



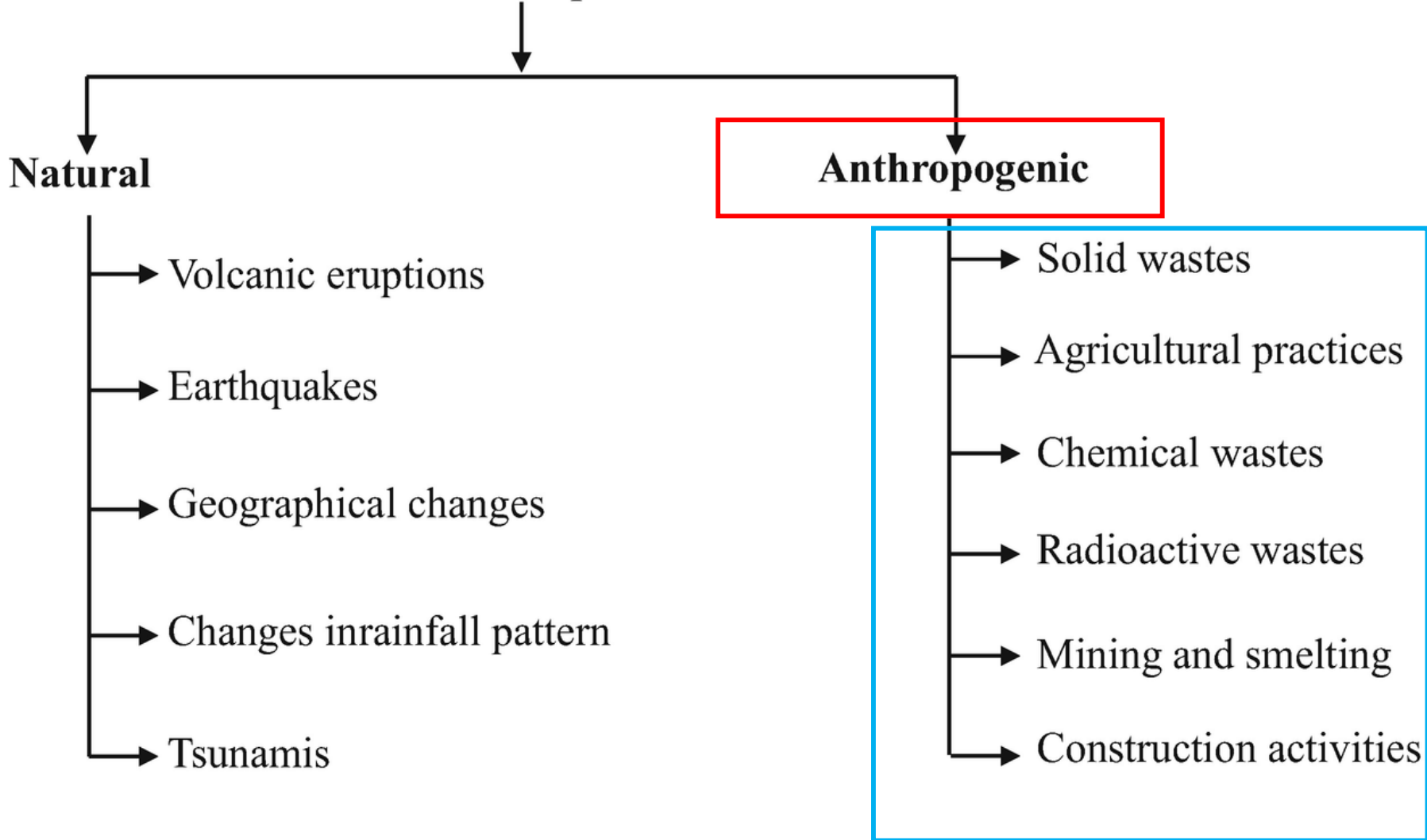
CAUSES OF SOIL POLLUTION

AAUE1003 SOIL POLLUTION
Oğuz Can TURGAY (Ph.D)

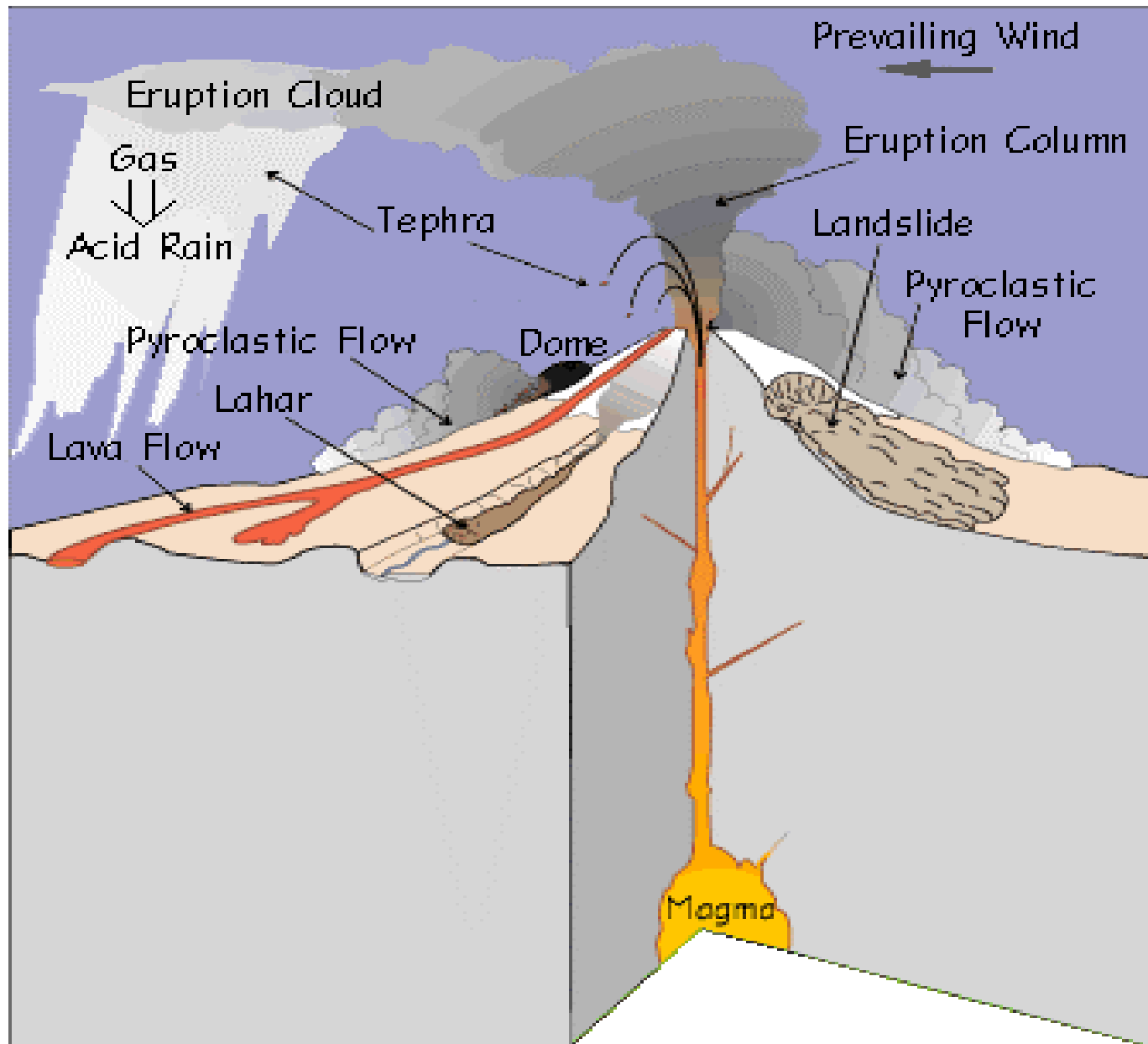
Department of Soil Science and Plant
Nutrition
Faculty of Agriculture
Ankara Universty



Causes of soil pollution



VOLCANIC POLLUTION



LAVA CONTAINS MANY HEAVY METALS!



GLOWING LAVA FIELD IN THE TWILIGHT "After several days waiting for good flying weather, I got my OK and went on the helicopter. I was incredibly lucky to have both a spectacular pink sunset and a new, red-hot lava formation in the foreground. I must have driven the helicopter pilot crazy going over this segment again and again, but in the end, I got what I wanted!" says Erez about this stunning photo. Photo/Erez Marom

SO₄ and CO₂ EMISSIONS DUE TO VOLCANOS



EARTHQUAKE (tsunami) POLLUTION



<https://www.theguardian.com/weather/2015/mar/17/japan-tsunami-earthquake-debris-us-shore>

“..About 1m tons of debris was still lingering in the Pacific Ocean four years after a magnitude 9.0 earthquake – the most powerful ever recorded in [Japan](#) – set off a series of massive tsunami waves that devastated a wide swath of Honshu’s Pacific coastline and killed nearly 20,000 people...”

SOLID WASTES

Unwanted solid materials (i.e. garbage, paper, plastics and other synthetic materials, metals, and wood). They are generated in public places such as factories, companies, hotels and schools.

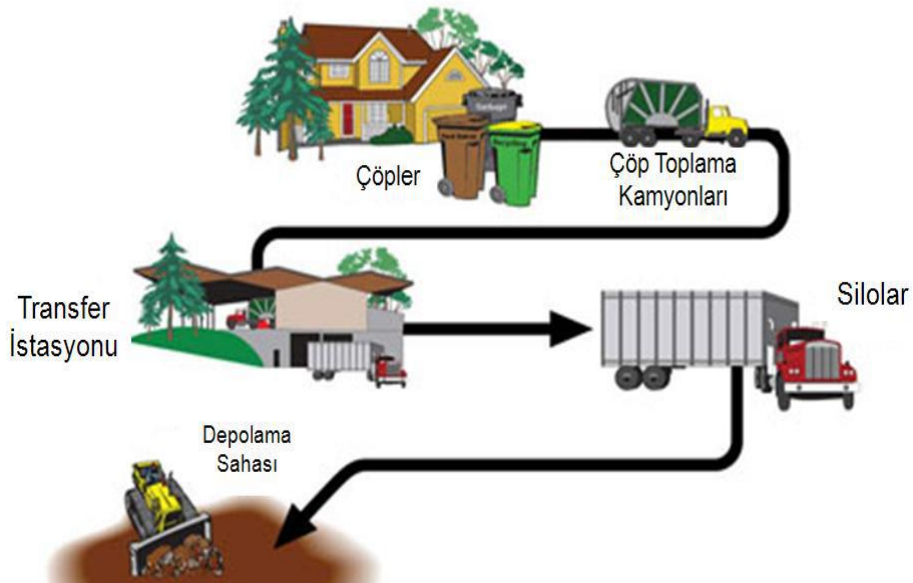


Biodegradable wastes can be decomposed naturally is (plant and animal residues and leftover food)



Non-biodegradable wastes cannot be broken down naturally and ruin the natural nutrient and water cycles if contaminated and accumulated in the nature

Municipal waste disposal in landfills and incineration are the two most common systems used in waste management...



Many pollutants, such as heavy metals, polyaromatic hydrocarbons, pharmaceutical compounds, personal care products accumulate in the surrounding soil environments, either directly from landfill leachates that may be polluting soil and under groundwater, or by ash fallout from incinerating plants.



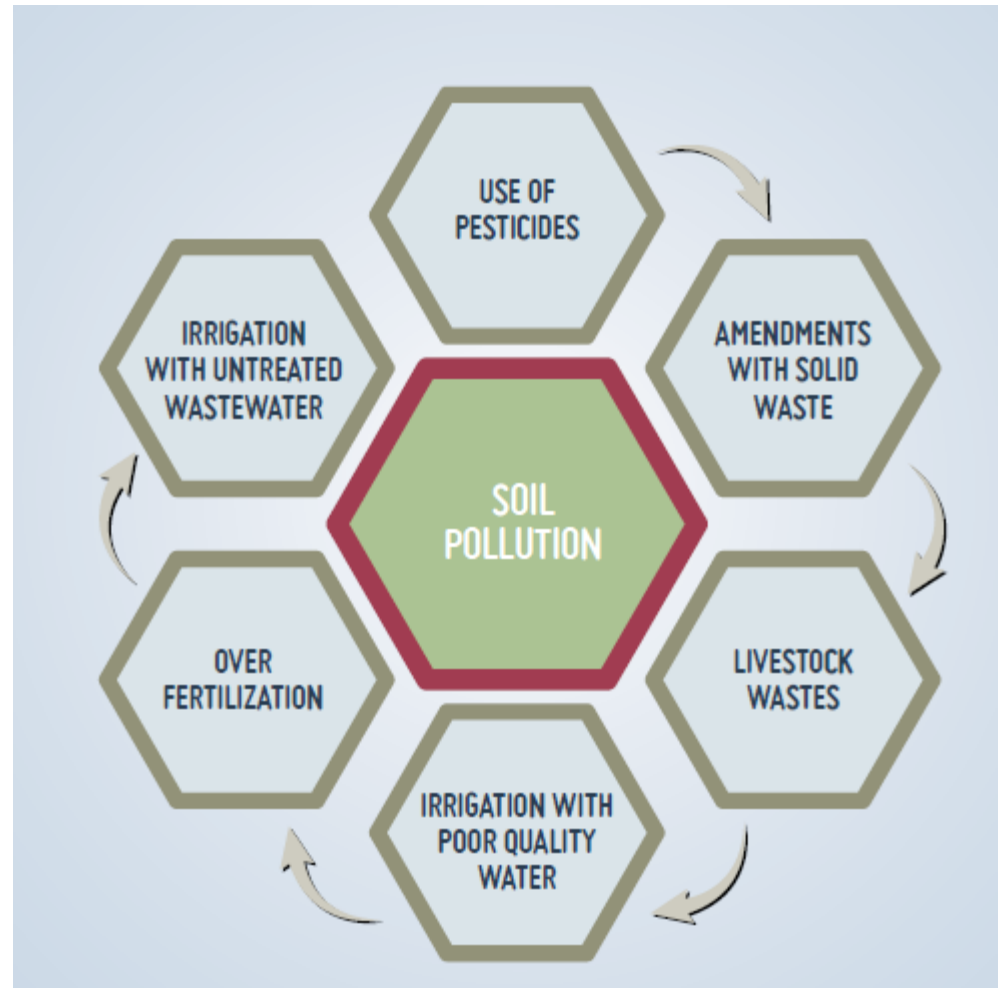
WILD STORING





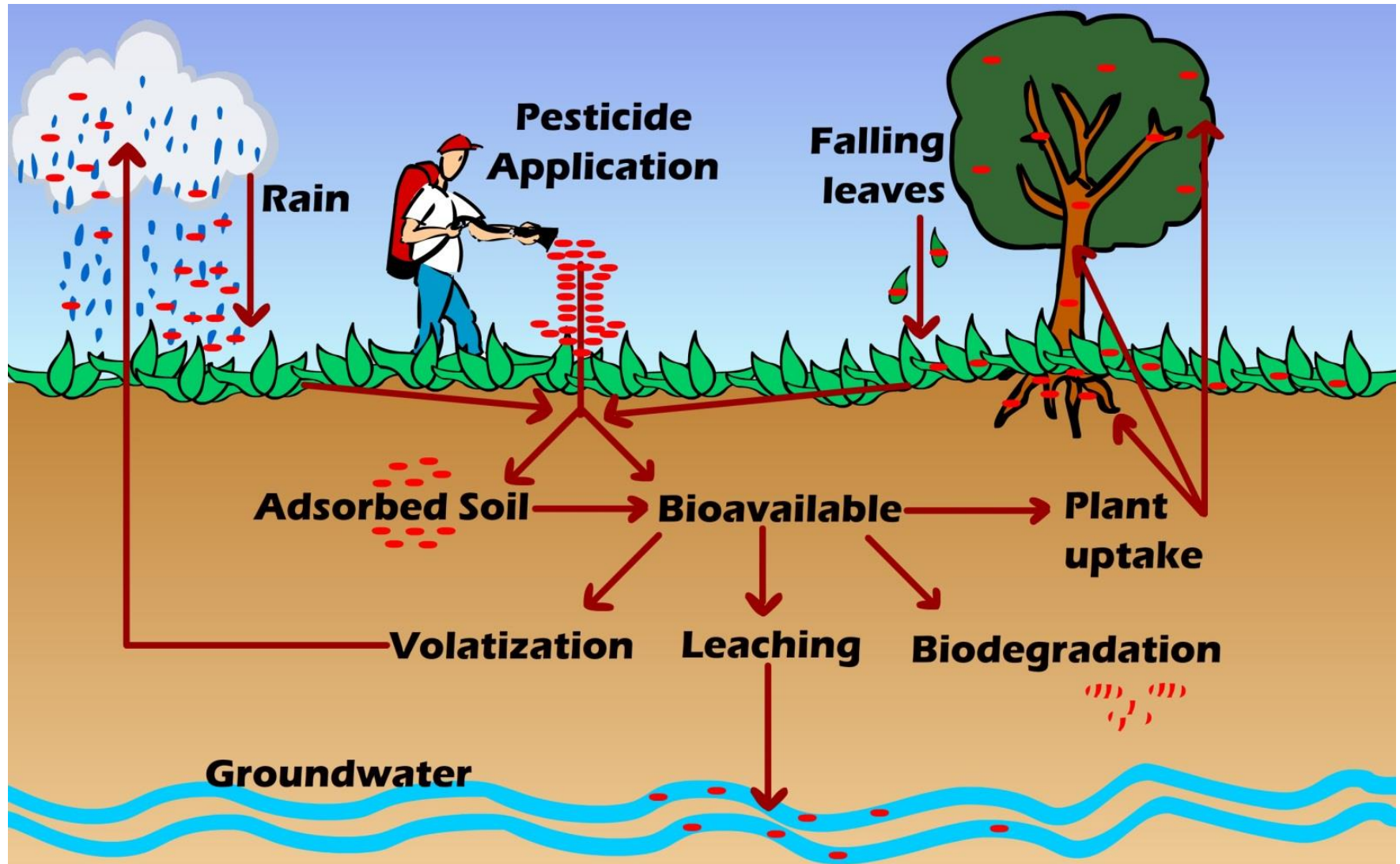
AGRICULTURAL PRACTICES

Agricultural wastes are produced as a result of various agricultural activities including cattle and poultry manure applications, fertilization, irrigation

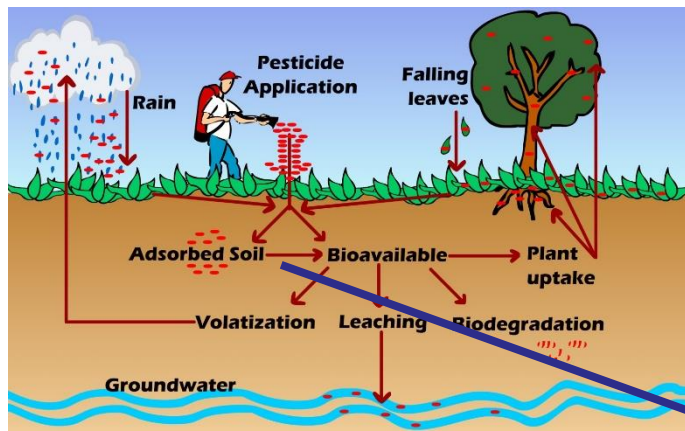


Rodríguez-Eugenio N, McLaughlin M, Pennock D (2018) Soil Pollution: a hidden reality.

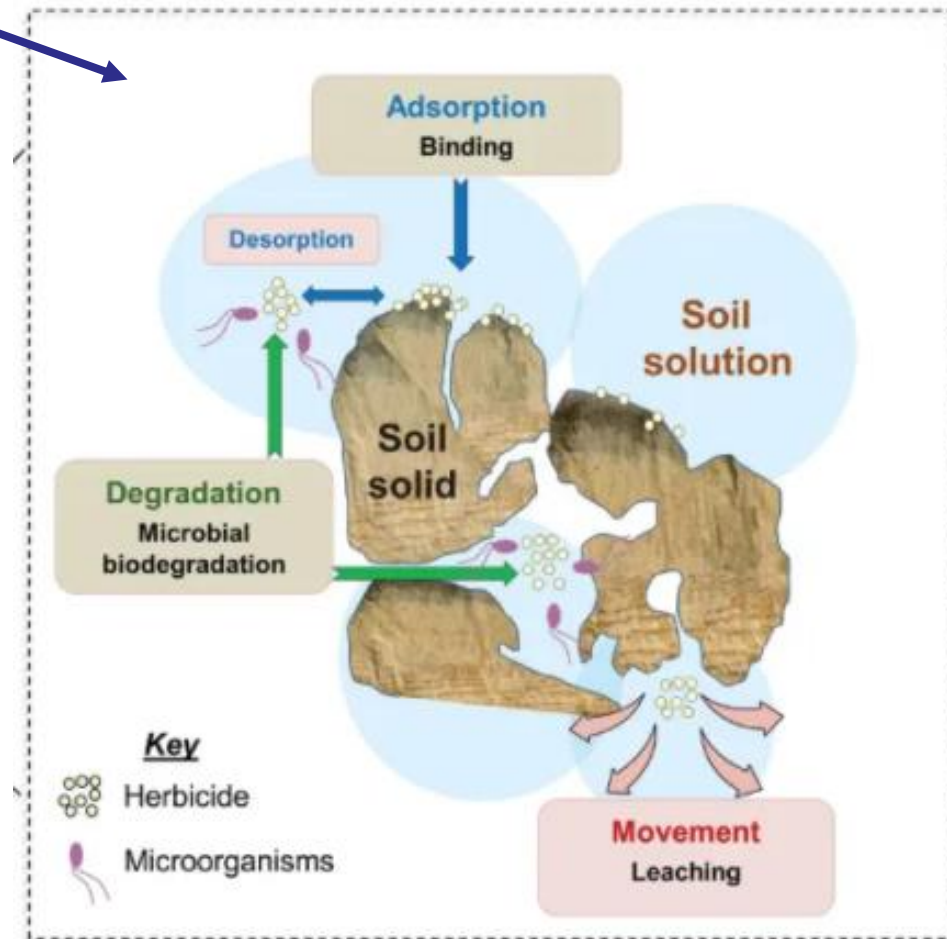
FATES of PEST RESIDUES IN NATURE



FATES of PEST RESIDUES IN SOIL



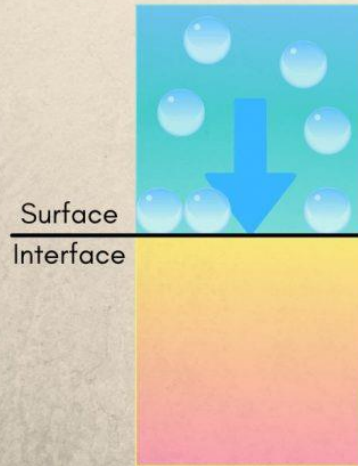
- Pest residues can be captured by soil surface (**adsorption**) and released back to soil solution (**desorption**)
- **Leaching** is the movement of plant nutrients and also pollutants (pest residues) through deep soil layers and underground water, causing underground water pollution in most cases
- Microbes living in soil can eat pest residues completely or change their chemical structure into harmless / less harmful / very harmful compounds (**microbial biodegradation**)
- Pest residues can move in soil using **soil solution** (soil water)



Adsorption vs Absorption

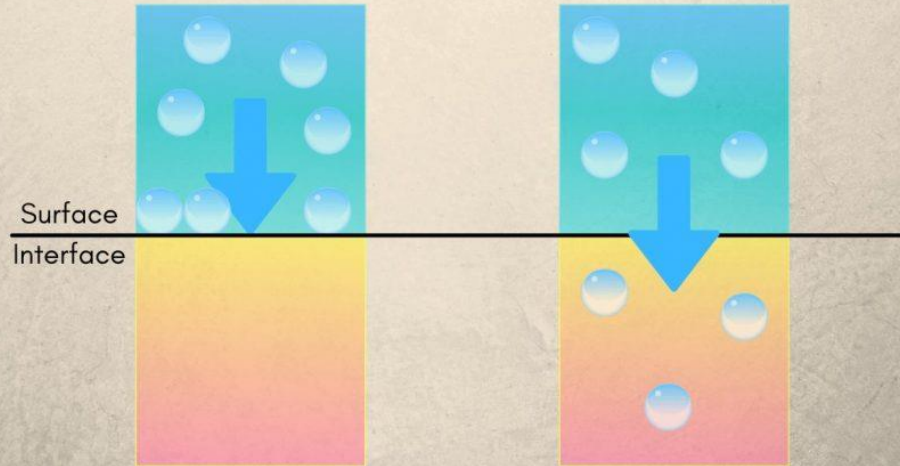
Adsorption

Particles stick to the surface of the other phase.



Absorption

Particles soak into the bulk of the other phase.



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Soil sorption mechanisms

CHEMICAL WASTES

Chemical Waste Disposal Guideline

Innocuous aqueous waste <ul style="list-style-type: none">• Acid (pH < 4)• Alkali (pH > 10)• Harmless soluble inorganic salt• Alcohol containing salt• Hypochlorite solution• Fine (100 grade) silica and alumina <p>These chemicals should be washed down with excess water.</p>	Organic Solvent <ul style="list-style-type: none">• Chlorinated Example: DCM, Chloroform, Chlorobenzene etc.• Non Chlorinated Example: THF, ethyl acetate, hexane, toluene, methanol, etc. 	Red List <ul style="list-style-type: none">• Compounds with transitional metals• Biocides• Cyanides• Mineral oils and hydrocarbons• Poisonous organosilicon compounds• Metal phosphides• Phosphorus element• Fluorides and nitrites.	Solid Waste <ul style="list-style-type: none">• Lightly contaminated Example: Gloves, empty vials/centrifuge Broken Glassware <p>Broken glassware are usually collected in plastic lined cardboard boxes for landfilling. Due to contamination, they are usually not suitable for recycling.</p>
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Chemical wastes are made from harmful chemicals. Soil contamination due to chemical wastes may occur during their transport, landfill and disposal activities.



chemical wastes dumped in the nature

Chemical Waste Disposal Guideline

Innocuous aqueous waste

- Acid (pH<4)
- Alkali (pH> 10)
- Harmless soluble inorganic salt
- Alcohol containing salt
- Hypochlorite solution
- Fine (tlc grade) silica and alumina

These chemicals should be washed down with excess water.

Organic Solvent

• Chlorinated

Example: DCM, Chloroform, Chlorobenzene etc.

• Non-Chlorinated

Example: THF, ethyl acetate, hexane, toluene, methanol, etc.



Red List

- Compounds with transitional metals
- Biocides
- Cyanides
- Mineral oils and hydrocarbons
- Poisonous organosilicon compounds
- Metal phosphides
- Phosphorus element
- Fluorides and nitrites.

Solid Waste

- Lightly contaminated
- Example: Gloves, empty vials/centrifuge .

Broken Glassware

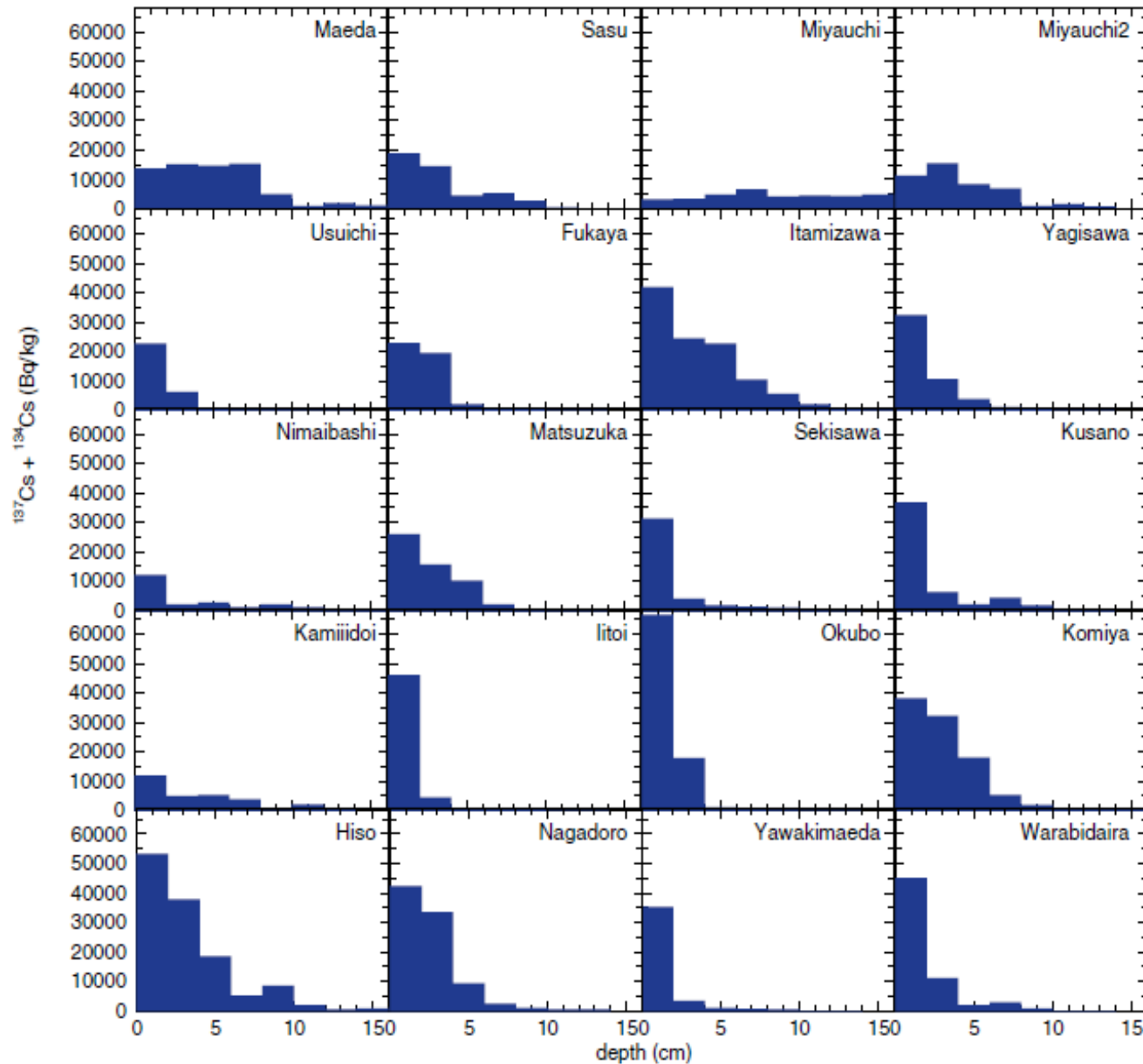
Broken glassware are usually collected in plastic-lined cardboard boxes for landfilling. Due to contamination, they are usually not suitable for recycling.

RADIOACTIVE WASTES (fallouts)

Fukushima Nuclear Power Plant Disaster, 2011



^{137}Cs distribution in soil...



- Accumulation of ^{137}Cs in surface soils of 19 prefectures

Mining and smelting Activities



Bor / Serbia - July 13, 2019: Copper mine and smelting complex of Zijin Bor Copper in Bor, Eastern Serbia, one of the largest copper mines in Europe owned by Chinese mining company Zijin Mining Group

Mines and smelters produce large quantities of waste, usually deposited on land or into aquatic systems. The major consequence of these activities is **contaminations of air, soil, river water and groundwater systems by heavy metals such as Cd, Pb, Hg, Cr and As)**

Önemli ağır metallerin ekolojik sınıflaması (Davies,1980)

G: Gerekli
K:
Kirlenici

Element	Özgül Ağırlık g/cm ³	Bitki ve Hayvan İçin Gereklilik	Kirlenici Olup Olmadığı
Ag (gümüş)	10.5	-	K
Cd (kadmium)	8.7	-	K
Cr (krom)	7.2	G	K
Co (kobalt)	8.9	G	K
Cu (bakır)	8.9	G	K
Fe (demir)	7.9	G	K
Hg (civa)	13.6	-	K
Mn (manganez)	7.4	G	-
Pb (kurşun)	11.3	-	K
Mo (molibden)	10.2	G	K
Ni (nikel)	8.9	G	K
Pt (platin)	21.5	-	-
Tl (talyum)	11.9	-	K
Sn (kalay)	7.3	-	K
U (uranyum)	19.1	G	K
V (vanadyum)	6.1	G	K
W (tungsten)	19.3	G	K
Zn (çinko)	7.1	G	K

Periodic Table of the Elements

1 H Hydrogen 1.008																	18 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.972	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.906	44 Ru Ruthenium 101.07	45 Rh Rhodium 101.064	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.757	52 Te Tellurium 127.6	53 I Iodine 126.905	54 Xe Xenon 131.29
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanide	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.387	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [209]	85 At Astatine [210]	86 Rn Radon [222]
87 Fr Francium [223]	88 Ra Radium [226]	89-103 Actinide	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [263]	107 Bh Bohrium [264]	108 Hs Hassium [265]	109 Mt Meitnerium [266]	110 Ds Darmstadtium [268]	111 Rg Roentgenium [269]	112 Cn Copernicium [277]	113 Uut Ununtrium [278]	114 Fl Flerovium [277]	115 Uup Ununpentium [278]	116 Lv Livermorium [276]	117 Uus Ununseptium [276]	118 Uuo Ununoctium [276]
57 La Lanthanum 138.905	58 Ce Cerium 140.12	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium [145]	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.054	71 Lu Lutetium 174.967			
89 Ac Actinium [227]	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [252]	100 Fm Fermium [257]	101 Md Mendelevium [258]	102 No Nobelium [259]	103 Lr Lawrencium [260]			

The term **heavy metal** refers to any metallic chemical element that has a relatively high density and is **toxic** or poisonous at low concentrations. Examples of **heavy metals** include mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl), and lead (Pb).



Itai-itai is a disease name given to the mass cadmium poisoning of Toyama Prefecture, Japan, starting around 1912. The term "**itai-itai** disease" was coined by locals for the severe pains (Japanese: 痛い **itai**) people with the condition felt in the spine and joints.

Construction Activities (soil sealing)

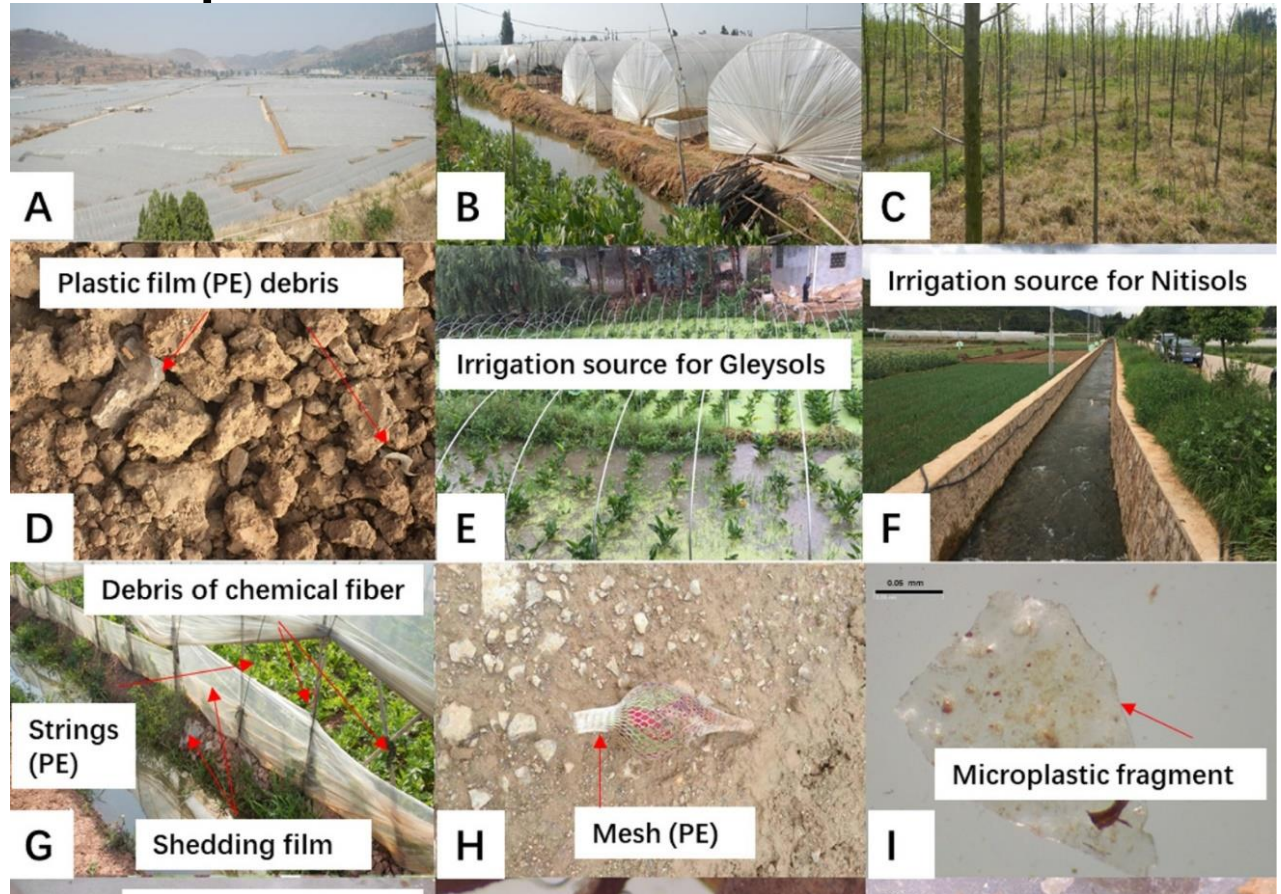
Soil sealing can be defined as the destruction or covering of **soils** by buildings, constructions and layers of completely or partly impermeable artificial material (asphalt, concrete, etc)





Microplastics in soil

- Sewage Sludge
- Waste water irrigation
- Mulching
- Composting
- Industrial emissions,
- Atmospheric deposition



22:10



 INDEPENDENT



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Environment

Microplastics discovered near summit of Mount Everest

Scientists discovered microplastics at an altitude of more than 8,000m, the highest point they have been detected on Earth

Daisy Dunne Environment Correspondent
| @daisydunnesci | 2 hours ago





Yeşilyurt

Üründü

Burmahancı

Antalya-Serik

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Gümüşhane'nin Köse ilçesinde DOKAP destekleriyle 2 stadyum büyüklüğünde bölgenin en büyük çilek bahçesi tesis edildi.

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