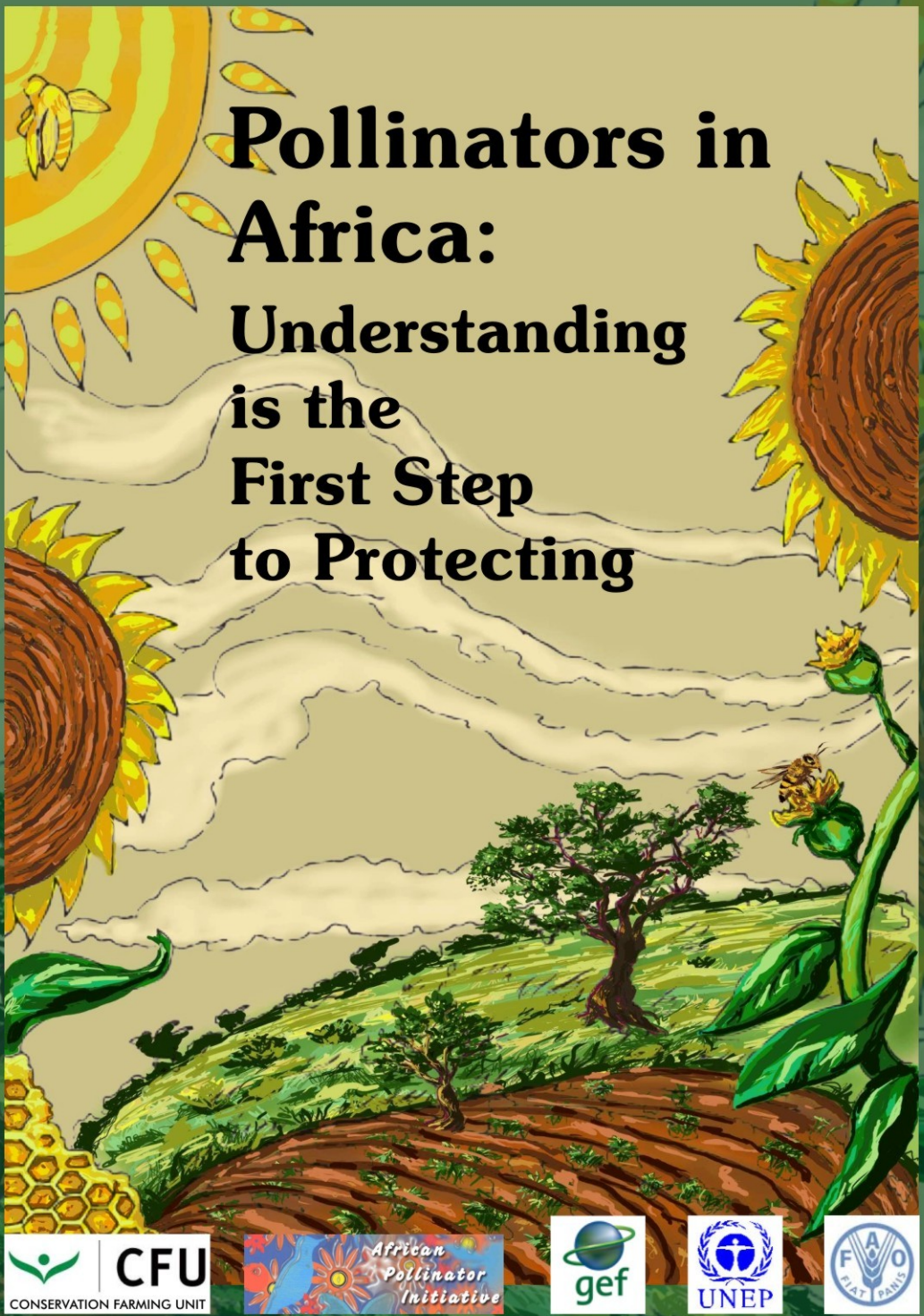
Pollinators in Africa:

Understanding is the First Step to Protecting



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Pollinators in Africa: Understanding is the First Step to Protecting

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Written by Daphne Mayes, Peace Corps Volunteer and Master's International student, Zambia, 2009–2011.

Photographs courtesy of Tyson Mayes

Cover art and illustrations by Jacob Jones

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This edition

Editor: Linette Ferreira

This edition of the booklet is printed by the South African National Biodiversity Institute (SANBI). This publication contributes to the outcomes of the Global Pollination Project, Conservation and Management of Pollinators for Sustainable Agriculture through an Ecosystem Approach implemented in 7 countries—Brazil, Ghana, India, Kenya, Nepal, Pakistan and South Africa. The project is coordinated by the Food and Agriculture Organization of the United Nations, with financing from the Global Environment Facility (GEF) and implementation support from the United Nations Environment Programme (UNEP). In South Africa, the project is implemented by SANBI and will run until the end of 2013. The booklet is intended to create general public awareness about pollinators in Africa. Information relating to specific crops in South Africa will be generated as outputs of the project. More information about the project can be obtained from the SANBI website (www.sanbi.org) under the section Ecosystem Services.

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Introduction

In recent years a decline in both wild and managed pollinators has been observed in countries around the world. Disease, habitat loss and invasive species are only a few of the factors attributed to the declines, but there is still much to be learned regarding current pollinator health and status.

The African Pollinator Initiative (API) is the regional arm of an international effort to conserve and protect pollinators in Africa. This initiative, as with the International Pollinators Initiative, is not 'owned' by any one organisation; it is made up of contributions from many actors to overall pollinator conservation and sustainable use. South Africa, Kenya and Ghana, amongst other countries in Africa, have ongoing research and pollinator-focused activities taking place. Educating the public and key stakeholders about the importance of this field is a component of the API. This manual is an extension of these efforts.

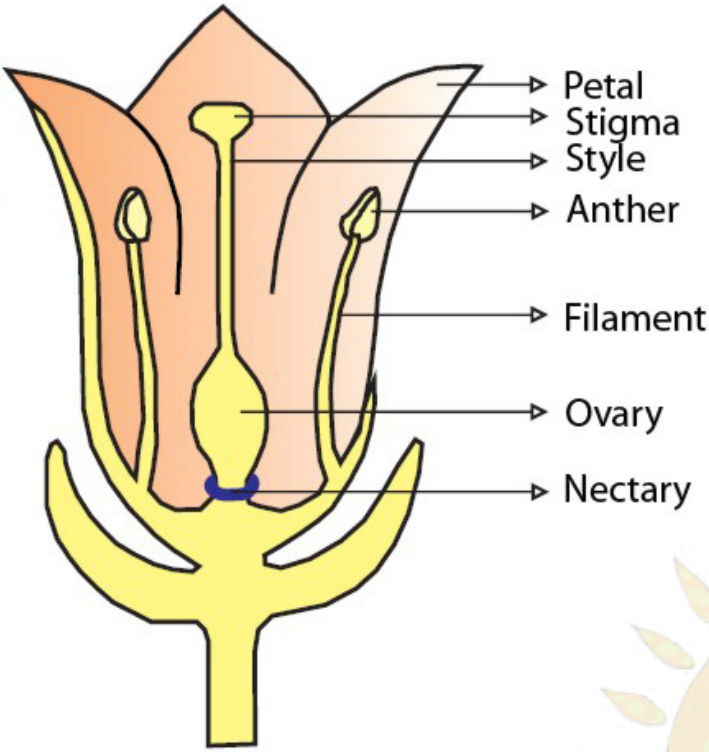
Pollination of one-third of the foods we consume requires a living organism to unite the reproductive parts of a flower. Insects, birds, bats and other animals serve as pollinators while they forage for their own survival, consequently providing a free service we depend upon. A reduction or loss of these organisms would inevitably result in concerns regarding food security and nutrition in areas already facing stresses such as the impact of HIV & AIDS.

The purpose of this manual is to inform and engage stakeholders, extension agents and landowners about the importance of pollinator conservation and to provide practical advice regarding land management. Most of the focus in literature regarding bees in Africa relates to beekeeping. This manual aims to provide a broader understanding and appreciation of the many contributions made by all pollinators.

What is pollination?

Pollination is the movement of pollen grains (male) from the anthers to the stigma (female) of a flower. This occurs by wind, water and biotic means and varies among plant species. The plant continues the path of producing seed and fruit after being fertilised. Pollination is therefore a requirement for seed and fruit production.

Plants are pollinated during their flowering period. Generally cereal grains like wheat, maize and sorghum are wind pollinated, while most fruits and vegetables are pollinated by animals. Cross pollination is necessary for most plants and occurs when pollen is delivered to a flower from a different plant. Even plants that can 'self pollinate' (when pollen grains are carried from an anther to the stigma of the same flower) often benefit by cross pollination.



Parts of a flower. Image: T. Essington Brown and B. Ferreira (editors). Guia de Manejo e Conservação de Abelhas Silvestres, produced by the Probio Programme in Brazil.

What is a pollinator?

A pollinator is a living organism that transfers pollen to the stigma of a flower. This can take place within the same flower, within flowers of the same plant or among flowers in a given locality. This occurs as a result of an animal foraging for nectar or pollen among flowers. Insects, birds and bats are the most commonly observed animals involved in pollination. Bees are notable within the insect community because they actively forage among flowers of the same species—thereby increasing the chance of successful fertilisation

Pollinators. Clockwise from top left: A Honeybee collecting pollen; a butterfly collecting nectar; a sunbird (resting between flights) collecting nectar and a Solitary Bee foraging.

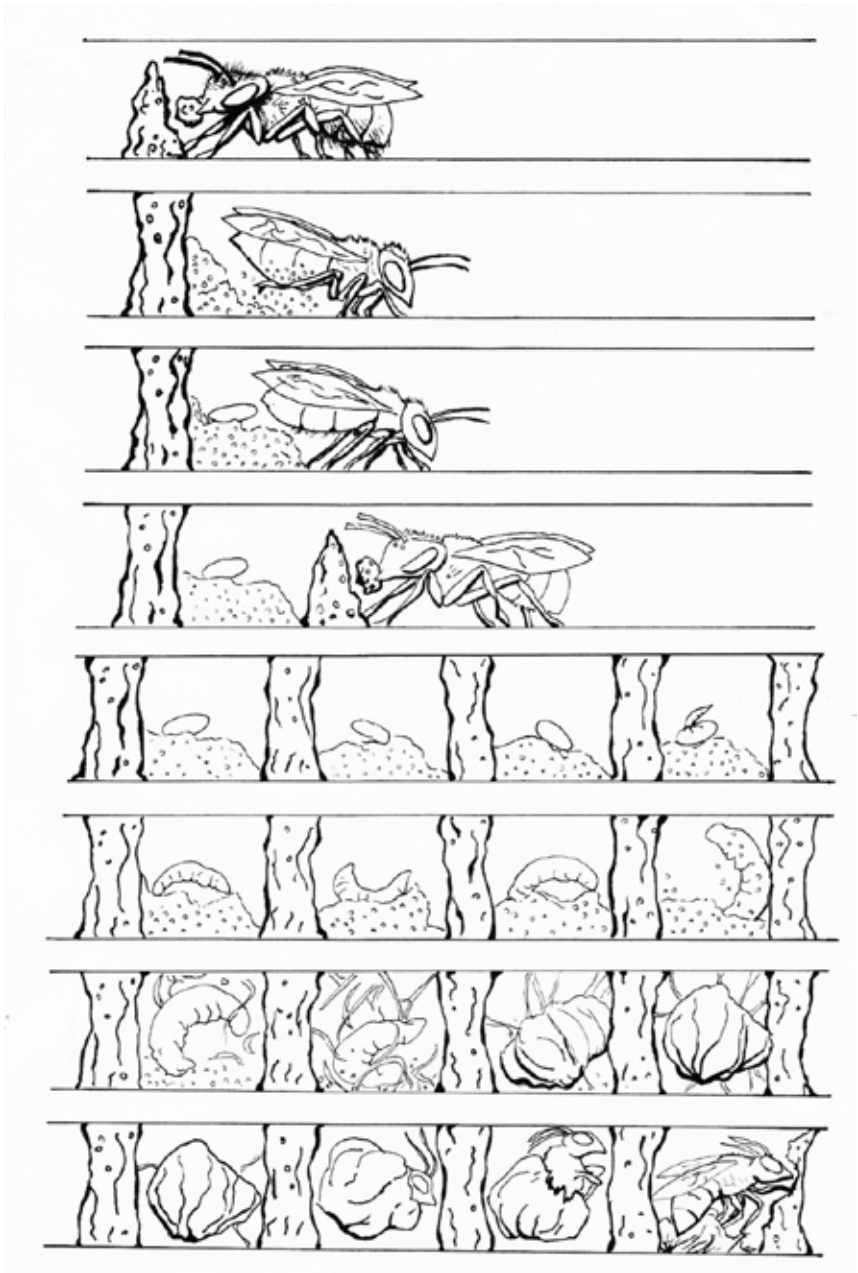
Pollinators have different needs and life cycles

Pollinators come in many shapes and forms and require different resources to survive and thrive. Most pollinators depend on natural areas such as forests for part of their life cycles. Birds and bats must have undisturbed areas to reproduce and nest while insects use soil, dead trees and abandoned holes, such as those in termite mounds, to complete their life cycles. This manual focuses on the needs and life cycles of bees since they are the primary pollinators in agricultural systems.

Bees are the most efficient pollinators of crops because they forage among the same plant types in a single visit, while others such as butterflies are more random in the flowers they visit. Bees are additionally equipped with small hairs that pollen grains can stick to while they search for food.

There are many different types of bees that forage on plants at different times of the day, year and at different temperatures. Some are more effective pollinators of certain plants than others due to their size and behaviour.

Carpenter Bee (*Xylocopa senior*) collecting nectar and pollen.

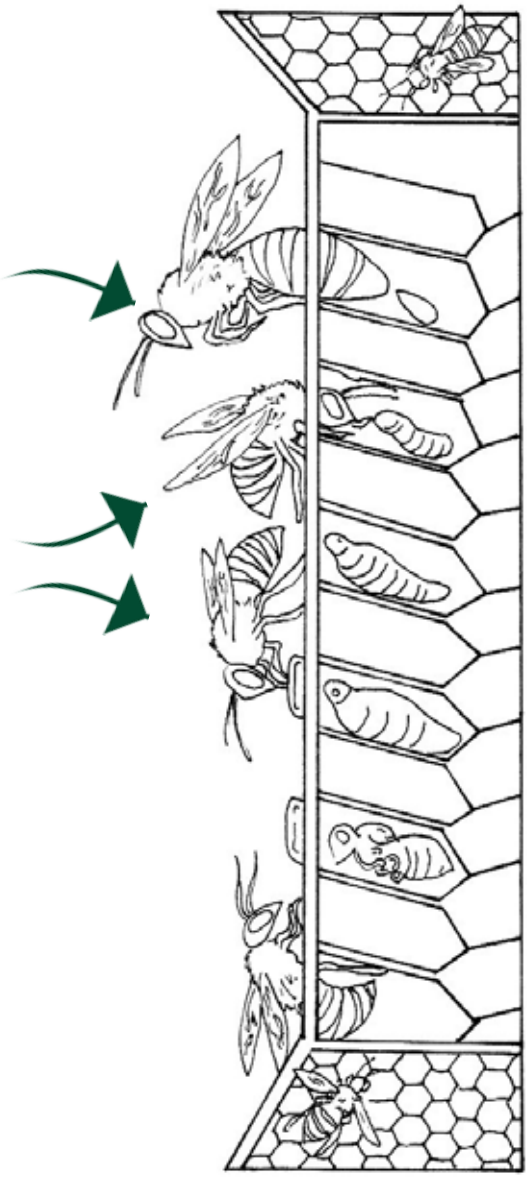


A cross-sectional view of a Solitary Mason Bee (in the family of leafcutter bees, Megachilidae) building a nest inside a cavity. Wet mud or clay is used to build a nest in which fertilised eggs are deposited. Eggs develop into larvae that feed on nectar and pollen.

Did you know?

Honeybee colonies maintain a social society which includes the following three castes:

- The **queen bee** is the only fertile female in the colony and can live up to five years.
- **Worker bees** are all non-reproducing females and make up the majority of bees in a hive. They also do most of the work which includes foraging for food, raising the young as well as building, cleaning and protecting the hive.
- **Drone bees** are the only males in a colony and their main role is reproduction.



A cross-sectional view of Social Honeybees feeding and caring for developing larvae. Each bee colony has a single queen bee that deposits fertilised or unfertilised eggs into chambers of the honeycomb which is built by worker bees.

Why conserve pollinators?

Pollination happens before fertilisation, which is required for fruit and seed development. If no pollinators are present to facilitate pollination, the result is little or no fruit and seeds. Imagine what our diets would be like without fruit!

Pollinators are therefore an integral part of our food supply as well as the many plants that other wildlife depends upon for food and shelter.

Unfortunately pollinators are declining throughout the world: from western honeybees—suffering from the impact of disease and habitat loss—to the many species of wild bees that come to visit crop flowers and end up being sprayed with pesticides.

It is therefore crucial to focus efforts on pollinator conservation.

Pollinators contribute to food security, biological diversity and the economy. The current and future status of pollinators is uncertain due to the combined threats of climate change, population pressures and land degradation. The following chapters include examples of ways to protect these important animals.

Sunflowers benefit from pollinator activity.

Sonka Mubanga enjoying the fruit of a mango—a fruit tree that depends on insects for pollination.

Pollinators in and around farms

Animals are needed to pollinate 35 percent of crops grown worldwide. Cross pollination contributes to more productive farmland and results in increased seed sets (the number of ovules that successfully develop into seeds) and crop harvests as well as fruit quantity, size and quality. Pollinators vary in size, behaviour, appearance and needs.

The decline of managed European honeybees in North America and Europe and the reliance on this one species for crop pollination resulted in lower yields of almonds in the United States. This happened because there were not enough managed honeybees to fulfill the pollination needs and populations of wild pollinators had decreased due to habitat loss and pesticides. This serves as an important lesson for sustainable agriculture and emphasises the need to conserve wild pollinators.

Pollinators can thrive naturally in and around farms if the land is managed with pollinator conservation in mind. The next section addresses this topic in detail and focus on farming practices used in Zambia specifically, due to its expanding agriculture which influences how resources are used. Education is the first step to conserving these important contributors of agricultural productivity and sustainability.

These fields have permanent planting basins and are surrounded by trees, which provide a habitat for pollinators and serve as windbreaks that reduce soil erosion.

How pollinators can benefit from farms and communities

Communities and people can provide food and habitat for pollinators by:

- Supplying a constant source of nectar and pollen.
- Leaving undisturbed areas untouched for nesting.
- Creating pesticide-free gardens that will allow predatory insects to control pests in a natural way.
- Creating healthy, diverse gardens that beautify the environment and serve as a food source.

Top, clockwise: A small garden near the home provides food for people and pollinators; a butterfly displaying and a praying mantis awaiting its next meal.

Health and food security depend on pollinators

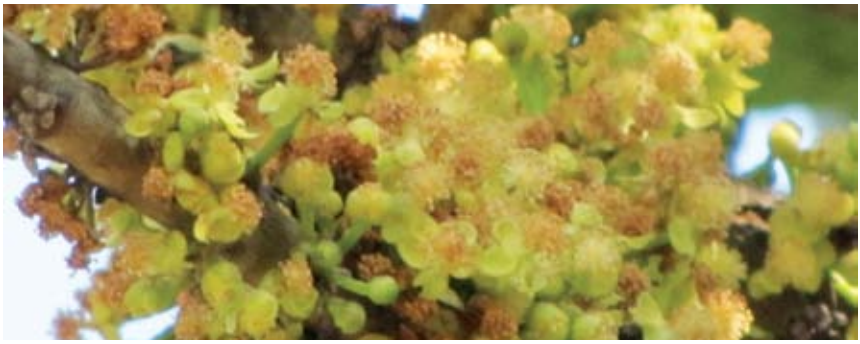
Pollinators contribute to our health and food security by pollinating many of the fruits and vegetables we eat. The following table indicates some of the food plants that are grown in Zambia and also the method of pollination that is needed for fruit or seed production.

Plant name	Method of pollination
Common bean (*Vicia faba*)	Self pollination; bees
Cowpea (*Vigna unguiculata*)	Self pollination; bees
Eggplant (*Solanum melongena*)	Bees
Cucumber (*Cucumis sativus*)	Bees
Hot/Sweet pepper (*Capsicum* spp.)	Self pollination; bees
Okra (*Abelmoschus esculentus*)	Self pollination; bees; wasps; flies; birds; beetles
Pumpkin squash (*Cucurbita* spp.)	Bees
Tomato (*Lycopersicon esculentum*)	Self pollination; large bees
Watermelon (*Citrullus lanatus*)	Bees
Bottle gourd (*Lagenaria siceria*)	Bees; bats; hawk moths
Passion fruit (*Passiflora edulis*)	Large bees

Pumpkins greatly rely on pollinators to create good quality fruits and seeds. In Zambia many people enjoy pumpkin leaves also called cibwabwa. Without pollinators this relish would not be available!

Avocados are pollinated by bees, wasps and thrips.

Spiny cucumbers are found in fields and bushy areas. These nutritious snacks rely on insect pollinators to develop properly.



Parinari curatellifolia, known locally as mupundu, provides wild fruits which are high in vitamin C.

Pollinators greatly benefit trees, orchards and forests

Pollinators not only benefit fields and gardens, but also assist with fruit and seed production of trees. Not much is known about the ways many of Zambia's indigenous trees are pollinated, but they most likely benefit hugely from animal pollinators.

Plant name	Method of pollination
Avocado (*Persea americana*)	Bees; wasps; thrips
Apple (*Malus domestica*)	Bees
Orange, lemon, *Citrus* spp.	Bees; insects
Fig (*Ficus carica*)	Fig wasps
Guava (*Psidium guajava*)	Self pollination; bees; insects
Litchie (*Litchi chinensis*)	Bees; flies; ants; wasps
Papaya (*Carica papaya*)	Butterflies; hawk moths
Cashew nut (*Anacardium occidentale*)	Flies; ants; bees
Coconut (*Cocos nucifera*)	Wind; bees
Oil palm (*Elaeis guineensis*)	Beetles
Cacao (*Theobroma cacao*)	Midges; thrips; ants
Coffee (*Coffea arabica*)	Self pollination; bees
Wild loquat (*Uapaca kirkiana*)	Insects
Marula (*Sclerocarya caffra*)	Bees; insects
Sausage tree (*Kigelia africana*)	Insects; birds
Baobab (*Adansonia digitata*)	Flies; bats; wind

(Gordon Rodger *et al*. 2004).

Peak flowering times of the Miombo woodlands

Zambia is largely covered by Miombo woodland which is dominated by three tree genera namely *Brachystegia* spp. (locally known as musamba), *Julbernardia* spp. (locally known as mutondo) and *Isoberlinia angolenis* (locally known as mutobo). Beekeepers in Zambia are quite familiar with these trees because they determine the two main honey flows that occur each year. (*Honey flow* is a term commonly used by beekeepers to indicate that one or more main nectar sources are in bloom and that the weather is favourable for bees to fly and collect nectar in large quantities).

The *musamba* and *mutobo* trees flower from September to December, while the *mutondo* trees flower from March to June. This makes a large amount of pollen and nectar available to pollinators and is especially noticeable for people managing honeybees. Following these peak flowering times, hives are often overflowing with honey which is then harvested.

Beekeepers often harvest honey in June and December. This particular harvest occurred in June. Mr. Mukuka (left), Mr. Mulubakwenda (middle) and Mr. Chanda (right) using a honey press to process comb honey.

Farming practices that impact pollinators

Pollinators are important players in agriculture and must be considered when applying certain management strategies. The Conservation Farming Unit advocates many practices that are beneficial to the soil and pollinators which include reduced tillage, no burning as well as the creation of a diverse landscape that include multiple crops and trees.

Other important impacts on pollinators include the misuse of pesticides, water pollution and the overstocking and overgrazing of livestock.

If farmers provide an agricultural landscape which includes pollen, nectar, water, nesting sites and materials needed by pollinators to complete their life cycles, they will enable pollinators to thrive and this will benefit both pollinators as well as the overall productivity of the farm.

Jinny Sekeleti has been practicing conservation farming for three years. Here she poses with her cotton crop which is thriving even after a three week drought in Mwachisompola!

When and how to use pesticides

Pollinators can be the victims of pesticide poisoning when chemicals are used in fields and gardens. This negative impact can be reduced if pesticides are applied while the crop is not in bloom. Pollinators are mostly active during the day when flowers are open and farmers should be encouraged to apply pesticides in the evening when flowers are closed.

Use pesticides with care:

- Try not to use broad-spectrum pesticides because they are designed to kill a wide range of animals and can affect or kill all insects including beneficial ones.
- Use pesticides that target specific insects if necessary and apply only if a problem persists.
- Use pesticides with caution and take note of all instructions provided with the products.
- Pesticides in the form of liquids and granules are better than powder ones because they can be better controlled and directed at target problem areas.
- Use pesticides sparingly and in the evening when pollinators are not active.

A Honeybee foraging in a cotton flower. Honeybees may improve the quality and yield of cotton and should be considered when pesticides are used to treat pests such as bollworms and aphids.

Soil improvement and pollinator conservation

Soil fertility can complement the needs of pollinators in and around farm fields. A healthy, nutrient-rich soil that contains organic matter is good for crops and allows certain types of pollinators to complete their life cycles. Flowers of crops, on the other hand, provide nectar and pollen that is necessary for pollinators to survive.

The following practices will protect pollinators and improve the soil's fertility and structure:

- Minimal tillage of soil.
- Crop rotation with legumes.
- No burning.
- Planting of cover crops such as red sun hemp on unplanted lands will provide nitrogen to the soil and nectar and pollen to pollinators.
- Intercropping (the growing of two or more crops closely together) will create diverse farming systems.
- Planting of trees in and around fields will mimic the natural environment and allow beneficial insects to thrive. Nitrogen-fixing trees such as *Faidherbia albida* (known in Zambia as musangu), *Sesbania sesban* and *Leucaena* spp. will provide nectar to pollinators all year round.

Soybeans and pollinators benefit each other as well as the soil. Honeybees improve the production of soybeans by cross pollination.

Natural areas on farmlands have many benefits

Leaving areas of a farm uncultivated will provide the necessary habitat for pollinators to thrive e.g. Carpenter Bees depend on logs for their nests, Honeybees may build nests in tree cavities or termite mounds while Mason Bees use clay and Leaf Cutter Bees use leaves.

A strip of uncultivated land around a farm field can also act as a wind-break which helps to reduce soil erosion. The removal of invasive weeds before they go to seed will ensure that they do not invade natural areas.

Natural areas are important safe havens for pollinators and ensure that other ecosystem services continue. Not only do natural enemies of crop pests benefit from these areas, but they also serve as carbon sinks that reduce greenhouse gases.

The cavity in this living tree is home to a wild Honeybee colony which forages and improves the productivity of the crops.

Conclusion

Farmers around the world can no longer depend on the free services that pollinators provide without taking their needs for survival into consideration. By implementing a few simple practices these vital organisms can be protected and conserved.

Many of the methods and techniques mentioned in this manual are not only beneficial to pollinators but also to the agricultural system as a whole. The health and needs of pollinators are vital for the future of sustainable agriculture, as is improved soil fertility, food security and productivity which are by-products of these methods.

Educating all stakeholders in the agricultural field about the importance of pollinators will be of great benefit to all and will ensure a more productive and secure future.

A rainbow beyond a cotton and maize field in Mwachisompola.

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Websites:

www.internationalpollinatorsinitiative.org

- Includes documents on the value of pollination services and methods to determine when a crop is suffering from a shortage of pollination. It also links to a Pollination Information Management System where information on the pollination needs of individual crops is available.

www.arc.agric.za/home.asp?pid=3493

- Explains the formation and role of the African Pollinator Initiative including its objectives.

www.xerces.org/pollinator-conservation/

- Includes updated lists of threatened and endangered pollinator species, identification guides, policies affecting pollinators, education and outreach tool.

Daphne Mayes served as a United States Peace Corps Volunteer and Master's International (MI) student through the University of Wisconsin-Stevens Point from February 2009 to April 2011. She worked in Zambia under the Peace Corps LIFE (Linking Income, Food and the Environment) program, where she taught rural Zambians about environmental topics that included conservation farming, environmental education, beekeeping as well as fuel efficient stoves and cookers. Her MI research and projects focused on pollinator conservation and sustainable agricultural methods.

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