Relationship between Environmental Impacts and Modern Agriculture

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***Abstract**: There are many problems faced by modern agriculture, include: urbanization of farmland, water rights and usage, environmental concerns, and the procurement of government subsidies. Cycles of nutrients, energy, water and wastes have become more open, rather than closed as in a natural ecosystem. Despite the substantial amount of crop residues and manure produced in farms, it is becoming increasingly difficult to recycle nutrients, even within agricultural systems. Animal wastes cannot economically be returned to the land in a nutrient-recycling process because production systems are geographically remote from other systems which would complete the cycle. In many areas, agricultural waste has become a liability rather than a resource. Recycling of nutrients from urban centers back to the fields is similarly difficult. The specialization of production units has led to the image that agriculture is a modern miracle of food production. The environmental impacts of ecological diseases have been associated with the intensification of food production. They may be grouped into followings: erosion, loss of soil fertility, depletion of nutrient reserves, salinization and alkalinization, pollution of soil and water systems, loss of fertile field lands to urban development, loss of crop, wild plant, and animal genetic resources, elimination of natural enemies, pest resurgence and genetic resistance to pesticides, chemical contamination, and destruction of natural control mechanisms. Agricultural policies must consider new parameters, such as massive reallocation of agricultural land use, the substitution of current food crops with energy crops, and the potential contributions of agriculture to global economic development. It is clear that there is no choice but to produce more with less. Environmental sustainability in agriculture is no longer an option but an imperative. There are three crucial environmental challenges in the agriculture sector: conservation of biodiversity, mitigation of climate change and the global shift towards bioenergy.*

***Keywords**: Modern agriculture; environmental impacts; arthopogenic activities; pollution*

1 Introduction

World population continues to grow and is predicted to reach about nine billion in 2050. The demand for agricultural produce will continue to grow, needing to double the production by 2050, driven by population growth and changing food habits. FAO estimates that "the future may see some drastic decline in the growth of aggregate world production, to 1.5 percent p.a. in the next three decades and on to 0.9% p.a. in the subsequent 20 years to 2050"6. An increase in demand for biofuels could further increase pressure on inputs, prices of agricultural produce, land, and water.

2 Environmental Problems of Agriculture

Among the environmental problems of agriculture, water-related problems occupy an important place. It can be said that water is the blood of an ecosystem. Water not only influences the plant's growth per set but serves as an important medium of transfer for nutrients, etc., in soils. It influences the soils physical properties, both directly and indirectly due to biochemical processes.

Environmental problems in agriculture have proven difficult to address due to the spatial heterogeneity and temporal variability intrinsic to agriculture. Agriculture is largely a struggle against nature; both its sustainability and the prospects for improving environmental performance and farm income simultaneously are thus inherently limited. Agriculture's high degree of variability makes direct regulation inefficient. Subsidies for improving environmental performance can have negative consequences and have proven ineffective in practice, due largely to bureaucratic culture. Pollution taxes should be the most effective and efficient form of policy. Interdisciplinary research is needed to provide models for performance evaluation.

The world's need to increase agricultural production leads to various impacts on the environment, some of them closely related to water processes. Water serves as a medium for transporting matter both inside and outside the given agroecosystem. The water-related environmental problems of agriculture are connected with mechanical treatment of soil and use of fertilizers, pesticides, and other chemicals, and are naturally closely related to irrigation. The components of the environment most damaged by agricultural practices are soil and waters pollution. The water-related environmental problems of agriculture at a field level will be studied by means of simulation models. The most important water-related environmental problems of agriculture, grouped in sets, are briefly discussed in this report. The sets are predetermined to a great extent by the natural conditions of the region. Major Agricultural Problems are due to:

- Increasing population growth,
- Waterlogging and

- Land erosion and Salinity converting the arable land into non-agricultural uses.

Our joint challenge is to identify the real problems and the effective solutions to:

- Increase food production,
- Reduce poverty and hunger and
- Reduce over-exploitation of natural resources.

A challenged food system:

- Natural resources are the foundation of food production.
- Past successes in food production and distribution, have been obtained in part by unsustainable use of natural resources such as soil, water, energy and biodiversity.
- As a warming planet with an already large and rapidly increasing population, the earth faces a difficult debate about how to secure and distribute its future food supply in an equitable and sustainable manner.
- Producing 70% more food for an additional 2.3 billion people by 2050 while at the same time fighting poverty and hunger, facing increasing challenges to use energy and other scarce natural resources more efficiently, preserving biodiversity and adapting to climate changes, are the main challenges which world food systems will face in the coming decades.

Worldwide, agriculture accounts for 38% of land use, 66% of water withdrawals, and 85% of water consumption [1]. It is responsible for most of the habitat loss and fragmentation that threaten the world's forests, biodiversity, and terrestrial C stores and sinks. Due to the improvements in productivity the seeds varieties helped to increase global yields for all cereals, the grains that are grown on 45% of the world's cropland. Cereal yields went up by 126% between 1961 and 1998 [1]. Some characteristics of the processes in a field are also determined by regional features. That is why geographical analysis might be useful in the assessment and modeling of environmental problems of agriculture.

3 Physical Factors of the Agricultural Environment

3.1 Water

- o Salinization and regimes of underground water:
  - Salinization
  - Water-lodging

- Lowering of water tables
- Loss of irrigation water

- Waters hed management:
  - Lass of water control
  - Water erosion of soil
  - Siltation of reservoirs
- Water quality:
  - Irrigation water quality
  - Fertilizer runoff and leaching; eutrophication and effect on human health
  - Runoff of pesticides and similar agricultural chemicals
  - Water-borne diseases
- Land reclamation:

3.2 Soils

- Erosion: wind and water
- Desertification
- Chemical pollution of soil
  - Soil oxidation, especially of acid sulfate soils
  - Toxic chemicals in soil, especially as result of mining activities
- Soil structure, fertility, and composition
  - Soil compaction
  - Soil structure and fertility

3.3 Atmosphere and Climate

- Atmospheric effects
  - Air pollution
- Climatic effects
  - Climatic perturbations
  - Climatic change

4 Biological Factors of the Environment

4.1 Pest and Weed Management

- Pests
  - Pest attack
  - Pesticide resistance
- Weeds
  - Weed attack and control

4.2 Conservation

- Loss of genetic resources
- Loss of natural habitats
- Loss of arable land to other uses.

To more fully exploit these high-yielding crop varieties, farmers implemented a set of complementary technologies. Yes, these caused environmental problems. Yet they increased productivity, reducing the amount of land devoted to agriculture.

- **Irrigation**: Water diversions for agriculture are a major problem for many aquatic species. But irrigating the land, on average, triples its. Currently, 18% of global cropland is irrigated [1]. If all irrigation were halted, then at least an extra 1.31 billion acres of land would be needed to compensate for the lost production.
- **Fertilizers**: The use of fertilizers is the major source of nutrient loading in the world's waters. But fertilizer use has, in some cases, doubled yields.
- **Mechanization**: Tractor usage increased 2.3-fold between 1961 and 1998 [1]. While increasing society's dependence on fossil fuels, it reduced the need for human and animal labor on the farm. This helped reduce food costs and lessened the need to cultivate additional land to feed work animals.
- **Pest Control Systems**: In the absence of pesticides and other pest controls, an estimated 70% of the world's crop might be lost, instead of the current 42% [2]. Thus, without them, at least 90% more cropland would be required to offset the loss in production. It is true that as much as 99% of pesticides are wasted and end up in the environment [3]. Even so, a number of cost-benefit analyses indicate that aggregate economic, public health, and environmental benefits of pesticide use may outweigh the aggregate costs [4]. These studies do not take into account the environmental benefits that come from reduced habitat conversion.

Other factors contributed to farm productivity include: (1) innovations in animal husbandry, (2) technologies for storage, handling and processing and (3) a wider global infrastructure for the efficient transportation, storage, distribution and trade of agricultural inputs and outputs [5]. Recognizing the benefits of these technologies does not mean that the tendency to overuse inputs such as water, fertilizers, pesticides and energy should ignore, in part because of subsidies and, in the case of water, lack of property rights. So although total benefits of various technologies probably exceed total costs, marginal costs may not always exceed marginal benefits. To put a long-term focus on the environmental pros and cons of agricultural technologies, many effects of agricultural pollutants seem reversible, although not always rapidly and sometimes at substantial cost. In the richer nations, new laws and large investments in new and clean technologies have helped many freshwater systems and aquatic and avian species recover from decades, if not generations, of abuse [6].

Agrobiodiversity used in food production underpins humanity's life-support system. Agricultural intensification and expansion have destroyed biodiversity and habitats, driven wild species to extinction, accelerated the loss of environmental production services and eroded agricultural genetic resources essential for food security in the future. Climate change is expected to cause modifications to biodiversity at all levels, including ecosystems, species and genes. In turn, the increasing frequency of storms, drought and flooding caused by climate change threaten the viability of agro-ecosystems. Thus, the direct effects of agricultural pollutants seem no more long-lived or irreversible than the indirect ecological and biodiversity effects of additional land clearance that would have occurred without those technologies.

So, failure to produce enough food would not necessarily have led to protection of habitat for the rest of nature. Between 1961 and 1998, population increased by 117%, food supplies per capita grew 19%.Yet cropland increased by only 5% (to 420 million acres). Forest and woodland area expanded 21% between 1961 and 1994 (from 141 to 170 million acres) [1].

By reducing hunger, agricultural technology has not only improved human welfare and reduced habitat loss but has made it easier to view the rest of nature as a source of wonder and not merely as one’s next meal or the fire to cook it with. It also decreased the socio-economic cost of conservation. These factors helped create the conditions necessary for support of conservation within the body politic. Finally, in the absence of technological progress, would the World Conservation Union’s Red List, which classifies about a quarter of all mammalian species as threatened [7], been larger, because more species would be threatened or smaller, because more species were extinct? It should be knotted that:

- The environmental impacts of modern agriculture as the consequence of the path of technological development taken in this country.

- The technological package of modern agriculture as a system with its own internal logic fueled and maintained by the techno-scientific and socio-economic systems in which it is situated.
- The development of agricultural mechanization, agricultural chemicals, and agricultural biotechnology in this light.
- The major environmental impacts and human health risks of modern agriculture: water, soil, and air, biological diversity, and human health.
- The barriers to adoption of conservation measures that would reduce these risks.
- The set of organic/sustainable farming practices that are used to avoid risks to environmental quality and human health.
- The policy and economic changes that need to take place in order to develop more sustainable productions systems.

4.3 Limits on Sustainability

Another implication of this resource- or ecosystem-based perspective on the nature of agriculture is that there are real limits on the "sustainability" of agriculture. Agriculture itself is inherently unnatural in a fundamental sense, because it involves an attempt to maintain ecosystems unable to last without continuous human intervention. Rarely, if ever, do ecosystems as lacking in biodiversity as fields of crops, orchards, vineyards, or tree plantations occur in nature. If they do by some chance occur, they don't endure because of the bounty they offer to weed competitors, herbivorous insects, plant parasites, and diseases. They also don't endure because of evolutionary obstacles: Maintenance of these artificial ecosystems amounts to exercising natural selection pressure which essentially breeds better pests, i.e., organisms better suited to exploiting the ecological opportunities we insist on offering year after year.

4.4 Environment and Agriculture

- Agriculture increasingly faces the challenge of balancing its multiple functions in a sustainable way.
- However, concepts to address the wide range of issues and functions typical for agriculture are still scarce.
- Environmental and Agricultural Modelling presents the understanding current of integrated and working tools to assess and compute alternative agricultural and environmental policy options, allowing:
- Analysis at the full range of scales and focusing on the most important issues emerging at each scale;

- Analysis of the environmental, economic and social contributions of agricultural systems towards sustainable rural development and rural viability;
- Analysis of a broad range of issues and agents of change, such as:
  - Climate change,
  - Environmental policies,
  - Rural development options,
  - Effects of an enlarging global,
  - International competition, and
  - Effects on developing countries.

4.5 Principles of Soil Management and Conservation

- *Soil conservation in relation to:*
- Soil productivity,
- environment quality, and
- agronomic production
- *Critical information on:*
- management,
- organic farming,
- crop residue management for industrial uses,
- conservation buffers (e.g., grass buffers, agroforestry systems).
- *The global issues including:*
- C sequestration,
- net emissions of CO_2 and
- erosion as a sink or C source under different scenarios of soil management
- *The implications of the projected global warming on soil erosion and vice versa*
- *The concern about global food security in relation to soil erosion and strategies for food production*
- *Factors and causes of soil degradation and restoration.*

Agricultural policies must consider new parameters, such as:

- Massive reallocation of agricultural land use,
- Substitution of current food crops with energy crops, and
- Potential contributions of agriculture to global economic development.

It is clear that:

There is no choice but to produce more with less. Environmental sustainability in agriculture is no longer an option but an imperative.

There are three crucial environmental challenges in the agriculture sector [8]:

- Conservation of biodiversity,
- Mitigation of climate change and
- The global shift towards bioenergy.

1. *Biodiversity*

- Agrobiodiversity used in food production underpins humanity's life-support system.
- Agricultural intensification and expansion have destroyed biodiversity and habitats, driven wild species to extinction, accelerated the loss of environmental production services and eroded agricultural genetic resources essential for food security in the future.
- Climate change is expected to cause modifications to biodiversity at all levels, including ecosystems, species and genes.
- In turn, the increasing frequency of storms, drought and flooding caused by climate change threaten the viability of agro-ecosystems.

2. *Climate change*

- In turn, the increasing frequency of storms, drought and flooding caused by climate change threaten the viability of agro-ecosystems.
- Agriculture practices (such as deforestation, cattle feedlots and fertilizer use) currently account for about 25% of greenhouse gas emissions.
- Changes in farming seasons, and shorter cycles for all organisms, will lead to new pests and diseases, while a general increase in risk patterns and variability will affect economic returns and food security.

3. *Bioenergy*

- Cautions should be consider, the shift to bioenergy raises concerns for food security, as land and other productive resources are taken from food production.
- In addition, intensified biofuel operations could have significant negative impacts on water and soil, natural habitats and biodiversity.
- There is an urgent need to assess the feasibility of bioenergy systems based on countries' needs and resource endowments, prevailing policies, and plausible scenarios for the economic, environmental and policy variables.

- Biofuel policy cannot be successfully managed outside the overall policy and regulatory framework of the agricultural sector.
- The trade-offs involved in such major changes to global agricultural production objectives are difficult to evaluate in terms of:
    - overall ecological impact,
    - effects on food security,
    - food prices,
    - agricultural labour prices,
- The terms of trade between countries and regions, and access of the poor to land, and social equity.

The crucial challenges are conservation of biodiversity, mitigation of climate change and the global shift towards bioenergy..."Climate change is expected to cause modifications to biodiversity at all levels, including ecosystems, species and genes", "Agriculture practices - such as deforestation, cattle feedlots and fertilizer use - currently account for about 25% of greenhouse gas emissions", "The shift to bioenergy raises concerns for food security, as land and other productive resources are taken from food production", and "The trade-offs involved in such major changes to global agricultural production objectives are difficult to evaluate..." [9].

A recent FAO study (2007) found that livestock production is one of the major causes the world's most pressing environmental problems, including global warming, land degradation, air and water pollution, and loss of biodiversity. "Environmental externalities need to be explicitly factored into policies through the application of the 'provider gets, polluter pays' principle", "Industrial livestock units need to be located as close as possible to cropland that can be used to dispose of the waste", "Competition is increasing for other uses of grazing land, such as water-related services, biodiversity conservation and bio-fuels", "The mobility of the livestock industry allows its relocation without major problems becoming apparent" [9]. There is a clear relationship between population growth, agricultural stagnation and environmental degradation. While population has increased rapidly to reach 6.7 billion today, the agricultural growth rates have often not kept pace [10]. Conversion of forest land to agricultural land in the humid and sub humid regions, as well as the increased use of marginal lands for cropping in the semi-arid and arid tropical regions, have also contributed to land degradation and desertification.

Conclusion

There will be four plenary, interactive solution sessions:

- Looking towards 2050 and beyond: Income, distribution, population, food security, natural resources and climate;

- Reforming the food production system: Molecular biology, agro-ecological methods, aquaculture, land and water efficiency;
- Rethinking the food processing chain: Infrastructure distribution, energy efficiency, recycling, packaging and storage facilities;
- Moving towards economic incentives, improved governance and full costing: Institutions earmarking of payment, green taxes, ecosystem services, and market-orientation and policy reforms.

The right technological solutions combined with the right policy directions for the future can effectively contribute to a sustainable and equitable global food system.

A new global food system should assure that everybody has access to sufficient food and that poverty should be reduced significantly without doing damage to the natural environment. Despite of environmental disasters that attend it, agriculture is still potentially a renewable enterprise. In every century on a global scale, agriculture is seen as potentially renewable and fundamentally different from the industrial sector of society. It is only in the last 50 years, with the expansion of industry and the chemicalization of agriculture, that the inherently extractive economy has acted as though the renewable resources that support agriculture are fair targets for exploitation in industrial terms. That is what makes the modern era different.

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