bin. Ensure the pile is in a sunny area with good drainage. Layer the compost materials, starting with rich materials like dry leaves or straw which are carbon-rich.

3. Add and spread a layer of chicken manure on top of the compost materials. The compost materials should be more than the chicken manure.
4. Add alternating layers of chicken manure and other compost materials, such as vegetable scraps or grass until you make a complete pile.
5. Moisten the compost pile lightly after each layer to maintain moisture
6. Turn the compost pile every few weeks, using a garden fork or shovel to ensure air circulation and even heat distribution.
7. Monitor the compost pile regularly.
8. Once the composting process is complete, the compost should be dark and have a soil smell. To test the compost, one can plant a few seeds to see how well they grow. If the plants thrive, it indicates that the compost is ready to use.

### **How to apply chicken composted manure on your vegetable farm.**

1. Obtain the composted chicken manure. Apply before planting just after soil preparation. It's important to balance the amount of compost manure when applying.
2. When applying to grown vegetables, spread the composted chicken manure evenly over the soil surface around the base of the cabbage and spinach or other vegetables plants, keeping it at least a few inches away from the stems. Piling the compost directly on top of the plants may cause burning or damage.
3. Gently incorporate the composted chicken manure into the soil using a garden Jembe. This will help the nutrients mix with the soil and improve its fertility.
4. Ensure to water the vegetables thoroughly, to help in nutrient uptake and also reduce any chances of burning that can be caused by the manure.

It is important to note that, one needs to know the proper application rate of composted chicken caged manure. When applied in high concentration they can result in high salt build-up in the soil and nutrient imbalances despite its great benefit. When it comes to accessibility, one can buy already composted chicken caged manure from suppliers or make their own at home if they have materials.

## INNOVATION

# Hybrid dryer to reduce post-harvest losses

Farmers can now sigh in relief as young innovator launches a hybrid drier

By Caroline Mwendwa

WHEN JAMES NYAMAI'S mother found herself with 50 tonnes of pumpkins on the verge of going bad for lack of market, she could not help but regret accepting the deal to produce them on the promise of a sure market, which turned out to be a huge flop. The pumpkins were hybrid varieties with one weighing 30 kilograms.

Luckily, she had invested in her son James, who had graduated with a bachelors' degree in mechanical and production engineering from Moi University a few years back. James was keen to not just settle on a job but utilize his skills and talent in providing solutions to the society. And just within his house, was an apparent problem that would lead to huge losses, if no solution was found. So, he set out to gather information on pumpkin production and markets in the country. That is when he realized that it was not just his mother, many farmers across the country had fallen in the same trap having been promised a market if they planted the hybrid seed varieties in large volumes.

He started thinking of how he can process the raw pumpkins to lengthen their shelf life. This led him to launch an inquiry about methods of drying farm produce for processing.

While doing his research at the Kenya Climate Innovation Centre, he found out that the available driers are solar powered which means that during the cold seasons, they could not work. "I was informed that during cold seasons which last six months in a year, employees have to be laid off as the solar driers can't be relied upon," he says.

This gap prompted him to develop driers that do not wholly depend on solar heat to function. He targeted to build simple hybrid driers that serve commercial facilities as well as small holder farmers in managing post-harvest losses.

That is how he built a system that uses clean hot air mostly from biomass or biogas, to make sure it does not contaminate the food. This ensures that farmers can dry the produce whatever the season. In the process, they first used an insulated container with a source of heat, which did not work efficiently as the heat was not regulated. "We then decided to use the solar driers with a conduit that brings in hot air. The temperatures here are controlled using a digital temperature controller as very high temperatures can deplete the nutrition value of the produce. Fruits such as mangoes require 50°C to dry, while tubers require 60°C," he elaborates.



**So far 3,200 farmers have the driers installed. There are different models to fit different users. Farmers come together in groups to purchase and use. There are models that can serve 10 farmers and others 100 farmers depending on the size of the group**



In 2017 to 2019 James and his team tested the model they had developed with different farmers, and it proved to fit the vision. The technology was then patented with the Kenya Industrial Product Development in the year 2020 and released into the market.

"So far 3,200 farmers have the driers installed. There are different models to fit different users. Farmers come together in groups to purchase and use. There are models that can serve 10 farmers and others 100 farmers depending on the size of the group," he says.

The solar driers suited for small holder farmers cost Ksh25,000. Driers customized for commercial use range between Ksh120,000 and Ksh565,000. Having dubbed his enterprise BioAfriq Energies, James has observed an increase for the technology's demand especially since he partnered with German Agency for International Cooperation (GIZ) in 2022 in enhancing market activation and sensitization.

The solar driers can dry a myriad of farm produce including tomatoes, chili, fruits, and herbs. James observes that market for dried products is increasing, as climate change effects are reflected on farmer production seasons. "Some farmers harvest plenty only once a year and they have to look for ways to preserve the fresh produce for the dry seasons, and the only way to do this is by drying," he says.

Even though his mother eventually lost the pumpkins as they rotted away, the problem was a good challenge for James to be innovative in coming up with a solution that could help generations of farmers to process and preserve farm produce.

### His motivation

Early in his career, James realized that employment limited his innovation and stayed true to his love for farming. "When I got my first office job in a manufacturing company, I did poultry farming as a hobby, and before long I quit formal employment to focus on farming which at the time was more fulfilling for me," he says. That is when he moved from Nairobi to his rural home with a dream to produce vegetables and keep poultry for the market. His fortunes were good as he secured tenders with local supermarkets to constantly supply onions, tomatoes and chickens. With time, he scaled his enterprise but soon after, his

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## Hybrid dryer to reduce post-harvest losses

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entire flock of 6000 chickens was wiped out by a disease. He closed his vegetable business also as sometimes markets failed, and he would in the process lose valuable produce. It was this experience as a small holder farmer that gave him a clear understanding of the challenges faced by farmers and when his mother was faced by a similar challenge, he knew it was time to act.

### Recognition

BioAfriq Energies has won various awards for the innovation that has completely changed the lives of many farmers. In 2019, they won an award from Total Kenya through a grant of Ksh1.5 million to activate the product into the market.



He recently won The Circular Economy Award which honours innovators who develop products that help reduce wastage. The hybrid drier technology is indeed a game changer in reducing wastage as it makes use of waste biomass and it is also a gasifier.

Looking into the future, James is focused on scaling the enterprise to reach more farmers with the technology. "I dream of a time where every Self Help Farmer group dealing in vegetables or fruits or herbs will have their own drier," he says noting that improving farmers' livelihoods means that the farmer is food secure to a point that they can use and sell some produce and at the same time preserve some for later, when there is scarcity.

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### SOIL FERTILITY

## Biochar Production and its use in Agriculture

**Bio activated charcoal helps improve soil fertility and plant growth. In addition, it slows decomposition, reduces the bioavailability of heavy metals and organic pollutants**

By **Carolyn Anaye**

AGRICULTURE IS THE backbone of many countries of the world. However with the increased population there is need for more food which in most cases requires a lot of chemical fertilizers and soil amendments in order to meet the demand. These chemicals have high carbon levels and when overused they contaminate the environment and water bodies. Consequently, this degrades soil ecosystem and there is need to seek alternative methods of food production such as the use of biochar to supplement the existing methods.

Biochar also known as bio activated charcoal is a black carbon compound that helps improve soil fertility and plant growth. In addition, it slows decomposition, reduces the bioavailability of heavy metals and organic pollutants. This eventually helps reduce the need for chemical fertilizer and soil amendments application. Biochar has a porous structure and large surface area that leads to better soil, water and nutrient retention. Additionally it promotes the growth of beneficial soil microbes such as fungi and earthworms that increase plant nutrient availability especially the major nutrients (N, P, K) and micronutrients. Studies have shown it can also protect crops against fungal, leaf infections and nematode attack.

### How to prepare biochar

Organic materials such as rice stalks, wheat stalks, corn stalks, cotton stalk, forestry waste and livestock waste from pigs, cattle, and poultry can be used as raw materials for the preparation of biochar. However, care should be taken to avoid mixed wastes or plants used in hedges such as Oleander as they contain toxins which when not burned well can affect other plants. Several methods exist for preparation of biochar but the commonest at the farm level is slow pyrolysis, which is the traditional method.





### Steps for preparation

1. Heat organic material at low temperatures in the absence of oxygen (several hours to several days).
2. Drying after a long pyrolysis time (several hours to several days).
3. Leave it for several days before using it.

Burning piles of wood (forest waste) and covering it with soil will allow it to burn slowly with limited air.

### Important steps for using bio char in the farm:

1. Activate biochar by creating a 50-50 mix of biochar and organic material, such as compost, mulch and leave it for 10-14 days.
2. Alternatively soak raw biochar in liquids like compost tea (water from soaked compost) that is high in nutrients and microbes.
3. Mixing small quantities of biochar with manure or compost works better than using lots of biochar.
4. Small quantities of bio char applied in the farm every year is better than lots of biochar all used at once.

**Note:** Activating biochar loads it with nutrients, water, and beneficial soil microbes that support soil fertility and promote plant nutrient availability and plant growth.

### Post-treatments

They are important in improving the effectiveness of biochar and include;

1. Mixing biochar with soil over time so that it can adsorb nutrients to its surface.
2. To attract beneficial microbes and fungi mix your new biochar with compost or manure
3. Spray new biochar with EM to start healthy communities of microbes.
4. Mix new biochar with ash to raise its pH and help release nutrients in soil that crops cannot absorb because of the acidity.
5. To add trace elements and minerals farmers are advised to dust biochar with clay and clay water mix.

### Advantages of using biochar in livestock/ poultry farming

1. When 1-3% bio char is added chicken feed/ pasture it leads to increase in weight gain by 20%.
2. The bio char when added to pasture and molasses protects cattle from many digestion problems by improving the microbes in the cattle's gut.
3. It also reduces diseases in chicken when used in their feeds.
4. Biochar when mixed with the floor litter reduces ammonia smell and increases egg production in chicken farming.

*Benefits of biochar in agriculture and forestry systems*



## AGROFORESTRY

# Tips to enjoy full benefits of agroforestry

## Integrating woody perennials with crops and/or animals on the same piece of land

By **Bramwel Soita**

Agroforestry has a full range of benefits, but one must understand the attributes of good practice in agroforestry and the various ways of practicing it. This article gives a guide on these critical elements of agroforestry.

### What is agroforestry?

Agroforestry involves deliberately integrating woody perennials with crops and/or animals on the same piece of land. The integration can be either in a partial mixture or in a temporal sequence. There are ecological and economic interactions between woody and non-woody components in agroforestry.

### Agroforestry has the following attributes:

- i. Increases productivity in a farm land;
- ii. It must meet the needs of the present generation without compromising the ability of future generations to meet their own needs
- iii. It should be culturally acceptable and environmentally friendly.

### How is Agroforestry helpful for livelihoods?

- It reduces poverty through increased production of agroforestry products for home consumption and sale.
- It increases yields by restoring farm soil fertility and creating favorable micro-climates for food crops.

### How is Agroforestry helpful for adaptation to climate change?

- It increases the diversity of on-farm trees, crops, and tree cover to cushion farmers against the effects of global climate change.

- It enhances or maintains wildlife habitat as well as biological diversity.
- It reduces deforestation and pressure on woodlands by providing fuelwood grown on farms.

Trees provide microclimate conditions that are suitable for crop growth by protecting the soil from excessive heat, exposure to wind, and moisture loss.

- It increases food security by increasing the production of fruits, nuts and edible oils.
- It improves nutrition to lessen the impacts of hunger and chronic illnesses.
- It augments accessibility to medicinal trees, the main source of medication for 80% of Africa's population.

### How Agroforestry is helpful for climate change mitigation?

- Trees store carbon. The key characteristics that differentiate how much carbon is stored are tree density and the products derived from the system.
- The soils of agroforestry systems contain significant quantities of carbon. Generally, the amount of carbon stored in a system's soil remains steady, increasing slowly with time.

### Agroforestry systems:

Farmers desiring to integrate agroforestry in their farms can use any of the following systems depending on the need:

#### a) Dispersed trees on cropland

Trees may be grown in fields while crops are grown alongside or underneath. The practice of growing trees in this way can be done either by protecting and managing the trees that are already there or by planting new trees.

#### b) Buffer zone agroforestry

These are agroforestry practices carried out around protected forest areas to serve in

- Reducing human pressure on protected forest reserves.
- Improving living standards of people around protected areas within the ecosystem.

The poster for World Food Day 2023 features a central image of a person's profile with a globe of water splashing over their face. On the left, the Sustainable Development Goals logo is displayed. A dark blue hexagonal button with the text 'JOIN US!' is positioned above the central image. To the right, a date box indicates '16 OCT 2023' and lists the venue as 'BUKURA AGRICULTURAL TECHNICAL COLLEGE KAKAMEGA'. At the bottom, the text 'WORLD FOOD DAY' is written in large, bold, black letters, followed by the slogan 'Water is life, water is food. Leave no one behind.' in blue. Logos for the FAO, Eastern Africa Team, and national emblems are shown at the bottom.



- Sustaining water quantity and quality.
- Reducing soil erosion; and
- Enhancing the production of multiple products

#### c) Alley cropping

Alley cropping is also known as alley farming or hedgerow intercropping. Rows of woody plants are grown with annual crops planted in the alleys in between. The main purpose of this method is to maintain or increase crop yields by improving the soil and micro-climate through the cycling of nutrients, mulching, and weed control.

#### d) Trees on boundaries

This involves planting trees on farm boundaries. It requires agreements between the neighbors involved to avoid conflicts due to the shading effects of the trees.

#### e) Live fences and hedges

Live fences are established all around the farm; it is common to establish such a fence around homesteads. It is relevant in most farming systems except irrigation schemes. It is particularly important in controlling livestock grazing.

#### f) Fodder lots and fodder banks

Trees and shrubs are intercropped with fodder grasses to maximize fodder production.

Trees and shrubs with palatable leaves and/or pods are attractive to farmers as feed supplements for their livestock because they require little or no cash for inputs; they can be grown on boundaries as trees (often pollarded to reduce competition) or as hedges.

#### g) A fodder banks

This is a store of conserved grasses (hay or silage) which is deliberately accumulated over and above the normal seasonal requirements, for use by livestock in unpredictable, lean times such as an unseasonal dry period, a severe hailstorm, or an armyworm outbreak.

#### h) Trees in homesteads

This is a practice where trees are grown in homesteads or adjacent to the homestead. These trees include fruit trees, nuts, shade, and ornamental trees.

#### i) Biomass transfer

Biomass transfer involves the incorporation of leafy plants into the soil. It transfers nutrients from an area of a farm into the cropland. It aims at improving nitrogen, potassium, phosphorus, manganese, and calcium in the soil. The most used plants in Western Kenya are: *Tithonia diversifolia*, and *Lantana camara*.

#### j) Improved fallows

This is the targeted use of a fast-growing tree species to obtain the benefits of a natural fallow. Nitrogen fixing trees and shrubs are planted with the main aim of improving nutrient input into soil. They fix nitrogen and add organic matter to the soil. The practice is common where land is regularly fallowed especially in semiarid areas. Nitrogen fixing trees and shrubs include *Sesbania sesban*, *Markhamia lutea* (*siola*), *Calliandra*, *calothyrsus*, *Casuarina equisetifolia*

#### k) Trees on soil conservation structures

Contour vegetation strips are living barriers of trees and shrubs which are planted along the contour lines of a slope. These lines of vegetation can serve the same purpose and can also provide useful products such as food, fuel, building poles, fodder, or gum.

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### SYLVIA'S DIARY

## Bio-diversity Culture and Food Traditions

**Culture and food is important to create healthy, diversified, and appropriate diets**

By Sylvia Kuria

I have made the observation that when we ask children in the city what their favourite food is, most of them say foods such as pizza, French fries, chips, pasta, and noodles. Recently, I was visiting a local primary school in my village in Ndeiya, Kiambu County, and teaching children how to grow a kitchen garden. I decided to ask the children what their favourite foods were, and the majority of them said ugali, sweet potatoes, and chapati, and only one child hesitantly said pizza!

According to the FAO definition of biodiversity, culture, and food traditions, it states that culture and food is important to create healthy, diversified, and culturally appropriate diets, and agroecology contributes to food security and nutrition while maintaining the health of ecosystems.

The majority of city dwellers in Africa who were born before 1990 were born and raised in the country. But due to the increased education and career opportunities found in major cities, many have relocated to the city and adopted city life. Generally, city life has been seen as a good life with access to numerous amenities, luxury and "good food." Many city dwellers have acclimatised to buying food in plastic packages, enjoying processed foods, shopping in supermarkets as opposed to local open-air markets, and buying ugali flour from the shops instead of milling flour at the "kisiagi" (posho mill).

Small wonder city children innocently love the foods they are introduced to and have not been given a chance to enjoy our culturally appropriate foods. To also cut city parents some slack, access to our indigenous foods is also lacking in the major cities, mainly because farmers have also abandoned our indigenous foods and focused on modern foods that have been promoted by the western way of life that has infiltrated the African continent.

### Diversity and Nutrition

Back to the FAO definition of culture and food traditions, we see that there is an emphasis on diversified diets. If we think about the foods that

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city children enjoy, we notice that these foods are mainly simple carbohydrates that have no or very little nutrition. These simple carbohydrates convert to sugar in the body, which gives one a “good feeling” that is often temporary and makes one crave for more. I normally challenge my young children and ask, why is it that they can eat a full pizza with no problem but cannot finish a big bowl of boiled cassava?

This mainly has to do with the fact that cassava is high in fibre and will make one feel full very quickly. Research has found that we have more than 100 types of African indigenous vegetables, but we mainly eat about 20 varieties. This goes to show that we are all living below the potential of the diversity that is available to us.

**Culturally appropriate diets**

If we take time to research how culture shapes our food patterns, we will find that our forefathers knew what kinds of foods were important for each season and reason. I am originally from western Kenya, and to date, a new mother is normally encouraged to consume African indigenous leafy greens that are generally high in iron, which she needs as she recovers from childbirth.

**Health of ecosystems**

Finally, we need to be aware that when we grow a variety of local indigenous foods, we improve our ecosystem and the health of our soils. Before the age of synthetic inputs, we were food secure and our crops were hardly affected by pests and diseases. When hybrid crops were introduced to farmers in Africa as a way of improving and increasing crop yields, unfortunately, these crops were accompanied by pests and diseases that were not known. Consequently, the harsh and hazardous synthetic inputs that have been used over the years to control pests and diseases have completely decimated our healthy ecosystems.

We have eroded the natural balance of the environment and replaced it with hybrid monocrops that are yet to feed us adequately. My encouragement to the readers of this piece, please go back to growing a large variety of indigenous foods suited for your location.

At Sylvia's Basket organic farm shop, we are deliberate about promoting our local foods. We are growing our brand as one that partners with small holder farmers to grow and supply local indigenous foods. In our outlet, you will always find seasonal indigenous leafy greens, pumpkins, sweet potatoes, arrow roots, millet, sorghum, indigenous maize, and a variety of seasonal local fruits.

There is a huge demand for our indigenous foods in the city, and if African farmers can make a deliberate choice to go back and grow our local indigenous foods, they have a chance of making a sustainable income as well as renewing and improving their local ecosystems.

Sylvia Kuria is an organic farmer and sole proprietor of Sylvia's Basket. Tel: 0738- 895- 395; Email: sylviakuria@gmail.com



**LEARNER'S CORNER**

## Mutulani Primary School makes gardening a leisure activity

By **Caroline Mwendwa**

Gone are the days when learners played under the scorching heat of the sun, engulfed in dust. Teachers and pupils from Mutulani Primary school, Makueni County can tell the story of a once bare land and dusty school compound that is now a sight to behold as they are now enjoying the transformational effects of agro-forestry and kitchen gardening.

The school was introduced to the technologies of establishing kitchen gardens and planting fruit trees within the school gardens and compound by Joseph Mbithi an extensionist of Biovision Africa Trust based in Makueni County.

“Since our school is located in a semi-arid area, the sun can be so hot that pupils find it uncomfortable, but now as you can see, there are shades all over the compound as trees bring a natural sense of beauty and a cool atmosphere,” says Ms Vaati Musyoka, the school deputy headteacher.

Just adjacent to the classes are green patches of well laid out vegetable gardens that pupils are excited to nurture. “During breaktime you will see learners from the Greening club, running to water the vegetables as they look forward to see them blossom,” she adds. The pupils are enthusiastic about the project as it not only brings them fulfillment, but they have also learnt



that farming is a reliable source of income.

"The Competency Based Curriculum teaches the essence of being innovative in generating income, and the kitchen gardens around our school has opened our eyes to the opportunities around us," says Brielle Nyambura one of the Agricultural Club members. She attests that since she discovered the pleasure in nurturing a vegetable garden, she is rarely idle, even when at home, it is for her a hobby that is rewarding.

The school garden has fruit trees such as paw paws, passion fruits, mango trees, avocado trees; all of which bear fruits in season that are either enjoyed by the school community or sold to buyers within the school. The technologies used in kitchen gardening especially the art of improvising materials such as tyres, old bags and containers are practical lessons for the CBC learners on ways to be creative in utilizing the available resources to produce food and generate income.

"So many parents in this community have learnt from our garden and replicated the same in their farms," says Ms Vaati. She adds that the knowledge has transformed the way parents farm, especially since vertical gardens can survive in dry weather regions as they do not require high volumes of water but can thrive on recycled kitchen water. Not only have parents learnt that they can grow vegetables for consumption and sale to neighbours, but the practice has also diversified diets in households.

"Some time with the inadequate rainfall, parents are forced to feed their families with imbalanced diet, but as they learn these technologies, their families enjoy vegetables in most meals," says Ms Vaati.

The school is a testimony that learners can change their parents' way of thinking by showcasing how innovative thinking can save them from being dependent on buying everything when they can produce some foods just within the homestead. "This has helped in demonstrating to the learners that they have the solutions to the challenges they face at the family level," says Mr. Martin Musemi, the Patron of the Greening Club at Mutulani Primary School.

Caroline Mwendwa is the Project Officer of The Organic Farmer Magazine; [Cmwendwa@biovisionafrica.org](mailto:Cmwendwa@biovisionafrica.org)

## CROP CARE

# How to control fruit flies using Integrated Pest Management Strategies

By **Beritah Mutune**

Fruit flies are insect pests that attack soft, fleshy fruits of a wide variety of fruit and vegetable crops. Examples include mangoes, avocados, pawpaws, bananas, citrus fruits, watermelon, pumpkin, courgette among others.

### What are the damage symptoms on fruits?

Attacked fruit usually shows punctures (made by females while laying eggs). By so doing, they introduce bacteria cause rotting of the tissues surrounding the egg. When the eggs hatch, the maggots feed on the fruit flesh making galleries.

These provide entry for pathogens and increase the fruit decay, making fruits unsuitable for human consumption. Small holes on the fruits are visible when the maggot leaves the fruit. The affected part of the fruit becomes soft and the fruit falls to the ground as, or just before the maggots pupate. Fruit flies are also ranked as quarantine pests and thus restrict access to the international market for the infested crops.

### Use of Integrated Pest Management (IPM) strategies

Most farmers often use synthetic insecticides to control fruit flies, which are not always effective, are expensive increasing production costs and are hazardous to human health and the environment. In order to sustainably produce fruits in Kenya, farmers need to adopt the use of Integrated Pest Management (IPM) strategies developed by icipe to effectively control fruit flies. The fruit fly IPM package which has enormous benefits among mango farmers and consumers, includes use of population monitoring, male annihilation technique, spot application of protein bait, field sanitation, biological control which includes use of natural enemies (predators and parasitoids) and the application of *Metarhizium anisopliae*-based biopesticides in combination. This IPM package has been effective on mango production and can also be applied to all fruit crops that are infested by fruit flies.

#### 1. Population monitoring

Fruit fly monitoring is an action taken to understand the population dynamics of the fruit flies in the field to guide control measures. Monitoring tells the growers on how the population of fruit flies is changing within or outside the cropping area. Results from the monitoring exercise are used to decide when to start control and determine the efficacy of the control measures. Monitoring is also important to detect invasion of new fruit flies and their distribution. It is done using traps baited with attractants (lures) such as protein baits (e.g Fruit Fly Mania) or male attractants (such as methyl eugenol). Another method is to collect fruits and check for infestation, but this is labour-intensive.

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Tuko Mbele Pamoja!

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## 2. Spot application of protein bait

Female fruit flies require protein to mature their eggs. Sugars in protein bait are also important for the fruit flies to survive and mature. Protein bait, therefore, is attractive to female and male fruit flies. When mixed at the recommended concentration with appropriate insecticides called spinosad, they attract different species of fruit flies that attack fruits and vegetables. The bait attracts the flies from a distance which feed on the bait, ingest the toxicant and die. It is, therefore, an 'attract and kill' management method. Fruit Fly Mania is commercially available in Kenya and can be purchased from Kenya Biologics. Blanket spraying of pesticides is not recommended because the large quantities of chemicals are hazardous to the environment and farmers end up using a lot of pesticides hence the need for the "spot" application of bait.

## 3. Male annihilation technique

Male annihilation is the process of mass trapping of male fruit flies using male attractants such as methyl eugenol (ME) in combination with an approved insecticide. The attractants are mixed with recommended soft insecticide, applied on a cotton wick and placed in a trap. The baited trap is placed in a given area to attract the majority of the males. If the male population in an area is significantly reduced, the fruit fly population will decline due to lack of males in the population to mate with females. The shortage of males reduces the chances of successful reproduction and results in a population crash. They can be made at home using plastic cooking fat containers or water bottles. These traps are available at Kenya Biologics Ltd, Koppert Biological Systems, and other specific agrovets.

## 4. Biological control using parasitoids

Biological control of fruit flies involves the human use of specifically chosen organisms (parasitoids, predators and pathogens), also known as "farmers' friends" to reduce damage caused by a pest. They include parasitic wasps, predators, and pathogens, and are naturally available in our farms. Two foreign parasitic wasps are mass-reared at International Centre of Insects Physiology and Ecology and released in various mango farms in Kenya for effective control of fruit flies. Farmers are encouraged to adopt practices that conserve these natural enemies, such as



zero application of synthetic chemicals, use of augmentorium for field sanitation, maintaining flowering plants and planting more trees in their farms.

## 5. Biological control using biopesticides

A commercial fungal-based biopesticide called Campaign®, which was developed by both icipe and ReallPM is used for the control of fruit flies in Kenya. It is based on an insect pathogenic fungus *Metarhizium anisopliae*. Campaign can be used as a soil drench to kill the larval and pupal stages of fruit flies in the soil and also in the auto-dissemination technique for the control of adult fruit flies.

## 6. Orchard/Field sanitation

Field sanitation is the process of collecting and destroying all infested fruits containing fruit fly eggs and maggots, on the ground and trees, to reduce fruit fly populations in the field. The most recommended method is the use of the 'augmentorium'. This is a tent-like screen structure that is designed to retain fruit flies inside the tent. It has the advantage of allowing the natural enemies of fruit flies that may be in the fruit to escape via a yellow screen on the top and re-enter the field. The retained fruit flies and the rotten fruits could be used as components of compost. Augmentoria can be easily constructed by growers. Other recommended cultural practices in this strategy include: - fruit bagging, burying, burning and use of the rotten fruits as animal feed (pigs, cows) and many others.

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