

## **Prevention and Control of Pesticide Poisoning on Vegetable Farmer in Karo District (A Review of Pesticide Studies in Karo District)**

Donal N<sup>a\*</sup> and Paul S<sup>b</sup>

<sup>a</sup>*Department of Epidemiology, Public Health, STIKes Sumatera Utara, Medan, Indonesia*

<sup>b</sup>*Department of Health Policy, Public Health, STIKes Sumatera Utara, Medan, Indonesia*

\*Corresponding author: [nababan\\_donal@yahoo.com](mailto:nababan_donal@yahoo.com)

---

**ABSTRACT:** Pesticides are substances ultimately meant for preventing, destroying or mitigating any pest. Nonetheless, they may cause acute and delayed health effects in workers who are exposed. The purpose of this article is to provide an overview of pesticide poisoning in Karo District and the relevant epidemiologic characteristics. Data Source: Most of the literatures used as reference in these review were journal and previous academic research results (*i.e.* thesis and academic paper). The results show that the majority of farmers were men of junior high school education, aged 30-39 years, have long term use of pesticide > 10 years, and daily long term of spraying pesticides for more than 4 hours and use more than one kinds of pesticide. The pesticide impacts to human were health complaint including vomiting, salivating and suffering from poisoning. To environment, deposition of organochloro-pesticide residues in soil and clean water were the impacts. Factors related to the pesticide poisoning were young age (RP=1.86), low education level (RP=2,52), long duration of exposure of more than two hours (RP=2,23), poor use of PPE (RP=1,69), farmer's habit, (OR 3,121) and lifetime days of pesticide application (OR = 1.74; 95%). Intervention is needed against factors related to pesticide poisoning in Karo District by managing pesticide and spraying time, promoting and providing information, and improving the quality of the surveillance data. In conclusion, strong evidence exists for impact of pesticide exposure including human health and environment. Monitoring and intervention are needed to be given continuously by competent authority in counseling and guiding how to handle pesticide correctly to avoid pesticide exposure in the farmer activity.

**Keywords:** prevention, control, pesticides, poisoning, Karo district

## Introduction

A pesticide is a substances primarily used to prevent and destroy agricultural pests. Some of these pests tare unwanted insects and microbes that destroy plants, affect humans in a bad way and in some instances, they may kill humans too. Pesticides are included in scientific and technological developments. They are beneficial in such that they control insect infestation and increase agricultural production. However, they are designed to destroy living organisms and therefore also create hazards for human and animal health, and the environment. Synthetic pesticides have occupied a significant place among the more than 70,000 chemical substances available on the market and they have become the principal strategy for the control of pests.

Poisoning as a result of pesticide use includes acute and chronic in nature. Acute poisoning is the severe poisoning which occurs after exposure to a single dose of pesticide. Chronic poisoning is the poisoning which occurs as a result of repeated, small, non-lethal doses over a long period of time with symptoms may appear, such as nervousness, slowed reflexes, irritability, or a general decline in health.

General Symptoms of pesticide poisoning could be of three categories where mild poisoning such as headache, weakness, nervousness, nausea, diarrhea, loss of weight, thirst, moodiness, skin irritation and eye irritation are resulted. Moderate poisoning such as nausea, diarrhea, excessive saliva, stomach cramps and difficulty in breathing can be the common signs while severe poisoning such as fever, intense thirst, increased rate of breathing, vomiting, inability to breathe can lead to fatality.

The causes of pesticide poisoning, depending on the circumstance of exposure, can be:

- i) Occupational, Exposure to pesticides during work (Reeves, 2003).
- ii) Accidental, Exposure to pesticides that occurs unexpectedly (WHO, 2004).
- iii) Intentional, Exposure to pesticides with intent to cause harm (Calvert, 2006).

It is estimated that about 3% of exposed agricultural workers are suffering from an episode of acute pesticide poisoning (APP) every year. More than 50% of all APPs occur in less industrialised countries, though the quantity of pesticides used is less. This illustrates the

deficient hygiene and safety conditions under which these products are used. In addition to the acute effects, prolonged periods of low level exposure to pesticides can also produce chronic effects such as damages to the central nervous system, congenital malformations, mutagenic effects, cancer, skin, lungs and eye lesions, damage to the immune system, and masculine sterility.

There has been a constant increase in the use of pesticides, in some countries, unfortunately, this increase was accompanied by inappropriate use of the products, deficient storage and production conditions, a lack of understanding of the real health effects due to unspecific symptomatology, and a lack of research on the long term effects of these products on health and environmental deterioration. However, underreporting is still considerable due to difficulties of farm workers access to health services, erroneous diagnoses, and problems in registration and reporting.

Many pesticides are poisonous and detrimental to human health. Pesticides also affect the environment and the atmosphere. The WHO and the UN Environment Programme estimate 3 million workers in agriculture in the developing world experience severe poisoning from pesticides, about 18,000 of whom die annually.

To evaluate the epidemiology and characteristics of acute poisoning, data of 2867 patients with poisoning who had been treated at the Emergency Center, Fujian Provincial Hospital, China from January 2004 to December 2009 were analysed by Feng *et al.* (2010). The incidence of poisoning in a descending order were alcohol poisoning, medication poisoning, and pesticide poisoning (Feng *et al.*, 2010).

Farmers in Karo District are the most user of pesticide at national level in Indonesia. A paradigm shift of traditional agriculture from chemical usage to organic approach is needed in Karo District (Harian Waspada Online, 2009).

## **Methodology**

The purpose of this article is to provide an overview of pesticide poisoning in Karo District and the relevant epidemiologic characteristics. The data was obtained from research reports

and papers published on the internet. Based on these data, the trend of pesticide poisoning was analysed; further, the effect of pesticide to human health and environment were analysed. The data on the number of cases of pesticide poisoning was used for the epidemiological analyses. These epidemiological data were stratified by sex, age, and cause of pesticide poisoning. Proportional analyses were done for each journal and for the other source. The statistical analysis shows the trends of the epidemiological of pesticide poisoning.

## **Results and Discussion**

### ***(a) The Impact of Using Pesticide***

The impact of pesticide use on human health can be seen from the following research results:

#### *i) Human Health Effect*

The descriptive study about characteristic and personal hygiene of horticultura farmer and health complaint in using of pesticide was reported that majority were men of junior high school education level, aged 30-39 years with long term of using pesticide for more than 10 years, daily long term off spraying more than four hours, involving using more than one kinds of pesticide, having good personal hygiene such as change working clothes and bathing with soap (78.6%), washing hands before lunch, drink, and smoke (100%). Complaints of vomiting and salivating were reported (Meliala, 2006).

Another study reported that 21.7% of 23 woman farmers suffered from poisoning (Meliala, 2012). The study used a cross-sectional design involving 60 people through interviews and examination of blood. This study showed that the entire power sprayers in PT Bibit Baru in Dolat Rakyat sub district had acetyl cholinesterase enzyme activity below normal. Long time spraying factor, spraying time lag and spraying method significantly associated with enzyme activity levels of acetyl cholinesterase (Sitepu, 2010).

Pesticide exposure can cause a variety of adverse health effects, ranging from simple irritation of the skin and eyes or to more severe effects such as nervous system disturbance, reproductive problems, as well as cancer. A review found that "most studies on non-Hodgkin lymphoma and leukemia showed positive associations with pesticide exposure" (Jurewicz and Hanke, 2008). Strong evidence also exists for other negative outcomes from pesticide

exposure including neurological, birth defects, fetal death, and neurodevelopmental disorder (Jurewicz and Hanke, 2008).

A 2007 study by the California Department of Public Health found that women in the first eight weeks of pregnancy who live near farm fields sprayed with the organochlorine pesticides dicofol and endosulfan are several times more likely to give birth to children with autism (Roberts *et al.*, 2007).

*ii) Environment Effect*

The impacts of pesticide use on environment are obvious. A study reported that there are deposits of organochloro-pesticide residues in soil, where the levels of pesticide residues are found the most numerous is DDT, either on a sample I and II (Simanullang, 2010). A study in Surbakti village Simpang Empat Karo District reported that the kind of pesticide was Organofosfat (Dursban, Curacron, Perfecthion, Orthene, Lebaycid, etc) and carbamate (Manik, 2012). Another study reported that the clean water found containing nitrate but still qualified health because it still under set the maximum limit of 10 mg/L (Ginting, 2007).

To investigate the pesticide residues level, samples of citrus fruit were collected from citrus field operated by trained farmers as well as from untrained farmers. Research shows that the biodiversity level of soil arthropod on the citrus fields operated by trained farmers is higher than on untrained farmers. The pesticide residue analysis shows that no pesticide residues found on the fruit samples collected from the trained farmers. Unlikely, the residue of Fenvalerate (0.0928 mg/kg) is detected on the fruit samples of untrained farmers, although the level is still under the maximum allowable limit of the residue (Wita, 2013).

In order to reduce negative impacts, pesticides need to be deactivated in the environment. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water and soil. Pesticide drift occurs when pesticides suspended in the air as particles are carried by wind to other areas, potentially contaminating them (Miller, 2004). Pesticides are one of the causes of water pollution, and some pesticides are persistent organic pollutants and contribute to soil contamination (Miller, 2004).

**(b) Factor Related to the Pesticide Poisoning**

Pesticide management is in activity including the purchase, transportation, storage, dilution, use and disposal of pesticide in Berastepu village, Simpang Empat sub-district, Karo District in 2011. This study was a descriptive survey. The data was taken from the interview and observation on the community of pesticide users (orange fruit farmers) in Berastepu village, Simpang Empat sub-district, Karo District. The population of orange fruit farmers was 100 families and the sample was taken were 50 orange fruit farmers with simple random sampling. The data used was primary data by distributing the questionnaire and the secondary data. The objective of this research was to know the pattern and behavior of orange fruit farmers, pesticide spraying and its impact on the society health at the survey location. The results of the research showed that mostly the characteristics of the respondents were aged between 31-39 years old (38%), working hours in the application of pesticide was between 2-3 hours/day (82%), duration of working in the application of pesticide was between 5-10 years (50%), while the education level of them could be up to senior high school (46%). The behavior in the management was with moderate knowledge (94%), moderate attitude (74%), moderate practice (80%). Mostly the complaints of pesticide poisoning were related to eyes health (32%), and mostly the frequencies of spraying were once in 10 days (42%). The research concluded that orange fruit farmers had moderate knowledge, moderate attitude, and moderate practice in the management of pesticide and the frequency of spraying was generally good (Sitepu, 2012).

Pesticides are chemical compounds of highly toxic and harmful material that can induce negative impacts for human health and the environment if improper handled. Prevalence proportion of pesticide poisoning on citrus farmers spray in Perteguh village, Simpang Empat sub-district is as high as 57.13%. A research on poisoning issues on citrus farmers spray in Cinta Rakyat village, Merdeka sub-district conducting in 2010 using a cross sectional design method involved 120 farmers aged 19-60 years. Based on a direct interviewing using closed-questionnaires, univariate-bivariate data analysis, and chi-square test, the prevalence proportion of pesticide poisoning was 36.7%. Chi-square tests showed significant relationship association among young age (RP=1.86; p=0.00); low education level (RP= 2,52 ; p=0.00); duration of exposure of more than two hours (RP= 2,23; p=0.00) and also poor protective equipments wearing (RP=1,69; p=0.03) for pesticides poisoning event (Ginting, 2011).

A nationwide sampling survey of male farmers was conducted in South Korea in 2011. A total of 1,958 male farmers were interviewed. Severity of occupational pesticide poisoning in 2010 was evaluated according to symptoms, types of treatment, and number of pesticide poisoning incidents per individual. A multinomial logistic regression model was used to estimate the odds ratio with 95% confidence intervals for risk factors of acute occupational pesticide poisoning. It was found that the risk of acute occupational pesticide poisoning increased with lifetime days of pesticide application (OR = 1.74; 95% CI = 1.32–2.29), working a farm of three or more acres in size (OR = 1.49), not wearing personal protective equipment such as gloves (OR = 1.29) or masks (OR = 1.39). Those who engaged in inappropriate work behaviors such as not following pesticide label instructions (OR = 1.61), applying the pesticide in full sun (OR = 1.48), and applying the pesticide upwind (OR = 1.54) had a significantly increased risk of pesticide poisoning. There was no significant risk difference by type of farming. In addition, the magnitude of these risk factors did not differ significantly by severity of acute pesticide poisoning. In fact, our findings suggest that work-related risk factors contributed to the development of acute occupational pesticide poisoning without relation to its severity (Kim *et al.*, 2013).

### **(c) *Prevention and Control of Pesticide Poisoning***

Farmer's knowledge and attitudes were important factors that influenced the practice of farmers in the used of pesticides. Those with knowledge and good attitude were expected to have good practice in the use of pesticides. A Quasi Experiment with the design of "Separate sample pretest-posttest" where the provision of counseling with lectures and distribution of leaflets involving 40 people to evaluate the effectiveness of counseling on knowledge and attitudes in citrus farmers spray pesticides were conducted in Serdang village Barusjahe Sub-distrik, Karo District in 2011. Before the counseling, citrus farmers having good knowledge in the intervention group and control group were 65% and 35% respectively. The intervention group achieved 100% while in the control group still, the level remained unchanged. The attitude of citrus farmers after counseling also increased to 100% (Tarigan, 2012).

A research held in Perteguhun village, Simpang Empat Sub-district, Karo District involving 15 respondents showed that there was a difference of knowledge and attitude of the pesticide applicators after the pesticide extension (Girsang, 2009). Tanjungsari village is one of shallot producers in Brebes Regency. Out of 6689 population, 85% are shallot farmers. A research

conducteg showed that the factors influencing significantly on pesticide use behavior are education, knowledge, attitude and peer support. Multiple logistic regression analysis result shows that the most dominant factor influencing on pesticide use behavior is attitude.

Based on the various literatures reviewed here, pesticide poisoning can be reduced by:

- i) Managing spraying time lag and spraying method of pesticides sprayers to reduce pesticide attack (Sitepu, 2010).
- ii) Paying attention and to have correct pesticide management, especially for those orange fruit farmers in bad category (Sitepu, 2012).
- iii) Making counseling about the impacts of using and managing pesticide against risk of pesticide poisoning, do blood-test for those got symptoms of poisoning and increasing of farmers knowledge about the using wearing protective equipments (Ginting, 2011).
- iv) Health promoting and counseling to increase knowledge and attitude citrus farmers in spraying pesticides. Expected to health workers in health centers for providing information about the use of pesticides to the public to help increase the knowledge of farmers in spraying pesticides. (Tarigan, 2012).
- v) Using the group discussion and simulation to intensity the pesticide extension (Girsang, 2009).
- vi) Socialising personal hygiene for farm workers and their families continually.
- vii) Improving the quality of the surveillance data for the effective prevention and control activities.

## **Conclusion**

It is conclude that literature review is useful to look at several studies simultaneously so that new findings on a particular topic can be synthesised.

## **References**

Calvert, G.M., Barnett, M., Mehler, L.N., Becker, A., Das, R., Beckman, J., Male, D., Sievert, J., Thomsen, C. and Morrissey, B. (2006). Acute pesticide-related illness among

- emergency responders, 1993–2002. *American Journal of Industrial Medicine*, **49** (5): 383-393. doi:10.1002/ajim.20286. PMID 16570258.
- Feng, C., Jun-ping, W., Xiao-ping, W., Qing-ming, L. and Cai-jing, L. (2010). Epidemiology and characteristics of acute poisoning treated at an emergency center. *World J Emerg Med.*; **1**(2):154-156.
- Ginting, M. (2007). Analisa kandungan pestisida dan nitrat pada penyediaan air bersih desa cinta rakyat kecamatan simpang empat kabupaten karo tahun 2006. <http://repository.usu.ac.id/handle/123456789/38616>).
- Ginting, R. (2011). Faktor yang berhubungan dengan kejadian keracunan pestisida pada petani penyemprot jeruk di Desa Cinta Rakyat Kecamatan Merdeka Kabupaten Karo Tahun 2010. [http:// repository.usu.ac.id/handle/123456789/22988](http://repository.usu.ac.id/handle/123456789/22988).
- Girsang and Julietta. (2010). Pengaruh penyuluhan pestisida terhadap pengetahuan dan sikap penyemprot pestisida di Desa Perteguhen Kecamatan Simpang Empat Kabupaten Karo Tahun 2009. <http://garuda.dikti.go.id/jurnal/detil/id/0:800059/q/pestisida,%20karo/offset/0/limit>).
- Kim J.H., Jaeyoung, K., Eun Shil, C., Yousun, K., Doo, H.K. and Won, J.L. (2013). Work-related risk factors by severity for acute pesticide poisoning among male farmers in South Korea. *International Journal of Environmental Research and Public Health* ISSN, 1660-4601. [www.mdpi.com/journal/ijerph](http://www.mdpi.com/journal/ijerph).
- Jurewicz, J. and Hanke, W. (2008). Prenatal and childhood exposure to pesticides and neurobehavioral development: review of epidemiological studies. *Int J Occup Med Environ Health*, **21**(2): 121–32. (doi:10.2478/v10001-008-0014-z. PMID 18614459).
- Manik, T.R. (2013). Kandungan pestisida pada tanah dan jenis-jenis pestisida yang digunakan (study kasus) di Kecamatan Simpang Empat Kabupaten Karo Provinsi Sumatera Utara. Accessed at: [http:// repository.usu.ac.id/handle/123456789/32813](http://repository.usu.ac.id/handle/123456789/32813).
- Meliala, A. (2005). Karakteristik dan hygiene perorangan petani hortikultura serta keluhan kesehatan dalam penggunaan pestisida di Desa GuruKinayan Kecamatan Payung Kabupaten Karo Tahun 2005. Accessed at: <http://garuda.dikti.go.id/jurnal/detil/id/0:797493/q/pestisida,%20karo/off/0/limit/15>.

- Meliala, I.S. (2012). Strategi pencegahan keracunan pestisida berdasar pada perilaku petani di kabupaten Karo. Accessed at: <http://garuda.dikti.go.id/jurnal/detil/id/0:773767/q/pestisida,%20karo/offset/0/limit/15>.
- Miller, G.T. (2004). *Sustaining the Earth*, 6th edition. Thompson Learning, Inc. Pacific Grove, California, 9:211-216.
- Module 9: Symptoms of pesticide poisoning, Pesticide Safety Education Program (PSEP) part of the Pesticide Management Education Program <http://psep.cce.cornell.edu/Tutorials/core-tutorial/module09/index.aspx>
- Reeves, K.S. and Schafer, K.S. (2003). Greater risks, fewer rights: U.S. Farmworkers and pesticides. *International Journal Of Occupational And Environmental Health*, **9(1)**: 30–39. PMID 12749629.
- Roberts, E.M., English, P.B., Grether, J.K., Windham, G.C., Somberg, L. and Wolff, C. (2007). Maternal residence near agricultural pesticide applications and autism spectrum disorders among children in the California Central Valley. *Environ Health Perspect*, **115(10)**: 1482-1489. (Doi: [10.1289/ehp.10168](https://doi.org/10.1289/ehp.10168). PMID 17938740. PMC 2022638. Lay summary: *EHP*, 2007).
- Simanulang, L. (2012). Analisis kandungan residu pestisida organochlor pada lahan pertanian masyarakat di Kecamatan Barus Jahe Kabupaten Karo Surnatera Utara, <http://garuda.dikti.go.id/jurnal/detil/id/0:773952/q/pestisida,%20karo/offset/0/limit/15>
- Sitepu, B.K. (2012). Pola dan perilaku penyemprotan pestisida terhadap keluhan kesehatan petani jeruk di Desa Berastepu Kecamatan Simpang Empat Kabupaten Karo Tahun 2011. [http:// repository.usu.ac.id/handle/123456789/30821](http://repository.usu.ac.id/handle/123456789/30821).
- Sitepu, J. (2010). Analisis dampak pestisida terhadap kadar cholinesterase penyemprot pestisida di PT. Bibit Baru Kecamatan Dolat Rakyat Kabupaten Karo Tahun 2009. [http://repository.usu.ac.id/handle/ 123456789/24767](http://repository.usu.ac.id/handle/123456789/24767).
- Suroso. (2002). Factors related to the pesticide poisoning on vegetable farmer in Jambi City in The Year of 2001, Post Graduate Study University of Indonesia, Majoring in Rural Health Management School of Public Health. Thesis, Juli 2002.
- Tarigan, B. (2012). Pengaruh penyuluhan pestisida terhadap pengetahuan dan sikap petani jeruk dalam menyemprot pestisida di Desa Serdang Kecamatan Barusjahe Kabupaten Karo Tahun 2011. <http://repository.usu.ac.id/handle/123456789/24225>.

- WHO. (2004). The impact of pesticides on health: preventing intentional and unintentional deaths from pesticide poisoning. 2004: [http://www.who.int/mental\\_health/prevention/suicide/en/PesticidesHealth2.pdf](http://www.who.int/mental_health/prevention/suicide/en/PesticidesHealth2.pdf).
- Wita, K. (2013). Dampak penggunaan pestisida terhadap keanekaragaman arthropoda tanah dan kadar residu pestisida pada buah jeruk (kasus petani hortikultura Di Kabupaten Karo). [http:// repository.usu.ac.id/handle/123456789/16653](http://repository.usu.ac.id/handle/123456789/16653).