AVSF
AGRONOMES & VÉTÉRINAIRES SANS FRONTIÈRES
VSF INTERNATIONAL NETWORK

Training guide

AGROECOLOGY AS A SUBSTITUTE FOR PESTICIDES

Reducing the use and risks of pesticides and veterinary products using viable alternative practices

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Although the authors of the guide recognize the importance of taking into account matters of gender, in particular the importance of recognizing the place of women in agricultural activities as well as taking into account the risks associated with the products mentioned, not to mention the importance of providing women with the means for participating in the activities mentioned and making corresponding decisions, the decision has been made to forgo the use of inclusive language in the body of the text to establish a less formal tone and in order to more effectively communicate this document's content in different linguistic contexts.

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SUMMARY

List of important documents available online:

International nomenclature of "risk phases":
https://clp-info.ineris.fr/sites/clp-info.gesreg.fr/files/documents/tableau_cl_fr.pdf

FAO, 2013. Code international de conduite pour la distribution et l'utilisation des pesticides (International Code of Conduct on the Distribution of Pesticides):
http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/Annotated_Guidelines_FR.pdf

ephy-Anses datasheets describing the modes of action and toxicological classification of pesticides and registered NPLCs in France:
https://ephy.anses.fr/lexique/ppp/a

Protection agroécologique des cultures (Agroecological crop protection). QUAE.291p. Deguine, J.P, Gloanec, C., Laurent P., Ratnadass A., Aubertot JN (coord.), 2016 containing § "Passer de la protection intégrée à la protection agroécologique des cultures" (Transitioning from integrated protection to agroecological crop protection").

Guide technique du programme Gamour à la Réunion, exemple de lutte agroécologique (Technical guide of the Gamour program in Reunion, an example of agroecological control):
http://gamour.cirad.fr/site/index.php?option=com_docman&task=doc_download&gid=97&Itemid=118

Lutte biologique contre la mineuse de l'épi de Mil (Biological control of the millet leaf miner) (DGPV Niger – May 2019) document is accessible via the accessible RECA Niger site:
https://reca-niger.org/IMG/pdf/module_elevage_habrobrcon_2019_gpv_cra.pdf

Farmer training module of the Malian CNOP on natural treatments:
https://www.cnop-mali.org/index.php/17-thematiques/agroecologie/46-l-agro-ecologie-paysanne-un-bond-en-avant

FAO, 2014. Gestion intégrée de la production et des déprédateurs du coton- Guide du facilitateur pour les champs écoles des producteurs (Integrated management of farming and cotton pests – facilitator's guide for farmer field schools):
http://www.fao.org/3/a-i3722f.pdf

List of registered biocontrol products in France: ecophytopic,
https://ecophytopic.fr/proteger/liste-des-produits-de-biocontrole

List of the main acronyms

ACSA: Community animal health officer

ADIVALOR: Farmers, distributors, industrialists for the recovery of agricultural waste

AMM: Marketing authorization

ANSES: National Agency for Food, Environmental and Occupational Health Safety (France)

AVSF: Agronomes et vétérinaires sans frontières (Agronomists and vetrinarians without borders)

ECOWAS: Economic Community of West African States

CIRAD: French agricultural research and international cooperation organization

CMD: Compagnie malienne de développement des textiles (Malian society for textile development)

CNOP: Coordination nationale des organisations paysannes (Mali) (National Farmer Organization)

CRPM: Rural and Maritime Fisheries Code (France)

CUMA: Coopérative d'utilisation de matériel agricole (Cooperative for the use of agricultural equipment)

CSP: Sahelian Pesticides Committee

DGPV: Direction générale de la production végétale (Niger) (General direction of crop production)

EPI: Personal protective equipment

FO: Farmers Organization

FFGM: French Facility for Global Environment

IFAD: International Fund for Agricultural Development

GAEC: Groupement agricole d'exploitation en commun (Agricultural association of joint exploitation)

HBG: Glyphosate-based herbicides

IER: Institute of Rural Economy (Mali)

INRAE: Institut national de recherche pour l'agriculture, l'alimentation et l'environnement (National institute of agricultural, food and environmental research) (France)

IRAN Institut de recherche agricole du Niger (Niger National Institute of Agricultural Research)

LBCGH: Lutte biologique par conservation et gestion des habitats (Biological control through conservation and habitat management)

MSA: Mutualité sociale agricole (France)

WHO: World Health Organization

OPA: Organisation professionnelle agricole (professional agricultural organization)

TA: Animal traction

EU: European Union

Glossary: some definitions used in this guide

ACTIVE INGREDIENT *(or active substance):*
Means the biologically active part of the pesticide (Cf. International Code of Conduct on the Distribution and Use of Pesticides).

PRODUCT *(of a pesticide or veterinary medication):*
Means the form in which these products are packaged and sold *(cf. Manual on the development and use of specifications of the FAO and the WHO for pesticides and veterinary medications).* A pesticide "formulation" serves to introduce the active ingredients in a stable form and enables their application. The manufacturer adds other **substances, co-formulants intended to enhance and facilitate their effects.** These co-formulants comprise adhesives, emulsifiers, stabilizers, phytoprotectors, anti-transpirants, dyes, substances repellant to humans (odor), etc. **Some of these co-formulants may have a higher toxicity than the active ingredients they accompany,** hence the importance of avoiding all non-registered products, which account for a large percentage of pesticides in Africa (for example, in 2018, RECA Niger identified **65 commercial herbicide products, of which only 17 were registered** by the *Sahelian Pesticides Committee* and **11 contain banned active ingredients).**

PEST:
Means an organism that causes (or which is prone to causing) unacceptable direct damage to a crop, animals or stored agricultural yields. Pests include microorganism pathogens (virus, bacteria, fungi, etc.), mites, nematodes, insects, gastropods and myriapods as well as rodents, birds, monkey, etc.... If one excludes certain parasitic plants (striga, for example), the weeds that compete with crops are not pests.

BIO-PEST:
This term refers to the pests defined above and weeds.

(CROP) AUXILIARY:
Means a predatory animal or parasite that, through its way of life, assists in the destruction of crop pests.

PESTICIDE:
According to the FAO, a pesticide is "a substance used to neutralize or destroy a pest, a vector of human or animal disease, a plant or animal species that is harmful or disruptive to the production or storage of agricultural products." In terms of etymology, pesticide translates literally as **"killer of pests"** (= capable of destroying harmful organisms). **Also known as phytosanitary or phytopharmaceutical products, they are synthetic and natural chemicals** (e.g., extracts of the pyrethrum flower) **which are used in agriculture to control various kinds of harmful organisms.** Their name reflects their primary function: **insecticides** (kill insects); **acaricides** (kill Acari); **herbicides** (weeds); **fungicides** (fungi); **molluscicides** (slugs, snails); **rodenticides** (rodents); **taupicides** (moles); corvicides (birds), etc. It should be noted that a herbicide can still have harmful effects on insects and biodiversity in general. In this guide, the authors distinguish between pesticides, that is, synthetic chemical pesticides (including synthetic substances that mimic natural substances), biopesticides or NPLCs (natural preparations of low concern) made by farmers from plants and other ingredients present in their environment.

RISK AND DANGER:
risk is based on the intrinsic hazard of a compound or group of compounds, associated with the exposure of the target, humans or the environment. **There are two possible ways to reduce a risk: reduce exposure and/or reduce the hazard of the chemical products**. The risk assessment is based on lab trials, some of which are supplemented with field tests where necessary. These trials are provided in the registration file by the agrochemical company that intends to market a pesticide. A chemical compound is never entirely risk-free. And a pesticide can only be marketed if its risk is considered acceptable.

LOW-RISK PESTICIDE:
Following assessment, these are pesticides posing a low risk to human and animal health and to the environment according to the criteria defined by the European Commission *(Article 22 of EU Regulation 1107/2009).*

NATURAL PREPARATIONS OF LOW CONCERN (NPLC):
These are not pesticides; NPLCs are not subject to assessment prior to Marketing Approval (MA). In France, the Law on the Future of Agriculture *(Art. L.253-1 of the Rural Code)* define them as composed of two types of substances, **both of which are exclusively of natural origin:**

(1) **The constituent substances** defined and listed in Article 23 of the European regulation 1107/2009 https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:309:0001:0050:FR:PDF and, in France, in the Law on the Future (LAAF) of October 2014. There, one finds plants and very basic products such as vinegar and sunflower oil.

(2) **Natural Substances for Use as Biostimulants or NSUB with a fertilizing effect** defined in the decree of the French Ministry of Agriculture in April 2016 and listed in Article D4211-11 of the French Public Health Code. This article lists the plants or parts of medicinal plants whose sale is authorized by persons other than pharmacists. **More than one hundred plants are registered there. Biostimulants** that are regulated by a MA make specific claims concerning their effect on the plant *(improvement of roots use of soil, enhancement of the plant's metabolism, optimization of photosynthesis, etc...),* while NPLCs may not make any claims other than those relating to their natural character for use as a biostimulant.

APPROVAL:
process by which national or regional authorities approve the sale and use of a pesticide or a veterinary medicine after having examined scientific data demonstrating that the product effectively contributes to the set objectives and does not pose unacceptable risks to human or animal health or to the environment. Approvals must be regularly reviewed to account for the advancement of knowledge.

INTEGRATED PEST MANAGEMENT (or integrated production and pest management = IPM):
according to the FAO and the International Organization for Biological Control (IOBC), **integrated pest management** or **integrated protection** is defined as "a crop protection strategy whose application involves a combination of methods that meet ecological, economic and toxicological

requirements". Integrated pest management methods include well-known agro-ecological practices (including the choice of hardy varieties and species, observing crop rotation, numerous cultivation practices and animal husbandry practices, etc.), biological control including the use of NPLCs. In the context of agro-ecological transitions, the use of pesticides (synthetic or of natural origin) should only be considered as a last resort by refusing to use pesticides with known toxicity such as **Carcinogenic, Mutagenic and Reprotoxic products (CMR)** or certain **well-identified endocrine disruptors (EDs)**.

AGROECOLOGICAL CROP PROTECTION (definition by Deguine et al, 2016 - Cirad):
more ambitious than IPM, it is a global **strategy that extends to the landscape level, for the management of animal and plant populations taking into account ecological issues from the outset.** This requires rethinking of crop systems and agricultural practices, which should prioritize the habitats of crop auxiliaries and biological control. This effective management of biodiversity makes it possible to significantly reduce or even eliminate the use of pesticides.

BIOLOGICAL CONTROL:
It allows pests to be controlled using antagonistic living organisms (crop auxiliaries, trap plants, etc.), pheromones, etc... The aim is to keep pest populations below an identified threshold of harmfulness.

BIOLOGICAL CONTROL *:*
These are pesticides of natural origin or which are chemically synthesized, but which are identical to natural compounds. Some of these products can be used in organic agriculture in the EU while others have "-ide" modes of action with elevated toxicity. **The difference between biocontrol products and conventional pesticides therefore lies solely in their nature and not their toxicity** (https://agriculture.gouv.fr/quest-ce-que-le-biocontrole).

In France, these biocontrol products are defined in Article L. 253-6 of the French Rural and Maritime Fisheries Code as "agents and products that use natural mechanisms in connection with the integrated control of crop pests". These comprise in particular:

- macro-organisms;
- plant protection products consisting of micro-organisms, chemical mediators such as pheromones and kairomones [1] as well as pheromones and natural substances of plant, animal or mineral origin."

[1] A **kairomone** is a substance produced in the air, water or soil by a living emitter, which may be a plant, animal (including aquatic), fungus or bacterial colony. When released into the environment, it triggers a behavioral response in another species (receptor) benefitting the latter. Kairomones are involved in interspecies communication while **pheromones** are involved in intra-species communication."

The list of biocontrol products approved by the French Ministry of Agriculture can be found at https://ecophytopic.fr/proteger/liste-des-produits-de-biocontrole[2]. It is more restrictive than the definition from the Rural Code because it excludes products with elevated toxicity (health and/or environment). It therefore follows that biocontrol products should be included in comprehensive integrated pest management approaches.

MEDICATION (cf. definition of EU Directive 2001/82/CE):
Medicinal product means any substance or combination of substances having properties for curing or preventing disease in humans or animals, and any substance or combination of substances which may be used in or administered to humans or animals for the purpose of medical diagnosis or restoring, correcting or modifying their physiological functions through pharmacological, immunological or metabolic action.

ETHNO-VETERINARY STUDY:
Means the study of livestock farming and animal health practices within a human society. Its main aim is to document the traditional veterinary practices of such a human society in order to leave a written record of them and to try to validate and enhance them before they are lost.

ONE HEALTH APPROACH:
This concept was developed in the early 2000's and promotes **an integrated, systematic and unified approach to public, animal and environmental health at the local, national and global level.** Though it originated in the United States, the idea of a unified vision of health and the importance of the environment has ancient roots that date back to early Greece. The One Health approach encourages collaborative, multi-sectoral and transdisciplinary approaches to developing new strategies for disease prevention and control. For Michel Duru (INRAE Toulouse), the concept extends to a systematic concept linking the "health of the planet, plants and humans" *(cf. http://www.inra.fr/Chercheurs-etudiants/Evenements/11mars19-seminaire-One-Health).*

[2] In France, **2 definitions of biocontrol products coexist.** One broad definition according to the Rural and Maritime Fisheries Code (CRPM) (Article L253-6, https://www.legifrance.gouv.fr/codes/id/LEGIARTI000006583210/2000-09-21/ and a list of products subject to greater restriction which adds the criteria of toxicity and ecotoxicity introduced by Articles L253-5 and L253-7 of the CRPM. For example, the broad definition of biocontrol includes **copper** or **azadirachtin** in this category. However, these active ingredients are excluded from the ministry's list on the basis of their toxicological and/or ecotoxicological profile. There is currently no definition of biocontrol products at the European level.

INTRODUCTION

What is the purpose of this guide?

The use of pesticides and certain veterinary products as well as the conditions of their use around the world are becoming increasingly alarming, particularly in developing countries. For many years, AVSF has worked on these issues and developing agroecological alternatives (cf. insert below). However, these problems persist and even continue to worsen in the cooperation countries. Moreover, initiatives undertaken in partnership with farmers' organizations to promote agro-ecological transitions do not always systematically and thoroughly consider this issue of the use of pesticides and veterinary products.

It is therefore **essential to strengthen the skills of farmers and technicians** in order to genuinely raise awareness of the risks [3] associated with the use of pesticides and certain veterinary products in all cooperation countries, and to demonstrate in a practical and concrete manner the full range of alternatives for reducing their use. Knowledge of the risks to health and the environment, the emergence of resistance, and knowledge of alternatives must be technically and economically sound in order to be able to compete with conventional pesticides, which are easy to use, exhibit adequate direct efficacy and are readily accessible because their marketing and distribution are poorly controlled.

The objective of this training guide is, on one hand, to provide key elements for determining the ways in which pesticides and veterinary products are used and applied, and for raising awareness of the risks associated with such use, and, on the other hand, to illustrate the diversity of agro-ecological alternatives that enable farmers and technicians to eliminate the use of dangerous pesticides while preserving their plant and animal production.
The content of the modules presented here does not constitute a "turnkey teaching kit" that can be used as is in a training context, but rather as a toolbox enabling the development of training materials adapted to the context and specific target audience. Each trainer who uses this guide will therefore have to prepare the most appropriate material for the training and awareness-raising provided.

The key elements of the training modules proposed in this guide are fully aligned with the process **of supporting agro-ecological transitions among smallholder farmers.** The primary goal is to improve the knowledge of farmers and technicians on the modes of action, targets and risks of treatments based on pesticides and veterinary products already in use and available, and to facilitate their acceptance of alternative techniques to be jointly tested and adapted with them.

Chapter I explains how to use this guide and presents an overview of its contents, in particular the training objectives of the six modules and corresponding topics.

Chapter II provides some examples of the situation of pesticide use and usage conditions in developing countries.

[3] That is, the hazard level coupled with the level of exposure to these products (cf. Glossary).

Chapters III to VIII present the six proposed training modules and corresponding topics. Their contents are supplemented by some appendices and documents accessible via internet link.

Finally, Chapter IX provides examples of strategies to reduce pesticide use and develop agro-ecological alternatives at the level of regional farmers' organizations, individual countries or groups of countries.

AVSF's position and convictions regarding pesticides and certain veterinary products

For two decades, AVSF has been working on these issues with various partners, particularly in Latin America and Africa. Faced with the challenges of public health (the health of humans, farmers and consumers, animal health), the preservation of biodiversity and the economic autonomy of farmers, AVSF advocates the following vision:
- **urgent elimination** of the use of the most toxic pesticides: Carcinogens, Mutagens, Reprotoxics[4] (CMRs) and certain endocrine disruptors (EDs);
- adopting a global vision for agro-ecological transitions by considering the use of pesticides (synthetic or of natural origin) only as a last resort when reliable agro-ecological techniques do not yet exist and are within the reach of farmers, making it possible to combat dependence on chemical inputs;
- the rational and controlled use of veterinary products (in particular antimicrobials) that respects the balance between animal health, human health and environmental protection;
- the priority given to research and training and the dissemination of agroecological alternatives accessible to all farming families, including those with few resources.

This vision is necessarily adapted to account for the realities of the practices and problems of farmers who are sometimes caught up in the "routine" of conventional practices without being aware of the many harmful consequences associated with the use of pesticides and the improper use of veterinary products.

Thus, several training courses on the reduction of pesticide use and the promotion of viable alternatives have been carried out in partnership with farmers' organizations (FOs) in Northern Togo (2014 and 2016), in Kolda in Senegal (2016) and in Kita in Mali (in 2018 and 2019). In 2014, AVSF joined forces with other associations to promote alternatives to pesticides. In March 2015, a campaign was launched, concerning a ban on the most dangerous pesticides in developing countries and the effective application of the Rotterdam Convention. AVSF's actions on these issues are part of a global approach to support agro-ecological transitions at the level of farming families and territories, with coordinated consideration of issues and problems for human health, animal health and environmental health (One Health approach).

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[4] **Carcinogen:** a factor, particularly a chemical compound, that causes, aggravates or sensitizes the development of cancer; **Mutagen:** agent (chemical compound, radiation) that increases the number of genetic mutations in the genome of an organism; **reprotoxic:** product that affects reproductive capacity by reducing fertility or causing sterility.

How to use the guide and overview of its contents

Who is this guide for?

This guide was created to help **organize training courses for mixed groups of farmers, farmers in leadership positions and technicians.** Based on AVSF's training experience, a group made up of these different participant types leads to richer exchange and field observations than if these different profiles are trained separately. The presence of women is essential, as they are often most concerned about health issues and can be a driving force in the adoption and implementation of alternatives such as NPLCs *(Natural preparations of low concern)* and biopesticides. The presence of health services representatives involved in monitoring the toxic effects of pesticides can also be very beneficial.

The guide is therefore intended to be used directly FO managers and technicians in developing countries: its aims to help them develop such training courses by relying on the stakeholders and partners involved in supporting agroecological transitions.

In light of the professional experience of the authors of this guide, numerous examples and illustrations concern French-speaking regions, with a few examples from the French experience when the issues turn out to be similar to those of southern countries. However, the guide has been devised for a broader purpose. Some of the examples come from other parts of the world with even more such examples to follow in future versions of the guide.

Objective of the guide

The main objective of this guide is to provide content to farmers and technicians participating in training courses in order to **develop greater awareness of the risks associated with the use of pesticides and certain veterinary products, and skills in connection with agroecological alternatives that help to reduce their use. This means being able to:**

- diagnose phytosanitary or animal health problems and determine what kind of action needs to be taken;
- be aware of measures for preventing risks associated with the use of pesticides and certain veterinary products for the health of humans, animals and the environment;
- identify alternatives to both crop and livestock products and know how to adapt them to local situations;
- mobilize target groups and carry out collective actions that improve application (or further development) of the regulations on the use of these products and create favorable conditions for the development of alternatives.

Depending on the profiles of the training participants and their expectations, the proposed training modules and the majority of their topics can be addressed independently.

Rather technical topics such as those concerning pesticide toxicity indicators or certain new biological control methods can be addressed in specific training courses. The same applies to veterinary issues or lobbying actions.
With respect to training on agroecological alternatives, including biological control, particular attention is paid to the most basic techniques which are accessible to farmers with limited income.

When and how should this guide be used?

This guide can be used in a variety of ways depending on the needs and situations requiring intervention:

- With respect to the **training of trainers,** persons in charge of training will be able to use the modules in this guide to develop and provide participants with teaching materials that are adapted to local contexts to the greatest extent possible. The numerous weblinks in this guide give trainers access to up-to-date information.

- For **"basic"** training for groups of 20 to 30 farmers and technicians, which can be carried out by technician/farmer trainer pairs, the guide proposes key elements of content as well as concrete and illustrative examples in the various modules that they will have to familiarize themselves with prior to the training sessions in order to develop suitable teaching aids (presentations, posters, exercises, etc.). Educational guidance for implementation is provided for some modules. According to AVSF's experience, interventions by human health specialists are desirable, even for training courses that only concern crop production.

- **For self-training,** the guide can be used by farmer trainers, technicians, project managers or FO managers to deepen their knowledge of the range of risk prevention measures, measures for the reduction of pesticide use and promotion of agroecological alternatives.

For each of the modules and topics developed, additional information, survey guides and examples from AVSF pesticide training courses carried out in Northern Togo, Kita in Mali and Kolda in Senegal are provided (see project sheets on the AVSF website *)*.

Several documents or links complete each module, including training or outreach documents from CIRAD, African research institutes, the network of chambers of agriculture (RECA) in Niger, the national confederation of farmers' organizations (CNOP) in Mali, etc.

Contents and objectives of the six training modules

MODULE 1: PRELIMINARY PARTICIPATORY DIAGNOSTICS

Educational objective: To be able to carry out participatory village diagnostics in order to identify the main problems leading to the use of pesticides, their management and the agroecological alternatives already known to farmers.

Topic 1: In the villages, identify where the persons undergoing training come from, **the main problems posed by crop pests** and **animal diseases**, **weeds**, etc.

Topic 2: Be aware **of the use of synthetic pesticides and veterinary** products in the villages and identify the places of purchase and sources of advice.

Topic 3: Identifier the **pesticide application methods**, the nature of protective equipment used, packaging management, accidents, previous accidents involving people and animals and their frequency.

Topic 4: Identify agro-ecological, **chemical-free alternatives** implemented by people from the villages for crop and animal care, collect opinions on their relevance and factors limiting more widespread use. To a greater degree, take advantage of local knowledge to devise new approaches based on solutions existing in nature *("Nature-based solutions").*

MODULE 2: RISK PREVENTION OF PESTICIDES

Educational objective: Be able to prevent and limit risks associated with the use of pesticides and the management of their packaging.

Topic 1: Identify **the main forms of pesticide toxicity on humans and the environment** (contamination of water bodies and soil, reduction of biodiversity...). Know the meaning of the main pictograms, classes and hazard codes on the labels of chemical products *(including those on synthetic pesticides).* Identify the **active ingredients used in the villages if they are classified as CMR substances.**

> **Supplements to topic 1 =** Additional objectives for technicians leaders of FOs and local authorities: (1) Establish **the list of active ingredients used in the villages but currently banned by the country's pesticide legislation;** (2) **Define actions to improve compliance with this** legislation (e.g., ban the presence of pesticides not authorized in the country in the markets of the municipalities concerned); (3) Establish the list of active ingredients still used in their country although they are now banned in the EU.

Topic 2: Know pesticides' main routes of entry into living organisms and how they develop along the food chain to humans and animals; devise priorities in terms **of physical protection**, the method and place of **storage** of products and **management of their packaging** after use so that they do not disturb the ecosystems.

Topic 3: Identify **protective equipment** available in the region concerned, including its advantages but also limitations, and even the risks posed by certain equipment in rural and tropical conditions. Identify ways to improve farmers' access to the equipment considered most useful (e.g. gloves, boots, masks).

Topic 4: In the event of severe insect infestations, diseases, etc. and, if effective alternatives are not yet available, **identify the least toxic pesticides and use them more effectively by reducing risks and carefully adjusting dosages.**

Topic 5: List village practices for **managing pesticide packaging**. Identify improvements that can be made in partnership or not with input sellers,FOs and village authorities.

MODULE 3: PROMOTION OF PESTICIDE ALTERNATIVES

Educational objective: Be able to prevent and limit risks associated with the use of pesticides and the management of their packaging.

Topic 1: On village lands, identify specific examples **of how pesticides have negatively impacted cultivated and uncultivated biodiversity.**

Topic 2: Together with participants, identify the crop pests causing the problems specified in the surveys conducted in Module 1 on village lands as well as beneficial organisms and endogenous solutions that could help resolve these problems.

Topic 3: Identify and implement ecological transitions that minimize as much as possible the use of pesticides. To achieve this goal, and based as much as possible on the participants' practices, identify possible options for crop rotations, choice of farmed plant species and varieties or livestock species, choice of sewing methods and mechanical weeding tools, etc.

Topic 4: Know and promote **biological control methods that can be used in African or other tropical farmers' agriculture.**

Topic 5: Improve and expand **local production of biopesticides and natural preparations of low concern (NPLC)**

MODULE 4: REDUCTION OF HERBICIDES

Educational objective: Be able to propose improvements in agricultural mechanization in order to allow family farms to significantly reduce their use of herbicides.

Topic 1: Know the evolution of herbicide use by farmers in your region.

Topic 2: Know how the use of animal traction has evolved in your region and identify the problems encountered with the maintenance and replacement of animal traction equipment.

Topic 3: Analyze mechanization alternatives currently being proposed to farmers by governments.
Topic 4: Identify and promote mechanization options that help to reduce the use of herbicides.

MODULE 5: IMPROVING HOW VETERINARY PRODUCTS ARE USED

Educational objective: Be able to prevent the risks associated with the use of veterinary products and recommend livestock farming practices and ethno-veterinary treatments which help reduce the use of these products in line with the "One Health" approach.

Topic 1: Know **the types of livestock farming practiced** by training participants and their context as well as the main **pathologies present in these environments**.

Topic 2: Understand the "One Health" approach and why it is needed for more sensible **use of antibiotics and anti-parasitic products.**

Topic 3: Identify and implement **herd management practices that reduce the need to use veterinary products.**

Topic 4: Recover and disseminate **relevant**alternative traditional practices from the areas of training participants.

MODULE 6: INFORMATION AND MOBILIZATION OF CITIZENS

Educational objective: To reduce the use of pesticides and prioritize the elimination of the most hazardous ones, understand the objectives of citizen initiatives which are: (1) the application and strengthening of national laws on pesticides; (2) compliance with related international and regional conventions; (3) support for the implementation of alternative agroecological solutions.

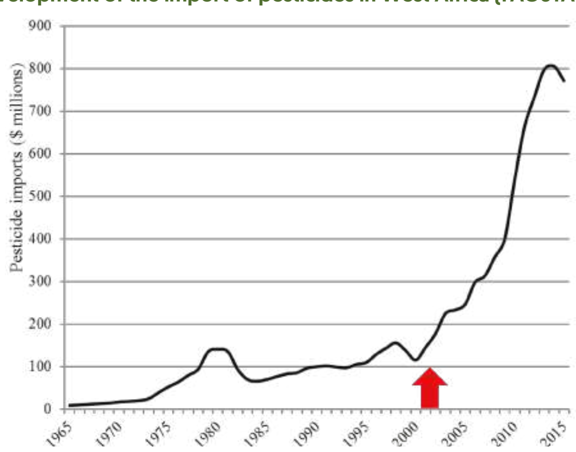
Topic 1: Determine and summarize mobilization challenges **to be overcome** for genuine alternatives to the use of hazardous pesticides and explore **examples of mobilization** in France, Africa and South America.

Topic 2: Initiatives for the implementation of **international conventions** on pesticides.

Some information on the use of the pesticides and certain veterinary products in developing countries: a situation which is growing more alarming by the day

Increasing consumption and dangerous flaws in the application conditions of pesticides and veterinary products are a cause for growing concern worldwide, particularly in developing countries. In these countries, the volume of these products used remains limited due to poverty, but the registration rules are less strict and difficult controls, we often find pesticides banned elsewhere because of their impacts on health and/or the environment[5].
With regard to pesticides, since the 2000s there has been a sharp increase in imports into West Africa (see the FAOSTAT graph below) and a fairly recent dominance of herbicide imports (see table below, from Haggblade, 2019). They are often old active ingredients with numerous negative effects on populations and the environment [6].

Development of the import of pesticides in West Africa (FAOSTAT, 2018)



[5] L'Afrique risque de devenir un déversoir pour des pesticides bannis d'Europe (Africa risks becoming a spillway for pesticides banned in Europe), article by Laurence Caramel, Le Monde, published November 15, 2019.
[6] Le Bars M. et al, 2019. Evaluation des risques liés à l'utilisation des pesticides en culture cotonnière au Mali (Evaluation of the risks associated with the use pesticides in cotton cultivation in Mali); in Soumare, In Mamy & Havard (Coord.). African cotton zones. Dynamic and durability. Proceedings of the Bamako convention, 21-11/23/2017. CIRAD, IER, USSG Bamako. http://agritrop.cirad.fr/593138/

Importation de pesticides en Afrique de l'Ouest (Import of pesticides in East Africa), 2015*
(Source: Comtrade, 2017; FAOSTAT 2017)

Pesticide products	Imports	
	Millions of $	Percentage
Herbicides	552	62%
Insecticides	229	26%
Others **	104	12%
Total	**885**	**100%**

*Average from 2014 to 2016
**Fungicides, growth regulators, rodenticides, nematicides

Moreover, as the box and table (Haggblade et al - 2018 and 2019) indicate, a significant portion of pesticides marketed in Africa are not authorized and are counterfeit[7].

Estimates in 8 African countries (Source MirPlus2012)
Unregistered products: 27%
Counterfeit products: 7%
Total fraudulent products 34%
Percentage of fraudulent herbicides in Mali: 25 to 45%

Dosage of fraudulent and registered products (Source: Haggblade et al., 2019)

	Laboratory dosage/indicated dosage			
	Average	Distribution		
Status		75%	75-89%	90-100%
Fraudulent[1]	0.82	35	35	30
Registered (CSP)	0.91	0	35	65
Total	**0.87**	**18**	**32**	**50**

(1) Fraudulent products account for 39% of products not approved anywhere and 6% that are approved in neighboring countries and therefore illegally distributed in Mali.

The IRSS (Research Institute of Health Sciences) in Burkina Faso has conducted several large-scale studies on methods of pesticide use and health-related incidents involving pesticides. The findings reveal a very worrying situation, both in terms of distribution conditions and the manner in which pesticides are used, and cite multiple cases of intoxication (see box below).

[7] Haggblade S., 2019. Pesticides frauduleux en Afrique de l'Ouest: croissance des marchés et faiblesse du suivi post-homologation (Fraudulent pesticides in West Africa: growing markets and a lack of post-approval follow-up);
https://www.canr.msu.edu/fsp/outreach/presentations/haggblade%20fraudulent%20pesticide%20overview%20west%20africa%2 0ver5.pdf

Overview of the 2015-16 IRSS study on the impact of pesticides in western Burkina Faso.[8]

"The intensification of agriculture has led to an increase in the use of agricultural inputs, particularly pesticides. In order to improve the health of populations and preserve the environment, the Rotterdam Convention financed this study in Burkina Faso on the use of agricultural pesticides during the 2015-2016 agricultural season. Its purpose is to study the different practices of farmers in the use of pesticides and to analyze agricultural pesticides residues in sediment, soil and water.

This study was conducted through surveys of 509 agricultural producers, 353 pesticide distributors and 69 health centers in three regions *(Boucle du Mouhoun, Cascades and Hauts-Bassins)*. The evaluation of the state of environmental contamination is based on the collection of 27 soil, water and sediment samples at 9 sites. The main findings are as follows:

- 95 % of the distributors surveyed do not have approval from the National Pesticide Management Committee and are not aware of the existence of the Sahelian Pesticide Committee.
- 216 pesticide formulations were identified, of which only 112 (52%) are registered in Burkina.
- 52% of the farmers did not attend school.
- 82.5 % of the farmers did not wear personal protective equipment when using the pesticides.
- 107 cases of intoxication were reported in the sample of 509 producers surveyed. The symptoms reported were dermatological (itching, tingling, burning of the skin, rash, sores, complete destruction of the contaminated area), respiratory (tingling, burning and itching of the airways, breathing difficulties and coughing), ocular (burning of the conjunctiva, visual disturbances, tingling and burning of the eyes, loss of sight), gastrointestinal (abdominal pain, nausea, vomiting), as well as headaches and dizziness.
- From 2010 to 2015, 341 cases of pesticide intoxication were identified in 69 of the health centers surveyed [9]".

In many developing countries, there is still an insufficient amount of user information regarding the increasing number of intoxications, serious accidents or chronic diseases linked to pesticide exposure. As mentioned by the authors of the study summarized above, **training on these topics and on alternatives is essential.**

The increase in the sale and use of pesticides identified in Burkina Faso is also dramatic in other Sudanese and Guinean countries in West and Central Africa. The data below concerns the Ivory Coast and Ghana *(source Traoré and Haggblade 2017)*.

[8] Ouedraogo J.B, Ouedraogo R. Ilboudo S., Bayili B., Pare T., Kekele A., Sawadogo B. 2016. Study on the use of agricultural pesticides in three regions in West Burkina Faso and the evaluation of their impact on health and the environment. http://www.pic.int/Portals/5/download.aspx?d=UNEP-FAO-RC-Workshop-BurkinaFaso-Report-201212.Fr.pdf

[9] 341 cases of pesticide intoxication have been recorded at 69 of the health centers surveyed, but in only 81 of the cases has the pesticide at fault been identified: 22.2 % of the known cases were attributed to glyphosate-based products, the same amount for cypermethrin, 19.7% to paraquat, 13.6% to thiram and 11.1% to lambdacyhalothrin.

Development of the number of approved importers of pesticides, sellers and applicators (Source: Traore et Haggblade, 2017)

	Millions of $	Percentage	Annual growth rate
Ivory Coast			
Importers	12	67	11%
Resellers	113	779	13%
Applicators	44	396	15%
Guinea			
Importers	2	21	16%

A significant number of these pesticides come from China whose herbicide exports were $2 billion in 2015, up from nearly zero in 1990.

In addition, problems of biodiversity destruction, soil, water, air and food contamination were increasingly verified, while demand among consumer and citizens is growing for safe and healthy food, also with respect to the environment.

This alarming diagnosis of health and environmental risks linked to pesticides is widely shared by the scientific community[10]. With applications for both crop and livestock production, agroecology is also recognized by scientists and international institutions (FAO, IFAD, UN) as a sustainable alternative to the excessive use of pesticides and certain veterinary products.

The March 2017 UN report [11]entitled "Human Rights and Pesticides" accurately describes the use of pesticides in agriculture globally and its negative impact on human rights. It notes the numerous impacts on human health, the environment and society, impacts that are often monitored under the limited perspective of "food safety". It notes that environmental and human rights provisions do not sufficiently protect farmers and agricultural workers, consumers and vulnerable groups. It encourages farmers to "adopt agroecological practices that improve biodiversity and eliminate pests through natural methods".

[10] Cf. Appel d'Arusha à l'action sur les pesticides (Arusha call to action on pesticides/May 2019), French version: https://www.centrepsp.org/sites/default/files/Appel%20dArusha_FR_FINAL.pdf

[11] https://www.refworld.org/cgi-bin/texis/vtx/rwmain/opendocpdf.pdf?reldoc=y&docid=58ad94774

Additional data on pesticides from the IUTA (International Union of Food, Agricultural and Allied Workers) pesticide training manual [12]

"Since the vast majority of pesticides are synthetic products that do not exist in nature, there are often no naturally evolved organisms which break down these poisons into less harmful substances. Consequently, if they are not broken down by hydrolysis, redox, decarboxylation ..., many pesticides remain persistent in the human body, soil and water, and some of them accumulate in the food chain and the environment. They are one of the few groups of chemicals deliberately released into agricultural places of work and the environment". Their persistence and ability to accumulate in fatty tissue means that traces are found in most humans and in all kinds of wildlife, even in remote areas of the planet (= far from their point of use).

For example, persistent organochlorine insecticides (such as DDT) can be found in the breast milk of Inuit women in the Arctic in quantities exceeding the safety limits prescribed by the WHO. Therefore, there is no "safe use" of pesticides, **there are only measures to try to protect against their effects.**

Developing countries use only **20%** of the world's pesticides but account for **80% of deaths and poisonings.** In these countries, as well as in countries in transition, many highly toxic pesticides are used on farms and plantations, especially for the production of export crops such as cut flowers and fresh vegetables. Many industrialized countries continue to export pesticides, which have been banned or severely restricted in their own countries, to the world's poorest regions. For example, it is estimated that 70% of the gross tonnage of pesticides used in agriculture in India are products banned or strictly regulated in countries of the Northern Hemisphere.

Despite the existence of numerous international conventions prohibiting the use of certain pesticides (see Appendix 1 for a list of these substances), developing countries and many middle-income countries often lack the regulations, enforcement framework and resources necessary for the sound management of pesticides and monitoring of their marketing.

It will be impossible to reduce the number of poisonings and level of contamination as long as numerous highly toxic active ingredients and formulations continue to be traded internationally and are not replaced by less toxic pesticides and especially by other less dangerous methods of controlling diseases, pests and weeds".

[12] Source: http://www.iuf.org/w/sites/default/files/2004%20Manuel%20de%20formation%20sur%20les%20pesticides_0.pdf

With regard to veterinary products, several issues are also important, such as the insufficient regulatory framework for the evaluation of the quality, marketing and conditions of use of veterinary drugs. This concerns in particular antimicrobials whose use is increasing rapidly with a number of studies estimating that their use in connection with livestock activities will increase by 67% between 2010 and 2030 *(Van Boekel et al. -2015[13])*.

With regard to the quality of veterinary drugs, according to a study published by the OIE in 2008 *(Teko-Agbo A. et al.)*, respectively 69% of the drugs obtained from markets in Cameroon and 67% in Senegal were found to be inconsistent with their formulation, which could alter both their efficacy and safety. In 2 to 4% of cases, no active ingredient was present in the marketed drug.

Furthermore, a summary review of literature published by the OIE in 2014 *("Résidus d'antibiotiques et denrées d'origine animale en Afrique : risques de santé publique" (Antibiotic residues and food of animal origin in Africa: public health risks), Mensah S.E.P et al.)* specifies that the prevalence rates of veterinary drug residues in food of animal origin is less than 1% in Europe, while it is reportedly as high as 94% in some African countries. In particular, it cites the following examples which demonstrate the high level of antibiotic residues in foodstuffs of animal origin*(beef and milk)*:

- in Ghana, the prevalence rates of antibiotic residues are 30.8% for beef, 29.3% for goat meat, 28.6% for pork, 24% for sheep meat and 6.8% for eggs;
- in Niger, even higher rates have been reported, 33.1% in broiler chickens, 52% in gizzards and 81% in chicken livers (and also in Senegal, Kenya, Tanzania…).

Similar to pesticides, **professional support** for livestock farmers in connection with the use of these products and a dose appropriate for the pathology to be treated and the compounds used is very insufficient. For instance, in West Africa, land pressure and the reduction of collective grazing areas are leading to a decrease in pastoralism and the development of sedentary agricultural livestock farmers practicing small-scale fattening and dairy farming. This development has led to access to and the use of veterinary products, often poorly controlled, with very limited professional supervision of the breeders, which means there is no guarantee that veterinary drugs are used in a sensible and relevant manner (antiparasitics and antibiotics in particular). This situation creates risks for animal and human health and for the environment:

• **Emergence of pathogen resistance, in particular to antibiotics**, leading to a decrease in the effectiveness of treatments, with economic impacts for farmers (failed treatments and increase in morbidity and mortality), as well as in human health[14] due to possible resistance of zoonotic germs that will then affect humans and decrease the possibilities of treatment;

• **The diffusion of product residues in the environment** could accelerate the development of resistance and have adverse effects on the environment, such as the excessive use of antiparasitic treatments with consequences for soil fauna and eventually on their fertility.

With respect to the use of veterinary drugs, AVSF's establishment in several countries (Togo, Senegal, Mali, Madagascar, Cambodia) of networks of Community Animal Health Workers (CAHWs) supervised by local veterinary services has helped give livestock farmers access to treatment methods, advice and technical supervision on the use of these products[15].

[13] Thomas P. Van Boeckel et al -Global trends in antimicrobial use in food animals, Proceedings of the National Academy of Sciences, 112(18) -March 2015. PDF version can be downloaded via the following link: https://www.researchgate.net/publication/274248344_Global_trends_in_antimicrobial_use_in_food_animals

[14] World Bank October 2019 report on the "Lacunes dans les connaissances et la mise en oeuvre pour lutter contre la résistance aux antimicrobiens" (Lack of the knowledge and implementation necessary for fighting antimicrobial resistance): it is estimated that Anti-Microbial Resistance (AMR) already costs up to 700,000 lives per year (O'Neill, 2016), although the true burden of resistant infections remains unclear. The number of deaths caused by multidrug-resistant organisms (MDROs) could be more than six times the widely cited figures (Burnham et al. 2019).

[15] Cf. https://www.avsf.org/fr/posts/644/full/dispositifs-de-sante-animale-de-proximite-et-de-qualite-les-enseignements-de-l- experience-d-avsf

NOTES

MODULE 1: PRELIMINARY PARTICIPATORY DIAGNOSTICS

EDUCATIONAL OBJECTIVE:

Be able to carry out participatory village diagnostics in order to identify the main problems leading to the use of pesticides, their management and the agroecological alternatives already known to farmers.

Educational advice
These diagnostics can be performed by literate farmers using the survey frameworks developed with technicians. As carried out in Kita in 2017 in partnership with UR-CUMA of Kita, teams of 2 or 3 literate farmers can take charge of the 3 issues below. We suggest that women participate in these surveys, or even take charge of some of them as experience shows that they are often more aware than men of the impacts pesticides have on human health. Appendix 2 provides village survey guides on pesticides and alternatives.

TOPIC 1:

In the villages, identify where the persons undergoing training come from, the main problems encountered with "weeds" management and the main pests and diseases impacting crops and animals.

The task is to know the problems associated with crop and livestock farming systems that can explain the use of pesticides and veterinary products.

TOPIC 2:

Be aware of the use of synthetic pesticides and veterinary products in the villages and identify the places of purchase and sources of advice:

1 Main crops being treated with pesticides in the village with, for each crop, the name of the main products used and their target organism, the relative importance of the treated areas and the application periods of these products.

2 Veterinary products used for animals including – sorted by species type – the name of the products used, the purpose of the treatment and frequency.

3 Place of purchase and price of the main products used. Attention: insecticides, herbicides, fungicides, veterinary products ... can be purchased in different locations.

4 Names of "illicit" pesticides purchased on the market, including those that are not registered in the country and, in particular, those whose labels are not in an official language of the country and therefore cannot be read by farmers or even by technicians.

5 Identification of persons and organizations providing advice on the use of these different pesticides and veterinary products. Identify which of these persons give advice which can be considered objective (or "neutral") because it is not linked to a sales context.

TOPIC 3:

Identify the pesticide application methods, the nature of protection used, packaging management, incidents involving people and animals and their frequency.

1 Collection of information on **application methods** for herbicides, insecticides, etc. (type of equipment and types of nozzle used for insecticides, herbicides, etc.) as well as on the usual practices concerning treatment conditions: time of day, taking into account or not the temperature, wind, dew, probability of rain, etc.

2 **Types of protective equipment used:** boots, gloves, masks, overalls, etc.; how often each type of protection is used; steps taken between multiple treatments: is protective equipment cleaned? If yes, how? Or is new equipment used? Factors restricting their use (economical, accessibility-related, technical and physiological, sociological, etc.)

3 **How is the packaging** (container and bags) **of the pesticides managed?** How aware are those involved of the risks associated with such packaging? What are the storage locations for packaging that still contains pesticides or for empty packaging? Proportion stored in closed locations which are not accessible to children? Proportion of packaging buried or burned? Reuse of containers and nature of their reuse (in connection with food, other)? What alternatives have been implemented in the villages to prevent reuse? Are there any efforts to collect this packaging? By whom? Possible involvement of vendors and distributors in their collection? (Appendix 3 provides some answers to these questions based on surveys in villages in Kita Cercle Mali).

4 **Nature, cause and frequency of incidents involving people** (including any suicides) following the use of pesticides in the participants' villages over the past 10 years? How are these incidents handled and how is care administered (traditional methods or those implemented in health centers)?

5 Have certain pesticide application practices led to animal mortality (as noted in several villages in Kita Cercle, incidents can occur when animals enter plots that have just been treated with certain pesticides)?

The following box summarizes the findings of AVSF teams in northern Togo and the next one mentions human incidents that occurred in four villages in Kita Cercle Mali.

Summary of findings in 2014 in Northern Togo (Savannah Region)
Excerpts from the report of an AVSF-UROPC-S training session

1. Numerous active ingredients used in the Savannah Region are, due to their high toxicity, prohibited in the EU and many other countries in the world. A significant portion of these active ingredients are old compounds that are no longer protected by patents and whose prices are very low on the African markets (cf. glyphosate, paraquat, atrazine, diuron, alachlor, lambda-cyhalothrin, ...). These low prices explain the increase in their use. Some of the products containing highly toxic active ingredients come from China or India. However, they are no longer allowed in Togo, but nonetheless enter illegally through borders that are too porous (see border with Ghana). These "illegal" products are often sold in plain sight and the authorities fail to enforce their own legislation.

2. The majority of farmers in the Savannah Region are illiterate and cannot read the labels on pesticide containers. It was documented in the surveys that some of those surveyed confused insecticides and herbicides! The problem is compounded when the labels of these products are in English and not readable by most technicians.

3. Pesticides are often stored in the farmers' homes; only a small number of farmers store them in closed rooms that are not accessible to children.

4. With a few exceptions, there is no protection for the people performing the treatments; they often walk through the treated vegetation in shorts and flip-flops. However, the skin is the main route through which pesticides enter the body!

5. The spraying of "cotton" insecticides on food crops associated with cotton is sometimes observed, even though these "cotton" insecticides are most often not authorized for use on food crops, particularly organophosphates (given the strong land pressure, the husband's cotton is rarely grown on its own; his wives often plant cowpeas, Guinea sorrel, okra, sesame, etc.). A portion of the biomass of these food crops is directly used in food or sold on markets without taking into account chemical treatments (e.g. sorrel leaves and flowers, cowpea leaves and pods), ...).

6. The use of pesticide containers by humans for watering is observed although it is very difficult to eliminate the active materials that have impregnated the plastics. Unlike the majority of EU countries, no recycling of packaging has been organized to date in Togo.

7. On the markets, one also encounters the sale of very dangerous pesticides in stores which also sell food products.

Some pesticide-related accidents noted during surveys conducted by an AVSF team in 4 villages in Kita Cercle in 2017

1) In the village of Kéniéroba, a woman ate the fruits of a shea tree in a field treated with the insecticide Tenor 500 EC (Profenofos). The woman died following consumption.

2) In the village of Noumouténé, 6 children consumed shea fruits from a field treated with the herbicide known as Béret rouge (glycel - glyphosate 41% S.L). The children were hospitalized and the families spent more than 80,000 CFA francs to treat them.

3) In the same village of Noumouténé, a farmer mixed the insecticide TENOR 500 EC (Profenofos) in earthenware to coat his granary. He died the next day.

4) After treating a field with the insecticide CALIFE 500 EC (Profenofos), a farmer went to work in the field the next day without waiting for rainfall. He fainted in the field but fortunately did not die.

5) In the village of Kodala, an elderly woman used NOMOLT 150 SC (Teflubenzuron) insecticide to try to kill lice that were on her children's heads. This had a severe effect on the 8 children and the mother, but no one died. NB: Teflubenzuron is no longer registered in France and in the EU [16].

6) One farmer failed to take into account the wind direction during an insecticide treatment of cotton with the product ATTAKAN (imidacloprid 200 g/l + cypermethrin 144 g/l). Local treatment with dah leaves (Guinea sorrel), lemon and curd saved him.

TOPIC 4:

Identify agro-ecological, chemical-free alternatives implemented by people from the villages for the care of their crops and animals, collect opinions on their relevance and the limits on widespread use. To a greater degree, take advantage of local knowledge to devise new approaches based on solutions existing in nature.

1. **Listing by crop of the main pests** (with their vernacular names) and **alternative chemical-free practices** identified in the village.

2. **Concrete examples of the implementation of alternative practices to pesticides** in the village with a description of the time needed to collect the ingredients, the preparation time, the application methods and their frequency. This census is very important: a form that can be used for surveys among farmers is attached 4.

3. **Listing of traditional animal care practices,** including a description of the plants used, recipes for their preparation, intended uses (for which diseases and which animals?), and if possible feedback on the effectiveness of these uses. This listing presupposes a thorough survey of several livestock farmers in the area concerned, and even of traditional practitioners if they exist: an example of a survey form used in the context of a veterinary thesis is given in Appendix 5.

4. **Users' opinions on the effectiveness of each alternative method identified.**

5. **Collection of constraints reducing the dissemination of alternative** methods recognized as the most effective.

Appendix 6 presents a table summarizing the documents produced as a result of this type of study within the framework of actions carried out by AVSF and/or its partners. Other studies and bibliographical references may be available depending on the country, as practices are by definition very much linked to the specific territory in which one is located.
The box below lists the main farming practices identified in north Togo. This is a basic list: the effectiveness of these practices has not been validated.

Alternative farmer practices identified by AVSF teams in 2014 in northern Togo.

These are mainly plant-based repellents **and bio-pesticides** available in the Savannah region. Some of these plants do not pose any toxicity problems for humans.

Animal products such as cow dung and urine are also used. Mixed with plants, dung-based preparations can be used as bio-stimulants or foliar fertilizers or as repellents.

On the other hand, other preparations contain active ingredients with a fairly high toxicity for humans, such as neem or tobacco.

1. Use of chili pepper (Capsicum frutescens) based sprays to control slug attacks on young plants produced in nurseries (vegetable or forest nurseries).

2. Spraying of decoction of **tobacco** leaves and stems to keep away small ruminants that feed on young fruit and forest plants.

3. Spraying of dung-based **slurry** on the leaves of forage plants (and young forage shrubs) to prevent ruminants from feeding on these plants.

4. Sprinkling of **ordinary ash** on young Guinea sorrel plants to control insects.

5. Soaking of **African locust bean** and **African mahogany** barks and use of the filtrates on poultry to control newcastle disease.

6. Use of **Sapium elliptium** (in moba: “Koudaltug”) or Anogeissus leiocarpus leaves to control lice and insects in chicken coops.

7. Planting of **greasy vetiver** in the fields to attract termites which disturb the crops.

8. Soaking of **néré pods (Parkia biglobosa) + onion + omo washing powder** (wetting agent) to control tomato insects.

9. Preparation for controlling insects attacking cabbage: a bowl of neem seeds in a 10-liter bucket of water + **cow dung**; let the mixture soak for 3 days. The mixture should be stirred at least once a day. Then filter and spray it.

10. Use of **neem seed soaked preparation + chili + omo washing powder** to protect onions for various insects.

11. Use of a mixture of **eucalyptus, neem and**

[16] Source: https://ephy.anses.fr/node/1280/deconnecte

caulcedra leaf ash for insects attacking stored goods (ordinary ash can also be used but it would be less effective).

12. To control **storage insects**, use ultra fine sand mixed with seeds in a sealed container (ultra fine sand reduces the amount of air available and prevents insects from moving). A suitable sieve is then used to separate the seeds from the sand.

13. To also reduce insect **attacks**, use of **Hyptis spicigera leaves** (in Moba: Djou-guelangbiang) placed on the floor of the granaries.

NOTES

MODULE 2: RISK PREVENTION OF PESTICIDES

EDUCATIONAL OBJECTIVE:

Be able to prevent and limit risks associated with the use of pesticides and the management of their packaging.

Educational advice
Survey phases and classroom phases can alternate each day as was done during the training conducted by AVSF in Kita in 2018: The mornings were devoted to surveys and observations in the villages and, in the afternoons, the work was carried out in the classroom with feedback from the surveys conducted by the groups of farmers and analysis of the data collected in the field. Illustrated and concrete complements were then provided by the trainers.

TOPIC 1:

Identify the main forms of pesticide toxicity on humans and the environment. Know the meaning of the pictograms shown on pesticide labels. Identify the active ingredients used in villages despite being classified as CMR; know the most dangerous active ingredients prohibited by international conventions.

Forms of pesticide toxicity and practical consequences

Reminders: The term pesticide includes the suffix -cide which comes from the Latin cida meaning to kill and the English word pest *(NB: in Latin, pestis means contagious disease).* **Pesticides are therefore by definition products toxic to certain living organisms.** They eliminate pests in fields, gardens, livestock stalls, crop storage areas and homes. Depending on the organisms to be killed, there are insecticides, fungicides, herbicides, molluscicides, nematicides, bactericides, rodenticides, virucides, etc. Some pesticides used for crop insects are also used on domestic animals and humans *(for example, several insecticides are used to kill lice).*

When ingested in excess of the **dose** limits per kilogram of body weight, these pesticides can cause immediate death or very serious effects to animals and humans. Delayed **effects** must also be taken into account because even a small amount of certain pesticides ingested on a regular basis can have serious consequences for human health over time. It has also been proven that mixtures of certain products and active ingredients can have far greater effects on health than individual active ingredients (= **cocktail effect**).

In addition, **co-formulants** are added to the products or directly to the sprayer to increase the action of the active ingredients or to promote their penetration into the organisms to be destroyed. These co-formulants and, in particular, solvents may be more toxic to humans than the active ingredients themselves, or their use in combination with an active ingredient may increase the toxicity of the pesticide alone. **This co-formulant issue has been demonstrated for numerous glyphosate-**based formulations for which the ANSES *(French National Safety Agency)* estimates that "the data provided by the manufacturers do not allow for conclusions regarding their possible genotoxicity" [17]. Due to the toxicity of co-formulants, pesticides manufactured in China or India are not authorized in the EU, nor are they authorized by African registration committees such as the SPC (Sahelian Pesticide Committee).

Buying an unregistered product at a market increases the risk to your health! It doesn't mean that there is no risk in using registered products....

Types of pesticide toxicity
(Source Mutualité sociale agricole - MSA – France)

Type of toxicity	Description
Acute toxicity	Effects after one or two exposures over a short period of time
Skin and eye toxicity	Dermatological reactions on the skin and eyes
Sub-chronic toxicity	Effects following repeated exposure over a prolonged period of time
Genetic toxicity (= reprotoxic and mutagenic) = **R and M**	Influences on genes and **reproduction** (for example, decline in the production and fertility of spermatozoa) and **mutagenic effect** (= results in the birth of children with deformities)
Chronic toxicity and carcinogenic = **C**	Long-term effects **(risk of cancer, Parkinson disease, etc...)**
Neurotoxicity	Effects on the nervous system
Physical toxicity and hormone disruption	Effects on the development and functioning of the organism through effects on hormonal balance **(= endocrine disruptors)**
Toxicity to fish, bees, etc.	**Effects on biodiversity and, in particular, beneficial fauna**

[17] **12/9/2019, ANSES, banned 36 glyphosate-based products.** In 2018, these products accounted for **3/4 tonnes of the** glyphosate-based products sold in France for agricultural and non-agricultural use (cf. https://www.anses.fr/fr/content/l%E2%80%99anses-annonce-le-retrait-de-36-produits-%C3%A0-base-de-glyphosate).

Some effects of pesticides are immediate and others are delayed
(Source MSA-France)

Immediate effects

within a few hours to a few days

- Nausea
- Skin irritation
- Severe burns with sequelae
- Loss of sight
- In some cases, death
- Other effects...

Long-term effects

within a few weeks to 40 days

- Cancer
- Neurological diseases
- Reproductive disorders
- Changes in organ function (kidney, liver...)
- Other effects...

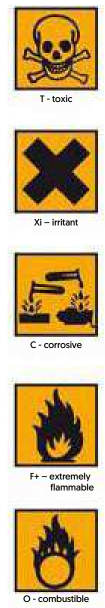
Beware of carcinogenic, mutagenic and reprotoxic pesticides = CMR!
(Source MSA-France)

CMR (H350, H351, H340, H341, H360, H361)

	Categories	New categories	New corresponding hazard statements	
Carcinogens	1	1A	H350	May cause cancer
	2	1B		
	3	2	H351	Suspected of causing cancer
Mutagens	1	1A	H340	May induce genetic anomalies
	2	1B		
	3	2	H341	Suspected of inducing genetic anomalies
Reprotoxics (toxic to repro-duction)	1	1A	H340	May adversely affect fertility or the fetus
	2	1B		
	3	2	H341	Suspected of adversely affecting fertility or the fetus

The pictograms on the labels indicate the level of toxicity
(Source MSA-France)

old pictograms



Identify the hazard, particularly the pictograms above: "I kill", "I am harmful to health", "I am seriously harmful to health" as well as "I pollute"
Get informed about the toxicity of the products BEFORE buying them!
Do not purchase CMR products (C = carcinogenic; M = mutagenic; R = reprotoxic)
Do not purchase products without a label or products whose label is written in a language you cannot read

What should be on the label of a pesticide container or bag (synthetic chemicals but also biocontrol products):

- The name of the active ingredient contained in the commercial product
- Its mode of action
- The concentration of the active ingredient(s) in the commercial product
- The recommended dose per unit of area and per treatment
- The frequency of treatment recommended by the manufacturer
- The risk phrases and the lethal dose LD50
- The pictograms that specify the types of danger
- Waiting times between treatment and harvest or food consumption
- The expiration date of the product (=> use before it has lost its effectiveness)

Supplements to topic 1 = Additional objectives for technicians leaders of FOs and local authorities.

1 • Prepare **the list of active ingredients used in the villages even though they are currently prohibited by the country's "pesticides" legislation and/or by international conventions.**

2 • **Devise actions to improve compliance with this legislation** (for example, market ban on pesticides not authorized in the country).

3 • If possible, establish the list of active ingredients still used in your country although they are currently banned in the EU. The list of compounds actually authorized in the EU can be accessed online: https://ec.europa.eu/food/plant/pesticides/eu-pesticides-db_en

As an example, **here is the list of the main active ingredients encountered in Dapaong** (Togo) **in 2014 and in Kolda** (Senegal) in 2016 including their toxicological classifications (old nomenclature) and specification of those banned in 2019 in the EU. These classifications were identified using the **French site** https://ephy.anses.fr or the **Canadian site** www.sagepesticides.qc.ca.

Please note: **the old toxicological classification is still present in Africa but, since 2015, the international classification CLP [18] has been adopted:** see classification, pictograms and risk statements on: https://clp-info.ineris.fr/sites/clp-info.gesreg.fr/files/documents/tableau_cl_fr.pdf).

The equivalence between the two rating systems is presented on the site: https://environnement.brussels/sites/default/files/user_files/docu_tab_clp_lienr_fr.pdf.

HERBICIDES

Active ingredients	Toxicological classification in 2016 according to the old nomenclature found in Africa
Glyphosate (isopropylamine salt)	R51/53 and sometimes also N - Xi - R41 (this classification varies according to the nature of the co-formulants used by the various manufacturers) - prohibition planned in the EU after 2022 and resolved on 12/9/2019 by ANSES in France for 36 formulations sold in France.
2-4-D (amine salts)	Xn – R22 – R37 - R41 – R43 – R52/53
Pendimethalin	Xi, N, R43, R50/53
Oxydiazon	N - R50/53 – B**anned in France since 2016**
Propanil	Xi, R11, R41, R67 - No longer authorized for use in France since 2009 and **banned in the EU since 2013**
Terbuthylazine	Xn – R22

[18] As of 2015, CLP **classification** *(classification, labeling, packaging)* of the toxicological risks is mandatory in the EU. It is inspired by the **General Harmonized System of classification and labelling of chemical products developed at the international level.**

Fluorometheron	Classified as moderately toxic, but data have not been updated since 1987
Metolachlor	Xn, N, R43, R50/53 - **Banned in France since 2003 but replaced by a very similar product, S-metolachlor**
Atrazine	Banned in the EU since 2002 - numerous risks including C3 (carcinogenic risk)
Propisochlore	**Banned in the EU since 2012**
Acetochlor	**Banned in the EU since 2013**
Diuron	**Banned in the EU since 04/17/2007**
Clethodim	Xn R20/22 R36/38 R52/53 (and for information, hazard statements retained in the new CLP classification: H304: May be fatal if swallowed and enters the respiratory tract - H317: May cause a skin allergy - H336: May cause drowsiness or vertigo - H412: Harmful to aquatic organisms with long term adverse effects - EUH066: Repeated exposure could cause dryness or chapping of the skin).

INSECTICIDES

Coconut and soy oil	Unclassified bio insecticide - more of a repellent, low risk
Deltamethrin	T – N - R23/25, 50/53 – Authorized in traps for organic agriculture and biocontrol
Cypermethrin	(alpha and beta cypermethrin) - Xn – N - R22– R50/53
Acetamiprid	Banned in the EU since 2019, highly toxic to bees
Lambda-cyhalothrin	T+ - N – R21 – R25 – R26- R50/53 – Fatal to humans if inhaled, toxic if ingested and toxic to aquatic organisms, highly toxic to bees - endocrine disruptor
Dimethoate	Xn – R21/22 – R10 – R42/43 – R 57 – possible carcinogen in Canada (cf. www.sagepesticides.qc.ca) and the USA – **Has been deregistered in several EU countries since 2016**
Endosulfan	**Banned in the EU since 2005**
Chlorpyrifos ethyl	T - N – R25 – R50/53 - banned in the European Union since 2020
Abamectine	T+ - N – R28 – R50/53 - Very high toxicity to humans, bees and beneficial insects
Pyrimifos-methyl	Xn – N – R22 – R38 – R50/53 – R65 – Since 2016, UE reduced the maximum residue limits (MRL). **And this active ingredient is now banned for preserving corn.**

Aluminum phosphide	T+ - F – N - R15/29, 28, 32, 50
Cadusafos	**Banned in the EU since 2005**
Promethrin	**Banned in the EU since 2013**
Fenpropathrin	**Banned in the EU since 2003**
Permethrin	**Banned in the EU since 2002**
Profenofos	**Highly toxic - banned in the EU since 2003**
Malathion	**Banned in the EU since 2008 in agriculture** but used in Guyane until 2015 to control the mosquito vectors of chikungunya

FUNGICIDES

Thirame	Xn – R20/22 – R36/37 – R43 – R48/22 – R50/53 – **Banned in France since 2011**
Mancozeb	**Strong debate on their ban in the EU because of the toxicity of this chemical family,** dithiocarbamates (suspected of harming the fetus; can cause skin allergies and very toxic to aquatic organisms). Limits on usage have been implemented.
Maneb	
Methyl-thiophanate	Xn, N, R20/22, R43, R51/53, R68
Chlorothalonil	**T+, N, R26, 37, 40, 41, 43, 50/53 - banned in the EU since March 2019**
Copper	**Authorization extended in the EU until 2025, but with a clear decrease in quantities per ha. In the Netherlands and Denmark, ban on the phytosanitary use of copper.**
Sulfur	**Low toxicity and authorized for organic farming**

An analysis of these tables **shows that about half of the active ingredients used in 2014 in Dapaong and in 2016 in Kolda are now banned in the EU…**

It is also important to teach technicians and farmers to identify counterfeit products.

The Network of Chambers of Agriculture of Niger (RECA) has conducted training on this subject. See this link: https://reca-niger.org/spip.php?article686

Here is an example of a properly licensed product.

A regulatory label for a SPC approved product

- the name of the manufacturer of the commercial "product"
- the name of the distributors
- the registration (approval) number

For the Sahelian Pesticide Committee, all numbers are of this type and end with "Sahel"

And here is an example of counterfeiting and fraudulent marketing practices identified by RECA Niger:

Imitation

The actual product

The postal code does not correspond to the city mentioned (Neuilly)
Neither does the phone number.
A check of the fax number on the internet shows that this number is not listed
(impossible for a company)

The imitation is a fraudulent

Know the most dangerous active ingredients prohibited by international conventions

A minimum framework has been put in place by widely ratified international conventions. Conventions are international agreements signed by several states or lists that are scientifically recognized and agreed upon. We distinguish:

- The Stockholm Convention: the POP list "Persistent Organic Pollutants" dated 2006.
- The Rotterdam Convention: the PIC list "Prior Informed Consent" dating back to 2004 and initiated by the United Nations Environment Programme.
- The Montreal Protocol, dating back to 1987 for the protection of the ozone layer.
- The PAN list (Pesticide Action Network) 12, dating back to 2011 including a list of the 18 most dangerous compounds used in agriculture.
- The WHO lists 1a and WHO 1b: these two lists classify extremely hazardous compounds (1a) and highly hazardous (1b) to health. It was established by the WHO, the World Health Organization. It dates back to 2007.

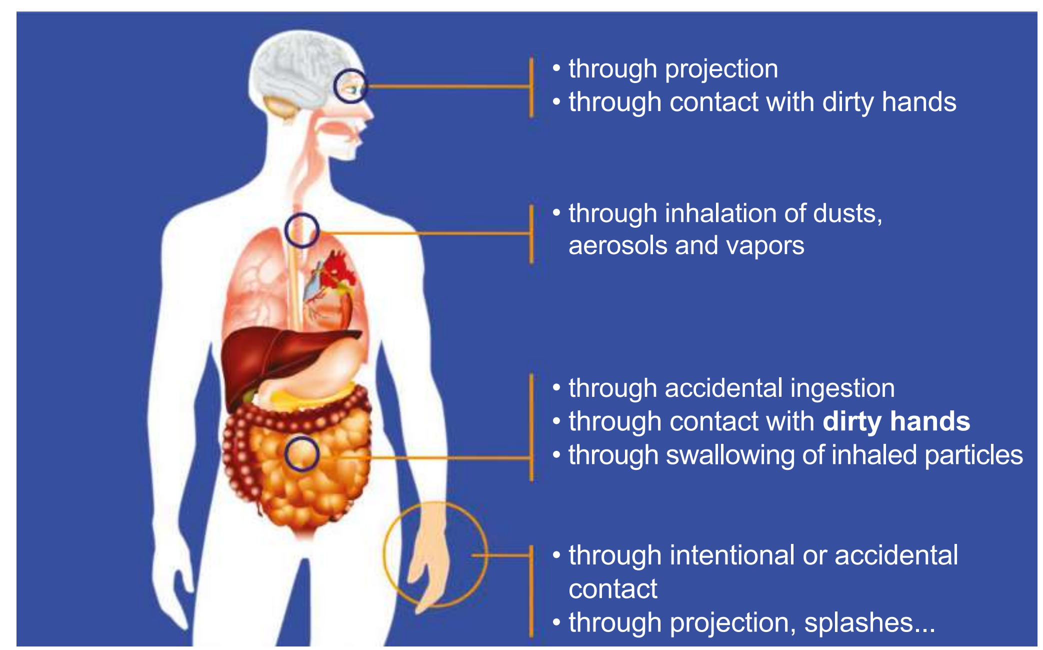
All the active ingredients listed by these conventions are specified in Appendix 1.

In addition, there are families of pesticides or active ingredients that have been condemned by numerous scientists, such as endocrine disruptors for human health, or neonicotinoids that are particularly toxic to pollinators (bees, crop auxiliaries). The latter are listed in Appendix 7.

TOPIC 2:

Know the main routes through which pesticides enter living organisms and their development along food chains. Devise priorities in terms of physical protection, how and where products are to be stored and their packaging is to be managed.

There are many ways for pesticides to enter the body: inhalation, skin contact, ingestion, etc. If one is not protected, which is very often the case in Africa, pesticide absorption can occur while preparing sprays and spraying *(source MSA France for the two boxes below - Certiphyto training slideshow - MSA - 30-05-2016).*



Given the routes of penetration described in the previous diagram, **the situations in which one is exposed and the factors aggravating such exposure are as follows:**

- **Exposure situations:**
  - o Preparing the spray mixture and filling the backpack sprayer
  - o Treatment of the crop
  - o Cleaning of the backpack sprayer
  - o On-farm storage and field transport of pesticides
- **Exposure factors:**
  - o Climatic conditions (excessively high temperatures, strong wind, ...)
  - o Technical incident during treatment (nozzle clogging, backpack sprayer lid seal failure, ...)
  - o Applicator hygiene (no smoking, drinking, eating, biting of nails during treatment)

TOPIC 3:

Identify protective equipment available in the region including its advantages, drawbacks associated with the risks of certain equipment types in farming and tropical conditions. Identify ways to improve farmers' access to certain equipment.

Exposure to hazards varies with the type of equipment used (Source MSA)

Type of sprayer	Tractor with cab and boom sprayer 	Backpack sprayer 
Spraying height	Low	Low and high
Body parts most frequently contaminated	Hands, legs, then trunk	Legs, trunk and hands
Intensity of global contamination	Low to moderate	Very substantial

Contamination is most severe with the backpack sprayer. It is further aggravated by **the fact that applicators often walk in the biomass that has just been treated!**

Protective and washing equipment used in industrialized countries (Source MSA)

Personal protective equipment (PPE) considered essential in France (Source MSA)

Too often, physical protection is not worn in Africa and in other tropical countries

Northern Togo (Photos V. Beauval)
Multiple and often unprotected applications of insecticides and herbicides (in this case, of glyphosate).
With backpack sprayers, you walk through the area that you just treated…

Debate on PPE adapted to family farming in tropical countries

Physical protection
(Source MSA)

Protect your hands

Protection of feet

Waterproof goggles, mask

Protection of eyes

The importance of goggles, basic masks, gloves and boots appears to be without question[19]. Unlike Latin America, *(including its tropical zones)*, such equipment is rarely used by African farmers. Group **purchasing** through their OPA could improve the farmers' access to this type of protection. **On the other hand, there does not appear to be interest in disposable suits and masks with filters. Suits are rarely the solution in tropical conditions as they greatly increase sweating, which can then facilitate the skin penetration of pesticides passing through the fabrics of the suit:** this is known as "**suit permeation"**[20]. These suits should be systematically replaced after each day of work, which implies having the financial means which smallhold farmers in African countries do not have…

The importance of **masks with filters** for farmers who use backpack sprayers can also be questioned. They slow down the flow of air to the lungs and, given the physical effort involved in using a backpack sprayer in very hot conditions, they can cause respiratory problems for some people. They also cause substantial increases in heart rates. Over time, they are loaded with pesticides and become very toxic. They would therefore have to be changed often, which is impossible for a smallholder African farmer. Moreover, finding the right filter for the mask you bought is difficult in Europe and, even more so in developing countries.

Therefore, there is no miracle solution to protect yourself and it would be best not to have to spray such toxic products!

More information on this topic 3 (Source MSA France):

	Measures in the event of ingestion
The measures for ingestion recommended by the MSA mentioned below do not correspond to the usual practices observed in rural areas of Africa where drinking milk is considered a traditional remedy for pesticide ingestion.	• **Immediately consult a healthcare professional** • **What not to do in case of ingestion:** **- do not induce vomiting** **- do not ingest any liquid (water, milk…)**

After treatment, the period before re-entering the plots should be respected for humans and animals. This is often a problem mentioned in West Africa. It causes serious health problems in humans and can increase conflicts between farmers and herders. The table below shows the officially recommended re-entry periods in France in 2015 and the footnote mentions the tightening of the times adopted in 2017[21].

[19] Provided, however, that certain precautions are taken, such as preventing the liquid from flowing into boots.
[20] cf. Alain Garrigou et al: "Critical review of the role of PPE in the prevention of risks related to agricultural pesticides" https://sfrp.asso.fr/medias/sfrp/documents/19-Garrigou.pdf.
[21] Since May 4, 2017, the re-entry period has been extended to 24 hours after any spraying or powder-based application of products with the hazard statements of the CLP classification: H315, H318 or H319. It is extended to 48 hours for products with one of the following hazard statements: H317, H334, H340, H341, H350 et H350i, H351, H360F, H360D, H360FD, H360Fd H360Df, H361f, H361d, H361fd or H362.

Period prior to re-entry after treatment
The regulation of June 12, 2015 amends the regulation of September 12, 2006 on the marketing and use of plant protection products

- **In a general manner:**

> 6 H min **on outdoor crops,** after spraying is complete
> 6 H min **on indoor crops,** after the end of spraying

- **at least one of the risk phrases H319, H315, H318:**

> 24 H min after spraying is complete
H319: causes severe eye irritation
H315: causes skin irritation
H318: causes severe eye damage

- **at least one of the risk phrases H334, H317**

> 48 H min after spraying is complete
H334: can cause allergic symptoms or asthma or respiratory difficulty through inhalation
H 317: may cause a skin allergy

TOPIC 4:

In the event of severe insect infestations, diseases, etc. and, if effective alternatives are not yet available, identify the least toxic pesticides and use them more effectively by reducing risks and carefully adjusting dosages.

1) Taking into account the toxicity of products, **make substitutions between chemical products to reduce health and environmental risks** (for example, eliminate carcinogenic, mutagenic and reprotoxic pesticides, they can be identified through the CLP classification mentioned on the labels, the main risks being H350, H351; H360, H361 and H340 and 341).

2) Identify the conditions under which pesticides (or biopesticides) can be applied, which often significantly reduces the doses and risks to those carrying out the treatments.

3) Taking into account the mode of action of the products (chemical or natural), identify **mistakes that must not be made when applying them** (see exercise with answers in Appendix 8).

To facilitate the effectiveness and penetration of products, **it is preferable not to apply them when it is very hot. Most treatments should therefore be carried out preferably in the evening.** For reasons of efficacy, it may also be advisable to perform applications early in the morning. However, this practice is not recommended because of the risk it poses to bees and other auxiliary insects that drink the dew on plants at sunrise.

Depending on the products and active ingredients present, advisory sheets can be created, particularly for the active ingredients of least concern, to help farmers improve their treatment practices and better manage the use of pesticides. These sheets can be developed based on those published online by the RECA Niger: https://reca-niger.org/spip.php?article659.

TOPIC 5:

List village practices for managing pesticide packaging. Identify improvements that can be made in partnership or not with input vendors, with FO, village and communal authorities who are aware of these issues.

Storage and disposal of pesticide containers or bags

Pesticide contamination can occur from container fumes, which should never be kept in the home! These containers should be stored in properly closed locations that are out of the reach of children. Pesticides and food products should never be kept in the same room.

A pesticide room that is not locked and can be accessed by children (at the home of a farmer in Kita Cercle) Photo V. Beauval

A farmer in Kita uses a herbicide container (right) and a motor oil container (left) to store milk) Photo V. Beauval

Mixture of pesticides on the market of Harobanda, one of the districts of Niamey - Source: Patrick Delmas – RECA Niger

Resale of empty pesticide containers at the weekly market of Tounfafi in Madaoua Department – source: Moussa Bizo Abass - Agricultural Advisor Regional Chamber of Agriculture of Tahoua - RECA Niger

After use, pesticide packaging should not be used for water or food products. According to the FAO, they should be rinsed and rendered unusable by deforming them and, under certain circumstances, incinerated rather than buried.
Refer to: http://www.fao.org/3/a-bt563f.pdf

Examples of solutions developed in various situations:
• A collection system for packaging with very large containers has recently been set up by CMDT in the cotton-growing areas of Mali, but there are not enough of them and they are not locked or secured.
• One village in Kita Cercle, Dougouracoroni, has dedicated a village store to the collection of pesticide packaging.
• In Cambodia, an AVSF project to implement preventive health and medical measures to protect human and animal health led to the distribution of recycling bins and the construction of incinerator ovens for burning waste: https://www.AVSF.org/fr/posts/2100/full/sante-animale-et-sante-publique-au-cambodge

However, collecting or burning pesticide packaging is not enough! On the contrary, channels for treating such packaging without causing pollution and posing risks to humans have to be set up...

In France, procedures have been recommended for phytosanitary waste by the government and its partners: http://driaaf.ile-de-france.agriculture.gouv.fr/IMG/pdf/plaquette_dechets-novembre2016_cle01bd18.pdf

Specific channels such as ADIVALOR (farmers, distributors, industrialists for the recovery of agricultural waste) have been set up and are proving to be quite effective in treating this packaging without pollution and danger to humans: https://www.adivalor.fr/

In Morocco, such channels have been planned since 2017, but are not yet operational: http://mapecology.ma/non-classifiee/agadir-lonssa-fao-organisent-atelier-gestion-emballages-vides-de-pesticides/

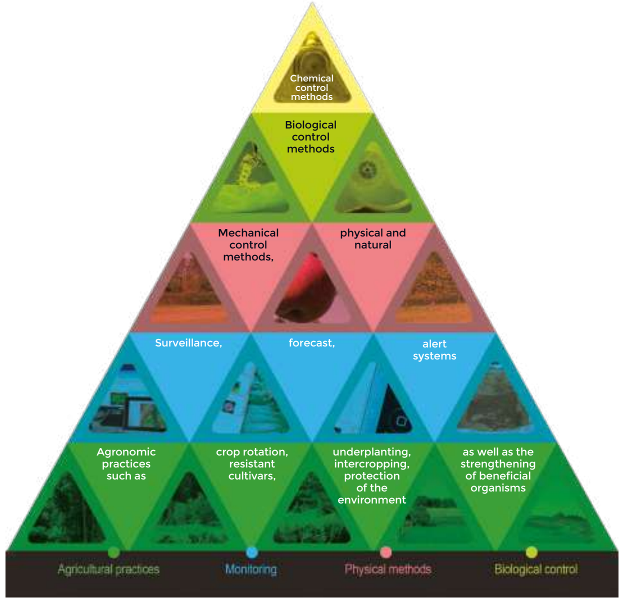
NOTES

MODULE 3: PROMOTION OF PESTICIDE ALTERNATIVES

EDUCATIONAL OBJECTIVE:

Know how to identify insects and diseases, better prevent their development and propose alternatives to pesticides that are less dangerous to humans and the environment.

The objective of this module is to develop biological control and a better knowledge of pests and auxiliaries in order to implement a crop protection strategy without pesticides. With respect to global principles, the pyramid below presents the different tools and methods that can be implemented by farmers to allow them to avoid the use of pesticides as much as possible. To obtain the healthiest possible crops, basic principles of agroecology lie at the base, including a variety of practices, cultivation systems and landscapes. Then come the observations, which are crucial for making the right diagnosis and choosing the right strategy.
This is followed by the choices made by farmers in the management of their crops: in the event of crop infestation by pests or weeds, integrated pest management methods are mentioned first and, at the top, chemical pesticides should only be used as a last resort[22]:



[22] Extract from the IPM guide "Integrated Pest Management, working with nature" IOBC, PAN Europe, IBMA Global - Free to download in English and French. Here is a link to the French version: https://www.pan-europe.info/sites/pan-europe.info/files/public/resources/other/La%20Lutte%20Inte%CC%81gre%CC%81e%20Travailler%20avec%20LA%20Nature.pdf.

TOPIC 1:

Identify specific examples of how pesticides have negatively impacted biodiversity in cultivated and uncultivated areas.

1. the destruction of beneficial trees in plots due to the use of total weedkillers;

2. the impossibility of combining cereal crops with legumes, okra, bissap, etc., for those who use cereal-specific herbicides;

3. the negative effects of cotton insecticides (including organophosphates and neonicotinoids) on bees and other beneficial insects;

4. in connection with the previous point, the development of "white flies" (= Bémisia Tabaci or whitefly), particularly in vegetable crops are close to cotton fields and in those where vegetable crops in the rainy season follow those farmed in the dry and cold seasons;

5. in several cotton-growing areas of Africa, okra, cowpea or guinea sorrel (whose fruits and/or leaves are consumed by humans) are sometimes combined with cotton, which is treated five times during its cycle, with insecticides not registered for food crops. There, it is human biodiversity that is directly threatened!

6. cross-reactions of cotton insecticides on malaria-carrying anopheles have been observed by some researchers (source: communication from JF Gueguen, INRAE et IRD).

Presentation of the association Bee Friendly's role

It is sometimes difficult for farmers to clearly understand how their practices impact biodiversity. An ideal way to overcome this would, if possible, be to get in touch with local beekeepers. Through observation of their bees, they have detailed knowledge of melliferous and nectariferous resources available throughout the year and also the state of environmental pollution linked to the use of pesticides. In Europe, this is the work of the Bee Friendly association.

This association restores the link between beekeepers and farmers in order to build a new agricultural model. Whether wild or domestic, the protection of bees is at the heart of practices that promote agro-ecological transitions involving the elimination of the most toxic pesticides for bees, the development of biodiversity to feed pollinators and constructive exchanges between beekeepers and farmers. It is also known that crop auxiliaries also feed on nectar: "what is good for the bees is good for the farmer". (https://www.certifiedbeefriendly.org/).

TOPIC 2:

Together with participants, identify the crop pests causing the problems specified in the surveys conducted in Module 1 on village lands as well as beneficial organisms and endogenous solutions that could help resolve these problems.

For example, the task is to:
1. Identify the insect pests that attack crops: their life cycle, from egg/larva to adult stage, the different plants or places in which they live, reproduce and feed throughout their life, know their date of emergence and end of cycle (see box below).

How can knowledge about insect pests and auxiliaries be developed?

The basic principle is observation. The greater the number of observations, the more precise and reproducible the diagnosis will be.

1) Data collection
The easiest way is to take a picture of the insect, with a smartphone for example. The location/plant on which it is observed, the date and time taken as well as weather details *(temperature, dry or wet weather, after a rain or not) should be systematically noted).*

As practiced by RECA Niger and two GRET teams in Kifa and Kaédi in Mauritania, a WhatsApp group can be created and shared with volunteer technicians and farmers. Sub-groups for individual crops can also be created. In this way, participants will be able to publish all the photos taken of insects found on a specific crop and exchange them with specialists and researchers.

In order to observe insects closely and identify them, it may make sense to capture them and keep them in an insect tube or a plastic bottle for example.

An **insect net** can be used for more detailed observation. This method always makes sense because the quantity and quality of the insects present on a crop can be shown (generally, our eyes tend to see much less than what is present).

This method also allows for comparison of different insect populations based on the time of capture, weather conditions, or a plant's development cycle.

2) Identifying insects
The internet can be used to identify the main crop pests and crop auxiliaries. The insects observed must first be organized in two categories: crop auxiliaries and pests. For crop auxiliaries, the main question should be: how do I encourage them at the right time on my crop? For pests, the main question is: which insect feeds on the pest, its eggs or larvae?

In this case, the first step is to identify the name of the insect. A Google search for "[crop] insect" may be helpful while accessing the image search to identify the insect spotted or captured. There are also applications on smartphones *(to be tested, however, depending on the country)* such as "Agrobase", "les insectes ravageurs" (insect pests), neither of which are free of charge, however, there are others that are freely available.

Some Facebook pages also show insects or farmers and technicians can post their pictures and ask what the name of the insect is *(example: RECA Phyto Facebook page)*, "Which insect is this?" "Insectes de France - identification, discussion" *(despite its name, there are sometimes photos of insects from all over the world)* or in English "Ask an Entomologist".

There are also websites that can be easily found via an internet search, for example, "cotton insect pests". Some databases can be consulted, such as the ephytia database of Inrae (France), the ecophytopic website, etc. There are also specialized books on crop insects: "Insectes et acariens des cultures maraichères en milieu tropical humide" (Vegetable crop insects and mites in the humid tropics) P. Rickewaert and B.Rhuno, 2017.

Once the insect has been identified and its scientific name has been found, internet research allows us to understand its way of life, its diet, its breeding grounds and, finally, the methods to be implemented to promote or limit it.

In addition, many countries have entomology experts. Contacting them always proves to be informative and is recommended, especially if they agree to collaborate with the WhatsApp® groups that have been set up and, if necessary, to come to the farmers' fields.

2. Know the insects and birds present in the villages, which are recognized as beneficial for crops (= crop auxiliaries). Many insects contribute to the pollination of crops and therefore to the quantity and quality of the harvest. As we will see later, other beneficial insects kill one pest or the other (pest/auxiliary pair).
To increase the population of an auxiliary insect, one must be familiar with its life cycle, the plants required for its growth and reproduction.

The importance of pollination for adequate crop quality: the case of strawberries

a lack of insect pollination can lead to yield and quality losses in agricultural crops, e.g. deformed fruits in the case of strawberries

Source:https://www.agroscope.admin.ch/agroscope/fr/home/themes/environnement-ressources/biodiversite-paysage/compensation-ecologique-fonctions/abeilles-sauvages-pollinisation/cultures-entomophiles-souffrent-elles-uisse-deficit-pollinisation.html

TOPIC 3:

Identify and implement ecological transitions that minimize as much as possible the use of pesticides. To achieve this goal, and based as much as possible on the participants' practices, identify possible options for crop rotations, selection of crop species and varieties of livestock animal species, choice of sewing methods and mechanical weeding tools.

Include the reduction of pesticide use in more global agro-ecological transitions

Reducing the use of pesticides is an essential part of transitions towards more sustainable forms of agriculture. To achieve this objective at the level of a plot, herd, farm, or even territory, a global approach is advisable as is a combination of knowledge and practical skills from agronomy, ecology, but also from socio-economic sciences such as geography, land management methods, etc. The following box explains a number of key principles of agroecology.

Source: books on **the functioning of agroecological systems**
M. Altieri and de S. Gliessman [23]

1 High biomass productivity per unit area or regular input of organic matter into soil

Nourish the soil with **organic matter** to stimulate biological activity, improve its structure and chemical fertility.

2 Permanent plant cover over the soil

Protect the soil against erosion and high temperatures to better conserve water and fertility.

3 Deep and dense network of roots

Improve **the physical structure** and biological efficiency of nutrient recycling

4 Minimal use of chemicals *(fertilizers, pesticides...) and* **improved farm autonomy**

Achieving sustainable production and maintaining a high level of **biodiversity** in crops, soils and around plots.

5 Minimum soil work

Do not disturb **the bio-physical structure of the soil** prevent it from drying out and oxidation and erosion of OM and nutrients.

In **bold**, the pillars of agroecological systems. The arrows indicate interactions between the components.

[23] S. Gliessman, 1998: "Agroécologie, the ecology of sustainable food system" - Miguel Altieri – 2002: *"agroecology: the science of natural resource management for poor farmers in marginal environments"*

More specifically, how to better manage diseases and pests and reduce pesticides?

Basic rules:

- Know the **cycles of the aggressors** (the time when attacks are frequent as well as their technical and economic implications), and if possible those of the auxiliary insects. In order to progressively develop biological control through conservation (see Topic 4), it is important to cultivate knowledge of the interactions between pests and their auxiliaries, and of the treatment practices and landscape components (grass belts, trees and shrubs, hedges, etc.) that influence the presence of auxiliaries.

- to **recognize the arrival of insects of concern** in the plots but also **the presence of certain beneficial** insects, use a few panels coated with glue, ideally several colors (each type of insect has its preferred color) and yellow bowls containing water and a small amount of odorless dishwashing liquid, which prevents the insects from floating (https://www.terresinovia.fr/-/la-cuvette-jaune-le-piege-incontournable-pour-detecter-l-arrivee-des-ravageurs-du-colza). NB: At this point, the task is not to attempt to capture as many insects as possible, but simply to identify their presence in the plots.

- **Evaluate the risks at the level of the crops and herds** (treat once a certain threshold is reached to avoid ineffective preventive treatments).

- Know the **primary methods for controlling the identified pests.**

- Benefit **from data collected by a network of farmers and technicians** (e.g. bulletin de santé du végétal (plant health bulletin)) in France, targeted pest management for cotton in some countries, network of agricultural advisors and farmers' observers trained by RECA Niger).

- In order to ensure collective control of certain pests, **encourage grouped treatments** involving farmers from the same area.

Preliminary and preventive measures to reduce the risks of attack (diseases, pests):

- Avoid **monocultures** (importance of long rotations of different species).

- For a given crop, **identify the plots where risks of diseases or pests are high.**

- Give preference to **varieties that are tolerant** to the diseases or pests identified as significant.

- Cultivate **combinations of varieties** or **mixtures of species** with varying tolerances to major diseases or pests. Attacks are reduced with certain annual crop combinations, certain tree-crop combinations *(cf. advantages of agroforestry)*; (**however, the opposite can occur** and not all species combinations or ecological infrastructures around the plots are beneficial [24]! **In these areas, it is necessary to capitalize on references and share technical, environmental and economic results with farmers.**

[24] In areas where seed-eating birds have a significant impact, farmers are averse to the presence of trees in or around the fields because they serve as nesting spots or perches for these birds.

- **Do not sow contaminated seeds or plants** (frequent problem with certain viruses, fungus spores, insect larvae or eggs). This involves taking precautions when selecting seeds in the field, storing them or buying them from outside sources.

- **Disinfect** the storage places of crops and seeds with natural, low-toxicity products (use of ash and certain plants).

- **Treat seeds with methods that are not hazardous to human health** *(avoid hazardous fungicides and insecticides).* Low-impact treatments: very mild sun exposure on tarpaulin laid out on the ground; ashes or low toxicity plants; very fine sand mixed with seeds, which significantly limits the movement of insects; the mixture is later sifted at the time of sowing *(see Module I, Topic 4 of this guide Alternative farmer practices identified by AVSF in 2014 in Northern Togo and, Topic 5, NPLCs)*;freezer where possible and seed quantities are reduced...

- **To conserve cowpea [25] attacked by multiple insects including bruchids, use triple-bottom bags** called PICS bags (this synthetic material bag lined with two plastic bags can be used for long-term storage of cowpeas without the need for chemicals; see https://reca-niger.org/spip.php?rubrique9).

- Preserve as much as possible **the beneficial insects** (e.g. bees for pollination) and other beneficial animals or insects that already live in or around the plots *(thanks to hedges, [26], grass belts, etc...).* In this context, avoid the drift of insecticide treatments along plot edges; avoid treatments when insects are feeding; opt for treatment times at the end of the day.

- **Firmly oppose the use of neonicotinoid insecticides[27] on the land!** They destroy beneficial insects. Indeed, scientists have observed the decline of wild and domestic bees in areas where such active ingredients are used (https://www.lemonde.fr/afrique/article/2019/11/15/l-afrique-risque-de-devenir-un-deversoir-pour-des-pesticides-bannis-d-europe_6019278_3212.html). Like bees, most crop auxiliaries feed on nectar. Therefore, protecting the food resources of the bees also helps to promote crop auxiliaries.

- **Foster shelter and breeding areas for birds and beneficial insects,** such as in trees or dead branches left on the ground in an uncultivated area of a vegetable plot (cf.https://www.eco-conso.be/fr/content/8-idees-toutes-simples-pour-favoriser-la-biodiversite-au-jardin). But be careful, managing nature is no simple task and false solutions should be avoided (https://www.terrenature.ch/favoriser-la-faune-pres-de-chez-soi-les-fausses-bonnes-idees-a-eviter/).

[25] Statement by Patrick Delmas, RECA Niger: "Too many prohibited products are used in Niger to protect cowpeas. For instance, to conserve the seeds, the producers spray them with Dichlorvos *(= an organophosphate insecticide banned in the EU since 2007, banned by the CSP but authorized in Nigeria...).* This is probably the most widely used insecticide in Niger. It is responsible for deaths and multiple intoxications".
[26] For several reasons, the introduction of hedges can be complicated or even prohibited in many regions in Africa (e.g., refusal of landowners who fear that their land rights will be challenged or refusal of herders who do not wish to limit the free movement of their livestock).
[27] There are currently 7 active ingredients from the neonicotinoid family on the market: acetamiprid, clothianidin, imidacloprid, thiacloprid, thiamethoxam, nitenpyram and dinotefuran, and two other compounds recognized as having identical modes of action: sulfoxaflor and flupyradifurone (cf. *Appendix 7).*

• Remove from the plot (or shred) crop residues that may contaminate subsequent crops (e.g., eggs, larvae of certain butterflies and other insects that survive on these residues).

• Cultivate trap plants in or around the plot that repel or attract certain pests.

Preliminary measures to reduce the pressure of "weeds" that penalize crops:

• **Rotations of sufficient length with alternating species.**

• **Weeding** before, during and after cultivation **to control the most troublesome weeds** before they set seed. Not easy, however, with rhizome-growing perennial weeds or with striga...

• **Stale seed bed** (where possible...).

• **Crop combinations that can limit the development of certain weeds** (e.g. combination of corn, sorghum or millet and creeping cowpea varieties that cover the soil relatively quickly).

To illustrate some of the approaches described above, Appendix 9 describes a combination of practices used on a crop farm in Anjou (Western France).

Other practices *(unfortunately not all of them are applicable to all farmers and in all pedoclimatic contexts):*

• **Collective control of certain pests** (e.g. monkeys, warthogs, etc. in Africa; wild boars, muskrats and coypu in France).

• In arboriculture, **nets for protection** against birds and certain insects ...

• **Fruit bagging** (banana bunches) or grafting.

• **Decoys** *(cf. role of scarecrows but also of scaring hawks and owls).*

• **Various biological control methods described under Topic 4 below, taking care to prioritize those that are accessible and not too costly for the farmers.**

• **Use of old mosquito nets as veils.**

Use of veils in a Mauritanian market garden (Photo V. Beauval)

These veils can protect the crops from birds, flies, whiteflies (= Bemisia tabaci), etc...
This solution is appropriate at certain times of the crop and pest cycle, however, several crop species require pollinators which the veils may impede.

TOPIC 4:

Know and promote biological control methods that can be used in African or other tropical farmers' agriculture (11 examples).

The main objective of biological control is to reduce the use of chemical pesticides by promoting natural mechanisms and interactions between species.

As illustrated in box [28] below,**biological control is based on managing the balance of pest populations rather than eradicating them.**

The different types of biological control

• Biological control by **introducing a predator, parasite or pathogen.**
• Biological control **in the form of "flooding"** with **massive and seasonal releases of crop auxiliaries.**
• Microbiological **control** *(e.g. Bacillus thuringiensis producing a toxin).*
• **"Autocidal"** control through the introduction of sterilized males.
• **Biological control** through conservation to protect, maintain and increase populations of crop auxiliaries.

One tends to distinguish as follows *(source: Ecophyto site of the French Ministry of Agriculture):*

• the **target** (of the control) is an **undesired organism, pest** of a cultivated plant, livestock parasite, etc.;

• the **control agent** *(or auxiliary)* is a different organism, most often **a parasite or predator of the former**, which kills it in a more or less short term by feeding on it or by limiting its development. The crop auxiliaries that we try to use are most often insects, entomophagous mites. They also include bacteria, viruses and fungi that cause certain diseases in insect pests. In some cases, larger animals are also used, such as fish to control mosquitoes or ducks to control snails in rice fields.

The table below lists some examples of targets and predators of these targets.

[28] Source: "La lutte biologique classique: exemples et leçons de la Polynésie française" (traditional biological control: examples and lessons from French Polynesia). JY Meyer, J Grandgirard. The entire slide show is important in order to be aware of the successes and failures of biological control. Available on the internet: http://eee.mnhn.fr/wp-content/uploads/sites/9/2016/01/lutte_biologique_Polynesie_francaise.pdf.

Target = predator	Damage caused by the predator	Auxiliary = predator of the target	Action of the auxiliary
Aphid	Sap collection; virus transmission; plant deformation	Ladybug (insect) (larva and adult); hoverfly (larva)	Feeds exclusively on aphids
Mosquito	Bites; spread of viruses, benign diseases in mammals	Gambusia (fish)	Feeds on mosquito larvae
Bombyx caterpillar (moth)	Weakening of the plant making it vulnerable to other diseases or insect pests	Bacillus thuringiensis (bacteria)	Following paralysis, causes septicemia in the caterpillar
European corn borer	Devours corn leaves and causes the cobs to fall off	Beauveria (fungus) Trichogramma (insect)	The spores of the fungus germinate on the corn borers and kill them. Lays its eggs in the pyralid eggs; the larvae devour the contents of the egg
Whitefly	Punctures the leaves and fruits of the tomato	Encarsia (insect) (adult)	Lays its eggs in those of the whitefly
Horse chestnut leaf miner	Brown color and premature leaf loss of chestnut trees	Dacnusa (insect) (adult)	Lays its eggs in the larvae of the leaf miners
Cochenille	Weakening of the plant due to taking of sap; seriously impairs the photosynthetic activity of the plant	Beetle (insect)	The larva of the ladybug feeds on mealybugs

A particular form of biological control **is autocidal control:** sterile males are released in very large numbers to compete with wild males and thus effectively limit the offspring of females. This method is particularly suited to greenhouse crops but requires the presence of an organism producing these sterile males.

A similar method consists **of using pheromones to attract males in the traps and thus limit their number.** A pheromone is a chemical signal emitted by the virgin female to attract the male for reproduction. Research made it possible to decipher this signal and reproduce, allowing the selective capture of males. Pheromones are an ecological control method. Contrary to insecticides, these compounds, diffused locally and in very low concentrations, do not generally present a risk to health and the environment.

This method, similar to mating disruption, is generally very effective and does not have any adverse effect on health or the environment, at least as long as the pheromone dispensers are not opened or left on the ground or in the water. However, it must be implemented on large areas to be genuinely effective, multiple farmers must join together and install the hormone diffusers at the same time and at the right moment while taking into account the life cycle of the pest.

Examples of biological control are described below in the boxes. It was possible to deploy all these methods thanks to the knowledge of insect pests and/or crop auxiliaries. Depending on the method, they target the larvae, adults or the reproduction phase of the insect pests:

1. **Use of a small wasp** *(trichogramma)* **to destroy the larvae of the corn borer** which cause substantial damage to corn and other crops.
2. **Biological control of the millet earworm.**
3. **Prospects for biological control of fall armyworm.**
4. **Capture of male banana weevils with pheromone traps.**
5. **Sexual confusion also using pheromones.**
6. **Use of Bacillus thuringiensis (Bt) toxins in vegetable and potato production.**
7. **Use of a fungus, Beauveria bassiana, to control various insects.**
8. **Stimulation of plant defenses with eliciting substances or biostimulants**[27]
9. **Presentation of push-pull**
10. **Integrated approach with a combination of various biological control methods** *(example of the control methods used for the vegetable fly in Réunion).*
11. **Biological control through habitat conservation and management: the need to work at the landscape level.**

Some preliminary remarks concerning these biological control methods

1) One of the current limitations of many biological control methods is their often high cost to farmers. Crop protection companies are aware that the future of many of their registered pesticides is compromised due to their toxicity and have realized that so-called "biocontrol" products represent a very promising market in the future. Initially, however, they take in very attractive margins on these products, as was the case for glyphosate when it was approved.

For example, the cost per hectare in France of a Spinosad application is currently 5 to 10 times more expensive than a chemical insecticide based on pyrethrins or neonicotinoids! It is a fermented product derived from the mixture of two toxins *(Spinosyn A et D)* secreted by a soil-dwelling bacteria, Saccharopolyspora spinosa. Spinosad is controversial but allowed in organic farming in Europe.

Consequently, whenever possible, priority should be given to low-cost biological control methods that are within the reach of farmers. For example, in home gardening, the use of old mosquito nets or preparations based on chili, garlic, hyptis spicigera, caïlcedrat, certain ashes and other NPLCs that can be safely prepared at home *(cf. (see Topic 5 of this module)* **are alternatives that should be prioritized from now on.**

2) Certain public health emergencies should lead to the funding of biological control methods. For example, vegetable garden operators in many parts of Africa (especially in peri-urban areas) use various highly toxic pesticides without being aware of (or observing) the recommended doses and frequencies of treatment, nor observing the duration of the products' persistence and therefore the date of the last application prior to marketing.

According to surveys conducted by ITRA (Togolese Agricultural Research Institute) in the vegetable garden areas around Dapaong, three quarters of the pesticides used to treat vegetable crops are insecticides or acaricides, mainly Lambda-cyhalothrin, which pose significant human health and environmental risks *(cf. Module II, topic 1)*. In Africa, treatments with this active ingredient are sometimes applied in peri-urban vegetable growing areas twice a week on vegetable crops and pure cowpea crops.

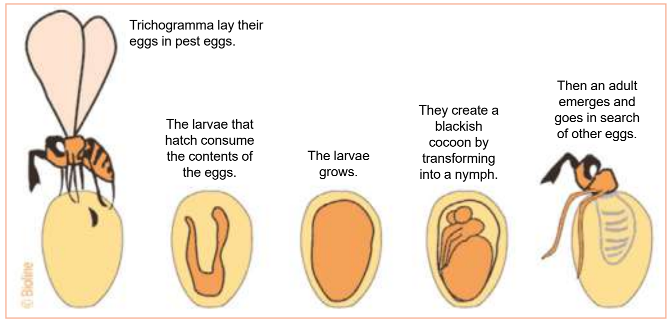
Due to its toxicity to humans and insect pests, it is considered to be of high concern in Europe. On 06/20/2019, the EU moreover reduced the maximum residue limits of this active ingredient (cf. https://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=CELEX:32019R1015).

Consequently, biological control alternatives that make it possible to forego Lamda-cyalothrin *(or dimethoate, chlorpyrifos, Dichlorvos, etc...)* **in vegetable crop plots could be subsidized and widely diffused.**

1 - Use of Trichogramma to destroy the larvae of various predatory insects

Trichogramma are tiny Hymenoptera that destroy predatory insect populations in various crops. Their use has been developed by INRAE in France since the 80s and this method of biological control has been proven on a large scale in corn, vines, etc....
For example, with corn, when flights of pyralid moths have been reported, plates of Trichogramma brassicae specific to the borer are introduced to the plots (time requirement = 15 to 20'/ha). The Trichogramma then lay their eggs in the moth's eggs and their larvae destroy them. These Trichogramma are effective parasites that completely destroy their host and whose effectiveness is not inferior to that of previously used insecticides (Source: ARVALIS - AGRICULTURAL OUTLOOK • N° 341 • JANUARY 2008).
The cost per hectare of Trichogramma is currently limited in Europe (€ 25 to 30/ha) and each plate contains 3 to 4 generations at different stages that provide crop protection for 2 months.
This technology has now spread to several Latin American countries and can be used to control about 20 pests of various crops including cotton, food crops (including beans), sugar cane, etc. (cf. https://www.ideassonline.org/pic/doc/BrochureTrichogramma.pdf). On the other hand, in order for the Trichogramma to remain active before being introduced in the fields, they must be protected against extreme heat and excessively dry periods, which can limit their use in the hot regions of the world which include the Sahel zones.
It should be noted that Trichogramma that act as crop auxiliaries occur naturally and are more frequent **when the biodiversity of plants is high in the plots and when there are ample refuge areas around the plots**(https://lasef.org/wp-content/uploads/BSEF/118-2/1641_Lamy_et_al.pdf).

Pyralid moth larvae on corn
Source: http://www.fiches.arvalisinfos.fr/fiche_accident/



Cycle of Trichogramma
Source for this Trichogramma cycle and the photos above: https://www.insectosphere.fr/traitement-bio-contre-pyrale-buis/47-trichogrammes-anti-pyrale-buis-3760221163935.html

Actual size of Trichogramma

Enlarged Trichogramma

Plate containing multiple generations of Trichogramma[29]

Manual installation of the plates every 20m x 20m on a leaf of corn (time required = around 15' per ha)[30]

[29] Photo source: https://www.lesterrenales.com/wp-content/uploads/IMG_4528-683x1024.jpg.
[30] Photo source: https://wikiagri.fr/uploads/article/cover/3546/home_big_Trichogramme__De_Sangosse_.jpg

2 – Biological control of the millet leaf miner

Source: articles of Boukary Baoua Ibrahim and M. Laouali Amadou (Niger researchers) https://www.researchgate.net/publication/281816567_La_lutte_biologique_contre_la_Mineuse_de_l'epi_Heliocheilus_albipunctella_De_Joannis_Organisation_et_evaluation_des_lachers_du_parasitoide_Habrobracon_hebetor_Say)

Summary of the articles by these two authors: The millet ear miner, Heliocheilus albipunctella De Joannis *(Lepidoptera, Noctuidae)* is one of the most harmful millet pests in Niger (and in other Sudano-Sahelian countries). Ear infestation levels can reach 95% with grain yield losses ranging from 8 to 95% depending on the area and the year. Pest damage is often recognized at the end of the season after farmers have invested all their efforts.

The National Institute for Agricultural Research of Niger (INRAN) in collaboration with the Université Dandicko Dankoulodo de Maradi (University of Maradi/UDDM) have developed a technology based on **the release of Habrobracon hebetor Say, an ectoparasitic hymenoptera of lepidopteran larvae.**

Leaf miner damage to millet ears [31]

Habrobracon hebetor and the millet leaf miner larva - Source: CSAN Niger Csancfsn

3. Prospects for biological control of fall armyworm

Fall armyworm damage on a male corn cob
Kaédi Mauritanie – January 2020
Photo V. Beauval

Fall armyworm
Kaédi Mauritanie – January 2020
Photo V. Beauval

[31] Photo source: https://www.cirad.fr/nos-recherches/resultats-de-recherche/2014/combattre-l-erosion-et-reguler-les-bioagresseurs-du-mil-conflit-ou-synergie.

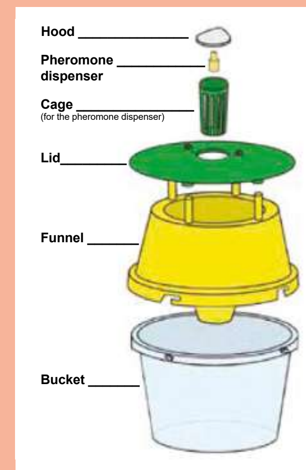
As the map below shows (Source FAO: http://www.fao.org/fall-armyworm/faw-monitoring/faw-map/fr/), the armyworm spread across the various continents from 2016 to 2020 (that is, in a mere 5 years!) and **causes extensive damage to various crops including corn.** Its rapid spread can be attributed to globalization, but also by the fact that the moth *(Spodoptera frugiperda, a member of Noctuidae)* is able to travel up to 100 km in a single night!

This moth has **several natural enemies** in its native environment, the Americas. They help to limit its proliferation. These include ants, earwigs, bugs, **parasitoids** *(see micro-hymenoptera)* and other beneficial organisms. These crop auxiliaries are beginning to be studied in Africa.

One hope would be to identify Hymenoptera parasitizing eggs or caterpillars such as **Trichogramma** used for corn *(first example above)* or **Habrobracon hebetor** parasitizing eggs and caterpillars of the millet leaf miner (second example) or **Telenomus remus** or **Cotesia icipe, parasitoids** already present in some West and Central *African countries (cf. work of various research teams including IRD, Centre for Agriculture and Biosciences International = CABI, etc...).*

Other possible control methods include: (1) conventional chemical methods; (2) GMO Bt corn, however, the *Spodoptera frugiperda* caterpillar has reportedly started to show resistance to "Bt corn" (http://www.fao.org/3/a-i7471f.pdf) or again (3) pheromone traps (cf. box below).

Trap model for use in destroying the fall armyworm (= funnel trap or universal trap)
Source: http://www.fao.org/3/i9124fr/I9124FR.pdf



Male moths are attracted by a **pheromone** similar to that of the females and stuck in a round bucket **with an insecticide pellet** that kills the captured moths. This type of trap captures a large number of moths. It can be used for prolonged periods.

The traps must be placed in the field one month before planting. Counting **should begin as soon as the crop** emerges in order to better detect the first arrivals of noctuid moths.

The trap is hung from a pole or branch about 1.25 m above the ground and set up on the edge of the field so that it is always 30 cm above the crop height. The trap must be set up regularly taking into account the plant growth. One trap **must be set up for 1 to 2 ha.**

4 – Use of pheromones to control the banana weevil

Source: http://transfaire.antilles.inra.fr/spip.php?article8

The black weevil Cosmopolites sordidus *(Coléoptères, Curculionidae)* is the main pest of banana and plantain. The female lays her eggs in the bulb of the banana tree. After the eggs hatch, the larvae dig channels in this bulb, damaging the insertion points of the primary roots. The banana is weakened and could break or fall.
Traps that use sordidin *(a specific pheromone)* capture **male weevils** and are effective in controlling banana weevils. The population can be monitored with traps on the plots (4 traps per hectare) or the traps can be used for mass trapping in the most severely infested fields (16 traps per hectare) or along the periphery of the fields by creating a "barrier" to limit colonization.

For this method to remain effective over time, it must be supplemented with other control techniques such as rotations, fallowing and other biological control agents such as entomopathogenic fungi like Beauveria bassiana and Metarhizium anisopliae. This is referred to as "integrated pest management" *(see Philippe Tixier, CIRAD "Lutte intégrée contre le charançon noir dans les systèmes de culture bananière" (Integrated control of the black weevil in banana cropping systems).*


Black banana weevil


Pheromone trap
https://bsvguyane.wordpress.com/le-charancon-du-bananier-cosmopolites-sordidus/

5 – Sexual confusion also using pheromones.

Source: https://fr.wikipedia.org/wiki/Confusion_sexuelle and the Bioprox site
It is a method widely used in Europe, for example, for the codling moth, grapevine worm or box elder moth,... This sexual confusion is achieved by using synthetic pheromones reproducing the hormonal scent of females and specific to each species. **An area is saturated with female pheromones, making it more difficult for males to find females for mating.** *NB: In France, the company Bioprox produces, with the support of INRA, 72 different synthetic pheromones.* This method limits the production of eggs and therefore of larvae which cause direct damage *(destruction of flower buds, consumption of fruit)* or indirect damage *(wounds which are entry points for secondary parasites).*

Diffusers containing pheromones **are installed in the plot.** They come in the form of links, sprays or capsules. The capsules protect about 20 m², so you need about 500 per ha. The sprays cover a larger area = 5 000 m² (0.5 ha).
To be effective, sexual confusion must be used homogenously and on a sufficiently large area, estimated at a minimum of 5 ha. **It requires farmers to work together to ensure effective protection of their plots.** The periphery of the protected area is not immune to the penetration of female moths fertilized outside this area and the use of insecticides is sometimes necessary along the edge of the plots.

6 – Use of a fungus, Beauveria bassiana, to control various insects.

Source: https://fr.wikipedia.org/wiki/Beauveria_bassiana

Beauveria bassiana, formerly known as Tritirachium shiotae, is a fungus that grows in soils and causes diseases in various insects by acting like a parasite. The fungus causes "white muscardine" disease. When the spores come in contact with the host insect, they germinate and penetrate the interior of the body, eventually killing it by using it as a food source. A white mold develops on the corpse, producing new spores. The contaminated insect acts as a vehicle for the fungus until its death.

This fungus does not appear to infect humans or other warm-blooded animals. Most insects living in, on, or near the soil have developed natural defenses for this fungus. On the other hand, **many aerial insects are sensitive to it.** However, other insects could develop, through natural selection, resistance wherever it is used intensively.

It is used to control termites, banana weevil, Paysandisia archon, red palm weevil, etc.. Its use for the control of **mosquito vectors of malaria** is being evaluated: the microscopic spores are sprayed on nets. Its use is also being studied on soil pests, such as the wireworm (Agriotes obscurus L). **Also note that Beauveria hoplochelii controls sugarcane grubs very well.**

Cultivation of Beauveria bassiana

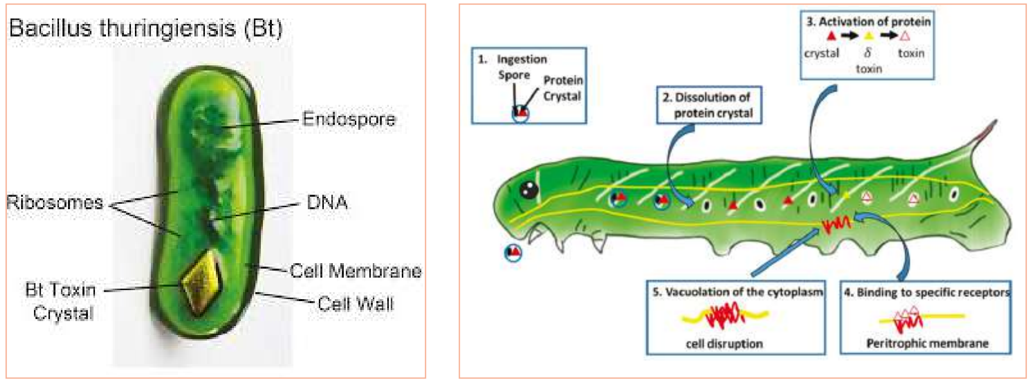
Attacked insect

Attacked bug

7 - Use of Bacillus thuringiensis (Bt) toxins in vegetable and potato production.

Source: https://tel.archives-ouvertes.fr/tel-01674214/document

Better known as Bt, this bacterium is naturally present in the soil, air and water. Some of the 80 species listed are insecticides because they produce toxin crystals (more than 150 Cry proteins have been identified). Once ingested, these toxins are released into the insect's digestive tract and cause septicemia by destroying its intestinal walls, resulting in the insect's death. Bt-based products are biocontrol products.



Cross-section of Bacillus thuringiensis and mode of action:
Source: https://www.researchgate.net/figure/Mode-of-action-of-Bacillus-thuringiensis-in-Lepidopteran-caterpillar-1-ingestion_fig1_318039006

Today, such Bt-based products are estimated to account for 50% of the world market of bio-insecticides, representing **3 to 4% of the total insecticide market.** Commercial Bt formulations consist of spore and crystal preparations obtained from cultures grown in fermenters. These products have no pre-harvest interval (PHI) constraints and are generally available as wettable powders or liquid concentrates for spraying. Following dilution in water, the solution should be sprayed on the entire foliage of the plant to be treated, making sure to cover all suspended parts *(leaves and stems).*

When exposed to sunlight and environmental microorganisms, Cry toxins degrade rapidly and their duration of action is limited to a few hours. Bt-based products cannot be used as a preventive treatment and, in case of heavy infestation, the curative treatment should be repeated every 7 to 10 days to eliminate newly hatched larvae. (source: https://www.jardinsdefrance.org/la-lutte-biologique-avec-bacillus-thuringiensis/).
There are several strains *(or serotypes)*of Bt that, depending on the nature of the toxin synthesized, enable specific control of a particular insect group. *Bacillus thuringiensis* based treatments are effective against attacks by:

- **Lepidopteran larvae:** budworms, noctuid moths, cabbage white (upon hatching), codling moth, leek and olive moths, etc. As soon as a large number of young caterpillars appear, it is recommended that the treatment be applied quickly given that Bt products are less effective on older caterpillars. It should be noted that, generally, leaf miners cannot be controlled with Bt because they feed on the inner leaf tissue and not on leaf surface so the product cannot reach them.
- **Beetles and their larvae:** Colorado potato beetle, lily beetle,...
- **Diptera:** flies mosquitoes.

In Europe, each Bt treatment costs between 20 and 30 euros per hectare and, if the infestation is severe and requires repeated treatments, this can lead to dismissive costs, at least for crops that do not generate enough added value per unit area.

8 - Use of "eliciting" substances

Source: http://ressources.semencespaysannes.org/document/fiche-document-43.html

Plants are fixed organisms that cannot flee from attacks. As a result, over time, they have learned to develop internal defense mechanisms. When an insect or a fungus attacks, for example, the plant can reinforce its walls to defend itself or produce chemical compounds to attack the pest.

During an attack, a specific compound circulating in the plant will inform it of the attack. This substance is called an elicitor *(or Natural Defense Stimulators = NDS).* Scientists are working on a solution that harnesses this natural reaction of the plant and hope to identify products that will mimic the attack, "tricking" the plant into believing that it is under attack and that it must therefore bolster its natural defenses.

The use of micro-organisms or elicitor compounds capable of activating at least one of the typical defense responses of plants without infection can therefore be an effective solution for protecting plants efficiently and long-term against the stresses they are exposed to.

Products that stimulate plant defenses can be made from certain marine algae, plant extracts or micro-organisms...

More and more companies are developing such products which are much safer than pesticides. For example, Elephant Vert S.A. markets a product in Morocco that strengthens the cell wall of certain plants thus making them more resilient in the event of attack: http://wordpress.elephantvert.ch/content/uploads/2017/10/Fiche-Reysana.pdf

For more information on this subject, cf. https://fr.wikipedia.org/wiki/%C3%89liciteur

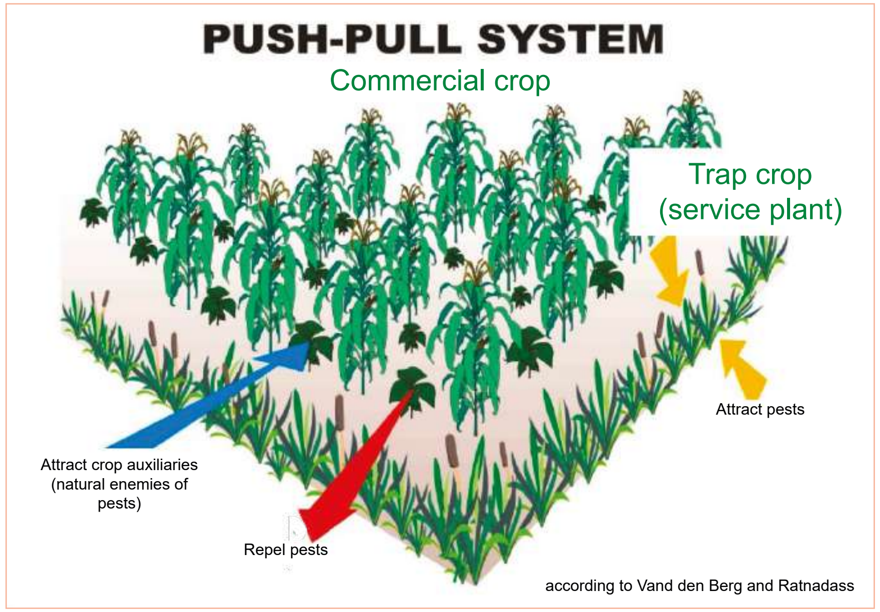
Practical application on cotton in Mali without the use of purchased products!
Source: https://coton-innovation.cirad.fr/content/download/4856/35361/file/ITKInnovation-14-Mali%20Ecimage.pdf

According to recent research by researchers at the Malian IER and CIRAD, **complete topping of the cotton plant reduces insect pest populations by an average of more than 65% from the topping period to the end of the cotton cycle.** 20% topping of cotton plants would also have an insect-repelling effect and reduce subsequent use of insecticides.**This effect is due to the production of eliciting substances by the topped cotton plants** which strengthen their walls making them less susceptible to larvae and piercing-sucking insects.

Extracts from this CIRAD-IER file: "The topping of the cotton plant is performed 10 days after the first flower blossoms, that is, approximately 65 days after its emergence, which corresponds to the emergence of the 15th fruiting branch. On this date, the first two insecticide treatments have already been applied as well as the application of urea and use of the weeding-hilling technique. On average, three men/day are needed to top 20% of the cotton plant and 6 - 7 men/day are needed for complete topping of cotton plants".
"Topping is not difficult, but is time-consuming, especially because of the movement required within a plot. When carried out in accordance with the recommendations of this technical data sheet, topping does not lead to a loss of production. According to 2015 data, its economic benefit to farmers lies in a reduction of over 40% in insecticide applications".

9 – Push-pull - Sources Wikipedia and Cirad

Also known as repellent-attractant or push-pull, this is a biological control approach that involves "chasing" insect pests away from a main crop and "luring" them to the edge of the field. This method is relatively complex in terms of its implementation and depends on the arrangement of plants with the biological or chemical ability to repel, attract or trap insects. For example, it must be ensured that plants, which attract insect pests and are situated outside the plot, remain attractive throughout the crop cycle *(at least as long as it is susceptible to this pest).* The best arrangements avoid the use of synthetic insecticides or GMOs.



The technique was developed in Kenya by the Indian entomologist, **Zeyaur R. Khan** of ICIPE *(International Center of Insect Physiology and Ecology)* and is used in East Africa, especially in Kenya, to control insect pests of corn (cf. https://fr.wikipedia.org/wiki/Push-pull_(agriculture)). CIRAD has also worked on this topic in Africa. Some of this work is summarized in the paper by Alain Ratnadass et al entitled: "Stratégies Push-Pull au Cirad" (Push-pull strategies at Cirad) (cf. https://agritrop.cirad.fr/572796/). The conclusions and perspectives described in this document are as follows:

- Evidence of synergistic push and pull effects of the product GF-120 *(mixture of spinosad in an amount of 0.02% and food attractants based on sugars, plant proteins)* on 2 different groups of fruit flies and via 2 opposite processes.

- Reduction of Helicoverpa armigera infestation and damage to okra thanks to planting of a pigeon pea belt around the plot via bottom-up (trap plant) and top-down effects *(better vegetative development of okra, attraction of less harmful piercing-suckers attracting spiders that regulate the larvae of the moth).*

- Evidence of reduced infestation of tomatoes by *Helicoverpa zea* with a corn belt.

- Significance of the Java sweet corn variety on which larvae do not develop as well and remain longer on the silk where they are more susceptible to predation.

The **"push-pull"** technique has also been tested empirically by the AVSF Kita team who combined organic cotton, okra and Guinea sorrel in well-defined arrangements. The results were satisfactory but these tests should be repeated to ensure their effectiveness, or even tested on other plants.

10 - Integrated pest control using a combination of several biological control methods

The control of vegetable flies on Réunion Island has been developed and disseminated by Cirad, the Chamber of Agriculture, the Fdgdon, farmers' groups, etc.... It uses various non-chemical methods summarized in the attached diagram:

The technical booklet of the Gamour program presents this combination of biological control methods in a simple and educational way (cf. http://www.ecophytopic.fr/concevoir-son-systeme/livret-technique-gamour-gestion-agroecologique-des-mouches-des-legumes).

The augmentorium technique:
First developed in Hawaii, it was developed on Réunion Island to control vegetable flies. It is a tent-like structure in which infested, pierced fruit collected in the field is regularly deposited. The key to the structure is the mesh size of the nets placed on the top. Indeed, the structure must make it possible to **keep the pests inside while allowing crop auxiliaries, which parasitize these pests, to enter and leave.**

The resulting effect is twofold:
- the biological cycle of the insect is broken by destroying the multiplication sites;
- the insect's natural enemies multiply.

This tool is therefore both a prophylactic method and a biological control method.

Sexual trapping attracts male flies with pheromones and therefore reduces female fertilization.

Trap **plants** such as corn or forage cane are also used to trap flies.

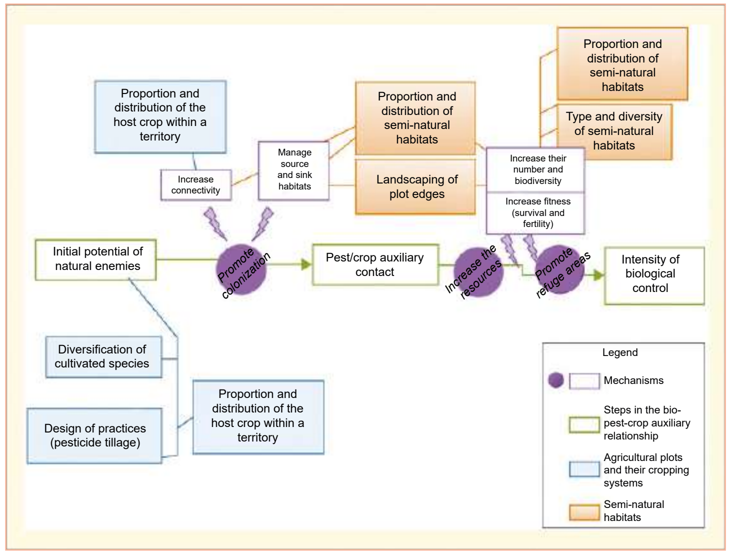
11 - Biological control through habitat conservation: the need to reason at the landscape level) – Sources Cirad et Inrae

In 2013, François-Régis Goebel *(Cirad entomologist)* published an article entitled "Changer d'échelle: De la parcelle au paysage" (Changing the scale: from the plot to the landscape"). Here are some extracts from the introduction to this article: "For the last twenty years, pressure from insect pests on agriculture has grown. **This growing pressure is due to the expansion of monoculture farming and the intensification of cultivation practices that modify landscapes and reduce biodiversity.** It is amplified by climate change, which encourages insect migration and modifies their biology.

Fighting against this growing pressure while reducing or stopping the use of pesticides, means one must act not only at the plot level but also at the landscape level. This change of level allows the harnessing of biodiversity to regulate pests and also to coordinate the practices of stakeholders, as shown by the fight against pests of sugarcane and cotton.

However, this requires detailed knowledge of the interactions between populations of pests and their auxiliaries on the one hand, and landscape components, biodiversity and human activities on the other, which gives rise to new fields of transdisciplinary research".

In an article entitled "Comment favoriser la régulation biologique des insectes de l'échelle de la parcelle à celle du paysage agricole pour aboutir à des stratégies de protection intégrée sur le colza d'hiver?" (How to promote insect biological regulation from the plot level to the agricultural landscape level to achieve integrated protection strategies on winter rape), published in 2012 in the OCL review N°83, Muriel Valantin-Morison (Inrae) presents the following diagram of insect-natural enemy-crop plot **interactions and the expected effects of semi-natural habitats and agricultural practices at the landscape level.**



This approach is conceptualized by stakeholders advocating **biological control through habitat conservation and management.** As indicated by the exchange platform for the implementation of agroecology[32], **the unique aspect of this approach involves modifying the environment to favor auxiliaries and disadvantage pests of one or more crops.** The goal is to redesign crop systems and landscapes **in order to harness as much as possible natural regulation processes.**

The sustainability of this approach differs from biological control "through augmentation or flooding", which consists, for example, of releasing parasitoids that the farmer must purchase each year. Indeed, the goal is to maintain naturally occurring auxiliary populations and not have to introduce them every year.

This complex yet exciting process combines two approaches: "top-down" regulation and "bottom-up" regulation".

As stated below in the abstract of Noelline Tsafack Menessong's dissertation defended on July 10, 2014, these landscape approaches are crucial when it comes to better understanding what is happening in the cotton fields (cf. https://www.cirad.fr/actualites/toutes-les-actualites/articles/2014/science/ecologie-du-paysage-et-lutte-integree-en-afrique).

Which landscapes reduce the presence of moth pests in cotton fields in Benin? Answer: those that include corn crops.

To obtain this result, Noelline Tsafack analyzed landscapes within a 500 m radius around 20 cotton plots in northern Benin over two agricultural seasons. **This kind of research on a pest, which takes into account the ecology of the landscape, makes it possible to improve the effectiveness of integrated pest management.**

The pest monitored is the noctuid moth *"Helicoverpa armigera"*. This moth lays its eggs on several cultivated plants (mainly cotton, tomato and corn). The flowers and part of the plants are then eaten by the larvae. And in northern Benin, Helicoverpa armigera can reduce cotton yields by up to 62%!

According to the findings obtained by Noelline Tsafack, Helicoverpa armigera larvae are less prevalent in cotton plots surrounded by corn fields because the moth is attracted by the flowering corn. Thus, corn fields located near cotton crops can limit the damage this moth causes to cotton fields.

Remarks:
- This once again demonstrates the limits of monocultures and the importance of diversified landscapes. However, in northern Benin from the 1960s to 1980s, the extension services of cotton companies promoted blocks of about 20 ha cultivated with the same cotton variety...
- Moreover, better protection of cotton is good, but not proposing an integrated pest management method to protect corn would be dangerous for the food security of farming families!

[32] https://osez-agroecologie.org/images/imagesCK/files/syntheses/f454_synthese-technique-lutte-biologique-par-conservation-et-gestion-des-habitats.pdf

TOPIC 5:
Improve and expand local production of biopesticides and natural preparations of low concern (NPLCs).

Appendix 4 of this guide includes a survey guide for collecting information on the preparation and use of biopesticides and NPLCs produced in the villages of training participants. This survey needs to be completed before covering this topic.

Reminders about NPLCs and biopesticides

These two types of products are rarely differentiated in Africa and in other countries of the Southern Hemisphere although farmers tend to have extensive knowledge in this area. It is therefore important to clarify **the differences between these two categories.** Although both are natural preparations, they differ in terms of their toxicity to humans and the environment.

1. Natural preparations of low concern (NPLC) are not plant protection products and do not require marketing authorization (= MA). This point is important because it facilitates independent production of preparations on the farm and consequently the autonomy of the farmers. With respect to NPLCs, French legislation distinguishes between basic substances and natural substances for biostimulant use.

- **Basic substances with phytosanitary value** but which are mainly used for purposes other than plant protection (some are foodstuffs*)*. They are subject to a simplified approval procedure in France, but **must be approved at the European level for one or more specific uses.** 19 basic substances listed in the official table below are currently authorized, 10 of which can be used in organic farming.

  Note: In France, among these basic substances, the Technical Institute of Organic Agriculture (ITAB) prohibits the use of sea salt and clay coal.

List of approved basic substances (updated 28 May 2018)		
active substances	**usage**	**UAB**
Sodium bicarbonate	fungicide for fruit trees, vines, vegetable crops, ornamental crops	ongoing evaluation
Beer	covered slug trap, all crops	authorized
Clay carbon	vine fungicide (esca)	ongoing evaluation
Chitosan	fungicide and bactericide for small fruits, vegetables, crops for animal feed; cereals, potatoes, beets (seeding and growing)	authorized
Diammonium phosphate	attractive (mass trap) for fruit flies, Mediterranean fly	ongoing evaluation
Willow bark	fruit (apple, peach) and vine fungicide	ongoing evaluation
Mustard seed flour	fungicide (treatment of wheat and spelt seeds: decay)	authorized
Fructose	stimulator of apple tree natural defense mechanisms (codling moth)	authorized
Sunflower oil	tomato fungicide	authorized
Calcium hydroxide/ slaked lime	fruit fungicides (Neonectria galligena canker)	authorized
Lactoserumlwhey	curcubitaceae fungicide	authorized
Lecithins	fungicide for fruit, vegetables, vines, ornamental crops	authorized
Nettle	insecticide, fungicide, acaricide for fruit, vegetables, vines, ornamental crops	authorized
Hydrogen peroxide	fungicide and bactericide (soil) solanaceae, lettuce, flowers	No
Horsetail	fungicide for apple, peach, vine, cucumber, tomato, ornamental crops	authorized
Saccharose/sucrose	natural defense stimulator for sweet corn (borer) and apple (codling moth)	authorized
Sea salt	vine fungicide and insecticide, mushroom fungicide	ongoing
Talc	insecticide and fungicide in arboriculture and fungicide in viticulture	No
Vinegar	fungicide and bactericide (seed or plant treatment) cereals, tomato, carrot, ornamental crops	authorized

- Natural substances with biostimulant effects, most of which were identified by the elders and constitute "farmer knowledge", some of which have been scientifically validated. More than 200 plants are currently authorized in France (see site https://www.legifrance.gouv.fr/affichCodeArticle.do?cidTexte=LEGITEXT000006072665&idArticle=LEGIARTI000006913464&dateTexte=&categorieLien=cid). This list includes many tropical plants such as acacia senegalensis (gum tree), *(gum tree)*, garlic, tropical almond, basil, carob tree, lemon grass, clove, Cola acuminata, cilantro, turmeric, eucalyptus, fennel, fenugreek, ginger, ginseng, clove, carob, guinea sorrel, lemongrass, various mints, nutmeg, orange trees, nettles, pawpaw, chili, sage, tamarind, etc...

  Animal products such as cow urine and dung are also frequently mentioned by farmers in the Southern Hemisphere and can be included among the NPLCs. If their effectiveness as fertilizers no longer needs to be demonstrated, the scientific references in terms of plant protection remain to be established[33].

All NPLCs classified as natural substances for biostimulant use and **obtained through a process accessible to any end user,** i.e. untreated or treated only by manual, mechanical or gravitational means, by dissolution in water, by flotation, by extraction with water, by steam distillation or by heating only to eliminate water, can be used in organic agriculture.

Additional remark concerning the NPLCs: A French association, ASPRO-PNPP *(association for the promotion of NPLCs)*, submitted, to the Ministry of Agriculture and ANSES in 2017, a request for evaluation of nearly 800 plants and natural elements. It should be noted that in Germany, the United Kingdom, the Netherlands, Austria and Spain, natural preparations are included in specific lists that do not require the inclusion of basic substances in the European list. As a result, many NPLCs are not approved in France are now marketed in these countries.

2. Unlike NPLCs, biopesticides require MAs because they are able to kill *(cf. suffix cide)* insects, fungi, etc... and they are likely to have, beyond a certain dose, **negative effects on human health and also on pollinators and other beneficial insects.** Among these biopesticides, the case of tobacco and neem *are briefly mentioned below (we could also mention natural pyrethrum or Dalmatian pyrethrum = Tanacetum cinerariifolium).*

Tobacco or neem-based preparations are often used in Africa and their toxicity is rarely mentioned. However, these plants contain compounds that are highly toxic to humans if their concentrations in the preparations are high and the dose absorbed during the preparation of the pellets and during spraying exceeds certain thresholds (which cannot, however, be easily measured).

- For the nicotine contained in tobacco, the toxicological sheet of the INRS *(French Institute for Health and Safety at Work)* notes that, for humans, "acute nicotine intoxication can lead to death". Tobacco leaf preparations were used in numerous Northern countries in the 1960s. Given their toxicity to humans (*cf. health incidents involving farmers who used them to treat their crops)*, nicotine-based insecticides have been withdrawn from the market in most countries and are now banned (but they are still sold over the counter in some countries, including India ...).

- The azadirachtin contained in the leaves and above all the seeds of neem has multiple, impressive properties *(insecticide, fungicide, nematicide, consumption inhibitor and growth inhibitor...).* This compound is effective against more than 200 insects including field pests such as aphids, white flies, Scarabaeidae, white worms and cutworms, borers, diamondback moths, noctuid moths, locusts, mites and pests of stored products (cowpea bruchids, weevils). Its odor and bitter taste also have a repellent effect on adult beetles and whiteflies. However, azadirachtin has no effect onmealybugs,lice, bugs, fruit flies and mites.

[33] In order to discern what is true and what is false when it comes to "cowpathy", the current Indian government has set up a scientific committee whose mission is to study the curative properties of cattle dung and urine (cf. https://www.willagri.com/2018/03/12/la-filiere-de-lurine-de-vache-en-inde/).

As a consequence of the above, and in particular of its broad spectrum of action, the registration of azadirachtin-based products is the subject of debate in several European countries (cf. https://fr.wikipedia.org/wiki/Azadirachtine). Recent studies show that this compound has negative impacts on aquatic environments, that it causes atrophy in young bees and some studies suggest that it is an endocrine disruptor (cf. https://www.sagepesticides.qc.ca/Recherche/RechercheMatiere/LoadPrintModal?MatiereActiveID=220).

It is therefore important to remember that if a natural product is toxic to numerous insects or fungi, it can also be toxic to humans. If it must be used due to necessity, it is absolutely imperative that one is properly protected. It is not a matter of advocating the cessation of the use of neem leaves and seeds, which abound in many African villages, but of being cautious and taking, when using them, precautions equivalent to those concerning synthetic pesticides.

Examples of the promotion of these biopesticides and NPLCs in Africa

Chili, garlic, onions and neem, ingredients often used in West Africa
(Photo IRD)

Treatment with a biopesticide based on chili, garlic and neem leaves
(Photo IRD)

Numerous NGOs and farmers' organizations promote biopesticides and natural preparations of low concern, but generally fail to distinguish between these two types of products in terms of toxicity to humans and/or the environment.

Three examples of the use of biopesticides and/or NPLCs are presented below: (1) The activities of a project funded by the FFGM from 2014 to 2018 in northern Togo and implemented by AVSF and RAFIA, a local NGO and an OPA, UROPC-S; (2) training activities on these topics by the Malian CNOP; (3) tests carried out by an AVSF team and the Union of CUMAs of Kita Cercle in Mali.

Example 1: "Sustainability and resilience of family farming in the Savannah" project - Togo

27 types of natural preparations were identified by the project team *(see list with composition and use in Appendix 10)* and 5 preparations were tested and disseminated over 3 seasons in rainfed crops and vegetable crops in the 6 cantons where the project intervened in partnership with UR-POC-S groups. These 5 preparations are the following:

N°	Composition	Crops treated	Area to be treated
1	500 g of neem seeds + 500 g onion + 100 g onion + 50 g chili + a pinch of soap	Tomato, cotton, chili, cowpea during the whole cycle, apple cabbage	400m²
2	1 kg of neem leaves + a pinch of soap	Young cabbage or tomato	400m²
3	150 ml of neem oil + a pinch of soap	3-leaf tomato (low dose), apple cabbage, flowering pepper, flowering cotton, guinea sorrel, okra	400m²
4	50 g chili + a pinch of soap	Young cabbage Trichogramma (insect)	400m²
5	1 kg of neem leaves + 50 g chili + a pinch of soap	Tomato in bloom	400m²

It is noted that 4 of these preparations contain azarachitine (*(and other active ingredients from neem)* and only one preparation can be qualified as a NPLCs *(the preparation based on chili and soap)*. The soap *(or "omo" in other African countries)* ensures that the slurry better adheres to leaves *(NB: Caustic soaps should not be used as they can burn the leaves)*.

The UROPC-S farmer groups tested 6 different treatment schedules alternating these 5 preparations and found them all to be effective. The costs of production and use of these 5 preparations were established and compared with the costs of synthetic pyrethrin (Decis). However, performance comparisons were not made. They would be difficult because the majority of the plots have been harvested in stages. **In order to go further, scientific support for the AVSF project team from the Togolese research institute (ITRA) would have been desirable.**

Comparison of the costs of production and use of the 5 preparations with Decis for an area of 400m².

Preparation ingredients	Preparation 1		Preparation 2		Preparation 3		Preparation 4		Preparation 5		Deltamethrin (Decis)	
	Qty (g)	Price (fcfa)	Qty (g)	Price (fcfa)	Qty (g)	Price (fcfa)	Qty (g)	Price (fcfa)	Qty (g)	Price (fcfa)	Qty (l)	Price (fcfa)
Onion	500	150	-	-	-	-	-	-	-	-	-	-
Garlic	100	250	-	-	-	-	-	-	-	-	-	-
Chili	50	75	-	-	-	-	50	75	50	75	-	-
Soap	1	25	1	25	1	25	1	25	1	25	-	-
Neem seeds	500	0	-		150	0	-	-	-	-	-	-
Neem leaves	-	-	1000	0	-	-	-	-	1000	0	-	-
Chemical pesticides	-	-	-	-	-	-	-	-	-	-	0.04	200
Family workforce (base 1000fcfa/ HJ)	1/8 HJ	125	1/8 HJ	125	1/4	250	1/8 HJ	125	1/8 HJ	125	1/8 HJ	125
TOTAL COSTS	**-**	**625F**	-	**150F**	**-**	**275F**	**-**	**225F**	**-**	**225F**	**-**	**325F**

Following the presentation of the above table by the AVSF Northern Togo team in charge of monitoring these tests, observations by members of the farmers' organization (UROPC-S):

- As neem is present everywhere in the villages, natural treatments based on this plant are less expensive than chemical treatments. On the other hand, the first preparation based mainly on garlic and onion exceeds the cost of a treatment with Decis*(this cost would however be lower when these alliums are self-produced by the family)*.

- The chemical treatment with Deltamethrin *(or Lamda-cyhalothrin)* is, however, ultimately the most expensive given that numerous farmers apply it every week and even twice a week, whereas the long-lasting effect of neem-based preparations does not require such a high frequency of treatments.

- One difficulty reported by farmers who use NPLCs **is their conservation.**

- Furthermore, they wish to improve their equipment for larger-scale **production of the preparations** *(for example, to use these preparations on cowpea or cotton plots)*.

Example 2: Training module for farmers of the Malian CNOP on natural treatments and examples of distributed preparations

This straightforward, educational document was prepared by the National Coordination of Malian Farmers' Organizations (CNOP), a union promoting farmer agroecology.
It revisits the principles that must be respected when preparing natural products, the necessary equipment, the need to use them exclusively for this purpose *(and not to also use them for food-related applications).* The target group is also reminded of the need to protect nature when collecting plants and to protect oneself ("put on gloves") when preparing them.

It then presents the importance of two preparations based on neem leaves and seeds. It also includes multiple preparations *(mostly NPLCs)* to be used based on a diagnosis of leaf damage. For vegetable crops, it recommends multiple treatments *(NPLCs and neem-based biopesticides).* Finally, this guide presents, on the basis of examples, the importance of collective organization at the local or community level to solve relevant phytosanitary problems.
This CNOP training module is included in Appendix 11.

Example 3: Tests carried out by an AVSF team and CUMA regional union of Kita in Mali (CUMA RU)

The composition and method of preparation of the biopesticide tested and distributed by the AVSF team in Kita are as follows: **2.5 kg neem seeds + 120 ml of crabwood oil** (Carapa procera) + **2.5 kg of diola** *(Chamaecrista nigricans)* **+ 100g of chili** all in a container containing **20L of water** let ferment for 3 days and spray.
This biopesticide is used on all crops in a dose of **20L/ha** and would be very effective when applied properly. According to the farmers who use it, the cost of producing it is about **1000 Fcfa per ha.**

Some UR-CUMA farmers compared this preparation proposed by the AVSF team with an endogenous preparation consisting of **kitchen ash filtrate, chili pepper and Hyptis spicigera leaves**, a plant traditionally used to preserve seeds in the granaries of most of the Sudanian zones of West Africa and not identified by research as a plant with active ingredients as toxic as the azadirachtin in neem. Refer to the site of the French Society of Ethnopharmacology and the numerous references in human and animal pharmacopoeia concerning Hyptis spicigera regarding this subject: http://www.ethnopharmacologia.org/recherche-dans-prelude/?plant_id=3271.

Visually, both preparations appear to be effective on cotton. However, a thorough follow-up of their impacts on cotton and cowpea insects should be carried out as well as a measurement of the yields obtained.
Having different preparations available offers two advantages:

1) using only one preparation risks encouraging the multiplication of resistant insects;
2) the reduction of the use of neem is desirable in terms of human health, preservation of bees, etc...

NOTES

MODULE 4: REDUCTION OF HERBICIDES

EDUCATIONAL OBJECTIVE:

Be able to propose improvements in agricultural mechanization in order to allow family farms to significantly reduce their use of herbicides.

TOPIC 1:

Know the history of herbicide use by farmers in your area.

As mentioned in the introduction to this guide, there has been a **substantial increase in the use of pesticides since the early 2000s,** mainly due to herbicides, whose prices have fallen sharply and which are increasingly available on rural markets. For example, in Africa, these herbicides represented 62% of the pesticides used in volume in 2015 *(sources: Haggblade et al and FAOSTAT 2018)* and their use has become widespread in many Sudanese and Guinean areas.

Such increased use of herbicides is also observed in developing countries in Asia and Latin America. However, their use is very limited in semi-arid areas such as the Sahelian regions of Africa where there is less weed competition that affects crop yields and where livestock is the main source of agricultural income (many crop weeds are forage for ruminants).

The use of total weedkillers (mainly glyphosate-based) has increased significantly, as has the use of specific herbicides (*or selective herbicides)* or cotton, rice, corn, sorghum, etc... Most of these are old active ingredients that are no longer protected by patents and whose prices have fallen sharply, such as atrazine, diuron, paraquat, alachlor, metolachlor... Because of their high toxicity, the use of these compounds has been banned since the early 2000s in most developed countries, including those of the European Union. Some EU countries unfortunately continue to manufacture them for export[34].

For glyphosate-based products, the active ingredient itself has come under fire *(classified as "probably carcinogenic" by the WHO)* and some co-formulants are said to pose significant, proven health risks, which, since 2016, has led the French health agency to ban many commercial products based on glyphosate [35]. Issues with co-formulants are also considered concerning for some glyphosate products from China and India.
Because of states' difficulties in implementing their national regulations and seriously monitoring where pesticides are sold, **many herbicides purchased by farmers are not registered** and, in many developing countries, some products may be counterfeit and do not contain the active ingredients

[34] Cf. https://www.lemonde.fr/planete/article/2020/01/28/pesticides-interdits-le-lobbying-des-industriels-pour-continuer-a-produire-en-france-et-exporter_6027530_3244.html
[35] Cf. https://www.anses.fr/fr/content/l%E2%80%99anses-annonce-le-retrait-de-36-produits-%C3%A0-base-de-glyphosate.

specified on the labels [36]. This problem also exists in the EU and every year, Europol agents intercept hundreds of tons of banned or counterfeit pesticides [37].

The problem briefly summarized above varies greatly from one agricultural region to another. Therefore, in order to adapt training, **ideally, the following questions should be discussed with participants** *(indicative list)*:

- Does the above reflect your own experience?
- Which crops are frequently treated with herbicides and what are the names and active ingredients of the products most often used? (before sowing; after sowing and before emergence; after emergence)?
- What do women think about the use of these herbicides?
- Can they still practice intercropping, or the gathering of certain edible plants used for cooking or medicinal purposes?
- What effects do the herbicides have on young trees on the plots?

TOPIC 2:

Know how the use of animal traction has evolved in your region and identify the problems encountered with the maintenance and replacement of AT equipment.

Weeding of peanuts – Senegal
(Photo M. Havard-Cirad)

Weeding of corn – Northern Togo
(Photo V. Beauval)

From the 1960s to the 1990s, driven by government programs often supported by external aid and certain industries *(e.g., peanut and cotton)*, the use of animal traction (AT) expanded greatly. For example, in sub-Saharan Africa, it has become dominant in many Sahelian and Sudanese areas *(on the other hand, trypanosomiasis, to which Zebu cattle are susceptible, has limited and continues to limit its growth in the Guinean areas).*

[36] Cf. https://www.scidev.net/afrique-sub-saharienne/cultures/actualites/afrique-herbicides-non-homologues.html and "Quality Comparison of Fraudulent and Registered Pesticides in Mali", February 26, 2019 - Author: Steven Haggblade, Amadou Diarra, Wayne Jiang, Amidou Assima, Naman Keita, Abdramane Traoré and Mamadou Traoré.
[37] https://www.lyoncapitale.fr/actualite/trafic-de-pesticides-une-question-prioritaire-pour-europol/.

Under the impetus of various innovators, including Jean Nolle [38], animal traction tools bearing the names Houe Sine, Ariana, Multiculteur, etc. were designed, and some of them, such as the Houe sine, the plough and the ridging body, were widely disseminated in rural areas of Africa.

Since the 1980s and 1990s, due to the withdrawal of the states demanded by the World Bank and the IMF, support for animal traction has diminished and today many family farmers still only have the AT equipment their grandparents had.

This has led productivity from working with these tools to stagnate. In terms of weed control, productivity is often less than half that of the same worker equipped with a backpack sprayer. Applying a total herbicide is much quicker than performing one or more runs using AT before seeding. To destroy weeds on the whole plot and not only between rows, it is also faster to use a specific herbicide than a hoe equipped with weeding teeth or a ridging body.

According to surveys conducted by AVSF at the end of 2018, the sharp increase in herbicide use in Kita, Mali can be explained in part by the horrendous condition of much of the AT equipment (*cf. photos V. Beauval below*). It should also be noted that there is no longer any government support for replacing AT tools and that the Malian cotton company *(CMDT)* promotes herbicides instead, which are often sold unchecked on rural markets at much lower prices than in the past.

Toothed weeding tools

Single row seeder

After this presentation on topic 2, it is recommended that some time be taken for discussion:

- Does the above reflect your own experience?
- Which AT tools do you use most frequently?
- What are the main difficulties you encounter with respect to maintaining such AT equipment and obtaining spare parts?
- Do women have access to AT equipment to work their fields? If so, does such access allow them to complete their work on time?
- What AT equipment would be most motivating to keep rural youth from leaving [39]?
- Do you have any final wishes in regard to animal traction equipment?

[38] Jean Nolle is a farmer from Northern France who has spent his life creating and distributing animal traction tools for small farmers around the world. He later founded an association, PROMMATA, which inherited the four tools he considered to be the most successful: The Houe sine and the Kanol which evolved into the Kassine in PROMMATA's first years, the Polynol and the Ariana (refer to the PROMMATA site: https://assoprommata.org/).
[39] This is an important question. In many rural areas, many young people are abandoning agricultural activities in favor of gold mining or migrating to cities or even outside the country. Without a sufficient number of motivated rural youth, the future of agriculture is compromised.

TOPIC 3:

Analyze mechanization alternatives currently being proposed to farmers by governments.

Parallel to the decline in support for the manufacture, distribution and maintenance of agricultural technology, several African governments have subsidized the sale of tractors to farmers, most from Europe before the 2000s and presently from China and India. For instance, since 2015, the Malian government has set up a pilot equipment operation[40] with tractors sold to farmers at prices which are 50% subsidized prices (see Chinese Foton 654 shown in the photo on the left below).

In addition to these recent tractors, there are also old tractors imported from Europe, *(see photo on the right above of a tractor equipped with a tridisc plough)*, which are already doing a significant portion of the ploughing in African cotton areas and in certain rice-growing areas such as those in the Senegal River valley. For soil cultivation, these tractors are mainly equipped with disc tools *(ploughs and disc harrows or "covercrop")* perform shallow tillage *(<15cm)*. The use of discs that roll over obstacles avoids damaging them on tree stumps and stones which are present on many plots. On the other hand, these obstacles can damage the coulters and mouldboards of ploughs, the teeth of cultivators, weeders and hoes, as well as the sowing coulters of seeders.

The development of motorized tillage, often performed by **tractor drivers with little training and knowledge of fertility management**, gives rise to a variety of ecological problems:

- Significant risk of increased **erosion** due to the "pulverization" effect and crumbling of the soil caused by the disc action, a risk that increases when plot trees are cut down and plots are cleared beforehand to facilitate the passage of the tractor.
- Impact of motorization on the **replenishment of beneficial trees** in annual crop plots in the Sudano-Sahelian zones of Africa (a driver in a hurry will not see the very young trees such as karite and African locust bean trees, whose lack of replenishment is currently a genuine problem in these zones, and, as a result, he will irreparably harm them).
- Disc-caused destruction of **tree roots and shrubs** that facilitate the recovery of soil fertility when tractor-plowed plots return to fallow [41].

[40] This 1000-tractors operation has been the subject of controversy in Mali: Cf. https://malijet.com/la_societe_malienne_aujourdhui/actualite_de_la_nation_malienne/209395-magouille-dans-le-march%C3%A9-des-1000-tracteurs-au-mali-le-dr.-bocar.html.

[41] cf. Potentialités des ligneux dans la pratique de l'agriculture de conservation dans les zones arides et semi-arides de l'Afrique de l'Ouest (Potential of woody plants to conserve agriculture in arid and semi-arid zones of West Africa) (authors: Babou André, BATIONO Antoine, KALINGANIRE Jules BAYALA - ICRAF).

As a consequence of the above, land development activities (hedge planting, regeneration/maintenance of beneficial trees, water and soil conservation structures, etc.) and the training of tractor drivers are essential prerequisites that are often neglected by governments involved in plans to promote tractor-based mechanization.
Another cause for worry is the fact that these tractors are very rarely accompanied by **multi-row seeders and hoes**[42], which would make it possible to do without herbicides, as practiced by organic farmers in Europe (and their grandparents before them, who did not use herbicides but had animal-drawn multi-row implements that allowed them to control the removal of "weeds" in crops like corn, beets, etc.). However, in this case as well, such efficient sowing and hoeing tools require prior clearing of the plots, which is time-consuming and, as mentioned above, limits the natural regeneration of plot fertility during fallow periods...

Some studies observe that the use of tractors is not usually accompanied by an increase in yields[43], instead farmers claim that they are faced with increasingly short rainy seasons and find that early planting often yields better results. However, working the soil with a tractor, which is much faster than with oxen, allows farmers to sow more often at the right time.

In summary, in Sub-Saharan Africa, but also in other countries of the Southern Hemisphere (Madagascar, Central America), one encounters the three situations summarized above, the last two of which can be viewed together:

(1) the use of old animal traction tools perceived as unappealing by many young people;
(2) the growing use of herbicides, which certainly reduces the arduousness of the work but often endangers biodiversity, the environment and the health of rural people and consumers;
(3) the use of poorly equipped tractors that can degrade the soil and/or contribute to reducing biodiversity and limiting agroforestry...

Currently, none of these situations is truly satisfactory!

Other consequences, in this case socio-economic, of increased motorization: the use of tractors makes working the soil less arduous and increases the amount of area cultivated per worker. Coupled with the use of herbicides, **the increase in the use of tractors in the Sudanese and Guinean zones may encourage the "patronization" of agriculture, with farms that were initially family-run becoming increasingly large, employing a large number of workers to maintain and harvest the crops[44].**

[42] Using a single row seeder does not allow for efficient hoeing given that the distances between the rows vary excessively and the teeth or blades of the hoes cannot get close enough (5 to 10 cm) to the seed lines, as is the case with the hoes used in Europe, which go to 5 cm when they are well adjusted. As a result, there are still too many weeds that must be removed by hand along the sowing line...

[43] See the seminar "Les dynamiques de mécanisation de la production et de la transformation agricole en Afrique de l'Ouest - Accompagnement des innovations dans les systèmes agro-sylvo-pastoraux d'Afrique de l'Ouest" ("Mechanization dynamics of agricultural production and processing in West Africa - related innovations in agro-sylvo-pastoral systems in West Africa), February 2016, Korhogo, Ivory Coast.

[44] Marie Balsé, Michel Havard et al, "Quand innovations techniques et organisationnelles se complètent: les CUMA du Bénin" (When technical and organizational innovations complement one another: CUMAs in Benin) AFA's Revue AES -December 2015, and Sidé Claude and Michel Havard "Développer durablement la mécanisation pour améliorer la productivité de l'agriculture familiale en Afrique" (Developing sustainable mechanization to improve family farming productivity in Africa) - 2015 - Int. J. Adv. Stud. Res. Africa. 6 (1&2): 34-43 - Available from: http://www.ijasra.org/

Following the presentation of topic 3, it is recommended that some time is taken for discussion:

- What are your observations following the above presentation?
- Do any of you use a contractor equipped with a tractor to prepare some of your plots? Occasionally or regularly?
- What do you think about the consequences of disc tools on the fertility of your soil?
- What do you think about the consequences of using tractors for the young beneficial trees present in the plots?
- In your community or region, what are the main problems observed in regard to the maintenance of tractors and the acquisition of their spare parts?
- Could training for tractor operators reduce any of these drawbacks?
- If yes, how can the work of tractor drivers be organized and monitored?

TOPIC 4:

Identify and promote mechanization options that help to reduce the use of herbicides.

In areas where the use of herbicides has become very widespread *(in Africa, especially the Sudanian and Guinean zones)*, what innovations should be proposed to farmers to improve mechanization and, in particular, the quality of sowing and weeding of crops, which would make it possible to greatly reduce the use of herbicides?

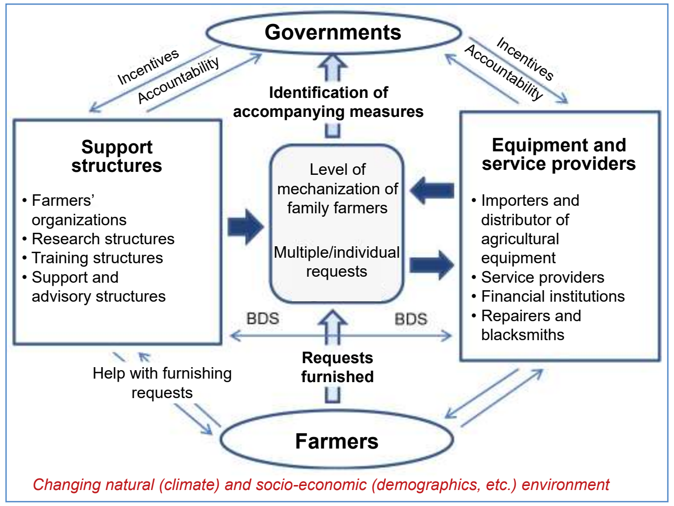
Some proposals:

1 - Encourage states to promote animal traction again

As mentioned by Side and Havard (2015): *"The major challenge facing Sub-Saharan Africa in the coming decade is equipping rural populations in order to meet the growing demands of production, conservation and processing of agricultural products necessary for the food security of a growing population, while ensuring that the environment is preserved. Governments have a key role to play in creating the economic, social and political conditions for the sustainable development of agricultural mechanization. Finally, public-private partnerships should be encouraged in this sector"* [45].

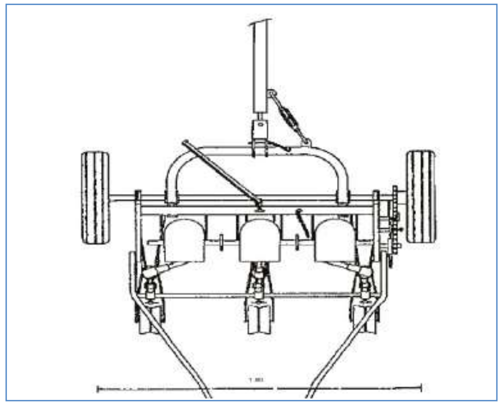
The following diagram (Side, 2013) summarizes the strategy that must be put in place to promote agricultural mechanization in Sub-Saharan Africa in a lasting manner. This diagram is valid in many other regions of the world.

[45] Cf. http://agritrop.cirad.fr/577133/. International Journal of Advanced Studies and Research in Africa, 6 (1): 34-43.).



2 - Promote, where possible, multi-row seeders and hoes (2 or 3 rows) that can be used in AT,

which could considerably improve hoeing precision thereby eliminating the need for herbicide application.



Schematic of the "polyculteur" (polycultivator) distributed in Senegal in the 1970s-80s [46]

AT tool for soil cultivation and subsequent seeding with constant row spacing

[46] The PROMMATA tool holder and those supplied in the 70-80s *(polycultivator that SISMAR is able to manufacture in Senegal, TROPISEM of Sulky, polynol of Jean Nolle, etc.)* were supplied with 3 rows for peanuts *(0.5 to 0.6 m row spacing)*, and 2 functional rows for cereals *(sorghum, millet, corn)* and cotton *(and cotton (with row spacing between 0.8 and 1 m)*. A few thousand copies of the polycultivator were distributed in Senegal, but farmers did not get behind it *(too expensive, not all farmers had pairs of oxen)* and it was mainly used in research stations ...

2-row animal traction seeder, Brazil (www.fitarelli.com.br/)

Very solid (but overly expensive) two row seeders allow uniform spacing between rows

Supplements proposed by Michel Havard[47], CIRAD agronomist specializing in agronomy, mechanization and production systems

To improve sowing and hoeing in Sudano-Sahelian zones and to reduce herbicide use, Michel Havard proposes that farmers classify their plots as follows:

- identify plots and relevant areas where **multi-row seeding and subsequent weeding would be possible:** plots without stumps, without shrubs with very few trees, without stones, etc.

- identify less adequately prepared plots (*(a few stumps, a few shrubs, a few stones, etc.)* **where seeding with an animal-drawn single-row seeder** is possible as the seed drill is guided during work by the operator who can lift it, move it, etc.; it is the same with the one-row weeding tool that is used afterwards. However, such conditions lead to irregular row spacing because farmers do not use a row marker and the distance between two rows can vary by 10 to 20 cm. Moreover, the lines rarely run parallel to one another from one end to the other.

- identify plots where mechanical seeding, even with a single row seeder, is not possible and **where only manual seeding is possible.**

In regard to the use of the multi-row seeder, he provides some usage recommendations:

- the need to be able to **lift the sowing units at the end of the line** so as not to sow while turning, nor to damage the sowing machine and **to have a system for disengaging the distribution system;**

[47] See also this article by Claude Sidi and Michel Havard: "Trajectoires possibles vers une agriculture motorisée dans les pays cotonniers – Du cas du Burkina Faso vers des propositions pour l'Afrique de l'Ouest et du Centre" (Possible paths towards motorized agriculture in cotton producing countries - from the case of Burkina Faso to proposals for West and Central Africa) – 2014 - https://agritrop.cirad.fr/574344/1/document_574344.pdf.

- the importance of **sowing the rows in the same direction** *(no cross rows)* to facilitate passage of the weeding tools;

- the importance of working with the same number of rows and adopting **the same spacing between the seeding elements of the seeder and the weeding tools;**

- with a two-row seeder, in order not to have difficulties with irregular row spacing between two passes of the seeder, **have the weeding tool work in the middle of the two rows and at the same time the two half-rows on each side.**

In regard to past experiences with multi-row tool carriers promoted in certain Sudanian -Sahelian zones, he provides the following reminders:

- The seeders installed on these tool holders had a system for disengaging the distribution system at the end of the line.

- On these same tool holders, weeding and hoeing tines could be mounted for 2 or 3 rows depending on the crop with, to guide the weeding tool, a parallelogram unit- **steered by the operator behind the polycultivator.**

3 - Promote, under environmental considerations and for certain plots, moderate motorization (tractors from 20 to 60 hp) with seeders and 3 or 4-row weeders?

As mentioned earlier, many of the programs for improving tractor access have had very poor results in sub-Saharan Africa. However, there are some positive developments. For instance, members of "motorized associations" in the Koutiala and Kléla Cercles in Mali were trained to drive and maintain their tractors and then improved **their tillage practices and combined the use of AT and the tractor with the planting of living hedges.[48].**

The CARTO center farm near Dapaong in Northern Togo also provides that it is possible to avoid using herbicides in combination with agroforestry (specifically alley cropping), the use of AT equipment, tractors and multi-row hoeing and seeding equipment *(Centre d'Animation Rurale Tambimong Ogaro/Tambimong Ogaro Rural Animation Center - cf. https://cartogaro.org/).*
As shown in the following photos, these developments can be observed in other tropical countries.

Living hedges on plots worked with AT and a tractor - Ethiopie Photo V. Beauval

Cashew and mechanized bean association) Rio Grande do Norte - Brazil Photo V. Beauval

[48] Cf. https://www.formad-environnement.org/YOSSI_haies_vives_au_sahel.pdf

4. Seek a balance between reducing the use of herbicides and controlling erosion

In fragile soils, which are very common in many tropical areas, particularly in West Africa, excessive tillage leads to several negative consequences in terms of erosion, leaching of essential crop nutrients and mineralization of organic matter.

Example in North West Togo:
In the northeastern part of the Savannah Region, the prevailing technical approach involves two passes of the animal-drawn ridger per year. This leads to an alarming amount of erosion, especially when such passes are not made along a contour line (cf. bottom left photo).

Erosion on a corn plot - Northern Togo V. Beauval

Ridging of corn - Northern Togo - V. Beauval

Nonetheless, as shown in the top right photo, these ridgers are very effective in managing weeds. Moreover, the use of herbicides is less frequent in the northeast of the Savannah region than in other Sudanese cotton-growing areas such as Northern Benin, Northern Cameroon or Kita Cercle in Mali, for example.

It has also been observed that such ridgers operate at a lower depth and are less disruptive to the soil when equipped with depth control wheels, which is unfortunately not the case for the many ridgers imported from Ghana.

Multiple steps can be taken to improve tillage practices:

- Train and provide material assistance to local blacksmiths to systematically equip ridgers with easy-to-adjust wheels and bearings.

- Train farmers to plant their crops more frequently on contours and reduce the depth of tillage when weeding-hilling.

- Encourage farmers, through farmers' organizations and ICAT (Togolese Extension Institute), to stop using the most toxic herbicides (e.g., atrazine and diuron, which are not authorized by the CSP, or glyphosate-based formulations that are not authorized in the EU). These herbicides are sold without any controls on the rural markets of Northern Togo and often come from Ghana and Nigeria.

- Cultivate the practice of direct seeding with a cane planter. This requires extensive modification of the technical procedures. ICAT tested this alternative for a few years in the Savannah region supplemented with the use of herbicides or passage of a toothed implement working at the surface between the rows. Presently, these tests have not changed farmers' minds. Moreover, without vegetation cover on these very sandy soils, which is difficult to achieve given the 7-month dry season and the practice of grazing, direct seeding would not effectively reduce erosion (it would not prevent sheet erosion).

Example in North Cameroon: Herbicides benefit farmers' income and soil conservation, but for how long?

In the savannahs of Northern Cameroon, as in all the cotton-growing areas of Africa, the cultivation of cotton has, for several decades, led to the introduction and expansion of the herbicide use. In the farmers' work schedule, cotton planting competes with the sowing and weeding of food crops *(corn, sorghum, etc.)*. The later the crop preparation and maintenance, the more weed problems increase and affect yields.

For instance, the introduction of herbicides in the 1970s was widely followed by farmers, with access facilitated through training, logistics and credit services provided by SODECOTON. Since the end of the 1990s and the entry into the public domain of several herbicides, in particular glyphosate, paraquat, atrazine and diuron, thousands of hectares of land in Northern Cameroon have been subjected to herbicide use[49]. The most common method is "chemical tillage" (glyphosate application in place of tillage) followed by direct sowing into the dead grass.

This technique offers undisputable economic advantages:

- Savings, depending on the crop, of 3 to 8 man-days per hectare in planting time compared to ploughing, which helps to accelerate the establishment of certain crops, and consequently to improve productivity and family income[50].

- Better control of perennial weeds due to the systemic mode of action of glyphosate *(otherwise, their elimination would require deep tillage and/or repeated hoeing).*

- In some soils, limitation of risks of erosion and an increase in rainwater infiltration through maintenance of the dead cover.

This technique is often combined with the use of selective herbicides such as atrazine and diuron and/or the use of animal-drawn implements for weeding and ridging the crops.

To meet the high demand of farmers, the National Confederation of Cotton Producers of Cameroon *(CNPCC)* now supplies herbicides on credit or for cash for both cotton and food crops. This service helps keep this umbrella organization [51] functioning and the system also benefits farmers in the sub-region, particularly in southern Chad where the cotton sector is not as well structured. According to surveys on farmers' perceptions of herbicide use *(Olina Bassala et al., 2015)*, **the vast majority of farmers are aware of the risks of using herbicides**, and most of them cite their harmfulness to humans and animals *(which may graze on freshly sprayed plots)*; all describe adverse medium-term impact on the fertility of the plots concerned and on biodiversity.

[49] **Martin José.** 2020. De la banalisation vox-populi des herbicides génériques au Nord-Cameroun et dans les zones cotonnières africaines. Bilan de communications 2019 en agro-malherbologie (Trivialization of public opinion regarding generic herbicides in Northern Cameroon and in African cotton-growing regions. 2019 Agro-weed science communications summary). Montpellier: CIRAD, 10 p. https://agritrop.cirad.fr/595830/
[50] **Olina Bassala J.P, Dugue P., Granie A., Vunyungah** M. 2015 - Pratiques agricoles et perceptions paysannes de l'usage des herbicides dans les champs familiaux au Nord Cameroun (Farming practices and farmers' perceptions of herbicide use in family fields in Northern Cameroon)https://agritrop.cirad.fr/579836/1/Pratiques%20et%20perception%20des%20herbicides%20Olina%20et%20al%202015.pdf
[51] It is therefore in the interest of this OF to sell as much herbicide as possible...

Farmers with little animal traction (which is common in northern Cameroon), **note that these herbicides are the "oxen of the poor"**. Given the low cost of these generic active ingredients, using them costs much less per hectare than renting a hitch *(probably a third, which is very important for those who do not have a complete animal traction system).*

In this context, **the use of herbicides** can only be reduced in stages, within the framework of a transition and by seeking compromises, in particular between the issues of soil conservation and adverse effects on human health and reduced biodiversity:

- **Communicate incidents and chronic health problems** and better document the problems of **water pollution** due to the diffusion of herbicide residues in order to raise awareness of the risks associated with the widespread use of herbicides such as paraquat, atrazine and diuron which, given their high toxicity, are no longer authorized in most developed countries.

- **Advise farmers of significantly less toxic active ingredients** and encourage them to pay more attention to the hazard statements on the labels of commercial glyphosate-based products **(some co-formulants are more hazardous than the active ingredient itself).**

- **Financially assist farmers with the acquisition of equipment for tractor-assisted cultivation** *(weeders and ridgers)* to reduce the use of specific herbicides.

- Promote systems with cover crops that are more easily controlled with little to no herbicide, provided that land tenure security and land management are prioritized at the same time to regulate grazing rights for agro-pastoralists[52].

Following this presentation of topic 4, a discussion could be organized concerning this module as a whole and the above draft proposals.

[52] In this regard, the results of the AFD project implemented by SODECOTON regarding these matters: https://www.afd.fr/fr/carte-des-projets/reduire-la-pauvrete-et-les-conflits-lies-aux-ressources-dans-le-nord?origin=/fr/carte-des-projets

NOTES

MODULE 5: IMPROVING HOW VETERINARY PRODUCTS ARE USED

EDUCATIONAL OBJECTIVE:

Be able to prevent risks associated with the use of veterinary products and recommend livestock farming practices and ethno-veterinary treatments that help to reduce the use of such products in accordance with the "One Health" approach.

TOPIC 1:

Know the types of livestock farming practiced by training participants and their situations as well as the primary pathologies present in these environments.

To conduct a detailed analysis of the conditions of access to and use of veterinary drugs by livestock farmers, please refer to Module 1 **"Preliminary participatory diagnostics"**of this guide. Some issues specific to the field of livestock and animal health are recalled here:

- Do farmers have frequent access to veterinary products (antibiotics and antiparasitics in particular) and can we say that the way these products are used leads to problems in the areas concerned? If so, identify, together with participants, improper practices involving the use of medicines *(adequacy of treatment for diagnosis, dosage and administration, observance of waiting periods...)*, of storage or disposal of vials and packaging. The task is also to assess how well pathologies and treatment methods are known in order to prepare the following training activities.

- Where are they bought and how much do the most commonly used products cost? Are some products purchased via "illicit" channels or on uncontrolled markets? In particular, are some of the products used not authorized in the country *(particularly those whose labels are not in an official language and therefore cannot be read by farmers or even technicians)?*

- Who are the health stakeholders in the areas concerned *(CAHW or other types of stakeholders, veterinary para-professionals, livestock technicians, private or public veterinarians, etc...)*? Refer to the village survey guides mentioned in topic 2 of Module 1.

- Do these health stakeholders participate in training and can they be mobilized for the following planned activities?

TOPIC 2:

Understand the "One Health" approach and why it is needed for more sensible use of antibiotics and anti-parasitic products.

a. Presentation of the One Health approach.

This concept was developed in the early 2000's and promotes **an integrated, systematic and unified approach to public, animal and environmental health at the local, national and global level.** The One Health approach [53] encourages collaborative, multi-sectoral and transdisciplinary approaches to developing new strategies for disease prevention and control. Though it originated in the United States, the idea of a unified vision of health and the importance of the environment has ancient roots that date back to early Greece. Antibiotic resistance is a key issue in the One Health approach and more broadly the development of resistance to treatments *(in pathogens: bacteria, parasites, etc...)*. These resistances represent a serious threat to animal and human health.

b. Within the context of this approach, **why worry about the harmfulness of "improperly used"** veterinary products (particularly antibiotics, but also antiparasitics including insecticides)?

Improper practices in connection with the use of veterinary drugs (use of a product that does not suit the pathology due to lack of established diagnosis, lack of technical support for the prescription, improper dosage, failure to respect waiting times for medications before use or marketing of the products, lack of traceability of the treatments *(identification of the animals, livestock register, ...)* contribute to the creation of the following problems for human and animal health and the protection of the environment:

1. A risk of antibiotic **or antiparasitic residues in foodstuffs of animal origin** *(in particular milk and meat)* consumed by farmers or consumers. While the prevalence of veterinary drug residues in foods of animal origin is estimated to be less than 1% in Europe, it may be as high as 80% in some African countries, according to a number of sources[54]. The presence of these residues in food of animal origin can have serious consequences in terms of **public health** by contributing to the development of allergies, cancers, changes in intestinal flora, bacterial and parasitic resistance and inhibition of fermentation processes in the dairy industry. This problem of microbial resistance has become a global issue for several years.

For the WHO: "Antibiotic resistance is one of the most serious threats to global health, food security and development today".

[53] Some documents for reference in regard to the One Health approach: https://www.avsf.org/fr/posts/2458/full/mise-en-oeuvre-du-concept-one-health-dans-les-pays-du-sud-policy-brief-de-vsf-international; https://www.AVSF.org/public/posts/2289/actes_AVSF-vsf-int_atelier_one_health_novembre_2018.pdf; https://www.AVSF.org/public/posts/2291/actes_atelier_national_one-health_AVSF_vsfi_mali_2019.pdf;

[54] Van Boeckel et al, 2015. Global trends in antimicrobial use in food animals, P Ntl A Sci 112, 5649–5654 et Résidus d'antibiotiques et denrées d'origine animale en Afrique: risques de santé publique (Antibiotic residues and animal products in Africa: public health risks), Rev. sci. tech. Off. int. Epiz., 2014, 33 (3), 975-986

2. The emergence of resistance and the resulting decrease in the effectiveness of treatments has the following effects:

- on human health, in particular potential resistance of germs that will then afflict humans and reduce treatment possibilities;
- economic effects due to increased losses for livestock farmers *(ineffective treatments, and, as a result, increased morbidity and mortality.*

Some examples of declines in the efficacy of pest control treatments can lead to fundamental restructuring of industries. This is the case with the resistance of strongyles (intestinal parasites) in sheep to anthelmintics, which is known in all sheep farming areas of the world. In Australia and New Zealand, 80% of sheep flocks exhibited multiple resistances in the 1990s, which forced some regions to restructure or even abandon sheep farming (this problem was also encountered in South Africa).

3. The dissemination in the environment of product residues which also contribute to the acceleration of the development of resistances and can have adverse effects on the environment, in particular on entomofauna such as dung beetles, highly beneficial insects which are killed by ivermectin, an active antiparasitic substance that is widely used around the globe.

Source https://fr.wikipedia.org/wiki/Ivermectine:
"Ivermectin is highly toxic to insects and aquatic organisms and poses additional fundamental ecotoxicological risks. Administered to cattle, sheep and horses, it is primarily eliminated in the feces with elevated concentrations in dung and droppings in the days following treatment. The duration of elimination in the feces of treated animals depends on how the medication is administered (intramuscular, bolus) and varies between **10 and 150 days**. Milk can also be contaminated. The highly adverse effect of ivermectin on non-target fauna (Diptera and coleoptera coprophages = dung beetles) has been established by numerous studies, even though the laboratory that markets it has published contradictory studies."

c. The issue of quality and availability of veterinary products.

The quality of the products used, which is all too often inadequate for both human and veterinary medicines, is further degraded by supplies outside the official channels. Thus, the percentage of non-compliant veterinary drugs found on the market *(formal and informal)* in West Africa could vary, depending on the compound and country, from 11 to 69%, according to various sources [55]. This observation is due to the lack of regulations governing the import, authorization and marketing of veterinary drugs, but also to a severe lack of resources for organizing controls to enable these regulations to be applied in the field.

For livestock farmers, purchasing poor quality medicines results in financial losses since the purchase cost is not compensated by the expected gain in the form of improved animal health and

[55] DOGNON et al., 2018, Qualité des antibiotiques vétérinaires utilisés en Afrique de l'Ouest et méthodes de détection de leurs résidus dans les denrées alimentaires (Quality of veterinary antibiotics used in West Africa and methods for detecting their residues in foodstuffs), Journal of Animal & Plant Sciences, 2018. Vol.36, Issue 2: 5858-5877.

productivity, as the active ingredients contained in counterfeit products are ineffective or even entirely absent.
Moreover, even in official distribution channels, the variety of products available on the market is often still insufficient for antibiotics, vaccines or antiparasitics.

d. Concrete measures that can be considered:

1. Train animal health workers and livestock farmers to make them **aware of good practices in the use of veterinary drugs** and, therefore, to create accessible training materials for this purpose.

In the specific case of antibiotics *(good practices in terms of the use of antiparasitics are described under topic 3 below)*, these materials could be inspired, illustrating them in a concrete manner, by some of the WHO recommendations for the agricultural sector regarding the prevention and control of antibiotic resistance:

- give antibiotics to animals only under supervision/advice by a veterinary professional;
- do not use products from uncontrolled markets and strongly encourage procurement through official distribution channels for veterinary drugs;
- do not use antibiotics as growth promoters or to prevent disease in animals;
- to reduce the need for antibiotics, use alternatives to antibiotics where available, including creating a vaccination **protocol** that is appropriate for the zone based on recurrence and type of disease and providing for contingency measures in the event of an outbreak;
- promote and enforce sound hygienic practices at each stage of the production process and processing of food of animal origin;
- In case of a bacterial infection threatening life or the stability of the herd, seek professional advice on how to implement suitable, selective treatment *(by carefully selecting, to the extent possible, only animals to be treated for the pathology in question)*, and have antibiotic susceptibility tests performed if such techniques are available *(which continue to be rare in certain contexts)* in order to use the most suitable drug possible.
- to raise awareness for post-treatment waiting times for the consumption and processing of animal products;
- increase biosecurity on farms to avoid infections by improving hygiene and animal welfare *(cf. topic 3)*.

Ideally, these training courses should be accompanied by follow-up to assess the effective change in the practices of the trained persons, either in the form of mentoring or feedback sessions "removed" from the training.

2. Better individual and collective management of waste (bottles, injection materials), of veterinary products to limit the intentional or unintentional discharge of these products into the environment, and even cross-contamination between animals in the case of the implementation of treatments. Examples of measures that could be implemented:
- at the individual level, raising of awareness among livestock farmers to the management of "bottle ends" and injection materials;
- provision of containers for the recovery and treatment of this type of waste;
- setup of networks for the recovery and treatment of such waste by medicine suppliers or other stakeholders , including those from the field of human health, to be identified.

3. Promote alternatives based on traditional knowledge and outside knowledge of herbal medicine or aromatherapy *(if quality essential oils are available and affordable - see Topic 4)*.

4. To support official authorities with **implementing regulations on the control** of the sale of veterinary drugs, and to encourage and support the **development of distribution** channels of quality drugs to farmers in rural areas *(veterinary warehouses…)* in compliance with local regulations and the structuring of the existing animal health network.

TOPIC 3:

Identify and implement herd management practices that reduce the need to use veterinary products.

Can we completely eliminate the need for medications? No, but we can establish, depending on the context, livestock farming practices that limit health risks or promote improved animal resistance:

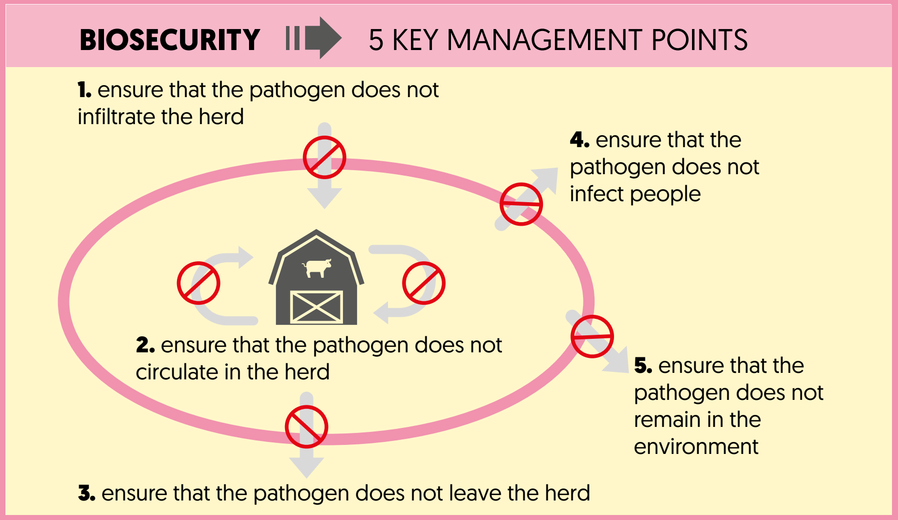
1. **Choose hardy breeds** and/or make selections based on hardiness and resistance to certain pests or diseases
2. **Reduce stress** as much as possible by establishing favorable livestock farming conditions, for example by avoiding the formation and reformation of groups by mixing animals of different origins, avoiding transport in extreme climatic conditions, noise and excitement, various forms of abuse…
3. **To provide quality feed in accordance with** the physiological needs of the animals according to the species, breeds, ages and expected production, and taking into account the plant species *(including fodder)* available locally, taking care to avoid food competition with humans *(especially for monogastric species)*.
4. **Cultivate the natural resistance of animals** to parasites through initial care for newborn animals *(quality colostrum intake)*, semi-foraging, grazing of animals from a young age to allow them to develop their immunity, etc…
5. Develop and implement biosecurity measures in livestock farming *(cf. focus a)*).
6. Implement integrated management measures to reduce contamination, particularly by parasites .
7. Implement, if necessary and depending on the context, **well thought-out vaccination plans** and use simple advance diagnosis to limit the risk of epizootics

Concrete measures that can be considered

a. Focus on biosecurity in livestock farming

Useful clarification in some working contexts: most of the biosecurity measures described below cannot be applied to pastoral livestock farming. In these situations where there is no livestock building, the measures that can still be applied are specified at the end of the section.

Biosecurity refers to all preventive measures aimed at reducing the risks of introduction, spread and transmission of infectious diseases.
Depending on the species raised and the livestock farming method (in buildings or not, with transhumance or not...), the applicable, prioritized biosecurity measures can vary greatly, but it is important to keep them in mind to limit the risks of introduction, and thus to limit the use of veterinary drugs. The accompanying diagram summarizes the biosafety concept.



We can distinguish:

1. External biosecurity, which aims to prevent and/or limit the introduction into farms of new microbial, viral or parasitic strains from various possible sources*(the environment, wildlife, introduced animals, shared equipment, humans, see diagram below).*

Possible sources of contamination	
Living	**Non-living: "inert"**
- the animal itself - the introduction of young breeding stock - humans (livestock farmers or other visitors from outside the farm) - surrounding fauna: mammals (including rodents) or wild birds, insects, other domestic animals (dogs, cats...)	- vehicles - equipment/material, surfaces on the premises - air - food, water, distribution systems - manure, dung - foodstuff (meat, milk, eggs...) or by-products - sperm (insemination)

When it comes to external biosecurity, the following measures are critical:

- Reduce the number of animals of different origins introduced into the farm; in particular, reduce the number of purchases and trades, increase in-herd replenishment as much as possible.
- Quarantine new animals purchased before they come into contact with the herd to ensure that they are not ill.
- Avoid **direct contact** (through habitat adaptation, fencing, etc.) with wildlife, and avoid contact of wildlife with feed (forage, grain, etc.) for domestic animals.
- Limit direct contact with animals from other neighboring herds *(e.g. during watering, or by organizing vaccination drives or other gatherings).*

2. In-farm biosecurity, consisting of measures to reduce the spread of germs within the farm:

- Isolation of **sick animals** from the rest of the herd to avoid contamination.
- In case of mortality, do not allow other herd animals or other animals *(dogs...)* to come into contact with **carcasses**, destroy the carcasses in a suitable manner *(bury the carcasses, process by composting small carcasses or incinerate them).*
- Proper management of **effluents** (storage to avoid direct runoff into waterways, composting of manure before spreading).
- **Clean and disinfect** materials *(particularly if they have been shared with other livestock farmers)* and the premises regularly.
- Use **protective** equipment when handling sick animals, or at least wash hands thoroughly after handling a sick animal. Preferably, start care *(feeding, change of litter etc...)* with the healthy animals and finish by taking care of the sick animals.

In **a pastoral context**, the most important biosecurity measures that should be taken to the greatest extent possible are (i) isolation of sick animals, (ii) limiting access to carcasses, and (iii) limiting contact to animals from other herds, in particular in organizing access to water points or during the organization of vaccination drives, in connection with certain measures developed by AVSF on conflicts of use.

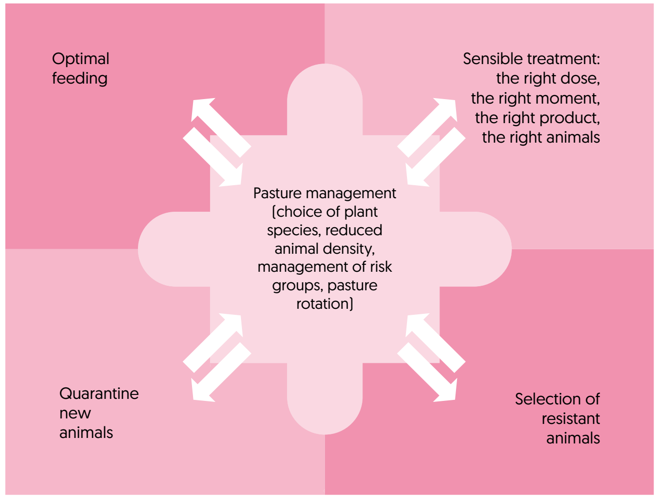
b. Implement integrated management measures to reduce contamination, particularly by parasites (cf. focus b).

To limit the risk of infestation by internal parasites that have important consequences in terms of animal growth and production, the main sound grazing practices are as follows:

- Avoid continuous grazing and prioritize **rotational grazing** by allowing a period of about 25 to 30 days to pass before returning to a previously grazed area.
- Limit **overgrazing**: parasite larvae are found close to the ground; the more animals overgraze, the more larvae they will ingest.
- Move animals from one plot to **another before the first rains** at the end of the dry period when larvae concentrate in the dung in the absence of abundant grass. The arrival of rain will release and spread the infesting parasite larvae in very large quantities on the plots and contribute to widespread infestation of the animals.
- **Graze adults and youngsters simultaneously on the same plots** because the adults shed less *(except in isolated cases)* and will thereby reduce parasite pressure on the youngsters.

- If the herd is managed by age group, it is better to graze **young animals on plots previously occupied by adults** than by other young animals, as adults are less likely to shed larvae and eggs because of their acquired immunity.
- **Mix species when grazing** *(e.g., cattle and horses)* because they are not susceptible to the same parasites, and will mutually limit the parasite pressure of the other species by ingesting larvae but not shedding eggs.
- Use of plants or plant extracts with anti-parasite properties to limit the frequency of treatments *(cf. topic 4.)*

The following diagram[56] summarizes the pillars of integrated management of internal parasites to reduce the need for pest control treatments. Of course, depending on the context, breeding practices and the availability of pasture land, the feasibility of these practices must be discussed with the livestock farmers so that they can be adapted to their situation.



This strategy reminds us that in cases of heavy infestations where parasite control treatments cannot be avoided, it is advisable to apply **sensible treatment practices,[53]** which include good practices in the use of pest control products, such as:

- do not use products from uncontrolled markets;
- limit the number of treatments administered and, in particular, avoid systematic treatments;
- verify the effectiveness of the compounds used, if possible by analyzing the feces (coproculture) of a few animals before and after treatment; this may also allow more specific targeting of the animals to be treated (selective treatment of the biggest shedders) and avoid having to treat the whole herd systematically;
- change the active ingredient on an annual basis by seeking advice from a veterinarian or other animal health professional;
- during treatment, estimate the animal's weight as best possible and observe the recommended doses to avoid under- or overdosing;
- observe usage precautions, particularly for "pour-on" products for external application (among others, do not use in rainy weather to avoid contaminating the environment);
- do not abuse long-acting dewormers or continuous-release products (boluses);
- and above all, do not treat preventively but curatively, by implementing all other integrated management measures!

[56] Source: project "Maîtrise du parasitisme interne chez les troupeaux ovins utilisant les pâturages" (Control of internal parasites in sheep herds using grazing pastures), 2007, CEPOQ *(Centre d'Expertise et de Production Ovine du Québec)*.
[57] 2013, Brochure of the Life Prairies Bocage project, "MIEUX RAISONNER LES TREITEMENTS ANTIPARASITAIRES DANS LES ÉLEVAGES" (A MORE RATIONAL APPROACH TO ANTIPARASITIC TREATMENTS ON FARMS)".

TOPIC 4:

Recover and disseminate relevant alternative traditional practices from the zones of training participants.

Ethnoveterinary practices consist of the traditional knowledge, skills, methods, practices and beliefs of people used to care for their animals. This concerns both diagnostic practices *(recognition and description of symptoms)*, prevention and treatment, in particular through the use of medicinal plants, but not only *(use of substances such as honey, ashes ...)* and also zootechnical practices *(see Topic 3, choice of breeds, diet ...)*. These practices can be very useful in the development of alternatives to allopathic treatments which may not be highly accessible (in terms of material or financially) or used in poor conditions, as described above.

More broadly, ethnoveterinary practices should not be considered only in terms of veterinary phytotherapy, but first and foremost be integrated into livestock practices in terms of technical management sequences **and agro-ecological food processes**, and even in terms of the culture and identity of the populations with whom we work. Thus, these practices are part of a multifunctional approach that must also be promoted. Moreover, the rational use of plants of medical importance *(including veterinary)* has the advantage of enhancing the value of these natural resources and enabling maintenance of biodiversity which, in certain agricultural contexts, is threatened.

One of the foundations of animal health is their diet, which for most species is mainly of plant origin. The addition, **in the food ration**, of plants whose properties offer the physiological benefits of strengthening or maintaining certain essential fundamental functions *(digestive, immune, respiratory, locomotor, reproductive...)* can be of great value without the drawback of potentially complex preparation of plant parts or which concentrates active principles and can involve problems of toxicity.

For example, from the point of view of proper healthy food diversity, the practice of natural selective grazing behavior by animals *(e.g., the animals themselves choosing certain forage species that have a natural anti-parasitic function)*, integrated pest management *(described above)*, root development without trampling and thus soil improvement *(and associated carbon storage)* are techniques often traditionally practiced by livestock farmers and which can be promoted and disseminated, all the more so since they are consistent with the maintenance of a transhumant way of life, characteristic of many contexts where such actions are developed. In more settled contexts, there is a strong interest in developing hedges that integrate forage species. Indeed, in addition to their importance from a biodiversity standpoint, water infiltration, runoff prevention, natural fences, they help enrich the plots with organic matter, and can be a source of forage particularly in times of drought when there tends to be a lack of grass.

Thus, for ethnoveterinary practices, there is both:
- the challenge of **collecting and conserving** these traditional practices *(knowledge and know-how)* which are often based on oral tradition and which may be disappearing in some regions;

- the challenge of **disseminating** the most tried and tested practices, to enable livestock farmers to preserve this know-how and to have access to diversified and effective livestock farming, prevention and treatment techniques.

The question of the "scientific" validation of phytotherapeutic practices and recipes remains a sensitive one, because the usual clinical test conditions of allopathic drugs are not well adapted to practices of this kind which, by definition, are not or are hardly standardized. Therefore, it is difficult to demonstrate effects related to the use of plant parts potentially containing several active ingredients, and whose concentration in active ingredients and efficacy are subject to many environmental factors *(seasons, method of preparation, uncertain dosages due to the imprecision of the measuring instruments…)*.

However, several studies have already been carried out to identify and promote ethnoveterinary practices, and this approach to documenting and popularizing certain proven practices warrants implementation in the countries/regions targeted by the training.

In **Appendix 6**, a table summarizes the documents produced as a result of this type of study within the framework of actions carried out by AVSF and/or its partners, referring, when the documents are available online, **to the detailed reports or outreach tools produced.** In the same Appendix 6, other examples of studies and bibliographical references are also cited, not exhaustively, as some studies not published online may be available depending on the country, as practices are by definition very much linked to the specific territory where one is located. Also as an example in a French context,**Appendix 12** presents a summary of phytotherapy and aromatherapy practices implemented in France on a cattle farm in Western France, and provides links to further information on the subject in the French and European context.

Ethnoveterinary practices should not be considered unique solutions and their inclusion and promotion does not mean abandoning "modern" veterinary medicine. **The two types of medicine can be used in a complementary way depending on the situation.**

Thus, in a certain number of cases, it is possible that one cannot completely do without veterinary drugs *(including antibiotics and antiparasitics)*, particularly during acute or sub-acute pathologies. However, apart from using them correctly in this case *(see previous sections)* it is also possible, in a preventive manner, to improve their effectiveness or to reduce their use significantly by using plants. Moreover, there are no contraindications to using the two types of approach *(allopathic and phytotherapeutic)* concomitantly.
Moreover, the use of plants can be part of a preventive approach by helping to keep animals in good health and therefore better able to cope with infections. Thus, the objective of using certain plants could be to reinforce physiological functions *(metabolism, detoxification, immunity…)* and thus to reinforce animal capacities of adaptation and defenses, rather than to look for a strict curative aspect.

Raising the awareness of animal health network personnel *(such as Community Animal Health Workers - CAHWs)* of the value of some of these practices, and in the long term, strengthening the capacity of traditional practitioners as well as connecting them to other animal health professionals, could be addressed in the scope of livestock support projects.
Moreover, as for any "natural" preparation, one should not underestimate the toxic potential of certain plants used, and thus the precautions to be taken when using them. For example, in Ethiopia, goat farmers boil castor oil leaves *(Ricinus communis)* to obtain a viscous liquid that they use to control mange in their animals. The active ingredient, ricin, is highly toxic and the preparation must therefore be handled with great care *(Peacock, 1996)*.

It is also of utmost importance to trace the origin of the plants that will be consumed by the animals in order to avoid rendering toxic or hazardous plants that normally are not toxic but may contain other biological or chemical contaminants (plants from dumps, industrial wastelands or urban pollution, risks of contamination by human excrement, soils that are regularly or freshly treated with chemical fertilizers or phytosanitary products). This applies both to the collection of plants and to the direct grazing of animals in these risk areas.

Thus, it may be important to know and **reduce the impact of using pesticides on crops on animal health** , and in particular to avoid acute intoxication of animals grazing on plots of land that have been freshly treated with pesticides, by putting in place **a warning system advising herders of phytosanitary treatments** *(e.g., to reduce intoxication in the case of grazing on plots of land that have recently been treated with herbicides, cases cited in Mali relating to the practice of "common grazing land")*.

NOTES

MODULE 6: INFORMATION AND MOBILIZATION OF CITIZENS

EDUCATIONAL OBJECTIVE:

To reduce the use of pesticides and prioritize the elimination of the most dangerous ones, understand the objectives of citizen initiatives aimed at: (1) the application and strengthening of national laws on pesticides; (2) compliance with international and regional conventions concerning them; (3) support for the implementation of alternative agroecological solutions.

The dangers of pesticides are increasingly documented and many stakeholders *(researchers, NGOs, consumer associations, some farmers' unions, elected officials, etc.)* are putting pressure on decision-makers to restrict or even abolish the use of the most dangerous ones and to change the legislation concerning them. These citizen initiatives are important and necessary levers for accelerating, ensuring compliance with and establishing a legislative and regulatory framework that protects the environment and human health.

Many people hope for the complete abolition of pesticides, a desirable objective, but our experience compels us to note that a step by step approach is preferable due to considerable inhibitions among farmers and the stakeholders who surround them. The necessary "exit from pesticides" cannot be achieved without:

- promoting **agroecology** on a grand scale accompanied by moving away from monoculture, water pollution and other adverse effects of excessively industrial agricultural production models. This means raising awareness among farmers, future farmers, consumers, citizens, elected officials, politicians, and stakeholders in the agri-food sector about the challenges of agroecology.

- An uncompromising fight against the practices of certain **agrochemical companies** *(lack of information for users, marketing of hazardous pesticides, lobbying to maintain the lack of transparency regarding the harmfulness of products and minimizing regulatory obligations regarding the studies necessary to evaluate a pesticide, etc.)*.

- Questioning of the objectives and organization **of the agricultural sector**, which gives priority to short-term economic considerations at the expense of medium and long-term sustainability. This is the case, for example, in West Africa for several cotton operations, but also for peri-urban vegetable farming operations involving mostly family farmers.

TOPIC 1:

Determine and summarize mobilization challenges to be overcome for genuine alternatives to the use of hazardous pesticides and explore examples of mobilization in France, Africa and South America.

Numerous examples show us that nothing is inevitable, that the fight against multinationals, who do not care about people's health, is not lost and that everywhere in the world, farmers have the ability to train themselves and to evolve their practices. Furthermore, smallholder farmers whom AVSF supports have answers to these challenges.

Thanks to their abundant labor force, rich biodiversity and the diversity of their climates, developing countries have the resources necessary to successfully overcome this challenge and develop sustainable agriculture that gives everyone access to quality food.

Examples of citizen initiatives in France, EU, Argentina and Africa:

AVSF initiative that addresses the issue of pesticides and promotes agroecological alternatives

For two decades, AVSF has been working on these issues together with its Latin American and Madagascan partners and, as of 2014, together with FOs in three West African countries *(cf. projets agroécologie financés par le FFGM et l'UE au Nord Togo et par l'Afd au Mali et Sénégal [agroecology projects financed by the FGEF and the EU in Northern Togo and by the Afd in Mali and Senegal]*. Several training courses on reducing the use of the most hazardous pesticides and the promotion of viable alternatives have been carried out in partnership with these FOs in Northern Togo *(2015)*, at Kolda in Senegal *(2016)* and at Kita in Mali *(2016 and 2018)*.

In 2014, AVSF joined forces with other associations to promote alternatives to pesticides *(cf. https://www.AVSF.org/fr/posts/1634/full/une-semaine-d-alternatives-aux-pesticides)*. In March 2015, AVSF launched a communication campaign focusing specifically on reducing the use of the most dangerous pesticides in countries of the Southern Hemisphere: https://stop-pesticide.org

In 2018, following a decision by AVSF's Board of Directors, a "pesticide, veterinary drugs and alternatives" working group was created within the NGO. Its members include agronomists, veterinarians and three experienced farmers. A roadmap has been drawn up and includes 3 axes, including the promotion of alternatives in partnership with farmers' organizations of Southern African countries, local or international development NGOs and African agricultural research centers.

Mobilization of elected officials to ban the use of dangerous pesticides on certain lands and near homes, schools, health centers ...

In Argentina, where the aerial application of herbicides has grown significantly in many of the country's regions, collateral damage to health and biodiversity has been observed by the population and verified by numerous scientists. For more than a decade, this has prompted the mobilization of elected officials and, on a more global level, numerous stakeholders in civil society. These struggles have sometimes been taken into account by government authorities who have called for the amendment of standards in order to better ensure the protection of inhabitants [58].

[58] Cf. https://www.fundeps.org/wp-content/uploads/2018/01/distancias_para_la_aplicacion_de_agroquimicos.pdf and also https://aldiaargentina.microjuris.com/2020/01/15/decreto-fumigado-se-anula-el-decreto-provincial-que-habilita-fumigaciones-con-agrotoxicos-cerca-de-escuelas-rurales-a-distancias-menores-a-1000-mts-por-tierra-y-3000-por-aire/

In France and in some other European countries, interest in the issue of exposure of local residents to pesticides is recent but, in adults as well as in children, there is abundant scientific data indicating an increase in neurological disorders, asthma and probable endocrine disruption. Serious questions remain regarding the risks of leukemia and brain tumors in children. *(cf. PELAGIE – INSERM study; http://www.pelagie-inserm.fr/)*. Faced with such alarming scientific data as highlighted in the box below, associations of local residents, elected officials and doctors*(e.g. the Alassac association in the Limousin region)* are mobilizing to better control, restrict or prohibit treatments near homes.

> **"Reeve, please let our mayors protect us"**
>
> In May 2019, the mayor of Langouët *(a village in Brittany - northwestern France)* felt that legislation failed to offer sufficient protection and issued an order prohibiting the use of pesticides "at a distance of less than 150 meters from any cadastral parcel containing a building for residential or professional use". The elected official's order was then challenged by the prefecture and he was brought before an administrative court, which overturned his order.... On the other hand, in November 2019, the administrative court of Cergy-Pontoise *(a city near Paris)* rejected the request to suspend two anti-pesticide bylaws issued by the city councils of Gennevilliers and Sceaux, on the grounds of a "serious risk to the populations exposed to these products".
>
> The French government has ignored the fears of mayors and retained in late December 2019 very small distances to homes (3 to 20m depending on the type of product and the method of spraying]. A hundred mayors then formed an association and have no intention of stopping their fight.

Citizen mobilization and advancement of scientific knowledge are leading to the banning of certain environmentally toxic insecticides in Europe.

The examples below concern the ban, in most EU countries, of the highly toxic insecticides: neonicotinoids and dimethoate.

Example 1: Ban in the EU of three insecticides from the neonicotinoid class
After many years of mobilizing beekeepers, scientists, environmental associations and farmers' unions promoting smallholder agro-ecologies *(including Via Campesina Europe)*, the high toxicity of insecticides of the neonicotinoid class has finally been taken into account*(known as "bee killers", they are neurotoxic and very persistent)*.

The scientific case for their toxicity is very strong and the European Food Safety Authority (Efsa) finally recognized in February 2018 that these neonicotinoids are highly toxic to honey bees, solitary bees, bumblebees and other pollinating insects.

Following these campaigns backed by scientific findings, the representatives of the EU member states have, in April 2018, by a qualified majority, ruled to ban three neonicotinoids on all outdoor crops. The banned neonicotinoids are clothianidin, imidacloprid and thiamethoxam, active ingredients currently widely used on cotton in Africa...

Unfortunately, a number of European sugar beet companies have obtained exemptions in 2019 in Belgium and for 2021, 2022 and 2023 in France allowing the continued use of neonicotinoids". The environmental requirements attached to these exemptions have certainly been strengthened, but this setback has left its mark on people's minds and encouraged other industrial sectors to request exemptions.

Example 2: Dimethoate ban procedure in France and a number of other EU countries
In February 2016, the ANSES [59] banned dimethoate *(organophosphate insecticide)* in France because of its impact on human health. The use of this old insecticide had experienced a significant renaissance in prior years, in connection with the arrival in France of a new summer fruit pest, which also affects cherries: the Drosophila Suzukii *(or Japanese fly)*. In addition to the threat dimethoate-based pesticides posed to the health of farmers, their employees and consumers, this compound exposed the cherry growing sector to a health hazard.
Despite opposition from the majority of business's leaders, its prohibition was a justified measure that was also supported by the consumer associations and an agricultural trade union, the Confédération Paysanne.

However, this decision should not result in production *(and associated pollution)* being relocated to competing countries. This is what would have happened if the French government had allowed cherry imports to replace local production, which became more expensive due to the dimethoate ban. For this reason, it engaged a safeguard clause, i.e. a provision of European law permitting derogation from the free movement of goods within the Single Market. It therefore prohibited the import of cherries from countries where dimethoate was still authorized. This protectionist measure did not trigger a trade war, contrary to what advocates of the free movement of goods claimed. Moreover, the majority of cherry-producing countries in Europe have in turn banned dimethoate *(for example, in order to maintain access to the French market)*. Nevertheless, some cherry exporting countries like Austria, Croatia, Turkey, Argentina or Chile still use this very toxic insecticide.

Example 3: Ban of metam sodium on lamb's lettuce in France in 2019
Despite multiple health incidents, the leaders of the French **lamb's lettuce** growing **business** (mainly export-oriented) wished to keep using metam sodium, a volatile and highly toxic multi-purpose biocide used to treat soils *(to control fungi, worms, weeds), ...)*. The public authorities withstood their pressure and finally decided to ban it in November 2018 *(however, only after dozens of cases of respiratory intoxication had been observed in farmers, their employees or in local residents.* Consumer prices for lamb's lettuce have risen slightly since then, but there have been fewer health problems for lamb's lettuce growers, their employees and their neighbors.

<u>Mobilization in 2019 of African and international researchers and the Arusha Appeal</u>

At the initiative of academics and researchers, an interdisciplinary conference entitled "Pesticides and Policy(s) in Africa" was organized in Tanzania from 28 - 31 May 2019. It was held in Arusha at the Tropical Pesticide Research Institute (TPRI) and the call for communication was very much in line with AVSF's guidelines and those of this training guide (cf. https://www.ehess.fr/sites/default/files/evenements/fichiers/cfp_conference_pesticide_politics_vf_final_lowres.pdf).

[59] ANSES: The French Agency for Food, Environmental and Occupational Health & Safety has a network of nine reference and research laboratories located throughout France.

France was highly involved in organizing this seminar in partnership with the Tanzanian authorities and with the support of the French Embassy. The majority of the 80 people present were researchers in the social sciences and humanities with some health specialists (for France, researchers from CNRS, IRIS, INRA). Half of the participants were Tanzanians and Kenyans. 6 people were from West African countries *(4 from Burkina, 1 from Ivory Coast, 1 from Benin)*.

At the end of the conference, the following appeal was launched and signed by the participants.

The Arusha Call to Action on Pesticides

Recognizing that the protection offered by personal protective equipment (PPE) under real-life conditions is insufficient for the safe use of pesticides, even by responsible and trained users;

Deeply concerned about the rise in Africa of non-communicable diseases with a known link to chronic pesticide exposure (e.g., cancers, neurological diseases, cognitive and neurodevelopmental disorders, reproductive disorders, cardiovascular diseases, diabetes, attention deficit disorders in children);

Aware of the high burden of acute pesticide poisonings - including voluntary ingestion as the result of suicide attempts;

Seriously concerned about persistent contamination of soil, water, air and food, and collateral damage to non-target organisms;

Acknowledging consumers' demand for safe and healthy food;

Recognizing the inadequacy of regulations, the almost universal failure to enforce them, the high cost of controls and the difficulty of managing product flows at borders;

Recognizing the enormous economic costs of collateral damage to public health and the environment from the use of pesticides;

We, the participants of the conference "Pesticides and Politics in Africa", conclude that, under their real-life conditions of use, pesticides cannot be used safely.
Recognizing the role played by farmers' organizations, non-governmental organizations and civil society organizations in combating the dangers of pesticide use and in seeking alternatives to synthetic pesticides;

Aware that the use of pesticides leads to serious human rights violations, which particularly affect vulnerable communities, such as smallholders, women, children and the elderly;

Realizing the potential of agroecology to promote environmental and social justice, human dignity, resilience and the fight against poverty;

We call on the African Union Commission, the Assembly of Heads of State of the African Union, the Conferences of Ministers of Agriculture and Health of the African Union, international organizations (United Nations, World Bank, IMF) and pesticide manufacturers to act to protect the environment and human health from the harmful effects of synthetic pesticides. This means doing the following, among other things:

1. Immediately banning HHPs (in accordance with the 8 criteria of the FAO/WHO Joint Meeting on Pesticide Management) that have been shown to contribute to non-communicable diseases and reproductive disorders;

2. Make publicly available all information on the toxicity of pesticides to human health and ecosystems, as well as data on pesticide residues in food products and the environment;

3. Setup operational systems for monitoring acute and chronic pesticide poisonings, as well as environmental contamination and pesticide residues in food, also by setting up certified laboratories;

4. Train health care providers in the management of pesticide poisoning;

5. Ensure effective cooperation between ministries to prevent pesticide poisonings;

6. Harmonize regulatory frameworks in Africa and ensure the effective implementation of international conventions, agreements and protocols on pesticides to which the recipients of this appeal are signatories;

7. Ensure the implementation and strict enforcement of existing pesticide regulations and the monitoring of their effects;

8. Hold pesticide producers, importers and promoters accountable for the effects of their products on human health and the environment, and require them to set up a collection system for empty pesticide containers, through incentive mechanisms;

9. Phase out subsidies and tax schemes that promote pesticide use;

10. Promote agroecological production, including training and outreach, and research into alternatives to synthetic pesticides for pest control, with the support of accredited laboratories and direct support to farmers in the use of mechanical alternatives.

All these measures will help to safeguard the right of African populations to dignity, social and environmental justice and will support their right to live in a safe environment.

Mobilization against the use of glyphosate in Africa

"Africa must immediately ban the use of glyphosate! " - African Centre for Biosafety – **Article printed August 2019 by Sasha Mentz Lagrange** *(independent sustainability consultant living in South Africa).*

Summary of this article: "Glyphosate and the additives used in formulations containing this herbicide have penetrated every part of our environment and our entire food chain. The persistence and the pervasiveness of these chemicals confronts us with one of the greatest health crisis that humanity has ever faced. This crisis is already manifesting itself as evidenced by the increase in health problems and chronic illnesses around the world *(particularly in Latin America where widespread poisoning has been reported as a result of aerial spraying)* and these health problems have been legally recognized by three recent court cases in the US.

Between 2015 and 2019, the number of countries with full or partial bans on glyphosate and glyphosate-based herbicides *(HBG)* has grown. But many countries, particularly those of the South, have already made this decision. For instance, national bans are in place in Oman, Saudi Arabia, Kuwait, the United Arab Emirates, Bahrain, Qatar, Sri Lanka *(with partial lifting for specific crops)*, Vietnam, Saint Vincent and the Grenadines. Bans are also in place in federal states [*(Punjab and Kerala in India) or in municipalities (Brussels and many English, Spanish and French cities).*

Glyphosate use by private individuals has been banned in the Netherlands *(2015)*, Sweden *(2017)*, Belgium *(October 2018)* and France *(2019)*, and restricted use is also in place in many countries *(Czech Republic, Denmark, Netherlands, Italy)*. In Africa, only one country, Malawi, has banned the import of glyphosate in April 2019.

The trend is the opposite in the majority of African countries, as glyphosate-based total herbicides are increasingly used in agriculture as well as in urban areas *(South Africa is reportedly the largest consumer of glyphosate on the continent)*. On the other hand, a link to the spread of pesticide-related diseases and deaths is difficult to establish because acute and chronic poisoning data are not collected at the level of each local authority and country. However, many African health practitioners are seeing a sharp increase in these cases in their areas of work.

Current registrations of glyphosate-based herbicides are unfortunately based on obsolete data which are often the product of pressure from the agrochemical industry including Monsanto/Bayer. However, glyphosate is currently listed as a hazardous substance. In 2015, the World Health Organization's (WHO) International Agency for Research on Cancer *(IARC)* announced that glyphosate was "probably carcinogenic to humans". As this classification is constantly being challenged by other agencies and industry, the IARC has been compelled to repeatedly affirm its finding of "strong" evidence of carcinogenicity, both for "pure" glyphosate and for glyphosate-based formulations". Other independent studies have clearly established the carcinogenicity of glyphosate and BPH and linked glyphosate to several chronic diseases. A fact largely unknown to the public, and to policy makers in particular, is that co-formulants or "inert" adjuvants used in the formulation of glyphosate-based products can make it more toxic than on its alone.

Glyphosate has also been shown to bioaccumulate, resulting in a concentration in the body greater than the human body can excrete. This has been confirmed in breast milk and urine samples. We still don't know what the long-term consequences of these residues in our bodies are.

In Africa, agricultural workers are the most exposed. It is known that individual personal protective equipment is either non-existent or inadequate and that spraying is often done by young people. Knowing that 90% of pesticides enter the body through the skin, an alarm has sounded regarding the health risks for this population.

The evidence accumulated to date on the toxicity of glyphosate-based herbicides to humans and animals calls for an immediate end to their use.

Two developments should also make us very vigilant:

- While industrialized countries are beginning to ban glyphosate-based herbicides, the manufacturers of these herbicides continue to sell them in countries of the South where their use is still authorized with very disturbing **co-formulants**. For instance, polyoxyethylene amine (POET, one of the co-formulants present in glyphosate-based products) has been banned in the EU since 2016, yet continues to be manufactured in China and India, where a significant portion of the glyphosate-based formulations used in Africa come from.

- Furthermore, following a possible ban on glyphosate-based products, other herbicides of particular concern will continue to flood the markets, including 2,4-dichlorophenoxyacetic acid (2,4-D amine salt), dicamba and paraquat, a herbicide that is extremely toxic to humans. **These herbicides should also be banned in Africa.**

The only way for African countries to reduce the use of glyphosate is to actively promote agro-ecological alternatives including mechanical alternatives".

<u>Mobilization against the Bayer-Monsanto Group in the United States and Europe</u>

In 2018, Bayer bought Monsanto for $63 billion, betting on the growing use of chemicals to feed an increasingly populous planet plagued by global warming. But the group has since had to deal with the controversial reputation of its American acquisition, both in the GMO seed business and in the pesticide business, activities that are the subject of various legal proceedings and political debates in many countries.

As of the end of July 2019, the German chemical and pharmaceutical company Bayer now faces 18,400 lawsuits filed in the U.S. against its subsidiary Monsanto's glyphosate herbicide. Bayer has been ordered to compensate California cancer claimants on three occasions. The amounts owed by the group in these three cases were nevertheless reduced by a second judgment, from $289 million to $78 million, from $80 million to $25 million and from more than $2 billion to $69.3 million respectively. Furthermore, Bayer plans to appeal and is challenging the very foundation of its liability, arguing that no organization in the world has concluded that glyphosate is dangerous since it was introduced in the mid-1970s.

However, in June 2020, Bayer announced that it would raise $10 billion to end the lawsuits and compensate more than 100,000 American citizens. These court cases and the ban on glyphosate in multiple countries have had a profound impact on Bayer's share price. By the end of 2020, it had fallen by more than half from its level at the end of 2017-early 2018.

<u>Mobilization against glyphosate in Argentina,</u> see video accessible via the following link: https://www.francetvinfo.fr/monde/environnement/pesticides/glyphosate/argentine-les-pesticides-au-coeur-du-debat_3841273.html

<u>Mobilization in France in 2018-2020 of citizens who have glyphosate in their urine and will file Bayer-Monsanto</u>

In April 2018, **the Glyphosate Campaign Association** (https://www.campagneglyphosate.com/) launched a national call to invite citizens to participate in a urine testing campaign to look for traces of glyphosate. The object of this campaign is:

- to show that everyone has pesticides in their body, glyphosate being one of the markers.

- to raise awareness among the general public, users and decision-makers.

- to file a lawsuit against those responsible for keeping this product on the market for endangering the lives of others, aggravated fraud and environmental damage.

More than 6,000 volunteers participated in late 2018 and 2019 in this campaign. 100% of the tests were positive [60], proof of the presence of pesticides in our body *(glyphosate is a synthetic, man-made compound and impossible to find naturally in the environment).* Hypotheses of contamination by food have been raised as well as by the air in rural areas.

Following this campaign, more than **5,500** complaints were filed in France **for "endangering the lives of others, aggravated deception and environmental harm".** The plaintiffs are targeting the CEOs and board members of all manufacturers of pesticides containing glyphosate, the presidents and members of the European Commission... In short, all those who could have a responsibility in this matter. All these complaints were directed to the health division of the Paris court in order to effect a single trial.

[60] "There is no official method for measuring glyphosate exposure levels in urine. However, two techniques are used: **the Elisa test and high performance liquid chromatography** and fluorimetric detection. The glyphosate campaign advocates have chosen the Elisa test. According to Frédéric Suffert, a specialist in plant epidemiology at INRAE, *"Scientific literature indicates that both techniques can be used to quantify glyphosate. Chromatography is probably more accurate, but more expensive"*. He also adds: *"An executory officer would have to intervene to ensure that approximately fifty samples are properly duplicated and sent simultaneously for analysis to a CHU lab for chromatography and to the Biocheck lab for ELISA. The approach would be 100% scientific and the result without appeal"*.

TOPIC 2:

Mobilization for the implementation of international conventions on pesticides.

Appendix 1 of this guide lists the main conventions regarding pesticides and other hazardous chemicals. It specifies which main active ingredients are concerned by each convention.
These are mainly the **Stockholm Convention** from 2006, the **Rotterdam Convention** initiated in 2004 by the United Nations Environment Programme, the PAN list from 2011 and including 18 highly hazardous compounds used in agriculture and also the **WHO 1a and WHO 1b** lists compiled by the WHO since 2007.

In addition **to the above international conventions, there is a convention signed in Bamako in 1991 concerning the prohibition of importing hazardous wastes and substances** *(including pesticides)* into Africa. The accompanying box describes the objectives of this convention and names the African States that have signed it. Unfortunately, 22 years after its entry into force, this Bamako Convention has not been genuinely applied in Africa. However, the elected officials and citizens of the countries that have signed it can use this text to demand its application by relying on the code established by the FAO (cf. http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/Annotated_Guidelines_FR.pdf).

An existing legislative framework to be tightened: example of the Bamako Convention on the prohibition of the import of hazardous waste into Africa

Established in 1991 in Bamako, Mali, by twelve nations of the Organization of African Unity and entered into force in 1998, the Bamako Convention is a response to Article 11 of the Basel Convention, which encourages parties to enter into bilateral, multilateral and regional agreements on hazardous wastes to help achieve the Convention's objectives. **This convention prohibits the import into Africa of hazardous wastes, including radioactive waste,** its incineration or dumping into the ocean and inland waterbodies. It promotes the minimization and control of transboundary movements of hazardous waste within the African continent. It also aims to improve and ensure environmentally sound management and handling of hazardous wastes in Africa, as well as cooperation among African nations.

The Convention has extended its scope to include hazardous substances, a category under which most hazardous pesticides fall *(cf. its Article 2[61]).*

Extracts from the preamble of the Bamako Convention:
"The Parties to this Convention,

1. are fully aware of the growing threat to human health and the environment posed by the increasing complexity and growth of hazardous waste production; [...]

[61] https://au.int/sites/default/files/treaties/7774-treaty-0015_ _bamako_convention_on_hazardous_wastes_f.pdf

4. reaffirm the fact that States should ensure that the producer fulfills its responsibilities for the transport, disposal and treatment of hazardous wastes in a manner consistent with the protection of human health and the environment, regardless of where they are disposed of;

6. also recognize the sovereign right of the states to prohibit the import and transportation of hazardous wastes and substances on their land for reasons relating to the protection of human health and the environment,... ".

Although ratified in 1998, it was not until 2013 that the parties held their first conference. However, a third COP-3 conference was held in Brazzaville in February 2020.

The following African States have ratified the Convention: Benin, Burkina Faso, Burundi, Chad, Cameroon, Comoros, Congo, Ivory Coast, DRC, Egypt, Ethiopia, Gabon, Gambia, Libya, Mali, Mauritius, Mozambique, Niger, Senegal, Sudan, Tanzania, Togo, Tunisia, Uganda, Zimbabwe, to which Angola, Guinea-Bissau, Liberia and Rwanda have been added since 2018. In total, in 2020, **29 states out of the 54** in Africa have ratified the Convention. Other African States must still be persuaded, and there is still much to be done to ensure that this Convention is applied[62].

Finally, it should be mentioned that the Bamako Convention does not deal with the **use** of hazardous products such as pesticides. For these products, the legislative framework depends on national regulations and laws.

[62] "The Bamako Convention is not actually applied in Africa, even 22 years after entering into force. This treaty of African nations prohibiting the import of any type of hazardous waste to Africa is still a mirage for most countries on the continent" (cf. https://www.afrik21.africa/afrique-22-ans-apres-la-convention-de-bamako-sur-les-dechets-dangereux-a-la-peine/ - 17 février 2020).

NOTES

STRATEGIES THAT CAN BE DEFINED FOLLOWING THE TRAINING COURSES

A BRIEF OVERVIEW OF THREE STRATEGIES IS PROVIDED BELOW:

1. Strategy defined by a regional FO
2. Strategy defined by a national Professional Agricultural Organization
3. Strategy that may involve ECOWAS countries and a combination of stakeholders

1. STRATEGY DEFINED BY A REGIONAL FO

For example, below is the strategy devised at the end of the training workshop carried out in Dapaong, Northern Togo, in 2014 *(42 participants, including 22 farmer leaders who are members of the partner farmers' organization, the Regional Union of Cereal Producers of the Savannah Region - UROPC-S - and some 20 technicians from various organizations)*. It included the following activities:

1. Better understand the reasons why farmers use pesticides and veterinary drugs. This will make it possible to provide more suitable advice and achieve a reduction in the use of the most hazardous products.

2. Develop training modules and organize training courses together with farmers at the level of all communities or the canton.

3. Improve the skills of project employees and UROPC-S members with regard to identifying the main pests and key points of their biology, and raise farmers' awareness for these issues.

4. Make an inventory of existing traditional practices that reduce or eliminate the use of the most dangerous pesticides, test them, validate them with the support of research structures (e.g. ITRA) and then disseminate them.

5. Make an inventory of existing traditional animal care practices, test them, validate them and disseminate them.

6. With the support of ITRA, test some bio-pesticides produced by some NGOs (in this case, the NGOs ARFA and AGIDE) and determine the economic viability of treatments.

7. Use various media to inform farmers about the proper use of registered pesticides.

8. Identify where registered products are sold and inform producers.

9. Include sellers of registered products in upcoming training courses.

10. Support and promote thegrouped supply of pesticides by UROPC-S to sellers of registered products (the aim being to obtain better prices but also to reduce the use of unregistered products of dubious quality from Ghana).

11. Partner with registered pesticide vendors to develop a packaging management system within the UOPC *(cantonal member unions of UROPC-S).*

Note: Due to the short duration of the EU- and FGEF-funded projects (3 and 4 years respectively) and the insufficient involvement of ITRA and a number of farmer leaders, this strategy was only partially implemented at the level of men's plots. On the other hand, it has been much better integrated and implemented in the vegetable growing plots managed by women.

2. STRATEGY DEFINED BY A NATIONAL PROFESSIONAL AGRICULTURAL ORGANIZATION LIKE RECA NIGER

In terms of pest control, more effective management of pesticides and promotion of more agro-ecological alternatives, the national network of Niger's chambers of agriculture produces numerous technical sheets and guides (see https://reca-niger.org/spip.php?article686) and provides **training on pesticides and alternatives for the chambers' agricultural advisors, as well as for farmers' training courses**, which run 2 to 3 half-days per week over 4 to 5 months (300 male and female farmers are trained per year).

Training for **farmer monitors** has been recently carried out at various vegetable growing plots in order to be more familiar with pest cycles and, in particular, to promote reflection together with the farmers both regarding the **use of pesticides** (organic or not) and **crop calendars** *(interaction between these two topics being very substantial).*

Network exchanges via Whatsapp are used by RECA Niger advisors to identify pests and share control methods.

3. STRATEGY THAT MAY INVOLVE ECOWAS COUNTRIES AND A COMBINATION OF STAKEHOLDERS

This guide, as well as the training tools designed by RECA Niger, the Malian CNOP, etc., and the resulting training, could become major elements of "better territorial management for agroecological transition".

These tools aim to train a new generation of technicians and professional managers. They are firmly established within the framework of the efforts required to renew the importance of agronomic and environmental sciences and agro-ecological practices in all their facets: scientific, technical, health, environmental, socio-economic, and regulatory.
These tools could also be made available to all agricultural education institutions.

A **regional network** such as the Alliance for agroecology in West Africa (3AO) could support these approaches by taking into account the very different problems of the three agro-climatic zones of West Africa: Sahelian, Sudanian and Guinean.

Created in 2018, this platform already brings together nearly 70 members, including farmers' organizations, research institutions and NGOs, including AVSF, all involved in actions to promote and support the agro-ecological transition in various West African countries.

The alliance, whose secretariat is handled by ROPPA[59], is a relevant representative body for multiple stakeholders that assumes a coordinating role, provides information, and promotes synergies between organizations and levels of action for increasing the impact of agroecological initiatives in the subregion.

Beyond the members, this platform is attracting the interest of public authorities such as ECOWAS, which is expected to support the alliance within the framework of its agroecology program implemented with the technical assistance of the AVSF-IRAM-INADES international consortium. The evolving action plan of 3AO is organized around different priorities such as the strengthening of training and farmer learning systems, the consolidation of the agroecological network and the mobilization of civil society, the development of participatory research and the combination of science and farmer know-how.

The members are committed to being involved in the implementation of the collaborative action plan, through the animation and support of various initiatives within the framework of these priority axes and according to their own objectives and means. To date, the action plan does not include a specific initiative on the reduction of pesticides and training in agroecological alternatives.

Such an initiative could be proposed by AVSF, with the support of other members working in this field (Gret, Agrisud, CARI, CIRAD, etc.), in order to launch an initial test phase for the implementation of training, which would enable the adaptation and improvement of the guide's content.

The system should also include producers' organizations (representative, technical and economic) such as RECA Niger or CNOP, as well as public services (research institutes, outreach services, plant protection, animal and human health).

Although this initiative's core work would continue to be **training** on the key topic of reducing pesticide use and promoting alternatives in animal and plant production, the regional focus and the link to ECOWAS could also make it possible to address issues at the local, national and regional levels of **enforcement of regulations, their application and control of pesticide markets.**

These activities could be based on the international code of conduct established by the FAO for the distribution and use of pesticides. This code provides a framework for the life cycle management of pesticides and was drafted for the attention of governments, the pesticide industry and other stakeholders involved in pest control and pesticide management to prevent harm to pesticide users, the public and the environment[64].

[63] Réseau des Organisations Paysannes et des Producteurs Agricoles de l'Afrique de l'Ouest (Network of Smallholder Farmer Organizations and Agricultural Producers of West Africa)(http://roppa-afrique.org/spip.php?article552)
[64] http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/Annotated_Guidelines_FR.pdf

NOTES

APPENDICES

LIST OF APPENDICES

[1] That is, the level of harmfulness coupled with the level of exposure to these products (cf. Glossary).

APPENDIX 1
List of active ingredients used in pesticides that are banned by international conventions

The following conventions are in place:
- **The Stockholm Convention:** the POP list "Persistent Organic Pollutants" dated 2006.
- **The Rotterdam Convention:** the PIC list "Prior Informed Consent" from 2004 and initiated by the United Nations Environment Programme.
- The **PAN 12 list,** dating back to 2011 including a list of the 18 most hazardous compounds used in agriculture.
- **The WHO lists WHO 1a and WHO 1b:** These two lists classify extremely hazardous compounds (1a) and highly hazardous (1b) to health. It was established by the WHO, the World Health Organization. It dates back to 2007.
- The **Montreal Protocol**, dating back to 1987 for the protection of the ozone layer.

Substances prohibited by international conventions	POP	PCP	PIC	WHO 1a	WHO 1b	Montreal Protocol
1,2 dibromethane (ethylene dibromide) (EDB)		x	x			
1,2 dichloroethane (ethylene dichloride)		x				
2,4,5-T (2,4,5 trichlorophenoxyacetic acid) and its salts and esters (dioxin contamination)		x	x			
3-chloro-1,2-propanediol (Alpha-chlorohydrin)					x	
phenylmercury acetate (PMA)				x		
copper aceto-arsenite (Paris green)					x	
acrolein					x	
allyl alcohol					x	
aldicarb			x	x		
aldrin	x	x	x			
alpha HCH (alpha-hexachlorocyclohexane)	x					
asbestos (such as crocidolite, actinote, antho-phyllite, amosite and tremolite)		x				
lead arsenate					x	
calcium arsenate					x	
sodium arsenite					x	
azinphos-ethyl					x	
azinphos-methyl	x				x	
beta-cyfluthrin					x	
beta HCH (beta-hexachlorocyclohexane)	x					
binapacryl		x				
blasticidin-S					x	
brodifacoum				x		
bromadiolone				x		
bromethalin				x		
methyl bromid						x
butocarboxim					x	
butoxycarboxim					x	
cadusafos (ebufos)					x	
captafol		x		x		
carbofuran					x	
chlordane	x	x	x			
chlordecone (Kepone)	x					
chlordimeform		x	x			
chlorethoxyfos				x		
chlorfenvinphos					x	
chlormephos				x		
chlorobenzilate		x				
chlorophacinone				x		
mercury chloride		x		x		
mercury and its compounds (mercury oxide, mercury chloride (calomel), phenylmercury acetate (PMA), oleate, phenylmercuric (PMO), alkyl mercury, alkyloxyalkyl and aryl mercury compounds)		x				
coumaphos					x	
coumatetralyl					x	
calcium cyanide				x		
sodium cyanide					x	
cyfluthrin					x	
DBCP (dibromochloropropane)			x			
DDT (dichlorodiphenyldichloroethylene)	x	x	x			
demeton-S-methyl					x	
dichlorvos					x	
Dicrotophos					x	
dieldrin	x	x	x			
difenacoum				x		
difethialone				x		
dinoseb (acetate and salts)		x				
dinoterbe					x	
diphacinone				x		

disulfoton				x		
DNOC and salt (ammonium, potassium, sodium)		x			x	
polychlorinated biphenyls/PCBs (except mono and bichlorinated)(Aroclor)	x	x				
Dustable powder						
edifenphos (EDDP)					x	
endosulfan	x					
endrin	x		x			
EPN				x		
ethiofencarb					x	
ethoprophos (Ethoprop)				x		
famphur					x	
fenamiphos					x	
flocoumafen				x		
flucythrinate					x	
fluoroacetamide		x			x	
sodium fluoroacetate (1080)				x		
formetanate					x	
furathiocarb					x	
heptachlore	x	x	x			
heptenophos					x	
hexachlorobenzene (HCB) (benzene hexa-chloride)	x	x		x		
hexachlorocyclohexane mixture of isomers		x				
hexachlorocyclohexane HCH/BCH	x		x			
isoxathion					x	
lindane (gamma-HCH)	x	x	x			
mecharbam					x	
bolybrominated biphenyl mixture (com-pound) (PBB)		x				
methamidophos		x			x	
methidathion					x	
methiocarb (mercaptodimethur)					x	
methomyl					x	
methylparathion		x	x	x		
mevinphos				x		

mirex	x					
monocrotophos		x			x	
nicotine					x	
omethoate					x	
oxamyl					x	
ethylene oxide (oxirane)		x				
mercury oxide		x			x	
oxydemeton-methyl					x	
paraquat		x				
parathion		x	x	x		
pentachlorobenzene	x					
pentachlorophenol (PCP), its salts and esters		x	x		x	
phorate				x		
phosphamidon		x		x		
zinc phosphide					x	
phostebupirim				x		
tetraethyl lead		x				
tetramethyl lead		x				
propetamphos					x	
strychnine					x	
thallium sulfate					x	
sulfotep				x		
tebupirimfos (phostebupirim)				x		
tefluthrin					x	
terbufos				x		
thiofanox					x	
thiometon					x	
toxaphene	x	x	x			
triazophos					x	
polychlorinated triphenytes (PCT)		x				
tris-phosphate (2,3-dibromopropyle)		x				
vamidothion					x	
warfarin (coumaphene)					x	
zeta-cypermethrin					x	

APPENDIX 2

Village survey guides on management of pesticides and their alternatives

Listing of agricultural pesticides found in the villages and, for each of them, active ingredients and primary uses

Commercial names	Product active ingredients	Pesticide type[65]	Crops concerned

How these pesticides are to be used (with or without boots, gloves, suits and masks, whether or not the wind is taken into account, frequency of treatments without any precautions)

Health incidents documented in the villages surveyed

[65] Herbicides, fungicides, insecticides*(NB: Acaricides and nematicides will be classified with insecticides)*

Examples of alternatives known to some farmers that do not (only) use these chemical pesticides (for each alternative, ease and frequency of application)

APPENDIX 3
Overview of surveys on the mode of management of pesticides in 3 villages in Kita Cercle, Mali

Surveys conducted by Sékou Traoré, member of UR-CUMA 09/29/2018

Last name and first name of farmer surveyed And village	Where are the containers stored	If locally, are they locked?	What must be worn for specific treatments (clothes, footwear, gloves)?	After treatment, where is the outfit kept?	Who washes the clothing and footwear?	How does the person who performed the application wash him or herself?
Django Keita Dougoura-coroni	Location near the house for full drums Village store for empty drums	Yes Yes	Personal clothing used Neither gloves nor a masque (only in the presence of dust) Closed foot-wear	Location on the field or in a tree	Himself	Bathing at the waterhole and then shower at home
Abdoulaye Keita Dougoura-coroni	Location on the field for full drums Village store for empty drums	Yes Yes	Full-body suit, boots and gloves obtained from WTDC	Location on the field or in a tree	Himself	Bathing at the waterhole and then shower at home
Mahamadou Kéita Kolondi	Full con-tainers kept at home Empty containers discarded on the field	Yes	Personal clothing used Neither gloves nor a masque (only in the presence of dust) Closed foot-wear	Location on the field or in a tree	His wife	Bathing at the waterhole and then shower at home
Mamadou Kéita Kolondi	Full con-tainers kept at home Empty containers buried on the field	Yes	Personal clothing used Neither gloves nor a masque (only in the presence of dust) Closed foot-wear	On a tree in the field	Himself	Bathing at the waterhole and then shower at home
Tiemoko Kéita Kolondi and 3 surveys at Siranikoro	Full con-tainers kept at home Empty containers burned on the field	Yes	Personal clothing used Neither gloves nor a masque (only in the presence of dust) Closed foot-wear	On a tree in the field	Himself	Bathing at the waterhole and then shower at home
Fadiala Kéita Siranikoro	Full con-tainers kept at home Empty containers burned on the field	Yes	Personal clothing used Neither gloves nor a masque (only in the presence of dust) Closed foot-wear	On a tree in the field	Himself	No watering hole. He goes straight home to wash.

Appendix 4

Information collection guide on natural preparations used in villages in crop production.

(document based on the work of asproPNPP)

Document for each preparation

Name of the preparation: Crops: Objectives of the preparation:

Primary materials used:

- Name of the plants
- Date of harvest of the plants used and time of harvest (morning, evening etc.)
- Place where the plants used were harvested
- Indicate the part of the plant used (leaf, root, wood etc.)
- ☐ Fresh plant ☐ Dry plant

Description of the different steps of the procedure, specifying if necessary:

- The container(s) used (size and material)
- Solvent(s) used or any other ingredients added (quantity and time when added)
- If the preparation is obtained through soaking, specify means for determining the total duration of this step. This time can be described according to the criterion(ia) obtained by the operator (e.g.: time, visual characteristic, odor, physicochemical parameters of the solution, others;)
- If the process involves a heating step, specify the means used to evaluate the temperature of the preparation and the heating time (e.g. visual characteristic, smell, physico-chemical parameters of the solution, time, other temperatures);
- If a filtration step is required, describe the filtration process;
- If a distillation step is required, describe the distillation process;

Packaging of the preparation:

Storage condition and storage time before application

Application

- Application date:
- Crop stage:
- Crop condition:
- If water is added, specify the quantities:
- Does the preparation need to be mixed before use:
- How much preparation for the respective field size?
- Specify the time and weather conditions for application
- Which part of the plant or field is the preparation is applied to?

APPENDIX 5
Guide for the collection of ethnoveterinary practices.

Proposal based on the veterinary thesis work of François RUAUD in Madagascar in 2018[66]. This guide is based on the "ethnoveterinary question list" protocol (Grandin and Young 2001) which recommends first collecting information on the farm environment: understanding the farming system and targeting the species raised; then establishing a list of diseases encountered by the farmers. The second step involves addressing a list of questions (see the tables below) regarding a given pathology and its associated treatment and to repeat this list as many times as necessary.

a) survey questionnaire

N°: Date: District: Duration of interview:
First and last name: Community: Fonkontany:
Sex: Locality: Agroecological zone:
Age: Number of persons involved: Contact:
Ethnicity: Primary activity: Secondary activity:
Literacy: Health workers:

Animals bred	**Cattle**	**Goats**	**Sheep**	**Pigs**	**Poultry**
Species/ breeds					
Housing					
Feeding					
Primary diseases/ symptoms (underlined if a traditional treatment exists)					
Tick prevention					

[66] RUAUD, F. (2018). "Etude ethnovétérinaire des pratiques thérapeutiques et préventives d'éleveurs du Sud de Madagascar" (Ethnoveterinary study of therapeutic and preventive practices of livestock farmers in Southern Madagascar) (Androy and Anosy regions), doctoral thesis, Faculty of Medicine of Nantes, Oniris: Ecole Nationale Vétérinaire, Agroalimentaire et de L'alimentation Nantes Atlantique (Nantes-Atlantic National College of Veterinary Medicine, Food Science and Engineering), 316 p.

PATHOLOGY DOCUMENT

Disease name(s)			
Specie(s) affected			
Age category			
Seasonality			
Contagiousness			
Favoring factor			
Symptoms			
Duration of progression			
Progression without treatment			
Disease prevention			

MEDICINAL PREPARATION FORM

Name of the preparation Preventive/curative			
Introduction method			
Procurement method (cost)			
Dosage			
Frequency			
Duration			
Toxicity			
Source of knowledge			
Other targeted diseases			
Conservation			
Assessment of effectiveness			
Conventional treatment (yes/no), cost and selection			

DISCUSSION REGARDING TRADITIONAL VS CONVENTIONAL MEDICINE

Disease name(s)		
Traditional medicine (plant-based treatment)		
Conventional medicine (synthetic drugs, vaccines...)		

b) List of questions to address to complete the pathology and medicinal preparation tables

1/ Which diseases (or clinical signs) are frequently observed in breeding?
Response objectives: list of diseases/syndromes by species.

2/ For which diseases do you know of traditional remedies?

3/ To assess each disease: list of questions for each disease:
- What is (are) the local name(s) given to the disease/syndrome?
- Which animals are affected?
- Are the young animals affected? Are the adults affected?
- When (at what time of year) does the disease appear?
- Are all the animals affected at the same time? (of 10 animals, how many are affected at the same time?)
- Are you aware of one or more factors that promote the emergence of the disease?
- How do you recognize the disease (symptoms)?
- How long does it take for the disease to develop?
- What happens if nothing is done? (Death or healing?)
- What can be done to prevent the disease from emerging?

4/ The following list of questions provides details on the treatment:
- What is the local name for the medical preparation?
- How do you obtain the treatment (self-prepared, traditional practitioner, veterinary assistant, veterinarian, market)

➔ If self-prepared:
- What are the preparation ingredients?
- How do you prepare the treatment?
- What dose do you administer, how often and how long does treatment take?
- Is there a risk of toxicity and how do side effects manifest themselves?
- Who taught you the recipe (family heritage, traditional practitioner, advice from another livestock farmer, veterinarian, assistant…)
- Is this treatment also effective against other diseases?
- Can this treatment be conserved, if so how?
- Do you find this treatment effective? (does it offer an effective cure? Of 10 diseased animals, how many heal?)

➔ If the treatment is provided by a third party
- Who applies the treatment?
- How much does the treatment cost?
- What dose do you give, how often and how long does treatment take?
- Do you follow the advice given (dosage and duration)?
- Do you conserve the treatment for future use?
- Do you know of a synthetic veterinary medication that would be effective for treating the disease?
- What does it cost?
- Why do you prefer the traditional treatment?

5/ Do you use traditional medicinal preparations to fight external parasites (in particular, ticks)?

6/ Do you know of other plants that could be used to treat the animals?

APPENDIX 6

List of studies on ethno-veterinary practices carried out within the scope of AVSF's activities.

Country	Date	Author/ articling student - contact	Document type	Practical tool/devel- oped land Document available	Direct links to online doc- uments when available
World	2004	Baldomero Molina Flores		Reasoned bibliographical review (doc. in English, Spanish and French)	
Mali		Marc Chapon		Excel table summarizing some traditional practices in northern Mali	
Brazil	2009	Emmanuel Bayle		Guide written in Portuguese on the use of medicinal plants on livestock in Brazil (Uso das plantas medicinais na criação animal)	https://fr.scribd.com/doc/124567746/USO-DAS-PLANTAS-MEDICI-NAIS-NA-CRIACAO-ANIMAL
Columbia Equateur	2012	Amélie Cornillet	Vet thesis	Booklet "CONOCIMIENTO ANCESTRAL INDÍGENA EN SALUD ANIMAL" 50-page booklet on key remedies in dairy farming referenced in Appendix 2 of the thesis + field trial results (to be recovered)	http://kentika.on-iris-nantes.fr/ListRecord-Visio.htm?idlist=5&re-cord=19283937124910011199 https://www.avsf.org/fr/posts/1678/full/conocimien-to-ancestral-indigena-en-sa-lud-animal-en-el-territo-rio-de-los-pastos-colombia
Togo	2014	ITRA Stefano/ Adom Aliti		Table summarizing some traditional recipes in North-ern Togo (ITRA)	
Cambodia	2013-2014	Victoire Delesalle	Vet thesis	Use of medicinal plants in chicken, pig, cattle and buf-falo farmings in Cambodia	http://theses.vet-alfort.fr/telecharger.php?id=2114
Equateur	2015	Fanny Parenton	Vet thesis	Practical guide (draft) "Guía práctica para la crianza agroecológica de los espe-cies minores"	http://oatao.univ-toulouse.fr/13339/1/Parenton_13339.pdf
Guatemala	2017	Sophie Polydor	Vet thesis	Practical guide for farming families and agro-veterinary promoters – 22p (Appen-dix 6)	http://oatao.univ-toulouse.fr/17632/
Bolivia	2017	Richard Labone	Vet thesis	Manual de Etnoveterinaria en la crianza camélida (in Spanish) Guía de medicina natural para las llamas	https://www.avsf.org/fr/posts/2118/full/man-ual-de-etnoveterinar-ia-en-la-crianza-cameli-da-en-bolivia http://kentika.oniris-nantes.fr/GED_BHV/194460291264/na_15_127.pdf
Madagas-car	2018	François Ruaud	Vet thesis	No	http://kentika.on-iris-nantes.fr/ListRecord-Visio.htm?idlist=2&re-cord=19317943124911351259
Columbia	2020	Marine BENOIT and Adrien DEMILLY	Volun-tary ser-vice (6 months) for the ECOPAZ project	Dissertation "Inventaire des pratiques thérapeutiques traditionnelles et mise en place de mesure de lutte contre les mammites de la vache laitière dans la région de Pasto – Nariño – Colombie" (Analysis of traditional therapeutic prac-tices and implementation of measures to control mastitis in dairy cows in Columbia's Pasto-Nariño region) 2 technical leaflets in Span-ish – treatment of guinea pigs and protocol for the management of bovine mastitis: Cartilla cuyes y Cartilla mastitis	Online publication on Ruralter in progress

Examples of complementary publications that can be consulted (non-exhaustive list):

- Identification of some plants used in ethnoveterinary medicine in Sinematiali (Northern Ivory Coast): https://m.elewa.org/Journals/wp-content/uploads/2019/03/3.Kone-Cedessia.pdf
Special dossier: "Médecine ethnovétérinaire" (Ethnoveterinary medicine) from la revue Ethnophar-macologia, volume 62, 2019: http://www.ethnopharmacologia.org/boutique/ethnopharmaco-logia-62-decembre-2020/

- Connaissances ethnovétérinaires des pathologies camélines dominantes chez les Touaregs de la région d'Agadez (Niger) (Ethnoveterinary knowledge of dominant camel diseases among the Tuaregs of the Agadez region (Niger)), 2006:
http://camelides.cirad.fr/fr/science/pathotouareg1.html

Also as an example, the box below includes some clinical signs and control practices by livestock farmers observed in village contexts by ITRA (Togolese Institute of Agronomic Research) in Northern Togo and some related research questions.

Clinical signs described by the livestock farmer	Disease suspected by the specialist	Village control practices
Loss of appetite Bird plumage puffed up Greenish diarrhea Enlarged head Leg paralysis Torticollis and sudden death	New Castle disease	The poultry farmer adds the following bark types to the drinking water: - cashew tree (anacardium occidentalis); - African locust bean (parkia biglobosa); - mango tree (manguifera indica); - or African mahogany (khaya senegalensis). Tobacco, aloe vera, neem (azadiracta indica) or chili leaves are sometimes used.
Presence of bumps or nodules on crest, barbs, beak and around the eyes	Avian pox	Mixture of potash (or traditional soap) and red palm oil. Lemon juice and ash mixture, Baobab fruit powder, African locust bean, or shea butter
Extremely weak, diarrhea Loss of appetite, Presence of worms in droppings	Internal parasitic diseases	Powder of leaves or bark of tobacco, shea butter, cashew, moringa and papaya seeds or potash in drinking water.
Diarrhea (whitish, gray, yellow, green or bloody)	Coccidiosis Salmonellosis Avian cholera (pasteurellosis)	Barks of African locust bean, shea, African mahogany, cashew, neem, vernonia sp, euphorbia hirta Lemon juice
Diarrhea (whitish, gray, yellow, green or bloody)	Coccidiosis Salmonellosis Avian cholera (pasteurellosis)	Barks of African locust bean, shea, African mahogany, cashew, neem, vernonia sp, euphorbia hirta Lemon juice
External bloodsucking parasites	Ticks Fleas	To kill ticks and fleas, farmers use bamboo, lemongrass and calotropis procera leaves, as well as banana peels, onion slices and potash

APPENDIX 7
List of active neonicotinoid-type substances or substances with an equivalent mode of action recognized as very harmful to domestic and wild bees

(These substances are banned in France and/or partially in the EU)

Active substance	Family
Acetamiprid	Neonicotinoid
Clothianidine	Neonicotinoid
Dinotefuran	Neonicotinoid
Flupyradifurone	Organochloride
Imidalclopride	Neonicotinoid
Nitenpyran	Neonicotinoid
Sulfoxaflor	Sulfoximine
Thiaclopride	Neonicotinoid
Thiamethoxam	Neonicotinoid

APPENDIX 8
Exercise to improve the use of synthetic and natural pesticides

Exercise used in Kita, Mali in 2018 and designed during training based on farmers' practices participating in these two training courses

Note: Farmers in these cotton-growing areas use numerous carcinogenic, mutagenic and reprotoxic pesticides (= CMR). Most of those mentioned below are nevertheless authorized by the CSP. Few of them have understood the mode of action of the products, which occasionally leads to very inappropriate applications. **When it comes to chemical pesticides or natural products, it is always very beneficial to consider their mode of action.**

This exercise was conducted in Kita in groups of 5 to 6 people (farmers and technicians mixed). Its lasted a total of approximately 3 hours (1h30' for the exercise itself and the same amount of time for the feedback). It allowed for valuable discussion regarding the preparation of the spray mixture, how they are used depending on the products, crops and climatic conditions. It also provided an opportunity to discuss the need for proper protection when preparing or spraying a certain spray mixture from natural products with tobacco or neem.

1. Name a total weed killer (which destroys all plants) absorbed via the leaves and the name of a selective herbicide for corn that is primarily absorbed via the roots *(selective herbicide = herbicide that does not destroy the crop to which it is applied).*

Answer: As total weed killers, products based on glyphosate such as Kalach and many others (very long list of commercial names) and, as selective weed killers for corn, products based on atrazine, acetolachlor or pendimethalin (also numerous commercial names).

2. What are the differences in the mode of action between pendimethalin and glyphosate?

Answer: Pendimethalin acts mainly via the roots and glyphosate via the leaves.

3. Bad weather is approaching. It could rain in the next half hour.
   a)I want to apply a glyphosate-based herbicide. Should I go ahead with application?
   b)I want to apply a herbicide based on pendimethalin (or atrazine, alachlor, acetolachlor). Should I go ahead with application?

Answers:
   a) Glyphosate should not be applied because foliar herbicides are often slowly absorbed and can be washed off by rainfall directly after application. For glyphosate, the information on the containers generally specifies 4h without rain. In fact, it all depends on the amount of rain. If there is only 1mm, then there's no problem.
   b) For pendimethalin, atrazine, acetolachlor, the opposite is true as the rain allows the product to better penetrate the soil. However, to avoid the risk of washout and to promote the penetration of the product into the soil, it is preferable to spray it on wet soil (and therefore just after the rain).

4. My corn plot is on a slope. My neighbor's cowpea plot is located below this plot. In the event of heavy rainfall, the runoff from my plot ends up on my neighbor's plot. If I use pendimethalin or atrazine for weed control on my corn crop, what problems does heavy rainfall pose?

Answer: Pendimethalin (and other products that act on the roots) can be washed onto your neighbor's plot during heavy rainfall and cause significant damage.

5-I want to apply a herbicide absorbed via the leaves but the wind is quite strong. What risk does this pose for neighboring plots? What risk does this pose for young trees on my plot?

Answer: Pesticides and in particular herbicides should not be applied when it is windy (in France, this is legally prohibited at wind speeds in excess of 19 km / hour). Damage to neighboring plots can be very severe, particularly when foliar herbicides are used. The risk can be the same for the shrubs surrounding or present in the plot. There are two methods for reducing this risk: (1) Use a cover; (2) work with low pressure and flat spray nozzles; never with the very fine droplet nozzles used to apply insecticides.

6. What happens if I use pendimethalin (or alachlor, acetolachlor and atrazine) for weed control on my corn plot and my wife has planted cowpeas, okra and guinea sorrel?

Answer: Pendimethalin (and other products that act on the roots are registered as weedkillers for corn) will be absorbed by the roots of the associated crops and will kill them or reduce their yield (legumes, okra, etc… are indeed very sensitive to these products). Another concern is that the shea, African locust bean, etc. will be unable to regenerate.

7. It is very hot and dry. Can I go to the field and apply a chemical or natural pesticide that is primarily absorbed via the leaves? (whether a herbicide, fungicide or insecticide).

Answer: When it is very hot and dry, the stomata of the leaves close. This greatly reduces the penetration of pesticide sprays. Therefore, pesticides should not be used in such conditions.

8. Name the insecticides that are fast acting on sprayed insects (however, they will have to be reapplied in the event of rain)).

Answer: Natural and synthetic pyrethrins have a fast, rapid effect. This group of insecticides includes products based on natural pyrethrum, deltamethrin, cypermethrine, lamda-cyanothrin, etc. Because they are fast acting at very low doses, they are generally less toxic to humans than other families of insecticides. On the other hand, they destroy the majority of beneficial insects… Their repeated use has many harmful effects such as the emergence of resistant insects as well as the destruction of bee populations and beneficial organisms. Such pyrethrin-based insecticides should no longer be applied as frequently!

9. Name the insecticides that penetrate the plants (they are called systemic insecticides and should not be reapplied in the event of rain).

Answer: *Most organophosphate and organochlorine insecticides penetrate plants and have a systemic effect. This is also the case for neonicotinoids such as imidachloprid (gaucho) or acetamiprid which are very harmful to bees and are highly persistent.*

10. If I want to kill as few bees (and other beneficial insects) as possible, what time of day should I apply my insecticide?

Answer: *It is recommended that you work late in the evening when bees (and other beneficial insects) are no longer in the field. However, this will not rule out an impact on the bees if they drink the dew that collects on the leaves, which may contain recently applied pesticides.*

11. Calculation: With the herbicide nozzle on my backpack sprayer, taking into account my forward speed and the type of nozzle I use, I need about 10 full backpack sprayers to treat one hectare (my sprayer holds 15 liters). To protect my cowpea plot from pod borer attacks, I bought a container of insecticide sold by an NGO (neem extract based product). It says on the container that I have to use two liters per hectare. How many milliliters (or cm3) of product should I fill in each 15 liter sprayer?

Answer: *With this type of nozzle and my forward speed, 200 milliliters of product (the tenth of the specified dose for one hectare).*

12-What type of nozzle should I use for herbicide applications? And for insecticide treatments?

Answer: *Flat jet nozzles for herbicides and mist jet nozzles for insecticides (we want ultra fine drops). For fungicides, flat jet nozzles if the vegetation to be treated is not too mature and mist nozzles if it is.*

APPENDIX 9
Practices implemented on a farm in Angers to significantly reduce the use of pesticides and eliminate highly toxic pesticides
(field report V. Beauval and J.F. Haulon)

1. Farm profile

From 1981 to 2010, GAEC de Varanne cultivated 66 ha in Louresse near Doué la Fontaine in the Saumur region. The farm consisted of an average of 15 ha of seed crops (hemp, several vegetables, etc...) and 50 ha of field crops (wheat, sunflower, beans, corn, fallow land and grass belts with grasses and white clover). Our soils are clay-limestone, often deep, with clay content ranging from 15 to 40% and pH above 7. About 30 ha are at the bottom of the valley. The farm is traversed by the pont de Varanne creek and its forebay over a length of 2300 meters near a creek which runs into the Layon, a river severely polluted with pesticides *(the quantities of pesticides found in certain months can be 20 times higher than the limit set out in the directive framework of the EU that came into force in 2015!).*

The 30 ha of the lower part of our farm include along the watercourses 2 ha of **grass belts** consisting of dactyl + fescue + white clover and lined with **3.5 km of hedges** with substantial biodiversity including hedges with multiple use *(firewood and biodiversity.*

2. Our agronomic practices to reduce the use of pesticides

Our main objective has been to test sustainable production practices while achieving relatively high productivity as our soils have significant potential. We have adopted a global approach based on frequent observations of the soil and crops, practicing crop rotation, selecting the hardiest varieties, increasing biodiversity, refraining from the use of any non-essential chemical treatments, etc...

Thanks to the agronomic choices summarized below, the objectives of Ecophyto 2018 (halving the use of pesticides) were achieved in the mid-1990s and CMR products were no longer used.

The selected practices included:

1. **Observing crop rotation:** This is of crucial importance for large crops. Our rotations are mainly quadrennial (for example, wheat/corn or beans/wheat/hemp or sunflower). Without ruminants or alfalfa, it was unfortunately difficult to perform prolonged rotations.

2. The **choice of disease-resistant varieties:** For example, by choosing our sunflower varieties carefully, we have never needed to use insecticides and fungicides on the plants.

3. For wheat, we have been using **combinations of varieties with the same characteristics** *(early maturity, baking properties, height...)* but with varying resistances to diseases for about fifteen years. By increasing the biodiversity cultivated on our plots, we are subject to fewer risks when we sharply reduce the doses of fungicides.

4.**Refraining from treating seed with systemic insecticides:** initially, rejection of the infamous "T3" which contained lindane and now rejection of Gaucho and Regent. These products raised suspicion from the start based on their toxicological profile. Many of these systemic insecticides kill earthworms and other soil fauna. However, soil vitality is an essential component of its fertility...

5. **Widespread mechanical hoeing** of spring crops *(and sometimes rape)* with a Fendt tool carrier equipped with a 6-row weeder placed between the tractor wheels.

6.For weed control in wheat: removal of substituted ureas suspected of being carcinogenic *(isoproturon, chlortoluron, etc.)* and replacement with active ingredients deemed to be of less concern *(iodosulfuron, bifenox, meso and metsulfuron, etc.)* and used at much lower doses. **The families of active ingredients are alternated in order to reduce the risks of resistance** *(wheat returns to a plot every two years, the same herbicide family returns only every 4 years).*

7. To **control slugs:** it is recommended that populations of their natural predators*(carabids for example) are maintained.* We did not use slug pellets such as measurol, whose toxicity to the soil fauna and carabid beetles raises concerns. Metaldehyde treatments are most often limited to plot edges.

8. **It is always essential to observe crops at key stages**, even if this is very time-consuming.

9. **The use of biological control whenever possible. Trichogramma** have proven effective against the corn borer for more than fifteen years.

10. **Taking into account the different degrees and forms of toxicity of phytosanitary products with the use of the ACTA phytosanitary index.** For instance, for corn, we used herbicides “exempted from classification” such as mesotrione or nicosulfuron rather than old active ingredients with a very poor toxicological profile such as alachlor or metolachlor (*products which, unfortunately, were sold widely following the atrazine ban).*

11. **Reducing doses whenever possible:** in particular, by performing treatments when humidity, wind and temperature conditions are favorable *(which, as with the observations, suggests one must wait for the right moment).*

Other GAEC practices that influence the use of pesticides and the management of weeds and pests:

12. **Sowing wheat using simplified cultivation techniques (SCT)***(several types of tools: direct seeding machine from our CUMA or a conventional seeder after very shallow tillage).* Performed after a well-cultivated summer crop *(such as sunflower, corn or hemp)*, SCTs often help to limit or avoid the use of graminicides on wheat.
1
3. The practice of **winter ploughing every other year,** specifically for spring crops *(the soil is bare from mid-December to April, i.e. generally 5 months out of 24).* We practice "agronomic ploughing" limited to a depth of 15-20 cm that helps to keep weedy grasses such as the vulpin and particularly the brome and vulpie seeds at a sufficient depth.

14. SCT sowing of **catch crops** following wheat (e.g. mustard, vetch, faba bean, at least when there is sufficient rainfall in the summer).

15. Collective trapping of coypu *(conducted in consultation with the farmers located upstream and downstream of the 2 streams crossing the farm).*

APPENDIX 10

Composition and use of 27 preparations based on natural products identified by the FFGM Northern Togo project from 2014 to 2018 in vegetable and field crops

Note: This is a basic list of sheets describing preparations based on natural products collected in Northern Togo and in other countries of West and Central Africa. The AVSF project team has not evaluated the effectiveness of the majority of these preparations.

A more scientific survey of plant-based preparations used in Africa and their effectiveness should be carried out by the CIRAD KNOMANA project of the INRA-CIRAD Glofoods metaprogram. This KNOMANA project, for "Knowledge management on pesticides plants in Africa" started in June 2017 and **aims to identify plants with pesticide use, their specific uses, their modes of action, the organisms they are likely to target** (cf. https://www.cirad.fr/actualites/toutes-les-actualites/articles/2017/science/recenser-les-plantes-naturellement-pesticides-en-afrique-knomanae and https://hal-lirmm.ccsd.cnrs.fr/lirmm-02344159/file/Martin_et_al_2019_WAOC.pdf).

At this stage, the KNOMANA project publications do not yet appear to be usable in a training guide for technicians and farmers' leaders. Let's hope that they will be very soon!

Sheet N° 01	**Neem powder for aphids and thrips**
	Preparation for 400 m²: • 1kg of neem powder in 15 liters of water • Soak for 24h • Filter without diluting and spray
Sheet N° 02	**Neem oil for aphids and thrips**
	Preparation for 400 m²: 150ml of neem oil in 16 liters of water
Sheet N° 03	**Tobacco and chili powder based acaricide**
	Preparation for 400 m²: • 1kg of soaked tobacco leaves • 100g of chili powder • 2 spoonfuls of oil • dilute the mixture in 15 liters of water
Sheet N° 04	**Preparation based on chili, garlic, onion and neem against various insects**
	Preparation for 400 m²: • 1kg of neem powder in 15 liters of water • Soak for 24h • Filter without diluting and spray
Sheet N° 05	**Neem powder for aphids and thrips**
	Preparation for 400 m²: • 100g of garlic • 500 g of onion • 50 g of chili • 500 g of neem powder • 5 liters of water • Soak for 24h • Filter and fill the contents to 16 liters
Sheet N° 06	**Dry neem leaves for numerous insect species**
	Preparation for 400 m²: • Dry the neem leaves in the shade • Crush 1 kg of the dry neem leaves into a powder • Place in 10 liters of water • Let stand for a day • Filter and treat without diluting
Sheet N° 07	**chili and soap powder**
	Preparation for 400 m²: • Crush 100g of chili powder • Dilute in 2 liters of water • Filter and add 5 times the volume of water or 10 liters • Add 10 g (2 pinches) of soap
Sheet N° 08	**Make an insecticide with neem seeds**
	Directions: • Pick or collect ripe fruits, remove the pulp (good fertilizer so do not discard) • Remove any moldy seeds • Dry the seeds in the shade • Store seeds in a dry and ventilated place (not in plastic bags)
Sheet N° 09	**Use of neem leaf powder**
	Directions: • Dilute 500g in 10 liters of water For a concentrated solution, one can add up to 1.5kg in 10 liters of water. • Let soak for 24h then filter • Add liquid soap in a dose of 1% (100ml or 100g for 10 liters of solution) • Mix well and use immediately otherwise it will lose effectiveness

Sheet N° 10	**Using neem leaves**
	Preparation for 5 liters of solution: • 2 kg of leaves (160 kg for 1 ha) • Crush or grind the leaves • Put them in water and let them soak for at least 12 hours • Filter the mixture and add 10 l of soapy water (100ml or 100g)
	Application: Dosage: Apply twice weekly in the event of severe infestation otherwise every 7 days for 50 m2
Sheet N° 11	**Use of neem oil**
	Directions: • Choose healthy dry seeds • Cold press to extract the oil • Keep the oil out of the sun and heat • Dilute the oil in 5 liters in 500 liters of water for 1ha. • Add 1ml (1g) of soap to 1l of water
	Application: • Treatment every week in case of severe infestation or every two weeks • The neem oil solution is more effective than the seed solution which is more effective than the leaf solution. • Adding soap helps the active mixtures to better adhere to plant leaves • For spraying, make sure to treat all parts of the plant • Apply the treatments the evening after watering
Sheet N° 12	**Use of neem oil**
	Directions: • **Part used:** Leaf • **Effect:** Fungicide for blight • **Directions:** finely crush 1kg of fresh leaves; mix with 1 l of water, let stand for at least 6h then filter and add 30 g of soap. This liquid is diluted in a ratio of ¼
	Application: 1l/20m2 every three days
Sheet N° 13	**Making insecticide with papaya leaves**
	Directions: • **Part used:** Leaf • **Effect:** Noctuidae and larvae, defoliators, grubs • **Directions:** finely crush 1kg of fresh leaves; mix with 10 l of water, let stand for two days, then filter and add 30g of soap.
	Application: 11l/20m2 every three 3 days

Sheet N° 14	**Make pure insecticide with papaya leaves**
	Directions: • **Part used:** Leaf • **Effect:** Fungicide • **Directions:** finely crush 1kg of fresh leaves; mix in 10 l of water, add clay; put the mixture in a container and put the lid on leaving an opening to allow air to enter; stir once a day; after 15 days of fermentation, filter and use directly without diluting.
	Application: As a preventive measure: 1l/10m2 every 15 days and as a curative measure: apply 2l/10m2 as soon as symptoms appear
Sheet N° 15	**Make an insecticide with chili peppers**
	Directions: • **Part used:** Fruit • **Effect:** Insecticide • **Directions:** crush the dry fruit. Let 2 spoonfuls of powder soak in 10 l of water for 12h. Take 2 liters of the mixture and add 4 liters of ready made soapy water.
	Application: • **As a preventive measure:** 1l/10m2 every 10 days one month before the supposed spread of the insect • **For curative purposes:** 1.5l/10m² every week
Sheet N° 16	**Make an insecticide for aphids based on chili powder**
	Directions: • 100 g finely ground chili pepper • Add 1 l of water and shake vigorously • Filter and dilute 1 part of this solution in 5 parts of soapy water
	Application: for aphids spray every week - 1liter/20 m².:
Sheet N° 17	**Make an insecticide with chili peppers**
	Directions: • Boil 500g of thinly sliced ripe chilis in 3l of water for 15 to 20 minutes. Add 30 g of soap • Add another 3 liters of water, let cool and filter.
	Application: • Application once a week if there is no rain but 2 to 3 times in case of rain. • 1 liter for 10 m²
Sheet N° 18	**Make an insecticide for locusts, borers, whiteflies based on chili, garlic and onion**
	Directions: • Mixture that can be used against locusts, chewing insects, whiteflies • 1kg of chili + 0.2kg of garlic + 0.5kg of onion + H_2O for 24h, • Filter, fill the contents in 16 liters for a sprayer.

Sheet N° 19	**Make an insecticide for bean leaf beetles based on chili, garlic and onion**
	Directions: • Mixture for use against bean leaf beetles • 30g of chili+50g of garlic+500g of onion+12lH2O soak for 24h • Filter and spray on the bean
Sheet N° 20	**Make insecticide for aphids based on chili and neem**
	Directions: • 50g of chili + 2.5kg of neem leaves • 2 spoonfuls of soap + H2O. • Let soak all night. • Filter and fill the solution to 20 liters
	Application: Spray every week for whiteflies
Sheet N° 21	**Use chili and neem to make an insecticide for aleurodes, diamondback moth and other phloem-feeding insects etc...**
	Directions: • 50 g of chili • 200g of neem powder • 4 liters of water • Soak 200g of neem powder in 4l of water for 24 h, • Then add 50g of crushed chili. • Filter and use twice a week
	Application: Spray twice weekly for whiteflies, diamondback moths, other phloem-feeding insects and chewing insects
Sheet N° 22	**Make an insecticide to control the leafroll virus from tobacco leaves and stems**
	Directions: • Crush 1 kg of dry leaves and wrap the powder in a cloth. • Soak the bundle in 9 liters of water, • Seal the container and let soak for 24h. • Crumble a piece of soap and soak 2 pinches in 1l of water, and stir well. • After 24 hours of stirring, press the firmly over the container. Remove the bundle and filter the juice containing the concoction. • Add one liter of soapy water to the filtrate.
	Application: For curative purposes: 0.1l/10m2 every 5 days
Sheet N° 23	**Use rice bran to make a product to control powdery mildew on cucurbits**
	Directions: • 1/3 liter of rice bran • Mix in 10 liters of water. • Let soak for 6h. • Filter and use directly without diluting.
	Application: For curative purposes: 0.1l/10m2 every 5 days

Sheet N° 24	**Use of moringa leaves against seedling damping-off**
	Directions: • **Part used:** moringa leaves • **Effect:** seedling damping-off • Bury fresh leaves in pots or seedbed in an amount of 1kg/m².
	Application: Spray twice weekly for whiteflies, diamondback moths, other phloem-feeding insects and chewing insects
Sheet N° 25	**Use garlic bulbs to make an insecticide for aphids**
	Directions: • **Part used:** Garlic bulb • **Effect:** insecticide (aphids) • **Directions:** dry and crush the garlic cloves when they are well dried. • Soak 2 spoons of powder in 10l of water for 12 hours. • Mix 2 liters of preparation with 4 liters of soapy water.
	Application: • As a preventive measure: 1 month before the proliferation of the insect, apply every 10 days 1l/10m² • For curative purposes: 1.5l/10m² every week
Sheet N° 26	**Make a citronella-based bactericide**
	Directions: • **Part used:** whole lemongrass plant • **Effect:** bacteria • **Directions:** grind 50g of leaves. • Let soak for a few minutes in 2 liters of hot water; filter.
	Application: •As a preventive measure: spray the soaked mixture + soapy water at a rate of 3l/10m2 every 2 weeks
Sheet N° 27	**Preparation of a broad spectrum insecticide based on chili, garlic and onion**
	Directions: • **Part used:** fruit, bulb • **Effect:** large-spectrum insecticide • **Directions:** crush 1kg of garlic, onion, chili and a small soap pellet. • Let everything soak in 4 liters of water for at least 5h. • Filter
	Application: • As a preventive measure: 3 liters/ha every 2 weeks. • For curative purposes: 6 liters/ ha every 2 weeks

APPENDIX 11
Training module on natural treatments (CNOP Mali)

TRAINING MODULE IN AGROECOLOGY NATURAL TREATMENTS

Page 1

Principal objective

Promotion and expansion of natural treatment methods in smallholder farming.

Specific objectives

*See the **charter** for the common topic*
Farmer agroecology and the charter

Topic 1
Challenges of natural treatments

Topic 2
Principles for preparations

Topic 3
Neem and soap an effective combination

Topic 4
Identify and treat damage on plant leaves

Topic 5
Natural preventative and curative treatment for some legumes

Topic 6
Organize collectively

Topic 7 :Collective evaluation

Expected outcomes

*See the **charter** for the common topic*
The women smallholder farmers have adopted the farmer agroecology charter

Topic 1
Explain the various challenges associated with natural treatments

Topic 2
What precautions are to be taken:
For collecting the ingredients
For the material

Topic 3
Know the 2 neem recipes
Explain the role of soap
Explain the role of insects and particularly bees

Topic 4
Know how to identify damage, its cause and natural treatments to be applied

Topic 5
Know how to identify the causes of damage
Know how to apply the natural treatments to vegetables

Topic 6
Know how to get organized collectively and identify strategies for developing natural treatments

Topic 7
Know how to assess

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TOPIC 1: CHALLENGES OF NATURAL TREATMENTS

Page 3

In our struggle **for food sovereignty and agroecology for farmers, we face many challenges in relation to land,** water and natural resources. By applying different agroecological practices: the combination and rotation of crops, agroforestry, composting, crop biodiversity with farmer seeds or local breeds, balancing our ecosystems and agrosystems, diseases and pest infestation that impact our crops are considerably reduced while at the same time we protect our health and our environment with healthier products.

Chemical products arrived 70 years ago alongside new cultivation techniques and widespread use of machinery approximately. Today, the outcome is catastrophic.

Deterioration of the environment
- Pollution of waterbodies and soils
- Depleted and barren land
- Adaptation of "weeds" and pests to chemicals requiring higher and higher doses, even if they are called microdoses
- Ecosystems, flora and fauna disturbed or destroyed
- Loss of biodiversity
- Soil erosion

Deterioration of health
- Rise in diseases: cancer, deformities...

Social deterioration
- Development of agriculture

DDT is the first known chemical to appear in the 1940s, contaminating humans, animals, plants and the soil, it has been banned but not entirely in Africa!

In spite of the use of chemical products, **1/3 of harvests are consistently lost** because of various parasites that are able to multiply as the result of large-scale monoculture and the use of selected varieties with increasingly fragile genetic heritage.

In the United States **thousands of hectares have been abandoned** because the fields infested with amaranth can no longer be farmed.
Chemicals are expensive, often not conforming to the label and tie farmers to suppliers **with whom they often accumulate debt.**

Today, **farmer innovations in natural treatments** cannot be commercialized because the standardized approval process is made by and for big business and is neither adapted to our means, nor to our needs nor does it preserve our knowledge and know-how of our farmers.

They make a profit by making us sick and treating us!

Six multinationals control the agrochemical sector: **Syngenta, Bayer, Monsanto, Dow, Basf and Dupont.** They are known as the "Big 6". They dominate a virtually unshared colossal market worth 50 billion euros .

These are the same people who make GMOs and hybrid seeds with poor reproductivity, or even sterile ones like the Terminator, which require extensive chemical inputs to achieve a proper yield
These are the same people who own pharmaceutical plants like Novartis

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TOPIC 2: PRINCIPLES FOR THE PREPARATIONS

Page 5

WARNING

The material should only be used for preparing natural treatments!

- Do not use for other purposes
- Do not leave materials or preparations within reach of humans or animals
- Put on gloves

Essential materials

Mortar and pestle, buckets, sieves, sprayer, containers, cloths, gloves...

Filtering technique

After preparing the solution, let it stand for 24 hours, use a clean cloth or sieve to filter the required amount and process immediately.

Be responsible when collecting ingredients

- When collecting, be responsible so as to conserve and allow for adequate replenishment
    - Ensure that the plant, tree or shrub can still reproduce
    - If needs increase, grow crops or plantations with farmer seeds, preferably in collective spaces.
- Choose plants in good condition
- Use clean or even disinfected sharp instruments to:
    - remove or cut the plants so as not to kill them by removing their roots
    - leave branches on trees or shrubs to keep them growing
- Respect the reproductive cycles of the plants, do not cut at the time of flowering
- Do not collect them in areas where pesticides or other contaminants may be present or used, such as roadsides, garbage dumps, gutters, areas surrounding mines, toilets...
- Do not disturb the habitat of fauna and

The role of insects

All organisms in our crops help to keep its ecosystem in balance. The use of weed killers, treatment products and soluble chemical fertilizers destroys this balance. Keep in mind that even our preparations can destroy this balance. Therefore, use them sensibly! The majority of garden organisms are of vital importance to plant health, crop pests only account for a small number of them.
Multiple crop combinations with different flowering times attract many beneficial insects. Ladybugs, lacewings, hoverflies, wasps, carabid beetles, earwigs... are carnivores. As a result, they feed on other insects and micro-organisms.
Spiders are particularly dangerous for insects.

Bees are essential to agriculture and ecosystems. **Without their pollination,** there would be no flowers, no fruits, no grain and no food for humans and animals ...and there would not be as much biodiversity.
Moreover, bees can improve our daily lives with honey, wax, pollen, propolis and royal jelly.

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TOPIC 3: NEEM AND SOAP AN EFFECTIVE COMBINATION

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The primary natural treatment is biodiversity in our fields and vegetable growing plots

Neem-based natural treatments

The seeds are more effective than the leaves

With neem seeds

Makes 20 liters of preparation
- Collect the seeds
- Dry in the sun
- Put on gloves
- Husk
- Sort: remove all moldy, damaged seeds...
- Crush 3kg of seeds
- Add the powder to 20l of water
- Add 100 gr of natural soap
- Mix, seal the container well
- Let stand for 24h
- Add 100 gr of soap,
- Stir
- Apply

With neem seeds

You will need 80 kg to treat 1 hectare
- Pick 4 kg of leaves
- Crush
- Soak in water overnight
- Filter with a fine cloth or sieve
- Add 1 liter of this preparation to 10 l of water
- Add 100 milliliters of liquid soap or neem oil
- Apply

The dosages of the preparations are only indicative.
With the same ingredients there are sometimes different preparations, it is up to you to:
- Test
- Innovate
- Note on a sheet to be added to this farmer agroecology training binder
- Share your own experiences!

The role of soap
- Add soap or oil to the preparation as a final step to help the product better adhere to the plants.
- Liquid soaps made with potassium are recommended for thrips and also provide mineral salts for the soil.
- **Liquid soaps or soaps made with caustic soda should not be used, risk of burning the leaves.**

Garlic, onion, chili, basil, lemon, papaya, neem... they are our allies, and in our immediate surrounding so we can make natural preparations.

Remember to always have them in stock, stored well in the form of powder, dry...

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TOPIC 4: IDENTIFY AND TREAT LEAF DAMAGE

SYMPTOMS ON LEAVES IN VEGETABLE FARMING

SYMPTOMS	CAUSES	NATURAL TREATMENTS	
Pierced leaves *Deformation* *Formation of knots*	Root-knot nematodes	**Neem** Leaves and powder to be put in the soil, particularly for nematodes	***Manioc*** Mulch with cassava peels and/or • Crush cassava roots • Mix as much juice as water • Crush 4 liters per m² • Plant 20 days later
		Manioc • Put 2 spoonfuls of chili powder in 10 l of water • Mix 2 liters of preparation with 4 liters of soapy water • Apply 1 liter to 10 m²	***Garlic*** • Crush well dried garlic cloves • Soak for 12h, 2 spoonfuls of this powder in 10l of water • Mix 2l of this preparation with 4l of soapy water • Apply 1 liter to 10 m²
Leaf browning, weakening of crops *Brittle, rolled back leaves*	Mites	**Neem** See recipe under Topic 3, page 4	
Spots of varying size: green-yellow, yellow, brown rot, wilting, withering	Mushrooms bacteria	***Lemongrass*** • Grind 50gr of leaves • Soak 10 mn in 2 liters of hot water • Filter • Add 1 liter of soapy water, • Apply: 3 liters for 10m²	***White fly trap*** • Place 200gr of leaves in 1l of water overnight • Grind the leaves • Filter • Add a small amount of soapy water, • Mix well: 3l for 10m²
Several different colors juxtaposed in a mosaic	White fly Lack of phosphorous Excess nitrogen	**Neem** • Paint a board approximately 20cm in size yellow and orange. Coat with grease • Put in the field when the paint is dry	**Neem** See recipe under Topic 3, page 4
Leaves eaten (like a window) on cabbage especially	Diamondback moth	• Growing cabbage with **tomatoes** • See page 7 *cabbage*	**Light traps** See above white fly trap

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OTHER SYMPTOMS

SYMPTOMS	CAUSES	NATURAL TREATMENTS	
Powdery mildew white color similar to a tissue in different parts of the plant	Mushrooms	**Ash** • Mix one tablespoon of red gum, mango, tamarind and/or eucalyptus wood ash in one liter of water • Let stand overnight • Filter • Plant 20 days later • Add a cup of milk • Dilute again with 3 l of water • Apply	**Papaya** • Crush 1kg of fresh leaves • Mix in 10 liters of water • Filter • Dilute in 4 liters of soapy water and apply **Sweet potatoes** • Crush the sweet potato leaves • Mix with water, filter and app
Gallery on stems	Larvae, weevil	**Neem** See recipe under Topic 3, pages	
Gallery in fruit	Fruit worm	***Ash*** Put wood ash on the leaves and at the base	**Garlic** See recipe in the previous chart
Seedling melt		***Moringa*** • Bury fresh leaves in the ground • As a preventative measure : bury 1kg/m2	

SYMPTOMS IN FOOD CROPS

SYMPTOMS	CAUSES	NATURAL TREATMENTS	
Striga	enrich the plant with compost in poor soil,	Perform crop rotations with cotton, peanut, niebe, Enrich your soil with compost	Spray outside the crop with 20% urea: Burn the striga Reduces seed production
Flowers and seeds eaten on millet, fonio, sorghum...	Large gray-brown Cantharide Nocturnal	**Trap and treatment** • Place blue bowls with soapy water in the field • Collect dead cantharides, dry them and grind them up • Dilute everything in water	**Predators** Grasshoppers Be sure not to disrupt the species' balance!

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TOPIC 5: PREVENTATIVE AND CURATIVE NATURAL TREATMENT FOR VEGETABLES

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Always plant lemongrass, garlic, basil, mint, as they have strong repulsive and disruptive odors for combating insects.

VEGETABLES	EFFECT	PREPARATION OF A NATURAL TREATMENT	
Eggplant	• **Recipe for repelling** larvae • **Enhance the natural defenses** of plants against fungi and bacteria	• In a cup, mix 3 cow pies in 10 l of water • Stir every day for 15 days • Sprinkle with clay when the smell becomes unpleasant • Dilute one liter of the mixture in three liters of water • Apply to the green parts of the plants and the fruits	
	Recipe for a curative insecticide for eradicating leafhoppers or jassids, light green, green-yellow insects with shiny, semi-transparent wings	**Neem** • Grind 500 gr = 3 double handfuls of seeds • Mix with 10l of water or 2 boxes of powdered head matchsticks in 1l of water • Let soak overnight. • Spray every 10 days	**Chili** • Chop 100 gr or 12 large ripe peppers • Soak in 11 liters of water for 24h • Filter • Add 5l of water + soap • Apply **Light trap** see page 5
Cabbage	**Preventative recipe** for preventing insects from laying eggs, especially the diamondback moth: small brown butterflies with a white stripe on the back. The larva is white	**Grow with tomatoes** • Boil 2 l of water with 1kg of leaves and chopped stems • Let cool for 5 hours • Filter • Spray the cabbage ever two days when the butterfly is there **Neem** see the recipe page 3	**Garlic** • Grind 1 garlic bulb • Add to 1l of water+soap • Spray immediately **Garlic + onion + chili** • Chop a clove of garlic, a large onion • Add 1 teaspoon of chili powder • Mix everything in 1 liter of soapy water • Filter and treat
Okra	**Curative recipe** for eradicating larvae, cotton thornwort, powdery mildew leafhopper	**Sweet potatoes** • Crush the sweet potato leaves • Mix with water, filter and app	
Green		**Garlic + chili**	**Onion peels**

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beans tomato	**Curative recipe** for eradicating larvae, cotton thornwort, powdery mildew leafhopper	• Finely chop 20 bulbs of garlic • Add 20 gr of chili pepper in 4 hot water + soap	• Mix 100 gr of onion peels in 1 l of water • Let stand for 4 to 7 days	
Zucchini, Cucurbitacée	**Curative recipe** for mildew: leaves are covered with a sort of white powder.	**Fly trap** • Place in 0.5 l of water, 100ml of urine, 1 peel of an orange or cucumber • Let stand overnight • Dilute in 15 liters of water. Fill into bottles	**Wood ash** • Spread the wood ash • Perhaps you can also use it for prevention	
Onion, Leek	**Curative recipe** for thrip: yellow/ brownish insect with long narrow wings lined with hairs. It scrapes the leaves which become silvery white.	**Soap** • Mix 30cl of liquid soap based on potassium in 5l of water • Shake and apply	**Ash + green lemon** • Mix ½ cup of wood ash + ½ cup of lime (green lemon) in 4 l of water • Let stand for 12h • Filter and treat	**Sweet potato** Treat with water used to cook sweet potatoes or cassava
Sweet potatoes	**Preventative and curative recipe** for weevils	**Wood ash** Soak the tubers in the wood ash before planting them deep	Treat with wood ash around the plant	
Chilli pepper	Mediterranean fly	**Fly trap** • Mix 100 gr of onion peels in 1 l of water • Let stand for 4 to 7 days in a covered container • Filter and treat		
Potatoes	Potato moth (Doriphore)	**Association of a crop with eggplant to keep away the Doriphores**		

AND AGAINST SMALL ANIMALS

Small rodents	**Make a trap** Bury a metal container that holds ca. 20 liters, so that the top 5 cm is above ground Pour in 5 liters of water with some peanuts in it Apply a generous 3-cm coat of peanut paste along its inner edge. Attracted rats and mice will drown inside.
Snails/ slugs	Bury a metal container that holds ca. 20 liters, so that the top 5 cm is above ground

Pate d'arachide

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TOPIC 6: ORGANIZING COLLECTIVELY

The CNOP agroecology intermediaries for farmers set up **agro-ecology huts, seed huts and biodiversity huts** for farmers to share knowledge, improve, disseminate and maintain the farmer agricultural practices of today and tomorrow! The agro-ecology huts for smallholder farmers are collective, social places where training courses, meetings and farmers' markets are held and where knowledge and seeds are exchanged...

To find collective, legal solutions for the development of natural treatments by communities, in September 2014, CNOP organized the workshop "Current natural treatments for plants and animals and their use in smallholder farmer agroecology" with researchers, state and institutional representatives, associations by questioning them rigorously "How are they tested? How do they get approved? How are they made? How are they distributed, sold at an affordable price?...while protecting the rights of farmers to their innovations. To be continued! **We want to develop regional strategies based on knowledge from smallholder farmers and for smallholder farmers.**

Bakari recalls *"one day some young farmers from his village brought the researchers compost they had made for analysis. They never heard back. But some time later a factory opened in the neighboring region selling compost with a formula that was very similar to theirs!"*

Moctar, arborist trainer intermediary for CNOP, in the context of smallholder agroecology, has made different types of natural treatment preparations which he has experimented with and produced in liquid and powder form. He explains how he did it, the ingredient properties, how the product was made, its basis and how to use it. *"The first researchers are the farmers, farmers test them, but the regulations to promote our innovations do not suit us. They even prevent us from progressing or even existing because the research and laws – through the lobbying of private interests like those of companies – are not adapted to our real-life situations."*

Create specific crop areas with a grove of trees, the symbol of our regions selected by the farmer intermediaries, for natural preparations with a securely sealed storage facility for the material and conservation of ingredients and preparations.

THEME 7 : EVALUATION

Daily evaluation

- Each morning, review of the previous day's events by one or several participants
- Perform the pre-evaluation of the topic of the day
- At the end of the day, evaluate the satisfaction of participants regarding the course of training and make necessary adjustments.

Final evaluation

Evaluate general satisfaction with a grading scale by module

Designation	Useful	Not useful	Acceptable	Good	Excellent	Observations
Training						
Conditions of acceptance						
Animation						
Participation						
Content						

Evaluate knowledge and practices learned individually or collectively

Some ideas for evaluation; remember to use the cards:

- Define farmer agroecology in a few words.
- Define the different uses of natural treatments.
- Know how to identify the symptoms on vegetables and food crops
- Know how to prepare a natural treatment.
- Outline the advantages and use of natural treatments.
- Describe one or several stages of preparing a natural treatment.
- Get organized collectively in order to choose the ingredients, prepare and conserve them for commercialization.

APPENDIX 12

Examples of practices based on phytotherapy and aromatherapy in cattle farming in Western France (field report D. Lebreton)

USE OF PHYTOTHERAPY AND AROMATHERAPY ON A FARM IN WESTERN FRANCE
Field report of Dominique Lebreton, livestock farmer and member of the board of directors of AVSF

PHYTOTHERAPY
Phytotherapy uses powdered plants as a preventive measure (herbal tea) and plant extracts in liquid form as a curative measure. Plant extraction methods and those frequently used in phytotherapy can be found in the document "Utiliser la phytotérapie en élevage" (Use of phytotherapy in breeding). - http://www.civambio53.fr/wp-content/uploads/2017/05/articles-Phyto-Aroma-Juillet-2015.pdf.
On our farm, we use phytotherapy to regulate physiological functions, detoxification and to strengthen immunity. We choose from a range of plants for prevention during the periods of risk, for curative purposes or to help with recovery. We prefer a synergy of several plants rather than using a single plant. Typical doses amount to 100 grams of the plant/liter of water. In the event of a 3-plants mixture: 100 gr/plant in 2 or 3L of water. To be repeated 1 to 3 times depending on the case.

AROMATHERAPY
The **essential oils (EOs)** have a powerful effect and act like a medication (allopathy). Just because they are natural products does not mean they are harmless! As a result, precautions should be taken when using them and doses should be respected. Our rules for use:
• Use oil or fat for the mixtures. Never mix in water.
• Also use them in honey or sugar.
• Do not use them in their pure form (particularly irritating EOs).
On our farm, we frequently use a mixture of 3 to 5 EOs
In terms of oral doses:
• The EOs are non-irritating and non-toxic:
  * 500-600 kg adult cattle: 1ml (30 to 35 drops)
  * Calf, sheep or goat: 0.20ml (6 drops)
  * Equine 500kg: 15 to 25 drops (0.5 at 0.66 ml)
• The irritating EOs (phenolated: oregano, clove and cinnamon):
  * 500-600kg adult cattle: 0.5ml (15 drops)
  * Veal, sheep, goat: 10 drops

Maximum amount administered, carrier oil, frequency and duration

Weight of the animals	Maximum oil quantity	Carrier oil	Frequency and duration
500-600 KG	5 ml	45 ml	2 times daily for a period of 3 to 7 days (depending on progression)
200-250 KG	2.5 ml	22.5 ml	
45-60 KG	1 ml	9 ml	
5 KG	1/2 drop to 1 drop/KG of body weight	A small amount of oil	If this is a chronic problem, once daily.

ANTI-INFECTIOUS
A mixture called APA at GENTIANA replaces certain antibiotics. It is composed of:
- tea-tree 25%
- palmarosa 25%
- bay laurel 25%
- COGA 25% (Chinese cinnamon + oregano + clove + athymol thyme. all 4 in equal parts)

Mix: 5ml of the EO in 45ml of the sunflower oil for one adult cattle
1ml of EO in 9ml of sunflower oil for salves, sheep, goats.

VIRAL DISEASES
Pneumonia, bronchitis: start the first days with APA (see above) then continue with an expectorant mixture:
- athymol thyme
- oregano
- tea-tree
- eucalyptus globulus
- Scotch pine
- rosemary-verbena
- ravintsara

DISEASES

▸ After calving: lack of appetite, non-delivery
Phytotherapy: mix of thyme, rosemary, nettle, solidago, hydrastis, horse chestnut, barberry, wormwood. 1 to 2 times daily for a few days.
Aromatherapy: we can intensify it with 30 drops of COGA, 30 of palmarosa, 30 of tea-tree, in 45ml of sunflower oil, administered orally.
If there is still no delivery, provide local intrauterine disinfection: 30 drops of tea-tree, 30 of palmarosa, 20 of geranium, 20 of lavandin and 10 of clove in 25ml of cleansing milk. Inject the mixture into the uterus with the help of a probe. To be renewed every 2 days until elimination of the placenta (which is expelled naturally around the 9th day).

▸ Mastitis
▸ Mild mastitis:
Phytotherapy: artichoke, burdock, milk thistle, echinacea, nettle, meadowsweet, thyme
Aromatherapy: via massage in the area: 15 drops of COGA, 20 of tea-tree, 20 of laurel, 20 of lemon eucalyptus, 20 of cypress and 20 of mint in 45ml of sunflower oil. Repeat for several days in the

morning and evening.
Sunflower oil is most suitable for udders because it penetrates better.

- Colibacillosis mastitis:
Phytotherapy: 2L of herbal tea with 100gr of artichoke and 100gr of rosemary, 3 times at 6h interval.
Aromatherapy: 10 ml of peppermint, 10 ml of lemon eucalyptus, in 80 ml of rapeseed oil to be consumed in the morning and evening for 4 to 5 days.
Drain the affected area often and make a plaster of clay and EO mixture (500 gr of clay (55% clay and 45% water)), 5 ml of peppermint, 5 ml of lemon eucalyptus and 50 ml of sunflower oil.

- Mammary edema:
Phytotherapy: plants that stimulate immunity, antitussives, expectorants
Aromatherapy: 25 drops of cypress, 25 drops of lemon eucalyptus, 25 drops of niaouli, 25 drops of geranium in 15ml of sunflower oil or sweet almond oil for massage.

- Wounds on teat, ulcer on sphincter: Prepare an ointment in 100 gr of lanolin or milking fat, EO 90 drops of tea-tree, 60 of palmarosa or geranium, 20 of COGA, 90 of lavandin and 60 of laurel.

- Infectious diarrhea in the newborn: dose for 40-50KG (calf, goat, sheep)
Phytotherapy: plants to treat enteritis, stimulate vitality and immunity
Aromatherapy: 6 drops of COGA, 6 of basil, 6 of tea-tree in 10ml of sunflower oil or better of liquid paraffine given orally 2 times a day + rehydrator.

- Interdigital panaritium: If taken at the beginning,
Aromatherapy: make a paste with clay and apply a plaster between the hooves twice a day. Mix 30 drops of COGA, 30 of tea-tree, 30 of laurel and 30 of lavandin into the clay.

- Heavy cough, bronchitis, a mild cold:
Aromatherapy: 40 drops of COGA, 50 of tea-tree, 30 of Scots pine and 30 of eucalyptus globulus in 45 ml of sunflower oil. If viral, see above VIRAL DISEASES.

- Acute bronchitis, irritation cough (dry and painful))
Phytotherapy: Elecampane, thyme, mullein
EO: Cypris, fennel

- Bluetongue disease (cattle or sheep): Antiviral effect and stimulating effect on immunity and vitality:
Aromatherapy: 30 drops of ravintsara, 30 of laurel, 30 of tea-tree, 30 of niaouli in 45 ml of canola oil.

- Keratitis: In the beginning, put a few drops of tea-tree mixed in honey and apply it to the eye twice daily for several days. Tea-tree is a very mild EO oil, it can be applied in its pure form.

To go further in the French context, see also:
-http://www.agriculture-durable.org/ressources/les-pourquoi-comment/pourquoi-comment-utiliser-les-huiles-essentielles-en-elevage-bovin/
- the thesis of Delphine Jeune: “Pratiques de médecines alternatives en élevage bovin français” (Alternative medicine practices in French cattle breeding), 2011, University of Lyon 1.

NOTES

Agronomes & Vétérinaires Sans Frontières is an international non-profit association, recognized public utility, which supports rural communities and farmers' organizations threatened by exclusion and poverty in the countries of the South.

The NGO mobilizes the expertise and skills of professionals in agriculture, livestock and animal health, with the aim of restoring food and economic autonomy to smallholder farmers.

AVSF provides technical advice to farming communities, financial support and training, while harnessing traditional smallholder farmer knowledge, to improve their living conditions, manage natural resources sustainably and participate in the socio-economic development of their lands.

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IMPRIM'VERT®

This training guide was written by the members of AVSF (employees and volunteers) who are deeply concerned about the growing use of pesticides and veterinary products in developing countries, particularly in sub-Saharan Africa, many of which are no longer authorized in developed countries due to their high toxicity. This situation has and, in the future, will continue to have numerous unsettling impacts on human and animal health as well as on the environment.
In this context, the objective of this guide is to improve the skills of farmers' and field technicians' organizations in order to better diagnose and resolve problems of plant and animal health by relying on a wide range of agro-ecological alternatives based on proven traditional knowledge and the latest scientific findings.

This guide is a toolbox for developing training aids adapted to the context and specific target audience with the objective of helping to eliminate the use of hazardous pesticides and promoting alternative solutions in line with sustainable agro-ecological transitions, but which are also economically viable and accessible to farming families with limited means.

This guide also addresses decision-makers in charge of national and regional regulations regarding pesticides and veterinary products, local elected officials and civil society associations so that solutions can be implemented for drastically reducing the import of illicit products and their sale on uncontrolled rural markets. Moreover, it is becoming increasingly clear that the reduction in the use of pesticides and certain veterinary products cannot be achieved without appropriate agricultural policy and financial support.
Together with contributors and reviewers, members and non-members of AVSF, this document was deliberately published within the open-source domain (CC BY-SA) in order to allow free use for the purpose of training. As a result, users of this guide can also help to improve it, for example, by incorporating further proven alternatives.

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