Sustainable agriculture in tropical developing countries– constraints and possibilities

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Abstract

The development of agriculture during the "Green revolution" led to dramatic increases in productivity, but has unfortunately been accompanied by a number of negative impacts. These are commonly treated as independent problems, while in reality being symptoms of the system error of industrial agriculture. To ensure long-term food production in the light of a growing world population, there is an urgent need for a paradigm shift towards a more sustainable alternative.

In this study we will argue that sustainable agriculture fulfills the requirements placed on such an alternative. Sustainable agriculture is based on natural processes, thereby minimizing negative effects on environment and human health. An increasing number of studies are showing satisfactory yields comparable to those achieved in industrial agriculture. In terms of food security, low cost inputs and small-scale solutions enabling farmers to increase productivity makes sustainable agriculture a better solution in developing countries. The agricultural development on Cuba is used to illustrate that a large-scale conversion to sustainable agriculture is possible. We identify several constraints obstructing implementation of sustainable agriculture. These include powerful economic interests and barriers of the mind.

Keywords: Sustainable agriculture; monocultures; tropics; food security; pesticides: IPM; BNF; SA; BC; IMF.

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1. Background

The agricultural system is the major food source for humankind, and is therefore of vital importance. Technical improvements have tripled the production of agricultural lands in the world during the last century (Worldwatch Institute, 2000). During the "Green revolution" from the 1960s and forwards, the agriculture in the industrialized world changed to a more intensive system (Granstedt, 1998; Matson, 1997). Global yield increased fivefold from 400 million tonnes in 1900 to 1,9 billion tonnes in 1998, through dramatically increased inputs of chemical fertilizers and pesticides (Worldwatch Institute, 2000). This development made possible a division of animal keeping and crop growing, which resulted in a decrease in recycling of resources. During the last 50 years we have thus managed to create an ineffective and unsustainable system with a number of harmful side effects (Granstedt, 1998). The traditional view of agriculture as a system that produces food through energy from the sun and nutrients from the soil is no longer valid for the agriculture in developed countries. The modern agriculture is in fact not a producer, but a consumer of resources. In 1979, US agriculture required 10 fossil fuel calories to produce a single food calorie (Jackson, 2002).

The overproduction in agriculture in industrialized countries is maintained due to a shortsighted consumption of non-renewable resources. This consumption is leading to serious and increasing environmental problems and it is only a matter of time before these resources are depleted.

However, there are alternative options to industrial agriculture. This is a rather new area of scientific interest, which has created a flora of different terms, such as conservation agriculture, organic farming and sustainable agriculture. These all encompass the same general concept. According to UN:s Food and Agriculture Organization (FAO), conservation agriculture “aims to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water and biological resources combined with external inputs. It contributes to environmental conservation as well as to enhanced and sustained agricultural production. It can also be referred to as resource effective agriculture”. In this study, we will use the term sustainable agriculture with this definition.

One of the most debated issues when discussing the future of agriculture is food security. Demographers predict that the population will grow to between 8 billion and 10 billion in the 21st century. Meanwhile, some 800 million people are malnourished today (Matson et al., 1997). Presently, agriculture therefore faces the double challenge of feeding a fast growing population and at the same time prevent the degradation of the agricultural resource base. There appear to be two options for developing countries; either improve agriculture through modernization, by emphasizing pesticides, fertilizers, machinery and modern varieties of crops; or use sustainable agriculture, promoting improved traditional, small-scale techniques (Pretty, 1999).

Around one third of the world population is supported by traditional agriculture, where the use of chemical inputs is totally absent (Pretty, 1999; IFOAM, 2000). There are profound differences between agriculture in developed and developing countries. In the latter, the majority of the population is engaged in farming activities compared to a minor proportion in the former. The industrial agriculture is designed to maximise the productivity of a scarce resource – labour. This system has proven to be wasteful of land and capital. When it is exported to countries with chronic unemployment and scarce land resources, the results are devastating and include rural-urban migration and social problems.

The aim of this study is to investigate whether sustainable agriculture in the tropics presents a valid alternative to industrial agriculture. Is sustainable agriculture really sustainable in the sense that it can produce enough food to support the expected population increase in tropical developing countries? This will be done by first addressing the major problem areas in industrial agriculture, followed by a presentation of sustainable management strategies and their implementation. The development in Cuba will serve as an example, showing that sustainable agriculture is a possible option and can support the food demands of a tropical developing country. Finally, we will discuss the barriers obstructing the implementation of sustainable agriculture in a larger scale.

2. Problem areas in industrial agriculture

2.1. Fertilizers

The intensive industrial agriculture of developed countries relies heavily on chemical fertilizers. These supplements replace certain nutrients, but do not supply the soil with organic matter. The result is soil compaction, increased runoff and a loss of soil fauna, with a subsequent loss of decomposing capacity (Granstedt, 1998).

The most important component in chemical fertilizers is nitrogen, the substance most frequently limiting crop growth (Hubbell, 1995). Presently, human alteration of the nitrogen cycle has approximately doubled the rate of nitrogen input to terrestrial systems (Vitousek et. al., 1997). Chemical fertilizers cause environmental problems in two ways. First, nitrogen fixation is extremely energy consuming (Socolow, 1999). The energy is today mainly derived from fossil fuels, thus contributing to global climate change. Second, in agriculture in the industrialised world the input of fertilizers (N, P, K) is commonly larger than the output of these substances in the crops produced (Granstedt, 1998). A large part of the fertilizers does not remain in the soil, but is leaking out of the agrosystem. This nutrient leakage is becoming a serious environmental problem. Nutrients are transported to water bodies and causing eutrophication, which might lead to harmful algal blooms, oxygen depletion, death of fish and loss of biodiversity (Sharpley et al., 2001; Vitousek et al., 1997). Also, nitrogen is leaking to the groundwater**,** causing nitrate contamination of aquifers, a widespread phenomenon in many rural areas of the world (Altieri, 1998; Agrawal, 1999).

For developing countries, the picture is somewhat contradictory. Fertilizer application rates have so far been low. Negative nitrogen balances and nutrient depletion in the soil are common characteristics (Sanchez, 1999; Bijay-Singh, 1995). At the same time, there is a need for increased yield levels per hectare to feed a poor and fast growing population. The fertilizers needed are often not available because of lack of economic resources.

However, increasing population and commercialisation of agriculture in these countries has led to dramatic increases in the use of chemical fertilizers over the last decades. The annual use is estimated to increase from 42 to 106 million tonnes nitrogen per year between 1990 and 2025 (Bouwman & VanderHoek, 1997), and there is a risk that developing countries in the near future will face deterioration of water resources with limited financial resources to tackle the problem (Agrawal, 1999; Lijkema, 1995; Tonderski, 1996).

2.2. Pesticides

The use of monocultures has not surprisingly lead to serious pest problems. The cultivation of one single crop in large areas constitutes a veritable smorgasbord for pests like insects and fungi. With no pest predator or parasite habitat present in a pure stand of crop, the pest species could not possibly have it better (Sullivan, 2001). This problem is particularly severe in tropical areas, because of the year-round growing season (Altieri & Rosset, 1997). The cure to this problem is presently the use of pesticides.

The knowledge of the risks of pesticide use gained public knowledge when Rachel Carson published "Silent spring” in 1962. This created a worldwide debate and a ban of many of the compounds previously used. Despite these undisputed facts, pesticides are today used globally and often extensively. The use has increased 26-fold during the last 50 years, although a decline has been shown the last years (Worldwatch Institute, 2000). The major reason for the increase is the notion that pesticides consistently have shown their worth by increasing global agriculture productivity, reducing insect-borne diseases and protecting/restoring plantations. Especially in developing countries in the tropical region pesticides are highly valued, thought of as a tool to enter the global economy by providing fruit and vegetables to countries in temperate climates (Ecobichon, 2001). However, due to genetically homogenous crops with lowered pest resistance, the reduction of natural pest enemy species and resistance to pesticides in pest species, pesticide use in agriculture is today often ineffective, and often causing more damage than good (Altieri, 1998). The dangerous reliance on pesticides causes the need for continuous development of new, more effective pesticides. Due to natural resistance in pest populations, the farmer soon has to use a new, even more effective pesticide. This keeps the farmer in what is known as the "pesticide treadmill" (Flint & van den Bosch, 1981).

The toxicity of pesticides has increased 10- to 100-fold since 1975, and even though many of the most toxic substances has been banned in the industrialised world, many of them are still sold to or manufactured in developing countries (Worldwatch Institute, 2000). This combination of factors has led to the consequence that the negative impacts of pesticides in developing countries today are very severe. The impact on human health is a continuously growing area of research. In 1990, the WHO estimated an annual worldwide total of some 3 million cases of acute, severe poisonings with some 220 000 deaths caused by the use of pesticides (Ecobichon, 2001).

Pesticides often have a severe impact on the environment. The agriculture itself is suffering from a decline in natural pest enemy species, evolved resistance and secondary pest outbreaks (Altieri, 1998). Together with a lowered decomposing ability due to a decline in microbial activity, the effects are depressions in plant yield. The impact on adjacent ecosystems is often very severe due to high persistence and poor methods of application, resulting in a loss of biodiversity (Castillo, 2000; Matson et al. 1997; Power, 1999). For instance in Costa Rican banana production, fungicides are applied by aircraft. Annually around 90 % or 10 million litres of these compounds do not hit their target but end elsewhere (Dahlerus, 1996).

2.3. Erosion

The practice of monocultures implies harvesting all the crops at the same time, leaving the soil more or less bare and vulnerable to climatic conditions, such as wind and rain.

The evidence found globally and throughout history is unanimous: deforestation followed by intensive agriculture and overexploitation of soils inevitably leads to erosion, which has both on- and off-farm effects (Jackson, 2002). The agriculture itself is affected by nutrient depletion with a following loss of productivity (Lal, 2000). Fertilizer and pesticide use depletes the soil of organic matter and microbes, which lowers the water retention capacity. As the soil loses its ability to hold water, groundwater runoff increases. This causes fresh water scarcity in often already scarce lands, and the high turbidity and input of nutrients cause severe damage to freshwater and coastal marine ecosystems (FAO, 1996).

2.4. Conclusion of impacts

Traditionally, these problem areas have often been addressed as individual issues, and therefore dealt with on an individual basis. The case, however, is more complex. As stated by Altieri (1998): “each ’ecological disease’ is usually viewed as an independent problem, rather than what is really is – a symptom of a poorly designed and poorly functioning system”. It is becoming increasingly evident that the focus should be on the use of monocultures, or the growing of only one type of crop. The practice of monocultures in both time and space has increased dramatically worldwide. In large-scale farming, monocultures are very common because of the ease of planting and harvesting. The inevitable consequences, however, are major problems such as lowered genetic diversity and resistance in crops, pest outbreaks, erosion and nutrient depletion as stated above. A change of the monoculture structure of agricultural systems should therefore be the most urgent and important component of an alternative management system (Altieri & Rosset, 1997).

3. Sustainable agriculture practices

”We are better off if we cooperate with nature and try to mimic the natural system, rather than competing with it” (Jackson, 2002)

Sustainable agriculture is a type of adaptive management, encompassing a number of techniques, which together will produce high yields in a more sustainable manner than industrialised agriculture. Many of the techniques are based on and use ecological functions and services already existing in the agroecosystem. The focus is on maintaining and improving the soil-microbe-plant-animal system – a holistic approach (FAO, 1998). Sustainable agriculture aims at creating a self-regulating system with the ability to buffer against disturbance. In this way, the system is based on preventing problems instead of curing them.

In the following section, we describe some of the most important techniques: intercropping, biological nitrogen fixation and integrated pest management.

3.1. Intercropping

Intercropping or multiple cropping is the growing of two or more crops in proximity to promote interaction between them. Yield decline caused by pests in intercropped systems is much less serious than in monocultures due to several factors. A diversity of crops does not provide a uniform background for pest multiplication. Crops grown simultaneously modify the environmental conditions so they are less favourable to the spread of certain pathogens, and enhance the abundance of predators and parasites, thus preventing the build-up of pests. Multiple cropping allows a more efficient use of available water, light, and nutrients (Sullivan, 2001; Altieri, 1999, Tonye & Titi-Nwel, 1995; Manrique, 1993).

Intercropping also provides a continuous vegetation cover of the land, especially when perennial crops are included. Thereby soil is protected from erosion, runoff, leaking and compaction. Other services include shading, water preservation and windbreaking (Manrique, 1993).

Agroforestry is a form of intercropping including trees. Trees serve as nutrient pumps in agroecosystems. They utilise nutrients from deep soil layers and this enriches the topsoil when leaves are shed. Many tree species used in agroforestry are also nitrogen fixing.. The products from agroforestry systems include - except food of various kinds - livestock feed, construction material, firewood, tools, medicines, etc.

Multiple cropping systems, and especially agroforestry systems, are important promoters of biodiversity as they commonly include a large amount of species (Rice & Greenberg, 2000). The layered structure is similar to tropical forests. An example from the Huastec Indians in Mexico shows a total of around 300 species in the system of agricultural fields, fallows, complex home gardens and forest plots (Altieri, 1999).

Crop rotation is the manipulation of crops between years, i.e. planting of different crop species at the same field but during different growing seasons. Benefits are similar to those of intercropping systems (Sullivan, 2001).

3.2. Biological nitrogen fixation and organic matter enrichment

There are several alternative techniques to satisfy the nutrient and organic matter requirements of the soil without using inorganic chemical fertilizers. Biological nitrogen fixation offers an economically attractive and ecologically sound method and is the most important alternative to chemical fertilizers (Bohlool et. al, 1992; Döbereiner et al, 1995). Intercropping and rotation cropping is commonly made with nitrogen fixing legumes. Nitrogen-fixing bacteria can be introduced in the soil to enhance nitrogen availability to both leguminous and nonleguminous plants. In Cuba, large-scale production and use of *Azotobacter* – free-living, nitrogen-fixing bacteria – are estimated to supply more than half of the nitrogen needed by nonlegumes (Oppenheimer, 2001).

Brazil has become the world leader in replacing chemical fertilizers by biological n-fixation; mean value of N application is as low as 10 kg per ha. Agriculture in Brazil is one of the main export activities, with soybeans the largest export product of the country (Döbereiner, 1997).

Crop residues from both legumes and nonlegumes can be returned to the soil after harvesting (green manure), thereby both enriching the soil with nutrients and increasing its organic matter content (Phirke et al, 2001). This practice is also beneficial to the microbial activity of the soil. Plants with high nutrient uptake capabilities (e g *Sesbania*, the sunflower *Tithonia*) can be grown and ploughed into the soil (Oppenheimer, 2001, Sanchez, 1999). Animal manure, compost, and mulching are also used in the same manner.

3.3. Integrated pest management

The philosophy of Integrated Pest Management (IPM) can be defined as ”a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health, and environmental risks” (US National IPM Network).

The aim of IPM is not pest eradication, but the control of pest outbreaks (Begon & Harper, 1996). This is done by the PADS approach: Prevention, Avoidance, Detection and Suppression (Stall, 1999). Prevention includes tactics as using pest free seeds, preventing weeds from reproducing and cleaning of farming equipment. Avoidance is used when pest species occur, but their impact can be avoided by some cultural practise. These includes crop rotation (avoiding pest host crops), choosing genetic resistant crops, using trap crops or avoid planting crops where pest species are most likely to occur. Detection of pest species is conducted by trapping, weather monitoring, soil testing and scouting programs. The final step, suppression, should always be succeeded by detection, and should only be used if the first steps are not successful. This is conducted by using cover crops and movement of fields.

Biological control, which should be considered as an alternative to conventional pesticides, can be used where long-term control is necessary. Chemical pesticides are seen as the final step, and should only be used if the cost-to-benefit ratio allows it. Application should be precision targeted and based on least negative effects. To avoid resistance, the same chemicals should not be used continuously in the same field. The positive effects of IPM on biodiversity both in and on farms have also been shown in several studies (Pekar, 1999; Suckling et al., 1999).

3.4. Production in sustainable agriculture

Evaluations of yields and productivity have commonly found that sustainable techniques produce less than industrial agriculture. These studies have had a tendency to evaluate one single technique only. This underestimates the full potential of sustainable agriculture, as the system is based on positive interactions leading to synergistic effects (Pretty, 1999). Nevertheless, there is evidence for yields of the same magnitude in sustainable systems compared to industrial systems, also when evaluating single techniques. For example, the yields in terms of harvestable products are generally 20-60 % higher in multiple cropping systems compared with monocropping systems (Altieri, 1999). The use of IPM has shown increased yields and profits in several investigations (Fernandez-Cornejo, 1998). To fully measure success, broad studies including many different techniques should be carried out. Surprisingly, there is a general lack of this type of investigations, especially from the tropics. The reason for this may be that sustainable agriculture is a fairly new, still controversial area, even among researchers. However, as described below, the turbulent international political climate in the late 80s forced Cuba into a large-scale conversion in food production. This case study constitutes an example clearly illustrating the possibilities of sustainable agriculture implemented on a large scale.

3.5. Case study: The Cuban example

The agricultural revolution in Cuba that has taken place in the last decade is perhaps one of the best examples today showing that alternative agricultural methods can work and support adequate food supplies for an entire population in a country.

After the Cuban revolution in 1959, Cuba became tightly connected to the Soviet Union in terms of trading and import, partly because of the US trade embargo (Rosset, 2000). Due to favourable terms of trade and other kinds of support, the country went through a rapid modernization process. The agriculture was defined by extensive monoculture systems, which demanded a high input of imported chemicals, modern machinery and petroleum. Sugar canes and derivatives constituted around 75 % of the countries total export (World resources, 2001). The average price obtained from these products when exported to the Soviet Union was 5,4 times higher than the average world price (Rosset, 2000). The result of this agro-economic expansion was that Cuba in the mid 1980:s exceeded most other Latin American countries in nutrition, life expectancy and GNP per capita (World Resources, 2001).

But in 1989-1991, because of the collapse of the Eastern block, all of this changed. Cuba lost 85 % of its trade (World resources, 2001).

And what was perhaps worse, the import of oil was reduced by 53 %, grain import was reduced by 50 % and the availability of chemical pesticides and fertilizers was reduced by 80 % (Rosset, 2000). This resulted in a major threat to the country's access to basic food supplies. The number of undernourished increased from 5 % to 20 % (World Resources, 2001). To avert widespread famine, Cuba had to find a way to produce twice the amount of food with just half of its previous agricultural inputs. The government stepped in and declared the "Special Period in Peacetime", and adopted a management practise known as Low Input Sustainable Agriculture (Oppenheim, 2001). This is organic/semi-organic agriculture using intercropping, crop rotation, IPM and no chemical pesticides or artificial fertilisers. Other major changes were the use of oxen's instead of tractors, and the implementation of urban agriculture (World Resources, 2001).

The fastest response to the change came from subsistence farmers, who controlled about 20 % of all farmland (Rosset, 2000). State farms had more problems in adapting to this new type of management, mostly because of low worker productivity. The government began experimenting with a program designed to "link people with land", which finally resulted in a radical shift where 80 % of all state farmland was turned over to Basic Units of Cooperative Production (UBPCs). By ownership came responsibility and the negative trend was turned. By mid-1995 the food shortage had been overcome, and food could be distributed to the major part of the population. In 1996, ten out of thirteen basic food items reported highest-ever production levels (Rosset, 2000). A major part of this increase came from subsistence farmers who contributed to 40 % of the national food supply (World Resources, 2001). Cuba's economy was again back on track, but this time in a much more sustainable manner.

What then made this spectacular conversion possible? A number of different factors working together created the possible climate that enabled this smooth change of management to be implemented. First, the lack of pesticides and fertilisers demanded an alternative solution. Second, a deeper, ideological issue was involved. In the Cuban scientific community, many scientists had become disillusioned with conventional farming methods, and especially the overuse of pesticides. Because of the tight connection to the Soviet Union and their financial support, Cuba had 11 % of the Latin American researchers, compared to only 2 % of the total Latin American population (Rosset, 2000). This scientific community could come up with new sustainable methods in pest and soil management (Oppenheim, 2001). Third, quick adoption by the subsistence farmers was possible due to the reintroduction of traditional farming practices, for instance in insect pest management. The old knowledge still existed, since it was the conventional method used only one or two generations back in time. Fourth, the introduction of UBPCs and the following economic shifts created, where the farmers became owners of what they produced, created opportunities to make effective use of the new technologies (Rosset, 2000).

The focus on local production and small-scale agriculture is a very important issue, when discussing food security and self-sustainability. When not being dependent on international sugar prices and turns in global economy, a more sustainable local socio-economic and environmental development could be introduced.

4. Discussion and conclusions

In view of our previous findings, we strongly believe that sustainable agriculture is a valid alternative to industrial agriculture**.** The growing base of evidence pointing out the hazards of industrial agriculture and how sustainable agriculture can avert these problems, should be enough to convince farmers of what the choice for the future must be. This means that the focus of future studies has to be somewhat redirected towards a more holistic approach. When evaluating agricultural systems, there has been a tendency to focus on yields only. Whether sustainable agriculture can produce yields high enough to feed the planet for the future has been the main issue of debate from critics (DeGregori, 1996; Pretty, 1999). As stated in previous sections, there is evidence for yields of comparable magnitudes. When making the transition from conventional agriculture, yields often decrease at first, thus creating a lowered profit for the farmer. But as soil fertility improves and pest predator numbers increase, yields appear to increase (Pretty, 1999). However, it is very important to recognize that yields alone are not a sufficient measure of success in agroecosystems. To ensure a long-term food production all aspects of sustainability, like soil productivity, biodiversity conservation and food security must be evaluated.

In terms of food security, sustainable agriculture is probably a better option for a number of reasons. World population growth is most rapid in developing countries, where also the problems with poverty and starvation are dominant. There is a general understanding that food production must increase, and that the increase has to come from existing farmland. Increase in population and food shortage, higher aspiration levels and other socio-economic factors seem to favour the highly productive, industrialised agriculture. However, budgets for these high-input systems are small in developing countries and modernization programmes have often failed (Badejo, 1998). To address hunger and malnutrition, it is not only necessary to produce more food, but it must be available for those who need it (Altieri, 1999). Since most hungry people are poor, even if modern technologies - such as mechanization, fertilizers and pesticides - are available, farmers simply cannot afford them (Pretty, 1999). Small-scale, low-cost solutions based on existing resources have to be found. Such innovations should enable farmers around the world to increase productivity enough to feed the world's burgeoning population for the next 40 or 50 years, without increasing the use of chemical inputs (Bunch, 1999).

Sustainable agriculture using practices of intercropping also functions as an insurance strategy. Planting several species and varieties of crops stabilises yields over the long term and promotes diet diversity (Pretty, 1999).

Why is then the impact of sustainable agriculture so small, if it repeatedly proves to be a better alternative? There are clearly a number of constraints preventing a large-scale implementation.

Since sustainable agriculture is based on the natural preconditions, extensive knowledge of the farmland is a necessary component. This makes sustainable agriculture difficult to apply at a large scale. The development on Cuba is an apparent example of this, where the conversion to small-scale farming proved to be a very important part of the positive development.

Further, sustainable agriculture is a low-input system. Companies selling chemical substances like pesticides and fertilisers are very interested to promote large-scale high-input agriculture, thus gaining a large profit. The use of such chemicals has been a prerequisite to get funding from institutions such as International Monetary Fund (IMF) and the World Bank, as they are viewed upon as a guarantee for high production.

One of the biggest constraints to the development of sustainable agriculture is that many scientists, politicians, extension officers and other decision makers often believe that alternative agriculture is not a feasible option to improve food security (FAO, 1998). This means that individual farmers will have difficulties in obtaining information about this management system. It is therefore crucial that more effort is put into scientific research studies, evaluating the benefits of converting to more sustainable techniques. This information then has to be spread outside the scientific community in such a way that it eventually can reach decision makers and the individual farmers.

In spite of the success of the Cuban agricultural conversion, uncertainties of whether it will persist remains. There are speculations that the organic revolution in Cuba may dissolve when economy improves and trade barriers are down. It is therefore important that the international community supports the system. Whatever the future outcome, it is important to remember what the Cuban example has shown us, in terms of the possibilities of converting to an alternative agricultural method on a national scale in a tropical country.

When discussing the future of sustainable agriculture, it is important to decide what the main objectives should be. We should perhaps not look for a total ban of chemical pesticides and fertilisers, like many advocates of organic agriculture are doing. There are areas in the tropics that experience pest outbreaks, which may demand the use of strong pesticides to protect the harvest. In certain tropical areas, the natural nitrogen level in the soil is so low, that to be able to grow certain crops, the use of artificial fertilisers may have to be included into management principles.

We have to decide what we are striving for with agriculture. The goal should obviously be to minimize negative impacts on the environment and human health, and at the same time have yields enough high to support the population of today and the future.

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