Strategy for Improve the Global Food Production

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Abstract: The specialization of food production 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. With the challenge of climate change and a growing world population, we need to ensure that we can feed ourselves in the following years to come by growing enough food sustainably. 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. Globally, more food production, protection and enhance the natural environment without damaging the natural resources are needed. This is the question that should be answered?

Keywords: *environmental impacts, concept of sustainable agriculture, limitations in food production, modern agriculture, strategy for food prodcution*

1 Intoduction

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 [1] 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 biofuel could further increase pressure on inputs, prices of agricultural produce, land, and water [2, 3].

However, agriculture is the sector that has the potential to transcend from being a problem to becoming an essential part of the solution to climate change provided there is a more holistic vision of food security, agricultural mitigation, climate-change adaptation and agriculture’s pro-poor development contribution [4]. The required transformation is much more profound than simply tweaking the existing industrial agricultural systems. However, the sheer scale at which modified production methods would have to be adopted, the significant governance and market-structure challenges at national and international level and the considerable difficulties involved in measuring, reporting and verifying reductions in greenhouse gas emissions pose considerable challenges [5]. Agriculture provides the livelihood for approximately 2.6 billion people (i.e. some 40% of global population) [6, 7].

2 Sustainable Food Production

Sustainable agriculture is concerned with the ability of agroecosystems to remain productive in the long term. Many authors distinguish environmental, economic and social sustainability. Ecological sustainability is defined as the maintenance of the global ecosystem or of “natural capital” both as a “source” of inputs and as a “sink” for waste. The ecological dimension of sustainability is fundamental to overall sustainability, as it is a prerequisite for the economic and social dimensions. Sustainable agriculture represents a broad spectrum of agricultural methodology, which supports the environment. These can range from conventional, more intensive methods or even alternative methods. The concept of sustainable agriculture is a recent one that had evolved in great earnest in the last two decades or so. The movement for sustainable agriculture has now increasing support and acceptance, as it may be a way to address many environmental and social concerns. Hopefully it can provide new and innovative as well as economically viable opportunities for farmers, researchers, consumers, policy makers and others in the food production arena. This concept of sustainable agriculture is still evolving and definitions and practice differ among practitioners. Essentially sustainable agriculture integrates three main objectives:

- economic sustainability and profitability
- environmental concerns
- social acceptability.

The sustainable agriculture model most preferred or practised by local proponents of sustainable agriculture is “organic agriculture” or “organic farming”. Organic agriculture is a holistic production management system, which promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on the low use of internal inputs and non-use of artificial fertilizers and pesticides. This takes into account that regional conditions require locally adapted systems. Other scientists define it as “farming” which does not use any synthetic chemicals whatsoever and is based on sound ecological principles. It avoids agrochemicals e.g., fertilizers and pesticides include fungicides, herbicides, etc. It involves systems that aim to achieve a balanced agroecosystem where both crop plants and pests can coexist without detrimental effects to each other.

Lairon [8] mentioned that food security, nutritional quality and safety vary widely around the world. Reaching these three goals is one of the major challenges for the near future. Up to now, industrialized production methods have clearly shown severe limitations such as a worldwide contamination of the food chain and water by persistent pesticide residues, and reduced nutrient and flavour contents through low-cost intensive food production and/or processing. The success of modern agricultural and forestry production can largely be attributed to monoculture systems using a few select species and heavy chemical inputs. This drive for maximizing yield and profit has caused serious environmental problems such as land- and water degradation and increased land-clearing. Modern agriculture is thus threatening its own foundations: land, water, forests, and biodiversity. During the past thirty years, however, the positive benefits of integrated land-use systems such as agroforestry to the producer and the environment have gradually been recognized. It is time for us to eschew the artificial dichotomy between agriculture and forestry, embrace the values and benefits offered by time-tested traditional land-use systems such as agroforestry, infuse scientific investments for their development, and encourage their incorporation into agricultural development paradigms [8]. As illustrated schematically in Figure 1, enhanced and sustained production of many typical ‘services’ normally associated with food or timber production systems is possible largely as a result of forced integration of trees, crops and/or animals in such a way that interactions are created both above and belowground.

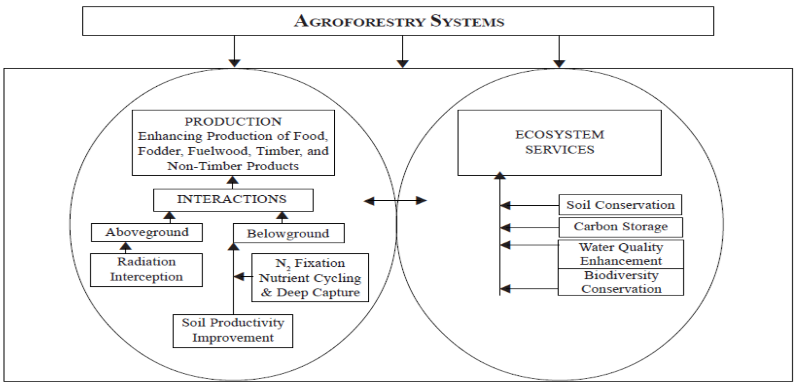

Figure 1

A schematic presentation of the major mechanisms and processes involved in production- and service attributes of sustainable agroforestry systems (Source: [8]).

According to FAO [1], despite increased world food production in the last few decades, the global effort to meet the Millennium Development Goal of reducing hunger by half by 2015 now appears beyond reach. As a matter of fact, the number of people suffering from chronic hunger has increased from under 800 million in 1996 to over one billion recently.

3 Protection of Resources and Environment

A major consequence of the exploitation of natural resources to satisfy human needs and economic development is environmental degradation. Among the negative externalities that evolved due to indiscriminate or over exploitation of natural resources were the following:

- land degradation due to soil erosion
- siltation of rivers
- groundwater contamination
- diminishing supplies of important resources e.g. irrigation water
- flooding
- salinization
- human health problems
- disturbance of micro-climate
- wildlife and natural species endangerment.

One of the tree-mediated benefits of considerable advantage in the tropics is that trees and other vegetation improve the productivity of the soil beneath them. Research results during the past two decades show that three main tree-mediated processes determine the extent and rate of soil improvement in agroforestry systems. These are:

- increased nitrogen (N) input by N_2-fixing trees (NFTs),
- enhanced availability of nutrients resulting from production and decomposition of tree biomass, and
- greater uptake and utilization of nutrients from deeper layers of soils by deep-rooted trees.

Countries all over the World are concerned with solving the environmental pollution problem due to industrial development, increase in rate of the worldwide population, and rise in the standard of living. Agroecosystems should produce much greater amounts of food, fodder, fiber and energy to meet the global needs, as well as improve human health and social life, reduce dependence on traditional fuels, adapt to climate change, reduce environmental degradation and decline in soil quality. Security, nutritional quality and safety of food production are varying widely around the worldwide.There is no evidence that organic foods may be more sensitive to microbiological contamination than conventional foods. Therefore the problems of climate change, hunger and poverty, economic, social and gender inequity, poor health and nutrition, and environmental sustainability are inter-related and need to be solved by leveraging agriculture's multi-functionality (Figure 2).

The term "organically grown food" denotes products that have been produced in accordance with the principles and practices of organic agriculture. Organic agricultural and food processing practices are wide ranging and overall seek to foster the development of a food production system that is socially, ecologically, and economically sustainable.

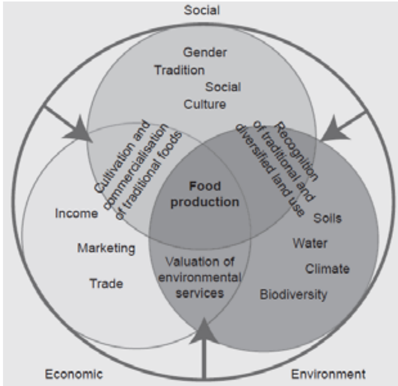

Figure 2

Multi-functionality of agriculture (Source: [10])

There are several limitations in food production over the worldwide due to e.g., contamination of the food chain and water by pesticide residues, reduction in nutrients, climate change, increasing food and fuel prices, soil erosion, fertility loss, pest control, water pollution, and biodiversity depletion and decreases in agricultural land areas used for food production. For example, global climate change is a current research hotspot, and clarifying its various effects is an important challenge for scientists. There is no doubt that climate change will increase the fluctuation of food production and have an important effect on global food security. Environmental impact of agriculture depends to a large extent on farmer production practices. The link however is indirect, as emissions to the environment depend on the state of the farming system, which in turn depends on farmer production practices but also on random factors such as rainfall and temperature (Figure 3).

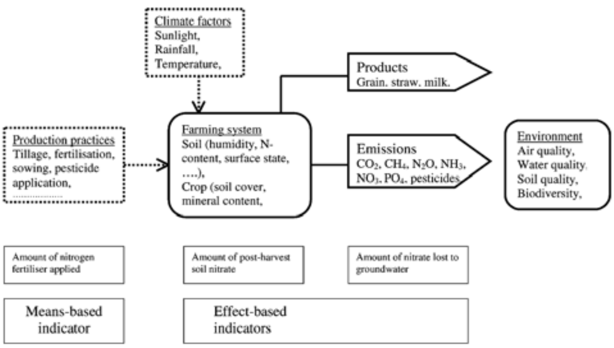

Figure 3

The factors affecting the farming system and the fluxes of products and emissions. (Source: [11]).

Figure 3 shows the Indicators of environmental impact may concern farmer production practices (means-based indicators), the state of the farming system or emissions to the environment. Consequently, indicators of environmental impact may be based either on farmer production practices ("means-based") or on the effects these practices have ("effect-based") on the state of the farming system or on emissions to the environment. The 12 methods reviewed here were selected from a literature research [11] as following:

- The farmer sustainability index
- Sustainability of energy crops
- Ecopoints
- Life cycle analysis for agriculture
- Agro-ecological indicators
- Agro-ecological system attributes
- Operationalising sustainability
- Multi-objective parameters
- Environmental management for agriculture
- Solagro diagnosis
- Life cycle analysis for environmental farm management
- Indicators of farm sustainability

These methods all use a set of indicators to evaluate the environmental impact of agriculture at the farm level. Some of the methods do not speak of "evaluation of environmental impact" but use the expression "evaluation of ecological (or environmental) sustainability". Although this expression is not always clearly defined, it obviously designs a situation in which environmental impact is limited to an acceptable level. Only methods that were sufficiently different from each other, well documented and showing proof of having been actually used or at least tested for assessment purposes were retained. Some of the methods analysed here also consider social and economic dimensions of agroecosystems, however, this analysis was limited to the part of the method addressing environmental effects. The time has arrived for a rethinking on the way of agricultural development programs around the world.

Science will be very important to develop crops that need less water, fertilizer or chemicals. Novel, environmentally-friendly solutions are proposed based on integrated information from basic and applied sciences such as agronomy, soil science, chemistry, toxicology, ecology, economy, agricultural biotechnology, gene technology, nanobiotechnology, molecular biology, and social sciences, etc. Research and development will be increasingly important as all countries learn to use the finite resources available sustainably to produce ever more food to feed the growing global population. The World Commission on Environment defines sustainability as: "A sustainable society is one that meets the needs of the present without compromising the ability of future generations to meet their own needs". Despite the site-specific and individual nature of sustainable agriculture, several general principles can be applied to help growers select appropriate management practices:

1. *species and varieties selection suited to the site and to conditions on the farm*;

2. *crops diversification to enhance the biological and economic stability of the farm*;
3. *soil management to enhance and protect soil quality*;
4. *efficient and human use of inputs*; and
5. *consideration of farmer's goals and lifestyle choices*.

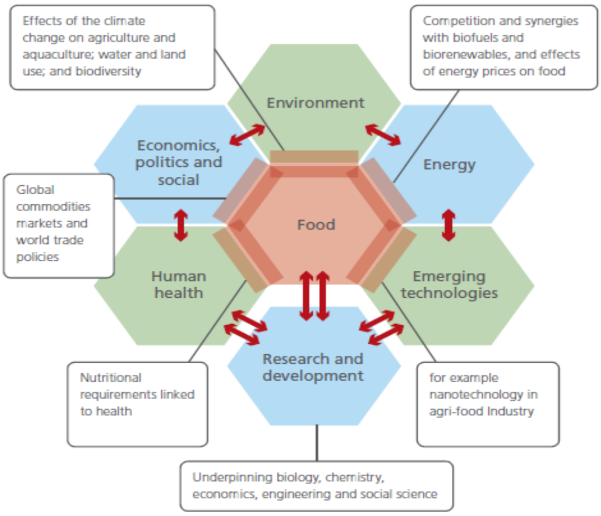

Figure 4

Collaboration between public and private sectors to innovate the field of food research (Source: [12]).

One of the most important food productions is the migration of young people from farming communities causing a reduction in the population base and economic infrastructure that is essential to establishing agriculture in a more sustainable mode. The immediate and complete change from industrial to organic agriculture is not practical in the world.

A conversion period from conventional to organic almost invariably leads to a temporary decline in yields. For fields in transition from conventional to organic, it may take a lot of years for increasing the levels of food production. Farmers should play the key for shorting the time for changing to organic techniques which could convert a portion of their land each year. Indeed, sustainable agriculture deciphers mechanisms of processes that occur from the molecular level to the agro-eco-farming system to the global level at time scales ranging from seconds to centuries. This integration should meet to the global food requirements based on the total agricultural land areas, soil quantity and quality and fertility resources.

There are many suggestions that the modern organic agricultural systems produce enough quantity and quality foods and have environmental and health advantages for consumers over food from conventional systems. Modern organic agriculture is an alternative parameter of food production should contain features of agroecosystems that promote the environmentally, socially and economically sound of food, fodder and fiber production. Organic agriculture is developing rapidly. The modern organic agro-eco-farms, processing, distribution or consumption is to sustain and improve the process of food safety and health at all stages of the agroecosystem in order to safe the food from phytopathogens, agrochemicals and additive food staff materials. But can this type of agriculture feed the world? To answer the question, we have to concern:

1. *conflict among agronomists and policy makers over the future of agriculture;*
2. *arguments for a second green revolution;*
3. *evidence for unsustainability of industrial agriculture;*
4. *evidence for the productive potential of organic agriculture;*
5. *economic and political roadblocks to an organic transition; and*
6. *steps that can be taken to facilitate a transition.*

There are many suggestions that the modern organic agroecosystems produce enough quantity and quality foods and have environmental and health advantages for consumers over food from conventional systems.

Food should produce, process, and distribute to feed a growing global population in ways which to use global natural resources sustainably, enable the continuing provision of the benefits and services given by a healthy natural environment, promote high standards of animal health and welfare, protect food safety, and make a significant contribution to rural communities.

Our food security is ensured through strong agriculture and food sectors, and international cooperation links with global partners which support developing economies. The countries have a low carbon food system which is efficient in using resources e.g., any waste is reused, recycled or used for energy generation. Reduce emissions from agriculture by using anaerobic digestion to manage slurry, reduce nitrous oxide emissions, and generate clean energy instead.

4 Increasing the Capacity of Land Productivity

The following paragraphs illustrate some of the ways in which this can be done.

4.1 Restore and Preserve Soil Organic Matter (SOM)

Maintaining SOM is critical to increase the efficiency of nutrient recycling in agroecosystems. Carbon compounds in SOM are energy sources for the soil food web. The organisms in these food webs range from bacteria, fungi, protozoa, nematodes and arthropods to earthworms. Nutrient-rich composts composed of manure, chicken litter, peanut hulls, and other natural products that feed the food web are an environmentally preferable alternative to inorganic fertilizers, because nutrient release into the soil is relatively slow. In the absence of SOM, nutrients are held in the soil only by weak electrostatic exchange on mineral soil particles.

As a result, nutrients are more readily leached to groundwater and streams and volatilized into the atmosphere. Other benefits of SOM include:

- The activity of soil micro and macrobiota that feed upon SOM improves the soil physical characteristics such as porosity, permeability, etc.
- Organic acids released from composts chelate iron and aluminium in soil, thereby solubilizing phosphorus bound in iron and aluminium phosphates and rendering the phosphorus available to crops.

4.2 Increase and Preserve Diversity

Maintaining crop species and genetic diversity through intercropping can lead to greater productivity in plant communities, less nutrient leaching, volatilization, and greater ecosystem stability. Greater productivity and nutrient retention comes about through resource partitioning. When different species have different resource requirements, complimentary interactions between individuals become more important competition.

4.3 Use beneficial Species to Control Pests

Environmentally based pest management helps by taking the advantage of interactions between pests and naturally occurring pest controlling organisms. Use of rotational schemes so that two crops from the same botanical family are not planted in the same field in successive years can be a big step toward reducing crop enemies such as parasitic nematodes.

4.4 Use Locally Proven Techniques

Integrating local knowledge into farming can improve the sustainability of cropping systems. Soil is actively aerated, resulting in improved growth and functioning of root systems and the soil biota that contribute to increased productivity. Any of these techniques can be adopted by farmers to improve environmental sustainability without necessarily becoming organically certified. In fact, agriculture that is certified “organic” may not necessarily is the best route to sustainability. Plant productions must be increased, and increases can be obtained only through more intensive application of inorganic N and other nutrients, increased irrigation, greater application of agrochemicals and through the use of genetically modified crops that are programmed to take advantage of these subsidies. Negative effects of this revolution are unsustainable for these reasons:

- It depends upon the synthesized agrochemicals and petroleum fuel for the agro-mechanics that spread these compounds.
- Because petroleum fuel supply is limited, agriculture based on these compounds is unsustainable. As the price of petroleum increases, prices for agricultural chemicals will increase. As prices increase, less

agrochemicals will be used, resulting in greater soil degradation and declining yield of agriculture.
- Use of genetically modified crops can increase yield, and increasing yield requires energy against pests and pathogens resistance and compete with weeds for nutrients and water.
- Farmers use genetically modified crops will be under international coorporations control of the crop production. The use of these crops spread, the world’s food supply becomes increasingly dependent on the economic goals of a handful of corporations and not on the needs and desires of consumers as well as the production of unknown diseases according to the unstability of the genetic map for crop and the effects of the climatic changes and other ecological factors.
- The vertical integration of the economic food chain in the revolution can be sensitive to disturbances. For example, agro-terrorists can disrupt the world’s food supply by introducing pathogens and other biological weapons into a few key links in food chain.
- The spread of monocultures in industrial agriculture food production systems leads to loss of genetic diversity. Low genetic diversity increases the risk of disease or insect outbreak.
- Half amount of N in fertilizer volatilized and enters the troposphere pose direct humans health threats and causes substantial losses in agricultural production.
- Animal and agricultural wastes near aquatic environments can significantly degrade water quality and endanger health.
- Overuse of agrochemicals in the agricultural industry has resulted in modifying resistance of pathogens and weeds kills beneficial soil biota and insects that can help in biocontrol.
- Methods of tillage may disrupt the structure of the soil result in erosion that is destroying croplands.

5 Relationship between Economic Activities and the Natural Environment

Many ecosystems provide benefits that are still essential to our economy. These benefits are often referred to as agroecosystem services and are vital to the entire food system:
- providing inputs, such as food and water,
- regulating systems, such as reducing the risk of floods, land degredation, and disease,
- supporting, such as forming soil and cycling nutrients,
- cultural, such as recreational (including tourism), spiritual, and other non-material benefits.

These make us poorer in the long term by limiting our ability to continue in this cycle (Figure 5). We need to consider the effects our behaviour has on the health of ecosystems, as these impact on their ability to supply us with essential goods and services in the future.

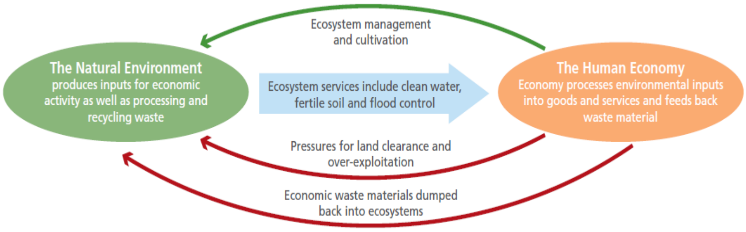

Figure 5

Positive and negative relationship between economic activities and the natural environment

6 Strategy for Food Production

This strategy considers the food system at global levels. A secure and sustainable food system will need us to focus on a number of important issues. The strategy is structured around these issues – what the challenges are, our goal for 2025, and the steps we will need to take to achieve this. This strategy is structured around six core issues for the food system as shown in Figure 6. Particular focus is given to the global dimensions of food policy on having a resilient, profitable and competitive food system, and on increasing food production sustainably.

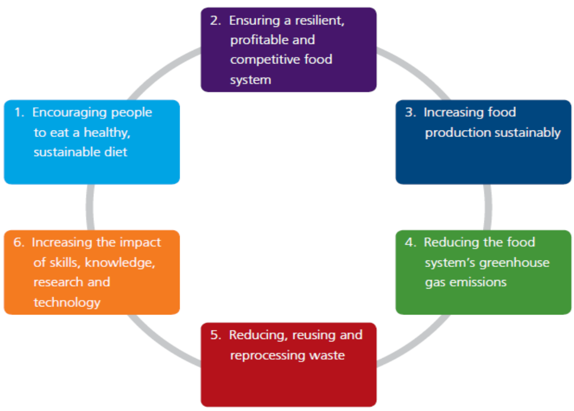

Figure 6

Structure of Strategy needed for increasing food production (Source: [11]).

7 For the Future

Consumers are informed, can choose, and afford healthy, sustainable food. This demand is met by profitable, competitive, highly skilled and resilient farming, fishing and food businesses, supported by first class research and development. Food is produced, processed, and distributed to feed a growing global population in ways which:

1. use global natural resources sustainably,
2. enable the continuing provision of the benefits and services given to us by a healthy natural environment,
3. promote high standards of animal health and welfare,
4. protect food safety,
5. make a significant contribution to rural communities, and
6. allow us to show global leadership on food sustainability.

Model simulation is an important way to study the effects of climate change on agricultural productivity. The future of environmentally friendly farming technologies are assessed and chosen in accordance with their contribution on three areas where, e.g., operating economical plans, green accounts and nature plans are treated equally. The figure demonstrates how the three bottom lines (production, environment, and landscape) constitute a unity when green technologies are selected for future agricultural systems

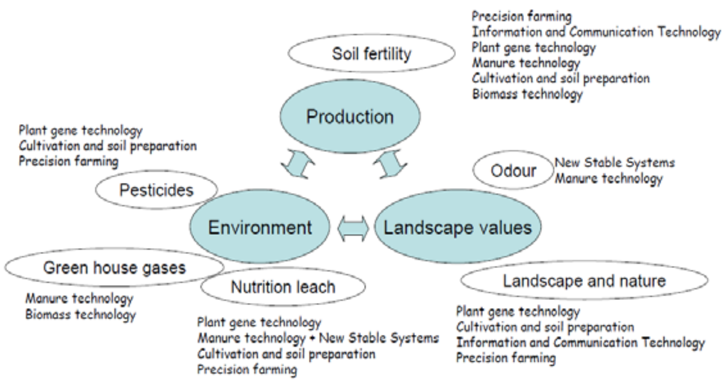

Figure 7

The agricultural triple bottom line

To feed the world on a sustainable basis, it is necessary for agriculture to become less environmentally and culturally damaging, and less dependent on fossil fuels. Techniques commonly used in organic agriculture have the potential to feed the world, although it could take several years for croplands in transition from conventional agriculture to organic to gain or regain their productive potential. Nevertheless, historical social changes, though slow and difficult, give us hope that with continuous effort, agriculture can be changed from exploitative of nature to working with nature. Environmentally friendly technologies alone do not secure future sustainable agriculture. There is a need for education and concepts that can make environmental and nature friendly technologies visible and thereby further them in the food production within which the agricultural production only accounts for the first stages. The solution of the question is simple:

- Mass education regarding these problems,
- Hand in hand with conservation,
- Family planning,
- Good stewardship for our environment and one another.

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 [13]. 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. 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.

8 Potential Environmentally Friendly Technologies

8.1 Plant Gene Technology

Plant gene technology is controversial, but can when used carefully provide an increased and environmentally friendly production and contribute to landscape and nature-related values. The perspectives for the technology are:

- to develop new farming products with increased market value based on vegetation that optimally use the Earth’s and climate’s resources
- to reduce the loss of nutrients by removing, reducing or changing vegetation’s nutrient content, which can prevent an effective intake of foodstuff in domestic animals
- to create resistant crops that can influence an increased biological diversity in the field

Many of these advantages can be reached by molecular marker assisted breeding, i.e., a solution without the use of modification. The technology is thereby also interesting for organic farming. Plant gene technology has at this moment in time only a future if a varied dialogue regarding advantages and disadvantages where public scepticism about the technology is taken seriously. It is, therefore, necessary to soon take a policy decision with respect to the use of gene modified crops, including an approval procedure and labelling that considers the public's very broad perception of risks. The technology is still at a somewhat early stage and research programmes within genetic vegetation technology and risk shall, therefore, be upgraded.

8.2 Information and Communication Technology

The technology includes both decision support systems and a more efficient communication of the latest knowledge about environmentally friendly farming production. The technology does at the same time give completely new possibilities for supervising, modelling and controlling biological environments. The perspectives for the technology are:

- that production data can be used in order to establish quantitative models of the biological system as well as decision support tools and management programmes that can be used by authorities and farmers so that they can make the best decisions;
- that the information about the animal and plant growth can provide the consumers with documentation showing that it concerns healthy and safe food products, which are produced environmentally friendly throughout the whole process "from soil to table";
- that a rational and efficient handling of data from the complex biological processes could be a deciding factor in a future knowledge-based food production.

The consumers' distance to the manufacturers means that the retailing link will play an important role when the consumers' demand for quality, food safety and environmentally friendly production is communicated down through the food production's many links.

8.3 Manuring Technology

Large amounts of ammonia are today discharged on the production of domestic animals. Nitrate is washed out when animal manure is fertilized that affects both eutrophication and increased production of laughing gas, which is a strong greenhouse gas. At the same time, there is also often a too high content of phosphorous in the sludge in comparison with crop needs. The perspectives for the technology are:

- to improve the management of nutrients and thereby improve the use of the resources within the domestic animal fertilizer;
- to lessen the nutrient load of the water environment as well as moors, commons and forests, etc.;

- to reduce odours from animal fertilizer storages and deliveries.

The integration of manuring technology with energy production is obvious, but it requires an increased research effort. There is also a need for the development of good systems that are compatible with agriculture's de-centralised structure and ensure an efficient logistical and reasonable economy.

8.4 Biomass Technology

Biomass technology is concerned with improving and developing technologies that can efficiently and cheaply change biomass to energy and industrial products with high value. The biomass technologies offer themselves to industrial as well as organic-oriented agriculture, but they are envisaged to be used on different centralised scales. The perspectives for the technology are:

- to develop bio refinery in combination with biogas that can offer new products as well as improve the strength of flexibility and competition within the agricultural sector that agriculture can become the net producer of CO_2-neutral energy;
- to grow more low input energy plants that can increase the diversity of the farming landscape for the benefit of animal life that the production of biomasses within agriculture occurs in areas that do not have any significant value in respect of the protection of the water environment, wildlife as well as the landscape and nature-related values
- to reduce the need for fossil fuel and thereby increase the supply safety and lessen the emission of greenhouse gasses by using biomass for power and heating production.

Biomass technology is a complex system of technologies and products that combined have a potential of increasing the value of farming products. It is necessary to have an inter-disciplinary research effort wherein consideration is taken to the future energy infrastructure.

8.5 Cultivation and Soil Preparation Technology

Intelligent usage of biological and agricultural knowledge can be an efficient strategy for minimising the environmental effect of farming. This can be summarised by the term "good agricultural management", which can in the future be improved by using expert systems and advanced Information and Communication Technology for the promotion of the new knowledge. The perspectives of the technology are:

- to reduce soil preparation and thereby gain savings on machinery and energy usage
- to improve better crop rotation and close loopholes in the nutrient circulation with catch crops in order to minimise nutrient loss
- to minimise environmental affects from fertilization and crop spraying with the help of integrating growth principles and knowledge usage

Diversity and recirculation are two fundamental principles in relation to growth technology in organic-oriented farming and increased focus on this within the industrial oriented farming can prove itself to be an important environmental gain. In order to take advantage of the potential of the technologies, it is necessary to have a considerable research effort to obtain more knowledge about the function and dynamic in agricultural ecology.

8.6 Global Position Systems (GPS) and Robots – Precision Farming

Precision farming is one of the options where the use of IT, sensors and robots can be utilised in order to adjust the production of raw material (plants and animals) to the specific areas' conditions or to the individual animal and plant needs for nutrients and care. The perspectives of the technology are:

- to obtain savings in labour, improved management and more homogeneous crop quality
- to reduce the use and loss of nutrients and pesticides, together with other possible environmentally harmful products

The gain from precision farming within the highly developed agricultural systems can only be reached through optimising the whole of the production system. There is at the same time a need to develop software that can interpret the sensors' total data as area specific and measured allocation of pesticides and fertilizers.

Conclusion

The planet can sustain 6 billion people. We have surpassed this number. At the present rate of population growth, we expect about 3 billion more people in the next 30 years. Produce more food in ways that protect and enhance the natural environment. Provide consumers with clear information on the impact of climate on food production. Make food chain more energy efficient by providing advice, using regulation sensibly. Reducing, reusing and reprocessing waste and offering financial incentives are our aims by 2025. Yes, by these conditionings, our global agroecosystem is safety and "balance". In every century on a global scale, agriculture is seen as potentially renewable and fundamentally different from the industrial sector of society. To feed the world on a sustainable basis, it is necessary for agriculture to become less environmentally and culturally damaging, and less dependent on fossil fuels. Techniques commonly used in organic agriculture have the potential to feed the world, although it could take several years for croplands in transition from conventional agriculture to organic to gain or regain their productive potential. Economic and political barriers to changing the industrial agriculture paradigm may be more difficult to overcome than technical barriers.

References

[1] FAO (2009): The State of Food Security in the World. Rome. Available at: www.fao.org

[2] Bayoumi Hamuda Hosam E.A.F. and Patkó István: Relationship between environmental impacts and modern agriculture. Óbuda University e-bulletin, volume 1, No. 1, 2010 pp. 87-98

[3] Bayoumi Hamuda H.E.A.F. and Patkó István: Some environmental problems in agriculture. Proceedings of 8th National Scientific Conference with International Participation "Ecology & Health 2010", Plovdiv, Bulgaria, May 18-19, 2010. pp. 37-44. ISSN 1314-1880

[4] Bayoumi Hamuda H.E.A.F. and Patkó István: Yes, our global agroecosystem is „out of balance" improvement of security, nutritional quality and safety of agricultural food production. The IV International Symposium „Ecological Approaches towards the Production of Safety Food". Non-Business Association „Territorial Organization Science and Technology Unions and House of Science and Technique". Plovdiv Bulgaria, June 8-9, 2011. pp.: 27-34. ISSN 1313-9819

[5] Hoffmann U.: Assuring Food Security in Developing Countries under the Challenges of Climate Change Key Trade and Development Issues of a Fundamental Transformation of Agriculture. No. 201 February. United Nations Conference on Trade and Development (UNCTAD) Discussion Papers are available on the UNCTAD website at http://www.unctad.org. 2011

[6] Herren H.R., Binns P., Najam A., Khan S., Halberg N., Cim L.C., Treyer S., Lal R., Atapattu S., Kodituwakku D., Tamo M., Neuenschwander P., Fernandez M., Bassi A., Kassam A., De Fraiture C., Kingamkono R., Perfecto Y., Khan Z.R.: UNEP Green Economy Report: Agriculture. Geneva. 2011

[7] World Bank: World Development Report: Agriculture for Development. Washington, DC. http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTWDRS/EXTWDR2008/0,,menuPK:2795178~pagePK: 64167702~piPK:64167676~theSitePK:2795 143,00. html. 2008

[8] Lairon D.: Nutritional quality and safety of organic food. Agron. Sustain. Dev., 30, 2010, 33-41

[9] Nair R.P.K.: Agroecosystem management in the 21st century: It is time for a paradigm shift. Journal of Tropical Agriculture, 46, 2008, 1-12

[10] IAASTD: Global Report. International Assessment of Agricultural Knowledge, Science and Technology for Development, Johannesburg. 2008Available at: www.agassessment.org

[11] van der Werf H.M.G. and Petit J.: Evaluation of the environmental impact of agriculture at the farm level: a comparison and analysis of 12 indicator-based methods. Agriculture, Ecosystems and Environment, 93, 2002, 131-145

[12] Global agricultural research spend is assessed under Theme 1 (Global Availability) of the UK Food Security Assessment (Defra, 2010)

[13] Jarraud M.: Agriculture and environment: climate change challenges and policy options. World Meteorological Organization, High-Level Segment of the CSD-16, New York, USA, 2008, 14-16 May