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SOURCES OF ENVIRONMENTAL THREATS IN EL-ORO PROVINCE (ECUADOR)

The authors analyze the impact of environmental threats in El-Oro province and also analyze factors of environmental threats dissemination, for example pesticides in surface waters, leaching of soil.

The article aims to identify sources of environmental threats and their impact on environment and public health, as well as to develop the measures for reducing the risk of potential threats.

Key words: *pesticides, environment, agriculture, threats, El-Oro province, leaching of soil, fertilizers, organochlorine pesticides, fungicide, chlorinetalonil.*

Introduction

The main banana exporter in Ecuador is El-Oro province. Banana industry is one of the most important sectors of Ecuadorian exports after oil, with 3.84% of GDP and half of all agricultural products. Banana companies employ directly or indirectly 12% of Ecuador population. Banana production like any other has a significant impact on the environment.

Today, due to environmental degradation, the question about ensuring the environmental safety for a single person and for whole population constantly arises. During many years people directed their activities to transform the environment according to human interests.

The result of these activities was growing number of sources of environmental threats. In order to prevent further conversion of potential threats in real ones, full exploration of their sources, assessment of their negative impact, developing measures for risk reducing, and implementing these measures into practice must be provided.

The purpose of the paper is studying the impact of environmental threats in agriculture in El-Oro province.

Main part

Environmental safety has an important role for ensuring the modern human life and created elements of artificial environment. To ensure the highest possible level of environmental safety at the global, regional and local levels, first of all one must identify the sources of environmental threats, find their detailed characteristics and identify methods of reducing their negative impact. As source of threat, the conditions and factors of environment may be considered, which have the potential threats to human and harmful or dangerous manifestations [1].

El-Oro province is located in south-western Ecuador. It is bordered by the Pacific Ocean to the west, and Peru to the south. Its area is 5850 km². The administrative center is the city of Machala. It is informally called the world banana capital [2].

El-Oro province is one of the leading Ecuador for bananas collecting. Cocoa is also grown here in large quantities, as well as coffee – on the east of the province in the foothills.

The province also has a lot of plants for agricultural products processing and food industry [3].

It is known that pesticides increase crop resistance. Bananas, cocoa and coffee have no exception. In El-Oro province pesticides are used for growing basic agricultural products. Organochlorine compounds are among the most widely used pesticides in Ecuador.

Organochlorine pesticides is the most persistent, toxic and distributed. Introducing chlorine in organic compound gives it a biological activity, which is manifested in blocking of important biological processes in microorganisms, plants and animals, so they are used to destroy harmful or unwanted microorganisms, plants and animals.

Chlorotalonil is widely used among organochlorine pesticides. It belongs to organochlorine compounds chemical group and is used as a fungicide. Chlorotalonil ($C_8Cl_4N_2$) is highly effective and low-toxic fungicide of chloronitriles class. Pesticides based on it have a wide range of action and are used to destroy pathogens of various diseases of many agricultural crops. Also it provides long-term protection against a number of pathogens of vegetative plant parts including against some fungi. Duration of protection is mainly determined by the growth speed of new young plant parts and may take up to two weeks. Chlorotalonil prevents germination of conidia and spores. It binds thiol groups of peptides, proteins and amino acids, disrupting functions of respiratory and glycolytic enzymes of cells. As a result, the pathogen can not penetrate the plants. Hence, these pesticides are used for preventing the disease “black Sigatoka”, banana leaves disease caused by a fungus.

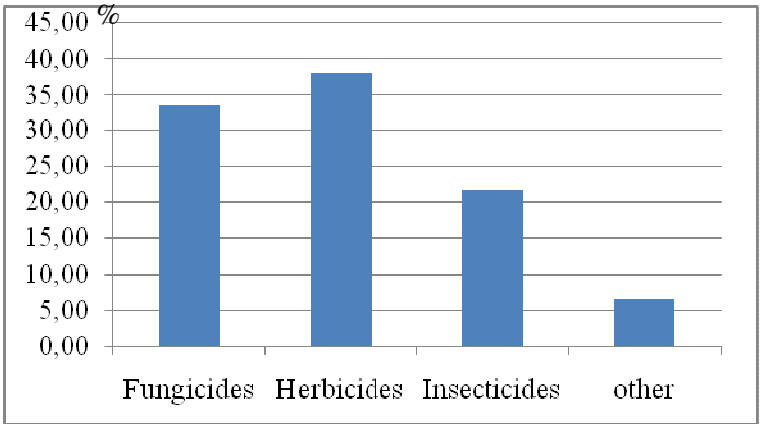

Fig. 1. Pesticides used in El-Oro province [6]

Widespread use of these substances in agriculture has led to a substantial increase of yields. However, in case of misuse or overuse it leads to soil and water pollution, which in turn causes the deaths of birds and small animals, and even pose a threat to human health. In Figure 1 we can see the percentage of agricultural chemicals used in El-Oro province. Here chlorotalonil (also used as a fungicide) is one of the most commonly used pesticides when growing bananas, its share is 34% [6].

The system of pesticides use in crop rotation is highly important part of farming. However, increasing volume of their use (particularly in case of low yields) leads to environmental pollution. Its main sources are as follows: pesticides from the fields surface is washed down into the water (about 50%); leaching of lyophilic elements in soil and their excessive accumulation in plow layer of soil due to the large amount of pesticide placed on the surface, misuse of animal farms and others.

Pollution of surface water by pesticides and fertilizers takes place in several ways. They come into the water when being washed down from plant-soil surface, during spraying fields with pesticides and when contaminated ground water flows into water body. Water pollution by pesticides and fertilizers is especially dangerous for its ubiquity. Water pollution by pesticides above permitted limits is prevalent in areas with constant use of irrigation at banana plantations. The most important consequence of water pollution is reducing the water quality due to pollutants. Usually, contaminated water is also unsuitable for industrial use because it violates the normal way of the technological process and reduces the quality of products produced [4].

Further intensive agriculture development in El-Oro province is inextricably connected to the growth of pesticides use, which increases the risk of their impact on the environment, especially on soils. Also, infringement of agronomic technologies of fertilizers use, storage, mixing and transportation often lead to soil degradation and productivity loss. The use of unreasonably high

pesticides doses in agriculture adversely affects soil processes, conduces to pollution of media contacting with soil by fertilizers residues and products of their transformation.

However, the proper pesticides use is achieved only together with other successful agricultural measures. As an important but not the only factor of yield increasing, agrochemicals are an integral part of the whole system of agrochemical measures (acidity removal from the soil, weeds extirpation, struggle against plant diseases and pests, etc.). An important role has reasonable definition of mineral fertilizers doses when one must consider reserve of available nutrients in the soil, organic fertilizers amount to be put in, and harvest to be cropped. In all cases, forming the system of soil fertilizing for whole crop rotation and its unswerving implementation is more efficient and economically justified than focusing on fertilizing of one-year crops.

It is known that primary means of weeds extirpation in El-Oro province are herbicides. Herbicides are chemicals affecting the inhibition of particular group of plants or other pests without causing much damage to crops. But chemicals provide only temporary defense because later they contribute to development of resistance to permanently used chemicals. This cause the necessity to use new more powerful substances that simultaneously reinforce negative impact on soil, water, air, products quality, flora and fauna, thus accelerating biological balance deviation in the environment.

Numerous studies have shown that banana fields have nearly 30 weed species, which were sensitive to herbicides earlier but have resistance to them nowadays. Surviving even after intensive use of herbicides, they cause significant banana yield losses.

It is known that unwanted pesticides distribution in the environment takes place by both physical and biological ways. The first way is the distribution by wind in the atmosphere and spread through watercourses. The second way is the transfer by live organisms according to a food chain. With the organisms movement to higher levels of a food chain, pollutants concentration increases accumulating in the internal organs, mainly liver and kidneys.

Therefore, pesticides use in agriculture can be assessed from two perspectives: as a cost-effective and environmentally dangerous both for the environment and for a human.

Fungicides are vital elements of modern agricultural production in El-Oro province. They are toxic and therefore their incorrect use may cause serious harm to human health and the environment.

Pesticides can contaminate soil and water sources, destroy useful organisms (such as pollinators) and they also are poisonous to other animals, thus destroying the biodiversity. When using pesticides people are exposed to toxic chemicals, which can cause chronic poisoning and damage of the liver, lungs, brain, and even cancer.

Besides, used pesticide containers have to be properly utilized. Rapid expansion of banana plantations after the crisis of cocoa growing has caused the felling of large tropical forests areas. Large areas are usually used for monoculture due to demand of frequent use of heavy agrochemicals in large doses at plantations. About 10 years ago, the norms and standards of banana production were changed in accordance with USA standards, but standards for growing were not modified. Toxic compounds such as nematicides and DBCP (dichlorbrompropane) are still used for growing. According to WHO, these chemicals have increased toxicity and negatively affect the reproductive function of humans and animals. Chronic effect on human reproductive function can be maintained even after the termination of pesticide exposure [5].

Environmental consequences of DBCP use are large because this chemical accommodates in the soil and is resistant to chemical degradation. It decomposes very slowly in soil and migrates over long distances. It was discovered in groundwater and surface water 10 years after use.

Bananas growing requires intensive use of agrichemicals at all stages: the use of herbicides, disposal of plastics treated with insecticides and used to cover and protect bananas field, disposal of "bands" and plastic strips treated with insecticides, nematicides treatment and air spraying of fungicides.

Air spraying of fungicides is also dangerous. Although employees have to be protected for two hours after spraying, in most cases they continue working while breaking these rules.

Fungicides are dispersed by wind not only on the plantation but also on workers buildings situated within plantations, roads and the surrounding area.

Dispersion of fungicides, which can last from 7 to 10 days, is carried out 15-20 times per year. Wastewater composed of these chemicals flows through drainage channels of plantations causing pollution of rivers and has large environmental and economic consequences.

Next chart shows the statistics of various diseases caused by the use of chlorotalonil having a high rate of respiratory diseases with the share of 42% (Figure 2).

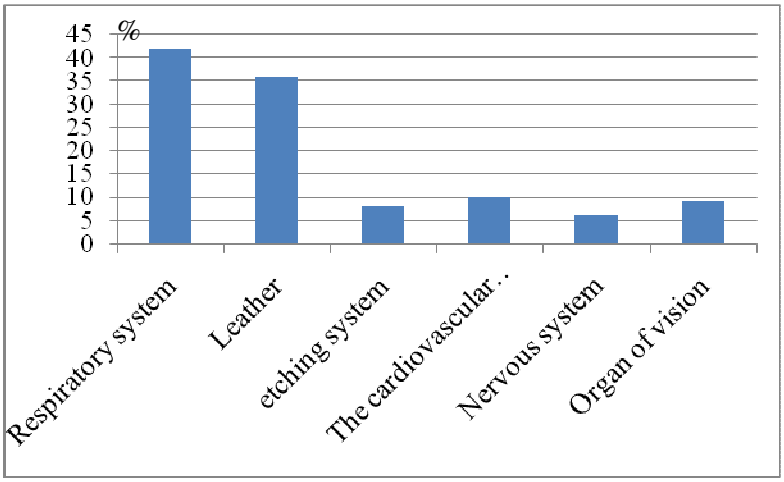

Fig. 2. Statistics of various diseases caused by poisoning of chlorotalonil [7]

At least 10 pesticides classified by WHO as extremely toxic (1 A) and high toxic (1 B) are used in the banana production [6].

This system creates health problems such as genetic mutation causing physical injury, diseases of skin, digestive system, vision, lung and respiratory tracts, headaches. Table 1 shows pathological changes in organs and tissues caused by chlorotalonil poisoning.

Table 1

Pathological changes in organs and tissues caused by chlorotalonil poisoning [7]

Organs	Pathological changes
Skin	irritation, dermatitis, loss of skin color (discoloration), burn
digestive system	nausea, vomiting, diarrhea
respiratory system	irritation, pulmonary edema
cardiovascular system	arrhythmias, heart failure
nervous system	brain edema, point hemorrhages in the white and gray matter of the brain, dizziness
vision	conjunctiva of ocular cavity and the anterior part of the eye

The index of protection when using pesticides in Ecuador is average 63.9% and in El-Oro province there is the highest rate of protection index (90.33%) [7].

Besides, the use of agrochemicals affects the flora and fauna in water, soil and air. Banana growing requires large amounts of water for irrigation and other purposes. Most people in rural areas have no water, drinking and using contaminated water. Food and Agriculture Organization of United Nations (FAO) does not recommend pesticides use at a distance less 200 meters from water

bodies. There are 47.71% of agricultural lands in Ecuador using pesticides and situated near water bodies [6].

Monoculture and the lack of organic matter recycling conduce to soil degradation. However, there are alternatives. 30% of Ecuadorian bananas and fruits are grown by organic way. Apart from environment and health protection, they have higher market prices. Fig. 3 shows the location of the provinces in Ecuador with large concentrations of pesticides.

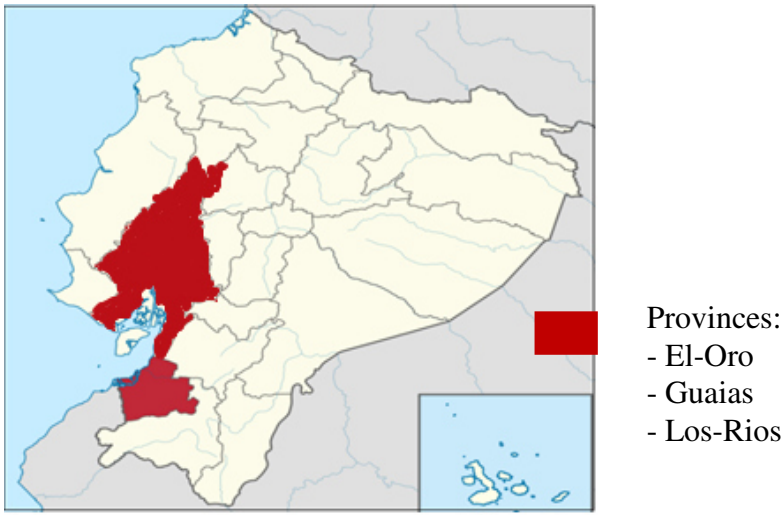

Fig. 3. Location of the provinces in Ecuador with large concentrations of pesticides [1]

Conclusions

Analysis of data presented makes it possible to conclude that the environmental situation in El-Oro province is unsatisfactory. That is due to pesticides use for growing basic agricultural products. Organochlorine compounds are among the most widely used pesticides in the province with a share of 34%.

Therefore, pesticides use in agriculture can be assessed from two perspectives: as cost-effective and environmentally dangerous both for the environment and for a human.

There are many diseases in El-Oro province caused by the use of organochlorine pesticides with high rate of respiratory diseases (42%).

People living near the plantations and work there have become hostages of the economic situation, which requires the use of harmful and hazardous agrochemicals without which sufficient production volumes will not be achieved.

Fungicides are vital elements of the current agricultural production in El-Oro province. They are toxic and therefore their incorrect use may cause serious harm to human health and the environment.

Nevertheless, the decision exists. It is gradual (step by step) implementing the programs of reforestation, training of safe agrochemicals use, development and implementation of environmental laws, rational resources use, recycling, regulation of agricultural chemicals use and the use of modern chemicals decomposing in the environment and other measures including environmental safety.

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