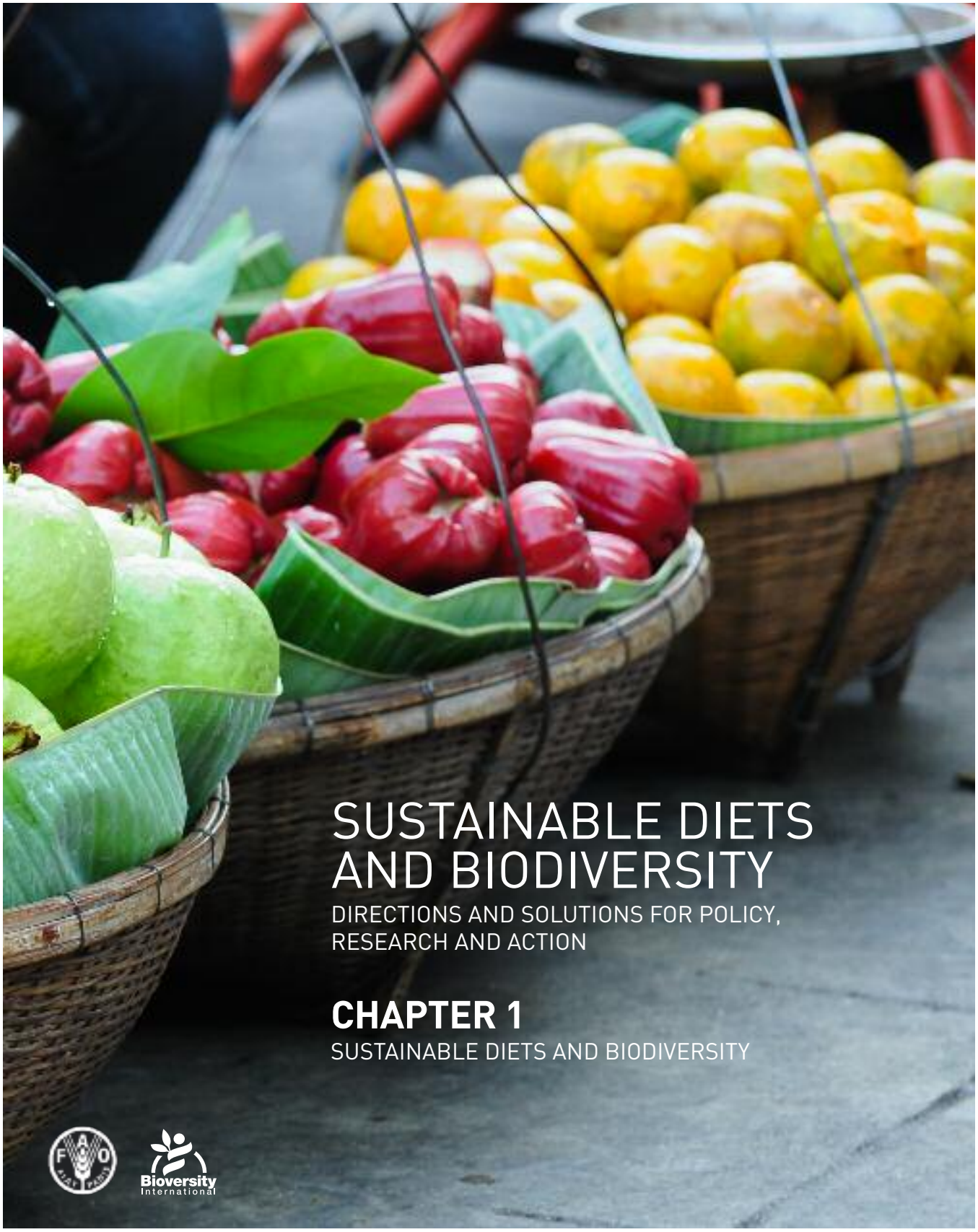

SUSTAINABLE DIETS AND BIODIVERSITY

DIRECTIONS AND SOLUTIONS FOR POLICY, RESEARCH AND ACTION

CHAPTER 1

SUSTAINABLE DIETS AND BIODIVERSITY

Bioversity International

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BIODIVERSITY AND SUSTAINABLE NUTRITION WITH A FOOD-BASED APPROACH

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Abstract
It is time to face the evidence of a worldwide unsustainable food system. Its complexity makes it extremely fragile to any climatic, socio-economic, political or financial crisis. Thus, we urgently need appropriate understanding and new strategies to really accommodate present and future population needs and well-being. In that context, we need sustainable diets, with low-input, local and seasonal agro-ecological food productions as well as short-distance production-consumption nets for fair trade. Cultural heritage, food quality and culinary skills are other key aspects determining sustainable dietary patterns and food security. Nutrition education about appropriate food choices remains essential everywhere. It thus appears very urgent to profoundly change our food strategy and to promote fair, culturally-appropriated, biodiversity-based, ecofriendly, sustainable diets. Authorities should urgently assume their responsibilities by orienting and supporting the appropriate and sustainable foodstuff productions and consumptions in all parts of the world.

1. Introduction

As the President of the Federation of European Nutrition Societies (FENS), gathering national nutrition societies of 24 countries in Europe, I was very pleased to have the FENS as one of the organizations associated to the International Scientific Symposium "Biodiversity and sustainable diets united against hunger", organized at FAO headquarters in Rome, 3–5 November 2010.

At the beginning of this new millennium, we are still facing an alarming challenge. One billion poor people still suffer from hunger and malnutrition while about 2 billion show undernutrition and micronutrient deficiencies (FAO, 2011). At the same time, about 2 billion are overweight and/or obese, a steadily increasing number in all countries in the world (WHO, 2011).

This double burden is found in both poor developing countries as well as in Brazil, Russia, India and China. It is noteworthy that an important fraction of the population in industrialized countries is suffering from poverty too and inadequate food and nutrient intakes. The recent trends for these patterns are quite alarming (CDC, 2011) thus highlighting the overall inadequacy of food supply and dietary patterns during the last decades and present time worldwide. For a few decades only, a multinational, industrial agrofood system developed worldwide that has progressively shifted producer activities as well as consumer demand and attitude. It has been clearly shown that low-cost foods are those energy-dense (fat- and sugar-rich) and nutrient-poor (Maillot *et al.*, 2007), inducing both deficiencies and overweight consequences of inappropriate food choices driven by household income and education level. The drastic changes that recently occurred and presently occur in most countries seem to originate in the erosion of the traditional ways of life and culture as the new "Western/North American" food model and system spreads over the world. This "modern" trend is now clearly facing the challenge of sustainability, both in terms of land use for food production, farmers' income and poverty, water availability, pollution of the environment by chemicals and pesticide residues, fossil energy decline and cost, environment and biodiversity degradation, climate change and global warming. As discussed below, this global challenge (Godfray *et al.*, 2010) urgently needs appropriate understanding as well as new attitudes and appropriate strategies from the research and development sector and stakeholders to really accommodate present and future population needs and well-being.

2. Facing the evidence of an unsustainable food system

Indeed, the present food production, food supply and food consumption system does not generally fit present and future human needs, because it is unable to satisfactorily feed everybody and relies on high

fossil energy use, chemicals, and energy inputs, long-distance transport, low-cost human work and cultural loss. It generates both micronutrient and fibre deficiencies as well as excess intakes of fat and sugar promoting overweight and obesity in a general trend of reduced physical activity and body energy expenditure. Food choices and their determinants are in fact central to the present situation. It is well known that they are increasingly driven by the world-wide economic sector through industrialized production simplification, generalized intensive food processing and refining, aggressive food distribution and advertising. In contrast, they are progressively less influenced by the local cultural heritage and a suited integration in the environment.

This very new food system has been developing since the mid-twentieth century, i.e. two human generations ago only, and it is known to generate large greenhouse gas emissions and promote marked alterations of ecosystems such as biodiversity loss, deforestation, soil erosion, chemical contaminations, water shortage. Specifically, it is widely based on a very low diversity of cultivated food crops and cultivars/breeds and an apparent but limited variety of foodstuffs purchased, processed and consumed. Despite an apparent opulence, the complexity of the present food supply system makes it extremely fragile to any climatic, socio-economic, political or as recently financial crisis (Brinkman *et al.*, 2010). This very recently happened with the rice financial crisis with prices increased fourfold in a few months in 2008 highlighting implications of high food prices for global nutrition (Webb, 2010) or with the 2011 earthquake in Japan that emptied food stores within 3 days in highly urbanized areas.

The high energy content of most food consumed can fit the important needs of people with a high energy expenditure but is in excess for most urbanized sedentary people. In addition, the low nutrient/fibre density of generally consumed food (raw and processed) is a widely acknowledged concern in all countries. As an example, the fibre, mineral, vitamin and anti-oxidant content of wholewheat bread compared with refined-wheat bread is about three to fourfold higher for the same amount of energy. The proportion of animal food (especially processed meat and full-fat dairies) is generally in large excess compared to minimal needs and markedly raises the cost of the daily diet (Maillot *et al.*, 2007).

3. An urgent need for sustainable diets

There is thus an urgent need to launch a new strategy to develop the concept and use of sustainable diets in the various contexts of industrialized and developing countries, to ensure food security and quality. Such systems should be based on low-input agro-ecological staple food production including limited animal husbandry, short-distance production-consumption nets, minimal food processing and refining, important culinary skills, diet and nutrition education, and firm links to positive traits of ancestral local cultures as well as appropriate use of recent technology tools. Biodiversity improvement appears to be a key for sustainable food production and food consumption.

3.1 Low-input agro-ecological food production

Since the origin of agriculture until the nineteenth century, the food production systems in very different geo-climatic contexts all over the world were low-input, ecologically integrated by necessity. Impressive skills have been developed over millennia and centuries to adapt to the specific environments and available means, and improve farming methods to sustain human development. While this process allowed the human species survival it was not sufficient to provide anybody appropriate food any time. This facilitated the emergence in the twentieth century of the intensive industrial agriculture system based on high fossil energy and chemical use. Although yields improved in the short term, present limits and persistence of one billion undernourished request new orientations, in the context

of the rapid and important increase in the population in some parts of the world. In fact, it has already been advocated through a conference co-organized by FAO (El-Hage Scialabba, 2007) that appropriate agro-ecological food production systems can perform better (around 180%) than agro-industrial ones to provide food to people in developing countries by combining traditional knowledge and skills with more recent concepts and means. This could allow the necessary improvement in staple foods yields in a sustainable way protecting natural and cultivated biodiversity as well as avoiding poisoning of ecosystems and humans. This has again been recognized by the O. De Schutter, UN Special rapporteur on the right to food by stating: "Small-scale farmers can double food production within 10 years in critical regions by using ecological methods. Agro-ecology is an intensive-knowledge approach: it requires public policies supporting agricultural research" (De Schutter, 2011). In industrialized countries, agro-ecological food production systems, generally called "organic" and supported in Europe by the Commission already represent 10 percent or even more of the agricultural sector and prove to be efficient to provide quality food with reasonable yields while respecting environment. It is a sounded approach towards the necessary need to integrate nutrition and ecology (McMichael, 2005).

3.2 Local production and short-distance production-consumption nets

To produce locally most staple food is the best way to ensure food security and to avoid disturbances due to globalization and international uncertainties. In line with the above points, this implies to grow productions in season with minimal inputs to improve sustainability. This would stimulate the search for adapted species and varieties and thus increase cultivated biodiversity.

These seasonally produced foods should be better consumed locally. This will optimize the flavours, tastes and nutritional quality of those foods harvested at top maturity and thus will favour their consumption (especially for fruit and vegetables). Short-distance purchases would limit transportation energy use and direct sales from farmers to consumers through new local organizations is the best way to get good prices in a fair trade as well as knowledge, understanding and confidence, thus the best way to reconcile the urban citizen and producers and be a better part of the whole ecosystem.

3.3 Food quality, culinary skills, dietary patterns and nutrition education

As introduced before, an overall food quality is a prerequisite for an optimal nutrition.

Regarding produced raw food, an optimal quality lies in tasty products, with high nutrient content and no/minimal contaminations by chemical toxicants. The products raised through the agro-ecological methods such as certified organic ones generally fit these two requirements by improving the dry matter and some nutrients contents and minimizing chemical and nitrate contaminations as recently reviewed (Rembialkowska, 2007; FSA, 2009; Lairon, 2010).

Minimal processing can be one of the best ways to keep original flavours and taste, without any need to add artificial flavouring or additives, or too much salt. This would also be the efficient way to keep most nutrients, especially the most sensitive ones such as many vitamins and anti-oxidants. Milling of cereals is one of the most stringent processes which dramatically affect nutrient content. While grains are naturally very rich in micronutrients, anti-oxidants and fibre (i.e. in wholemeal flour or flakes), milling usually removes the vast majority of minerals, vitamins and fibres to raise white flour. Such a spoilage of key nutrients and fibre is no longer acceptable in the context of a sustainable diet aiming at an optimal nutrient density and health protection. In contrast, fermentation of various foodstuffs or germination of grains are traditional, locally accessible, low-energy and highly nutritious processes of sounded interest.

Home processing of food, essentially cooking, is a cultural heritage of all people groups. Given the energy source does not compromise the ecosystem, it allows local preparation of foods of easy digestibility and of variable and enjoyable kinds. Cooking allows the use and mix of a huge variety of foods, herbs and spices. It identifies individuals and people groups around their cultural traditions, skills and way of life. Dietary patterns are acknowledged as the best descriptors of the day life food intake habits and of recommended nutrition guidelines. They can rely more or less on diversity, cultural heritage or healthiness. Overall, some patterns are thought to be rather detrimental such as the "Western diet pattern" which is energy-dense, rich in meats and dairies, saturated fat and sugar and poor in some micronutrients and fibre. Some others of "prudent" type are recommended which are more nutrient-dense and plant foods-based, with plenty of fruit, vegetables, nuts, wholegrains and some fish. In addition, knowledge, concepts and tools are now available to scientifically design the minimal changes necessary in terms of food consumed to make people able to fit the recommended nutrient and fibre intakes necessary to maintain and promote health (Maillot *et al.*, 2010 and 2011). In addition to empirical knowledge and tools, this new approach could help to identify and promote better food choices. Another necessary approach is to analyse the sustainability of dietary patterns in terms of life-cycle assessment and energy and land requirements (Carlsson-Kanyama *et al.*, 2002; Duchin, 2005). In fact, most traditional local dietary patterns are of the "prudent" type, the most famous being the Mediterranean (Willett *et al.*, 1995; Sofi *et al.*, 2008; Bach-Faig *et al.*, 2011) and the Asian ones. Their unfortunate progressive disappearance is associated with the erosion of the local culture and traditional food system, and a key challenge is to stop this negative trend and allow a sounded renewal and updating of such dietary patterns. This is now done with the modern Mediterranean dietary pyramid (Bach-Faig *et al.*, 2011; Reguant-Aleix *et al.*, 2009) which aims to reconcile traditional food productions and way of life with sounded food choices to fulfil nutrient requirements and fit with low energy use and environment and biodiversity protection. Another example comes from Northern Europe where health-promoting and environment friendly regional diets have been designed for Nordic countries (Bere and Brug, 2008).

Information and education about appropriate food choices is thus essential to improve the present situation in all countries given it is within a framework of sustainability, i.e. accounting for nutrition, culture, pleasure, equity, well-being and health, environment and biodiversity protection for all as illustrated in Figure 1.

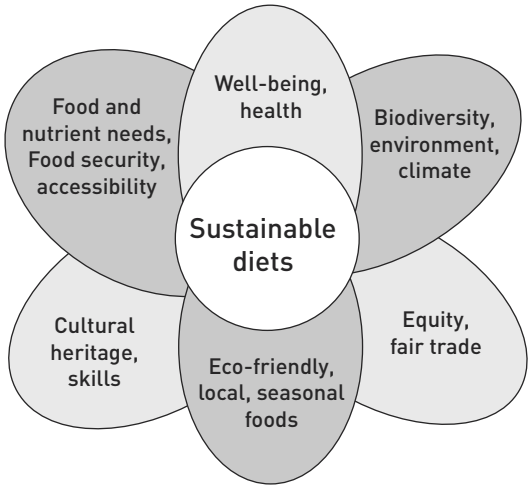

Figure 1. Schematic representation of the key components of a sustainable diet.

4. Conclusion

Somewhat opposite to the present economy, technology and finance domination, examples from agro-ecological local food systems that have the potential to supply people in rural as well as urban areas with appropriate food in terms of quantity and quality should be accounted for. This implies that the worldwide amazing food culture heritage is protected and further optimized to fit new challenges, especially to ensure food security. Appropriate and diversified cultivars or breeds should be cultivated

or raised, farming practices should improve biodiversity, protect soil, forest and water, minimize chemical contamination of people and food, sustain ecosystems in the long term and reduce global warming. Authorities should urgently assume their responsibilities by orienting and supporting the appropriate and sustainable foodstuff productions and consumptions.

Food and diets are among the key social determinants of health and well-being, but the present food system is profoundly unfair and generates social injustices. From the past half-century experiences and present trends, we are convinced that it becomes very urgent to profoundly change our food strategy and to promote fair, culturally-appropriated, biodiversity-based, sustainable diets. This is indeed a considerable challenge for nutritionists too.

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BIODIVERSITY, NUTRITION AND HUMAN WELL-BEING IN THE CONTEXT OF THE CONVENTION ON BIOLOGICAL DIVERSITY[36]

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1. The interlinkages between biodiversity and human well-being

Biological diversity, known as biodiversity, underpins the well-being of society. The poor, who depend disproportionately on biodiversity for their subsistence needs, suffer first and most severely from its degradation, but we all ultimately rely on biodiversity. Growing recognition of the links between ecosystem services and human well-being (Figure 1).

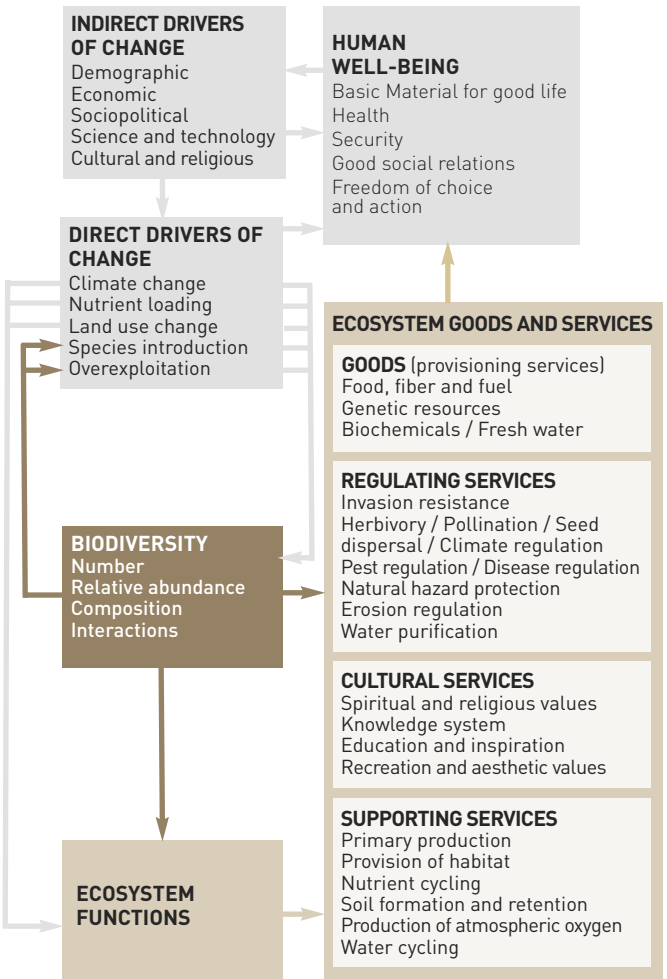

Figure 1. Biodiversity is affected by drivers of change and also is a factor modifying ecosystem function. It contributes directly and indirectly to the provision of ecosystem goods and services. These are divided into four main categories by the Millennium Ecosystem Assessment: goods (provisioning services) are the products obtained from ecosystems; and cultural services represent non-material benefits delivered by ecosystems. Both of these are directly related to human well-being. Regulating services are the benefits obtained from regulating ecosystem processes. Supporting services are those necessary for the production of all other ecosystem services (Secretariat of the Convention on Biological Diversity, 2006).

implies that biodiversity should be a priority in national and international efforts to address health and well-being, including nutrition and food security, as well as gender equity and poverty reduction in the context of sustainable development. However, this is often not the case and the continuing failure to recognize the value of biodiversity and its role in underpinning ecosystem services is rapidly pushing us towards critical tipping points, where many ecosystems risk shifting into new states in which the capacity to provide for the needs of present and future generations is highly uncertain. Actions taken over the next two decades will determine whether the relatively stable environmental conditions on which human civilization and well-being depends may continue beyond this half century.

2. The 2010 targets and the status of biodiversity

In April 2002, the Parties to the Convention on Biological Diversity (CBD) (see www.cbd.int for further information) agreed "to achieve, by 2010, a significant reduction in the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth". This pledge was subsequently endorsed by the World Summit on Sustainable Development in Johannesburg later in 2002, and by the UN General Assembly, as well as being incorporated as a new target within the Millennium Development Goals (Goal 7b).

The final review of progress towards the 2010 target was undertaken as part of the third edition of the Global Biodiversity Outlook (GBO-3) (Secretariat of the Convention on Biological Diversity, 2010). GBO-3 concluded that the 2010 target had not been met at the global level, despite the many actions taken in support of biodiversity, as the actions were not of a sufficient scale to address the pressures on biodiversity in most places.

Of the headline indicators used to assess progress towards the 2010 target, ten show trends unfavourable for biodiversity, while three show no clear global trend and only two show positive trends (Figure 2).

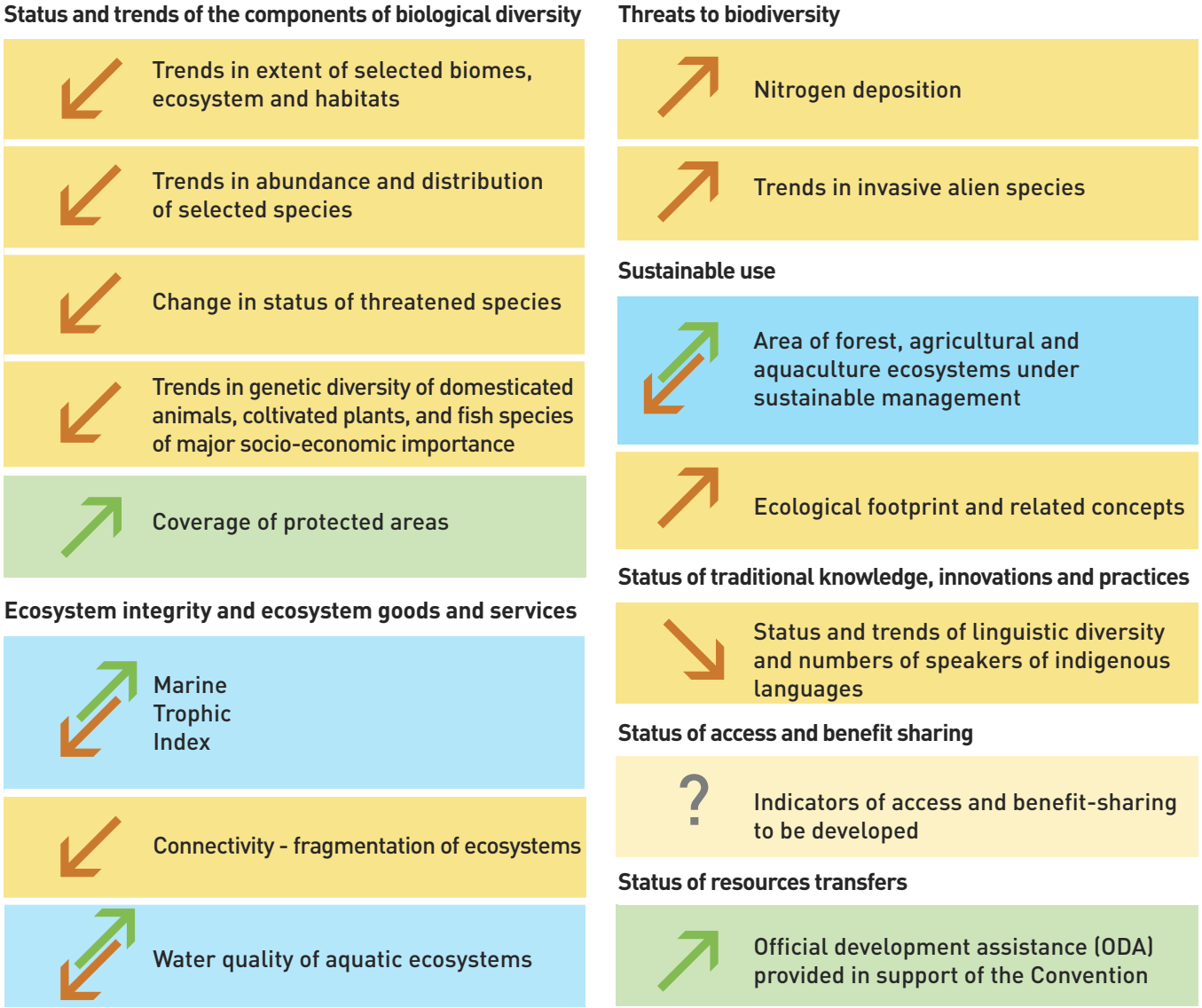

Figure 2. Trends of headline indicators of the 2010 biodiversity target with indicators of particular relevance to food and nutrition highlighted in red boxes (Secretariat of the Convention on Biological Diversity, 2010).

3. Future scenarios for global biodiversity and impacts for health

To examine different possible futures, GBO-3 examined available models that project the likely outcome of differing trends for biodiversity in the coming decades, and reviewed their implications for human societies. Three of the main conclusions from the analysis are that the projected impact of global change on biodiversity shows continuing and often accelerating species extinctions, loss of natural habitat, and changes in the distribution and abundance of species, species groups and biomes over the twenty-first century; secondly, there is a high risk of dramatic biodiversity loss and accompanying broad range of ecosystem services if the Earth's systems are pushed beyond certain tipping points (Figure 3); and thirdly, the study concludes that biodiversity loss and ecosystem changes could be prevented, significantly reduced or even reversed, if strong action is applied urgently, comprehensively and appropriately, at international, national and local levels.

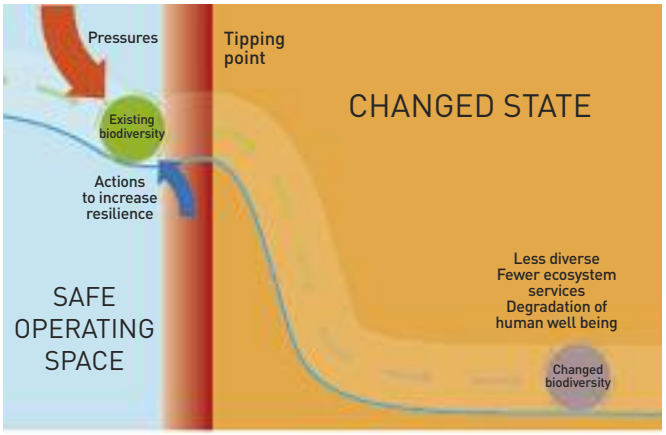

Figure 3. The mounting pressures on biodiversity risks pushing some ecosystems into new states, with severe ramifications for human well-being as tipping points are crossed. While the precise location of tipping points is difficult to determine, once an ecosystem moves into a new state it can be very difficult, if not impossible, to return it to its former state (Secretariat of the Convention on Biological Diversity, 2010).

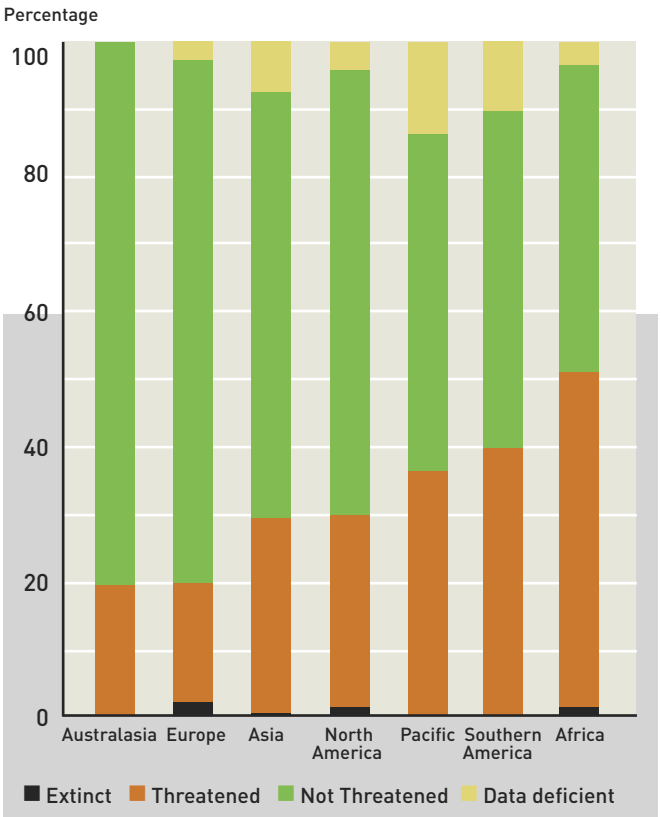

Figure 4. Conservation status of medicinal plant species in different geographic regions. The greatest risk of extinction occurs in those regions where medicinal plants are most widely used (Secretariat of the Convention on Biologival Diversity 2010 adapted from Vié *et al.*, 2008).

4. What does this mean for global food security and health?

Ecosystems around the world are becoming increasingly fragmented and species used for food and medicine are at an increasing risk of extinction (Figure 4). In addition to fragmentation, the degradation of freshwater, marine and terrestrial ecosystems is also a threat to food security. For example, the world's fisheries employ approximately 200 million people and provide about 16 percent of the protein consumed worldwide. However, almost 80 percent of the world marine fish stocks, for which assessment information is available, are fully exploited, overexploited, depleted or recovering from depletion (FAO Fisheries and Aquaculture Department, 2009). While the average maximum size of fish caught has declined by 22 percent since 1959 globally for all assessed communities and, in addition, there is an increasing trend of stock collapses over time, with 14 percent of assessed stocks collapsed in 2007 (Worm *et al.*, 2009).

Over the period 1980–2003, nearly one-quarter (24%) of the world's land area was undergoing degradation, as measured by a decline in primary productivity. Degrading areas included around 30% of all forests, 20% of cultivated areas and 10% of grasslands. Around 16% of land was found to be improving in productivity, the largest proportion (43%) being in rangelands. The areas where a degrading trend was observed barely overlapped with the 15% of land identified as degraded in 1991, indicating that new areas are being affected and that some regions of historical degradation remain at low levels of productivity (Bai *et al.*, 2008).

In addition to the decline in species populations, there is also a decline in genetic diversity in natural ecosystems and in systems of crop and livestock production. The decline in species populations, combined with the fragmentation of landscapes, inland water bodies and marine habitats, have led to an overall significant decline in the genetic diversity of life on Earth (Figure 5).

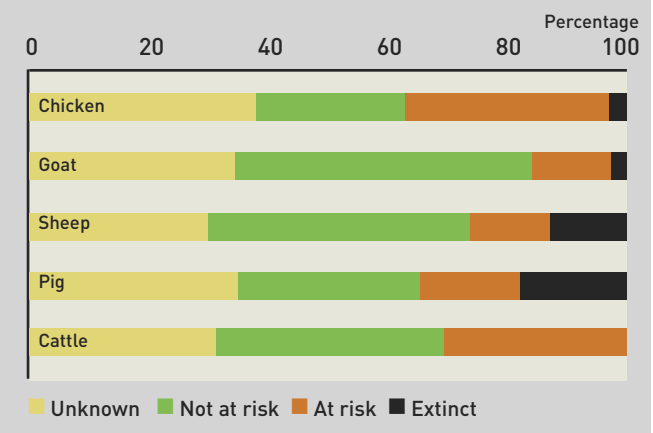

Figure 5. Large numbers of breeds of the five major species of livestock are at risk from extinction. More generally, among 35 domesticated species, more than one-fifth of livestock breeds, are classified as being at risk of extinction (FAO, 2007).

While this decline is of concern for many reasons, there is particular anxiety concerning the loss of diversity in the varieties and breeds of plants and animals used to sustain human livelihoods.

The reduction in the diversity of breeds has so far been greatest in developed countries, as widely-used, high-output varieties have come to dominate. However, the general homogenization of landscapes and agricultural varieties can make the food security of poor and marginalized populations vulnerable to future changes. For example, it is estimated that 21 percent of the world's 7 000 livestock breeds (amongst 35 domesticated species of birds and mammal) are classified as being at risk, and the true figure is likely to be much higher as a further 36 percent are of unknown risk status (FAO, 2007). More than 60 livestock breeds are reported to have become extinct during the first six years of this century alone (FAO, 2007).

In many developing countries, changing market demands, urbanization and other factors are leading to a rapid growth of more intensive animal production systems. This has led to the increased use of non-local breeds, largely from developed countries, and it is often at the expense of local genetic resources. In addition, the cross-breeding of indigenous and imported breeds is also leading to the loss of genetic diversity. For example, in Thailand, with the import of foreign breeds of livestock, indigenous breeds such as the Khaolamppon cow (species name 1), the Rad pig (species name 2), the Hinan pig (species name 3) and the Nakornpratom duck (species name 4) are disappearing (Office of Natural Resources and Environmental Policy and Planning, 2009), while in China there has been a decline in the number of local rice varieties from 46 000 in the 1950s to slightly more than 1 000 in 2006 (Chinese Ministry of Environmental Protection, 2008).

In addition to biodiversity providing food for human health, biodiversity underpins the functioning of the ecosystems which are responsible for providing freshwater, regulating climate, floods and diseases; providing recreational benefits as well as fibres, timbers and materials; aesthetic and spiritual enrichment; and supporting services such as soil formation, pollination, photosynthesis and nutrient cycling (Millennium Ecosystem Assessment, 2005). Biodiversity also contributes to local livelihoods, medicines (traditional and modern) and economic development. Ultimately, all human health depends on ecosystem services that are made possible by biodiversity. In this way, biodiversity can be considered as the foundation for human health and thus, biodiversity conservation, the sustainable use of biodiversity and the equitable sharing of its benefits is a global responsibility at all levels and across all sectors.

Previous actions in support of biodiversity have generally focused on addressing the direct pressures causing its loss and on intervening directly to improve the state of biodiversity, for example in programmes to protect particular endangered species. An estimated 80 percent of Parties reported in their fourth national reports to the CBD that biodiversity was important for human well-being in their country including, amongst other things, as a source of food. However, there has been limited action to address the underlying causes or the indirect drivers of biodiversity loss, such as demographic change, consumption patterns or the impacts of increased trade. Equally, action has tended not to be focused specifically on

protecting, and promoting, the benefits provided by ecosystems. The responses from now on should target these neglected aspects of biodiversity loss, while continuing to reduce direct pressures and intervening to protect threatened species and ecosystems.

5. Response of the Parties to the Convention on Biological Diversity

At its tenth meeting of the Conference of the Parties (COP 10), held in Nagoya, Japan in October 2010, the Parties to the CBD adopted a new ten-year Strategic Plan for Biodiversity to guide international and national efforts. The vision of this Strategic Plan is a world "living in harmony with nature" where "by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people".

The Strategic Plan includes 20 headline targets, known as the "Aichi Biodiversity Targets", which are organized under five strategic goals of 1) addressing the underlying causes of biodiversity loss 2) reducing the pressures on biodiversity 3) safeguarding biodiversity at all levels 4) enhancing the benefits for all provided by biodiversity, and 5) enhancing implementation including by providing for capacity-building.

Most of the Aichi Biodiversity Targets have indirect links to food, nutrition and sustainable diets. The following are particularly relevant:

a) Target 3: By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied [...]. Fishery subsidies that contribute to overfishing globally are potential areas for reform as is the continued and deepened reform of production-inducing agricultural subsidies. Bearing in mind the principle of common but differentiated responsibilities, this target does not imply a need for developing countries to remove subsidies that are necessary for poverty reduction programmes.

b) Target 4: By 2020, at the latest, governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption [...]. Reducing total demand and increasing efficiency will contribute to the target and can be pursued through each production- and consumption-related sector, including agriculture and fisheries, developing and implementing plans for this purpose.

c) Target 6: By 2020, all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem-based approaches [...]. Better management of harvested marine resources is needed to reduce pressure on marine ecosystems and to substantially diminish the likelihood of fishery collapses and hence better support food security.

d) Target 7: By 2020, areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity. The ecologically unsustainable consumption of water, use and run-off of pesticides and excess fertilizers, and the conversion of natural habitats to uniform monocultures, amongst other factors, have major negative impacts on biodiversity inside and outside of agricultural areas. On the other hand, sustainable agricultural areas not only contributes to biodiversity conservation but can also deliver benefits to production systems in terms of services such as soil fertility, erosion control, enhanced pollination and reduced pest outbreaks, as well as contributing to the well-being and sustainable livelihoods of local communities engaged in the management of local natural resources.

e) Target 13: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity. While substantial progress has been made in safeguarding many varieties and breeds through *ex situ* storage in gene banks, less progress has been made *in situ*.

In situ conservation, including through continued cultivation on farms, allows for ongoing adaptation to changing conditions (such as climate change) and agricultural practices.

f) Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded [...]. Ecosystem services related to the provision of water and food are particularly important in that they provide services that are essential for human well-being. Accordingly, priority should be given to safeguarding or restoring such ecosystems, and to ensuring that people, especially women, indigenous and local communities and the poor and vulnerable, have adequate and secure access to these services.

g) Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through restoration of at least 15 percent of degraded ecosystems [...]. Deforestation and other habitat changes lead to the emission of carbon dioxide, methane and other greenhouse gases. However, restored landscapes and seascapes can improve ecosystem resilience and contribute to climate change adaptation, while generating additional benefits for people, in particular indigenous and local communities and the rural poor. Consolidating policy processes and the wider application of these efforts could deliver substantial co-benefits for biodiversity and local livelihoods.

The Aichi Biodiversity Targets are an overarching framework on biodiversity not only for the biodiversity-related conventions, but for the entire United Nations system. Parties to the CBD agreed at the COP 10 meeting to utilize the flexible framework provided by the Strategic Plan for Biodiversity to set their own targets and incorporate these into national biodiversity strategy and action plans (NBSAPs) within two years, taking into account national needs and priorities and also bearing in mind national contributions to the achievement of the global targets (see decision X/2). Additionally, in decision X/10, the COP 10 meeting decided that the fifth national reports, due by 31 March 2014, should focus on the implementation of the 2011–2020 Strategic Plan and progress achieved towards the Aichi Biodiversity Targets.

The opportunity for urgent and sustained action towards implementation of the Strategic Plan for Biodiversity was also reflected in a number of other COP 10 decisions (see Programme of Work on Agricultural Biodiversity decision X/34) in which the COP acknowledged the importance of agrobiodiversity including underutilized crops for food security and nutrition, especially in the face of climate change and limited natural resources; the need to conserve *in situ* and *ex situ* genetic diversity/resources, species and ecosystems/habitats in adequate quantity and quality that are important for food production; the opportunity to better use food, agroecosystems and natural systems sustainably; possibilities for rehabilitation/restoration of agricultural ecosystems and landscapes; strengthening of approaches which promote the sustainability of agricultural systems and landscapes, such as Globally Important Agricultural Heritage Systems (GIAHS) and those in the Satoyama Initiative (Decision X/32), which aim to maintain and rebuild "socio-ecological production landscapes (SEPLs)" that include villages, farmland, adjacent woods, grassland and coasts for the benefit of biodiversity and human well-being; promoting public awareness of the importance of agricultural biodiversity and its relationship to food security. While, as part of the Mountain Biodiversity programme of work COP 10 noted the need to periodically collect and update information on genetic resources, particularly those related to food and agriculture (Decision X/30).

In addition, as part of the development and implementation of its access and benefit-sharing legislation or regulatory requirements, each Party shall consider the importance of genetic resources for food and agriculture and their special role for food security (see Nagoya Protocol on Access and Benefit Sharing, Article 8c. Special Considerations). Food, and food security, is one of the possible non-monetary benefits

that can be equitably shared.

COP 10 also examined the conservation and sustainable use of bushmeat (Decision X/32), while taking into consideration Article 10c as related to customary sustainable hunting practices for the livelihoods of indigenous and local communities and noted, amongst other aspects, that there is a need to develop options for small-scale food and income alternatives in tropical and sub-tropical countries based on the sustainable use of biodiversity in order to support current and future livelihood needs and food security.

6. Conclusions

For millennia, people's use of biodiversity and ecosystem services has contributed to human health and development. Biodiversity is crucial due to the services it provides for our well-being. Sustainable development relies on biodiversity therefore development strategies that undermine biodiversity are counterproductive for poverty alleviation and human well-being.

The recognition of the links between biodiversity, sustainability and human health present a significant challenge to current paradigms in many sectors. In support of the urgent need for action at all levels, the United Nations General Assembly, in Resolution 65/161, proclaimed the period from 2011 to 2020 as the United Nations Decade on Biodiversity.

Biodiversity loss is not a separate issue from the core concerns of society, including issues of nutrition, food security and sustainable development.

The current trends in biodiversity conservation and ecosystem services undermine these global goals and will impact on achievement of the Millennium Development Goals. With adequate resources and political will, this generation can take active steps to implement the Strategic Plan for Biodiversity and simultaneously contribute to achievement of the Millennium Development Goals of eradicating extreme poverty and hunger (goal 1) and ensuring environmental sustainability (goal 7); hence sustaining a healthy planet and benefits for all people.

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ENSURING AGRICULTURE, BIODIVERSITY AND NUTRITION REMAINS CENTRAL TO ADDRESSING THE MDG1 HUNGER TARGET

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Abstract
With less than five years left to accomplish the Millennium Development Goals (MDGs), it is with great hope that nutrition remains a central theme in achieving them. One of the targets of the first MDG is to reduce the proportion of people who suffer from hunger by half between 1990 and 2015, with hunger measured as the proportion of the population who are undernourished and the prevalence of children under five who are underweight. In low and middle income countries progress has been mixed. With one billion people hungry, 129 million and 195 million children are underweight and stunted respectively. Of the 117 countries analysed by UNICEF in late 2009, 63 are on track to meet the MDG1 target based on the proportion of children underweight. From this review, most strategies being implemented and scaled are focused on the direct nutrition-specific interventions – critically important and necessary. However the "nutrition-sensitive" interventions are less clear, particularly those in agriculture and agricultural biodiversity. This review provides an overview of the role of agricultural biodiversity in food and nutrition systems and its potential importance in addressing the determinants of malnutrition and a road to sustainable progress in achieving MDG1 and beyond. Integrating agriculture and agricultural biodiversity practices with broader nutrition-sensitive interventions to address underlying causes of nutrition insecurity is critical for generating durable and longer-term gains. Such an approach would inherently build on the knowledge and capacities of local communities to transform and improve the quality of diets for better child health and nutrition. Success in achieving the MDG1 hunger target will hinge on addressing the root causes of poor nutrition – through evidence-based and contextually relevant food system approaches that can rapidly be taken to scale.

Poverty reduction goals that the world agreed upon: The Millennium Development Goals

At the Millennium Summit in September 2000 the largest gathering of world leaders in history adopted the UN Millennium Declaration, committing their nations to a bold global partnership to reduce extreme poverty and to address a series of time-bound health and development targets. Among these MDGs is a commitment to reduce the proportion of people who suffer from hunger by half between 1990 and 2015. In 2011, some countries remain far from reaching this target, and ensuring global food security persists as one of the greatest challenges of our time. In the developing world, reductions in hunger witnessed during the 1990s have recently been eroded by the global food price and economic crises.

There are currently an estimated 925 million people suffering food and nutrition insecurity; however with food price increases, these estimates may be conservative (FAO, 2010). In addition to those who are hungry, there are also 195 million children under five years of age who are stunted and of those children, 90 percent live in just 36 countries. Malnutrition takes its toll; it is responsible for 35 percent of all child deaths and 11 percent of the global disease burden. Micronutrient deficiencies, known as hidden hunger, undermine the growth and development, health and productivity of over two billion people. At the same time, an estimated one billion people are overweight and another 300 million are obese in both the developed and developing world (WHO, 2006) which contributes to non-communicable disease risk such as diabetes and heart disease. With over-nutrition, many countries and urban communities in the developing world are experiencing the nutrition transition – going from undernutrition to obesity caused by insufficient exercise, sedentary lifestyles and unhealthy diets (Popkin, 2008).

Global, regional and national progress towards the MDG1 hunger target

One of the objectives in defining the MDGs was to create targets and objective indicators that could be

used to set benchmarks and monitor country-level progress. The MDG1 hunger target has two specific indicators: the prevalence of underweight children under five years of age, and the proportion of the population below a minimum level of dietary energy consumption.

In the developing world, the proportion of children under five years of age who were underweight, currently 129 million, declined from 31% to 26% between 1990 and 2008 (based on a subset of 86 countries with trend data for the period 1990 and 2008, covering 89 percent of the developing world's population). The average annual rate of reduction (AARR) of underweight is based on multiple data estimates available from 1990 to 2008 with the AARR needed to achieve a 50% reduction over a 25-year period (1990 to 2015). The rate of change required to achieve the goal is a constant 2.8% reduction per year for all countries. As of 2005, the AARR was at 1.4% per year which would reduce the proportion of children underweight by 37% by 2015. This progress is still insufficient to meet the goal of cutting underweight prevalence by half globally. When taking the recent crises into account, the task will be more difficult, but not unachievable in some countries.

Progress on the prevalence of underweight children

Among low and middle income countries, the greatest declines in the prevalence of children who are underweight have been in the regions of Central and Eastern Europe-Commonwealth of Independent States, East Asia and the Pacific with many countries in all three regions on track to reach the MDG target, in a large part due to progress in China. Latin America and the Caribbean also made progress, with levels declining from 11% to 6% between 1990 and 2008, with Mexico seeing major improvements in children who are underweight. In the Near East and North Africa, the prevalence of children who are underweight has remained roughly the same from 16% to 14% from 1990 to 2008. The stagnation in this region is primarily driven by the situation in Sudan and Yemen. The data also indicated that those living in cities were twice less likely to be underweight than children in rural areas. In South Asia, the prevalence of children who are underweight declined from 54% to 48% between 1990 and 2008, but with such high prevalence levels, attaining the target will be very difficult. In India, progress has been slow, and the country has the highest number of children who are stunted. There have been small improvements in sub-Saharan Africa, but the level of decline is too slow to meet the MDG target. Prevalence has decreased from 32% to 26% from 1990 to 2008. Most of the children who are underweight live in South Asia and Africa.

Of the 117 countries analysed by UNICEF, 63 are on track to meet the MDG1 target based on the proportion of children underweight. Three years ago, only 46 were on track, which holds some promise of improvements for certain countries. Of the 20 countries classified as not making any progress at all towards MDG1, most are in Africa.

It is important to recognize that within regions, just as within countries, great disparities exist in levels of undernutrition. Globally, among the highest levels of children stunted and underweight can be found in Burundi, East Timor (Timor-Leste), Madagascar and Yemen. In the Americas, Belize, Guyana and Panama are off track in meeting MDG1. In sub-Saharan Africa, countries with the highest underweight prevalence are Burundi, Chad, Eritrea, Madagascar and Niger. Conversely, some countries within the region are well on track to meeting MDG1 including Angola, Botswana, Congo, Ghana, Guinea-Bissau, Mozambique, Sao Tome and Principe, and Swaziland. In Asia, Bangladesh, India and Nepal are in the top ten countries with the greatest proportion of children underweight while Cambodia, Thailand and Viet Nam are on track to meet MDG1.

Progress on the proportion of the population who are undernourished

The proportion of undernourished in developing

countries, as measured by the proportion of population below minimum level of dietary energy consumption, decreased from 20% to 17% in the 1990s (a decrease in absolute numbers of 9 million) but both the proportion and absolute numbers have reversed their trend and increased in 2008 due to the food price crisis, which has severely impacted sub-Saharan Africa and Oceania regions. Sub-Saharan Africa has the highest proportion of undernourished with 29% followed by Southern Asia including India at 22%.

Most of the hungry reside in Asia and the Pacific and sub-Saharan Africa, much like the trends for underweight prevalence. Unfortunately, poor progress on addressing hunger coupled with persistently high fertility rates and population growth means the absolute number of undernourished people has been increasing since the 1990s. With 925 million people undernourished (FAO, 2010) it will be difficult to achieve either MDG1 or the 1996 World Food Summit target of reducing the absolute number of hungry people by half to 420 million by 2015 in many parts of the world.

Addressing MDG1 as part of a larger global nutrition effort

Scaling up nutrition-specific interventions

Poor nutrition arises from complex, multiple and interrelated circumstances and determinants. The immediate causes – inadequate dietary intake, water and sanitation and related diseases, lack of necessary knowledge – directly affect the individual, with disease perpetuating nutrient loss and poor nutritional status. Even without disease burden, children with inadequate nutrient intake will not grow sufficiently and are at risk of irreversible stunting.

The global community has responded to this malnutrition crisis and the lack of progress particularly amongst lagging countries (International Bank for Reconstruction and Development, 2011) by focusing on interventions that impact 90 percent of the global burden of malnutrition. There has been a particular focus on the "window of opportunity" – the first 1 000 days of a child's life from the 9 months in utero to 2 years of age. This window is critically important because nutritional setbacks during this time can result in irreversible losses to growth and cognitive potential, and reduce educational attainment and earning potential. The Scaling Up Nutrition Framework for Action (SUN),[1] recently endorsed by over 100 global partners and policy-makers,[2] highlights the need for early childhood and maternal nutrition-specific interventions which can be grouped into those that aim to:

- promote good child feeding and hygiene practices;
- provide micronutrient supplementation for young children and their mothers;
- support the provision of micronutrients through food fortification;
- treat acutely malnourished children with therapeutic feeding.

These core interventions will be critically important in addressing MDG1 as they are interventions with sufficient evidence of impacting 90 percent of the global burden of stunting in 36 countries, many of which are in Africa. Impacting this "window of opportunity" has a direct impact by reducing death, diseases and irreversible harm to future economic productivity. These actions are not costly and offer high returns over the entire lives of children at risk – in terms of their mental development, earning power and contribution to the economies and livelihoods of their communities. These nutrition-specific interventions have been identified among five of the top ten development investments that yield the highest social and economic returns.

Ensuring agriculture is a part of the scale up process

While the underlying determinants of malnutrition have been well understood for decades, the design,

[1] Scaling Up Nutrition, available at http://www.unscn.org/en/scaling_up_nutrition_sun/sun_purpose.php

[2] 1000 days initiative, available at: http://www.thousanddays.org/

testing and scaling of more holistic multisectoral packages that combine child and maternal care and disease control with nutrition-sensitive approaches, have been limited in their development and implementation. These nutrition-sensitive approaches work across development sectors to improve nutritional outcomes by promoting agriculture and food insecurity to improve the availability, access to and consumption of nutritious foods, by improving social protection (including emergency relief) and by ensuring access to healthcare (including maternal and child healthcare, water and sanitation, immunization and family planning) (Nabarro, 2010). With the tools and knowledge that are currently at our disposal, there is a renewed global focus to include interventions that address the root causes of food and nutrition security – both under- and overnutrition – as part of a wider multisector approach, which should be inclusive of agriculture.

Redirecting the global agriculture system to ensure better nutrition is critically important as agriculture is the main supplier of the world's food. The current global agriculture system is producing enough food, in aggregate, but access to sufficient food that is affordable and nutritious has been more challenging. Agriculture systems have largely become efficient at producing a handful of staple grain crops mainly maize, rice and wheat. In developing countries and particularly those in nutrition transition, people obtain most of their energy from these staple grains along with processed oils and fats, and sugars, resulting in diets that often lack micronutrients and other necessary dietary and health components.

Agriculture systems vary across the world–from large-scale monocrop landscapes to smallholder farmers who typically live on less than 2 ha of land. Smallholder farmers often farm on marginal lands without the tools, knowledge and resources to improve production, yet in places such as Africa, 90 percent of farmers are subsistence smallholder farmers. In the developing world, the majority of smallholder farmers are net food buyers, and rural households make up a substantial majority of the world's 900 million-plus hungry (FAO, 2010). As individuals who buy more than they sell, the access to affordable, nutritious food is a critical issue.

Achieving the MDG1 hunger targets clearly involve the agriculture sector–many of the poor are farmers and herders, as well as those who are hungry. Agriculture contributes to MDG1 by increasing food availability and incomes and contributing to economic growth, and higher agricultural productivity. By combining agriculture and economic growth simultaneously, with investments in health and education, child malnutrition can be reduced from 25% to 17% globally (Rosegrant *et al.,* 2006).

Agrobiodiversity: a link to what is grown and what is consumed?

Agriculture is the bedrock of the food system and biodiversity is critically important to food and agriculture systems because it provides the variety of life (Tansey and Worsley, 1995). Biodiversity includes the variety of plants, terrestrial animals and marine and other aquatic resources (species diversity), along with the variety of genes contained in all individual organisms (genetic diversity), and the variety of habitats and biological communities (ecosystem diversity). Biodiversity is essential for humanity, providing food, fibre, fodder, fuel and medicine in addition to other ecosystem services.

FAO (2010) estimates that of a total of 300 000 plant species, 10 000 plant species have been used for human food since the origin of agriculture. Out of these, only 150–200 species have been commercially cultivated with four – rice, wheat, maize and potatoes – supplying 50 percent of the world's energy needs and 30 crops providing 90 percent of the world's calorie intake. Intensification of agricultural systems has led to a substantial reduction in the genetic diversity of domesticated plants and animals in agricultural systems. Some of these on-farm losses of crop genetic diversity have been partially offset by the maintenance of genetic diversity of

seed and animal resource banks. In addition to the extinction of species, the loss of unique populations has resulted in the erosion of genetic diversity (contained in those species and populations) (Millennium Ecosystem Assessment, 2008). Yet the implications of this loss for the biodiversity and quality of the global food supply is scarcely understood and measured from a nutrition perspective.

BOX ONE:
The Convention on Biological Diversity's Definition

Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems, also named agro-ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes (CBD 2010).

Agricultural biodiversity specifically, pertains to the biological variety exhibited among crops, animals and other organisms used for food and agriculture, as well as the web of relationships that bind these forms of life at ecosystem, species and genetic levels (see Box One). It not only includes crops and livestock directly relevant to agriculture, but also many other organisms that have indirect effects on agriculture, such as soil fauna, weeds, pollinators, pests and predators. Agricultural biodiversity (or agrobiodiversity) is a fundamental feature of sustainable farming systems and encompasses many types of biological resources tied to agriculture, including (Thrupp, 2000):

- genetic resources – the essential living materials of plants and animals;
- edible plants and crops, including traditional varieties, cultivars, hybrids and other genetic material developed by breeders;
- livestock (small and large, lineal breeds or thoroughbreds) and freshwater fish;
- soil organisms vital to soil fertility, structure, quality and health;
- naturally occurring insects, bacteria and fungi that control insect pests and diseases of domesticated plants and animals;
- agroecosystem components and types (polycultural/monocultural, small-/large-scale, rainfed/irrigated etc.) indispensable for nutrient cycling, stability and productivity;
- "wild" resources (species and other elements) of natural habitats and landscapes that can provide ecosystem functions and services (for example, pest control and stability) to agriculture; and
- pollinators, especially bees, bats and butterflies.

Agricultural biodiversity is the basis of the food and nutrient value chain and its use is important for food and nutrition security as potentially:

- a safety net against hunger;
- a rich source of nutrients for improved diet diversity and quality; and
- a basis to strengthen local food systems and environmental sustainability.

This agricultural biodiversity includes species with underexploited potential for contributing to food security, health, income generation and ecosystem services. Terms such as underutilized, neglected, orphan, minor, promising, niche, local and traditional are frequently used interchangeably to describe these potentially useful species (both plant and animal) which are not mainstream, but which have at least significant local importance and considerable global potential to improve food and nutrition security. Yet, the major causes of neglect and underuse of these important crops are often related to poor economic competitiveness with commodity cereal crops, lack of improved varieties or enhanced cultivation practices, the inefficiencies in the processing and value addition, disorganized or non-existent market chains, and perception of these foods being "food of the poor" (Jaenicke *et al.,* 2009).

Interspecies and intraspecies variations of crops represent a considerable wealth of local biodiversity and could have potential for contributing to improved

incomes, food security and nutrition with a better understanding of their contribution and usage. They also have considerable potential to enhance adaptation to global climate change. Some of these species are highly nutritious with other multiple uses; are strongly linked to the cultural heritage of their places of origin; are highly adapted to marginal, complex and difficult environments and have contributed significantly to diversification and resilience of agro-ecological niches; and may be collected from the wild or produced in traditional production systems with little or no external inputs (Padulosi *et al.,* 2011; Bharucha and Pretty, 2010).

One area that requires further understanding is the role of agricultural biodiversity for improving diet diversity and dietary quality. Lack of diversity has been shown to be a crucial issue particularly in the developing world, where diets consist mainly of starchy staples with less access to nutrient-rich sources of food such as animal proteins, fruits and vegetables. Diet diversity is a vital element of diet quality – the consumption of a variety of foods across and within food groups, and across different varieties of specific foods, more or less guarantees adequate intake of essential nutrients and important non-nutrient factors.

Research has demonstrated a strong association between diet diversity and diet quality, and nutritional status of children (Arimond and Ruel, 2004; Kennedy *et al.*, 2007; Sawadogo *et al.,* 2006; Rah *et al.,* 2010). It is also clear that household dietary diversity is a sound predictor of the micronutrient density of the diet, particularly for young children (Moursi *et al.,* 2008). Studies have also shown that dietary diversity is associated with food security and socio-economic status, and links between socio-economic factors and nutrition outcomes are well known (Hoddinott and Yohannes, 2002; Ruel, 2003; Arimond and Ruel, 2004; World Bank, 2006; World Bank, 2007; Thorne-Lyman *et al.,* 2010).

Agrobiodiversity as an important aspect in accomplishing MDG1

The role and value of biodiversity and ecosystem services has been recognized at the centre of international efforts to reduce poverty and promote sustainable development, through the framework of the Millennium Development Goals (Ash and Jenkins, 2007). There is also a growing realization worldwide that biodiversity is fundamental to agricultural production and food security, as well as a valuable ingredient of environmental conservation, all of which are critically important to achieving the MDG1 hunger target.

Yet predominant patterns of agricultural growth have eroded biodiversity in, for example, plant genetic resources, livestock, insects and soil organism (Thrupp, 2000). Agrobiodiversity management for food security includes crop introduction, genetic manipulation, crop breeding, genetic resources conservation, agronomy, soil management and crop protection as well as delivering appropriate technologies and knowledge to farmers. Sound agrobiodiversity management therefore provides the main building blocks for appropriate and practical sustainable intensification of agricultural production for food security.

Traditional farming methods often maximize diversity in species and can provide sustainability where economic and demographic pressures for growth are low including polycultural systems that include home gardens and agroforestry systems. Agricultural biodiversity also provides ecosystem services on farms, such as pollination, fertility and nutrient enhancement, insect and disease management, and water retention (Thrupp, 2000). The practices used for enhancing biodiversity are tied to food sovereignty and cultural diversity and local knowledge that support the livelihood of agricultural communities. In many societies, women are often knowledgeable about plant and tree species and about their uses for

nutrition, healthcare, fuel and fodder (see Box Two).

BOX TWO:
Biodiverse-Sourced Local and Traditional Foods

There is no universally accepted definition of local foods or traditional foods coming from biodiverse sources. Traditional foods are defined as food from a particular culture available from local resources and culturally accepted. It includes socio-cultural meanings, acquisition and processing techniques, use, composition, and nutritional consequences for people using the food (CINE 2006).

Local and traditional foods generally refers to plants and crops, fruits, non-timber forest products, livestock, fish, hunted game, wetland species, wild or gathered foods and insects.

These components of agrobiodiversity have benefits. They contribute to productivity, resilience in farming systems, income generation, and food and livelihood security for numerous societies, and potentially, achieving the MDGs. Agricultural biodiversity is essential in augmenting the productivity and resilience of agricultural systems allowing a more stable food security for smallholder farmers (Thrupp, 2000; Jackson *et al.*, 2007; Borron, 2006). For example, agricultural biodiversity is an important factor in raising incomes, allowing farmers to sell diverse products at market, often characterized by positive value chain elements (Thrupp, 2000; Baumgärtner, 2010). Although rising incomes do not correlate directly with better nutrition, if they are coupled with the correct information dissemination and educations efforts, they may lead to extra money being spent on better, more nutritious foods (Blaylock *et al.,*1999). The role of agricultural biodiversity is also important in mitigating the need of pesticides as these have been shown to have multiple adverse effects on human health and nutrition (EPA, 2011).

For many populations, biodiversity overall, particularly plant species such as lesser-known grains and legumes, leafy green vegetables, tubers, crop wild relatives and forest fruits, play an important role in traditional diets and in some cases, income generation. As shown in Box Three, more research and understanding of the value of traditional foods is being developed. Nutritionists now increasingly insist on the need for more diverse agroecosystems, in order to ensure a more diversified nutrient output of the farming systems. However, little is known about most traditional plants' nutritional value, usage and consumption patterns and their subsequent impact on human health, chronic undernutrition and overnutrition and non-communicable disease risk.

Thoughts on sustainability beyond the MDGs

It is important that countries and the international community start thinking in a different way about agriculture, nutrition and health. It is no longer possible to see agriculture and nutrition as a simple matter of inputs and outputs which work in a semi-mechanical and extremely simplified way. It is essential that we take into consideration complex food system-based approaches in order to understand processes which are intrinsically affected by the complexity of life and living beings (Burchi and Fanzo, 2010). In order to produce healthy, nutritious foods we must encourage a healthy, sustainable model of agriculture based on healthy dynamic soils, the variety and rotation of different crops, on fair and inclusive market outcomes. In the same way, if we hope to combat malnutrition we must concentrate on more than just providing enough "fuel" to the body but rather understand that nutrition is closely interlinked with a myriad of factors such as agriculture but also customs, culture, preferences, tastes, health, sanitation, livelihood models, economics, history and anthropology.

In order to achieve MDG1, we must promote efforts aimed at improving the whole food system, starting from agriculture, passing through nutrition and health and terminating with what Amartya Sen defined as human "capabilities" (Sen, 1985). It is only inside a system which demonstrates biodiverse and biodynamic agriculture not only as a source of food but also as an economic livelihood, a source of

BOX THREE: Traditional African green leafy vegetables find their way to formal markets

African Leafy Vegetables (ALVs) are important sources of essential macro and micro-nutrients. In addition they offer a source of livelihood when marketed as well as contribute to crop biodiversity. Sub-Saharan Africa contains a large variety of nutritious, leafy vegetables—an estimated 800–1 000 species. In Kenya, where approximately 210 species are available, only about 10 find their way to markets (mainly African nightshade, leafy amaranth, cowpeas and spider-plant). Bioversity works with resource-poor vegetable farmers on the outskirts of Nairobi, in peri-urban areas. Together they have inventoried leafy vegetable species and identified the key issues hindering their cultivation, conservation, and marketing. Other activities include nutritional and agronomic studies, distribution of seeds to farmers, and dissemination of local recipes featuring leafy vegetables to stimulate demand. With support and training from the project, farmers on the outskirts of Nairobi began growing leafy vegetables. Results from a study commissioned by the Global Facilitation Unit for Underutilized Species (GFU) in 2006 show that over the last one decade, the growth of the ALV market within Nairobi has been tremendous. In Nairobi the market gross value has increased by about 213% between the period 2001 and 2006. The campaign for traditional vegetables between 1997 and 2007 brought notable positive changes in growing, consuming, marketing and nutritional awareness of ALVs. The growth of this market has been greatly influenced by an increased consumer demand that has been caused by a number of factors. These include promotional strategies of local NGOs and international organizations, increased health awareness and consciousness of Nairobi dwellers, effects of HIV/AIDs, and improved ALV presentation in super-markets and upmarket groceries. On the other hand supply has been enhanced by promotion of production in peri-urban and upcountry key production areas by international organizations and local NGOs, provision of external marketing support by NGOs, farmers' capacity for self-organization, and improvement of telecommunication technology (Gotor and Irungu, 2010).

a societal framework, and a source of customs and traditions, that we can attempt to ensure that nutrition is an outcome and benefits child and maternal health. In the same way, we must understand how water sanitation, health services, and economic pressures affect child nutrition and how these can be linked back to agriculture, rural society and markets.

It will be critically important to generate a better understanding of the links among agricultural biodiversity, diet quality, and nutrition and health, and the overall role of nutrition within agricultural food systems. Large-scale evidence is needed of the impact of agricultural biodiversity on health in diverse developing world settings. The feasibility of a long-term approach towards diversification of nutrient-dense crops and their impact on addressing the significant deficits in micronutrients and other important health factors amongst global communities is also under-researched. Biodiversity has been shown to be critically important in food security, sustainable agriculture approaches – both of which are essential in translated accomplishment towards reaching MDG1 beyond its life of 2015.

Accelerating progress towards the MDG1 hunger targets is less about the development of novel innovations and new technologies and more about putting what is already known into practice, with some efforts towards sustainable agriculture approaches that include the conservation and usage of agricultural biodiversity. Success will hinge on linking clear policies with effective delivery systems for an evidence-based and contextually relevant package of interventions that can rapidly be taken to scale. Persistent hunger and undernutrition remain an inexcusable unfinished agenda and successfully closing the few remaining gaps is a pre-condition for wider global progress towards achieving the MDGs.

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