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Environmental Problems Induced by Pollutants in Air, Soil and Water Resources

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1. Introduction

The rapid increase of population and intensive agriculture in our planet has resulted in large quantities of organic and inorganic wastes being discharged into environment, thus giving rise to serious environmental problems and deterioration of the agroecosystems. This process may also cause a risk in the human health. The potential problems in environment caused by pesticides, heavy metals, fertilizers, agricultural residues, wastewater, sewage sludge, solid wastes, atmospheric fallout and transgenic organisms. The results are an increase in toxic elements in air, soil and water resources. Once heavy metals enter the environment, they are very difficult to remove.

2. Important

The increase in animal and vegetable production obtained by using new technologies and methods has undoubtedly raised the productivity. However, it is not possible to provide an everlasting increase of product through the new methods and techniques implemented. Even though a quantitative product increase is provided by this way, some environmental problems also appear. Chemical products implemented in soil and plants with developed agricultural applications, various wastes pollute air, soil and water resources and make them uninhabitable for alive things living on them. Soils are systems having a high level of buffering power against external factors compare to water and air. However, the problems encountered when some deteriorations are created by some pollutants added in to the system become complex, difficult and costly to be corrected in the same degree. Some amount of these substances getting into bottom layers of the soil with rain and irrigation waters and then to underground waters deteriorate the quality of waters and make them impossible to drink.

In this chapter, discussion is focused on the environmental impact of agricultural and industrial practices in air, soil and water resources. Our work is an attempt at describing some environmental problems. Remediation options and strategies are considered in the following conclusions.

3. Information

3. 1 Pesticides

The fields convenient for agriculture is continuously decreasing due to many reasons like increase in residential areas in parallel to the continuous increase in world

population, opening of new urban residential areas, establishment of factories, increase in the number of highways and vehicles. Since the area of the world is limited opening new fields for agriculture is not possible in order to meet the requirement of increasing population. Pesticides come first among the inputs used to increase product amount to be obtained from unit of area. Pesticides are chemical compounds used with the aim of removing micro and macro pests in the agriculture. Use of pesticides in agricultural struggle applications appears the easiest and the cheapest method. This situation increases use of these compounds for long years. Pesticides found a widespread area of use in the measures oriented to human health during and after First and Second World Wars.

3.1.1 Environmental Risks in Pesticide Using

Increasing amount of pesticide using also creates a general and potential danger like use of other toxic materials. Three main problems determine the limits in continuous use of pesticides:

- a. Organisms become resistant against pesticides in time.
- b. Some pesticides do not undergo biodegradation easily, but remains resisting in the environment they are implemented or carried.
- c. They also harm some living things other than those targeted.

3.1. 2 Mobility of Pesticides in Soil

Pesticides are generally sprayed or applied on plants, soil surface and inside of soil. Pesticides applied may encounter one or more of following cases;

3.1.2.1 Evaporation

Atmospheric analyses indicated that some pesticides like DDT and dieldrin are mixed with the air. These chemical substances reaching to atmosphere from the soil can be mixed with soil or surface waters again with rain. Pesticides having the characteristic of mixing with the air by evaporating can be carried to very long distances with air flows from regions they are applied (Taylor & Spencer, 1990). Mixing of pesticides into the atmosphere through evaporation in the soil or their mobility in soil profile depend on vapor pressures of pesticides, adsorption characteristics of the soil, soil pH, soil temperature, texture of soils, and water content of the soil (Haktanır, 1983). Increase in temperature and soil moisture increase the evaporation speed of pesticides from the soil. Evaporation ratios of some pesticides are indicated in Table 1 which was put forward through researches made by Jiang and Cai in 1990.

3.1.2.2 Adsorption

Clay minerals and organic matter play a role in retention of pesticides in the soil. Adsorption occurs in oxides and hydroxides in sandy soil organic substance of which is low but containing Al and Fe. Pesticides like diquat, paraquat and dinoseb are in cationic form, and they are adsorbed in clay minerals. Metal ions like Cu, Fe, Mn, Co and Ni are effective in connection of pesticide molecules with clay minerals or soil organic matter.

Wang et al., (1989) and introduced that some characteristics of the soil like clay content of the soil, clay type, organic substance amount, soil structure, water content, temperature and

pH affect adsorption processes. According to Shan et al., (1994), clay soil contains more pesticides compare to sandy soil. Adsorptions of pesticides according to the texture of soil occur in following sequences;

Sand>Sandy loam>Loam>Clay

On the other hand, dissolubility of pesticides also affects the adsorption. Pesticides having more dissolubility have a less adsorption.

Pesticide	Molecular Weight	Vapor Pressure (mm Hg)	Water Solubility (mg/l)	Glass Film	Water	Soil
Trifluralin	335	65.0	0.3	99.5	92.6	6.2
Lindane	290	9.4	10.0	88.0	89.4	8.6
Methhyl-parathion	263	9.7	60.0	23.8	15.8	14.4
Carbofuran	221	20	500.0	97.9	3.6	15.6

Table 1. Volatilization Rate of Pesticides From Glass Film, Water and Soil (%)^a

3.1.2.3. Washing and diffusion

Washing of pesticides towards bottom layers of the soil occurs in the form of molecular diffusion and mass transport. Diffusion characteristics of pesticides, soil structure and humidity content of the soil are all effective in transport with diffusion. Movement of pesticides in form of mass transport is equivalent with washing. Increasing adsorption conditions decreases washing of pesticides. On the other hand, texture of the soil is also highly effective on washing. Sandy soil texture in the areas of intensive agriculture creates the risk of becoming polluted in groundwaters with pesticide residues. For this reason, residue amounts permitted in groundwaters have been determined by some international institutions like WHO and EPA. Some of these concentrations are indicated in Table 2. The EC Directive sets a maximum admissible concentration of 0.5 µg/l (0.0005 mg/l) for pesticides in total, and 0.1 µg/l for any individual pesticide.

Pesticides reach surface water resources with different ways. For example, they contaminate through their application in water to fight with water plants and water insects, through carriage of soils, plants and organisms containing pesticide residues to water resources with different ways, through discharge of pesticide production industry wastes into water resources, through washing of pesticide boxes and tools and equipments used in insecticide application, and through sedimentation of pesticide residues carried due to atmosphere pollution as a result of powder or liquid pesticide applications into water resources.

While some part of pesticide molecules reached to surface water resources through these ways dissolves in the water, other part remains suspended, and remaining part accumulates in the sediment. Then, pesticide is released from the sediment continuously.

^a Jiang & Cai, (1990)

Pesticides	WHO G.V. µg/l	EPA MCL µg/l
Alachlor	20	2
Atrazin	2	3
Carbofuran	5	40
Chlordane	0.2	2
2,4 D	30	70
heptachlor/heptachlor epoxide	0.03	0.4/0.2
methoxychlor	20	40
silvex	9	50

Table 2. Drinking Water Standards^b

3.1.2.4 Chemical decomposition

A large amount of pesticides can decompose with pure chemical events. Especially aluminum and iron oxides from soil compounds catalyzes the decomposition. Hydrolysis, oxidation, isomerization, ionization and salt formation among chemical decomposition reactions are not catalyzed. Clay content and pH of the soil are effective on chemical decomposition. Crushing especially in acid nature soils depends on the increase in hydrogen ion concentration close to clay mineral surfaces.

3.1.2.5 Biochemical decomposition

The most important part of decomposition of pesticides in the soil is composed of biochemical decompositions like many other toxic substances causing environmental pollution (petroleum and its derivatives, oils, detergents etc.). Microorganisms participating in such type of decomposition use -OH, -COO, NH₂, -NO₂ groups included in pesticide molecules as nutrients. Soil temperature, soil moisture, organic matter content of the soil and soil pH which affect the activities of microorganisms also affect biochemical decomposition processes. Most of pesticides are new compounds for soil microorganisms. For this reason, an inability can be seen in initial biological decomposition speed of due to adaptation absence of microflora. On the other hand, new compounds which emerge in different stages of biochemical decomposition may be sometimes more toxic than main compound. The list of microorganisms participating in biochemical decomposition processes of pesticides is given in Table 3.

3.1.2.6 Uptake by plants

Some pesticides do not harm plants since their chemical structure deteriorates after they are taken away within plants. By this way the amount of pesticides decreases. However, it is known that in agricultural fields where pesticide with content of dinitroanilin and metalaxyl is used for long years, seed germination decreases and so causes abnormal seed germinations. Cheng, (1985), PCBN, examined the effects of folpet, aliette and metalaxyl fungicides on beneficial endotrophic mycorrhiza (VAM) which leads a symbiotic life in roots of bean and clover plants for two years, and stated that fungicides can cause decreases in product amounts

^b Twort, et al., (1994)

Microorganism	Pesticides That Can Be Degraded by the Microorganism
<i>Achromobacter</i>	DDT, Carbaryl, 2,4-D, MCPA
<i>Agrobacterium</i>	DDT, Dalapon
<i>Arthrobacter</i>	DDT, Malathion, Diazinon, 2,4-D, MCPA, Simazin, Propanil
<i>Bacillus</i>	DDT, EPN, Parathion, Methyl-Parathion, Fenitrothion, Toxaphene
	Dalapon, Linuron, Monuron, Lindane
<i>Corynebacterium</i>	DDT, 2,4-D, MCPA, Dalapon, Dinoseb, Paraquat, Diquat
<i>Flavobacterium</i>	Parathion, Methyl-Parathion, Malathion, Diazinon, 2,4-D, MCPA, Dalapon
	Chlorpyrifos
<i>Pseudomonas</i>	DDT, Toxaphene, Malathion, Parathion, Dichlorovos, PCP, Diazinon, Phorate
	Carbaryl, 2,4-D, MCPA, Dalapon, Dinoseb, Monuron, Simazine, Paraquat, Lindane
<i>Xanthomonas</i>	DDT, Parathion, Fenitrothion, Monuron
<i>Aerobacter</i>	DDT, Methoxychlor, Lindane, Toxaphene
<i>Escherichia</i>	DDT, Lindane, Prometryne, Amitrole
<i>Streptococcus</i>	DDT, Diazinon, Simazine, Dalapon
<i>Nocardia</i>	DDT, 2,4-D, 2,4-DB, Dalapon, Maleic hydrazide
<i>Streptomyces</i>	Diazinon, Dalapon, Simazine
<i>Aspergillus</i>	DDT, Trichlorphon, Linuron, Carbaryl, MCPA, Atrazine, 2,4-D, Dalapon, Monuron
	Simazine, Simetryne, Prometryne, Trifluralin
<i>Cephalosporium</i>	Atrazine, Prometryne, Simetryne
<i>Cladosporium</i>	Atrazine, Prometryne, Simetryne
<i>Fusarium</i>	DDT, Trichlorphon, Fenitrothion, Carbaryl, Simazine, Atrazine, Chlordimeform, Lindane
<i>Penicillium</i>	DDT, Carbaryl, Trichlorphon, Parathion, Atrazine, Prometryne, Simazine, Propanil,
<i>Rhizopus</i>	DDT, Fonofos, Carbaryl, Atrazine, Trichlorphon
<i>Trichoderma</i>	DDT, Lindane, Dalapon, Atrazine, Simazine, Dichlorovos, Parathion, Malathion, PCP
<i>Chlamydomonas</i>	Metobromuron, Atrazine
<i>Chlorella</i>	Phorate, Parathion

Table 3. Microorganisms and Degradability of Pesticides^c

3.1.3 Persistences and Effects of Pesticides on the Living

Resistance of pesticide molecules against physical, chemical and biological decomposition displays their persistence feature. Pesticide residue amount in the soil is determined by

^c Huang, P.M. & Iskandar, I.K., (2000)

physicochemical characteristics, soil factors, agricultural and environmental factors. The factors effective on pesticide remnants in the soil are stated in Table 4.

Properties of pesticide:	Water solubility, vapor pressure, pKa, pKb, stability, polarity, ionizability
Soil factors:	Soil texture and structure, content of organic matter, salinity, moisture content,
	porosity, temperature, pH, cation exchange capacity (CEC), permeability,
	kind and content of heavy metal ion, kind and population of microorganism,
	hydrolic conductivity
Agricultural factors:	Cropping pattern, cropping practices, crop type, pesticide formulation,
	application method, time and rate, frequency and times, irrigation time and volume
Environmental factors:	Rainfall, air temperature, evapotranspiration, illumination intensity and time, wind

Table 4. Factor That Influence the Pesticide Residues in the Soil^d

Carbamate group pesticides are the group which should be preferred in terms of environmental pollution since they have a low level of persistence. The most resistant ones against decomposition processes and undesired ones in terms of environmental pollution are chlorine hydrocarbons and inorganic pesticides. On the other hand, chlorine hydrocarbon pesticides have the characteristic of accumulating in adipose tissue of mammals. By this way, they may cause more toxic effects in receiving living group by accumulating from one living to another. Mercury included in the content of pesticides is an important environmental pollutant. It can reach high concentrations in food chain since it is accumulated in animals. Mercury reaching high concentrations in fish and mussels may cause human deaths due to eating of these livings.

Indicator species are selected as experimental animal in toxicity tests of pesticides and LD₅₀ (Lethal Dose) parameter is based on while valuating results. LD₅₀ is defined as concentration required for death of half among organisms being tested in a certain time period (24 hours, 48 hours etc.). The lesser the LD₅₀ value of a pesticide through mouth, skin or respiration is, the higher the characteristic of making acute intoxication of the pesticide is in that ratio.

The residues of pesticides especially on vegetables and possible risks of them on human health has become the prior subject of pesticide researchers who evaluate vegetable quality recently. (Colume et al., 2001; Padron-Sanz et al., 2005).

Maximum Residue Levels (MRLs) are not exceeded if pesticides are applied according to appropriate agricultural techniques, but unconscious applications may lead to harmful remnants containing environmental pollution and possible health risks. Reductions frequently made in Maximum Remnant Levels (MRLs) accepted by the international institutions like EU and EPA and determination of levels by urgently creating purposive multi-residue methods are dramatical changes (Colume et al.,2001).

^d Zhu, (1994)

World public opinion has reached a highly sensitive position against allergen, mutagen and cancerogenic effects created by pesticide residues on soil, water and foods depending on extinction events occurred in bird species feeding with accumulated pesticide residue. Forbiddance of production and consumption of pesticides causing cancer has been recommended by World Health Organization (WHO) and International Cancer Research Institutions, some has been forbidden and production of some other has been decreased. Some among them are DDT, endosulphan, fenitrothion, fenthion, malathion, parathion and trifluralin.

3.2 Heavy Metals

It is known that heavy metals forming an essential pollutant group even in trace amounts have harmful effects on human health. An important amount of heavy metals tends to accumulate in livings, and their dissolubility in water is so low. The processes which cause heavy metals reaching to toxic and cancerogenic amounts in soil and water resources following their increase in the atmosphere depending on climate conditions can be listed as follow:

- Industrial flue gases
- Local and intercity vehicle traffic
- Fossil fuels
- Mines

Other processes creating heavy metal pollution are as follow: Agricultural irrigation made with domestic and industrial wastewaters. Contamination with fertilizers and pesticides. Contamination with leaking waters from solid waste storing areas, forestry activities.

The most important ones among heavy metals are Pb, Cd, Hg, Cr, Fe, Cu, Mn, Zn, Ag, As, and Boron. According to Uslu & Turkman, (1987), the amount of these elements in water resources may exceed determined standards depending on the pollutant resource and hydrochemical atmosphere. All of them excluding iron exist in underground waters almost always below 1 mg/l concentrations. The reason why the concentration is such low is that they are adsorbed in clay minerals, iron and mangan hydroxides or soil inorganic substances as well as their low level of dissolubility.

According to the EPA (1985), atmospheric lead concentration range from 0.000076 $\mu\text{g}/\text{m}^3$ in remote areas to 10 $\mu\text{g}/\text{m}^3$ near point sources. Average annual lead concentration in air in most areas were reported to be below 1.0 $\mu\text{g}/\text{m}^3$. The EPA calculated the average intake of lead from respiration to be approximately 1 $\mu\text{g}/\text{day}$. This very low compared to the maximum drinking water intake, which would be 100 $\mu\text{g}/\text{day}$, assuming there are 50 $\mu\text{g}/\text{l}$ of lead present and daily water intake of 2 liters.

Nriagu & Pacyna, (1988) stated that 38 thousand ton cadmium and 1 million ton lead are contaminated in the soil all over the world in every year through atmospheric fallout sweeping to the atmosphere, fly ashes, urban swinging, fertilizers and sewage sludge. The resources causing great anxiety both in public opinion and scientific world and creating heavy metal pollution are indicated in Table 5. Atmospheric fallout and coal ashes sweeping to the atmosphere constitutes the most important part among these resources.

Heavy metals can not only prevent waste waters from cleaning spontaneously but also restrict use of waste waters in agricultural irrigation in treated or untreated forms.

According to Ekmekyapar & Kaykıoglu, (2007), heavy metals also restrict the use of sludge for agricultural purposes. Characterization of sludge should be made with attention in these

types of application and agricultural soils should not be permitted to be overloaded with heavy metals. The U.S. Environmental Protection Agency (US EPA, 1993) has established regulations for the disposal of sewage sludge on land. (Table 6).

Source	Lead	Cadmium	Mercury
		kt/yr	
Agricultural and food wastes	1.5-2.7	0-3.0	0-1.5
Animal wastes, manure	3.2-20	0.2-1.2	0-0.2
Logging and other wood wastes	6.6-8.2	0-2.2	0-2.2
Urban refuse	18-62	0.9-7.5	0-0.26
Municipal sewage sludge	2.8-9.7	0.02-0.34	0.01-0.8
Miscellaneous organic wastes, and excrata	0.02-1.6	0-0.01	-
Metal manufacturing awstes	4.1-11	0-0.08	0-0.08
Coal ash	45-242	1.5-13	0.4-4.8
Fertilizer	0.4-2.3	0.03-0.25	-
Peat (agricultural and fuel use)	0.4-2.6	0-0.11	0-0.02
Commercial product waste	195-390	0.8-1.6	0.6-0.8
Atmospheric fallout	202-262	2.2-8.4	0.6-4.3
TOTAL	479-1113	5.6-38	1.6-15

Tablo 5. Additions of Lead, Cadmium and Mercury to Soils^e

	Limit Conc. for	Cumulative Loading Limit		Limit Conc.for	Annual
	Sludge	Area Basis	Soil Basis	"Safe Sludge"	Loading Limit
Pollutant	mg/kg dry wt	kg/ha	mg/kg soil	(mg/kg d.wt)	kg/ha/y
Arsenic	75	41	31	41	2.0
Cadmium	85	39	29	39	1.9
Chromium	3000	3000	2260	1200	150
Copper	4300	1500	1130	1500	75
Lead	840	300	226	300	15
Mercury	57	17	13	17	0.85
Molybdenum	75	18	14	18	0.90
Nickel	420	420	316	420	21
Selenium	100	100	75	36	5.0
Zinc	7500	2800	2100	2800	140

Tablo 6. U.S. Environmental Agency Limit Values for the Use of Sewage Sludge on Land^f

^e Nriagu & Pacyna, (1988)

According to Huang & Iskandar, (2000), soil loading capacity for heavy metals refer to the maximum load of heavy metals the soil is capable of holding within a given environmental unit and a given duration of time without the risk of exceeding the criteria for environmental quality, affecting the yield and biological quality of agricultural products, polluting the environment.

Arsenic compounds intake in body are connected in blood by hemoglobin protein and prevent the activity of many enzymes. The most harmful ones among mercury compounds are alkyl mercury compounds and they block oxygen supply mechanism of living tissues. Mercury is also used as a fungicide in agriculture. Mercury can also enter into the environment through mining and use of fossil fuels. Mercury is present in coal in the range of 10 to 46 000 mg/kg, though generally it is in the range of 200 to 400 mg/kg (U.S. EPA, 1985). Pb, Cd, Cr, Cu, Ni and Zn may be present in toxicological amounts in soils around highways with heavy traffic (Scanlon, 1991; Sezgin et al., 2003; Charlesworth et al., 2003). The important ones among negative effects created by lead are lead apoplexy, sense defectiveness, cerebral disorders and digestive system disorders. Traffic origin emissions stated by Novotny & Olem, (1994) are indicated in Table 7.

	Percent of Total Solids
Pollutant	by Weight
Volatile solids	5.1
BOD	0.23
COD	5.4
Grease	0.64
Total P	0.06
TKN	0.016
Nitrate	0.008
Asbestos	3.6 10 ⁵ fibers/g
Lead	1.2
Chromium	0.008
Copper	0.012
Nickel	0.019
Zinc	0.15
Emission rates of total solids	0.671 g/axle-km

Tablo 7. Traffic Emissions^g

Among heavy metals, Fe, Cu, Zn and Mn are trace elements which should be taken as low amounts in plant, animal and human nutrition. Their absence in the body may also cause important health problems. However, the reason why these elements are mentioned in scope of heavy metals is that their toxilological effects they create when they are taken in the body in high amounts are heavy just like other heavy metals. Environmental concerns of today necessitate determination of toxilological levels of heavy metals in drinking waters,

^f USPA, (1993)
^g Novotny & Olem, (1994)

purification sludge, soil, foods and especially foods consumed fresh. Heavy metal standards determined in drinking waters by different institutions like WHO and EPA are indicated in Table 8.

	WHO	EC DIRECTIVE	UK REGUL'NS	US EPA
	1993 Guideline	1980	1989	1992
	Value	MAC	Max.	MCL
	P=Provisional	GL=guide level		P=Proposed
		mg/l		
Antimony (Sb)	0.005 P	0.01	as EC	0.006
Arsenic (As)	0.001 P	0.05	as EC	0.05
Barium (Ba)	0.7	(GL 0.1)	1.0 (Av.)	2
Beryllium (Be)	NAD	No value set	as EC	0.001
Boron (B)	0.3	(GL 1)	2.0 (Av.)	
Cadmium (Cd)	0.003	0.005	as EC	0.005
Chromium (Cr)	0.05 P	0.05	as EC	0.1
Copper (Cu)	2 P	no MAC	3.0	1.3
Cyanide (CN)	0.07	0.05	as EC	0.2
Fluoride (F)	1.5	1.5@8-12 °C 0.7@25-30 °C		4
Lead (Pb)	0.01	0.05 in running water		0.015
Manganese (Mn)	0.5 P	0.05	as EC	no MCL
Mercury (Hg)	0.001	0.001	as EC	0.002
Molybdenum (Mo)	0.07	not listed	as EC	
Nickel (Ni)	0.02	0.05	as EC	0.1

Tablo 8. Drinking Water Standards^h

3.3 Fertilizers

Another input applied in order to obtain more harvest from a unit of area is fertilizers. Increase in world population forces the limits of agricultural areas in one hand, leads to excess use of fertilizers on the other hand. Fertilizers upgrade the quality of agricultural products as well as the increase in productivity. In addition, negative effects of application of fertilizers on the environment have emerged in the countries where consumption of fertilizers is high. Even though harmful effects of excess application of fertilizers on human health and environment in industrialized countries are clearly seen, consumption of fertilizers in these countries increases more and more.

3.3.1 Environmental Effercts of Excessive Aplication of Fertilizers

Environmental pollution due to fertilizers not only depends on soil characteristics but also climatic and geographical conditions. Washing and erosion events are among fundamental

^h Twort, et al., (1994)

factors in pollution of water resources. Fundamental negative effects created by excessive application of fertilizers are as summarized below: Causing eutrophication, its contribution in greenhouse effect, its harmful effects on soil microorganisms, its harmful effects on plants, Its effects on people’s health, its negative effects on soil pH. Macro and micro elements required in plant nutrition are provided through chemical fertilizers applied in the soil in different chemical forms for long years. Mostly macro-food elements are applied to the soil. These are nitrogen, phosphorus, potassium, calcium, magnesium and sulphur. The macro-elements causing most environmental pollution among them are nitrogen and phosphorus. Two nutrients called as eutrophication in water resources and removing beneficial using possibilities of water resources are nitrogen and phosphorus. Eutrophication is the event off algae and moss bloom and accumulation of toxic compounds in aquatic atmospheres as a result of nitrogen and phosphorus enrichment. It generally occurs due to human activities like land use, sewage and reach of industrial wastewaters to water atmosphere. Nitrogen and phosphorus loads coming with fertilizers from agricultural areas have an important share among nitrogen and phosphorus loads reaching to water resources from different areas. Nitrogen and phosphorus loads coming from those areas are indicated in Table 9.

Source		kg/ha/yr	
	Suspended Solids	Nitrogen	Phosphorus
Untreated dry weather wastewater flow	995	939	62
Wet weather diffuse urban loads	1241	223	26
Average agricultural loads		44-66	4-9

Tablo 9. Unit Loads of Pollutants from Diffuse Sourcesⁱ.

An important amount of NH_4^+ nitrogen come out as a result of mineralization of compounds applied to the soil with chemical fertilizers and organic nitrogen compounds are uptaken by plants. Remaining amount is adsorbed by clay minerals or used by soil microorganisms. For that reason, environmental risk in terms of NH_4^+ nitrogen is less compare to NO_3^- nitrogen. However, NO_3^- is not stable in the soil and cannot be adsorbed by clay minerals since it has negative valence. Therefore, NO_3^- nitrogen which cannot be adsorbed but pushed by soil colloids drains to groundwaters easily. For that reason, NO_3^- concentration in underground waters is essential. If nitrate concentrations in drinking waters exceed the value of 500 g NO_3^-/m^3 , it leads to digestive and urinary system infections in adults. According to Winton et al., (1971) high concentration of nitrate cause the disease called “methemoglobinemia” and deaths in little babies. While the limit value of NO_3^- nitrogen in drinking waters permitted by USA Public Health Service was determined as 45 mg NO_3^-/l , it was determined as 5-10 mg NO_3^-/l by World Health Organization (WHO), and as 50 mg NO_3^-/l by the European Union. Nitrogen fertilizers used in product cultivation made in anaerobic atmospheres like rough rice farming and having the characteristic of dissolving rapidly cause denitrification event. (Duxbury & McConnaughey, 1986). Denitrification event is an important environmental problem which leads nitrogen to be sent to the atmosphere from the soil in the form of NO_2 , N_2O , NO and N_2 . It contributes increase in industrial origin NO_x concentrations.

ⁱ Novotny & Olem, (1994)

It may create an amount of heavy metal pollution due to phosphoric fertilizers applied to the soil and Cd amount in their content. Concentration of cadmium in phosphoric fertilizers is higher than total Cd concentration in the soil. Main source of heavy metal pollution created by phosphoric fertilizer applications is phosphate rock. A dangerous amount of cadmium accumulation may occur in the soil and plant as a result of phosphoric fertilizer application continuously (Syers et al., 1986; Laegreid et al., 1999). The most important ones among heavy metals contaminated with fertilizers are Cd, Hg, Ni, Pb and Zn.

An important part of phosphate ions is uptaken by plants, and the remaining part is hardly adsorbed by soil colloids or forms insoluble compounds with Ca, Fe, Al or Mn depending on pH of the soil. Therefore, phosphate ions are fixed in the soil and do not create water pollution risk unlike nitrate ions. Main reason why phosphate ions applied with fertilizers cause eutrophication in surface water resources is the erosion. Rainfall especially just after the application of fertilizers accelerates this process. Fertilizers should be applied by dividing in a few sections with doses appropriate with scientific rules and some form of fertilizers which are dissolved in the soil slowly should be selected in order to prevent barrages and lakes from being loaded with excessive amounts of nitrogen and phosphate and not cause environmental pollution. According to Zabunoğlu & Karacal, (1992) nitrogen fertilizers made slow effective by covering with sulfur should be used or according to Pauly et al., (2002) slowly dissolving phosphoric fertilizers which prevent phosphorus from converting into an unbeneficial form by dissolving the whole phosphate and fixing in the soil should be ensured to be used.

The number of animals has increased in order to meet nutrition requirements of increased human population, so animal wastes have also increased and these wastes caused a significant degree of pollution in soil, water and air. According to estimations, 10 000 bovine animals produce approximately 300 ton/day manures. Gases deteriorating soil air like CO₂, NO₂, N₂O, and N₂ are formed during the process of decomposition and breaking up of manure. Excessively used manure cause salt and then Na accumulation in the soil, add destructive organisms in the soil like a large number of bacteria, fungi and virus, and accumulation of organic and inorganic compounds which are toxic for plants.

3.4 Agricultural Residues

Waste amounts also increase in parallel to increase in world population. Organic wastes have an important position among pollutions created by wastes. A large amount of organic wastes is composed of residues appeared as a result of agricultural production. Dispersed structure of these residues, and causing transport and workmanship costs are important problems. Agricultural residues can be examined in 3 groups: Residues remained as a result of vegetable production. Residues remained as a result of animal production. Residues come out as a result of processing agricultural products.

Field crops and animal breeding represent almost 90% of the sector. The amount and types of products constituting the basis of agricultural sector (wheat, sunflower, tobacco, cotton, corn, plant of greenhouse etc.) cause a large amount of agricultural residues. These wastes are processed in an uncontrolled way; they are either burned up in outdoor or left for corruption in solid waste storing areas. These wastes cause serious environmental pollutions in any case. Modern biomass resources are listed as energy forestry products and tree industry wastes, energy agriculture products, plant and animal wastes of agricultural sector, urban wastes, and agricultural industry wastes. Said biomass materials are processed

through low and high biomass fuel techniques and turned into solid, liquid and gas fuels (Exploitation of Agricultural Residues in Turkey, 2005).

Obtaining biogas through corroding agricultural wastes in controlled atmospheres, alternative and beneficial using forms of agricultural wastes, and cultivation of potential energy plants should be popularized and encouraged. Converting these wastes into wood or woody forms will also decrease burning of them in outdoor spaces.

4. Conclusions

Natural resources such as soil, water and air play an important role in preserving the existence as well as the development of our planet and its people. Currently, pollution of the agricultural environment is one of the serious environmental concerns in our planet. Proposed strategies for the protection of water, soil and air are as follows: At first, environmental education for all people is necessary. Growing ornamental plants, such as flowers, grasses, and woody plants in heavily polluted lands. The application of biodegradable pesticides in agriculture should be encouraged. In sustainable, or ecological agriculture, rather than only chemical pesticides is advocated, and fertilization is recommended with an emphasis on organic matter cycling. To facilitate positive advances in remediation, development of appropriate methods and efficient pollutant removal technologies is necessary. Control of total amount of pollutants discharged and treatment of all the waste laws, scientific management of pollutants and its perfect the legal system, are of primary importance. Broader objectives for environmental policy based upon the concept of sustainable development, and focus upon resource conservation as well as pollution control. We must understand only exist one world.

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