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Original Article

Farmers' Exposure to Pesticides and Strategies for Reducing Exposure Risks: A Policy Summary

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Abstract

The use of thousands of tons of various industrial chemicals, including chemical fertilizers and pesticides, in agriculture has created hazardous conditions for public health, society, and the environment. According to reports from the World Health Organization (WHO), over 3,000,000 cases of pesticide-related poisoning have been reported. Studies show that, in the United States alone, more than 2 billion pounds of pesticides are used each year across various sectors, including agriculture and forestry. Due to high consumption, people's exposure to these toxins has risen, causing more adverse effects on human health. Pesticides are widely used due to their high stability and minimal cumulative effects on various environments. Diazinon, a well-known organophosphate, is commonly used in cultivation and veterinary medicine. This toxic substance is very hazardous to many humans and animals. Based on several studies, issues related to improper use include unauthorized stocking of pesticides, inadequate monitoring of exposure thresholds, the sale of pesticides without prescriptions, and indiscriminate crop planting. Furthermore, the unnecessary use of pesticides can have adverse health effects. Using antioxidants is an effective solution to mitigate the toxic effects of diazinon. Barberry is an effective herbal composition used worldwide as a healthy and valuable food additive. In addition, a wide range of its therapeutic and pharmacological properties has been investigated in humans and animal models. The high antimicrobial, anti-inflammatory, and antioxidant effects of the barberry plant may be due to berberine, the plant's primary bioactive compound, along with other compounds such as flavonoids, triterpenes, and palmatin. As studies have mentioned, a solution or decision-making approach for such complications is recommended by developing a policy brief based on confirmation. Therefore, to make evidence-based policy decisions while considering existing obstacles and opportunities, it seems essential to use intervention plans to reduce pesticide use and strengthen farmers' defenses.

Keywords: Barberry, Farmers, Pesticide, Policy Summary

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The Importance of Developing a Policy Summary

Agriculture is considered a threat to food security. The use of pesticides has increased to enhance agricultural output [1]. The US definition of pesticide states that "a substance that is used to prevent, destroy, repel, or reduce any pest" [2]. Studies show that in the United States alone, more than 2 billion pounds of pesticides are used each year across various sectors, including agriculture and forestry [3]. Due to high consumption, people's exposure to these toxins has risen, leading to greater adverse effects on human health. For instance, the American Public Health Association estimates that approximately 1,275,000 American farmers are exposed to various pesticides [4]. It is noteworthy that, compared to developed countries, poisoning by these toxins is more common in developing countries due to the increased use and availability of various types of pesticides. For instance, in China alone, it is estimated that poisoning with pesticides, mainly caused by organophosphates, results in around 175,000 deaths annually [5]. According to the Food and Agriculture Organization (FAO), approximately 3.8 million tons of pesticides were used on agricultural land worldwide in 2012 [2]. Most agricultural products that are exposed to pesticides and offered for sale to consumers shortly after spraying are contaminated with pesticide residues. In agricultural production, the use of pesticides has been shown to increase yields significantly, but excessive or improper use can result in concentrations that exceed the maximum residue limit (as set by national and international standards) [6]. In developing countries, over two million people are exposed to health hazards caused by pesticides [7]. Additionally, the use of chemical pesticides leads to the destruction and reduction of some beneficial insects that are natural enemies of pests, as well as soil contamination and other environmental hazards [8]. Research shows that agricultural exposures are the most common cause of pesticide exposure. The World Health Organization (WHO) categorizes these toxins from Class I (highly toxic) to Class III (slightly harmful). In fact, the WHO advocates a policy of banning or restricting the use of Class I pesticides and recommending only a limited number of pesticides with lower risk to human health [9]. Therefore, due to the large amount of pesticides consumed, human exposure to these toxins is almost unavoidable and can occur unintentionally, accidentally, or as a result of pesticide use and their persistence in the environment and on objects [10]. DZN is a widely used agricultural pesticide applied to control insects across a broad range of crops, such as rice fields, various fruits, sugarcane farms, and corn and potato cultivation. The toxicity of diazinon extends beyond the target insect, and its side effects can cause developmental problems in other organisms, such as humans and other animals [11]. Principally, the primary mechanism of DZN toxicity is acetylcholinesterase inhibition, which can lead to the accumulation of acetylcholine at cholinergic synapses in the nervous system [12]. A significant document shows that cellular secondary mechanisms are involved in subchronic and chronic DZN poisoning, as oxidative stress, playing an important role in many toxicities [13]. In general, the brain is highly susceptible to oxidative stress. Recent research shows the fundamental role of free radicals in damaging brain neurons and even causing their death. The role of oxidative stress in diseases, such as Alzheimer's, Parkinson's, and brain aging, has been established. Barberry is a valuable medicinal plant commonly used as a spice worldwide [14]. The potent antimicrobial, anti-inflammatory, and antioxidant effects of the barberry plant may be due to berberine, its main bioactive compound, as well as other compounds, such as flavonoids, triterpenes, and palmatin.

This compound exhibits various effects, including analgesic and vasodilator effects that have been reported in extracts or individual compounds of this plant [15]. To prevent the destruction and loss of their agricultural products, which require significant expense, effort, and time, and also due to population growth and existing limitations in food production, humans use multiple methods to control and eliminate plant pests [16]. Natural antioxidants can act as reducing agents, scavengers of free radicals, complexing agents for prooxidant metals, and quenchers of singlet oxygen formation. Many studies have reported the antioxidant effects of barberry extract in reducing toxicity from various toxins by reducing oxidative damage to the brain in

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different laboratory animals [17]. In third-world countries, issues such as unauthorized stockpiles, the lack of proper management of poison sales without appropriate sample preparation, farmers' unawareness, and unselective establishment can be related to various reasons. Despite the potential to assess and regulate pesticide use, excessive and improper use of pesticides by farmers and the public continues to threaten human health and the environment. Therefore, implementing policies to reduce the negative impacts of agricultural pesticide use remains a worthwhile goal. The study was established to guide policy options by considering current obstacles and opportunities, aiming to reduce pesticide intake and increase farmers' defense levels, so that health organizers and policymakers can advise on plans and mediation strategies with greater certainty.

Criticism of the Present Situation

As mentioned in this field, expanding the range of caring techniques for planters through the use of herbal additives during pesticide application can serve as a strategy to prevent acute and chronic health complications by increasing the antioxidant system [6].

Policy Recommendations

1. Monitoring and updating standards related to maximum pesticide residue levels in horticultural products, cereals, fruits, and vegetables.

2. Determining the slope of pests, diseases, and wildflowers for major agricultural harvests, along with the list of pesticides and optional products for their regulation.

3. Issuing a Product Health Promotion Certificate in the Electronic Agricultural Licensing System (SEMAC) to identify plant products in production units.

4. Using herbal supplements and native antioxidants for the nation and documenting their effectiveness based on clinical trial results to reduce secondary complications.

Recommendation (1).

- Responsible entity: National Standard of Iran
- Establish safe exposure limits for each crop based on international protocols.

Recommendation (2).

- Responsible entity: Ministry of Agricultural Jihad, Plant Protection Organization
- Determining and communicating clear instructions for pesticide contact and informing about their toxic effects.

Recommendation (3).

- Responsible entity: Ministry of Agricultural Jihad
- Certification of all products and pesticides used in Iranian farms and households' food supplies.

Recommendation (4).

- Responsible entity: University of Medical Sciences
- Use laboratory approaches to produce native herbs of the country to enhance protection against potential poisons for workers and farmers.

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Authors' Contribution

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Competing Interests

There is no conflict of interest among the authors.

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Ethical Approval
This study was reviewed and approved by the Ethics Committee at Hamadan University of Medical Sciences (Approval Code: IR.UMSHA.REC.1403.236).

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