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Addressing Highly Hazardous Pesticides in Mozambique

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On August 26, 2014, the Government of Mozambique cancelled the registrations of 61 pesticide products containing 31 different active ingredients. The Government also announced risk reduction measures for another 52 pesticide products.

This concluded a 2-year FAO project to identify the Highly Hazardous Pesticides (HHPs) authorized for use in Mozambique and develop a risk reduction plan. The project was prompted by the Government's concern about the use of hazardous pesticides and its desire to promote sustainable intensification of agricultural production. The project was also intended to serve as a pilot for other countries and for future FAO guidelines.

The project was supported by the Mozambican Ministries of Agriculture and Environment[1] and the Strategic Approach to International Chemicals Management (SAICM) under the Quick Start Programme. It included numerous interviews with farmers and consultations with representatives of commodity companies, the agro-chemical industry, and civil society. The good cooperation with these stakeholders and their support for the project were central to its success.

This brochure describes the process that was followed in Mozambique and the positive results of the project these results extended beyond phasing out the use of HHPs to enhancing the engagement of stakeholders in sound pesticide management in the country.

[1] *In 2015 Ministries were renamed Ministry of Agriculture and Food Security and Ministry of Land, Environment and Rural Development.*

Acknowledgements

The excellent collaboration between the Government of Mozambique and FAO was at the core of the success of this project in reducing risks posed by highly hazardous pesticides in Mozambique, in favor of an ecosystem-based approach to pest and pesticide management.

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Addressing highly hazardous pesticides

in Mozambique

Among all pesticide products on the market, a relatively small number have a high potential to severely harm human health and/or the environment. These products can pose unacceptable adverse effects. Especially in developing countries and economies in transition, where proper risk mitigation measures may not be in place,

The FAO/WHO International Code of Conduct on Pesticide Management defines highly hazardous pesticides (HHPs) as those pesticides that are **"acknowledged to present particularly high levels of acute or chronic hazards to health and/or the environment** according to internationally accepted classification systems such as the World Health Organization (WHO) or the Global Harmonised System of Classification and Labelling of Chemicals (GHS) or their listing in relevant binding international agreements and conventions. In addition, pesticides that appear to cause severe or irreversible harm to health or the environment under conditions of use in a country may be considered to be and treated as highly hazardous".

This project served to develop a methodology to identify HHPs in a country and to develop a risk mitigation plan in consultation with the main stakeholders.

The project served by a team that included the former national pesticide registrar, the head of the Quarantine Department, and three international pesticide management experts.

The methodology developed by the team focused on identifying HHPs used in the country, assessing their risks, and developing a risk reduction plan.

The project had 7 steps

1

2

Review of registered pesticides to identify HHPs

The project began by screening the pesticide products registered in Mozambique to create a shortlist of highly hazardous pesticides for review. The register included 648 products comprising 192 different active ingredients.

The review was done by evaluating the pesticides against the eight criteria for HHPs developed by the Joint FAO/WHO Meeting on Pesticide Management (JMPM). The project team reviewed the dossiers for the pesticides that had been evaluated during their registration in Mozambique as well as two pesticide products (containing DDT and methyl-bromide) that were no longer registered but whose stocks were allowed to be used. In addition, the team considered assessments done by WHO, FAO, the European Union, and the U.S. Environmental Protection Agency, and decisions taken under international conventions. Ultimately, the team identified 59 pesticide products comprising 26 different active ingredients as HHPs on the basis of the JMPM criteria.

The JMPM criteria for highly hazardous pesticides

Criteria 1	Pesticide formulations that meet the criteria of classes Ia or Ib of the WHO Recommended Classification of Pesticides by Hazard
Criteria 2	Pesticide active ingredients and their formulations that meet the criteria of carcinogenicity Categories 1A and 1B of the Globally Harmonized System on Classification and Labelling of Chemicals (GHS)
Criteria 3	Pesticide active ingredients and their formulations that meet the criteria of mutagenicity Categories 1A and 1B of the GHS
Criteria 4	Pesticide active ingredients and their formulations that meet the criteria of reproductive toxicity Categories 1A and 1B of the GHS
Criteria 5	Pesticide active ingredients listed by the Stockholm Convention in its Annexes A and B, and those meeting all the criteria in paragraph 1 of annex D of the Convention
Criteria 6	Pesticide active ingredients and formulations listed by the Rotterdam Convention in its Annex III
Criteria 7	Pesticides listed under the Montreal Protocol
Criteria 8	Pesticide active ingredients and formulations that have shown a high incidence of severe or irreversible adverse effects on human health or the environment

If one or more of the criteria are met, a pesticide is identified as highly hazardous.

An additional 54 pesticide products containing 16 different active ingredients were also considered to have a high hazard for human health in Mozambique although they were not triggered by the JMPM criteria.

These were identified on the basis of provisions included in the national pesticide legislation and included:

- Pesticides that fell into the more toxic range of Class II of the WHO Recommended Classification of Pesticides by Hazard;
- Pesticides marked in the WHO Classification as of particular concern with respect to chronic toxicity other than carcinogenicity, mutagenicity or reproductive toxicity;
- Pesticides for which carcinogenicity evaluations by different regulatory authorities did not lead to consistent classification as GHS Category 1A or 1B, but which were, based on the evidence provided by these authorities and the expected use in Mozambique, considered of particular concern.

COMPONENT 1

Creation of a shortlist of:

59 HHP products
containing 26 different active ingredients

54 other pesticides of concern
containing 16 different active ingredients

1

2

3

Review of pesticide import trends as a proxy for pesticide use

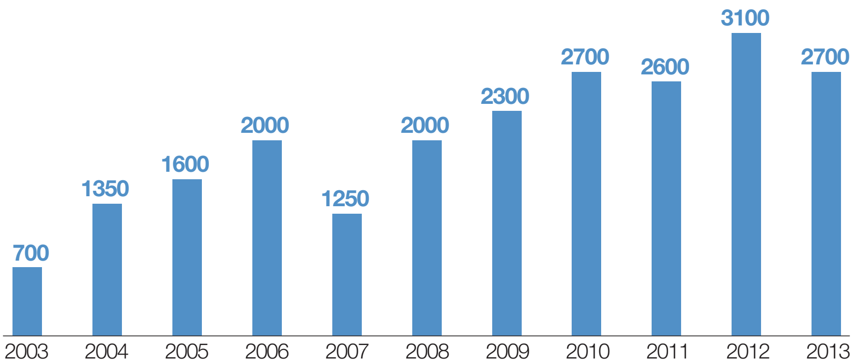
The next step was to determine which of the 113 shortlisted pesticides were actually used in Mozambique and which were not.

This was done by reviewing statistics from the National Directorate of Agrarian Services of all official pesticide imports into Mozambique between 2002 and 2013 **(Figure 1)**. Import statistics were considered a reasonable proxy for pesticide use as no pesticide manufacturing exists in Mozambique and local formulation is limited to a number of rodenticides and household pesticides. (Some unregistered importation of agricultural pesticides is known to occur but was not taken into account in this exercise, as it could not be quantified.)

Figure 1

Pesticide imports into Mozambique between 2003 and 2013

tonnes of formulated products per year



Source: Mozambican National Directorate of Agrarian Services

The statistics showed that in the 10-year period 2003-2013, pesticide imports into the country quadrupled, rising from 700 tons in 2003 to 2700 tons in 2013. During the same 10-year period, total agricultural area in Mozambique increased by just 1.4%, from 48,7 million to 49,4 million hectares, but there was a shift toward crops that tend to have higher pesticide use. In Mozambique, agricultural pesticides are used mainly on cash crops like tobacco, sugar cane, cotton, banana and vegetables. A significant increase in the area harvested was seen for some of these crops, notably for bananas, vegetables and tobacco.

All of the shortlisted pesticides that were not imported between 2010 and 2013 were identified as priority candidates for cancellation, as they were assumed to be off the market and of limited use and relevance in Mozambique. Pesticides that were imported in very small quantities (less than 250 kg or litres annually) were also targeted for cancellation after a review of their use and relevance.

Results of the review of pesticide import trends

A comparison of the import statistics and the shortlisted pesticides revealed that of the 59 pesticide products identified as HHPs, 30 were not imported, or were imported in very small quantities, between 2010 and 2013. Similarly, 5 out of 54 additional pesticide products of concern were not imported over the same period.

COMPONENT 2

Reduction of the shortlist by:

30 HHP products
no longer imported

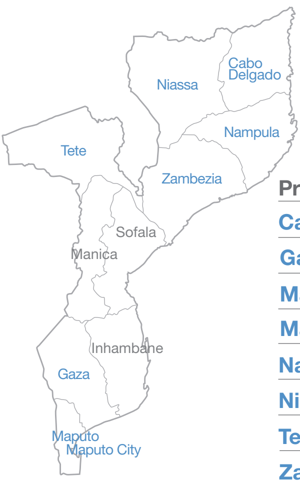
5 other pesticides of concern
no longer imported

Field surveys of pesticide use in key crops

The next step was to carry out field surveys to verify the conditions under which the pesticides were being used. As shown in Figure 2, the surveys were conducted in eight provinces known to have a high rate of pesticide use in agriculture. They focused on cropping systems where pesticides were used on a regular basis and/or where HHPs were known to be applied. These included vegetables, cotton and tobacco – crops generally managed by smaller subsistence farmers. **(Figure 2)**

Figure 2

Provinces and crops surveyed for pesticide use and handling practices



Provinces	Vegetables	Tobacco	Cotton
	# of farmers surveyed by crop		
Cabo Delgado			64
Gaza	30		
Maputo	28		
Maputo Ciudade	40		
Nampula			20
Niassa		25	11
Tete		48	25
Zambezia		19	15

The surveys consisted of interviews with farmers to determine what pesticides they used, on what crops and in what quantities, and how they used them.

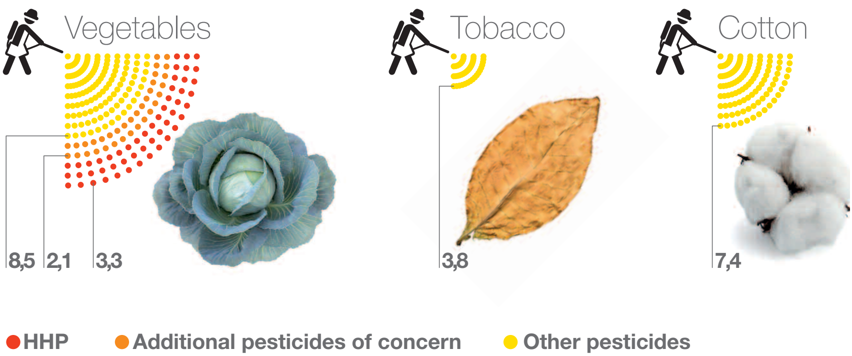
A total of 325 farmers were interviewed, providing a broad coverage of possible pesticide use situations. The interviews were done by plant protection officers of the Provincial Directorates of Agriculture, who had been trained in survey techniques and data collection.

Results of the field surveys

The surveys revealed that most of the farmers applied pesticides - only 17 of the 325 said they did not - and that the conditions of pesticide use were likely to result in undue exposure.

Half of the farmers interviewed had not received any sort of training in using agrochemicals, and even those who had often lacked a good understanding of the risks involved. Farmers reported spraying vegetable crops as many as 14 times per growing season, with one out of three applications being one of the shortlisted HHPs **(Figure 3)**.

Figure 3
Average number of pesticide applications per crop



Almost none of the farmers owned or wore adequate personal protective equipment **(Figure 4)**.

About half of the farmers reported being exposed to pesticides, especially when spraying. This was particularly the case for cotton and vegetables. A large number of farmers reported symptoms of pesticide exposure or poisoning during or after pesticide application. Most did not receive any medical follow-up. The pesticides self-reported by farmers as causing poisoning symptoms were not on the HHP shortlist but were nevertheless targeted for follow up in the Government risk reduction plan.

Figure 4

Percentage of farmers wearing protective equipment

1% **Full body protection**
overalls, rubber mask with filter, hat, eye glassesor goggles, gloves, rubberboots

6% **Intermediate protection**
long sleeves, long pants, gloves and shoes

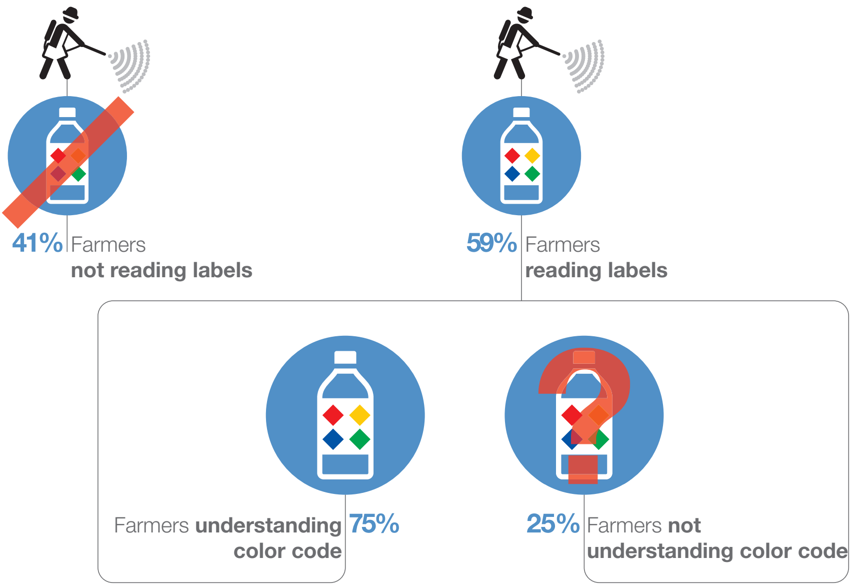
93% **Low or no protection**
only one protective item or none

Almost half of the farmers declared they did not read pesticide labels, including use instructions such as proper dosage and protective measures, the main reason being illiteracy. One out of four farmers poorly understood the colour band on pesticide labels that indicates acute toxicity **(Figure 5)**.

About half of the cotton and tobacco farmers stored their pesticides inside their home. This was much less common for vegetable farmers.

Figure 5

Percentage of farmers declaring they read pesticide labels and understood the color code



The survey results showed that the use of pesticides in general, and of HHPs in particular, was likely to result in undue exposure of farmers.

COMPONENT 3

Of 325 farmers surveyed:

95% applied pesticides

93% used little or no protection

Assessment of pesticide user risks

The project subsequently assessed the exposure of pesticide users, using two European occupational exposure models that mimicked as closely as possible local conditions of use for a subset of the shortlisted pesticides. The subset included nine pesticides in seven different cropping systems using 13 application scenarios, each with and without personal protective equipment (PPE) **(Table 1)**. The subset was limited to pesticides applied as sprays in agriculture, for which exposure models were available, and therefore did not include rodenticides, fumigants or vector control insecticides.

The exposure assessment used the registered dose rates and other application parameters for each pesticide based on farming conditions in Mozambique, including application with backpack sprayers (used in vegetables, tobacco, cereals and several other crops), hand-held rotary atomisers (used in cotton), and tractor-mounted boom-and-nozzle or air blast sprayers (used in sugar cane and fruit trees, respectively). The exposure of pesticide applicators wearing full PPE that is realistically available in Mozambique was compared to the exposure of applicators wearing shorts and a T-shirt, as is often the case for smallholder farmers.

Occupational exposure estimated by the models was then compared to the Acceptable Operator Exposure Level (AOEL) of each of the pesticides, as reported by reputable sources such as the European Union and the Rotterdam Convention. The AOEL is defined as the maximum amount of pesticide active ingredient to which an operator may be exposed without adverse health effects.

Results of the assessment of pesticide user risks

The results of the assessment showed that six out of the nine pesticides posed unacceptable risks to users under all application scenarios, even when PPE was used. Of the remaining three pesticides, two could only be used with acceptable risk in one cropping system with full PPE. Just one pesticide could be applied with acceptable risk in several crops, sometimes with but also sometimes without PPE.

Table 1

Outcome of the occupational risk assessments using European exposure models and Mozambican pesticide application conditions

Pesticide active ingredients	Occupational risk acceptable?	
	With PPE	**Without PPE**
dichlorvos **methamidophos** **2,4-D dimethylamine** **paraquat** **diuron** **oxyfluorfen**	**Never**	**Never**
endosulfan	**Only** **in ornamentals/ flowers** *but close to limit*	**Never**
oxamyl	**Only** **in tobacco** *but close to limit*	**Never**
mancozeb	**Yes** *for the lowest registered application rates in vegetables, fruits, bananas*	**Never** *except the lowest registered application rate in vegetables*

COMPONENT 4

Most shortlisted pesticides posed unacceptable risks to users under all application scenarios

Assessment of environmental hazard

The next step was to assess the environmental hazard posed by the shortlisted pesticides. The JMPM criteria for HHPs focus mainly on toxicity to human health and do not include environmental hazards due to the site-specific nature of ecosystem assessments. Environmental impacts were however considered important in Mozambique, and therefore an assessment of the environmental hazards posed by the imported pesticides was conducted by Alterra, a research institute of Wageningen University and Research Centre, to complement the JMPM criteria. This was done using a hazard indicator known as the Environmental Toxic Load, or ETL.

The ETL of each pesticide was calculated separately for fish, aquatic invertebrates (Daphnia), algae and bees, by combining the average amount of pesticide applied annually in the total agricultural area of the country with the toxicity of the active ingredient to each group of non-target organisms. It was used to compare average toxic loads between pesticides and between years. In addition, the potential of the pesticides to leach to groundwater was assessed, using the Groundwater Ubiquity Score (GUS index), a simple indicator of groundwater leaching potential.

Using the ETL and GUS indexes, the project evaluated hazard trends from pesticide use between 2002 and 2011. It then identified pesticides of primary and secondary environmental concern based on the contribution of each pesticide to the total ETL[2] or GUS[3] index in each year.

[2] *Active ingredients of which the imported quantity constitutes more than 50% of the total annual ETL value in 2 years or more.*

[3] *GUS class 5 and/or 4 active ingredients of which the imported quantity constitutes more than 1 and 2 percent respectively, of the annual GUS index value in 2 years or more.*

Results of the assessment of environmental hazard

The assessment showed that a considerable number of the pesticides were acutely toxic to fish, aquatic invertebrates, algae and bees, but that the less toxic pesticides were more widely used, particularly in the last few years. The pesticides that contributed most to the GUS index and/or to the ETL for each of the four non-target organisms, in two years or more, are listed in table 2.

Table 2
Pesticides that contributed most to the Environmental Toxic Loads (ETL) for fish, aquatic invertebrates, algae and bees, **and to Groundwater Ubiquity Index (GUS)**

	Pesticides of primary environmental concern	Pesticides of secondary environmental concern
Fish	**lambda-cyhalothrin**	*aluminium phosphide, chlorpyrifos, cyfluthrin, cypermethrin, endosulfan*
Aquatic invertebrates *Daphnia*		*chlorpyrifos, cypermethrin, DDT, dichlorvos, ethion, fenvalerate, lambda-cyhalothrin, pirimiphos-methyl*
Algae	**acetochlor**	*paraquat, ametryn*
Bees	**imidacloprid**	*bendiocarb, chlorpyrifos, cyfluthrin, cypermethrin, deltamethrin, lambda-cyhalothrin, profenofos, thiamethoxam*
Groundwater	**methyl bromide, tebuthiuron**	*atrazine, clomazone, hexazione, imidacloprid, propoxur*

The environmental assessment could identify those pesticides contributing most to environmental hazard, but not which pesticides would pose unacceptable risks. The Government's risk reduction plan therefore recommended more in-depth environmental risk assessments, using field monitoring or other locally adapted methods, for the pesticides of primary environmental concern.

COMPONENT 5

Pesticides of environmental concern identified

and further environmental risk assessments with field monitoring recommended

Consultation with stakeholders and capacity building

Consultation with stakeholders and capacity building was an ongoing process throughout the project and contributed to its success.

The project started with a workshop for technical staff of the Ministry of Agriculture and other Ministries to identify which crops were being treated with HHPs and what possible alternatives were already available in the country or could be developed.

All of the major pesticide importers were then visited to discuss possible risk reduction measures, including the phase-out of certain HHPs and replacement with lower-risk pesticide alternatives. In addition, the ongoing use and continued need for the HHPs was discussed in meetings with selected commodity companies (e.g. in cotton and sugar cane), extension services (e.g. in vegetables), and large-scale agricultural producers (e.g. of bananas). Alternative pest management options were also discussed with these stakeholders.

A risk reduction plan was then formulated with recommendations for regulatory action on specific pesticides and suggestions for alternative methods including integrated pest management (IPM). Consultations with representatives of commodity companies, the agro-chemical industry, civil society and producers were carried out to assess the implications of regulating HHPs and to find viable alternative solutions.

The risk reduction measures proposed by the Ministry of Agriculture at the end of the project were again discussed in a meeting with stakeholders, and the final list of measures was established only after relevant inputs had been addressed.

Results of consultation with stakeholders

The consultations undertaken throughout the project not only created awareness about the risks of using HHPs in Mozambique but also contributed to a broad acceptance of the final measures taken.

Equally important was the training and capacity building that was undertaken in the Ministry of Agriculture and its regional offices, The capacity built at the Plant Health Department of the Ministry of Agriculture for evaluating HHPs will better enable the staff to handle future pesticide registrations and identify potentially hazardous products. In addition, the training of regional plant protection staff in conducting field surveys of pesticide use and risks, in particular in smallholder farming, will help the staff during their technical support visits to farmers to identify high-risk pesticide use situations and to provide advice on risk reduction measures.

COMPONENT 6

Stakeholder consultations and capacity building key to success:

Ministries of Agriculture
Environment and Health
Large-scale agricultural producers
Small-scale farmers
Extension services
Agro-chemical industry
Pesticide importers
Commodity companies
Civil society

Cancellation of HHPs and other risk reduction measures

The project was concluded with the Government's announcement of its plan for reducing the risks posed by the use of HHPs in Mozambique.

Under this plan, the registrations of 61 pesticide products comprising 31 different active ingredients were cancelled. Many of these pesticides were no longer imported, or only in very small quantities. However, some of the cancelled pesticides were still imported in considerable quantities, but their human health or environmental risks were considered too high.

This was the case for methamidophos and dichlorvos, used in vegetable production, which were cancelled or severely restricted. To help the growers adapt, the Ministry simultaneously initiated a programme to strengthen IPM in vegetables while pesticide importers committed themselves to introducing lower-risk alternatives.

Similarly, all registrations of the herbicides 2,4-D, diuron and paraquat, used mainly in sugar cane, were cancelled. The Ministry of Agriculture engaged with the sugar cane producer association to assess alternative weed control options and facilitate registration of lower-risk herbicides.

The registration of 52 of the shortlisted pesticides were maintained under the risk reduction plan, but generally with accompanying measures or restrictions.

For example, further assessment of the need for or risks of some of the pesticides was recommended. This was the case of permethrin, used for the protection of stored food products, the nematicide oxamyl, and the (veterinary) disinfectant formaldehyde.

Additional studies were also recommended to supplement the preliminary assessment of environmental hazard and to inform further risk reduction measures in this area. Action was also recommended to follow up on farmer reports of adverse health effects potentially associated with the use of specific pesticides, both on and off the HHP shortlist.

Finally, the authorization to use certain HHPs was maintained, generally because no viable alternative could be identified in the short term, but restrictions were sometimes applied. Examples were the fumigant aluminium phosphide, the use of which was restricted to licenced applicators; DDT and bendiocarb, allowed only for indoor residual spraying in malaria control; the more concentrated dichlorvos products, limited to domestic fumigation and pheromone traps; and the fungicide mancozeb, to be used only in IPM in vegetables.

Lessons learned

The project in Mozambique provided valuable lessons on how to address highly hazardous pesticides in a country. These include the following:

- Active involvement of stakeholders is key to success in identifying HHPs and adopting risk reduction measures.
- Identification of HHPs on the basis of chronic toxicity classifications is complicated by the limited availability of international assessments.
- Reliable pesticide import, sales or use statistics are needed to identify HHP use in a country and to develop a risk reduction plan.
- Information on actual field use of pesticides in general, and of HHPs in particular, is needed to evaluate risks and develop a risk reduction plan.
- Approved methods and criteria for identifying HHPs on the basis of environmental hazards have not been established and are very much needed for country assessments.

- Assessing environmental risks is complex and requires local data which are often unavailable and too costly to collect.

- Regular poisoning and health surveys should be carried out in rural areas to identify pesticide products and use practices that are harmful to farmers' health.

For more information

For more information about HHPs see the web site of the FAO pesticide risk reduction group at: **http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/hhp/en/**

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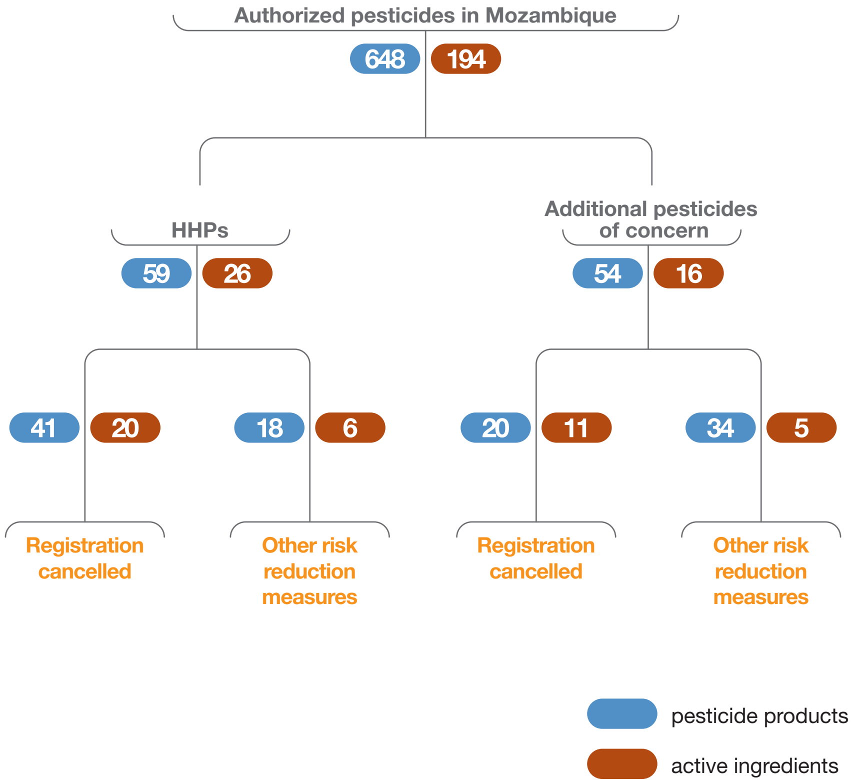
Overall outcome of the HHP risk reduction project in Mozambique



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