Community management of locusts and grasshoppers in central Senegal

Bay Sa Waar
Communities for Sustainable Agriculture

The women participating in the Early Warning System in Mbar survey locust and grasshopper activity and alert authorities of incipient outbreaks.

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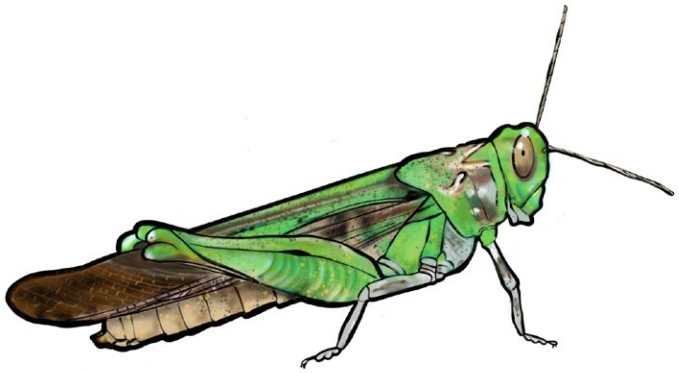

Introduction

Project participants in Gniby, Senegal.

This booklet was created as a part of the project “Communities for Sustainable Agriculture” (Bay Sa Waar). Funded by the U.S. Agency for International Development, Bureau for Humanitarian Assistance (USAID/BHA), the project combines the specialized research skills of American, Canadian, French, and Senegalese universities with local knowledge and experience of Senegalese institutions and farmers. It is a combined effort involving the Senegalese Plant Protection Directorate (*Direction de la Protection des Végétaux,* or DPV), Université de Gaston Berger, Arizona State University’s Global Locust Initiative (ASU/GLI), McGill University, the French Agricultural Research Centre for International Development (CIRAD), and communities in the Fatick, Kaffrine, Saint-Louis, and Thiès regions in Senegal. This project pilots novel methodologies for locust and grasshopper management in rural areas in Senegal where these pests endanger food security and wellbeing. The project’s name in Wolof, *Bay Sa Waar*, is a phrase that encourages farmers to “farm their part”—or do their part to engage in the monitoring and prevention of locusts and grasshoppers.

The original version of this booklet was distributed to project participants and partners in the Kaffrine and Fatick regions of Senegal. Written in Wolof and French, it has been translated here into English. As it was intended to serve Senegalese farmers, the original booklet was written with the assumption that the reader would be familiar with the area’s agriculture, environment, and culture. In this version of the booklet, however, we have provided a brief background on the country to contextualize the work for an international audience.

Country Overview

Senegal is the westernmost country on the African continent, spanning the Sahelian, Sudanian, and Guinean bioclimatic regions. Its unique situation permits a great variety of ecosystems, from dry steppe and short grass savannahs in the North to lush woodlands and forests in the South (CILLS 2016). A country of 15.5 million people, Senegal is divided into 15 regions, which vary in their demography, language, climate, and agriculture. GLI and its partners have worked predominantly with communities in central Senegal in the regions of Kaffrine and Fatick, where the project's first phase (2018–2020) took place.

Demography

Sharing meals is one aspect of Senegalese hospitality, or *teranga.* Passersby will be invited with calls of *kay lekk,* or "come eat" in Wolof.

Senegal's population is made up of more than twenty ethnic groups; however, 90% of the population belongs to five major groups: Wolof (43%), Pulaar (24%), Serer (15%), Jola (5%), and Mandinka (4%) (ANSD 2013). Though ethnic groups may differ greatly in their culture, many Senegalese are alike in their values of hospitality and generosity, strong family and community ties, and religious devotion. The majority of the population practices Islam (94.5%), but the government maintains a policy of religious tolerance and celebrates both Islamic and Christian holidays (Herzog and Mui 2014).

French is the official language in Senegal and the primary language of government and education. However, it is estimated that only 26% of Senegalese people are able to read and write French (Beck *et al.* 2018). Beyond French, the Senegalese government has designated 14 national languages, including Wolof, Serer, Pulaar, Mandinka, Soninké, and Jola, with at least 11 more in the process of achieving national language status (Benson 2020). Wolof is Senegal's lingua franca—the common language connecting different linguistic groups—and is spoken by approximately 80% of Senegalese (McLaughlin 2008). In community surveys conducted prior to the project's initiation, 76% of individuals designated Wolof as their primary language. Thus, both French and Wolof were selected for our publications in order to reach the greatest percentage of people in the area, regardless of their level of education.

Environment

Dry season field preparation in Keur Lahine Lobe, Kaffrine region.

Rainy season in Keur Lahine Lobe, Kaffrine region.

Kaffrine and Eastern Fatick are part of Senegal's Peanut Basin, or *bassin d'arachide*, an area where peanut cultivation was first introduced by the French colonial government and later expanded after Senegal's independence. Currently, agricultural parklands and savannahs dominate the landscape, with thorny shrubs and baobab scattered amongst cultivated fields or wild grasses (Tappan *et al.* 2004; CILLS 2016). During the dry season—which stretches from October or November to May or June—the heat is intense and rain scarcely falls. With the start of the rainy season in June or July, precipitation begins to fall intermittently, and the dry land turns green and lush. Rains persist until October, when the land returns to its parched, dusty state.

1. Photo by Steve Perron
2. Photo by Steve Perron

Agriculture

Agriculture in Senegal is primarily rainfed. Farmers in central areas plant millet either in advance of seasonal rain or after rain has started to fall in June. Millet usually matures and is ready for harvest by October or November.

Approximately 75% of the Senegalese workforce are farmers, the majority of whom produce crops for subsistence needs (USDA FAS 2007). Most farmers rely on the brief rainy season to grow their crops for consumption or sale, as only five percent of agricultural land is irrigated. The Kaffrine region is the second largest producer of cereal crops, including millet, a common subsistence crop and traditional food source in central Senegal (Sanogo 2017). Farmers in central Senegal plant millet either in advance of seasonal rain or after rains have started to fall, usually in June or July. Millet plants usually mature and are ready for harvest by October or November, at the end of the rainy season.

Environmental Risks

1. 

2. 

Land degradation threatens agricultural productivity in many parts of Senegal.

Agriculture faces substantial challenges in the central regions of Senegal. Agricultural expansion, particularly of peanut cultivation, has led to widespread deforestation and depletion of soil fertility (Mbow *et al.* 2008). Soils in this area are sandy and low in organic matter and nitrogen. Rising annual temperatures and decreased wet season rainfall put the area at high risk for drought and agricultural losses (World Bank 2011) (USAID 2017). Despite their toll on the environment, peanuts remain an important cash crop in Senegal, particularly in Kaffrine—Senegal's top-producing region (USDA FAS 2007, Sanogo 2017).

1. IFPRI/Milo Mitchell. May 10, 2013. "Tilling soil in Senegal." CC BY-NC-ND 2.0. https://www.flickr.com/photos/ifpri/16509902248/in/album-72157634585631190/.

2. Milo Mitchell. May 10, 2013. "Sheep traversing a parched ravine (Senegal)." CC BY-NC-ND 2.0. https://www.flickr.com/photos/ifpri/8783516571/in/photolist-2gfEaSp-eoKzzQ-r9VyK3-eoKAhs-eoaPsT-eoKzjQ-eoKzK1-31NLfk.

Locusts and Grasshoppers in Senegal

Oedaleus senegalensis

Schistocerca gregaria

In addition to poor soils and drought, locust and grasshopper infestations pose significant threats to agricultural production. The desert locust (*Schistocerca gregaria*) is a species of short-horned grasshopper that is known to form dense, highly mobile swarms that can sweep across an area and devastate all cropland in their path (Zhang *et al.* 2019). Localized outbreaks can quickly build to become larger-scale upsurges and plagues that threaten entire regions or continents, respectively (Cressman 2016). Outbreaks are infrequent and episodic, alternating between periods of relative calm and periods of intense infestation (Steedman 1990, Zhang *et al.* 2019). Many Senegalese farmers remember the desert locust plague of 2003–2005, which decimated crops in Senegal and many other countries throughout Western and Northwestern Africa, as well as Southwest Asia, and which cost an estimated $260 million to control (Belayneh 2005).

The Senegalese grasshopper (*Oedaleus senegalensis*) is a major pest in central Senegal and the wider Western Sahel region, feeding on grass crops like millet, corn, and sorghum (Cheke 1990, Maiga *et al.* 2008). In contrast to desert locust infestations, the spatial scale of grasshopper infestations is much smaller—spanning regions or country borders rather than an entire continent. However, the chronic impact can be severe. From 1986 to 1992, grasshopper outbreaks throughout the Sahel, chiefly outbreaks of *O. senegalensis*, cost $177 million to control (Maiga *et al.* 2008). Most Kaffrine and Fatick farmers are familiar with the Senegalese grasshopper, as it is a frequently observed pest in the area.

1. Photo: Michel Lecoq

Engaging Communities in Monitoring

Groups monitored their fields for *Oedaleus senegalensis* and reported information to the local DPV base in Nganda.

To quickly identify and manage locust and grasshopper outbreaks, more thorough monitoring on the local level is needed. The Senegalese Plant Protection Directorate (*Direction de la Protection des Végétaux*, or DPV) is the principal government organization involved in pest management in Senegal. The DPV maintains eight phytosanitary bases throughout the country, which are responsible for surveillance, early warning, and field control of agricultural pests in vast zones spanning two to three administrative regions each. The phytosanitary base in Nganda, which operates in project communities, has limited staff and spraying vehicles at their disposal, yet they must cover an area of approximately 6,207 square miles (or 1,607,600 hectares).[1]

Signs of a looming outbreak in a particular community can be easily missed, and the situation can quickly escalate to threaten the harvest in the larger area. To address this issue, we worked with Senegalese entomology experts, local community members, and DPV agents to establish an Early Warning System that integrated community members in data collection. With our local partners, we successfully trained groups of women to track grasshopper populations through the use of light traps and a simple counting method. These groups periodically relayed information to their local DPV base, whose staff then used the data to adjust their control strategy. We present here in this booklet the same monitoring techniques that proved successful in the field, but slightly modified for better data collection.

1. Personal communication with the Director of the DPV base in Nganda, Kaffrine Region.

Research-based Management Techniques

Fertilized field **Unfertilized field**

Fertilized fields are more resilient to attack by the Senegalese grasshopper (*Oedaleus senegalensis*), which prefers low-protein crops.

Just as community members can be involved in pest response plans, so too can they be involved in preventative measures. The last section of the booklet teaches several novel preventative methods to decrease or mitigate outbreaks. GLI's previous research revealed that Senegalese grasshoppers prefer low-protein crops. Much like marathon runners, they prefer to eat diets higher in carbohydrates relative to protein when available, presumably to fuel their long migrations. Thus, improving soil fertility of agricultural land can suppress activity of locusts and grasshoppers. As part of our pilot project in Kaffrine and Fatick regions, we taught 100 farmers about GLI's research results. We provided participants with fertilizer mixes and doses recommended by the Senegalese Institute of Agricultural Research (*Institut Sénégalais de Recherches Agricoles*, or ISRA) for millet and millet seeds. Each farmer cultivated two one-hectare fields: one with fertilizer and one without. Fertilized and unfertilized fields were compared over the course of the growing season. Preliminary data revealed that fertilized fields suffered far less damage by Senegalese grasshoppers and their yields were almost doubled. Illustrated within the following pages of the original booklet are simple techniques farmers can employ to preserve and increase soil nitrogen levels, with the goal of reducing locust and grasshopper attacks.

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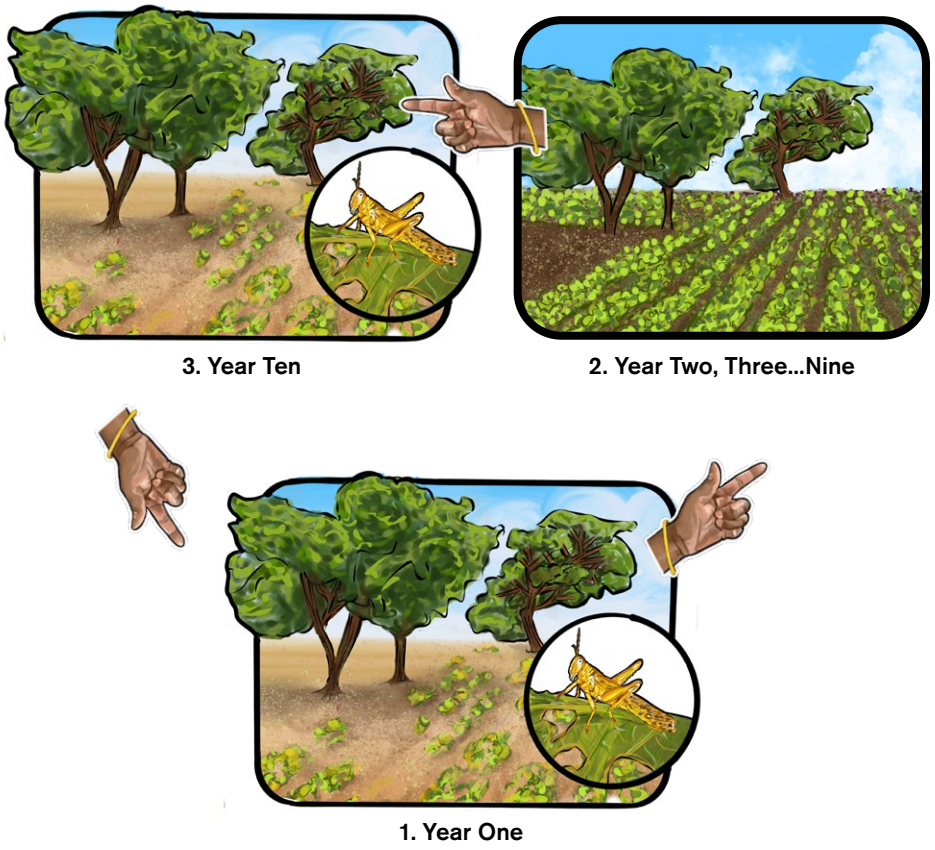
1.

The 2003–2005 desert locust outbreak in the Sahel caused an estimated 2.5 billion USD in harvest losses and drastically impacted the region's food security.

In Western Africa, the rains bring forth harvests of millet, peanuts, sorghum, and many other crops. It can be a time of abundance and prosperity. However, every farmer also knows that rain can also bring devastating pests—such as locusts and grasshoppers.

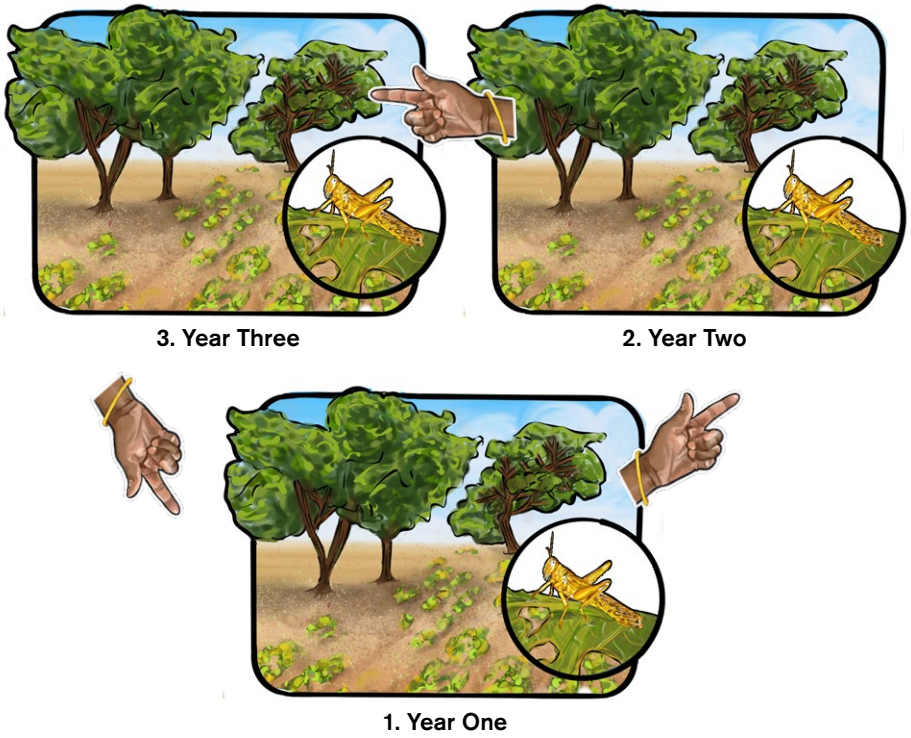
1. Photo: Food and Agriculture Organization & The Desert Locust Information Service.

Locusts are a specific kind of grasshopper that forms swarms and migrates great distances, quickly traveling across many countries.

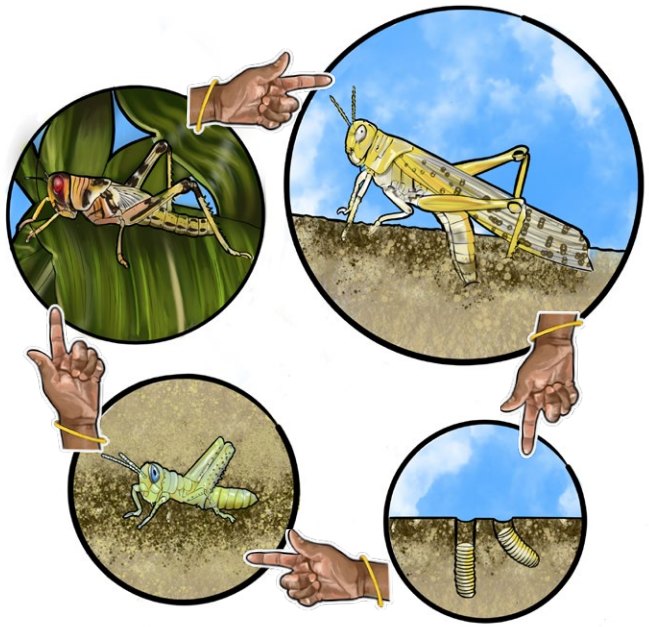


Locusts are not seen every year, but only from time to time. Once they form swarms, these species can ravage crops and pasture of all types. The principal locust in Senegal is the desert locust, or *Schistocerca gregaria*.

Grasshoppers do not travel as great a distance or affect as large an area as locusts do, but certain species can affect agriculture every year. In the central regions of Senegal, there are many types of grasshoppers that threaten the harvest.



For example, the Senegalese grasshopper, or *Oedaleus senegalensis*, is seen almost every year in central Senegal. Altogether, they can have a significant impact on the agricultural production of the region. Both locusts and grasshoppers negatively affect agriculture in Senegal and it is important to understand their biology and reproduction to manage them.



One generation

Both grasshoppers and locusts lay their eggs in the soil. When it begins to rain, the eggs hatch into nymphs and start to eat and grow. In a few weeks, the nymphs grow into adults and are ready to lay eggs of their own. This cycle of eggs being laid, growing into nymphs, and growing into adults ready to lay their own eggs is called a *generation.*

1.

Oedaleus senegalensis

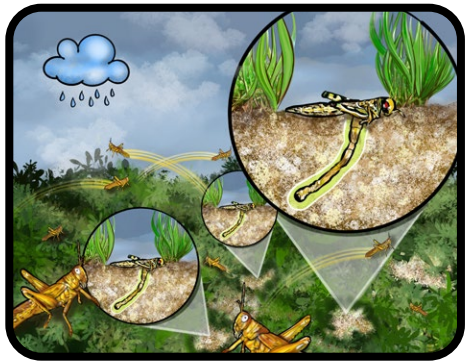
2.

Catantops stramineus

Some types of grasshoppers and locusts only have one generation a year, such as *Catantops stramineus*. Others, such as the Senegalese grasshopper, can have three generations in one rainy season.

1. Photo by Michel Lecoq
2. Photo by Michel Lecoq

Dry season (November to May)



Rainy season (June to October)

1.

Acrida bicolor

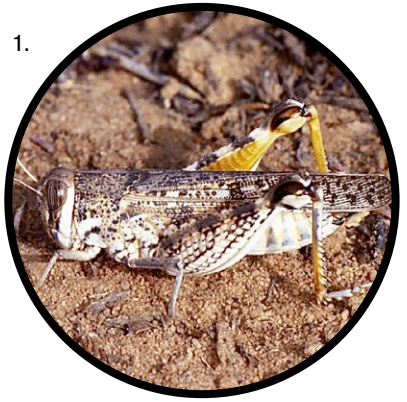
Some types of grasshoppers and locusts produce throughout the whole year, like *Acrida bicolor*.

1. Photo by Michel Lecoq

Dry season (November to May)

Rainy season (June to October)

1.

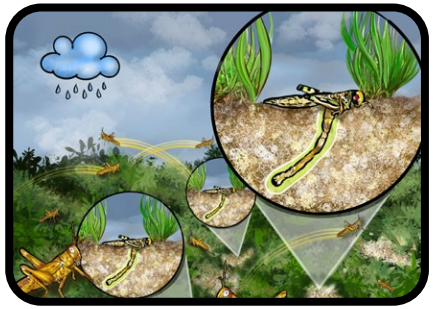


Acorypha clara

Some types of grasshoppers and locusts will stop developing at the end of the rainy season. You can see adults in the dry season, but none of them are laying eggs. When the rains come, they will begin laying eggs again.

1. Photo by Michel Lecoq

Dry season (November to May)



Rainy season (June to October)

1.

Oedaleus senegalensis

Some species, such as the Senegalese grasshopper, will reproduce during the rainy season, but the last generation in the season will not hatch. Instead, those eggs will stay dormant throughout the dry season. When the rains come again the next year, they will hatch and grow into adults.

1. Photo by Michel Lecoq

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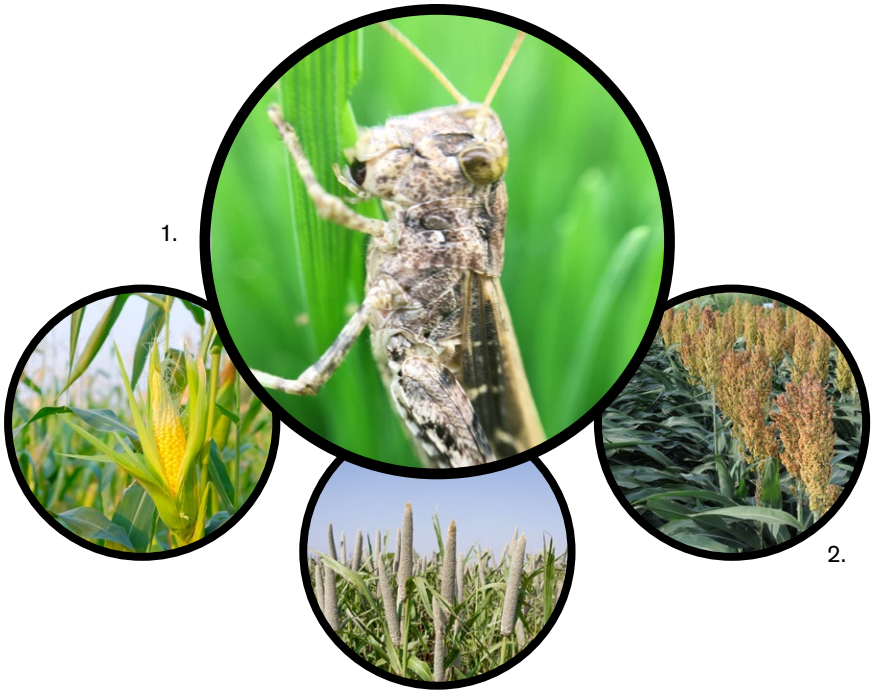
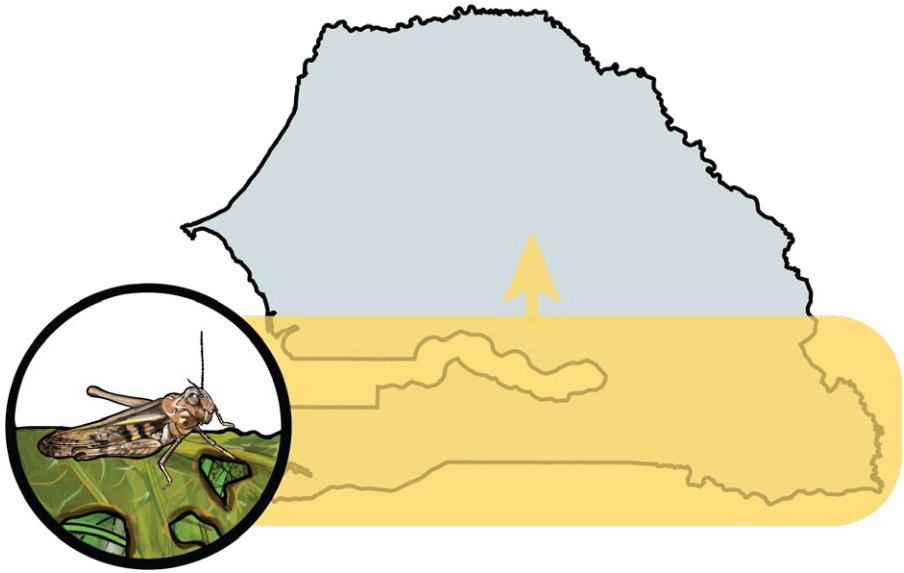


2.

The Senegalese grasshopper, in particular, is an important pest of millet and other grass crops. It's crucial to understand how they reproduce and move through an area in order to control them.

1. Photo by Marion Le Gall: *Oedaleus senegalensis*
2. Photo by K-State Research and Extension: Sorghum. CC BY 2.0.



Because the rains start earlier in the South of Senegal, outbreaks of the Senegalese grasshopper occur first in this area. As the rains progress to the North, the grasshoppers follow them.

When they move North, the grasshoppers lay eggs. The generation that hatches returns South as the rainy season ends.

1.

An agent of the DPV conducts egg prospection.

The Senegalese Plant Protection Directorate, or DPV, performs many activities to predict where locust and grasshopper outbreaks will happen and to control them when they do occur. For example, they conduct egg prospection and spray pesticides to kill pest species. But the area they cover is very large and they cannot know the situation in every village. You can help them by monitoring locusts and grasshoppers in your community.

1. Photo by Mamadou Diallo, Direction de la Protection des Végétaux.

If the community is monitoring grasshopper and locust populations in their area during the rainy season, they can warn the DPV and control authorities that an outbreak will soon happen. There are many ways of monitoring, but two of the easy techniques are counting nymphs and adults directly and using a light trap.

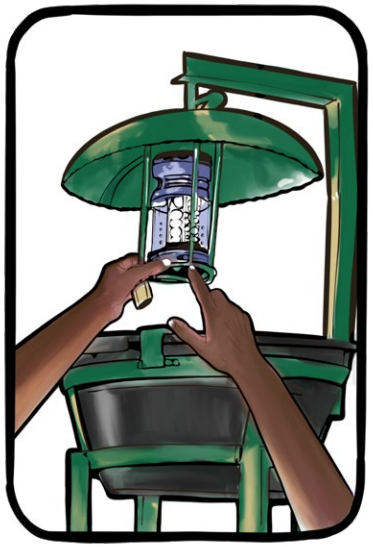
To count locusts directly, all you need is pen and a notebook! You will walk in a straight line through your field, from one side all the way to the other.

First, observe how many adults there are. Walk all the way across your field. How many do you see flying overhead? Count them and write down the number. If you recognize different species, record how many you see of each type.

You will measure nymphs on the ground now. Return the way you came. How many nymphs do you see hopping on the ground in your path? As you walk back to your starting point, write down the total number of nymphs you see. If you recognize different species, record how many you see of each type.

Your counts and related information can be reported to your local DPV base. These data can allow the agents to know how many adults and/or nymphs are in the area. Tell them who you are, where you observed the nymphs and/or adults, and how many of each you saw. If you know the types of grasshoppers or locusts you saw, tell them how many of each type you observed. Please also let them know how many meters you walked while counting.

A light trap attracts migratory locusts and grasshoppers when they are flying at night. When they see the light, they fly into it and fall into a bucket of soapy water below. Because the water is soapy, the locusts and grasshoppers can't get out and they die. By putting a light trap in your field, you can learn how many grasshoppers are travelling at night.



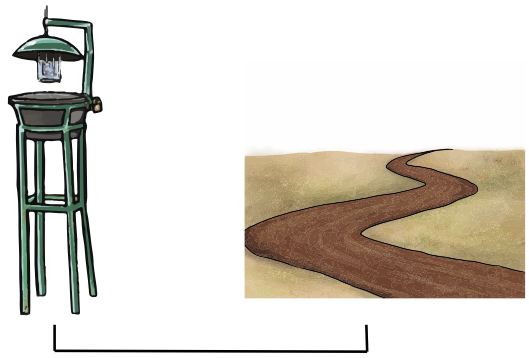
If you build a light trap, you will need:

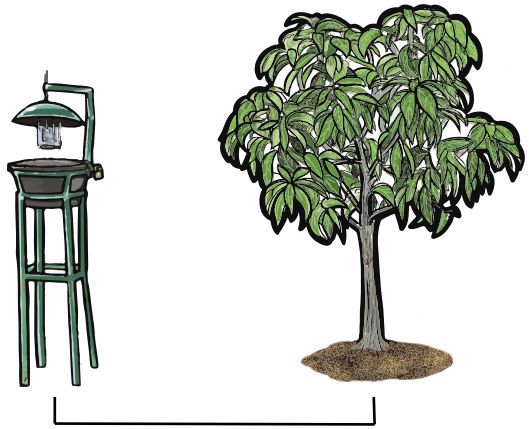
- One angle iron beam, 50 mm
- Two flat iron pieces, 40 mm
- One iron bar, 8 mm
- A lamp with batteries
- A large laundry basin
- Two locks, to secure the lamp and basin
- Paint
- Paint thinner

Bring your supplies to your local metal worker to build your light trap.

Share the dimensions below with the metalworker.

N°	Item	Number of pieces	Dimension
1	Lamp support	1	30 cm
2	Top cover support	1	120 cm
3	Top cover	1	130 cm
4	Lamp cage	4	24 cm per piece
5	Lamp	1	1.5 V
6	Basin security bar	1	65 cm
7	Large basin support belt	1	1.5 m
8	Basin	1	15 liters
9	Small basin support belt	1	1.30 m
10	Leg	4	1.5 m
11	Leg stabilizers	4	25 cm per piece
12	Feet	4	10 cm per piece

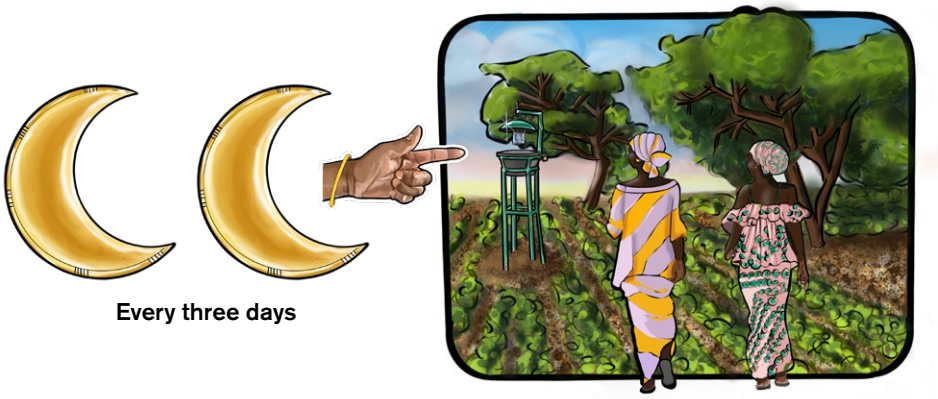




When the light trap has been constructed, bring it to the field. It must be in a location at least 50 meters from trees and roads, but it should not be too difficult to reach.

How do you use a light trap?
In the evening, go to the field where you put the trap. Bring water with you to fill the basin. Take the basin down, fill it with water, and add a little soap. Put the basin back and turn on the light. That's it! Go home for the night.

Go back to the field in the morning. Bring a notebook and an identification guide with you. Turn off the light and take down the bucket. Pour out the water over a sieve. There may be a lot of insects in the sieve, but are there any locusts or grasshoppers? Do you know any of the species?
You may not be able to identify all of them, but write down how many grasshoppers and locusts you see and what species they are if you do know.



Every three days

You will refill the basin with water and again turn on the light trap. Then you will measure the results the day after tomorrow.
Every three days, you will turn on the light and repeat the process of refilling the basin and counting insects.

When you are done counting, call the DPV and tell them how many locusts or grasshoppers you observed. Tell them who you are, where you counted the locusts or grasshoppers, and how many you counted. If you know the type of each grasshopper, tell them how many of each type you observed.

Abdu Jambar
(ab-doo jahm-bar)

Usseynu Yambar
(oo-say-nu yahm-bar)

How can farmers prevent outbreaks of locusts and grasshoppers?
Here are farmers Abdu and Usseynu to show us how. Abdu Jambar is very motivated, but his brother Usseynu Yambar is very lazy. They both inherited land from their father.

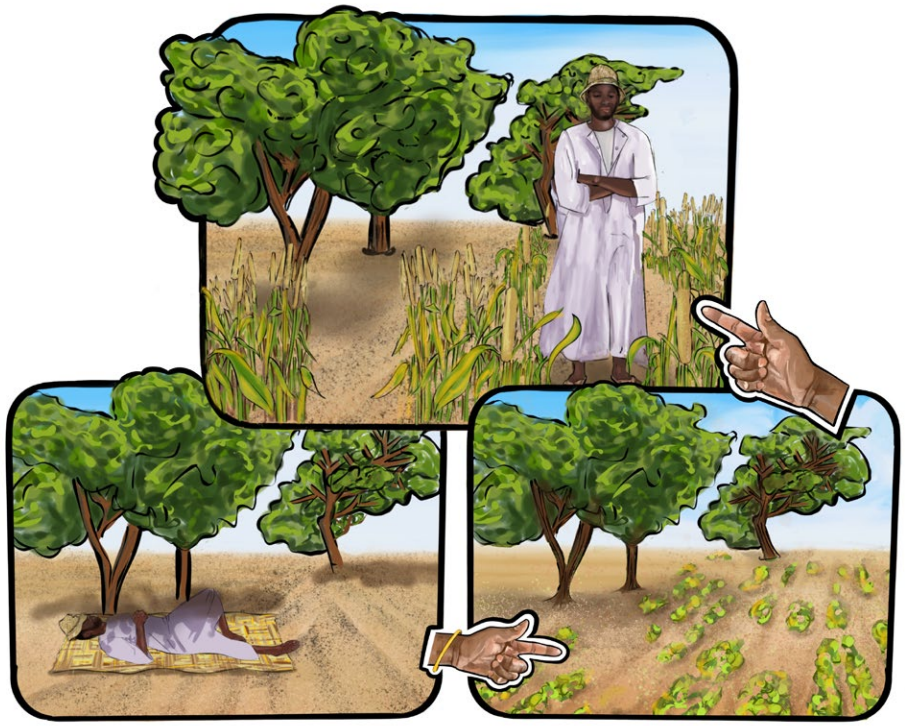
Fertilizer

Compost

Manure

Crops need nutrients to live and grow. An essential nutrient is nitrogen, which is what is in manure, compost, and fertilizers that make plants grow.

When Abdu Jambar puts a lot of manure on his soil, the soil is dark and fertile. His crops grow well.



Usseynu Yambar doesn't put any fertilizers on his crops. His soil is infertile and weak. His feeble crops do not grow well.

Poor soil

Fertile soil

What happens to locusts and grasshoppers? Locusts and grasshoppers don't like nitrogen-rich crops. When they eat such crops, they do not grow well and their eggs are very small. They would prefer to eat nitrogen-poor crops.

Because Abdu Jambar applies manure to his field, his soil is fertile and dark. Thus his crops are healthy and nitrogen-rich, and locusts don't eat a lot.

Usseynou Yambar doesn't apply any fertilizer or manure. His soil is weak and thus his plants are feeble and nitrogen-poor. The locusts eat a lot!

What else does Abdu Jambar do to make his soil strong? He doesn't cut down the trees in his field, and he plants trees that fix nitrogen, like *Faidherbia albida* and *Senegalia senegal.*[1]

1. *Faidherbia albida* and *Senegalia senegal* are native nitrogen-fixing species commonly seen in central Senegal. They add nitrogen to the soil and make it more fertile.

Usseynou Yambar cuts down his trees, and he has many grasshoppers.

Certain species of beetles, lizards, birds, and flies eat locusts, grasshoppers, and their eggs. We call them "natural enemies." If there are many natural enemies, there will be fewer locusts and grasshoppers to bother farmers and their crops.

But when you burn your fields or when there are bush fires, the natural enemies will die.[1] Preventing fires keeps them alive so they can continue to eat locusts and grasshoppers. Usseynou Yambar burns his fields, and the natural enemies die. He has lots of grasshoppers.

1. Farmers practicing traditional agricultural methods often burn crop residues and brush to prepare fields for cultivation. This practice can have a damaging effect on soil fertility.

What else does Abdu Jambar do? He monitors the grasshoppers in his fields. Because he alerts the DPV early, they are able to spray and kill all the grasshoppers before they ruin his crops.

Usseynu Yambar doesn't monitor his field at all. By the time he realizes there are a lot of grasshoppers and calls the DPV, it is too late! They spray, but his crops are ruined.

Abdu Jambar sees the good in the techniques he used, and he teaches his brother Ousseynou Yambar and all his neighbors how to use them, too. Since there are many people doing their part to monitor activity and enrich the soil, there are much fewer locusts in the whole area.

In summary, what can you do?

Together, we can stop locusts and grasshoppers from threatening farmers' livelihoods and well-being.

If you see concerning grasshopper or locust activity in your area, please call your regional DPV base.

Departments of Kaffrine, Birkelane, Malem Hoddar, Koungheul, Guingueneo, Diourbel, and Mbacke:
Nganda Base: 33 946 54 28

Departments of Sokone, Fatick, Foundiougne, Gossas, Kaolack, and Nioro du Rip:
Sokone Base: 33 948 31 21