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SYNDICATE – 02

DETRIMENTAL EFFECTS OF CHEMICAL PESTICIDES AND INSECTICIDES ON HUMAN BEING GLOBALLY

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DECLARATION

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ABSTRACT

1. Acute pesticide poisoning has become a major public health problem worldwide, following the intensification of agriculture and the promotion of agro chemicals in low- and middle-income countries, with more than 300,000 deaths each year. The easy availability of highly toxic pesticides in the homes of farming communities has made pesticides the preferred means of suicide with an extremely high case fatality. Similarly, the extensive use of pesticides exposes the community to both long-term and acute occupational health problems. A concerted effort is urgently needed to address the situation.

2. This syndicate is mainly directed towards how pesticides will affect harmfully on human being globally.

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LIST OF ABBREVIATIONS

1.	UAPP	: University of Aberta Paleontology program
2.	WHO	: World Health Organization
3.	DDT	: Dichlorodiphenyltrichloroethane
4.	ISO	: International Organization for Standardization
5.	MCPA	: 2-methyl-4-chlorophenoxyacetic acid
6.	DPA	: Diphenylamine
7.	IPM	: Integrated Pest Management
8.	DDE	: Dichlorodiphenyldichloroethylene
9.	DNA	: Deoxyribonucleic acid
10.	OP	: Organophosphate
11.	GCS	: Glasgow Coma Scale
12.	IV	: Intravenous
13.	FAO	: Food and Agricultural Organization
14.	UK	: United Kingdom
15.	MNH	: Maternal and Neonatal Health
16.	IPCS	: Intermittent Pneumatic Compression Service

OBJECTIVES

1 To identify the concept and problems of Detrimental effects of chemical pesticides on human beings globally.

2. To identify Healthcare facilities and treatments for Detrimental effects of chemical pesticides on human beings globally.

3. To identify the Management, prevention and substitutions of chemical pesticides.

CHAPTER ONE

INTRODUCTION

1. Pesticides are substances or mixtures of substances that are mainly used in agriculture or in public health protection programs in order to protect plants from pests, weeds or diseases, and humans from vector-borne diseases, such as malaria, dengue fever, and schistosomiasis. Insecticides, fungicides, herbicides, rodenticides, and plant growth regulators are typical examples These products are also used for other purposes, such as the improvement and maintenance of non-agricultural areas like public urban green areas and sport fields. Furthermore, there are other less known applications of these chemical substances, such as in pet shampoos, building materials, and boat bottoms in order to eliminate or prevent the presence of unwanted species.

2. Many of the pesticides have been associated with health and environmental issues, and the agricultural use of certain pesticides has been abandoned. Exposure to pesticides can be through contact with the skin, ingestion, or inhalation. The type of pesticide, the duration and route of exposure, and the individual health status (e.g., nutritional deficiencies and healthy/damaged skin) are determining factors in the possible health outcome. Within a human or animal body, pesticides may be metabolized, excreted, stored, or bioaccumulated in body fat. The numerous negative health effects that have been associated with chemical pesticides include, among other effects, dermatological, gastrointestinal, neurological, carcinogenic, respiratory, reproductive, and endocrine effects. Furthermore, high occupational, accidental, or intentional exposure to pesticides can result in hospitalization and death.

3. Residues of pesticides can be found in a great variety of everyday foods and beverages, including for instance cooked meals, water, wine, fruit juices, refreshments, and animal feeds .Furthermore, it should be noted that washing and peeling cannot completely remove the residues .In the majority of cases, the concentrations do not exceed the legislatively determined safe levels .However, these “safe limits” may underestimate the real health risk as in the case of simultaneous exposure to two or more chemical substances, which occurs in real-life conditions and may have synergistic effects. Pesticides residues have also been detected in human

breast milk samples, and there are concerns about prenatal exposure and health effects in children.

4. This current review aims at highlighting the urgent need for a new concept in agriculture involving a drastic reduction in the use of chemical pesticides. Given the fact that the health effects have been extensively discussed in the current literature, this paper focuses on the major chronic health effects and recent findings regarding health effects that have been associated with exposure to common classes of chemical pesticides, i.e., organochlorines, organophosphates, carbamates, pyrethroids, triazines, and neonicotinoids. More emphasis is given to the widely used herbicide "glyphosate," which is an organophosphate pesticide very closely related to current agriculture. The important health effects, as discussed below, reveal the urgent need for implementing alternative solutions.

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CHAPTER TWO

CURRENT USAGE OF CHEMICAL PESTICIDES AND INSECTICIDES

PESTICIDE USAGE IN WORLD

5. The use of pesticides in agriculture is increasing rapidly in developing countries, especially in Southeast Asia. WHO has reported that approximately 20% of pesticides are used in developing countries with increasing rate of usage. An annual increase in import of pesticides is reported as 61% for Cambodia, 55% for Laos and 10% for Vietnam.

6. The manufacturing of pesticides in India started in 1952, with the production of benzene hexachloride, followed by DDT. The synthesis of pesticides increased enormously. In 1958, India manufactured over 5000 metric tons of pesticides which increased to 85,000 metric tons in the mid-1990s with the registration of 145 pesticides and the major pesticides produced are insecticides. India is one of the major pesticides producing countries in Asia with annual production of 90,000 tons, and it stands at twelfth position in the world in the manufacturing of pesticides. In the past, India used and exported organochlorine pesticides on large scale including DDTs and HCHs. Similarly, in Pakistan, the pesticides usage started in 1954 with the import of 250 metric tons. The pesticides consumption in Pakistan increased to 78,132 tons per annum in 2017. During Green Revolution period, thousands of tons of pesticides had been imported from Europe and the USA to control crop pest infections, locust control and suppression of malaria in Pakistan. Use of pesticides in Bangladesh was low until 1970. The pesticide usage increased tremendously from 2200 million tons in 2007–2016 to 6500 million tons in 2007–2016. In Nepal, the first reported use of pesticides was DDT in 1956, which was followed by other organochlorines, organophosphates, carbamates and synthetic pyrethroids. It has been reported by plant protection division of department of agriculture, approximately 55.8 metric tons of pesticides is used annually in Nepal. In Sri Lanka, the pesticides are mainly used in agriculture sector. DDT was the first pesticide used in Sri Lanka after World War II for malaria eradication. Pesticides were introduced in Thailand and Vietnam in mid-1950s. In Vietnam, the use of pesticides accelerated in mid-1980s during economic liberalization. The use of pesticides in agriculture increased from 20 to 30 million kg, and it further increased to 77 million kg in 2018.

7. In China, pesticide production started in 1950 with the manufacturing of DDT. China has become the largest pesticide manufacturing country during past 50 years of development. In China, pesticides are mainly used for rice production. The consumption of pesticides in China has increased from 76 million tons in 1991 to 146 million tons in 2017. Japan is one of the largest pesticide consumers in the world and has biggest pesticide market in Asia.

PESTICIDE USE TRENDS IN SRI LANKA

8. Pest control in the past was primarily based on cultural, physical and mechanical methods or there was no pest control at all due to natural tolerance characteristics of traditional crop varieties. Investment on pesticides was also not feasible due to low yield potential of traditional crop varieties. However, with the green revolution technologies, the natural tolerance characteristics of crop varieties disappeared demanding chemical control of pests to ensure high yields to feed ever growing population. Farmers perceived that higher yield losses were due to pest attack (Selvarajah and Thiruchelvam, 2017). The cultivation of high yielding varieties of paddy under irrigated condition was 100% and the cultivation of high breed and high yielding varieties of vegetables and cash crops also had tremendously increased. Seed was only one of the inputs of the green revolution package. It was important to apply a considerable amount of fertilizers and agro chemicals to harness the full benefit of the package.

9. Table 1 indicates the import volumes of pesticides (insecticides, herbicides and fungicide) to Sri Lanka during the last six years. It shows that herbicides were the most commonly used pesticides in the country followed by insecticides. Paddy cultivation absorbs the higher number of herbicides compared to insecticides and fungicides. However, use of insecticides is very high in vegetable sector followed by fungicides, but use of herbicides is very minimal (Nagenthirarajah and Thiruchelvam, 2008). Fungicides are highly used in Potato cultivation where Propineb and Mancozeb are the most common fungicides (Liyanage *et al*, 2004).

10. Bulk number of pesticides had been imported into the country as formulations. Herbicides are the most used category of agro-chemicals amounting to around 70% of total imports by 2018. The table further indicates that the majority of the pesticides were imported as formulated products and importation for the local formulation was less (only 13% of total

imports by 2011). According to Sri Lanka regulations, the companies which wanted to carry out the local formulation of pesticides were required to have ISO standard certified premises.

11. According to Wilson (1998), pesticide use in Sri Lanka had increased by almost 110 times between 1970 and 1995. As per data maintained by the Registrar of Pesticides, imports of technical grade materials of pesticides had increased by 5.3 times whereas imports of formulated products had increased 11.4-fold in 2015 compared to 1995. Table 1 indicates the enormous increase in the imports of herbicides both in the form of technical materials and formulated products. Import of insecticides in technical materials has decreased, while formulated insecticides imports have increased by 9%.in 2018 compared to 2009. Overall pesticide imports show about 50% increase by 2018 compared to the imported volume of 2009. Most commonly used insecticide in Sri Lanka by volume is Carbofuran followed by Diazinon and Chlorpyriphos. Although the import volume of Carbofuran in the form of active ingredient is lower, the volume used locally as an insecticide is high as formulation contains only 3% of the active ingredient. Among the herbicide, Glyphosate is most popular followed by MCPA and 3, 4 DPA. The use of Chlorpyrifos becomes more popular after banning of broad spectrum Organo Phosphate pesticide of Endosulfan in 1998 (Taylor, 1999). The highest consumed fungicide is Mancozeb.

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Year	2011	2012	2013	2014	2015	2016	% change in 2016 compared to 2011
Technical Materials							
Insecticides	128.38	115.65	199.3	107.43	144.38	90.50	-29%
Herbicides	207.94	88.3	178.12	274.78	1605.58	1118.94	+438%
Fungicides	0.40	1.5	0.9	0.25	2	0.40	0
Sub Total	**336.72**	**205.45**	**378.32**	**382.46**	**1751.96**	**1209.84**	**+260%**
Formulations							
Insecticides	1576.41	1184.74	1585.74	1036.74	1843.95	1712.58	+9%
Herbicides	3197.06	4143.69	3808.39	2744.95	5366.63	5031.05	+116%
Fungicides	847.56	722.25	872.64	599.8	1048.02	949.40	+12%
Sub Total	**5621.03**	**6049.99**	**6266.77**	**4381.49**	**8258.6**	**7693.03**	**+37%**
Total	**5957.75**	**6255.44**	**6645.09**	**4763.95**	**10,010.56**	**8902.87**	**+49%**

Table 1: Volumes of Pesticides Imported to Sri Lanka during 2011-2016 (In mt)
Source: Internet

12. About 107 active ingredients of different pesticides have been registered at the office of the Registrar of pesticides by 2019 which are currently marketed in the form of 482 commercial products. The profile of registered Agricultural pesticides is shown in the Table No. 1. There are number of household pesticides imported to the country to cater to the demand of domestic (Ex: Control of rats and cockroaches), Industrial (Ex: Paint industry), public health (Ex: Mosquito control, hospital cleaning) and veterinary need.

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Category	Number of Active Ingredients	Number of Marketed Products
Insecticides	46	234
Fungicides	27	97
Weedicides	33	149
Molluscicides	1	2
Total	107	462

Table 2: Profile of Registered Agro Pesticides

Source: Internet

Category	Number of Active Ingredients	Number of Marketed Products
Domestic	27	66
Public Health	22	48
Industrial	17	48
Veterinary	2	4
Total	67	166

Table 3: Profile of Registered Household Pesticides

Source: Internet

13. As Nagenthirarajah and Thiruchelvam,; and Watawala *et al*, pesticides have been misused and overused highly in the agricultural sector of Sri Lanka over the years. Sri Lankan farmers use stronger concentrations of pesticides with increased frequency of applications and mixing of different pesticides together to combat pest resistance compared to neighboring countries like India (Chandrasekara *et al*,). According to the same report they have found after examining 20-year pesticide use data of farmers in Matale, Nuwara-Eliya, Badulla and Kandy Districts that, 59% of the farmers had used more than recommended number of pesticides in their vegetable cultivations. A recent study conducted among the intensive cultivating farmers in the hill country shows that, about 45% of farmers prefer to use more pesticides than the recommended amount and apply them in higher frequencies to ensure better

results in crop productivity (Watawala *et al*,). Over use of insecticide for vegetable cultivation is not limited to up country areas. It was found that, farmers in the Vavuniya district in the Northern Province also use pesticides extensively for upland vegetable cultivation as their crops are more susceptible to pests and diseases and as they could get higher economic return from cash crop cultivation (Nagenthirarajah and Thiruchelvam,). According to Selvarajah and Thiruchelvam (2007), about 60% of farmers in the Vavuniya district had applied 3040% higher concentrations of pesticides than the recommended dosage.

14. The reasons for the overuse of pesticides as per Watawala *et al* (2010) are limited knowledge of the farmers about adverse effects of pesticides they use. Selvarajah and Thiruchelvam (2007) have found that, there is no significant relationship between the strength of spraying mixtures with farmers' education, experience and cultivated extent. Similarly, some researchers have argued that, indiscriminate use of pesticides by Sri Lankan farmers is generally not due to lack of knowledge or lack of awareness on the harmful effects of pesticides (Nagenthirarajah and Thiruchelvam, 2008; Van der Hoek *et al*, 1998). However, Selvarajah and Thiruchelvam (2007) stated that, farmers in the Vavuniya district were unaware of the long-term and short-term effects on their health by wrong pesticide usage. At the same time Wilson and Tiddsell, (2001) have stated that, farmers in Sri Lanka have a tendency to ignore technical recommendations and depend on their own experience often leading to indiscriminate application. The importance of education and training of farmers in the developing countries is being increasingly recognized as a major vehicle to ensure safe use of pesticides (Aktar *et al*, 2014).

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CHAPTER THREE

ADVANTAGES AND DISADVANTAGES OF THE CHEMICAL PESTICIDES

ADVANTAGES

15. Pesticides can help to improve growth behavior of plants. If plants get attacked by pests, those have to defend against those pests. Pesticides will do the work for them.

16. Insecticides have a wide application in the field of medicine, agriculture, and industry. They have the potential to alter ecosystem components.

17. By using pesticides plants will have more energy to grow. So, higher crop yields. It can help to reduce global hunger. Local population can be supplied with more vegetables and fruits.

18. Lower food prices. If higher crop yields can be produced using pesticides in agricultural processes, also the supply of food will increase.

19. Pesticides and insecticides are easy to store. Farmers can buy large amounts of pesticides at a low price, store them and can use for many years.

20. Proven technology that worked for many years. Hence, many farmers also learned to use pesticides and insecticides.

21. They are rather inexpensive. Due to the technological progress, chemical pesticides and insecticides can be produced in large quantities at a quite low price. So, there is a good availability in many countries.

22. May help to increase visibility. They are not only helpful for agricultural purposes, but they can also help to avoid the spread of plants which could potentially lead to traffic accidents.

23. Use of pesticides and insecticides can reduce overall work for farmers. In order to reduce the amount of manual work for farmers, using pesticides and insecticides can be a great way to do so since pests and weeds can be removed.

24. Pesticides are not only useful to reduce the problem of plant pests, but they are also crucial to prevent serious diseases to spread across the general public. Pesticides are important to reduce mosquito populations. As well as avoidance of allergies for the local population. Protection against parasites.

DISADVANTAGES

25. Use of pesticides can lead to serious soil pollution. Over time, significant amounts of harmful elements will end up in the soil, which can be detrimental for many useful microorganisms in the soil.

26. Groundwater pollution is a problem. Excessive use of pesticides is also a major problem in the context of groundwater protection and farmers all over the world should therefore reduce the use of pesticides in order to protect the groundwater.

27. Can reduce populations of important insects. For instance, pesticides are known to reduce the number of bees and butterflies on a large scale. Therefore, pollination may become harder.

28. Pesticides are not selective enough. Pesticides often do not make a difference between harmful pests and helpful insects. Those pesticides will reduce the number of pests, but also the number of other insects like bees that farmers want to have on their fields.

29. Genetics of plants may get altered using pesticides.

30. Adverse health effects on farmers. Pesticides can also be quite harmful to our health. If farmers are exposed to those pesticides and do not wear proper protection, those farmers may suffer from serious long-term health effects like cancer. Pesticides

are often quite concentrated and if they are not handled in a proper manner, farmers can poison themselves in a serious manner.

31. Insecticides can kill more than intended organisms and are risky to humans. Also, when insecticides mix with water sources through leaching, drift, or run off, they harm aquatic wildlife. When birds drink such contaminated water and eat affected insects, they die. Some examples of insecticides, like DDT, were banned in the US as it affects the reproductive abilities of predatory birds.

32. Insects when repeatedly exposed to insecticides build up resistance until finally, they have little or no effect at all. The reproduction in insects is so quick that they produce a new generation every three to four weeks. Therefore, the resistance builds up rapidly.

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CHAPTER FOUR

DISPOSAL OF INSECTICIDES AND PESTICIDES AND THE WAYS OF ENTERING INTO HUMAN BODIES

DISPOSAL OF INSECTICIDES AND PESTICIDES

33. Disposal of pesticide wastes are a major problem for greenhouse and nursery producers. Improper handling of these chemicals poses a real threat to the environment, as well as to the health and safety of laborers. Excess application or improper disposal of "left over" mixtures, undiluted chemicals or even pesticide containers can lead to potential contamination of surface and groundwater. However, the risk of a serious incident can be reduced if proper management and disposal techniques are used.

34. Hazardous agricultural wastes are defined in the 40 Code of Federal Regulations (parts 261.31 – 261.33) as having one of the characteristics of a hazardous waste. Pesticide wastes which are regulated are as follows:

a. they contains a hazardous sole active ingredient.
b. they are hazardous mixtures.
c. they are acutely hazardous waste.
d. they are hazardous wastes identified by an EPA number.

35. In most areas, pesticides are called hazardous, acutely hazardous or regulated wastes if they require specific disposal procedures. Disposal of these chemicals usually requires completion of a Uniform Hazardous Waste Manifest before the chemicals can be shipped off-site for treatment, storage or disposal. This can be costly, so it is important to minimize amounts of hazardous waste.

36. The first step in minimizing chemical waste is to determine the optimum means for pest control. Integrated pest management (IPM) techniques have been developed to provide needed protection, with reduced use of chemical pesticides. In addition, biological control alternatives should be evaluated. If a pesticide must be used, the following management practices will help minimize waste disposal problems:

a. Select the appropriate pesticide.
b. Read the label carefully.
c. Apply the pesticide properly.
d. Clean up thoroughly.
e. Store the pesticide securely.
f. Dispose of containers safely.

37. With these basic guidelines in mind, several waste minimization techniques can be implemented.

LABELS

38. Once the need for a pesticide product has been determined, carefully review the label. Mixing and spraying directions, amount to be used over a specific area, equipment requirements, registered crops, spray timing, mixture specifications, as well as other useful information is stated. This information is extremely important and should be reviewed before each use. The label also provides some guidelines on pesticide storage and container disposal.

STORAGE

39. Pesticides should be stored in a locked, dry, cool, well-ventilated area. This will ensure that the chemical will maintain its active ability for the period it is stored before use. Safe storage will also help avoid non-authorized personnel from meeting potentially harmful materials. The storage area should be equipped with clean-up supplies, such as clay absorbents, in case a spill occurs. Water, food or feed should not be stored in the same locked areas as pesticides. Safely storing pesticides will help

minimize wastes by preventing spills and loss of chemical activity from degradation by heat, sunlight or other environmental factors.

APPLICATION

40. Improper pesticide application can create serious waste management problems. Misapplication limits a product's ability to control the target pest(s) and as a result, additional pesticide applications are frequently required. These subsequent applications significantly increase the potential for contamination. Overestimating the volume of pesticide required represents another waste management problem. Pre-application calculations should be conducted to accurately determine the amount of pesticide needed for a specific area. This will help avoid excessive, left-over mixture that will later have to be disposed of.

41. Equipment should be tested frequently to determine if it is in proper working order. A trial run with water can be used to determine the spray pressure needed to cover a specific area at the labeled rate. Check all nozzles to make sure they are dispersing similarly. Clogged nozzles or an improperly pressurized boom will cause uneven distribution, resulting in over or under application.

CLEANUP

42. All remaining mixture should be disposed of according to label instructions. For specific information on the state regulations in your area contact your local Extension office. Storing excess mixture is not recommended. Many pesticides degrade more quickly when mixed with water or oil. This may weaken or even completely inactivate mixtures saved for later use. Also, these mixtures are more subject to temperature and sunlight factors which can hasten pesticide degradation. Stored mixtures also present spill and leakage hazards.

43. All equipment should be triple rinsed both inside and out to minimize pesticide residues. If equipment is rinsed on a loading pad, a closed storage system could be used to collect rinse. If a closed system is not available, storage tanks or containers may be

used to catch the rinse water. If this material is stored, keep accurate records on the content of each tank. Never store assorted wastes in the same tank.

44. Rinse water should be applied to an area that would do some good in controlling the target pest but would not create a contamination hazard. Do not apply rinse water to areas previously treated. Reapplication over such an area could increase the potential for contamination or result in longer persistence of the pesticide in that area.

CONTAINER DISPOSAL

45. In many areas, specific requirements exist for the disposal of pesticide containers. Check with your county Extension office for state regulations. Typically, all containers should be triple rinsed with a solvent capable of removing any remaining content and the reinstate disposed of according to the disposal instructions on the label. Empty containers should then be punctured, crushed or otherwise rendered incapable of holding liquid. These containers can then be disposed of at a sanitary landfill or returned to the manufacturer or formulator.

TIPS TO FOLLOW WHEN TRANSPORTING PESTICIDES

46. Keep the pesticides in their original containers with the labels attached.

47. Place containers so they won't shift and/or spill.

48. Line the transport area in your vehicle or place pesticides in a plastic bin to contain any spills in case of an accident.

49. If pesticides are carried in the back of an open vehicle, secure and cover the load.

50. Don't put pesticides in the passenger compartment of a vehicle.

51. Keep pesticides away from groceries, including food for animals.

52. Go straight to the collection site once you have loaded your vehicle. Drive carefully.

SUMMARY

53. Managing pesticide wastes properly can help reduce potential hazards to the environment and employees. Although most of these practices are nothing more than common sense, we often tend to "cut corners" when time is short. However, careful attention to detail in this area is critical if we are to comply with the increasing regulations concerning the environment. Developing an effective waste management program can be relatively painless if you follow these basic guidelines.

a. Utilize IPM techniques to help minimize pesticide applications.

b. Be aware of alternative products which might be less toxic or even nonhazardous.

c. Store pesticides correctly to help maintain their activity.

d. Carefully estimate the amount of mixture required for a specific area.

e. Accurately calibrate pesticide application equipment to avoid over or under applications.

f. Read pesticide labels carefully and know how and where to apply products for optimum results.

g. Clean equipment inside and out and dispose of left over mixture and rinse according to label instructions. And Triple rinse empty pesticide containers and dispose of them properly.

WAYS OF PESTICIDES ENTERING TO THE HUMAN BODY

54. Pesticides can enter the human body by three common ways:

a. Through the skin (contact)

b. The mouth (ingestion)

c. The lungs (inhalation)

55. The state of the chemical, *i.e.*, solid, liquid, or gas, affects the chances of pesticide penetration into the body. Liquid or gas products can get into the body through all three routes of entry, whereas solids tend to have a lower chance of entry through the lungs. However, if solid particles of the pesticide are small enough or if they remain on the skin long enough, penetration into the body can take place in the same ways as those of liquids or gases.

DERMAL

56. The most common pathway for pesticide poisoning among common users is absorption through the skin. Dermal absorption may occur as a result of splashes and spills when handling (mixing, loading or disposing of) pesticides. To a minor degree, dermal absorption may occur from exposure to great load of residues. The degree of hazard by dermal absorption depends on the toxicity of the pesticide to the skin, the duration of the exposure, the pesticide formulation, and the body part contaminated. Powders, dusts, and granular pesticides are not absorbed so easily through the skin and other body tissues as are the liquid formulations. On the other hand, liquid pesticides containing solvents (e.g., organic solvents) and oil-based pesticides usually are absorbed more quickly than dry pesticides. For example, the emulsifiable concentrates, containing a great percentage of the toxic substance in a relatively small amount of solvent, are readily absorbed by the skin. Certain body areas are more prone to absorption of pesticides than other areas.

ORAL

57. Pesticides entering the body through the mouth (oral exposure or also called ingestion) may cause serious illness, severe injury, or sometimes even death. These products may be consumed inadvertently (*i.e.*, accidental oral exposure) or may be consumed intentionally by individuals who intend on personal harm (*i.e.*, deliberate self-poisoning). Oral exposure can also occur when hands are not properly washed before eating or smoking.

58. Furthermore, pesticides may be swallowed by mistake, when improperly stored in food containers. Materials that are ingested can be absorbed along the gastrointestinal

tract, with the small intestine being reported to be the major absorption site. Once absorbed, they find their way into the blood stream, through which they are capable of readily distributing throughout the entire body. Frequent cases of accidental oral exposure, probably the most frequent, are those in which pesticides have been moved from their original labeled container to an unlabeled bottle or food container. There are many cases where people have been poisoned by drinking pesticides or water stored in pesticide-contaminated bottles.

INHALATION

59. Pesticides entering the body through inhalation can cause serious damage to the nose, the throat, and the lung tissues. The rapid absorption of pesticides through this specific route increases the risk of respiratory exposure. The greatest potential for poisoning via respiratory exposure is with vapors and extremely fine particles of the spray solution.

60. Pesticide exposure is usually low when dilute sprays are applied with common conventional spraying equipment because larger droplet sizes are produced. By contrast, when low volume equipment is utilized to apply concentrated material, the potential for an event of respiratory exposure is increased because smaller droplets are produced. Pesticide application in confined areas (e.g., greenhouses) also contributes to high potential for exposure through inhalation. Respirators and gas masks can provide protection from respiratory exposure.

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61. Eyes are particularly sensitive to absorption, and therefore any contact of pesticides with the eye presents an immediate threat of injury, blindness, or sometimes even death. Eye protection is always a prerequisite when measuring or mixing concentrated and toxic pesticides. Proper protection of the eyes should also be used when there is a chance of exposure to the diluted spray or dusts that may drift into the eyes. Pesticides in a granular formulation may also present a high risk to the eyes due to the size and weight of the individual particles. If applied with power equipment, particles may bounce off vegetation and cause significant eye injury as well as poisoning to an applicator if struck in sensitive body areas (*i.e.*, the eyes). Therefore, protective goggles should be used whenever there is a possibility of pesticides meeting the eyes.

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CHAPTER FIVE

DETRIMENTAL EFFECTS OF CHEMICAL PESTICIDES ON HUMAN BEING

62. The pesticides, which may act on axon of nerve cell is called axonopathy. Axonopathy causes axon destruction. Chemicals may cause chemical transaction of axon and cause axon separation from the cell body. As a result, there occurs difficulty in sensation and motor strength. A person may not feel sensation from feet and hands. For example, solvents like n-hexane and acrylamide.

63. Those pesticides, which affect the myelination of axon of nerve cells, are called myelopathies. These chemicals may target myelin sheath and cause intramyelinic edema or demyelination. However, the cell body is still in contact and so it is not structurally affected. Triethyltin and hexachlophene are examples of chemicals that are reasons for edema. As a result, formation of vacuoles starts creating a spongiosis in the brain.

64. Neurotoxicants may interfere with neurotransmission. They can obstruct the release of neurotransmitter such as botulinum toxin, which prevents acetylcholine release, and as competitor for specific receptors. As a result, there occurs difficulty in signal transduction. This may lead to severe toxicity and may cause death of organism.

65. There are two types of toxic effects with respect to exposure as acute toxicity and chronic toxicity short duration of toxicity is called acute toxicity. It is caused by only single exposure of pesticides.

66. The harmful effects on single exposure mostly have four routes such as dermal (skin), inhalation (lungs), oral (mouth), and the eyes. Acute toxicity is measured by inspecting the dermal toxicity, inhalation toxicity, and oral toxicity of test animals. Other than these, eye and skin irritation are also examined. Acute toxicity is determined by the amount or concentration of a toxicant, which is

required to kill 50 percent of the animals in a test population. This measure is usually expressed as the LD50 (lethal dose 50).

67. Long-term exposure to pesticides is called chronic toxicity. Any harmful effects from small repeated doses over a certain time are known as chronic effects. Long-term exposure may have certain effects, which include birth defects, toxicity to a fetus, formation of benign or malignant tumors, genetic changes, blood syndromes, nerve infections, endocrine disorder, and effects of reproduction. The chronic toxicity of a pesticide is more problematic as compared to acute toxicity to determine through laboratory examination.

ORGANOCHLORINE INSECTICIDES

68. The most widely known organochlorine pesticide is dichlorodiphenyltrichloroethane, i.e., the insecticide DDT, the uncontrolled use of which raised many environmental and human health issues. Dieldrin, endosulfan, heptachlor, dicofol, and methoxychlor are some other organochlorines used as pesticides.

69. There are a few countries that still use DDT or plan to reintroduce it for public health purposes. Furthermore, DDT is also used as a solution in certain solvents. It is a ubiquitous chemical substance, and it is believed that every living organism on Earth has a DDT body burden, mainly stored in the fat. There is also evidence that DDT and its metabolite p,p-dichlorodiphenyldichloroethylene (DDE) may have endocrine-disrupting potential and carcinogenic action . *In utero* exposure to both DDT and DDE has been associated with neurodevelopmental effects in children. Moreover, a recent study related DDE to hepatic lipid dysfunction in rats.

70. The general class of organochlorine pesticides has been associated with health effects, such as endocrine disorders effects on embryonic development, lipid metabolism, and hematological and hepatic alterations. Their carcinogenic potential is questioned, but concerns about possible carcinogenic action should not be underestimated.

71. Organophosphates, which were promoted as a more ecological alternative to organochlorines, include a great variety of pesticides, the most common of which is glyphosate. This class also includes other known pesticides, such as malathion, parathion, and dimethoate; some are known for their endocrine-disrupting potential. This class of pesticides has been associated with effects on the function of cholinesterase enzymes, decrease in insulin secretion, disruption of normal cellular metabolism of proteins, carbohydrates and fats, and also with genotoxic effects and effects on mitochondrial function, causing cellular oxidative stress and problems to the nervous and endocrine systems.

72. Population-based studies have revealed possible relations between the exposure to organophosphorus pesticides and serious health effects including cardiovascular diseases, negative.

74. Effects on the male reproductive system and on the nervous system, dementia, and also a possible increased risk for non-Hodgkin's lymphoma. Furthermore, prenatal exposure to organophosphates has been correlated with decreased gestational duration and neurological problems occurring in children.

75. Regarding glyphosate, the safety of which is the subject of an ongoing scientific controversy, it is the most widely used herbicide in current agriculture, especially since the introduction of glyphosate-tolerant genetically modified crops, such as certain types of soybeans and maize. Its extensive use in genetically modified soybean cultivation has raised concerns about possible synergistic estrogenic effects due to the simultaneous exposure to glyphosate and to the phytoestrogen "genistein," which is a common isoflavone present in soybeans and soybean products.

76. Glyphosate can display endocrine-disrupting activity, affect human erythrocytes *in vitro*, and promote carcinogenicity in mouse skin. Furthermore, it is considered to cause extreme disruption in shikimate pathway, which is a pathway found in plants and bacteria as well as in human gut bacteria. This disruption may affect the supply of human organism with essential amino acids. Commercial glyphosate formulations are considered to be more toxic than the active substance

alone. Glyphosate-based herbicides, such as the well-known "Roundup," can cause DNA damages and act as endocrine disruptors in human cell lines and in rat testicular cells, cause damages to cultured human cutaneous cells, and promote cell death in the testicular cells of experimental animals. There is evidence also for their possible ability to affect cytoskeleton and intracellular transport.

77. A recent study examined the possible relation between glyphosate, genetically modified crops, and health deterioration in the USA. Correlation analyses raised concerns about possible connections between glyphosate use and various health effects and diseases, such as hypertension, diabetes, strokes, autism, kidney failure, Parkinson's and Alzheimer's diseases, and cancer. Furthermore, there are concerns about the possible ability of glyphosate to cause gluten intolerance, a health problem associated with deficiencies in essential trace metals, reproductive issues, and increased risk to develop non-Hodgkin's lymphoma.

CARBAMATE INSECTICIDES

78. Carbamate pesticides, such as aldicarb, carbofuran, and ziram, are another class of chemical pesticides that have been associated with endocrine-disrupting activity, possible reproductive disorders, and effects on cellular metabolic mechanisms and mitochondrial function. Moreover, *in vitro* studies have revealed the ability of carbamate pesticides to cause cytotoxic and genotoxic effects in hamster ovarian cells and to induce apoptosis and necrosis in human immune cells, natural killer cells, and also apoptosis in T lymphocytes.

79. Furthermore, it has been confirmed that carbaryl, which belongs to the category of carbamate pesticides, can act as a ligand for the hepatic aryl hydrocarbon receptor, a transcription factor involved in the mechanism of dioxin toxicity. There is also evidence for the ability of carbamate pesticides to cause neurobehavioral effects, increased risk for dementia, and non-Hodgkin's lymphoma.

OTHER CLASS OF CHEMICAL PESTICIDES

80. Triazines, such as atrazine, simazine, and ametryn, are another class of chemical pesticides that have been related to endocrine-disrupting effects and reproductive toxicity. Moreover, it was found that there is a possible statistical relationship between triazine herbicides and breast cancer incidence. Atrazine is the most known of the triazines, and it is a very widely used herbicide that has been associated with oxidative stress, cytotoxicity, and dopaminergic effects. Furthermore, the exposure of experimental animals to atrazine has been associated with reproductive toxicity and delays in sexual maturation.

81. Synthetic pyrethroids, such as fenvalerate, permethrin, and sumithrin, are considered to be among the safer insecticides currently available for agricultural and public health purposes. However, there is evidence for their ability to display endocrine-disrupting activity, and to affect reproductive parameters in experimental animals including reproductive behavior. Furthermore, a recent study related more than one pyrethroid metabolite to DNA damages in human sperm, raising concerns about possible negative effects on human reproductive health. It should also be mentioned that there are also concerns about their possible ability to display developmental neurotoxicity.

82. Neonicotinoid pesticides, such as imidacloprid, thiacloprid, and guadipyr, are relatively new and also the most extensively used insecticides that were promoted for their low risk for non-target organisms. However, there is plenty of evidence to the contrary; their effect on bees is a common example. There is also evidence for possible effects on the endocrine and reproductive systems of animals. Moreover, a recent study demonstrated that neonicotinoids are able to increase the expression of the enzyme aromatase, which is engaged in breast cancer and also plays an important role during developmental periods.

CHAPTER SIX

TREATMENT FOR PESTICIDE POISONING

83. Like other toxic chemicals, pesticides can poison people in different ways: through the skin and eyes, through the mouth (by swallowing), or through the air (by breathing). Each kind of poisoning needs a different kind of treatment.

WHEN PESTICIDES GET ON THE SKIN

84. Most pesticide poisonings are from pesticides being absorbed through the skin. This can happen when they spill while being moved, when they splash during mixing, during spraying, or when you touch crops that have just been sprayed. Pesticides can also get on your skin through your clothes, or when you wash clothes with pesticides on them.

85. Rashes and irritation are the first signs of poisoning through the skin. Because skin problems may be caused by other things, such as a reaction to plants, insect bites, infections, or allergies, it can be hard to know if the problem is caused by pesticides. Talk to other workers to find out if the crop you are working with causes this kind of reaction. If you work with pesticides and get any unexpected skin rashes, it is safest to treat them as if they are caused by pesticides.

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TREATMENT

86. If you or someone else gets pesticides on the body:

a. Quickly remove any clothing the pesticides spilled onto.

b. Wash the pesticides off the skin as soon as possible with soap and cool water.

c. If it got into the eye, rinse the eye with clean water for 15 minutes.

87. If the skin is burned from pesticides:

a. Rinse well with cool water.

b. Do not remove anything stuck to the burn.

c. Do not apply lotions, fats, or butter.

d. Do not break blisters.

e. Do not remove loose skin.

f. Cover the area with a sterile dressing, if available.

88. If pain lasts, get medical help:

a. Bring the label from the pesticide containers or the names of the pesticides with you.

b. Pesticides can stick to your skin, hair, and clothes, even if you cannot see or smell them.

c. Always wash with soap after using pesticides.

WHEN PESTICIDES ARE SWALLOWED

89. People can swallow pesticides by eating, drinking, or smoking cigarettes in the fields while working with pesticides, or by drinking water polluted with pesticides. Children can drink or eat pesticides, especially if pesticides are stored in containers also used to hold food or left in the open or low to the ground.

TREATMENT

90. When someone swallow pesticides:

a. If the person is unconscious, lay her on her side and make sure she is breathing. If the person is not breathing, quickly do mouth-to-mouth breathing. Mouth-to-mouth breathing can also expose you to the pesticide, so cover your mouth with a pocket mask, a piece of cloth, or thick plastic wrap with a hole cut in the middle, before you start mouth-to-mouth breathing.

b. Find the pesticide package and read the label right away. The label will tell you if you should make the person vomit up the poison or not. If the person can drink, give her lots of clean water. Seek medical help. If it is available, always take the pesticide label or name with you.

91. If you are sure vomiting is not a problem:

a. Gives the person a glass of very salty water or, 2 tablespoons of pounded strong-tasting edible plant (such as celery, basil, or another local herb) followed by 1 or 2 glasses of warm water. Keep the person moving around. This can help her vomit sooner.

92. After vomiting, use activated or powdered charcoal which can help absorb any poison still in the stomach. Mix ½ cup of activated charcoal or 1 tablespoon of finely powdered charcoal with warm water in a large glass or jar. Make powdered charcoal from burnt wood, or even burnt bread or tortilla. This is not as good as activated charcoal, but it still works. Never use charcoal briquettes. They are poison.

93. After the person vomits, or even if she does not, you can slow the spread of the poison while getting to a doctor by giving her a drink of a raw egg or a glass of cow's milk. Drinking milk does NOT prevent pesticide poisoning. It just slows the spread of the poison. If someone swallowed pesticides and does not have sharp stomach pain, they can take sorbitol or magnesium hydroxide (Milk of Magnesia). These medicines cause diarrhea, which can help to get poisons out of the body.

WHEN TO USE ATROPINE

95. Atropine is a medicine for treating poisoning from certain pesticides called organophosphates and carbamates. If the label on the pesticide container says to use atropine, or if it says the pesticide is a "cholinesterase inhibitor," use atropine as directed. If the label does not say to use atropine, do not use it. Atropine is used only for organophosphate or carbamate poisoning. Atropine does not prevent pesticide poisoning. It only delays the effects of poisoning. Atropine should never be taken before spraying. Atropine does not prevent pesticide poisoning. It only delays the effects of poisoning. Atropine should never be taken before spraying.

IMPORTANT

96. Do not give these drugs for pesticide poisoning: Sleeping pills (sedatives), morphine, barbiturates, phenothiazines, aminophylline, or any drugs that slow or lessen breathing. They can make the person stop breathing completely.

97. Every farm that uses pesticides should have an emergency kit with medicines and supplies to use in case of poisoning.

WHEN PESTICIDES ARE BREATHED IN

98. When pesticides are released into the air, we breathe them in through our nose and mouth. Once in the lungs, the pesticides quickly enter the blood and spread poison through the whole body.

99. Because some pesticides have no smell, it is often hard to know if they are in the air. The most common forms of air-borne pesticides are fumigants, aerosols, foggers, smoke bombs, pest strips, sprays, and residues from spraying. You can also inhale pesticide dust in a storage area, when it is being used in an enclosed area, such as a greenhouse, or when it is being transported to the fields.

100. Pesticide dust in the air can travel miles to pollute an area far from where it was used. It is easy for pesticide dust to get into houses.

101. If you think you have breathed in pesticides, get away from the pesticides right away. Do not wait until you feel worse.

TREATMENT

102. If you or someone else breathes in pesticides**,** Get the person away from the area where he/she breathed in the poison, especially if it is an enclosed area, following procedure is applicable:

a. Get fresh air.
b. Loosen clothing to make breathing easier.
c. Sit with head and shoulders raised.
d. If the person is unconscious, lay her on her side and watch her to make sure there is nothing blocking her breathing.
e. If the person is not breathing, quickly do mouth-to-mouth breathing. Seek medical help. Take the pesticide label or name of the pesticide with you.

GASTRIC LAVAGE

103. The importance of iatrogenic deaths as shown by the number of deaths occurring after ingestion of low toxicity pesticides needs to be emphasized (Eddleston et al., 2007). The role of inappropriate gastric decontamination in these deaths is important. There is a need to tailor treatment to the poison and the patient; for example, if a person has ingested a low toxicity pesticide and does not show clinical features of poisoning, it may be best to only observe and support the patient rather than carrying out gastric decontamination and giving antidotes. There is much discussion about the use of gastric lavage or forced emesis compared to activated charcoal in pesticide poisoned patients. Recent studies indicate that single or multiple doses of activated charcoal are safe in pesticide poisoned patients, including patients receiving appropriate amounts of atropine (Eddleston et al., 2008b). By contrast, both forced emesis and gastric lavage have potential serious complications if performed in non-consenting patients or unconscious patients without airway protection (Eddleston et al., 2007). However, in light of the absence of direct data showing the benefits of charcoal over

other forms of gastric decontamination, it is difficult to make a strong recommendation. Overall, if a patient presented within one hour to a health care facility, the administration of activated charcoal should be considered if the patient is conscious and gives consent. The patient should not be forced to accept the charcoal. Forced emesis is not recommended. Oral fluids should not be given.

ANTIDOTES

104. Atropine is the most important antidote for pesticide poisoning, being effective in OP and carbamate poisoning (Eddleston et al., 2008; Freeman and Epstein, 1955). However, the dosing recommendations given in different sources vary markedly and there is much variation in how it is given in practice (Eddleston et al., 2004). The effectiveness of the second antidote for OP poisoning, an oxime such as pralidoxime, also varies markedly according to the OP and the ingested dose. Current recommendations are to give oximes to all OP poisoned patients requiring atropine (Johnson et al., 2000); however, many patients do not seem to benefit (Eddleston et al., 2005). More data are required. Suxamethonium be avoided when intubating OP pesticide poisoned patients. There is great need for consistent evidence-based recommendations and more importance to be placed on sustainable access to antidotes in the rural hospitals that see most patients. Current research aims to identify new affordable and effective antidotes.

MONITORING

105. As to the immediate monitoring of the patient, the Glasgow Coma Score (GCS) on admission appears to be the best predicator of outcome - patients with GCS 15/15 have a <5% risk of death while patients with GCS <10/15 have a 60% risk of death. GCS is a clear marker of outcome in OP pesticide poisoning in particular (Davies et al., 2008).

WHERE TO TREAT

106. In view of the relatively high risk of death after pesticide poisoning, all patients should be sent as quickly as possible to the nearest health care facility. At that point the skills and resources available to the health care worker will determine whether the patient should be transferred urgently onwards to a better resourced hospital or kept under observation in the first health care facility. Many patients will present to peripheral elements of the health services, such as small rural hospitals, where staff and resources are inadequate to manage the patient. Such hospitals should safely transfer all patients who present to them. Patients should only be kept at these peripheral health units, if they do not show clinical features of poisoning and the staff are able to manage any patient who begins to show clinical features (see below). If these skills and resources are available, patients who do not develop clinical features can be safely discharged home without the cost of transfer to or observation in a distant referral hospital. For a pesticide poisoned patient to be safe in a health care facility, following minimum set of skills and resources must be available:

a. skills and knowledge about how to resuscitate patients and assess for clinical features of pesticide poisoning.
b. skills and knowledge to manage the airway, in particular to intubate and support breathing until a ventilator can be attached.
c. atropine and means for its intravenous administration if signs of cholinergic poisoning develop.
d. diazepam and means for its intravenous administration if the patient develop seizures.

107. If any of these skills and resources are not available in the health care facility, then the patient should be transferred to one that does. The availability of these skills and resources will allow asymptomatic patients to be safely observed in the peripheral unit until they develop clinical features of poisoning. At this point, since respiratory failure is the primary cause of preventable death in pesticide poisoning, symptomatic patients should be observed in a facility able to offer respiratory support, 24-hour observation (in an Intensive Care Unit) if required, and a large supply of antidotes. This

might be the first hospital to which the patient presented; however, it will most often be a secondary referral hospital to which the patient should be transferred safely as soon as possible. All facilities keeping poisoned patients for observation should be able to further assess ongoing suicide risk and mental illness in a poisoned patient. Often, a decision to provide supportive care only, without medical intervention is appropriate.

SURVEY OF PESTICIDE POISONING GLOBALLY

108. Pesticides are important in developing countries and will continue to be so in agriculture and in public health. The human diseases controlled by pesticides are a particular problem of tropical regions. For example, it is estimated that some 150 million clinical cases of malaria occur annually in the developing countries, and schistosomiasis and filariasis each account for nearly 250 million cases each year. Pesticides are essential for the control of the vectors of all of these diseases. The present study was undertaken to investigate the overall extent and characteristics of the problem of pesticide poisoning in Sri Lanka in order that appropriate action could be taken to minimize the problem. The data may give an indication of the morbidity and mortality of pesticide poisoning in other developing countries.

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Ser	Region	Subregion	Population in Subregion	Population in Review	Weight	Number of Countries	Sum of Fatalities in Review	Estimated Fatalities in Subregion
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
1.	AFRICA	East	405,425,679	42,752,218	0.10545	3	8.5	81
		Middle-Southern	217,729,520	53,771,984	0.24697	1	16.6	67
		Northern	228,846,848	133,894,911	0.58509	3	90.3	154
		Western	362,197,544	539,560	0.00149	1	0	0
2.	AMERICA	Caribbean	43,278,165	31,557,456	0.72918	19	6.1	8
		Central	174,988,756	167,463,654	0.957	8	283.4	296
		North	359,792,066	353,535,331	0.98261	3	5.4	6
		South	420,434,194	395,970,288	0.94181	12	215.2	229
3.	ASIA	Central	70,118,950	61,486,031	0.87688	4	3.5	4
		Eastern	1,616,177,218	1,532,006,035	0.94792	5	320.2	338
		South-Eastern	641,760,625	195,058,336	0.30394	5	48.4	159
		Southern	1,846,671,142	1,284,597,898	0.69563	3	6539.30	9401
		Western Asia	262,879,373	160,485,199	0.61049	12	23.6	39
4.	EUROPE	Eastern	293,011,923	94,597,984	0.32285	7	24.2	75
		Northern	96,464,409	94,640,537	0.98109	8	1.2	1
		Southern	160,067,370	154,290,938	0.96391	13	13.7	14
		Western	195,338,358	191,762,460	0.98169	7	6.6	7
5.	OCEANIA	AUS, NZ, Mel-Mic-Polynesia	40,153,128	28,353,352	0.70613	3	2.4	3
6.	All	All	7,435,335,268	4,976,764,172		117	7609	10,881

Table 4: Estimated worldwide annual fatal UAPP by region 2019

Source: Internet

109. The vast amount of these fatalities are expected to occur in southern Asia, which is covered in this review by three countries (India, Iran, Maldives) with 70% of the population in this region. Western Africa is poorly covered in this estimation, as there is a national estimation for only one country (Cabo Verde), representing about 0.15% of the regional population.

110. With respect to non-fatal UAPP (Table 4), national estimates are available for 44 countries reporting on 81% of the respective worldwide farming/occupational population. The sum of national estimates of approximately 309 million is extrapolated by our procedure to around 386 million non-fatal UAPP worldwide annually. The lowest share of countries in this review to the overall population of the sub-region is seen for Central America (2%), which is represented by Costa Rica only. For eastern Asia, a weight greater than one was calculated because the average population of the study years of the extracted papers was greater than the population of the respective FAO region in the reference year 2019. For some regions, our extrapolation was based on only one country. For example, for middle and southern Africa, figures were based on Cameroon, but its national estimate of non-fatal UAPP was derived from 5 surveys of rather good quality. No national estimates on non-fatal UAPP were available for central Asia and Eastern Europe.

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CHAPTER SEVEN

SUBSTITUTIONS FOR CHEMICAL PESTICIDES AND INSECTICIDES TO REDUCE DETRIMENTAL EFFECTS ON HUMAN BEING

111. Pesticides might improve crop yield and productivity, but they can also deteriorate the environment in the long-term contaminating ground water, soil and its fertility, and even the air. They can harm other beneficial soil organisms, insects and plants, and can be toxic to animals (like fish and birds).

112. With such clear environmental and ecological impacts of pesticides, it's no wonder government regulations have hammered down, becoming stricter. Moreover, the potential health effects of pesticide residue have scared more and more of us into buying products we think are pesticide-free. Even if policies are in place to ensure legal maximum residue levels, which have been deemed scientifically safe for consumption, the movement towards avoiding pesticides has been gaining momentum.

113. Yet, pests are still a major problem in food production. And, I'm not certain I would necessarily want to see a caterpillar in my salad (even if it's a good source of protein). Here are 3 agricultural alternatives that can keep crops pest-free without conventional pesticides.

BIOCONTROL

114. It's not as scary as it sounds think of bio in terms of biology, and control as in maintenance. Essentially, biocontrol is using a pest's natural enemy (like a specific insect or bacterial strain) to fend off the pests. Extensive research is conducted to ensure that these natural enemies don't inflict unintended damage to the native vegetation or other insects, only targeting the specific pests eating away at crops. But biocontrol is not a modern invention. In fact, it was first reportedly used in ancient China around 304 C.E., in which citrus fruits were protected by ants from other insects. Today, other organisms are also being used, like microscopic worms.

POLYCULTURE (COMPANION PLANTING)

115. Think of poly in terms of many, and culture in terms of growth (like crop growth in agriculture). Essentially, it means planting multiple types of crops in the same field rather than just one specific type. Within polyculture, there is a concept called 'companion planting'. It's just as it sounds: you plant partner-plants together with crops as a means to support the crop. From a pest-control lens, it's ideal to plant plants that naturally repel specific pests of your crop. For example, if you plant tomatoes with cabbage, the tomatoes naturally repel diamond-backed moth larvae that eat cabbage. Or, basil with tomato can fend of flies and mosquitoes.

NATURAL BARRIERS & PREDATORS

116. You know how feudal lords used to create a moat around their castle to create additional barriers of defense. Natural barriers against pests are somewhat similar, except it's more about planting rather than just digging. For example, UK farmers plant tussock grass to cut across the middle of their agricultural field, giving a home to beetles and spiders that would protect the nearby crops from aphid pests.

INSECT CROP COMBAT: BEETLES VS APHIDS

117. From the moment we plant our food in the ground to the moment we eat it, there's always something else looking to get a bite too. Whether fruit, veg or cereal, crops are a tasty morsel for many living things all the way through the process. Insects, for example, can be one of our biggest food foes. One method that farmers use to protect their crops is something called beetle banks. A beetle bank is a strip of land in the middle of a crop field specifically created for insects, not for crops. Beetle banks are intentionally put there to act as a home for aphid-eating insects and spiders. These beetle banks were the brainy idea of UK farmers from the early 1990s. The concept is simple, yet effective. So why do farmers want predatory Insects in the middle of the field. That valuable land which we can use for crops. Well aphids and few other insects out there eating their crops that's why. Naturally farmers want to get rid of these Pests as quickly as possible because it's not their crops in the rain and natural Predators will be a great

way to tick both the boxes. But you may be thinking why aren't these insects Already chomping up.

118. These aphids and their buddies If they are indeed their natural predators. Well, many of these predatory Insects can't reach. The pests in the middle of crop fields, with their homes being more naturally by Wide terrain Surroundings crop fields Even though for humans it might be a very little distance but for insects it's so very far distance. But this group sales are not the ideal place for insect especially when you cold weather is there. So here we used to Technique call beetle bank. Here we use a strip of land in the middle of crop field to plant grass & they act like in an apartment for the insects in Cold weather.

119. For this beetle bank we normally use tussock grass. So insect use this when they are in cold weather and they live in it and when the summer comes all the hot weather comes when the farms are filled with pests They eat all of them and this is a nice way to reduce all the bugs without using any pesticides. So, it is obvious that beetle band an agricultural technique which we can use the nature to save our foods only for us not for bugs by reducing crop damage. This is a technique well-mannered in Netherlands and Belgium and they have been lots of success through this.

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CHAPTER EIGHT

CONCLUTION

120. Pesticide self-harming is a significant supporter of populace examples of bleakness and mortality in non-industrial countries. The utilization of pesticides for self-harming may misshape regular epidemiological provisions of self-destruction in these nations and add to their overabundance untimely mortality. We gauge there are around 300 000 self-caused pesticide passing worldwide every year. Exploration going back more than 30 years has recorded the size of this issue but then contemporary examination takes the stand concerning its proceeding with sway.

121. Examination to distinguish the most adequate method for limiting the accessibility of pesticides inside provincial networks is direly required along with randomized controlled preliminaries to decide the best method for treatment and cost-viability of potential intercessions. A portion of this exploration is currently in progress (M Eddleston, unpublished). Preventive estimates should assess the nearby necessities and setting and ought to be thoroughly assessed.

122. Up to this point there has been no worldwide initiative to react to the issue. Commitment of public governments and initiative of the WHO, specifically the MNH and IPCS segments, on the issue is fundamental. Responsibility from industry and the requirement for them to recognize their obligation regarding a portion of these passing is fundamental (Table), similar to the need to guarantee they comprehend the scale, significance, and preventability of the issue. Lessening the quantity of pesticide passing by half could quickly decrease the quantity of suicides worldwide by 150 000. This is very conceivable.

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