Poltekita: Jurnal Ilmu Kesehatan
http://jurnal.poltekkespalu.ac.id/index.php/JIK

Vol.17 No.2 August 2023: Hal. 295-300
p-ISSN: 1907-459X e-ISSN: 2527-7170

Original Article

The Impact of Organochlorine Pesticides (OCPs) on Environment Health

Saiful Jamal[1*], Indang Dewata[1], Abdul Razak[1], Nurhasan Syah[1]

[1]Master of Environmental Science, Postgraduate, Universitas Negeri Padang, Indonesia

(Correspondence author email, farajanail@gmail.com)

ABSTRACT

Pesticides are toxic chemicals used mainly in agriculture to control pests and increase production. The use of pesticides is increasing with the development of special agricultural areas in the Nagari Sungai Nanam Solok district. Organochlorine pesticides are still used to control diseases on agricultural land, while the use of organochlorine pesticides has been prohibited due to the persistent effects they produce. The research aims to look at the potential environmental impacts caused by the use of specialized organochlorines on public water resources that are vital to daily life. The study used random purposive sampling techniques to determine respondents' characteristics and the water sources used. This study's respondents comprised 85 people obtained from the village group in the Nagari Sungai Nanam district of Solok. In contrast, the water samples were obtained from Galian wells and Pamsimas facilities. The results of the study showed that the level of risk of 8 (eight) means used by society could be determined by using the IKL form: there are two means (25%) at the high-risk level, three means (37.5%) at the medium-risk level, and three means (37.5%) at the low-risk level. As a result of the water sample testing, eight sampling sites found a concentration of lindane that exceeded the threshold of 0.45 ug/L lindane in the sample L.2771 (a water well in Jorong Pasa) and 0.62 ug/LL in the L.2775 sample (well water in Jorong Taratak Pauh). This condition describes the potential for higher pollution of wells due to organochlorine-like pesticides or other types that can harm health and the environment. The high use of pesticides, if not limited, will be a danger in the future for the surrounding community, which can lead to death, so an in-depth study is needed regarding the effect of pesticide use on the health conditions of the community and its environment.

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Keywords: Pesticide, Organochlorine, Environment

https://doi.org/10.33860/jik.v17i2.2601

INTRODUCTION

Pesticides are generally defined as toxic chemicals used to control intruders that harm human interests. The use of pesticides in agriculture provides benefits in increasing production. Today, pesticides are an indispensable tool, especially in protecting plants and crop products from losses caused by various pests and diseases. Even some farmers have a paradigm towards pesticides as a "savior god," which is very vital. This belief tends to increase the use of pesticides from time to time. Pesticides consist of various types, including insecticides, herbicides, fungicides, rodenticides, and fumigants[1].

Pesticides, especially insecticides, are divided into several groups based on their chemical properties: organochlorines, organophosphates, carbamates, and pyrethroids. One of the pesticides commonly used in Indonesia is the organochlorine group. Several organochlorine pesticides belong to this group of persistent organic pollutants (POPs), which are being questioned worldwide due to their chronic, persistent, and bioaccumulative nature. Organochlorine pesticides are persistent pesticides, namely DDT, Aldrin, Dieldrin, Endrin, Chlordane, Hexachlorobenzene, Mirex, Toxaphene, and Heptachlor[2]. In general, organochlorines are used as a spray. After spraying, organochlorines can be in the air and

soil environment[3]. Based on the phenotype and plant species density, an average of 35-50% of the pesticide is estimated to be deposited on the soil immediately after spraying through direct use. Meanwhile, the leaching process due to rain or precipitation can cause organochlorine pesticides to enter the aquatic environment[4].

According to research by Rahardrian (2016), the Citarum River, as one of the watersheds in West Java Province, often receives water runoff from human activities, including agriculture. Several studies have shown that organochlo-rines are still detectable in the water and sediments of the Citarum River, including Organochlorine residues detected in water, sediment, fish, and liver are linden, aldrin, heptachlor, dieldrin, DDT, and endosulfan[3]—pesticide residues in the environment risk impacting health and the environment itself. Based on research conducted by Noerdin (2015) at the Bandung Plantation Center, the results showed that pesticide residues were still present in both samples, namely river water and well water. The pesticide residues observed corresponded to the active ingredients of the pesticides used by the farmers, namely cypermethrin for the Lembang plantation area, abamectin for the Ciwidey plantation area, and chlorothalonil for the Pangalengan plantation area[5].

Accumulating pesticides at a certain threshold can cause adverse effects on the body; among others, brain disorders, tumors, and cancer, even in pregnant women, can cause congenital disabilities. If the exposed pesticides are mostly heavy metals, they can interfere with the nervous system. Data from the Department of Fisheries and Food of Solok Regency in 2017 stated that there were pesticide residues in several agricultural products in Lembah Gumanti District, the profenofos type (22.122 mg/kg) in the red chili sample and the methidathion type (0.063 mg/kg) in the green chili sample. In Rizki's research results, it is known that the levels of pesticide residues in spinach vegetables in Maharatu Village are relatively high, where out of 18 samples tested, only seven samples were below the pesticide residue threshold, namely <0.1 mg/kg, two samples were not detected and nine samples above the pesticide residue threshold, namely > 0.1 mg/kg[6].

Solok Regency is one of the main production centers for horticulture, especially for vegetable commodities, which has quite basic problems related to the use of pesticides in eradicating plant pests. It is no longer a secret that all farmers are now dependent on using pesticides to cultivate vegetable crops. Using pesticides that comply with applicable regulations and regulations will not be harmful to consumers or farmers. However, many farmers now need to follow the rules for using pesticides, which will negatively affect consumers and their farmers.

Based on several research results shows that the use of pesticides has an impact on the health of farmers, consumers, and also the environment. Seeing the high potential for agricultural development in Lembah Gumanti District, especially in Nagari Sungai Nanam, will potentially increase the negative impact on public health and the environment due to the many pesticides farmers use. This study aims to assess the impact on the environment and public health caused by using organochlorine-type pesticides in Nagari Sungai Nanam, Lembah Gumanti District, Solok Regency.

METHOD

This research took place in Nagari Sungai Nanam, Lembah Gumanti District, Solok Regency, and was carried out from October to December 2022. Data collection techniques were filling out a questionnaire instrument to obtain primary data on measuring levels of organochlorine pesticide contaminants in community water sources in Nagari Sungai Nanam using a form IKL. The IKL (Environmental Health Inspection) was observed from 85 respondents in Nagari Sungai Nanam, Lembah Gumanti District, Solok Regency.

The sampling method used is random purposive sampling to see the level of risk of contamination of community water sources; where in this study, there were 5 (five) dug wells and 3 (three) piping facilities sourced from Pamsimas, each facility taken 2 liters for testing, and observing organochlorine contaminants in the Laboratorium Kesehatan Daerah Provinsi Sumatera Barat. In this study, Testing for organochlorine presence used the parameters BHC, op-DDT, pp-DDT Aldrin, Lindane, and Endrin. Samples were examined at the Laboratorium Kesehatan Daerah Provinsi Sumatera Barat with the specification method SNI.06.6990.1-2004. Pollution risk level categories with observations using the IKL

form are grouped based on the following:

a. Very high: If the answer is "Yes" > 75%
b. Hight: If the answer is "Yes," 51% - 75%
c. Currently: If the answer is "Yes," 25% - 50%
d. Low: If the answer is "Yes" < 25%

Data analysis was carried out in a qualitative descriptive manner which was interpreted in the form of sentences, tables, and numbers, which were obtained from the results of processing and testing samples through the Laboratorium Kesehatan Daerah Provinsi Sumatera Barat.

The results of measuring the risk level of facilities using the IKL form for 8 (eight) facilities used by the community obtained: High-risk level there are two facilities (25%), moderate risk level 3 facilities (37.5%) and low-risk level 3 facilities (37.5%). And then, water sampling is carried out to support the results of observing the level of risk of pollution to community water sources.

RESULTS

Table 1. Organochlorine Distribution in Nagari Sungai Nanam Community Water.

No	Parameter	Result								Unit	Method
		L.2768	L.2769	L.2770	L.2771	L.2772	L.2773	L.2774	L.2775		
1.	BHC	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25	<0,25	ug/L	SNI.06.6990.1 - 2004
2.	op – DDT	<0,20	<0,25	<0,20	<0,20	<0,25	<0,20	<0,25	<0,20	ug/L	SNI.06.6990.1 - 2004
3.	pp – DDT	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	ug/L	SNI.06.6990.1 - 2004
4.	Aldrin	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	ug/L	SNI.06.6990.1 - 2004
5.	Lindane	<0,15	<0,15	<0,15	0,45	<0,15	<0,15	<0,15	0,62	ug/L	SNI.06.6990.1 - 2004
6.	Endrin	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	<0,20	ug/L	SNI.06.6990.1 - 2004

Sources: UPTD Laboratory of Office Health of West Sumatera Province, 2022

Sampling:
L. 2768 : Pamsimas Water in Jorong Lekok
L. 2769 : Pamsimas Water in Jorong Limpur
L. 2770 : Well Water in Jorong Limpur
L. 2771 : Well Water in Jorong Pasa
L. 2772 : Pamsimas Water in Jorong Koto
L. 2773 : Well Water in Jorong Aie Sanam
L. 2774 : Well Water in Jorong Pakan Sabtu
L. 2775 : Well Water in Jorong Taratak Pauh

DISCUSSION

Solok Regency has an area of 3,738 km^2 consisting of 14 districts with 74 Nagari and 414 Jorong. The district with the largest land area is in Lembah Gumanti District, which is located at coordinates 01°57'18" and 01°13'32" South Latitude, 100°44'48" and 100°55'45" East Longitude, with an area of 439 km^2[7]. The Lembah Gumanti sub-district has four villages: Alahan Panjang, Salimpat, Aie Cold, and Sungai Nanam. Nagari Sungai Nanam has the largest land area, 164.54 km^2, making it a center for horticultural production with high pesticide-intensity use. This problem is fundamental because the current trend of all farmers is to eradicate pests instantly through pesticides; in addition to making them easier to apply, they are also easy and cheap to get. However, these farmers do not realize that their exposure to pesticides can occur through various activities such as the process of bringing pesticides to agricultural land, the process of mixing pesticides, the process of spraying pesticides on agricultural land, and washing tools that have been used to spray, all of these activities have the potential to cause exposure to both farmers, through the skin or inhalation[8].

Pesticides are chemical substances, microorganisms, viruses, and other substances farmers use to protect crops[9]. There are many types of pesticides, but the most commonly used are the organophosphate, carbamate, and pyrethroid groups. Pesticides are categorized using many criteria, including chemical classes, functional groups, modes of action, and toxicity levels[10]. Pesticides are categorized based on the specific pests they are designed to target. These classifications encompass fungicides, insecticides, herbicides, and rodenticides. As an illustration, fungicides are employed to eradicate fungi, insecticides are utilized to eliminate insects, and herbicides are employed to eradicate weeds[11,12]. The use of pesticides in the agricultural environment greatly affects the existence of biota in the soil. In addition to threatening environmental conditions, the continuous use of pesticides also threatens health conditions because of the toxic nature of pesticides. Based on the phenotype and plant

species density, it is estimated that an average of 35-50% of pesticides are deposited on the soil immediately after spraying through direct use, while leaching due to rain or precipitation can cause organochlorine pesticides to enter the aquatic environment[4].

Based on data on water sources that are used by the community for their daily needs from the Puskesmas Sungai Nanam, Lembah Gumanti District, in 2021, 39.26% of the community has used water from pipes (PDAM, BPSPAM, PAMSIMAS) the rest use water from land. Whether in the form of dug wells or pump wells. Meanwhile, based on the results of observations made from 85 respondents, most of them use water sources that come from the Pamsimas program, namely Pamsimas Jorong Lekok, Pamsimas Jorong Lumpur, and Pamsimas Jorong Koto, and only 5 (five) respondents who still use well water. This water source determines the health status of the community; water is a vital need used by the community to meet their daily needs such as cooking, drinking, washing, and bathing. Thus, the need for clean water is the first point that must be considered so that people avoid various diseases. Observation data shows that 80 respondents (94%) have realized the importance of clean water sources to support their daily needs; it is just that there are still five respondents (6%) who still use the potential of dug well water. This condition worries that if the dug well water is contaminated with pesticides, it will certainly be a factor causing disease transmission.

Pesticides have four groups: organophosphates, organochlorines, carbamates, and pyrethroids. In general, organochlorines are used as a spray. After spraying, organochlorines can be in the air and soil environment. Organochlorine Pesticides (OCPs) consist of carbon, chlorine, and hydrogen atoms and are apolar and lipophilic[13]. Organochlorines (OC) are a group of chlorinated compounds widely used as pesticides. These chemicals belong to the class of persistent organic pollutants (POPs) with high persistence in the environment[14]. They are harmful to health because they are persistent, not easily decomposed, have chronic effects, and cause bioaccumulation in the food chain[15]. This can endanger human health and the environment because these chemicals can cause cancer, allergies, and damage to the nervous system (both central and peripheral) and can also disrupt the endocrine system causing damage to the reproductive system and the immune system. OCPs have the potential to be introduced into the aquatic ecosystem through multiple pathways, such as runoff originating from non-point sources, the release of industrial and sewerage wastes, and wet or dry deposition. Due to their persistent nature, Organochlorine Pesticides (OCPs) have the potential to undergo transfer into the food chain via water, after that accumulating in aquatic species such as plankton, so entering the food chain[16].

The results of the water sample tests conducted from 8 water sampling locations, lindane concentrations that exceeded the threshold were found to be 0.45 ug/L lindane in sample L.2771 (well water in Jorong Pasa) and 0.62 ug/L in sample L. 2775 (Water well in Jorong Taratak Pauh). Meanwhile, the other parameters are below the threshold. Lindane is a chronological mixture of hexachlorocyclohexane (HCH) whose main component (99%) is the isomer γ-BHC, HCH, and BHC, although isomers are different substances[17]. Lindane is used primarily in the treatment of seeds, soil for transplanting tobacco, leaves on fruit trees, nuts, vegetables, and wood[18]. Although the levels of lindane detected in the water samples did not exceed the WHO limit, exposure to large amounts of lindane has been reported to have negative effects on the nervous system, with symptoms from headaches and dizziness to convulsions and, more rarely, death[19].

Research Fosu-Mensah (2016) in his research found residues of organochlorine pesticides that were detected in water samples with lindane (0.01–0.03 µg/l), alpha-endosulfan (0.01–0.03 µg /l), endosulfan-sulfate (0.01–0.04 µg/l), dieldrin (0.01–0.03 µg/l) and p,p′-DDT (0.01–0.04 µg/ l). The presence of organochlorine pesticide residues found in water samples in the study area indicates that these chemicals are still being used illegally in some cocoa plantations in Ghana. The same study with a location in a densely populated Jabodetabek area conducted by Shoiful (2015) found that out of a total of 21 OCPs compounds, only a few OCPs compounds were detected in water samples, namely HCH and Lindane with concentrations of each in the range of ND-0.25 ng /L and 0.083 – 0.82 ng/L; meanwhile, interesting results were also found in the Ciliwung river where HCB was detected at a relatively high concentration of 688.28 ng/L[20].

Organochlorine pesticide residues in the samples may be attributed to farmers' illegal use of pesticides in the study area or their historic use since organochlorine pesticides are prohibited from agricultural use[21]. On the other condition, the utilization of OCPs within the agricultural sector has yielded an augmentation in crop productivity, leading to a decline in the cost of food grains. Consequently, this has been pivotal in mitigating hunger issues in densely populated nations, principally attributable to reduced food prices[22].

The basic characteristics of organochlorine pesticides are high persistence, low polarity, low water solubility, and high-fat solubility[19]. Organochlorine pesticides can enter the environment following the use of pesticides, polluted waste dumped in landfills, and discharges from industrial units that synthesize these chemicals. They are volatile and stable; some can attach to soil and air, thus increasing the possibility of high persistence in the environment, and are identified as agents of chronic exposure to animals and humans[23]. Thus, the ban on the use of organochlorine pesticides is a real step to stop the chain of disease in the future.

Organochlorines are renowned for their extreme persistence and toxicity. These pesticides cause neurotoxicity, endocrinopathies, and acute and chronic adverse health effects. Therefore, contamination with organochlorine pesticides has a devastating effect on the ecosystem. Farmworkers, their families, and those passing through a pesticide-treated area can all absorb a quantifiable amount of pesticides. Pesticide residues have been detected in the blood plasma of agricultural farm employees. Whether direct or indirect, pesticide exposure causes neuromuscular disorders and stimulates the metabolism of drugs and steroids[24]. Many organochlorine molecules are neurotoxic and carcinogenic[25]. Several examples were used to illustrate the perilous nature of organochlorines. The threat posed by endosulfan is extremely alarming. Endosulfan persists for extended periods in the environment and bioaccumulates in plants and animals, leading to contamination of human food[25].

CONCLUSION

The high potential for agricultural development in Nagari Sungai Nanam is directly proportional to the increase in the use of pesticides by farmers with lindane concentrations that exceeded the threshold, namely 0.45 ug/L lindane in samples L.2771 (well water in Jorong Pasa) and 0.62 ug /L in sample L.2775 (well water in Jorong Taratak Pauh). This condition illustrates that the potential for contamination of dug well facilities is higher due to the use of organo-chlorine-type pesticides or other types that can endanger the health and environment of the people of Nagari Sungai Nanam, Lembah Gumanti District, Solok Regency.

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