

Pesticides

An introduction, history of use, alternatives

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- **A pesticide** — substance intended for preventing, destroying, repelling or mitigating pest. Chemical substance, biological (virus, bacterium), antimicrobial, disinfectant
- **Pests** — insects, weeds, birds, mammals, fish, microbes that destroy property, spread disease or are a vector for disease
- Used to control harmful organisms. Kill mosquitoes transmitting yellow fever or malaria, kill bees, wasps or ants or parasites such as fleas, prevent sickness in humans. Used in grocery stores and food storages to manage rodents and insects.
- Each use of a pesticide carries a RISK.

Classification

- **By target organism** – algicides, avicides, bactericides, fungicides, herbicides, insecticides, miticides, rodenticides, virucides...
- **By chemical structure**
 - *Organochlorines* – removed due to persistence (DDT, Chlordane)
 - *Organophosphates* – affect the nervous system (insecticides, since 1932, in WW II as nerve agents, not persistent)
 - *Carbamates*

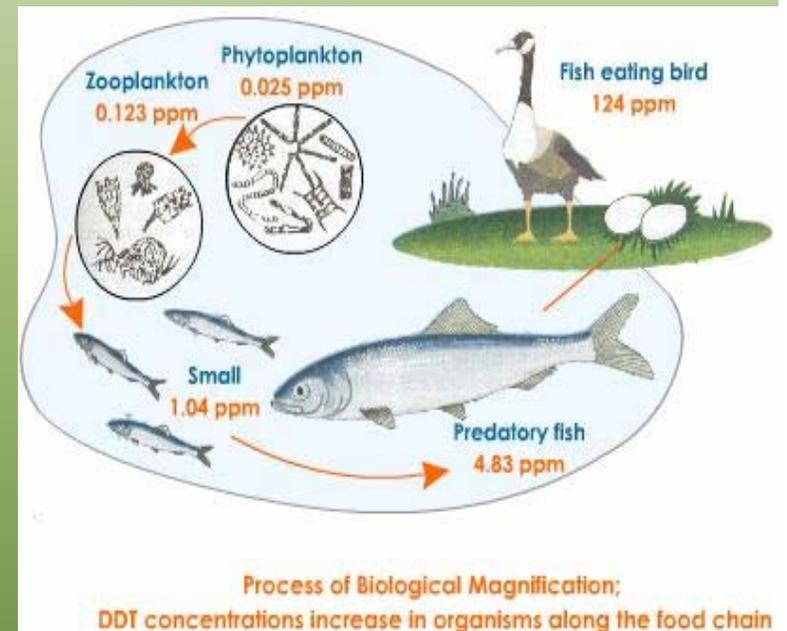
Inorganic, synthetic or biological

Biopesticides – from natural materials, canola oil and baking soda, 3 classes: *microbial*, (fungus, virus) *plant-incorporated-protectants*, (genetic material added to the plant) *biochemical* (non-toxic mechanisms – scented plant extract)

2009 – new class of fungicides – *pdloxins* – safer and greener

POPs = persistent organic pollutants

- Most dangerous, hazardous, a serious global threat to humans and ecosystems
- *Properties:*
 1. **Persistent:** resist physical, chemical and biological degradation
 2. **Bioaccumulative:** dissolve in fats, accumulate in the body tissues of living organisms (POPs from food accumulate, from a cow transformed to milk and meat)
 3. **Subject to long-range transport:** harm in distant locations, evaporate easily when it is warm and fall out at colder locations – severe POPs pollution in the Arctic
 4. **Likely to have adverse affects:** cancers, tumors, neurological disorders (agression), immune suppression, reproductive disorders (miscarriages), type II diabetes, hepatitis, cirrhosis etc.all linked to POPs



History of use

- Sumer – sulfur dusting 4,500 years ago, Greeks and Romans – arsenic, the Chinese – arsenicals in 16th century
- Europe – 15th century – toxic chemicals such as arsenic, mercury, lead, 17th century – nicotine sulfate, 19th century – pyrethrum, rotenone (natural), arsenic compounds leading to first legislation in 1900
- Synthetic pesticides – 1930, since 1950 – domination of organochlorines (DDT), replaced by organophosphates and carbamates by 1975, 60s – herbicides
- 40s and 50s – start of the „**pesticide era**“, since then increase 50times – now 2.3 million tonnes each year, 75% in developed countries
- 1960 – DDT affecting birds – banned in many countries in the 70s and 80s. Concerns in Eastern Europe and USSR, but many POPs in use long after banned



Social and economic problems

- Use of pesticides connected to a vicious cycle of financial dependency and dependency on credits for these inputs. Leads to indebtedness of farmers with negative effects for the economy of farm families and rural communities. Suicides committed because of debts are common. Other consequences – migration, loss of land and culture.
- Pesticides create a spiral of dependency as they destroy beneficial organisms and induce resistance, creating the need for new and more expensive pesticides. Dependency results in lack of choice for farmers in terms of choice of crops, seeds, production system, women deprived of access to land, to seed and to credit.



Obsolete pesticides

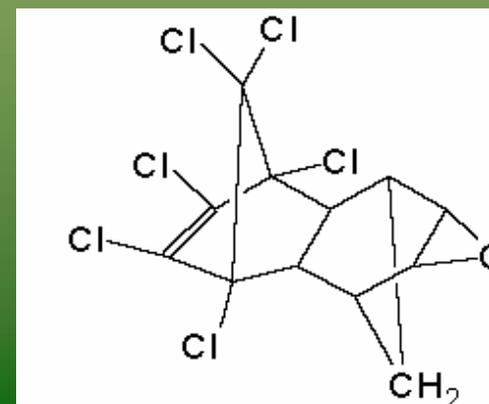
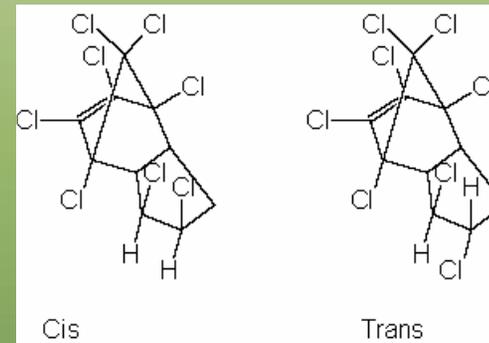
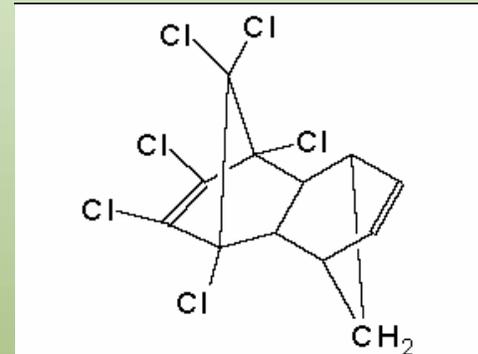
- Pesticides that can no longer be used for their intended purpose
- Threat to human health and the environment
- Reasons for stockpiles: lack of management, inadequate storage, poor quality of chemical formulation, lack of money – disposal of 1 tonne – 4,000 EUR, developing countries do not have facilities
- Eastern Europe and Central Asia – 260,000 tonnes (Soviet farms abandoned, stores neglected)
- Time bombs – health of humans and livestock (stored in populated areas), leak and contaminate groundwater, or get to the illicit pesticide market – high residues in food



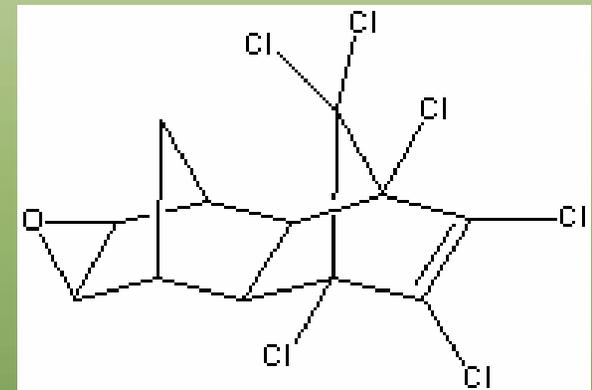
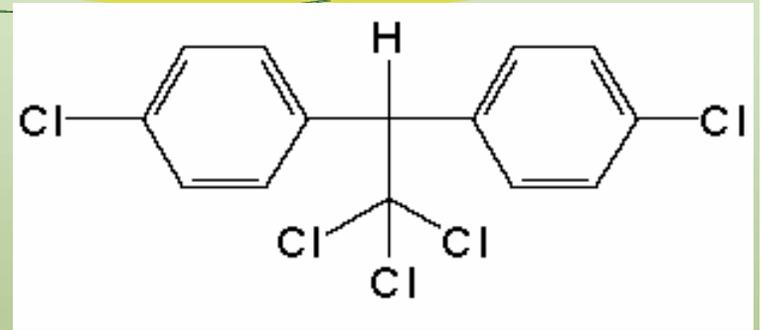
Pesticides getting into the food chain in Armenia

The most hazardous pesticides

- **Aldrin** – first in 1948, for control of soil insects – termites, corn rootworm, grasshoppers
- **Chlordane** – insecticide used in agriculture – vegetables, grains, maize, potatoes, sugarcane, fruits, nuts, cotton, jute
- **Dieldrin** – control of soil insects and insect vectors of disease, now restricted to control termites and against textile pests

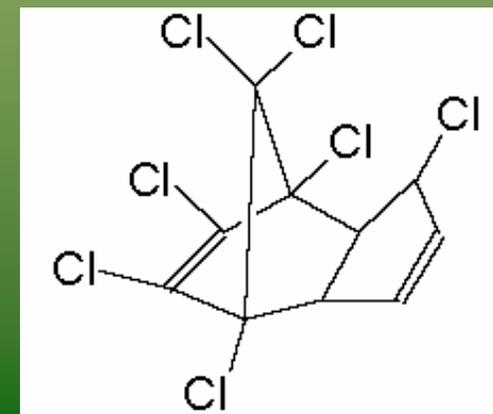


- **DDT** – Germany 1874, as pesticide since 1939. During WW II against malaria, typhus and other diseases. Still used to control mosquito vectors, probably also in Armenia (saved 7 million lives since 1945, but a study of WHO from Vietnam – non-DDT malaria controls more effective). Nowadays 50,000 tonnes produced per year. 1995 – 49 states banned, very controversial. High quantities stored under high-risk in developing countries – more than 10,000 tonnes. More than 5,000 tonnes of obsolete DDT stocks still wait for disposal in Azerbaijan.

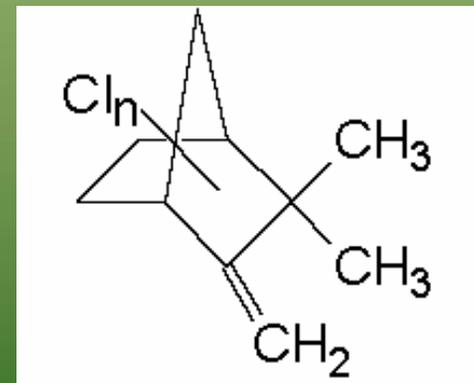
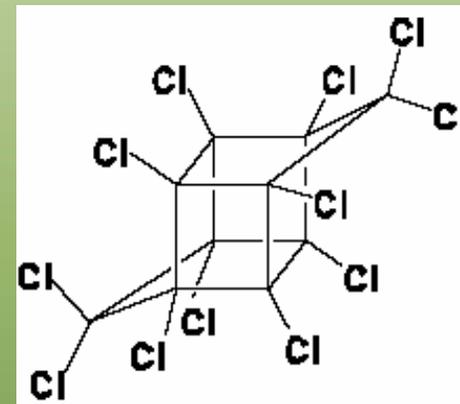
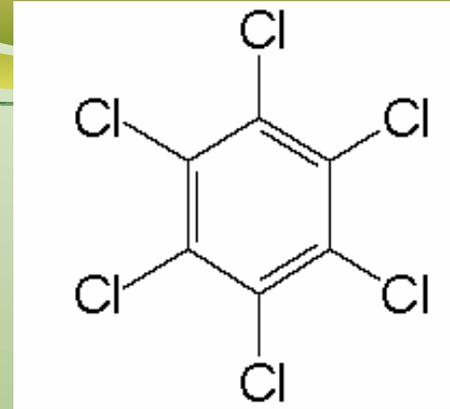


- **Endrin** – insecticide, field crops such as cotton and grains, rodenticide to control mice and voles, does not accumulate in fat as other compounds

- **Heptachlor** – non-systemic stomach and contact insecticide, against soil insects and termites, cotton insects, grasshoppers, to combat malaria



- **HCB (Hexachlorobenzene)** – fungicide since 1945 for seed treatment, control of bunt of wheat
- **Mirex** – stomach insecticide, used against fire ants, to combat leaf cutters in South America, harvester termites in South Africa
- **Toxaphene** – non-systemic and contact insecticide, used on cotton, cereal grains, fruits, nuts, vegetables, to control ticks and mites in livestock
- **Lindane** – not on the Stockholm list, but nominated, it has POPs characteristics and since it is cheap, it is commonly used. In shampoos to control head lice in children, produced by China and India (until recent years also in Romania)



- **Endosulfan** – nominated to be added to the Stockholm list. Used to control insects on a wide variety of vegetables, fruits, grains, cotton and tea. One of the main causes of poisoning in humans, toxicity increased with protein-deficient diet – a problem in poor countries. Very toxic to animals, especially aquatic. Detected in tissues and blood of polar bears from Norway and in minke whales. Benin – one of the worst poisoning including deaths of farmers, only after 10 years in 2008 banned. Many cases of poisoning due to contaminated drinking water and food. Even smoke from a cigarette, the tobacco of which contains residues, can lead to poisoning.



Worldwide efforts to combat the use of pesticides

- **International Code of Conduct on the Distribution and Use of Pesticides**
 - Pesticide regulation differ from country to country and pesticides traded across borders. To deal with inconsistencies delegates to a FAO conference adopted the code in 1985 to create voluntary standards of regulation for different countries.
 - A revised one adopted in 2002 by the 187 FAO members.
- 2 more initiatives wanting to improve regulation of pesticide trade also operate on a voluntary basis:
 - **United Nations London Guidelines for the Exchange of Information on Chemicals in International Trade** – seeks to ensure prior consent between countries buying and selling pesticides
 - **United Nations Codex Alimentarius Commission** – seeks to create standards for MRL



- **Stockholm Convention on POPs**

- A historic achievement as it is the first global, legally-binding treaty that requires governments to control a class of chemicals
- Ratified by more than 150 states, but much work still remains to be done
- According to a review from 2008, 5 out of the 12 POPs have been eliminated (Aldrin, Dieldrin, Endrin, Heptachlor, Toxaphene) with Chlordane and Mirex following soon. DDT still used for malaria control and Chlordane and Heptachlor for termite control.

The Stockholm Convention addresses 12 initial POPs:

- **9 pesticides:** Aldrin, Chlordane, Dieldrin, DDT, Endrin, Heptachlor, Hexachlorobenzene (HCB), Mirex, Toxaphene
- **2 industrial chemicals:** polychlorinated biphenyls, HCB
- **2 unintentional by-products:** dioxins, furans

- **The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade**

- Adopted in 1998

- Efforts needed for policies to control, regulate, challenge, and invoke accountability from companies manufacturing and profiting from pesticides. Women and men working in the agricultural sector in developing countries – 59% of global working population, and for any strategy to work and truly bring about change, it is they, who have to be at the very core of it.

Alternatives

- Conventional agriculture: high input of synthetic pesticides, concepts of intensification, specialization and concentration to achieve profitability
- Lost of traditional farming knowledge after 1000s of years of natural pest management when people and environment healthier, no dependency on foreign seeds and markets, the soil, insects, animals and plants were friends of farmers

Alternatives do exist, but conditions need to be met:

- Adequate institutional framework
- Consumer awareness and consumption patterns
- Pest management seen in a broad context of crop and livestock management and sustainable farming systems
- Holistic approach based on participatory research and indigenous knowledge, empowering women, enhancing biodiversity etc.





- Alternatives: methods of cultivation, biological pest control, genetic engineering (can bring other negative effects), interfering with insect breeding, application of composted yard waste
- In common: all methods are becoming more popular and usually are safer than chemical pesticides
- **Cultivation practices**
 - Polyculture
 - Intercropping – lessens the risk of total crop loss, protects soil from erosion
 - Crop rotation
 - Planting crops in areas where the pests do not live
 - Timing planting according to when pests will be least problematic

 - USA – spraying with hot water at the same cost
 - Release of other organisms that fight the pest – natural predators or parasites of the pests
 - Biosprays – parts of some plants contain substances which can repel or kill pests, for example garlic
 - Red pepper and soap mixture – effective on cabbage and green vegetables

Popular concepts

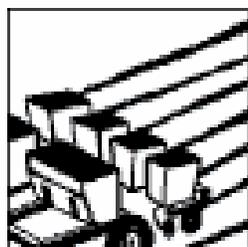
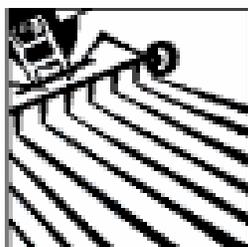
- Good Agriculture Practice (GAP) – officially recommended or nationally authorised uses of pesticides under actual conditions necessary for effective and reliable pest control.
 - Aim: less residue possible – base for calculation of the daily pesticide intake and maximum residue levels (MRL).
 - Problem: when toxic pesticides are authorised, their use is still GAP, policy needed
- Good Farming Practice (GFP) – EC – comprises observance of regulatory standards and exercise of care which a reasonable farmer would employ. Farmers should follow laws and guidelines on GFP.
 - Aim: to serve as a reference level and a base-line for support in agri-environment programmes. Member states establish verifiable standards for compliance with GFP.
 - Used in the special assistance programmes for agricultural and rural development in Romania and Bulgaria.

Integrated Crop Management (ICM) and Integrated Pest Management (IPM)

- IPM and integral part of ICM – more holistic, also focus on nutrient management and the entire agro-ecosystem, embraces the whole farm
- Synthetic pesticides not rejected in general, the goal is to reduce pests to levels that do not cause economic damage
- Control tactics: pest resistant or tolerant plants and cultural, physical, mechanical, biological and chemical methods. Allows pesticides if other methods not sufficient.
- Ecuador example: Carchi province – the rate of pesticide poisoning among the highest in the world. 4 out of 100 rural people poisoned. Due to old equipment pesticides even leaked out of the backpacks and ran down backs and legs. Using hazardous pesticides banned in the North, influence of agro-chemical companies. Very complex problem – an NGO started a project using transdisciplinary approach, gender issues, used phosphorescent dye to illustrate how residues travel and stay on people and in homes, dependence on pesticides reduced, long term success by demonstrating that win-win outcome possible. Thanks to this FAO funded similar projects in the area.

Soil
Preparation

Planting



Forecasting

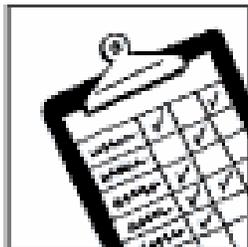


Pest
Trapping



Monitoring

An IPM Year



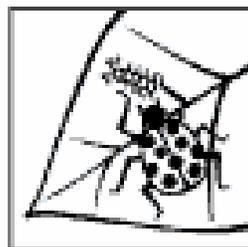
Evaluation and
Decisions
for Upcoming
Field Year



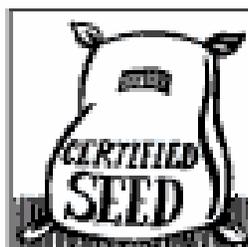
Recordkeeping



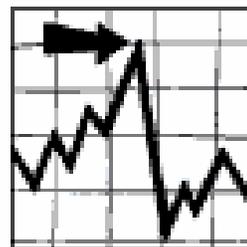
Chemical
Controls



Biological
Controls



Cultural
Controls



Thresholds



Farmer Field Schools – part of IPM, farmers learn about their fields, plants, insects, local communities can design and improve own alternative strategies. They learn „by doing“ research in their fields and develop the capacity to make well informed decisions which are also safe, productive and sustainable

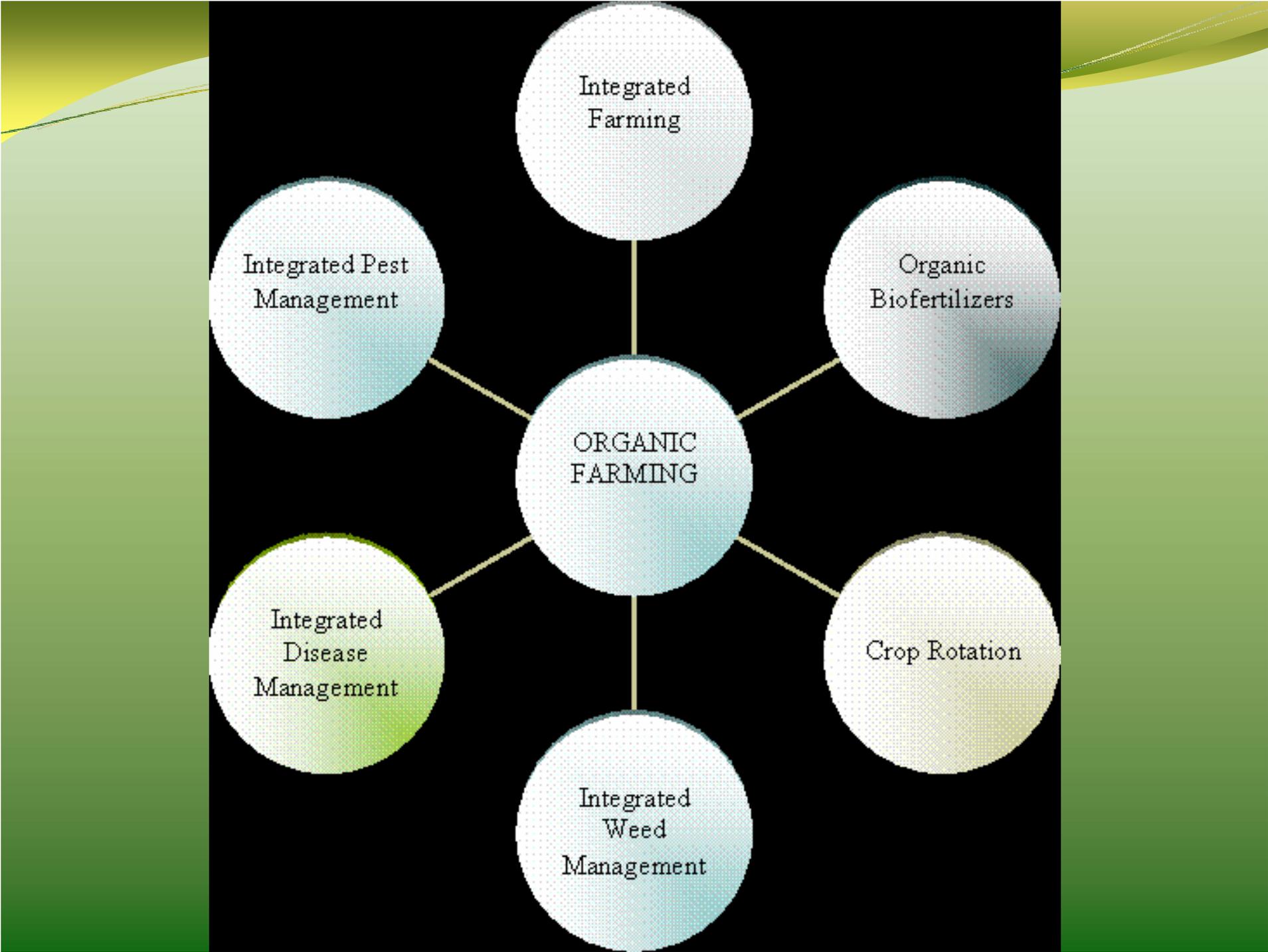


- Best Agricultural Practice

- The concept of BAP originally introduced at a UNDP/GEF workshop in Zagreb in 2003.
- Similar to GAP and GFP, but goes beyond these that are understood as „current practices“
- A step-by-step approach from bad to good to best practices by control of the use of pesticides, development of GAP/GFP, disposal system etc. Pesticides not eliminated, cautiously used.

- Organic Agriculture

- Previous concepts – risk management in conventional agriculture, organic farming – a true alternative
- Beginnings in the early years of the 20th century Northern Europe
- Aim – to stress the essential link between farming and nature and to promote respect for natural equilibrium
- promotes agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It favours renewable resources and recycling, respects the environment's own systems for controlling pests and disease and avoids use of synthetic pesticides, chemical fertilisers, growth hormones, antibiotics or gene manipulation



- India experience: growing organic cotton has positive impact on environment and on people's health, also beneficial for the socio-economic situation of farmers. They learnt to use preventive measures like planting robust common varieties, maintaining a diverse crop rotation, intercropping with maize and peas and planting marigolds and sunflowers to attract beneficial insects. With this approach their profit is 30-50% higher than before.
- In recent years, organic farming expanded to over 3,24% of agricultural land area in the EU at the end of 2001 and it could account for 10-20% by 2010. Important factor – shift in consumers awareness – realize the dangers and are willing to pay more for safe food, and to ensure that small farmers remain a part of their culture.



International NGO Networks

- At present more than 853 NGOs are registered, of which more than 159 engaged in problems of ecology and environment in Armenia
- NGOs interested in contributing to POPs elimination in their country can benefit from participation in international networks:
 - **The International POPs Elimination Network** – provides NGOs with support and information on issues relevant to Stockholm Convention
 - **The Pesticide Action Network** – working on replacing the use of hazardous pesticides with ecologically sound and socially just alternatives, provide info on obsolete pesticides
 - **Health Care Without Harm**
 - **The Global Alliance for Incinerator Alternatives (GAIA)** – sustainable waste prevention
 - **The World Federation of Public Health Associations**
 - **The International Society of Doctors for the Environment** – education on POPs
 - **Women in Europe for a Common Future** – 30 countries in Central Asia and Europe

Useful links

International Code of Conduct on the Distribution and Use of Pesticides:

<http://www.fao.org/DOCREP/005/Y4544E/Y4544E00.HTM>

Stockholm Convention on Persistent Organic Pollutants:

http://www.pops.int/documents/convtext/convtext_en.pdf

United Nations Environment Programme (UNEP)

<http://www.unep.fr/en/branches/chemicals.htm>

UN Food and Agriculture Organization (FAO)

<http://www.fao.org/ag/AGP/AGPP/Pesticid/>

World Health Organization (WHO)

http://www.who.int/topics/chemical_safety/en/

Inter-Organization Programme for the Sound Management of Chemicals (IOMC)

<http://www.who.int/ipcs/en/>

PAN International and its Regional Centres

<http://www.pan-international.org/panint/?q=en/node/35>

International POPs Elimination Network (IPEN)

<http://www.ipen.org/ipenweb/ipep.html>



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