Highly Hazardous Pesticides (HHPs) in Agro-industrial and Smallholder Farming Systems in Kenya

Pesticide application on a horticultural farm near Mount Kenya (photo: H. Augstburger)

Pesticide use increases in Kenya

In 2007, when the last information on pesticide quantities was published by Kenya's Pest Control Product Board, the country purchased 8,749 metric tons of pesticides – including herbicides, insecticides, and fungicides – worth over USD 34 million (PCPB 2007). The prices of agrochemicals have decreased since then, yet Kenya's spending on pesticides has risen. It paid USD 126.32 million for pesticides in 2013, a 270% increase in ten years (FAOSTAT 2017).

A decade ago, Macharia et al. (2009) found that 62 different pesticide products with 36 active ingredients were used in the Kenyan vegetable production. Today, there are 1,140 different products with 367 active ingredients registered for use in Kenya (PCPB 2018). The most commonly imported active ingredients are Glyphosate and its salts, Imidacloprid and Mancozeb.

These three substances are listed as "highly hazardous pesticides" (HHP) by the Pesticide Action Network (PAN), a collection of over 600 non-governmental organizations working in the field of pesticides. HHPs are either acutely toxic, have long-term toxic effects, are endocrine disruptors, pose a threat to the environment, or are known to cause a high incidence of severe or irreversible adverse effects.

At the same time, natural alternatives to synthetic pesticides are available in the region: Kenya has a considerable industry of bio-pesticides based on Chrysanthemum flowers (Rhoda et al. 2006). However, the

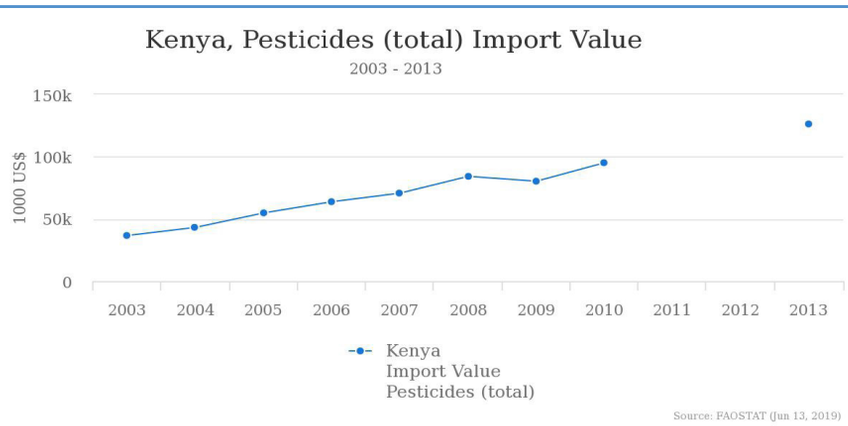

Figure 1: Value of imported pesticides to Kenya from 2003 to 2013. Source: FAOSTAT 2019 (no available data for 2011 and 2012).

KEY HIGHLIGHTS

- On horticultural farms near Mount Kenya, 40.8 kg of pesticides per hectare and cultivation cycle were applied – sprayed up to 15 times. Smallholder farmers applied less – 5.8 kg – but faced acute exposure risks.
- Of 64 different pesticide products identified on the farms, only 22 are permitted in Switzerland.
- In addition, 32 substances were found that are considered HHPs. Of these, 23 are not permitted in Switzerland, though many are produced by companies based in Europe.
- HHPs should be withdrawn from the market, starting with WHO Class I substances and organophosphates, in accordance with the precautionary principle (need for proof that a substance is not harmful).
- Double standards of pesticide regulation among different countries should be eliminated and international conventions implemented.
- Training and incentives for pesticide-free farming should be promoted, such as use of push–pull technology for crop protection.

products are almost completely exported, while more harmful synthetic pesticides are imported (Macharia et al. 2009). Local use of Pyrethrin instead of imported synthetic substances could be promoted, fostering the national alternative industry. However, as Pyrethrin is toxic to aquatic organisms, development of pesticide-free farming should remain the higher-priority longer-term goal.

Agro-industrial farms use many pesticides, including products considered highly hazardous

In a study conducted in the north-western Mount Kenya region as part of the Swiss r4d programme, researchers analysed three agro-industrial farms that produce vegetables for European supermarkets. Each farm is a certified member of the "Global G.A.P." initiative, for "good agricultural practices". Still, evidence was found of extensive pesticide use and HHPs. An average of 40.8 kg of pesticides was applied per hectare and cultivation cycle (four months for broccoli, five months for beans), with spraying occurring up to 15 times. For comparison, an average of 2.75 kg of pesticides are applied per hectare globally each year. Bhutan promotes organic agriculture and uses 0.12 kg. Of 53 products identified on the Kenyan agro-industrial farms, only 17 are permitted in Switzerland; 36 products (comprising 28 different substances) are listed HHPs. Examples include the products "Match" (containing Lufenuron: known to be bio-accumulative; persists in water, soils or sediments; highly toxic to aquatic organisms), "Escort 19 EC" (containing Emamectin benzoate: highly toxic to bees and aquatic organisms; persists in water, soils, or sediments) and "Pentagon" (containing Lambda-cyhalothrin: acutely toxic; suspected endocrine disruptor; highly toxic to bees).

Smallholder farmers use less pesticides, but face acute exposure risks

Three smallholder farms in the same area applied an average of 5.8 kg of pesticides per hectare and cultivation cycle (four months for beans, five for potatoes), with spraying occurring up to eight times. While this amount is seven times less than the agro-industrial farms nearby, it is still twice the global average. Eleven products were identified, eight of which (comprising seven substances) are listed HHPs; of these, five substances are banned in Switzerland and two in the EU. One product, named "Tigger" contains Chlorpyrifos, an organophosphate linked to reduced IQs, deficits in memory and attention, and autism in children (Hertz-Piciotto et al. 2018; von Ehrenstein et al. 2019).

Figure 2: Empty agrochemical bottles are often not disposed of properly. They are either used as household tools such as ladles or dumped in fields, rivers, or people's backyards (photo: H. Augstburger).

Figure 3: Criteria for HHPs (PAN 2018: 12)

Criteria	According to
High acute toxicity (class 1a,1b, or "fatal if inhaled")	World Health Organization Globally Harmonized System
Long term toxic effects (known or presumed cardnogenic,mutagenic or reproductive toxicant)	International Agency for Research on Cancer United States Environmental Protection Agency Globally Harmonized System
Endocrine disruptor (suspected or potential)	Globally Harmonized System EU priority list
High environmental concern (very persistent or very bio accumulative or very toxic to aquatic organisms)	UN Stockholm Convention UN Montreal Protocol
Hazard to ecosystem services (highly toxic for bees)	United States Environmental Protection Agency
Known to cause a high incidence of severe or irreversible adverse effects	UN Rotterdam Convention

According to over 100 interviews conducted in the study area, there are many local pesticide providers offering cheap products that lack proper instructions, quality, and safety information (Ottiger 2018). Due to their accessibility, these products are widely used by smallholder farmers. The farmers often do not possess sufficient knowledge about pesticide application as compared to the managers of agro-industrial farms, and often do not use protective gear (Ogolla 2018). Smallholders also use the empty pesticide containers for miscellaneous household storage and keep full bottles of pesticides in the home, putting themselves and their families at significant risk.

Unwanted side effects

Pesticide use can affect water quality and non-targeted organisms such as plants, fish, insects, amphibians, reptiles, or birds (Gitahi et al. 2002; Lambert 1997; Damalas & Eleftherohorinos 2011). There are four primary paths of exposure to pesticides: inhalation, ingestion, dermal absorption, or absorption through the eyes (Okello & Swington 2010). These can lead to symptoms ranging from skin or eye irritation to cancer or stillbirths (Thrupp et al. 1995). Side effects can also be caused by the three most-imported active ingredients in Kenya: Glyphosate is a probable carcinogen; Imidacloprid is highly toxic to bees; and Mancozeb is a suspected endocrine disruptor and a likely carcinogen.

Comparison with other studies

Another 2015 study in Kenya showed that nearly half of all people directly exposed to pesticides on the job suffered symptoms of general malaise, headache, and respiratory problems (Tsimbiri et al. 2015). A separate University of Bern study (2018) showed that not only the people directly working with pesticides suffer perceived harms, but also those living nearby due to wind distribution (Zähringer et al. 2018). And the majority of interviewees in a different r4d study claimed to be very concerned about pesticide effects on health (Hertkorn 2017). 37% of local farmworkers (N=361) indicated suffering ill health from use of agrochemicals, and 43% of the farmworkers had no training in agrochemical use (Ogolla 2018).

Table 1: A total of 32 HHPs were found on farms near Mt. Kenya; 28 HHPs on agro-industrial farms. Smallholder farmers used Beta-cyfluthrin, Chlorothalonil, Chlorpyriphos, Cypermethrin, Glyphosate, Mancozeb, and Pirimicarb (Ottiger 2018).

Active ingredient	Product name	Possible side effects (Source: Pesticide Action Network)
Abamectin	Amazing top, Dynamec	Acutely toxic (fatal if inhaled), reproductive and developmental toxicity, highly toxic to bees and fish/daphnia,
Acrinathrin	Rufast 10 EC	Highly toxic to bees
Beta-cyfluthrin	Bulldog	Acutely toxic, highly toxic to bees, bioaccumulative
Bifenthrin	Brigade 25 EC	Endocrine disruptor, bioaccumulative, highly persistent, highly toxic to bees and aquatic organisms
Bromoxynil	Bently Plus	Acutely toxic, developmental toxin, possible carcinogen, possible endocrine disruptor
Chlorantraniliprole	Coragen 20SC	Persistent in water, soils or sediments, highly toxic to aquatic organisms
Chlorothalonil	Daconil 720 SC; Orthiva	Acutely toxic, likely carcinogen
Chlorpyrifos	Trigger	Neurotoxic (cholinesterase inhibitor), reproductive and developmental toxicity, suspected endocrine disruptor, highly toxic to bees and aquatic organisms, bioaccumulative
Copper (II) hydroxide	Funguram	Acutely toxic, very persistent in water, soils or sediments, highly toxic to aquatic organisms
Cyhalothrin	Duduthrin, Karate Zeon	Acutely toxic, suspected endocrine disruptor, highly toxic to bees
Cypermethrin	Alpha 10 EC	Acutely toxic, possible carcinogen, suspecte dendocrine disruptor, highly toxic to bees and other beneficial organisms; highly toxic to aquatic organisms; bioaccumulative
Deltamethrin	Decis 25 EC, Atom, Keshet	Acutely toxic; highly toxic to bees; bioaccumulative
Diafenthiuron	Pegasus	Highly toxic to bees
Emamectin benzoate	Escort 19 EC; Prove 1.92 EC	Highly toxic to bees, persistent in water, soils or sediments, hihgly toxic to aquatic organisms
Etofenprox	Trebon	Likely carcinogen; suspected endocrine disruptor; highly toxic to bees, persistent in water, soils or sediments, highly toxic to aquatic organisms
Fenpyroximate	Ortus	Acutely toxic
Flubendiamide	Belt 480 SC	Persistent in water, soils or sediments, highly toxic to aquatic organisms
Glyphosate	Roundup Turbo	Probable carcinogen, potential groundwater contaminant
Imidacloprid	Confidor 70 Wg; Thunder 145 O-TEQ	Acutely toxic; highly toxic to bees (not allowed in EU)
Indoxacarb	Avaunt 150 SL	Highly toxic to bees and other beneficial organisms; bioaccumulative
Lambda-cyhalothrin	Tata Umeme 2.5 EC, Pentagon	Acutely toxic, suspected endocrine disruptor, highly toxic to bees
Lufenuron	Match	Bioaccumulative, persistent in water, soils or sediments, highly toxic to aquatic organisms
Mancozeb	Oshothane 80 WP, Dithane, Ridomil Gold	Likely carcinogen, suspected endocrine disruptor, developmental and reproductive toxin, highly toxic to aquatic organisms; produced contact dermatitis
Methiocarb	Mesurol 500 SC	Acutely toxic, highly toxic to bees
Paraffinic oil	SAF-T-Side	Known or presumed human carcinogen
Pirimicarb	Pirimor	Acutely toxic, carcinogen; neurotoxic (cholinesterase inhibitor); persistent in water, soils or sediments, highly toxic to aquatic organisms
Pymetrozine	Chess 50 Wg	Carcinogen; possible endocrine disruptor; potential groundwater contaminant
Sodium Borate	Solubor	Likely carcinogen and endocrine disruptor
Spinetoram	Radiant 120 SC	Highly toxic to bees and other beneficial organisms; persistent
Spinosad	Tracer	Highly toxic to bees and other beneficial organisms
Thiacloprid	Calypso SC 480	Likely carcinogen
Thiamethoxam	Apron star 45 WS, Actara 25 WG	Highly toxic to bees and other beneficial organisms; potential groundwater contaminant

International guidelines: Kenya's commitment

As a party to the International Covenant on Economic, Social and Cultural Rights (ICESCR), Kenya recognizes fundamental human rights in its constitution of 2010. The constitution emphasizes the duty of the state to guarantee people's rights to food, water, and health (Art. 43, 46, 53) and to life in a healthy, protected, and balanced environment (Art. 42). Kenya has ratified the Rotterdam Convention on the Handling of Chemicals, and the Stockholm Convention, which aims to protect human health and the environment from the harmful effects of hazardous waste.

Ways forward

A 2017 UN Report on pesticides strongly disputes the claim that pesticides are necessary to feed the world, and assesses their impacts on human rights. The report recommends (a) eliminating global double standards of pesticide regulation; (b) implementing policies to reduce pesticide use worldwide and phase-out HHPs; (c) promoting agroecology as an alternative; (d) placing strict liability on pesticide producers (Elver 2017). The UN Declaration on the Rights of Peasants – approved in 2018 by 121 countries, including Kenya and Switzerland – upholds "the right not to use or to be exposed to hazardous substances or toxic chemicals, including agrochemicals or agricultural or industrial pollutants."

This implies that while the Kenyan Government has banned the import of substances listed by the Rotterdam Convention, it should go a step further and ensure that Kenyans are able to produce enough sustainable food without risking harms to their health and the environment related to use of HHPs, in accordance with the precautionary principle and the long-term goal of pesticide-free farming.

Recommendations for policy in Kenya

Our observations and recommendations are in line with the 2017 report of the Special Rapporteur of the Right to Food to the Human Rights Council (Elver 2017), which calls for a policy framework to reduce pesticides and abolish HHPs:

- HHPs, especially WHO Class I substances and organophosphates, should be taken off the market (e.g. Beta-cyfluthrin, Methiocarb and Chlorpyriphos). Neonicotinoids such as Imidacloprid and Thiamethoxam should be phased out based on their risks to pollinators.
- Pesticide imports and use should be strictly monitored, and official, reliable information made available. The data should be gathered, stored, and made readily accessible by public entities with no ties to the pesticide industry. Monitoring should include regular farm inspections to ensure that not only food consumers, but also food producers are given the best-possible protection against pesticide harms.
- Pesticide-free agroecological farming practices should be pursued. Agroecological farming systems prevent pesticide exposure; enhance biodiversity; help to improve air, soil, and water quality; and mitigate climate change. Farmers should be encouraged and supported in transitioning to agroecological practices like crop rotation, soil fertility management, push–pull technology, and crop selection adapted to local conditions. Measures can include trainings, direct payments, and market development for agroecological products, e.g. via public procurement.

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References

Damalas, Ch.A. & I.G. Eleftherohorinos (2011): Pesticide exposure, safety issues, and risk assessment indicators. - International journal of environmental research and public health 8, 5, 1402-1419.

Elver, H. UN Special Rapporteur on the human right to food: Report to the Human Rights Council in 2017 for its 34th session, 27 February to 24 March 2017.

FAOSTAT (2018): <http://www.fao.org/faostat/en/#country/114> (Last updated: 2018) (Accessed: 21.12.2018).

Gitahi, S.M., D.M. Harper, S.M. Muchiri, M.P. Tole & R.N. Ng'ang'a (2002): Organochlorine and organophosphorus pesticide concentrations in water, sediment, and selected organisms in Lake Naivasha (Kenya). - Hydrobiologia 488, 1-3, 123-128.

Hertkorn, M. (2017): "Food that makes you strong": implicit and explicit knowledge in the food sustainability framework. Towards Food Sustainability Working Paper No.4, CDE, University of Bern.

Hertz-Piciotto, I., Sass, J.B., Engel, S., Bennett, D. H., Bradman, A., Eskenazi, B., Lanphear, B. & R. Whyatt (2018): Organophosphate exposures during pregnancy and child neurodevelopment: Recommendations for essential policy reforms. PLOS Medicine 15, 1.

IFDC (International Fertilizer Development Centre) (2003): An assessment of fertilizer prices in Kenya and Uganda: Domestic prices vis-à-vis international market prices. - Paper Series IFDC - PCD 27, 1-11.

Lambert, M.R. (1997): Effects of pesticides on amphibians and reptiles in sub-Saharan Africa. - Reviews of environmental contamination and toxicology 150, 31-73.

Macharia, I., D. Mithöfer & H. Waibel (2009): Potential environmental impacts of pesticides use in the vegetable sub-sector in Kenya. - African journal of horticultural Sciences 2, 138-151.

Ogolla, A. (2018): Actor's perceptions of health risks and impacts related to food system activities in North West Mount Kenya region. University of Nairobi.

Okello, J.J. & S.M. Swington (2010): From circle of poison to circle of virtue: Pesticides, export standards and Kenya's green bean farmers. - Journal of agricultural economics 6, 2, 209-224.

Ottiger, F. (2018): Resource use intensity in different food systems in the north-western Mount Kenya region. MSc. Thesis, University of Bern.

PAN (Pesticide Action Network) (2019): PAN International List of Highly Hazardous Pesticides. Hamburg

PCPB (Pest Control Products Board Kenya) (2007): Annual report, July 2006 - June 2007, Nairobi.

PCPB (Pest Control Products Board Kenya) (2018): Pest control products registered for use in Kenya. Nairobi.

Rhoda, B., B. Freyer & J. Macharia (2006): Towards reducing synthetic pesticide imports in favour of locally available botanicals in Kenya. Conference Paper: Conference on international agricultural research for development, 1-4.

Thrupp, L.A., G. Bergeron & W.F. Waters (1995): Bittersweet harvest for global supermarkets: Challenges in Latin America's export boom. Washington DC: World Resources Institute.

Tsimbiri P.F., W.N. Moturi, J. Sawe, Ph. Henley & J.R. Bend (2015): Health Impacts on Residents and Horticultural Workers in the Lake Naivasha Region, Kenya. - Occupational Diseases and Environmental Medicine 3, 24-34.

Von Ehrenstein, O.S., Ling, C., Cui, C., Cockburn, M., Park, A.S., Yu, F., Wu, J. & B. Ritz (2018): Prenatal and infant exposure to ambient pesticides and autism spectrum disorder in children: population based case-control study. BMJ 364, l962.

Zähringer, J. G.; Wambugu, G.; Kiteme, B. & S. Eckert (2018): How do large-scale agricultural investments affect land use and the environment on the western slopes of Mount Kenya? Empirical evidence based on small-scale farmers' perceptions and remote sensing. Journal of Environmental Management 213, 79-89.

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