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 reproduction)	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)

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 imitation is a fraudulent

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)

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.

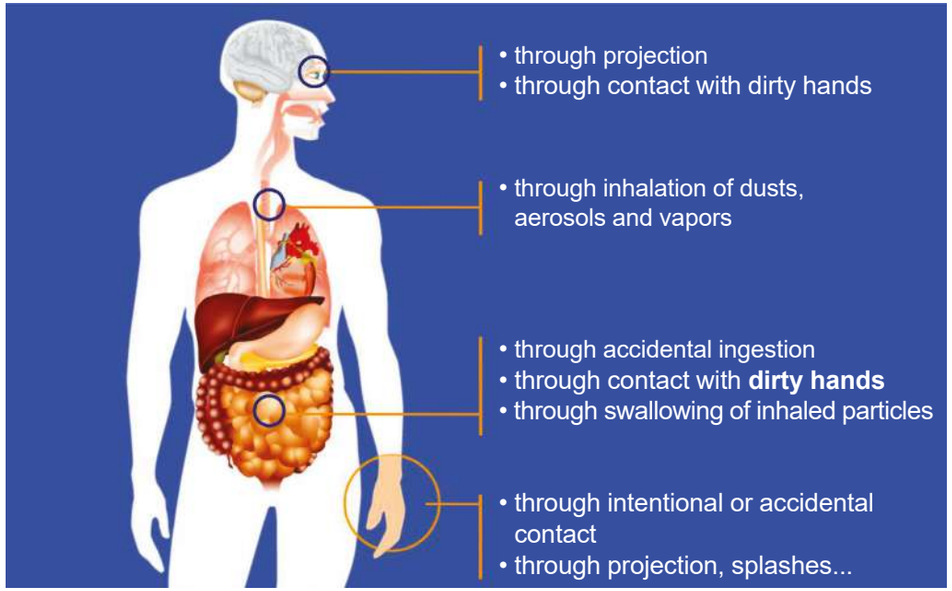
All the active ingredients listed by these conventions are specified in Appendix 1.

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