AgroLife Scientific Journal - Volume 2, Number 1, 2013
ISSN 2285-5718; ISSN CD-ROM 2285-5726; ISSN ONLINE 2286-0126; ISSN-L 2285-5718

WHAT ARE THE OPTIONS TO ENSURE A FUTURE SUSTAINABLE NUTRIENT SUPPLY?

Huub LELIEVELD

GHI Association, c/o Dept. Food Science & Technology, Universität für Bodenkultur, Muthgasse 18, 1190 Wien, Austria. Phone: +31 30 22 53 896, Fax: +31 84 74 68 555, E-mail: huub.lelieveld@globalharmonization.net

Corresponding author email: huub.lelieveld@globalharmonization.net

Abstract

A billion people are starving or severely undernourished but migration from rural areas to cities will not alleviate this. The situation can, however, be significantly improved by focussing on the actual problems where they occur and address these problems, using the vast amount of knowledge and experience that can be made available and by applying affordable technologies, such as needed for irrigation and reducing post-harvest losses. This cannot be done, however, without teaching the population also how to do this. In addition, smallholder farmers need to learn that cooperation will strengthen their position in negotiations conditions with traders. In areas where food production is scarce, arable land should not be used for breeding of animals for meat as it will be at the expense of growing crops, delivering at least five times less food per surface area. All children should receive at least primary education to ensure that knowledge is retained and will continue to be applied in the future.

Key words*: nutrient, food, agriculture, education*.

INTRODUCTION

Of the roughly seven billion people on earth, almost one billion do not have access to sufficient food and about 10% have no access to safe water. Globally, 17% of preschool children are underweight, with 28.5% stunted (United Nations System - Standing Committee on Nutrition, 2010). There are many organisations in this world that have been founded to improve this situation and sometimes it looks like there is some progress – globally, but the real problems largely are very local. There are areas where at times, people literally have no food at all and starve by the thousands a day. There are areas where the population has food in terms of calories, but lack much of the essential nutrients. There are areas where water is rare and if available it is far from safe and morbidity and mortality is high. Regrettably, with the way the world at large takes care of its resources, the people who do have enough today may also have to struggle for nutritious food and sufficient safe water in the future.

While organisations of the United Nations look at the global situation and advise what governments may do to alleviate the above problems, this article focuses on issues that can be solved without decisions of the UN, by trying to correct situations that make matters worse and discuss options to improve the availability of food, nutrients and water by means that are available today. The present ways do not provide for a sustainable future. Also, however, the past does not offer solutions for all foreseeable future problems, but past experience in combination with new insights may offer applicable, practical solutions.

Some populations are rich, but they do not know. They seem not to know that the soil on which they live, combined with the sun, water, labour and cooperation would provide them with their needs and more. Learning from others is a must, undue dependence on others is undesirable and should stop – there is no need for poverty.

GROWTH OF FOOD AND THE NEED OF PRESERVATION IN VARIOUS AREAS IN THE WORLD

Sometimes food and feed grow, sometimes they do not. Food and feed must be preserved to provide for the times that it does not grow. Growth and the need for preservation depend on local conditions. People live in areas that differ dramatically with respect to climate and consequently with the availability of water and the growth of food and feed. There are very fortunate areas, where there is always sufficient and often even overproduction. Other areas have sufficient production, be it not during the entire year. The third category consists of are large areas where regrettably the growth of food and feed is never sufficient and where a large part of the population is starving.

Areas with always sufficient food and feed and with even overproduction

- No need for preservation, because the local population has always access to enough fresh food.
- Fresh produce that is not needed by the local population may be exported to neighbouring areas.
- Another part of the surplus may be preserved for export to other places.

In these areas there should be no food in-security for anybody and the availability of safe water for drinking and food preparation may be expected to be sufficient too. Food related problems are likely obesity and possibly lack of some essential nutrients, resulting from bad eating habits. Nevertheless, care must be taken that also in the future there will be enough. This requires for instance that the soil is not exhausted or polluted, making the land unfit for future agriculture. Similarly, water sources should be protected from contamination and exhaustion, e.g. by irresponsible diversion the course of water for industrial reasons.

Areas with sufficient food and feed production

- Preservation for non-production months.
- Any surplus of preserved food may be exported.

Proper management should ensure that there is enough food available throughout the year, by not wasting the surplus of the production months. This of course requires proper preservation technologies. Preserved food may, however, provide sufficient energy, but may be lacking sufficient concentrations of essential nutrients. Most preservation methods reduce the concentrations of nutrients, although in some cases they make more of the nutrients available to the human body.

Areas with insufficient production of food and feed

- Need to import preserved food.
- Focus on vegetable food, minimising the need for feed.
- Locally applicable irrigation methods should be introduced.
- Even unpreserved, food and feed may be kept for days, weeks or even months, if properly stored.
- To improve yields, “greenhouses” may be developed that are simple and efficient.
- When food needs to be transported, product losses should be reduced to a minimum by preserving the food before transport (e.g., by drying) and by using means that do not damage the preserved food.

This applies to large areas in particularly Asia and Africa and the problems often are severe due to the climate and uncertain weather conditions, which may cause lack of water for very long periods and a massive abundance of water for very short times. Although is may be very hard to cope with the sometimes dramatic abundance of water, technologies may be used to cope with drought, technologies that have been successful in the past and may be even more successful today, if adapted to local circumstances. Greenhouses may be used to reduce water evaporation and provide protection from birds and some insects. Greenhouses need tot be complicated and expensive if locally available materials are used and the farmers learn what to do and how. Much of successfully produced food, however, is lost due to improper storage and transport, damaging the food and thereby causing the food to wilt and spoil by microbes. Improper storage may also lead to growth of moulds and the accompanying production of mycotoxins, which may make the food unfit for consumption. Locally available materials, in particular branches of trees and sturdy leaves may be used as construction materials for stockrooms and crates. All these are known technologies.

PRODUCTION AND PRESERVATION OPTIONS – PAST, NOW AND OPTIONS FOR THE FUTURE

FISHERY

Fish is an important source of many essential nutrients and a good source of protein. Growing fish is a more efficient way of producing protein than meat or even crops, but fishery needs to be done in a sustainable way.

Coastal countries and those with rivers used to gain much if not most of their food from the water and during the ages, people learned how to preserve food for times when the catch is less than needed. The simplest method was and still is drying in the sun, provided there is enough sun. When dry, food remains safe because microbes need water for their growth. Other methods include salting, which basically is also a matter of reducing the water activity of the food; fermentation, where harmless microbes produce acids and antimicrobial substances that inhibit harmful ones; and smoking, which has several synergistic effects, such as reducing water activity, inactivation of surface microbes and depositing bactericidal substances on the surface. These traditional methods worked well and still work well. With increasing knowledge of how these methods work, they can be applied more effectively. Fishermen, their families and communities should therefore not have problems with the availability of healthy food. Increasingly, however, there are such problems and the cause if simple: governments sign away fishing rights to other nations that have large vessels and modern equipment. The resulting over-fishing of - in particular pelagic - fish, often dramatically reduces the catch by the local population. In addition, it deprives sea birds and water animals their food, disturbing the food chain. The revenues go to governments, not to suffering local populations. Such governments should be coerced, one way or another, to stop signing away fishing rights. They ought to respect the rights of the local population to their fishing grounds and thus any agreement should **seriously** take into account the needs of the local population and ensure that fishing grounds would not be overexploited. This will not only require correct agreements, but also adequate inspection of the fishing vessels. An alternative way of securing enough food is by fish farming under carefully controlled and tested conditions, as is the case in Kenya right now.

AGRICULTURE

While about a billion people depend mainly on fish, most people depend on agriculture and agriculture depends on the availability of soil, sun, water and energy, be it from labour or mechanical means. Some countries have a nearly perfect climate, but most have not and depend for their food supply on the periods in the year that there is enough sun, water and the right temperature. Farming has been practised for more than ten thousand years and all over the globe, cultivating food rather than just gathering it from what grows in the wild. It made it easier to ensure the availability of food in times that it would not grow. Although many crops can be stored for long times without preservation, people also discovered that such food alone was not enough to stay alive. Staple foods often lack sufficient essential nutrients. It is likely therefore that in conjunction with the development of agriculture therefore also preservation methods were discovered and of course initially just drying. With many staple foods such as cereals, drying works, and many cereals are naturally dry enough to be properly preserved. Nevertheless, care must be taken that the product remains dry enough to prevent the growth of moulds, meaning that the relative humidity should remain below 50%. Many moulds produce toxins that can be very harmful if ingested. If the concentration of mycotoxins is very high, consequences may be immediate. In low concentrations these toxins may cause cancer, which in the past nobody knew (and anyhow, most people did not get old enough to develop cancer in the first place). It is estimated that approximately 50% of the world production of cereals becomes unfit for consumption due to the presence of too high concentrations of mycotoxins, obviously a severe problem that threatens the availability of staple food. Preventing too high humidities in stored grains, and equally in other products preserved by drying, require understanding the migration of water from warm to less warm areas in the bulk of the food. Most farmers would not understand this and might have

blamed and probably still blame spirits or curses by enemies or witches for the spoilage of their stocks. It is therefore important to teach farmers and because large numbers of farmers are illiterate, teaching should be by pictorials rather than texts. To improve the situation for the future, children should be educated, to learn to read and write. Obviously, mankind also discovered other preservation methods, such as salting, fermentation and later, artificial acidification. Self-evidently, the food should also be adequately protected from insects and other pests.

It is a good thing to have these preservation methods if there is enough to preserve, but there are many areas, such as in sub Saharan Africa, where there is nothing to preserve, because the production is insufficient even for todays meals. In these regions, irrigation is required but chronically insufficient and people either starve or depend on sustenance by others. One way of irrigation is diverting water from rivers to the farming area and another traditional way of irrigation is digging wells and use buckets to get the water to the surface, to be used for drinking, preparing food and irrigation. It is deplorable that governments sign agreements with companies to allow them to dig deep wells to source water for bottling and export. This leads to dramatically lower levels of groundwater, making it inaccessible for the local population. The governments are either ignorant, in which case there is hope that they would change their policy, once they have been made to understand, or they willingly ignore the rights of their population to water and deny them what they need for drinking, preparation of food and irrigation.

Understanding the properties and migration of water may help alleviate the drought problem. Even in very dry climates agriculture is possible and even without high-tech solutions although high-tech solutions may help if affordable. Firstly, there are crops that need little water and are capable to retain any water that has been captured for a long time. Further, irrigation on small scale is possible, e.g. by applying drip technology, delivering the scarce water where it is needed, at the roots of the plants. There are also simple but effective condensate technologies, such as the small-scale airdrop technology (Ed Linacre, 2011). On a larger scale permaculture technology may be applied (John D. Liu, 2012).

Nutrient deficiency may be addressed by selecting crops with a higher concentration of the required nutrients and by improving bioavailability of nutrients that tend to be retained by the plant cells while passing the digestive tract, as a result of the strength of cell membranes, which have evolved to protect the contents of the cell. Here novel technologies may help, such as in particular pulsed electric field (PEF) treatment, which is based on the used of electric pulses with a duration of 2-3 microseconds. The principle and the application of PEF for preservation of food are described in Lelieveld *et al*. (2007). Recently, however, the technology has found another application, cooking. For millions of years, perforation of the cell membranes required chewing, for most of the day. The discovery of fire, less than 100,000 years ago, changed that. Heating of the food for a few hours also destroys cell membranes. The next step is the use of PEF that too destroys membranes and at the same time can be used to heat the food to the adjusted, desired temperature. The entire process needs less than a second and neither flavour nor nutrients are destroyed. The energy needed is in the order of 10% or less of what is needed for traditional cooking. Almost all parts of vegetables and fruits can be used, but nevertheless, much is wasted. Here scientific input about the constituents and how to separate them may help. As discussed above, PEF treatment perforates plant cells, facilitating also harvesting intracellular constituents.

Globally, about one-third of the food produced is wasted. In low-income countries food is mainly lost during the early and middle stages of the food supply chain, while much less food is wasted at the consumer level. In medium- and high-income countries food is to a great extent wasted at the point of consumption, even if it is still suitable for consumption (Gustavsson et al., 2011). Is seems likely therefore that between 30 and 50% of food is wasted between harvesting and delivering to the local market. Agricultural products are prone to mechanical damage and if damaged it may become unpalatable. A part of the losses may happen during storage at the production site, but a larger proportion may be lost during

transport. There must be ways to protect the products using locally available materials and some efforts to convert these materials into protective contraptions.

ANIMAL HUSBANDRY

The use of animals to produce food for human consumption is very important in many countries. Traditional products include milk from a variety of animals, eggs from birds and meat. Milk from all sources usually can be preserved by fermentation with lactic acid bacteria, yeasts, moulds or combinations thereof, resulting in products like yoghurt, kefir and a variety of soft cheeses. These products remain safe for a few days to several weeks, depending on the conditions of storage, particularly of course on the temperature. For longer-term preservation, making hard cheese from fermented milk is a good solution, because properly stored cheese can be kept for a very long time. The animals, however, need feed and where feed is grown, there is no growing of food. Because animal products contain several essential nutrients, most importantly vitamin B12, animal husbandry is important in places where there is no or very limited availability of fish or other seafood. The conversion of feed into protein and energy by animals, however, is very inefficient. To produce 1 kg of animal, 5-20 kg of feed is needed (National Research Council, 2000), which in principle could also be healthy food. Because of this inefficiency, the cultivation of animals for production of meat is not sustainable and should be discouraged. Animals, raised for production of milk and eggs, when no longer capable of production, however, need not be wasted and hence a moderate consumption of meat is acceptable, also on the long term.

EDUCATION

Many people in low-income countries cannot read or write and therefore, instructions to increase production, reduce production losses and avoid food related diseases should be with pictures. Children, however, should learn to read and write. Primary education must be strongly encouraged, universally.

Where conditions are harsh, the population must be taught that migration to cities is very unlikely to improve their situation, that instead conditions are very likely to become harsher, not better. It is understandably a difficult task, but a crucial one to remediate poverty. At the same time they need to be made to understand taught that applying affordable techniques for agriculture will yield what they need locally for themselves and for others in their community and they may also be able to produce even more to feed those who live in cities. To teach all this, appropriate teaching materials evidently must be developed and made available.

Smallholder farmers need to learn that cooperation among them may help to negotiate better conditions when selling their products to traders. Cooperative marketing is the best practice for smallholder farmers and therefore this should be stepped up and encouraged in many countries.

There are many technologies to make water safe for drinking and use in food preparation (Voigt, Jäger and Knorr, 2012). It again is a matter of teaching, making these technologies known and then also accessible.

The International Union of Food Science and Technology (IUFoST)

There are many solutions to problems that farmers face. The farmers, however, usually are not aware of the technologies that may provide efficient and affordable solutions. Local experts may be invited to identify the largest problem causing harvest failures in their region and have that problem discussed and solved by groups of experts, from wherever on the globe, based on use of locally available labour and materials. The International Union of Food Science and Technology (IUFoST) is a global organisation that may be instrumental in setting up such groups of experts, as IUFoST has access to more than 300,000 food scientists and technologists. IUFoST is keen to do what is in their capacity to improve global and sustainable nutrient security as can be concluded from the IUFoST Cape Town Declaration (http://iufost.org/cape-town-declaration, accessed 19 May 2013).

CONCLUSIONS

It is disappointing that in 2013 there are still a billion people who are severely undernourished, while “the world” is aware of the lack of access

to food and water to so many people, for many decades, while also so many programmes have been set up to address these issues. The on-going discussions in the United Nations to monitor and evaluate the situation in the world and to develop new programmes, should not withhold the people from alleviating their problems by applying appropriate and affordable technologies, assisted by experts with experience in similar situations elsewhere on the globe. Experts may teach teachers who in turn can teach farmers what they can do and how. Meanwhile, everybody should exert pressure on governments and indeed the UN to become practical and promote primary education of children, to make them illiterate and capable even perhaps of teaching their parents. Governments should be pressed to stop selling rights to water and food (especially fish) to other nations and companies for the benefit of themselves and shareholders, denying their own citizens these rights. Experts in countries with undernourished populations should identify the most pressing issues and discuss these issues with experts from all over the world – they are there and many of them are accessible. In addition, there would be more progress if governments would stop wrongdoings: abusing people and resources. Governments should impose a penalty on greed and impropriety. Governments have the power to do this – if they care, dare and cooperate – globally.

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