High Hazzard Pesticides (HHPs) in Near East and North Africa (NENA), constrains and recommendations to mitigate the risk of HHPs

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Abstract

This report gives an overview of the current situation of highly hazardous pesticides (HHPs) in North Africa and Near East countries (NENA). This work reviews the registered pesticides in the region and identify HHPs being used according to the Criteria 1–8 for HHPs of FAO/WHO Guidelines on HHPs. In addition, to identify the weakness and the need of the region to mitigate the risk from the use of HHPs, the report ended with recommendations needed in the region to improve the pesticide managements and registration, such as improving the agricultural practices by adopting the integrated pest management IPM and including replacing HHPs with ecosystem-friendly alternatives if available. The total number of pesticides registered and used in NENA region are 642 actives ingredients (IA). 89 HHPs are still in use in NENA region and 50% of them are evaluated under 1–7 criteria of GHS HHPs. This evaluation shows that 50% of HHPs are insecticides, 22% fungicides, 10% herbicides, 8% nematocides, 10% rodenticides. The rest of 38 HHPs are identified under criteria 8. This high number of HHPs still in use in some NENA countries urge the need technical assistance to reduce the use of HHPs. The type of assistant varies from country to other, to identify the priority of technical and legal assistant needed a country-based assessments must carry out at near future.

1. Introduction

Over the last years, an abundance pesticides and uncontrolled use, with exposure and adverse health effects on human health and environment, have become a serious issue to be concerned, especially when the number of intentional and unintentional poisonings have been increased in the Low- and Middle-income countries (LMIC). In addition to serious environmental impacts such as undermining the biodiversity, destroy the beneficial insects and natural enemies in the ecosystems. The highly hazardous pesticides (HHPs) increased risks to people through indirect or direct contact during life cycle of pesticide, including production, handling, use, and even the obsolete products. It also causes adverse effects on food security from the contaminated vegetables and fruits. It is one of the major sources of water and soil pollution. Their continues use will adversely affects the sustainable agriculture scheme in LMICs. However, HHPs are limited in numbers but it causes most of the high poisonings and adverse effects on human health and the environment, particularly in low and middle-income countries. ". In 2015, the fourth session of the International Conference of Chemicals Management (ICCM4) of SAICM, adopted a resolution that recognized HHPs as an "issue of concern" and called for concerted action to address HHPs (https://www.who.int/ipcs/features/hazardous_pesticides.pdf?ua=1). That global issue has been addressed by FAO, WHO and UNEP as well as those of many other public and private stakeholders active in the topic. Therefore, actions are needed on these HHPs, which is now widely known and there is no justification for waiting any longer before acting appropriately to ban them or restrict their use.

1.1. Acute poisoning of HHPs globally and in NENA region

At global level, pesticides are used in agriculture, horticulture, public health protection, and domestically, in addition to be used in general commerce and in therapeutic medicine. Agricultural pesticide poisoning is one of the major underlying public health problems, and it is one of the most common self-injury images in the global southern hemisphere (Ballantyne and Salem, 2006). However, Boedeker et al. (2020) reported that unintentional acute pesticide poisoning cases exceeds 350 million every year, especially in farming communities in low and middle-income countries LMIC, which means about 44% of worldwide farming population of approximately 860 million are poisoned by pesticides every year. Self-poisoning with pesticides represents 14–20% of global suicides and is particularly common in low-income and middle-income countries, where there are easy access to highly hazardous pesticides by farmers of small-scale farming, (WHO, 2020).

Mew et al. (2017), estimated the total suicides and calculated the portion due to pesticide poisoning, for seven WHO regional and income strata, the data were collected from 108 countries. The estimation indicated that there are approximately 110,000 pesticide self-poisoning deaths each year from 2010 to 2014, which is equivalent to 13.7% of the global suicides. The weighted estimates of the percentage of pesticide suicide and the annual cases in high-income countries is 1.7%, and 3,300 case respectively; many countries (44%) reported no pesticide suicides. In Eastern Mediterranean regions, an estimates of 7.1% and 2100 suicide are due to pesticide poisoning reported annually. While in African region, the portion is 3.5% and 2100 cases respectively. The data of high-quality method suicide was unavailable for several countries in Eastern Mediterranean and African regions. Therefore, the incidences are underestimated in these regions.

The percentage of the poisoning due to pesticide varies considerably between middle-income countries in regions. Where, the lowest rate of poisoning at 0.9% was in the middle-income countries in the European region and the highest rate of 48.3% was in LMIC in the Western Pacific region (WHO, 2008; 2015; Mew E.J. et al. 2017). Moreover, in the Qassim Region of Saudi Arabia from 1999 to 2003. The number of chemical poisoning cases increased from 66 to 114, the average age of patients was 17.7 years, and over 39% were children aged ≤ 5 years. Most cases were due to pesticide poisoning, nine deaths were recorded, of which four were by pesticide poisoning (Moazzam et al. 2009). While, in Jordan the number of fatal pesticide poisoning cases has increased over a 20-year period from 23.5 to 35 cases per year, while in other study organophosphorus (OP) was responsible for 308 deaths over 13 years (Abu Al-Ragheb, et al. 1989; Abdullat, et al. 2006). Furthermore, WHO Class I OP pesticides can cause severe poisoning, but the exposure doses are usually smaller than that with intentional poisoning (WHO, 2008; 2015). The registration process of pesticides supposed to be restricted only to those pesticides that are used for intended function, and such use does not promote adverse side effects either on human health or on the environment. Many cases of pesticide poisoning, appear to be as result of careless acts. That occur because of lack of knowledge of the toxicity of the pesticide, lack of awareness, lack of preventive measures, and not use of protective equipment during spraying and handling pesticides, as well as easy access to extremely or highly toxic pesticides, in addition to that some of HHPs are readily available and insufficiently regulated (WHO, 2004; Maroni et al. 2006; Atreya, 2008; Martínez-Valenzuela et al. 2009). The ready availability of highly hazardous pesticides is a problem because they are so lethal, and the easy accessibility of HHPs, can make the difference between survival and death.

In this context, HHPs are responsible for severe cases of poisoning. Suicides due to pesticide poisoning are a very significant problem in many stressed, rural agricultural communities in LMICs. A review of global pesticide suicides estimated that there were 160,000 every year with HHPs, (Mew et al 2016, Karunarathne et al, 2020). However, Dylan Weir (2021) from center for pesticide suicide prevention (CPSP) reported that, "Introduction of (HHPs) into poor rural

communities in the 1950s and 60s without the resources to support their safe use resulted in a rapid increase in number of accidental, occupational and suicidal poisoning deaths". More than 14 million people have die from pesticide suicide in these communities, in addition to hundreds of thousands likely death from occupational and accidental poisoning. Most of these incidents occur in developing counties, notably Africa, Asia, and Central and South America, where highly hazardous pesticides (HHPs) are readily available and insufficiently regulated. There is strong evidence that a high proportion of such death can be averted completely by making HHPs less accessible (Eddleston, Lancet 2020). The relatively simple and immediately achievable approach that could drastically reduce deaths caused by pesticides worldwide are: ban on highly hazardous pesticides. Implementation of the international recommendations to phase out highly hazardous pesticides by the 2006 FAO Council could significantly reduce the burden of unintentional acute pesticide poisoning. The banning of HHPs as mitigation measure succeeded in Sri Lanka to reduce the rate of suicide dramatically by more than 70% over 20 years (Gunnell et al. 2007).

1.2. Chronic health effect of HHPs

The intensive use of pesticides including those are classified as Highly Hazardous pesticides HHPs in agricultural which ultimately polluting the food. For example, in 1994, the cost of chemical pesticides in Jordan Valley farms reached about 24% of operating costs. The haphazard use of such chemicals causes major damage to air quality, soil, crops, and groundwater, consequently affecting human health on the long-run (Hajjar, 2012).

The pesticide residues have been found in blood plasma of labors in agricultural farms. Direct or unintentional exposure to pesticides causes neuromuscular disorders and stimulation of drug and steroid metabolism (Subramaniam and Solomon, 2006). In Eastern Mediterranean, The population in the Region are often exposed to pesticide residues, which may be illegal (prohibited or internationally restricted) or obsolete pesticides, as well as legally permitted pesticides. Intensive exposure to certain types of pesticides may lead to harmful and serious human health effects, such as increased risk rate of cancer, reproductive disorders, disruption of the immune system, neuro-behavioral impairment, disruption in endocrine system, Genotoxicity and an increase in birth defects (Philippe and Yousfi, 2020).

HHPs are endanger people's health in multiple ways, that due to increases the accidental and intentional poisonings and food contamination cases. Whereas in the most recent review by Philippe, et al (2021) from relevant scientific publications were available for 10 of the 22 countries in the Eastern Mediterranean Region, namely Egypt, Iran, Jordan, Kuwait, Lebanon, Morocco, Pakistan, Qatar, Saudi Arabia and Tunisia. The data were collected from more than 6,000 samples of fruits and vegetables were analyzed in the region from 2005 to 2019. They reported that fourteen pesticides were identified, which were reported in at least two countries in the region and at least two times in in considered commodity not authorized to be used on it or at a concentration above the international Maximum residue levels (MRLs). These 14 compounds are all insecticides belonging to the following chemical classes: 5 organo-phosphates (OP) (chlorpyrifos, diazinon, dimethoate, malathion and profenofos), 3 pyrethroid (cypermethrin, deltamethrin and fenpropathrin), 3 neonicotenoid (imidacloprid, thiacloprid and acetamiprid), 1 carbamate (carbofuran), and 1 sulfonate (propargite). In addition, 7 organochlorine (OC) pesticides (namely DDT, aldrin, dieldrin, chlordane, endrin and Heptachlor, and endosulfan). However, in the earlier study, Philippe, et al (2020) Concluded that in Eastern Mediterranean Region, The exceedance in values set by FAO and WHO of pesticide residues found in fruits and vegetables is likely to lead to consumer health problems. Moreover, the residues of several organic chlorinated pesticides, taht are listed in the Stockholm Convention has been repeatedly reported in fruits and vegetables. Unintentional exposure in general to public are occurred by eating contaminated food or drinking pesticide-contaminated water, also to whom live near field where pesticides usually used, (Jaga & Dharmani, 2003). Moreover, in Jordan, Abdullat *et al*., (2015) reported that as results of use of OP insecticides, the cholinesterase levels among workers living in agricultural communities with intensive agricultural activity showed 52% inhibition in plasma and 41.1% in erythrocyte as compared to the normal levels observed in urban areas. Non-occupational exposure originating from pesticide residues in food, air and drinking water generally involves low doses and is chronic cause of health problems including the incidences of cancer, neurological illnesses such as Parkinson's disease and reproductive, endocrine disruption, and developmental disorders (Ntzani et al., 2013). However, in Eastern Mediterranean Region, Philippe and Al-Yousf (2020) identified a clear relationship between occupational exposure to pesticides and a number of non-communicable diseases (NCDs). For examples, respiratory symptoms were reported in 65.9% of farmers exposed to pesticides in Pakistan (Khoso, et al 2019); lymphoproliferative disorders reported with farmers following exposure to pesticides (Salem, et al 2014); while, in Yemen hepatocellular carcinoma reported with 73.7% of farmers having a history of contact with chemical insecticides (Salem et al. 2012). In some cases, spills of chemicals, leakages, or faulty spraying equipment led to a great risk from accidental exposure to pesticides. The exposure of workers increases specially if workers not paying attention to the safety instruction on how to handle and use of pesticides. In addition, the retail workers at pesticide stores are at risk of exposure to pesticides that available in stores, especially if they deal with various pesticide products including the HHPs. The presence of such hazardous chemicals in the working environment without taking precaution measures will constitutes potential occupational exposure. Evidently, workers who deal directly with pesticides such as those who mix, handle, transport and apply pesticides will be exposed to high doses of pesticide directly or indirectly because of the nature of their work and are therefore at higher risk of potential acute intoxications (Fenske, et al 2005; Reeves & Schafer 2003; Calvert, et al. 2008).

1.3. POPs insecticides in NENA region:

The Organochlorine (OC) pesticides were the most widely used insecticides such as DDT, hexachloro cyclohexane (HCH), aldrin and dieldrin in the period of 1945–1980, in developing countries of Africa and Asia (FAO, 2005). OC pesticides are considered as HHPs because it act as endocrine disrupting chemicals (EDCs) (Sohail et al., 2004). In addition, most of OC are carcinogens and neurotoxic, (Kaiser, 2000), they are considered as persistent organic pollutants (POPs) and can persist in the environment for decades such as DDT, which pose a global threat to the entire ecological system. The intensive use of OC insecticides in controlling horticulture insects, mosquito species and other public health insects, resulted in global contamination of the organochlorine insecticides in the soil and water all over the world (Jayraj et al. 2016). The data about the level of organochlorine contamination in soil and water in Middle Eastern region are very rare, with few investigations were conducted. The presence of OC insecticides were detected in soil of Damascus countryside and in soil and water sample from costal area of Syria (Hajjar, 2001; 2012), as well as found in the soil, ground water and Nile river water of Kafer El-Zayat- Egypt (Doghem *et al*1996), the DDTs were the main compounds were detected in most of the samples. Although, none of the chlorinated hydrocarbon pesticides is presently recommended, or registered for the use in agriculture. Nevertheless, many incidents of food contamination with POPs insecticides are still being reported that, due to their

persistence in soils (Philippe, et al. 2021). Pesticide residues of POPs in soils can contaminate food even more than 30 years after their last application (Yadav et al 2015).

Organochlorines cause chronic health problem to human because, it acts as endocrine disrupting chemicals (EDCs) by interfering with molecular circuitry and function of the endocrine system (Sohail et al., 2004), in addition, many OC are carcinogens and neurotoxic, reproductive toxicant and cause disproportion of thyroid hormones, that can lead to a variety of disorders (Jayraj et al. 2016). Moreover, women of reproductive age, especially during pregnancy, are much more vulnerable to toxic compounds such as POP pesticides that can be passed through the placenta and breast milk to their infants (Hajjar & Maky 2016; Costa Souza et al 2020). Whereas Torres-Sánchez et al. (2009) found that, prenatal exposure to p,p'-DDE and its presence in cord serum lead to disappearance of neuronal development after 12 months of infant age. However, these persisted organic compounds are still exist and detectable in many different types of environmental samples (e.g., soil, water, fish, sediment, vegetables, fruits, milk, foodstuffs), also potentially cause human's chronic health problem. These compounds have Potential for long-range environmental transport and its residues detected distant from the treated area (Srivastava 2018; Fitzgerald &. Wikoff 2014; Hajjar 2012; Yadav et al 2015).

1.4. Effect on environment and biodiversity:

Pesticides including HHPs are a threat to the environment because they undermine biodiversity, wild birds are an essential part of biodiversity and of great importance to the ecosystem. Decline in the bird community is an important indicator of environmental pollution. The continuous use of HHPs is one of the main causes of bird death and reduction. Whereas, the impact in many cases, was not due to direct exposure, but results from indirect exposure, for example, the frequent use of pesticides in the soil transmitted to earthworms which are ingested by birds, (Pereira et al. 2009: Mitra et al., 2011). Insecticides and acaricides are usually used to control insect and mite populations in agricultural production systems. However, most of insecticides are not specific in their effete, as it does not only kill the target pest but also indirectly harmful to natural enemy, causing destruction and rapid decline in beneficial insect populations (Cloyd R.A. 2012; Abbar et al. 2010; 2012). Continuing reliance on pesticides may eventually lead to several potential ecological problems including resistance, secondary pest outbreaks, and/or target pest resurgence. Pesticides enter the environment can kill, inhibit or alter the functions of non-target organisms, whereas, many of these non-target organisms are beneficial. According to global monitoring data of 452 invertebrate species, there has been a 45% decline of invertebrate populations over the past 40 years (Dirzo, *et al*. 2014). Agricultural practices and pollution are the key factors that threaten up to one million species with extinction, where, many incidental toxicity of farm and wild animals, were reported, (Mansour, 2004; Ibitayo, 2006; Jayraj, et al. 2016).

Most insecticides are highly toxic to honeybees, unlike most fungicides and herbicides, systemic insecticides are considered highly toxic to honeybees, also destroy pollinators, so their toxicity is not limited to the adults of bee workers directly, but also will be transferred to the pollen in treated plants and the contaminated pollen collected by bees in the treated fields is stored in the hive and remains toxic for an extended period, this will negatively affect hives, causing a high death rate in bees (Kumar, et al. 2020). Exposure of pollinators to pesticides can be decreased by reducing the use of pesticides, by implementation of IPM as alternative forms of pest management in addition to ban or restriction on the use of HHPs (IPBES 2016). However, herbicides contribute to reduced plant diversity and reduce or alter pollinators' food and nesting resources (IPBES 2016). In near east region, many experiments were conducted and prove the harmful toxicity of conventional pesticides including the Organophosphate, Pyrethroid and Carbamate on the local natural enemies, for example, *Trichogramma cacoeciae, Aphelinus mali HALD* and *Ascogaster quadridentata* Wesmael *(*Hajjar & Al-Masoud, 2018; Abbar et al. 2010; 2012 a, b). However, to minimize the adverse effects of pesticides on natural enemies, there is an urgent need to assess and measure the risks of pesticides against natural enemies and identify the harmful insecticides. Pesticides may lethal to non-targeted organisms in addition to sub-lethal effects on behavioral and development of the beneficial insects, such as changes in rates of efficiency, longevity, sex ratio, and adult emergence (Cloyd R. A, 2012; Firake et al., 2012; Blibech et al., 2015).

1.5. Recommended mitigation:

Apparently, ban or restriction of HHPs is the direct and prompt scheme that could save hundreds of thousands of lives a year. Therefore, it should be common practice in LMIC, those countries should be assisted to build capacity and create an integrated system for the management, registration and monitoring of pesticides and establishing a pesticide database. Newly developed pesticides are generally safer than the older pesticides wich still used widely in LMIC countries. While the major multinational pesticide industry are keen to sell the newer pesticides, which are most likely to be more effective on the intentional pest and less toxic to unintentional species. But it's unlikely that the generic and black-market industry in low- and middle-income countries would change their sales as they keep producing the conventional highly toxic pesticides. One obstacle in ban or highly restrict the HHPs in NENA is probably a common belief by local farmers that pesticide use, and even HHP use, is essential for agriculture. This problem can be mitigated by awareness scheme. Guidance to the alternative practices and products to control pests in fields. The lack or absence of data on the problem of HHPs in many LMIC are due to underreporting of poisoning and suicides cases. This misrepresents the scale of the problem and can affect the governmental decision to deprioritize pesticide bans. Although, most of HHPs are banned or severely restricted by developed countries. Nevertheless, they are still widely used in LMIC. Even if their numbers are limited, they are known to be one of the main causes of most health and environmental problems, including poisoning, suicide, and chronic diseases such as cancers, in addition to severe pollution of water and soil as well as food. Their continued use therefore affects sustainable agriculture, food safety and public health

2. Objectives Of The Study

The objective of the report is to assess the situation of HHPs use and the associated potential risks arising from HHPs in Near East and North Africa and make recommendations on risk mitigation for better protection of human health and the environment and supporting transformation to a more efficient, inclusive, resilient and sustainable agri-food system in Asia.

3. Methodology

The sequence of the study :

1- Preparation of Study Concept

2- Nomination of the National Focal Points of each country in NENA region

3- Training program and introduction to the HHPs project concept in NENA

4- Development of Study Tools for national survey and collecting the data

5- Sorting out the data and information, identification of the HHPS at national level

6- Data Analysis and Compilation

7- Validation

8- Overall Analysis of HHPs in region and identification of needs to reduce the risk of HHPs

9- Proposed mitigation measures for NENA region

Box (1): The process for mange HHPs is organized around three key steps (*Source: adapted from FAO/WHO Guidelines on HHPs*)

1. Identification of HHPs

Country analyzes and pesticide registries according the eight criteria to identify the highly hazardous products. The FAO/WHO Joint Meeting on Pesticide Management [2008] recommended that highly hazardous pesticides should be defined as having one or more of the following characteristics:

Criterion 1: Pesticide formulations that meet the criteria of classes Ia or Ib of the *WHO Recommended Classification of Pesticides by Hazard*;

or

Criterion 2: Pesticide active ingredients and their formulations that meet the criteria of carcinogenicity Categories 1A and 1B of the *Globally Harmonized System of Classification and Labelling of Chemicals* (GHS);

or

Criterion 3: Pesticide active ingredients and their formulations that meet the criteria of mutagenicity Categories 1A and 1B of the *Globally Harmonized System of Classification and Labelling of Chemicals* (GHS);

or

Criterion 4: Pesticide active ingredients and their formulations that meet the criteria of reproductive toxicity Categories 1A and 1B of the *Globally Harmonized System of Classification and Labelling of Chemicals* (GHS);

or

Criterion 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;

or

Criterion 6: Pesticide active ingredients and formulations listed by the *Rotterdam Convention* in its Annex III;

or

Criterion 7: Pesticides listed under the *Montreal Protocol*;

or

Criterion 8: Pesticide active ingredients and formulations that have shown a high incidence of severe or irreversible adverse effects on human health or the environment.

2. Needs and risks assessment of HHPs

Countries assess the actual needs and benefits for each product identified in the first step, as well as the associated risks to human health and the environment, taking into consideration available alternatives.

3. Mitigation of HHPs risks

Countries identify risk mitigation options. The most appropriate mitigation measures may be different for each HHP and for each condition of use. However, the availability of alternatives is the key enabling factor in mitigation of HHPs risks.

4. Inputs Of The Study

4.1. Nomination of National Focal points:

To establish a regional network for HHPs, the regional office invites the relative ministries in NENA region to nominate the national focal point (NFP) in HHPs. Nine countries of near east and north Africa nominated the NFPs. the official nominations were from; Jordan, Iraq, Tunisia, Kingdom of Saudi Aribia (KSA), Kuwait, Bahrain, UAE, Egypt, Morocco.

4.2. Building capacity of NFPs and Data collection:

With reference to previous reports, data and observations about the pesticides registration system and management that available at FAO in Near East and North Africa. The regional consultant in collaboration with the regional Plant protection officer (FAO NENA), plan the training and data collection plans through three phases: the national focal points (NFPs) for member states need intensive and **provisional training, which cover the following tasks** (box 2)

Box (2) the training contents:

1- The definition and of the most used HHPs (active ingredient and formulation) based criteria 1 to 7 in FAO/WHO Guidelines on HHPs according to internationally accepted classification systems such as WHO or GHS or their listing in relevant binding international agreements or 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. The NFPs in the countries of the region also trained on how to list the registered pesticides and HHPs with the required information including the crops on which they are mainly used,

2- The NFPs trained on Assessment of HHPs

Countries assess the actual needs and benefits for each product identified in the first step, as well as the associated risks to human health and the environment, taking into consideration available alternatives. Which involves: Risk assessment; Need assessment

Risk assessment can be based on:

√ Studies about actual impact

√ Models to assess risk

√ Exposure monitoring data

√ Field observations or surveys of use if available

√ Bridging risk assessments from other countries/regions

√ Risk assessment can be quantitative but also qualitative

Needs assessment. using stakeholder fora to determine:

√ For what purpose are the pesticides being used?

√ What chemical and non-chemical alternatives are registered/available, or can be made available?

√ How effective are the alternatives?

√ What are the limitations of the alternatives?

The assessment is carried out through two steps, at first list of products that require attention, and then in the second step each product should be assessed to determine whether action is desirable.

3- The mitigation Countries identify risk mitigation options. The most appropriate mitigation measures may be different for each highly hazardous pesticide and for each condition of use. A key enabling factor in mitigation is the availability of alternatives Step 3 uses the outcome of Step 2 to determine, for each product, whether risk mitigation measures are required, and if so, which risk mitigation options would be most appropriate and applicable.

Risk mitigation options: Regulatory

√ Banning (a.i),

√ Cancellation of registration (formulated product), with or without phasing out

√ Severe restriction (only for very specific purposes and to be applied by licensed applicator)

√ Revision of registration with (further) limitations in permitted uses

√ Pesticides only available on prescription

Risk mitigation options: Non- regulatory (policy and administrative measures)

√ Promotion of alternatives, with emphasis on IPM approaches

√ Product management measures to enhance proper use and risk reduction (e.g. training in proper use, ensuring availability and use of PPE, precautionary label statements, etc.)

5. Outcome Of The Study

1- Lists of Registered pesticides, and identification of HHPs in NENA

Identification of the most used HHPs (active ingredient and formulation) based criteria 1 to 7 in FAO/WHO Guidelines on HHPs in the countries of the region and the crops on which they are mainly used.

2- Identify the key actions carried out by Member states in the region to reduce risks and phase out HHPs.

3- Support the ongoing Action Plan on HHPs by providing drafted HHPs work plan for NENA region.

Two sessions of training were conducted to build the technical capacities of the nominated NFPs on how to identify lists the HHPs. The obstacles and difficulties that faced the NFP, to list the pesticides and HHPs were discussed clearly in the training sessions. The technical problems were solved in the

meeting with the consultant. Most of the problems were with different explanations or understanding of the eight criteria for HHPs. However, the outcome of the training was with lists of the registered pesticides, and HHPs in were prepared by registration authorities with the NFP.

5.1 Registered pesticides in in near east and North Africa

All countries in the region have legal arrangements and systems for the registration and management of pesticides. Pesticides are registered in all countries, but registration mechanisms vary among countries in the region, although some states declare that they have a good registration system, but the application is poor because of the staff of the registration authorities are in lack of technically and knowledge of toxicity and risks assessment of pesticide.

In other hand, some countries have a registration system that not fulfilling the international pesticide registration systems as stipulated in the International Code of Conduct on Pesticide Management. Where pesticides are registered without adequate documentation and data on the pesticide, and there is insufficient control methods and tools of pesticides quality. Such cases indicate a legislative and legal weakness in the management and registration of pesticides system. It is assumed that the legislation regulates the registration of pesticides and aims to restrict the use of hazardous chemicals. However, the two workshops of the capacity building of NFPs in NANE regions resulted in updating the list of registered pesticides in most of The Near east and North African Countries (NENA). The information reported or presented in the building capacity workshops and meeting by NFPs have represented that the management of dealing, use and distribution of Pesticides needs to strengthen the technical capacities of workers and improve the technical management for proper use and proper transportation of pesticides and safety storage of pesticides to comply with international standards in order to reduce the risks that these toxic compounds can cause. The study has shown that a total of 642 active ingredients of pesticides are currently registered in the formulation of Insecticides, Fungicides, Herbicides, Acaricides, Rodenticides, Nematocides, Bio pesticides, Bactericides, Molluscides (Table 1).

Table 1
Number of registered pesticides by country in Near east and North Africa

	Rodenticide	Nematocide	Molluscide	Insecticide	Herbicide	Fungicide	Botanicals	Bio-pesticide	Bactericide	Acaricide	Other
Lebanon	3	1	1	25	8	44		5		9	
Yemen	4	2		54	3	44	1	2		11	
Tunisia	2	7		68	79	158		21		19	2
Egypt	5	12	1	61	71	84	1		2	14	2
GCC	13	7	1	88	35	66	30	10		17	8
Jordan	4	4	1	126	37	74	4	8	2	32	4
Iraq	3	5		100	48	74	6	4		26	11
Palestine	8	7	1	107	94	112					8
NANE	14	16	1	149	130	231	12	46	2	34	7

The total number of registered pesticides in NANE were 642 Active ingredients (AI) in 12 countries. The main registered pesticides are Fungicides of 231 products, at 36% out of the total registered pesticides and followed by Insecticides of 149 AI, at approximately 23%, then herbicides (130 AI) at 20%, followed by Bio-pesticides of (46 AI), at (7%), Nematocides at (2.5%), Rodenticides (2%), Molluscicide (0.16%), Botanicals (1.9%) and others (1%) as shown in Figure (1). Currently, insecticides and fungicides are mainly used followed by Herbicide. The use of pesticides is still not under control or restriction in most of the NENA countries, the use by farmers in rural area is still not compatible with safety precaution measures for agricultural workers. However, recently there are many agricultural companies with large production farms. Those have tended to use biocides and botanical pesticides in control pests. The application of Good Agricultural practices (GAP) open wide international market to their products, and especially in the organic agriculture, so we find that the number of biocides registered is increasing, especially in the Arab Gulf countries, Jordan and Tunisia.

The highest number of registered pesticides as shown in figure (2) recorded in Tunisia, which was equivalent to 18% of the grand total in all 13 countries. Followed by Palestine at (17%), Jordan at (15%), Iraq at (14%), GC countries (SAUDI Aribia KSA, United Arab Emirate UAE, Kuwait, Qatar, Bahrain and Oman) at (13%), Egypt at (12%), Yamen at (6%) and Lebanon (5%).

5.2 Status of pesticide registration and management system in NANE

The registration is the first important step in in pesticide management, as it allows the responsible authorities primarily to identify pesticide products that are permitted to be used and for what purposes have been registered. In addition to exercise control over quality, usage rates, claims, labelling, packaging and advertising of pesticides, thus ensuring that the best interest of end-users as well as the environment are well protected (Code of conduct, FAO, 2010). The registration process of pesticides supposed to be restricted to those pesticides are only used for their intended function and such use does not promote unreasonable effects either on human health or on the environment. Based on information from NFPs and from previous information from FAO in the Near East and North Africa. The authorities' performances and system of pesticide registration and monitoring in the region is weak and needs to be evaluated in countries of region to identify weaknesses and strong points in the system and develop plans to strengthen the pesticide management and registration system in those countries. However, we may exclude some countries, for example the Arab Republic of Egypt, which has a good and integrated registration system and a qualified and highly experienced staff in this field. In addition, GC has a good and integrated registration monitoring system for pesticides, but some the GC countries are in lack of the qualified staff to run this system in proper manners.

Moreover, one of an important weakness in the monitoring and management of hazardous pesticides is that all the countries of the region are members of the Rotterdam Convention, (PIC). However, the practices of implementation of this convention by most of NENA countries is very week, and even they do not take any intuitive to evaluate the risk of the used pesticides. However, one of the advantages of the PIC convention is that all countries in the region banned Pesticide active ingredients and formulations listed by the *Rotterdam Convention* in its Annex III.

Further analyses of the collected data on country bases we notice that in (table, 1), the scenario of registered pesticides changes from one country to another. We notice that at major number of insecticides were registered in Jordan, Iraq GCC and Yemen, the number of fungicides were major to the insecticides in Tunisia, Egypt, Palestine and Lebanon. That may due the wide varieties of horticulture, crop and vegetables are grown in this area, in addition to the local conditions of humidity, mild temperature which encourage the spores to emerge and the diseases spread fast on the plants.

5.3 The status of Highly Hazardous Pesticides in NENA

However, two sessions of training were conducted to build the technical capacities of the nominated NFPs on how to identify lists the HHPs. The outcome of the training was with lists of the registered pesticides, and HHPs in were prepared by registration authorities with the NFP. However, the information and the data of HHPs provided by the NFPs were not adequate and some of them even not fulfilling the criteria 1–7, of GHS. The lists of the registered pesticides and the suggested HHPs by each country was reviewed and updated by the consultant, and then send back the nominated NFP with the amendment and the updating, with the aim of learning NFPs by doing of practice. After, the consolidated lists of the registered pesticides and HHPs in North Africa and Near East countries were circulated to all NFPs for final review before validation. Validation meeting was organized with NFPs to present and validate the evaluation results of the consolidated lists of registered pesticides and HHPs, (annex 1).

The consolidated lists of registered pesticides and HHPs were extracted and reviewed from data received from, GC countries. Egypt, Iraq, Jordan, Lebanon, Palestine, Tunisia, Morocco. However, no information received from Algeria, in addition Morocco and Syria did not send or provide us with the requested data of the registered pesticides.

The data/information were collected and listed in the consolidated HHPs list for NANE region (annex 1) was analyzed. The main challenges and difficulties to the national registration authorities were the estimation of LD50 for the formulation products. One of the main outcomes of the project is that most of the registration authorities in NENA countries do not require the LD50 value of pesticide formulation in documents for registration, they ask for LD^{50} value of Active Ingredients only. Therefore, most the producer company or the supplier did not support the registration dossier with the required information. In addition, in near east and North African countries, most of the national pesticide companies and formulator do not provide the registration authority with all required documented information and data for registration. The luck of such document and data could be due to that most of the national companies failed to obtain a letter of accesses to the toxicology data from multinational pesticide companies, and that may be due to quality and financial matters.

5.4 Analysis of the collected and reviewed data of identified HHPs evaluated against the 1–7 criteria

The reviewed and updated data collected from NENA countries are consolidated in HHPs list against 1–7 criteria for NANE region as shown in Annex (1). However, the rate of HHPs identified in group 1 of the acute toxicity pesticides of the criteria (1) are 57.8% total HHPs, in addition 40.2% identified as long term effect of the criteria (2, 3, 4), where are only 2% identified HHPs to criteria related environmental convention, because all the pesticide listed by the Stockholm Convention in its Annexes A and B, or listed in the annex III in Rotterdam Convention are banned in all countries of NENA, figure (3).

The number of HHPs that evaluating against the 1–7 criteria of GHS are 50 HHPs annex (1). Whereas 25 of them are highly hazardous insecticides (HHIs), at almost 50% of the total and all HHIs in the list are met the criteria 1, with an exception of two registered insecticides that met the criteria 4, in addition to DNOC meet criteria 3 and Methoxychlor met criteria 2 & 5. In addition, 11 registered fungicides listed as HHPs, and identified as long-term effect (criteria 2, 3, and 4) of GHS. Five Herbicides were identified as HHPs and all of them meet the criteria of long-term effect and some have acute effect as shown in the annex (1). Four nematocides listed as HHPs were identified as acute toxicity met the criteria 1, with an exception to Ethoprophos which meet the criteria 2 of HHPs (GHS). In addition to 6 rodenticides are identified as HHPs two of them (Coumatetralyl and Flocoumafen) are identified with reproduction toxicity (criteria, 4), the rest four rodenticides are identified as acute toxicity (criteria, 1 GHS). Figures (4) shows the percentages of HHPs reported by NFPs of each country. The highest rate of 48% of the total 86 HHPs identified and listed by GC countries, such rate reflects the development and improvement of pesticide registration and monitoring management systems in the Gulf States, followed by Jordan at 24%, Iraq at 14%, Egypt at 11%, Palestine and Tunisia at 5%. While no HHPs is reported by Lebanese NFP. That do not mean no HHPs are used in such countries, but the monitoring and registration system of pesticides are very week and in need of an argent improvement action.

5.5 Analysis of the collected and reviewed data of Identified HHPS evaluated against the criteria 8

All pesticide registered in one or more countries of NENA and listed as restricted products were considered as HHPs under the criteria 8. Since The NFPs in meeting agreed on that the registered pesticides that listed as restricted pesticides and still under use in the region with no international databases/lists, should be considered as HHPs in accordance to Criteria 8, of the high incidence of adverse effects, based on the results of the surveillance from comparable countries indicating high incidence of poisoning or environmental impact. Therefore, the rest of 38 pesticides listed as restricted pesticides and not meet any of the criteria from 1–7 are identified to be HHPs according to the criteria 8. However, when those pesticides are considered to be met the (criteria 8 of GHS) added to the HHPs list that met the criteria 1–7 of GHS, the number of identified HHPs in the Nearest & North Africa become (89) HHPs (annex, 1); However, the data shows that 72 HHPs were classified under criteria 8, while only 36 HHPs were classified under Criteria 1 (Fig. 5). This highest numbers of HHPs

related to criteria 8 is due to that, 38 AI identified as HHPs according to (criteria 8) of GHS, in addition to 34 HHPs are identified with one or more of the (criteria 1–7) plus 8 as shown in the (annex 1).

However, some the registered HHPs in the region are still under use but most of them are under restriction, and some of them are banned in other countries of region. In addition, the percentages distribution of registered HHPs against criteria (1–8), by type of pesticide showed that, the highest percentage is with Insecticides at 51% of the total registered HHPs in the region, followed by fungicides at 15%, then rodenticides at 13%, herbicides at 8%, nematocides at 7% and acaricides at 5%, (figure, 6). However, the order of HHPs distribution is like that above mentioned with the list of HHPs identified against criteria 1–7.

5.6 The ratio of the registered HHPs to the registered pesticides

The total of the registered HHPs are 89 products at almost 14% out of 642 the total grand of the registered pesticides as active ingredient s (AI). The Highly Hazardous Insecticides is at almost 14% out of the 149 registered insecticides. The Highly Hazardous fungicides at 5.6% out of the 231 registered Fungicides, the Highly Hazardous herbicides at 4.6% out of the 130 registered herbicides. The Highly Hazardous nematocides at 25% out of the 16 registered nematocides and the Highly Hazardous acaricides at almost 3% of 34% out of the 34 registered acaricides. This analysis and evaluation showed that the most hazardous pesticides are insecticides, with more than 51 of registered compounds of active ingredients are identified as HHPs and most of them were with acute toxicity referred to the criteria 1 of GHS.

6. The Common And Compatible Outcome Of The Hhps In The Region

By reviewing the data provided by NFPs for HHPs, we found some of the following points were common and compatible and some were different between countries:

- Some pesticides are banned in some countries, but are not banned in the rest of the countries, therefore they are listed in the list of the registered products and the list if HHPs

- Pesticide active ingredients listed by the Stockholm Convention in its Annexes A and B, are banned in all countries of NENA.

- Pesticide active ingredients and formulations listed by the Rotterdam Convention in its Annex III are banned in all countries of NENA.

- All pesticide registered in one or more countries of NENA and listed as restricted products were considered as HHPs under the criteria 8 of GHS. Since The NFPs in meeting agreed on that the pesticides listed as restricted pesticides use in the region with no international databases/lists, should be considered as HHPs in accordance to Criteria 8, of the High incidence of adverse effects, based on the results of the surveillance from comparable countries indicating high incidence of poisoning or environmental impact.

- Methyl bromide are banned in all NENA countries since 2015.

- In the near east & North Africa (89) HHPs; some are still under use but most of them are under restriction, and some of them are banned in other countries.

- Some HHPs, like Paraquat and Paraquate Dichloride, are banned in the region, but still registered in Jordan for exportation only, which reflect Jordan authorities take the duple standing measures.

- This number of HHPs are still in use in some NENA countries which sets the alarm for the need of an urgent technical assistance to take action to reduce the risk that caused by the use of HHPs to human, animal health and Environment.

- The type of assistant needs will vary from country to country, so preliminary assessments of each country must be carried out to identify technical and legal needs and training to reduce the risk caused by the use of these pesticides.

6.1 Evolution of the current situation of pesticides management; dealing, handling, distribution and use in North Africa and Near East countries.

In addition, the training, followed by two meeting with the NFPs, to review the progress of the required tasks in the project, and answering all inquiries. However, most of the NFPs addressed the real situation of pesticides management and monitoring in their countries in addition to discussing some issues that may improve the mitigation measures can be taken by Near east and North African countries. The discussion helped the consultant and the FAO officer to identify the need of the region to improve the management of HPPs and reduce the risk. In addition to suggest recommended alternatives to the HHPs. Helping the decision makers to take the right action ether by banning the products or amending the registration of some product to become severely restricted products. The distribution of the current situation in the region help to set the action plan for reducing the risk of HHPs; NFPs addressed the following issues that representing current situation of pesticides management and identifying the weaknesses points in in North Africa and Near East countries.

The first thing is the lack of planning, and poor experience trained personals in pesticide management and some countries are with inadequate infrastructure of registration, monitoring, use and handling of pesticides.

Limited capacity for pesticide risk assessment and monitoring of incidents of impacts of HHPs to environment and human health. This stems from outdated legislation, which means there is no proper system in place to track monitor and manage the pesticides: some and even few countries do not know the accurate data of the registered pesticides and the country of original of the imported pesticide. In addition to luck of information about the stockpile of pesticides, the condition of the stored products, and the quantity of the obsolete pesticides. Not all those countries are willing to admit they are having these

issues, and even they are not asking for technical assistant to build their technical and personal capacities in pesticides management. Therefore, we need to try to be clear and to protect the future.

Furthermore, smuggling of pesticides is one of the most important issue. Whereas those pesticides are not subjected to national monitoring system of pesticides. In many incidents, the uncontrolled smuggled products were fake pesticides and may contain some highly hazardous ingredients to human and environment. The illegal pesticide trade has the highest impact on farmers. In addition, very few countries such smuggled products can sold anywhere, even by the side of the road.

Accredited labs to analyse pesticides efficiently, accurately required for quality control and impurity of pesticides to identify the active ingredients or the precise quantities in the products. In some countries in the region, do not have pesticide labs to provide accurate information and no national legislation to mandate controls and follow-up internationally. Since, such labs are not available in many countries in the region therefore it continuously is a big gap in the region. Syria for example has no accredited labs at all. They were destroyed during the war. Yemen and Iraq do not have any either. Other countries like Lebanon have them but they are not able to run these labs properly with fall capacity because they lack the basic materials or agents to run the testing. So, we set up a small FAO project to give Lebanon the materials they need to carry out the tests.

Labelling of pesticide's bottle and container, in a clear manner according to GHS, the international standards is still an important issue need to be solved in accordance with the requirements of GHS for label. Where some labels are made in a very primitive way, without logos or clear warnings signs that reflect the level of hazard of the pesticide, and even there is lack of information on the impact of the pesticide product on environment. In some cases, pesticides are divided by retailers and refilled in small bottles and sold without label or any information of use nor the indication to toxicity.

Very rare to find farmer mix chemical by their hands, but most of the farmer in the NENA region are not using the protective equipment when they are handling, mixing and using the pesticides. Across the developing world, the use of PPE is highly problematic, with some exception in large farm operations, and especially if they applied the Global GAP, or Saudi Gap, labour rights are more closely monitored, and employees tend to use PPE. Even in the large farm, some workers may find the PPE uncomfortable and therefore do not wear it, and the employer or supervisor does not necessary take responsibility to ensure that workers use it. Also, high portion of farmers do not know how to read the labels. Even they do not know how to use the pesticides, or how to protect themselves. They mix the chemicals with tool by their hands without wearing gloves, and without wearing a mask.

No proper import plan of pesticides quantities that countries' need is exist in most country of NANE. We report that some country import pesticides quantities 10 times more than that the national need. The question is how give importing permissions? It is needed to understand the objective of importing, giving permissions should be based on country needs. However, most of the imported pesticides and specially those chip pesticides are usually imported from China or India are smuggled to other neighbouring countries. Such case reflects the impact of inefficient registration and management of pesticides in Lebanon and Syria and reflects without any doubt the unguided use of pesticides.

7. Recommended Mitigations To Reduce The Risk Of Hhps

In the fourth meeting the NFPs suggested and approved the following steps of mitigations should be taken into consideration to reduce the risk of HHPs in their countries and improve the pesticide life cycle management in their countries and in the region of NENA, the recommended action should be considered in the region to reduce the risk of HHPs:

7.1 National Pesticide restriction programmes

√ Building up the National Pesticide restriction programmes, that restricting the availability of highly toxic or locally more common used pesticides can indeed be effective in reducing total death rates from unintentional and intentional self-harm

7.2 Implantation of integrated pest management (IPM)

√ Farmers usually find the spray of pesticides is the easy way and cheapest to control the pest, one of the objectives of the project is to shift the attention of farmers to green solutions, by showing them the alternative of environmentally sound techniques, including the biological control.

√ Changes in farming practice: By adopting the farmer field school approach (FFS) to train farmers by doing on implantation of IPM tactics, use alternative to chemical control and introduce the knowledge of pest economical threshold.

√ Strengthen scientific research, agricultural extension and supporting regional networks. in the areas of agroecology, organic farming, and IPM.

7.3 Improving/or building the system of pesticides risk assessment

√ Building capacity for pesticide risk assessment and monitoring of incidents of impacts of HHPs to environment and human health.

√ Explore available and appropriate options to make regulatory risk data more transparent and publicly available. This may require long-term actions in supporting, financing of the underlying risk research of HHPs.

7.4 Improve/ or building pesticide national registration and management systems

√ Regional Base line evaluation of national registration, regulations and management, of pesticides in accordance with the International Code of Conduct on Pesticide Management.

√ Building the national capacity and coordination in the scoop of pesticide labeling standardizations in accordance with the Global harmonized System (GHS).

√ Strengthening the technical and personal capacities in pesticide efficacy testing and determination of post-harvest interval (PHI) under local conditions.

7.5 Ban the HHPs

Governments should phase out highly hazardous pesticides and include in their plans the gradual approach to non-chemical pest management; supporting research into agro-ecological practices; raising awareness and promoting knowledge about biodiversity-based ecological agriculture and integrated pest management.

7.6 Improve medical management of pesticide poisoning

√ Most patients with pesticide poisoning reach hospital alive. Therefore, improved management and medical performance of self-poisoning treatment could also reduce suicide rates rapidly. Improvement will come from clinical research, implementation of outcomes into clinical practice, and improved supply of essential antidotes.

√ Governments should have training programm to ensure that health practitioners are trained in diagnosing and treating pesticide poisoning.

7.7 Improve/or introduce the precaution and safety measures

√ Training the farmer and explains the need for personal protection equipment (PPE) and how best to use it, in addition to have greater access to information that explain the important of use PPE and the type of PPE required upon the type of the chemical and purpose of use.

√ HHPs pesticides cannot be used safely without the use of PPE, Therefore, governments and industry in LMIC countries should not manufacture nor register pesticides that required PPE, especially because of a lack, inadequate or unable to purchase personal protective equipment.

√ Governments must ensure that all dealers of pesticides are trained and licensed to be capable to advice on proper use pesticide; and establishing systematic compliance monitoring system of all pesticide dealers.

7.8 Improve the implementation of international environmental conventions

√ Collaborate with the Rotterdam Convention to strengthen capacity and the knowledge base maintained by the Convention obligations and commitments.

√ Capacity-building in the implementation of Stockholm Convention obligations.

7.9 Inventory, safe gardening and disposal of Obsolete Pesticides

√ Building capacity on inventory, safe gardening safe disposal of obsolete pesticides and preventing their future accumulation.

7.10 monitor and Combat Illicit Trade in agrichemicals

√ Combat Illicit Trade in agrichemicals and pesticides and members include pesticide manufacturers, defines illegal pesticides as obsolete and unauthorized pesticides.

8. Conclusion

89 HHPs are still widely being used in countries in NENA and are posing great threats to human health and the environment. The weak capacity of pesticide management in the regions lead to continuation of harms associated HHPs

HHPs undermine vital health conditions and ecosystem services, for present and future generations, and jeopardize transforming to efficient, inclusive, resilient and sustainable agri-food systems and achieving the UN Sustainable Development Goals. Elimination harms of HHPs become a big concerns of the region.. Therefore, an action plan to reduce the risk of HHPs should prepared as soon as possible considering the above-mentioned recommended mitigations to reduce the risk of HHPs, therefore such action required.

Work-plan to be as baseline evaluation to each country in the region to identify needs of each country in the region and then set a plan for duration of 5–10 years to improve the pesticides registration and management and take the action to reduce the risk of HHPs in the region, in addition to harmonize the regulations and legislations of pesticides among the countries of the Near East and North Africa. Time plan to execute the recommended mitigation measures where is necessary to reduce the risks of HHPs and harmonize the regulations and legislations of pesticides among the countries of the Near East and North Africa in accordance with International Code of Conduct on Pesticide Management. Sufficient funding should be made available to achieve the above recommendations in developing countries and those with economies in transition.

Declarations

Ethical statement

The data in this report were officially provided by the officially nominated focal points in Near East and North African Countries (NENA).

Conflict of Interest

The authors declares no conflict interests.

Authors contribution

Thaer Yaseen, and M. Jamal Hajjar; are equally involved in collecting the data and information of registered pesticides in the NEN regions. Identification of HHPs, assessment of risks and proposed mitigation upon the recent situation of pesticides uses in the evaluated countries. Preparing and drafting the report of HHPs in NENA region .

Gu Baogen; was involved in review the lists of identified HHPs and risk assessment and the draft of the report.

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Data availability

All data are mentioned in the body of manuscript, tables, and figures.

Conflict of Interest

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Consent for publication

Not applicable.

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Annex

Annex 1: List of HHPs (Criteria 1-8) in (BAHRAIN. EGYPT, IRAQ, JORDAN, KUWAIT, LEBANON, OMAN, PALESTINE, SAUDI ARABIA, TUNISIA, UAE and MOROCCO)

S.N.	Name of HHPs	Identification Criteria (Criteria 1 -7)	Remarks
1	1.3- dichloropropene	1 & 8	nematocide
2	carbofuran	1 & 4 & 8	insecticide
3	Chloropicrin	1 & 8	nematocide
4	Acetamiprid	8	insecticide
5	Alfa-Cypermethrin	8	insecticide
6	Aluminium Phosphide	1 & 8	insecticide
7	Azinphos Methyl	1	Insecticide
8	Benomyl	3 & 4	fungicide
9	Beta-Cyfluthrin	8	insecticide
10	Beta-Cypermethrin	8	insecticide
11	Bifenthrin	8	insecticide
12	Brodifacoum (tetraboratedecahydrate)	8	rodenticide
13	Bromadiolone	8	rodenticide
14	Bromethalin	8	rodenticide
15	Bromoxynil	4 & 8	Herbicides
16	Bupirimate	2	fungicide Suspected of causing cancer
17	Carbendazim	3 & 4	Fungicide
18	Carbosulfan	8	insecticide
19	Chlorophacinone	8	rodenticide
20	Chlorothalonil	2 & 8	fungicide
21	Chlorpyrifos	8	insecticide
22	Chlorpyrifos-methyl	8	insecticide
23	Coumatetralyl	4 & 8	Rodenticide
24	Cyfluthrin	8	insecticide
25	Cypermethrin	8	insecticide
26	Cyproconazole	2 & 4	Fungicide
27	Diazinon	8	insecticide
28	Dichlorvos (DDVP)	8	insecticide
29	Difenacoum	8	rodenticide
30	Difenoconazole	8	Fungicide
31	Difethialone	8	rodenticide
32	Dinocap	1 & 4	fungicide & acaricide
33	Dinotefuron	8	Insecticide
34	Diphacinone	8	rodenticide
35	DNOC (Dinitroorthocresol) and its salts	1 &3	insecticide
36	Epoxiconazole	2& 4	fungicide
37	Ethoprophos	1&2	nematocide
38	Fenamiphos	1 & 8	insecticide & nematocide
39	Fenbutatin oxide	8	Acaricides, Insecticides
40	Fenpropathrin	8	insecticide
41	Fipronil	8	insecticide
42	Flocoumafen	4 & 8	rodenticide

43	Formetanate HCL	1	Insecticide & Acaricide
44	Gamma-Cyhalothrin	8	insecticide
45	Glyphosate	8	herbicide
46	Hexaethyltetraphosphate (HETP)	1 & 8	insecticide
47	Hydramethylnon	1 & 8	insecticide
48	Hymexazol	8	fungicide
49	Imidacloprid	8	insecticide
50	lambda-Cyhalothrin	8	insecticide
51	Magnesium Phosphide	1 & 8	insecticide
52	Malathion	8	insecticide
53	Mancozeb	4 & 8	Fungicide
54	Metam-potassium	1	nematocide
55	Methidathion	1 & 8	insecticide
56	Methiocarb	1 & 8	Molluscicides, Bird repellents, Insecticides
57	Methomyl	1 & 8	insecticide
58	Methoxychlor	1 & 2 & 5	insecticide
59	Naled	1	insecticide
60	Oxamyl	1 & 8	insecticide & nematocide
61	Paraquat	1 & 8	Herbicide Registered only in Jordan for export
62	Paraquate Dichloride	1 & 8	Herbicide only in Jordan for export
63	Phenamiphos	1 & 8	insecticide
64	Phenothrin	8	insecticide
65	Phosphine	1 & 8	insecticide
66	Picloram	8	Herbicides
67	Pirimiphos-methyl	1 & 8	insecticide
68	Propanil	2 & 1	Herbicides
69	Propetamphos	1 & 8	insecticide
70	Propyzamide	2 & 8	Herbicides
71	Rotenone	8	insecticide and acaricide for public health
72	Strychnine	1 & 8	Rodenticide
73	Tefluthrin	8	insecticide
74	Temephos	1 & 8	insecticide
75	Tetramettrin	8	insecticide
76	Thallium sulphate	1 & 8	Rodenticide
77	Theta-Cypermethrin	8	insecticide
78	Thiacloprid	4 & 8	insecticide
79	Thiomethoxam	8	insecticide
80	Thiophanate-methyl	2 & 3 & 8	Fungicide
81	Triazophos	1	insecticide
82	Warfarin	1 & 8	rodenticide
83	Zeta-Cypermethrin	1 & 8	insecticide
84	Zinc phosphide	1 & 8	rodenticide & insecticide
85	Thiram	8	Fungicide
86	Propiconazole	4	Fungicide

87	Triadimenol	4	Fungicide
88	Triflumizole	4	Fungicide
89	Spirodiclofen	2 & 8	Acaricide

Figures

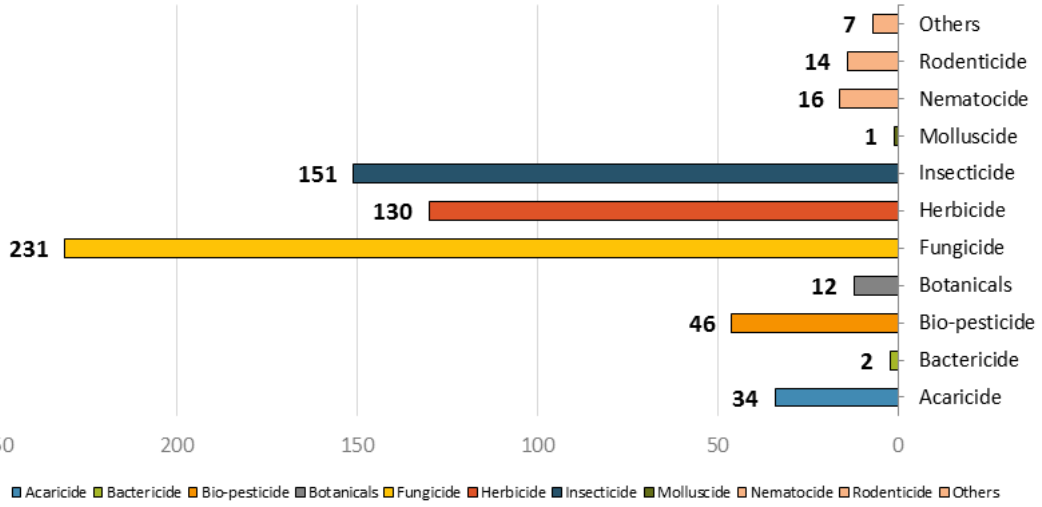

Figure 1

The total number of the registered pesticides in NENA region based on pesticide use.

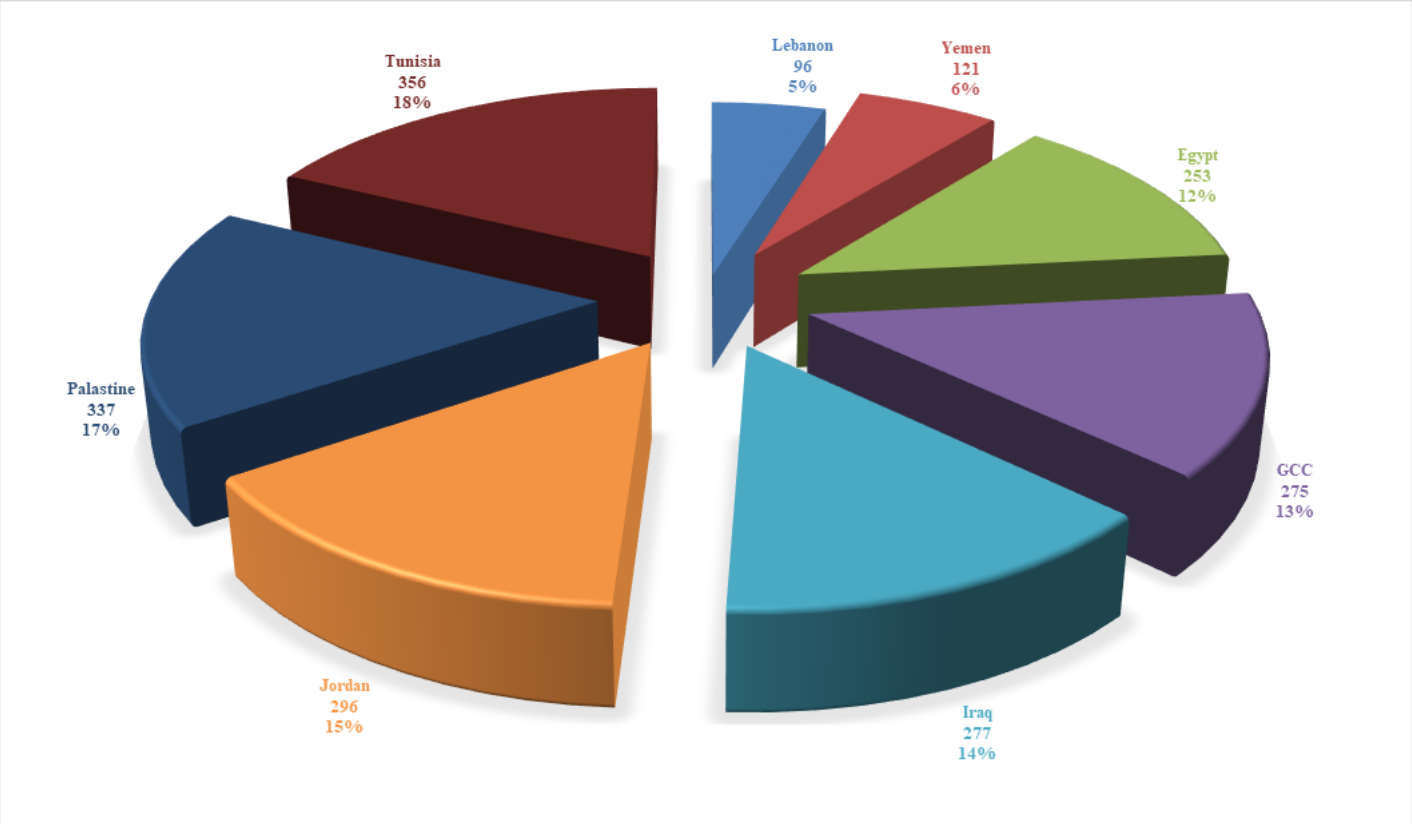

Figure 2

Grand total and the percentage of registered pesticides by countries.

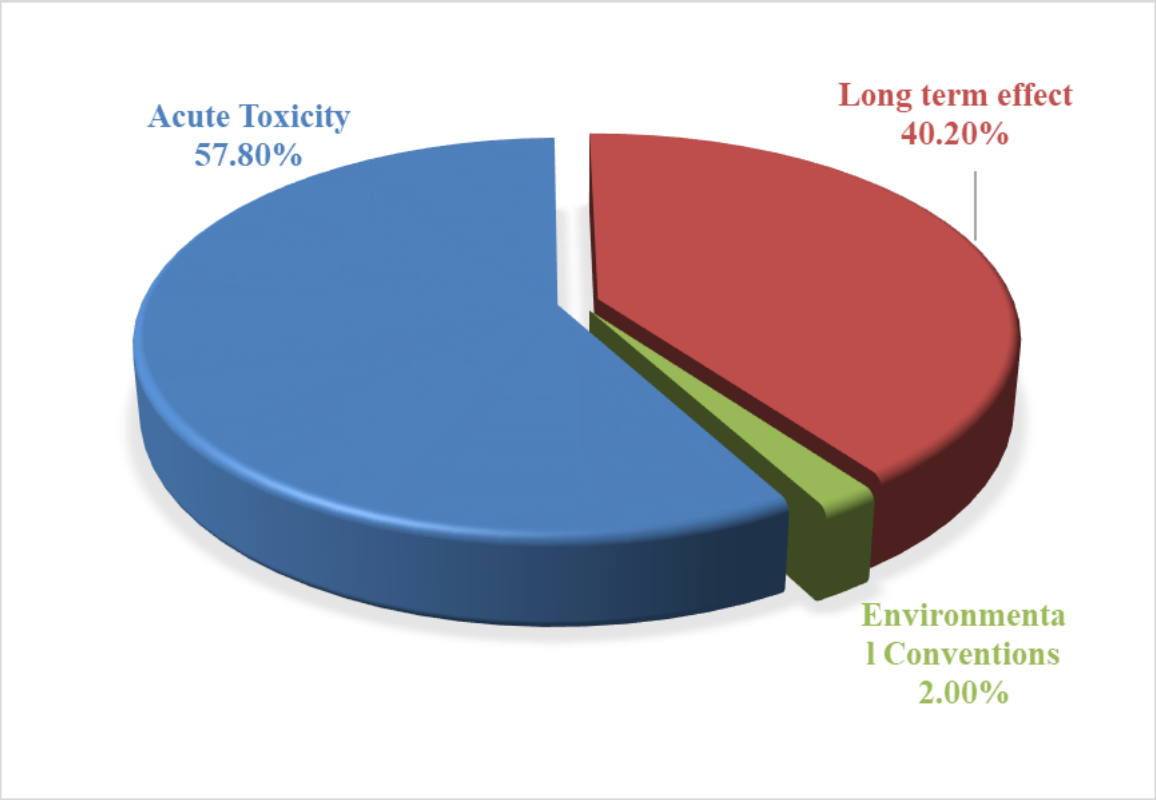

Figure 3

The rate of HHPs in in NENA countries divided based on acute toxicity, long term effect and environmental convention.

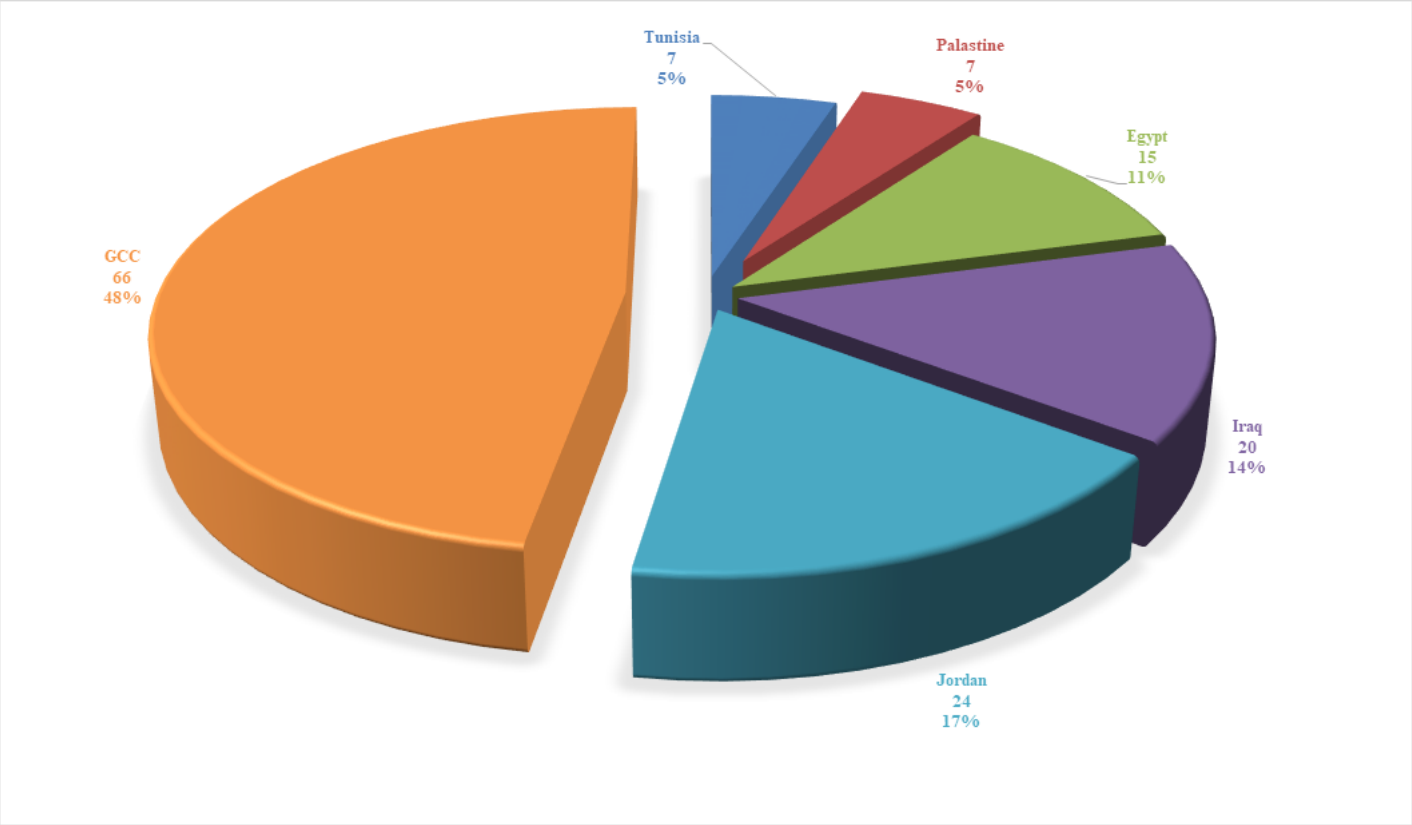

Figure 4

Percentage of HHPs in NENA region based on the country of registration.

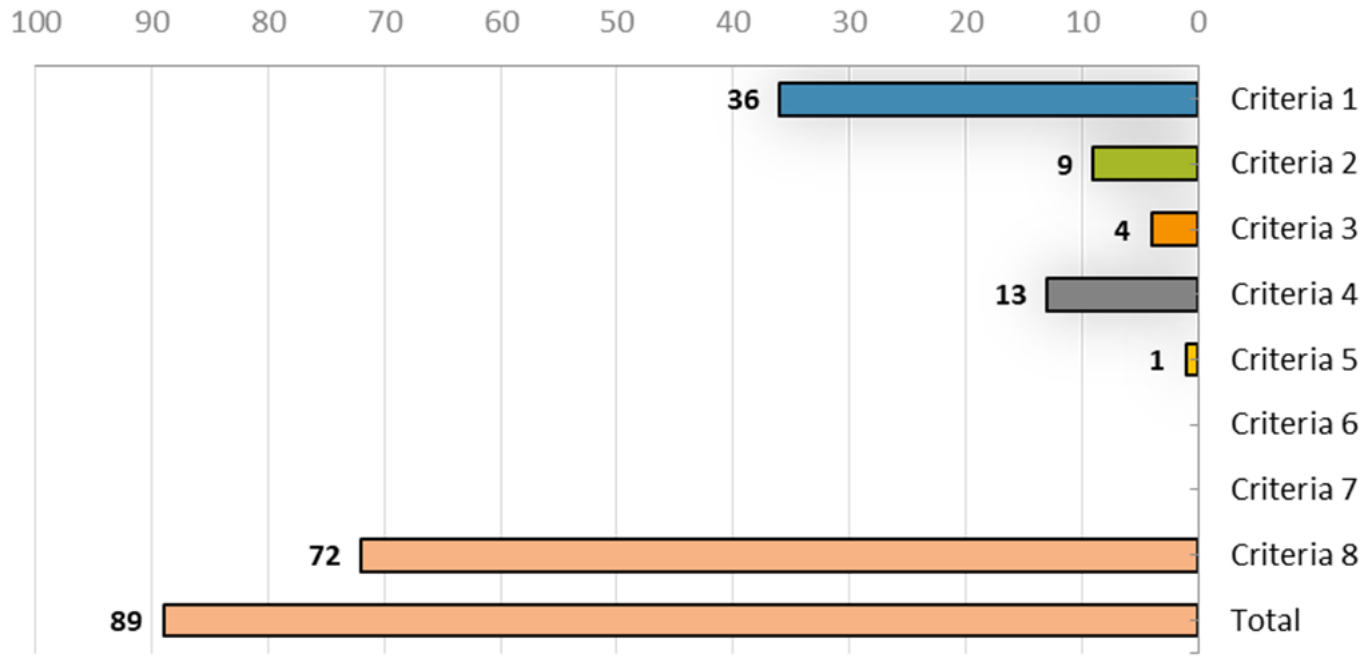

Figure 5

The number of HHPs in NENA region organize based on the criteria

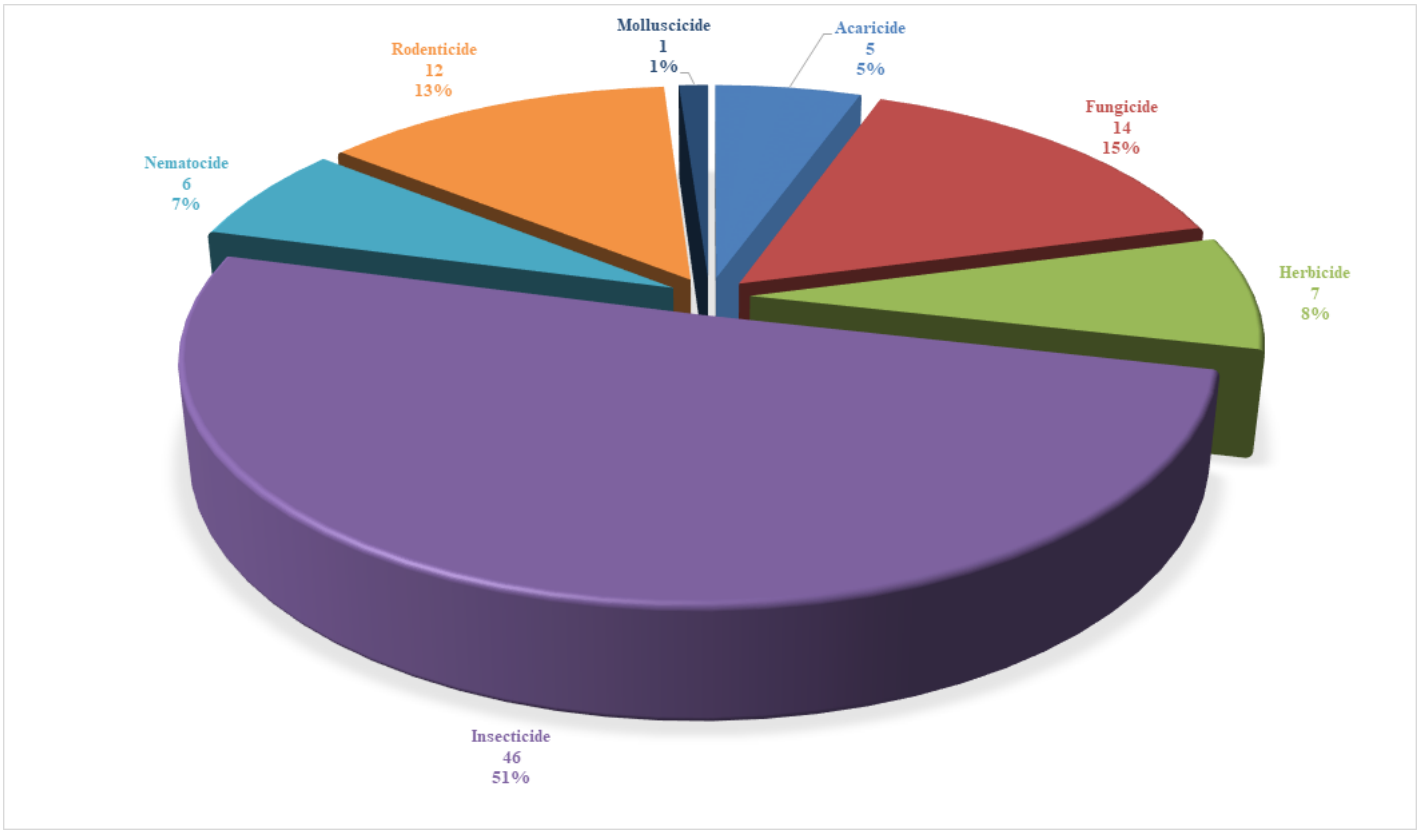

Figure 6

The percentage of HHPs in NENA region classified by the category of the pesticides

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