

AGRICULTURE AND ENVIRONMENT INTERACTION

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Abstract

The resources necessary for food production have shown a disquieting deterioration during the last three decades. Modern intensive agriculture has an adverse effect not only on the physical environment but also on human health. On the other hand, 'Sustainable Agricultural Systems', which has gained importance in recent years, deals with both the protection of natural resources and the increase in plant production. In these systems, production is ensured by directing the resources obtained from the system cycle, not the chemicals and inputs that harm human, plant and environmental health, and quality healthy products are obtained. In 'Organic Farming', which is one of the sustainable agricultural systems, it is aimed to cause the least damage to the environment by producing healthy foods without disturbing the natural balance. The risk of pollution is less because less economic input is used in these and similar protected sustainable agricultural systems.

While the inputs used in agricultural production stage increase the productivity of the product produced per unit area and make it more resistant to diseases and pests, they can have negative effects on the living things in the immediate vicinity and the ecosystem. While the development of agriculture in a region positively affects the natural life, oxygen production and climate in the region, inorganic nitrate pollution, pesticide pollution and salinity problems can be listed as the negative effects of agriculture on the environment, especially in regions where intensive agriculture is practiced. Also, agricultural water use, application of fertilizers and pesticides may negatively affect the water courses, deforestation, and crop and animal raising may result in greenhouse gas emissions, unsuitable agricultural practices may have detrimental impacts on soil, genetic resources and biodiversity.

In order to ensure sustainability in agriculture, by abandoning the agricultural production methods based on excessive chemical pesticides and fertilizers that the producers have applied until now; an economical fertilization, preserving the organic matter ratio of the soil by preventing stubble fires, reduced tillage, combating diseases, pests and weeds in integration with a suitable crop rotation are of great importance.

Keywords: Agriculture, environment, sustainability.

1. INTRODUCTION

Agricultural practices aiming at over-utilization and high efficiency and profit only in the production period have adversely affected human, animal and plant health and ultimately have caused the deterioration of entire ecological balance at a level that threatens entire life on earth. Monoculture farming system, use of synthetic chemicals such as hormones, antibiotics and additives, malpractice of chemical pesticides, improper irrigation practices, poor management of pasture and meadows and improper practices in animal breeding have caused various adverse

effects on the earth's ecosystem we live in (Biswas, 1994; İlbaş, 2009; Parlakay et al., 2016). Such an effect has emerged with the development and spread of new synthetic agricultural inputs and agricultural mechanization, especially in the period that started in the 1950s and so called as the green revolution. Immediately after the WWII, with some chemicals used in the war as inputs in agriculture, there was an intensity in agricultural activities. For example, nitrogenous compound ammonium nitrate, which is the raw material of explosives used during the war, was used as nitrogen fertilizer in agricultural fields after the war. Again, organophosphates, which were used as nerve gas during the war, took their place in agricultural activities as a very powerful insecticide after the war (Makal, 2001).

Existence of a balanced relationship between agriculture and environment is explained by the concept of "sustainable agriculture". Sustainable agriculture also necessitates the management of natural resources in a way that will be beneficial in the future. The beneficial use of land and natural resources and protection of environment should be within a balance (Dişbudak, 2008). Agricultural activities, which have been practiced for centuries, have been the basic way of life for majority of the world. Over the years, agricultural operations have gradually developed and become more efficient. However, with new research and technological developments, the negative effects of agriculture on the environment have begun to emerge (Aydemir, 2008; Parlakay et al., 2016).

Agriculture has a complex relationship with natural resources and environment. It is difficult to state that certain environmental impacts are caused by agriculture and this is not fully comprehended. Agriculture is the main user of land and water resources and sustainability of the quantity and quality of these resources is necessary. Agriculture generates waste and pollution and also conserves natural resources and contributes to its cycle. It also changes the rural environment and habitats for wildlife (Karaer and Gürlük, 2011). Majority of environmental impacts of agriculture remain within the industry itself, but impacts outside the farmland are also significant. Impacts are often concentrated on a local and regional scale, although some are of national and international significance. There is a general acceptance that it is necessary to increase the environmental performance of agriculture by improving its beneficial environmental effects and reducing its harmful effects to ensure sustainability of the resource use (Haktanır, 2009; Bennett, 2017).

2. AGRICULTURE – ENVIRONMENT INTERACTION

2.1. General

Under natural conditions, polluting substances are diluted in the air and water and decrease to a level that does not harm living things. Some pollutants become harmless or less harmful as a result of the effect of microorganisms in the environment and some of them as a result of physical and chemical processes. In this sense, natural soil and water are cleaner substances. However, the amount of pollutants that people leave to nature as a result of their various activities exceeds the cleaning capacity of nature. Some substances cannot be converted into harmless or less harmful in a short time in nature and can accumulate in living things through the food chain. This phenomenon is so called as bioaccumulation (İlbaş, 2009). Synthetic organic chemicals, constituting the raw materials of some pesticides such as DDT and PCB, hormones, inorganic compounds such as nitrite and nitrate, some radioactive substances such as isotopes of strontium, thorium and uranium, heavy metals such as mercury, cadmium, lead, nickel are among the primary bio accumulative substances. Synthetic organic compounds, so called as chlorinated hydrocarbons are used as pesticides. These substances can spread far from the place where they were applied with water and wind in the

ecosystem and remain non-decomposed in the ecosystem for a long time and cause bioaccumulation (İlbaş, 2009).

2.2. Environmental Impacts of Agriculture

2.2.1 Effects of Agriculture on Water Resources

The effect of agricultural practices on water resources can be listed as the negative effect of water taken from water resources for irrigation, depending on the structure of the water resource, on the water resource, and the pollution that occurs in water resources as a result of the intrusion of fertilizers and pesticides used in agricultural production into water resources (Kukul et al., 2007; Karaer and Gürlük, 2011; Serdar and Verep, 2018).

2.2.1.1 Agricultural Water Use

Irrigation is a fundamental and indispensable factor in increasing and securing agricultural production in arid and semi-arid regions. Irrigation and drainage projects have highly significant effects on both agriculture and human life. In addition to positive effects of these projects, there are also negative environmental effects (Özkay et al., 2008; Kapluhan, 2013).

Irrigation for intensive agricultural activities can cause unsustainable water use. Land drainage can lead to lower groundwater levels as well as the destruction of wetlands, which are habitats for many species. In addition, nitrates from pesticides and fertilizers can leak into groundwater and nitrogen and phosphorus from fertilizer can also be mixed with surface flow. Irrigation and drainage can affect groundwater levels and cause soil salinization. Erosion-induced sediment can have negative effects on water resources and wetland ecosystems (Dişbudak, 2008).

The amount of water used in irrigation varies based on climate, crop variety, soil properties, water quality, tillage practices and irrigation methods. Yield levels increase with irrigation and the risks in dry periods are reduced, allowing more profitable crops to be grown. However, environmental problems that can reach serious dimensions arise as a result of improper irrigation practices (Dişbudak, 2008). The important ones are:

- Nutrient and agro-chemical-induced water pollution,
- Excessive groundwater withdrawals,
- Damage on habitats and living things,
- Intensive irrigated farming lands replace the highly valuable natural ecosystems,
- Soil tillage on sloped lands facilitate erosion,
- Salinity, mineral pollution in surface and groundwater,
- Adverse impacts of water transfer programs.

In European Union (EU) and United Nation (UN) countries, the most important environmental effects of irrigation can be listed as follows (Anonymous, 2000; Anonymous, 2019):

- In regions with intensive irrigated agriculture (Mediterranean coastline from Spain, Portugal to Greece, some regions in Northern Europe including the Netherlands), excessive use of groundwater, salinity, nutrients and pesticide-induced pollution,
- Soil erosion due to intensive irrigated farming activities and abandonment of traditional terrace farming on the slopes. Erosion is a major problem in some southern countries including Spain, Portugal and Greece.

- Drying of wetlands and destruction of highly value habitats due to the spread of irrigated agriculture. This remains a major problem historically in many Member States in the north and south.
- When assessing these impacts, it should be taken into account that there was a clear north-south distinction. Some of the impacts are common in the southern Member States, while in the north they may not be (eg. salinity problem). Some impacts are much more severe in the south than in the north (eg. nutrient pollution, erosion, habitat loss and degradation).

2.2.1.2 Fertilizer Use

The negative effects of fertilizers on surface waters are mostly related to unbalanced use of nitrogenous and partly phosphorus fertilizers. Nitrate, which can be mixed into the waters with the use of fertilizers or accumulate in the plant, is a substance result in pollution. The limit value of nitrate nitrogen in drinking water can be exceeded with high nitrogen losses into water sources close to places where fertilizers were heavily used and in soils with high infiltration capacity. Thus, nitrogenous fertilizers are prohibited in groundwater protection zones in many European countries (İkincikarakaya et al., 2013; Serdar and Verep, 2018). As a result of the use of fertilizers with high nitrogen content, significant nitrate and nitrate accumulation is observed in plant tissues. The accumulation of these nitrogen forms in the plant can cause significant health problems in humans and animals fed with these plants. The effect of overuse of fertilizers on water resources can be summarized as follows:

- Increase in nitrate quantity in surface and groundwater due to leaching from soil as a result of high level of nitrogen fertilizer use,
- Increase in phosphate quantity in surface and groundwater as a result of the transport of phosphorus fertilizers by surface flows,
- Eutrophication of aquatic ecosystems, mainly due to excessive increase in plant growth by increased nitrogen and phosphorus content. In EU legislation, there is a comprehensive directive on the protection of waters against nitrate pollution from agriculture, which entered into force in 1991. In Turkey, the Regulation on Protection of Water Against Agricultural Nitrate Pollution was prepared in accordance with the 1991 EU Directive on Protection of Waters Against Nitrate Pollution Originated from Agriculture and entered into force in 2004 and was revised in 2016 (Anonymous, 2016).

2.2.1.3 Agro-chemicals (Pesticides)

Pesticides are synthetic organic compounds and commonly used to destruct undesired organisms on agricultural commodities. Plant protection chemicals are the primary agro-chemicals. Besides various benefits in agricultural activities, excessive or uncontrolled use of pesticides may pose serious risks on ecosystems and human health. Therefore, some harmful pesticides have already been banned and some have been significantly restricted (Altıkat et al., 2013).

In Turkey, pesticide consumption increased 7 times in 2017 compared to 1979 (Kekillioğlu and Bıçak, 2020). Despite this increase, pesticide consumption in Turkey is quite low as compared to developed countries. While 80% of the world's pesticide market share is in developed countries Turkey's share is only 0.6% (Yeşil and Öğür, 2011). Although less pesticides are consumed in Turkey in general, pesticides that are consumed the most carry significant risks in terms of environment and health (Delen et al., 2005; Altıkat et al., 2013).

Different categories of pesticides have different effects on organisms. Although it has terrestrial effects, the main way of its environmental effects is water sources polluted by pesticide leaching. Pesticides can pass into the fatty tissues of organisms and accumulate from the bottom up in the food chain. Human and animal health can be adversely affected by direct contact (for example, pesticide-producing workers, farmers using them, etc.) (Altikat et al., 2013).

2.2.2 Effects of Agriculture on Climate Change

Before the 1920s, agriculture was a major source of increased carbon dioxide emissions to the environment. Although the same situation does not continue today, it can be said that current agricultural practices have negative effects on both the local and global environment (Rodriguez et al., 2004).

Since the mid-1800s, carbon dioxide emissions from agriculture have increased and before the 1920s, it became the main source of carbon dioxide emissions. Today, fossil fuels constitute the primary source of CO₂ emissions, but land use conversions also generate serious CO₂ emissions. Turning the land into an agricultural area causes carbon dioxide emissions into the air as a result of removing the vegetation on it. Agricultural activities have a 20% share in the carbon dioxide emissions resulting from all human activities in the world (Boote et al., 2010; Litterman et al., 2003). With processes such as agriculture and deforestation, the combustion of biomass causes carbon dioxide emissions to the atmosphere. These activities increase the rate of dissolution of organic carbon in the soil. The spread of agricultural areas causes the land to be cleared of vegetation and loss of organic carbon. The CO₂ released by these activities causes global temperature increase (Litterman et al., 2003).

The agricultural sector is the driver of gas emissions and land use is thought to contribute to climate change. In addition to being an important user of land and fossil fuels, practices such as paddy farming and animal husbandry directly contribute to greenhouse gas emissions. The Intergovernmental Panel on Climate Change stated three main reasons for the increase in greenhouse gases over the last 250 years as fossil fuels, land use and agriculture.

The CO₂ emissions of agriculture mostly come from:

- Deforestation-induced CO₂ emissions,
- Paddy-farming-induced methane emissions,
- Livestock methane emissions through enteric fermentation,
- Fertilizer-induced nitrous oxide emissions.

These agricultural practices account for 54% of methane and 80% of nitrous oxide and land use-related carbon dioxide emissions (Anonymous, 2000).

2.2.3 Agriculture and Soil Resources

Desertification, erosion, decrease in organic matter, soil pollution, soil compaction, decrease in soil biodiversity and increased salinity can reduce the capacity of soil to perform its main functions. Such degradation can result from inappropriate agricultural activities such as unbalanced fertilizer use, excessive groundwater withdrawal for irrigation, excessive irrigation, inadequate land drainage, inappropriate pesticide use, heavy machinery and overgrazing. The abandonment of certain agricultural practices may also contribute to the degradation process of the soil (Kızıloğlu Algan and Bilen, 2011).

Effect of fertilizer use on the soil happens in terms of soil reaction, structure, soil organisms and enrichment of soil with toxic substances. However, the effect of chemical fertilizers on the basic

properties of the soil occurs in a very long period and in the case of using one-sided fertilizer in the same form every year, and these effects are not very severe and negative effects (Taşkaya, 2004). Agricultural environmental measures suggest opportunities to support the formation of soil organic matter, increase soil biodiversity and reduce soil erosion, pollution and compaction. These measures include support for organic farming, protection and maintenance of terraces, integrated crop management, rangeland management and the use of certified compost.

2.2.4 Genetic Resources

Biodiversity ultimately results in various environmental problems including global warming, climate change, deforestation and environmental population. On the other hand, biodiversity is not only the cause but also the result of environmental problems. Thus, within the scope of such environmental problems, loss of biodiversity is also closely related to socio-economic, ethical and humanitarian issues (Kurt, 2017).

2.2.5 Agriculture and Biodiversity

Turkey signed the agreement on Biodiversity in 1996 and the agreement entered into force in 1997. The main purpose of the Convention is to protect biological diversity, to ensure its sustainable use and to ensure the equal and fair sharing of the benefits arising from genetic resources. It has been decided by the United Nations to celebrate the year 2010 as the "2010 International Year of Biodiversity" all over the world. The purpose of this decision; is the promotion of biological diversity at the level of countries and all interest groups, raising awareness on this issue, attracting their attention and keeping the issue on the agenda in terms of protecting the biological resources we have in the world and leaving this wealth as a legacy without consuming it for the future generations (Anonymous, 2019; Arslan, 2010).

2.3 Sustainable Agriculture

To ensure continuity of agricultural production, abandoning the agricultural production methods based on excessive use of chemical pesticides and fertilizers, which the producers have applied until now, in other words, an economical fertilization, preservation of organic matter ratio of the soil by preventing stubble fires, reduced tillage, combating diseases, pests and weeds in integration with a suitable crop rotation are of great importance (Gökçe and Usta, 2013).

Sustainable agriculture is agriculture that allows sufficient food production without depleting natural resources or creating environmental pollution. It is self-sustaining agriculture like nature, in which the principles of nature are followed in the development of systems for plant or animal breeding (Earles, 2005).

Sustainable agriculture combines together the environmental health, economic profitability and socio-economic equality. Sustainability is largely dependent on meeting the needs of the present without any potential impacts on future needs. Thus, natural and human resources should be so managed that sustainable use of resources would be possible. Today, sustainable agricultural practices generally include the following issues:

- Crop rotations to reduce weed, pests and diseases; alternative sources of soil nitrogen; reduced soil erosion; reduced risk of water pollution.
- Implementation of integrated pest management practices.
- Increased mechanical or biological weed control.
- Conscious use of natural and synthetic inputs.

3. CONCLUSIONS

All living things, especially human beings, always need a suitable environment in which they can continue their lives in an orderly manner. However, in recent years, as a result of various human activities, deterioration and imbalances have occurred in living environments. Agriculture is one of the human activities that cause environmental degradation and pollution. Agricultural activities, on the one hand, are greatly affected by environmental changes, on the other hand, they can cause pollution and deterioration of the environment. Therefore, in all activities, including agriculture, the principle of sustainability should be perceived instead of excessive and destructive use in the short term.

Today, although the importance given to environmental awareness and health varies from society to society, significant progress has been made all over the world. New agricultural approaches that are compatible with nature, use resources correctly, aiming for sustainable development, perceiving animal welfare and considering spiritual and sensory satisfaction of human beings in agricultural activities have begun to spread all over the world. Although some of these new approaches have not gone beyond being a concept yet, some other concepts have entered the path of reaching the methodological level and have turned into new agricultural systems. Instead of conventional production techniques that increase environmental pollution in agriculture, negatively affect human health and threaten the future of a livable world, agricultural production techniques that are compatible with nature and carry the least risk in terms of environment and health should be adopted.

When these agricultural practices are not carried out in place, on time, with appropriate intensity and with appropriate methods, they cause health and environmental problems. Erosion is the leading agricultural problem. The amount of soil lost by erosion in a year in the world is estimated to be approximately 24 billion tons, and this amount is reported to be 500 million tons in Turkey. About 86% of Turkish soils are exposed to erosion, 7.22% of which is mild, 20.04% is moderate, 36.42% is severe, 22.32% is very severe. As a result of erosion, dam lakes and ponds are filled with displaced soil (sediment), thereby reducing their water storage capacity. Therefore, measures should be taken to prevent erosion in agricultural areas, meadows and pastures and forest areas.

To prevent erosion in cultivated lands, excessive tillage should be avoided and appropriate tillage tools should be selected. The soil surface should be covered with vegetation or plant residues as much as possible and agricultural techniques that increase soil organic matter and include perennial plants in crop rotations should be chosen. All these measures have become mandatory practices in organic farming activities. In order to prevent pollution caused by agricultural activities and to protect natural ecosystems, the application of sustainable agriculture techniques and the most important of them, organic farming techniques, can be encouraged or made compulsory in and around areas requiring special protection such as coasts, bays, river basins, lakes, ponds and wetlands. For a better and livable world, agricultural activities should be practiced with more caution. Otherwise, the heritage we leave to our future generations will be a polluted environment.

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