

FAO GEA Rio+20 Working Paper 4 :: Utilization

# IMPROVING FOOD SYSTEMS FOR SUSTAINABLE DIETS IN A GREEN ECONOMY

WORKING PAPER 4

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1 March 2012



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## BACKGROUND AND DISCLAIMER

This is one of four working papers (see titles below) developed by the Food and Agriculture Organization of the United Nations (FAO) to promote discussions and support the preparation of FAO's contribution to the RIO+20 process. The content has been prepared by FAO officers and has been revised based on comments received including those from participants to the FAO/OECD Expert Meeting on Greening the Economy with Agriculture (GEA) in Paris, France, 5-7 September 2011. The views expressed in these working papers are therefore those of the contributors, they may not be consistent between the different working papers nor necessarily reflect the views of the Food and Agriculture Organization of the United Nations (FAO).

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### The four working papers are as follows:

Working Paper 1: FOOD AVAILABILITY AND NATURAL RESOURCE USE IN A GREEN ECONOMY CONTEXT (availability)

Working Paper 2: DECENT RURAL LIVELIHOODS AND RIGHTS IN A GREEN ECONOMY ENVIRONMENT (access)

Working Paper 3: STABILITY OF FOOD SECURITY IN A GREEN ECONOMY ENVIRONMENT (stability)

Working Paper 4: IMPROVING FOOD SYSTEMS FOR SUSTAINABLE DIETS IN A GREEN ECONOMY (utilization)

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## CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>3</b>
<b>I. INTRODUCTION .....</b>	<b>4</b>
<b>II. FOOD SYSTEMS NEED TO CHANGE.....</b>	<b>6</b>
<b>A. IMPACTS OF MALNUTRITION AND OBESITY .....</b>	<b>6</b>
Undernourishment.....	6
Malnutrition.....	6
Obesity .....	7
Healthy diets .....	7
<b>B. THE ENVIRONMENTAL CONSEQUENCES OF FOOD PRODUCTION AND CONSUMPTION .....</b>	<b>8</b>
Global environmental impact of food systems.....	8
Assessing diets: carbon footprint.....	9
Energy intensity .....	10
Food losses and waste .....	11
<b>C. TRENDS TOWARDS 2050.....</b>	<b>12</b>
Traditional food systems are threatened.....	12
Changes in food systems, led by growing urbanization.....	13
An increasing demand .....	14
<b>III. IMPROVING THE SUSTAINABLE EFFICIENCY OF FOOD SYSTEMS .....</b>	<b>16</b>
<b>A. PRESERVING THE DIVERSITY OF TRADITIONAL FOOD SYSTEMS.....</b>	<b>16</b>
<b>B. FOOD-BASED APPROACHES TO NUTRITION SECURITY.....</b>	<b>17</b>
Agriculture-based interventions to improve nutrition security.....	18
Enhance agricultural biodiversity for balanced diets.....	20
<b>C. IMPROVING SUSTAINABLE EFFICIENCY OF FOOD CHAINS.....</b>	<b>20</b>
Reducing food losses.....	21
Develop local processing .....	21
Develop sustainable packaging.....	22
Improve energy efficiency.....	22
Food safety and traceability.....	23
<b>IV. SUSTAINABLE CONSUMPTION DRIVER OF THE GREEN ECONOMY .....</b>	<b>25</b>
<b>A. HARNESSING FOOD DEMAND INCREASE.....</b>	<b>25</b>
<b>B. REDUCING FOOD WASTE .....</b>	<b>25</b>

C.	PROMOTING SUSTAINABLE DIETS .....	27
	Informing the consumer on nutritional value of foods.....	27
	Informing the consumer on environmental and social impact of food .....	28
D.	OPENING CONSUMER CHOICES.....	28
	Local food.....	29
	Quality associated to the place of origin .....	31
	Voluntary sustainability standards.....	32
	Organic agriculture .....	33
E.	EMPOWERING SMALLHOLDERS TO ACCESS GLOBAL MARKETS.....	34
<b>V.</b>	<b>CONCLUSION:.....</b>	<b>36</b>
<b>REFERENCES</b>	<b>.....</b>	<b>39</b>

## EXECUTIVE SUMMARY

1. The world is producing enough food to feed all its population. Yet almost one billion people go hungry. Two billion are malnourished, lacking the essential micronutrients they need to lead healthy lives. One billion adults are overweight and almost half a billion are obese. These figures show profound imbalances in consumption and diets.
2. The green economy aims to improve human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. As such, it also aims to reduce these imbalances.
3. Malnutrition, in all of its forms, places an intolerable burden not only on individuals and national health systems, but on the entire cultural, social and economic fabric of nations. It represents one of the greatest – and most preventable – impediments to the fulfilment of human potential. Improving nutrition and food utilization is a key tool to ensure sustainable development.
4. Improving nutrition and food utilization is also in itself an important mark of the achievement of sustainable development objectives. Indeed food consumption trends and patterns and related agricultural production trends and patterns are identified as one of the most important drivers of environmental pressures, especially habitat change, climate change, water use and toxic emissions of pollutants. Population and income increase as well as urbanization are driving increased food and feed demand. Because of that, and also to respond to other trends such as urbanization and globalization, food systems are already suffering profound changes worldwide.
5. It is necessary to address the needs of a growing world population, richer and more urbanized, while at the same time preserving resources. Food utilization, if pushed towards more sustainable diets, should be seen as a main lever to orient the evolution of food systems towards more efficiency in the use of natural and productive resources. Directions of the needful evolutions include: Preserving traditional food systems, often more balanced, from the threat of environmental degradation and economic and social changes; Promoting food-based approaches for improving nutrition and health as compared to more expensive and non-sustainable supplementation programmes; Grounding nutrition in agricultural systems, using diversified crops and local varieties rich in micronutrients to improve diets; Improving the efficiency of food chains to feed the increasing urban population; Reducing the extent of food losses before consumption, particularly in developing countries.
6. Sustainable consumption is a powerful driver of Green Economy, to reduce ecological scarcities and improve social equity, between consumers and also between nations. It involves harnessing global demand by promoting more sustainable diets in rich countries, where reducing waste at consumer level should be a priority. Voluntary sustainability standards can help sustainable consumption drive sustainable production and create value for producers. Well managed, they can become tools participating to the empowerment of smallholders to access global markets.
7. The transformation of food systems towards sustainable diets is an essential part of the green economy. It offers vast economic and social opportunities, while preserving natural resources. It requires enabling policies and investments and a strong involvement of the private sector. Giving its true value to food – nutritionally, economically and symbolically – could be a core principle of the green economy, driving development especially in rural areas and developing countries.



## I. INTRODUCTION

8. The world is producing enough food to feed all the world's population. Yet almost one billion people go hungry. Another billion are malnourished, lacking the essential micronutrients they need to lead healthy lives. One billion adults are overweight of which almost half a billion are obese. The imbalances in consumption and diets are profound.
9. Food utilization, an essential dimension of food security, refers to how humans use food's various nutrients. General hygiene and sanitation, water quality, health care practices and food safety and quality are all determinants of food utilization. Adequate intakes of energy and nutrients by individuals is the result of access to, and consumption of, foods that are adequate in quantity (calories) and quality (variety, diversity, nutrient content and safety) for a healthy diet conditioned by household food and nutrition security as well as by good care and feeding practices, food preparation, and appropriate intrahousehold distribution of food. While food security has traditionally been measured as sufficient food energy and protein, the term "food and nutrition security" makes explicit the importance of the quality of the food supply not just calories and in addition to calories also looks specifically at proteins, fats, micronutrients and trace elements needed for a healthy diet. Solving the problems of hunger and malnutrition requires more than just producing more food, and more than ensuring physical and economic access to enough food. It requires that foods be also properly used by the body for good nutrition.
10. Malnutrition, in all of its forms, places an intolerable burden not only on individuals and national health systems, but also on the entire cultural, social and economic fabric of nations. It represents one of the greatest – and most preventable – impediments to the fulfilment of human potential. Improving nutrition and food utilization is essential to ensure sustainable development. It is both a tool and an achievement for the green economy.
11. Good utilization, good nutrition and food security itself, are traditionally seen through a human lens that focuses on making the most of available and accessible food for a human living. But today, merely ensuring adequate nutrition is not enough to characterize proper utilization of food.
12. Food consumption trends and patterns and related agricultural production are also identified drivers of environmental pressures, especially habitat change, climate change, water use and emissions of pollutants. Increase in food and feed demand is directly linked to population and income increase. Increased urbanization will also profoundly change the very organization of food systems, in an increasingly globalized world.
13. This is why food systems have to be considered in their entirety, acknowledging the interdependency of sustainable consumption and production. A sustainable diets approach aims to address at the same time nutrition requirements, both in terms of energy and nutrients and resources used for food production, including local biodiversity, used to produce traditional and local foods with their many nutritionally rich species.
14. To address the food and nutrition needs of a richer and more urbanized growing world population, while preserving natural and productive resources, food systems have to undergo radical transformation, improving resource efficiency, improving the efficiency and equity in the consumption of food and transitioning towards sustainable diets.
15. Transformation of food systems is an essential part of the green economy. Not only because vast investments, both public and private are needed to achieve these transformations, but also because they are themselves an extremely powerful way of developing rural areas and creating added value along food chains while preserving resources, particularly in developing countries.



16. This paper first describes the economic, social and environmental impacts of production and consumption of food, underlining the challenges. Second, it identifies the main ways to address these challenges, examines how to harness the increased demand while adding value for producers and discusses how sustainable diets can be a driver of green economy. The final section envisages policy options for the sustainable consumption and production of good and healthy food within the context of a green economy.

### **Box 1: Food systems and food chains: definitions**

A food chain is the sum of all processes involved in getting a specific food to consumers, and is often described by slogans such as “from farm to fork,” or “from fish to dish”. The sum of all food chains makes up a food system, which involves multiple food chains operating at global, national and local levels. Some of these chains are very short and not very complex, while others circle the globe in an intricate web of interconnecting processes and links. The main conceptual difference between a food system and a food chain is that the system is holistic, comprising a set of simultaneously interacting processes, whereas the chain is linear, involving a sequence of activities that must occur in order for people to obtain food.

Food systems encompass the ecosystem and all activities that relate to the production, processing, distribution, preparation and consumption of food. A food system also includes the inputs needed and outputs generated by each of these activities as well as their outcomes, insofar as they contribute to food and nutrition security. Such outcomes include food availability, access and use. A food system operates within, and is defined by, social, economic and environmental contexts. Interactions between and within those contexts influence both activities and outcomes<sup>1</sup>. Esnouf *et al.* (2011) distinguish various types of food systems (domestic, local, territorial, agro-industrial and quality differentiated) and call for assessment of their efficiency and sustainability.

A household food system comprises all of the food chains in which the households participates to meet its consumption requirements and dietary preferences and all of the interactions and feedback loops that connect the different parts of the chains. All households need resources that give them sufficient purchasing power to buy the food that they need but are unable to produce for their own.

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<sup>1</sup> Adapted from GECAF (Global Environmental Change and Food Systems) definition at [www.gecafs.org/glossary/index.html](http://www.gecafs.org/glossary/index.html)

## II. FOOD SYSTEMS NEED TO CHANGE

### A. IMPACTS OF MALNUTRITION AND OBESITY

#### UNDERNOURISHMENT

17. According to the *State of Food Insecurity in the World 2010*, a joint report from the Food and Agriculture Organization of the United Nations (FAO) and the World Food Programme (WFP), the total number of undernourished people in the world was estimated at 925 million in 2010. While this figure was down nearly 10 percent from the number of undernourished people in 2009, due to the partial recovery of the global economy, it was still significantly higher than the level that existed in 1996 – 828 million – when the World Food Summit set a target to reduce the number of the world’s hungry by half by the year 2015. Developing countries account for 98 percent of the world’s undernourished people and, as of 2010, had a 16 percent prevalence of undernourishment. Again, this number was an improvement from the 18 percent estimated in 2009 but still well above the target set by the Millennium Development Summit in 2000, to reduce the proportion of people who suffer from hunger by half.
18. Sub-Saharan Africa has the world’s largest nutrition gap – defined as the difference between food that is available for consumption, and food that is needed for a healthy diet. The United States Department of Agriculture (USDA) estimates that 67 percent of the world’s current nutrition gap can be attributed to sub-Saharan Africa, a gap expected to increase.

#### MALNUTRITION

19. Malnutrition in its multiple forms causes widespread suffering in adults as well as in children. In children, malnutrition commonly leads to poor growth and reduced mental development, increased morbidity and, all too often, early death. According to the World Health Organization (WHO, 2000), malnutrition plays a major role in half of all under-five year old deaths in developing countries each year. In adults, it leads to lethargy, weakened immune response, frequent illness and poor health, decreased cognitive function, increased absenteeism, reduced ability to do work leading to the loss of earning and learning potential and reduced productivity. In pregnant women, it can lead to miscarriage, low birth-weight babies, and both maternal and infant death. Widespread hunger and malnutrition are severe impediments to social and economic development, at both the community and national levels.
20. Today, micronutrient malnutrition – often referred to as “hidden hunger” – affects around 2 billion people worldwide, more than one-third of the global population. These vitamin and mineral deficiencies, including iron, iodine, zinc and vitamin A, lead to poor physical growth and development, lowered mental capacities, reduced productivity, impaired immune systems and other health problems. Today, around 2 billion people are anaemic, mainly due to iron deficiency<sup>2</sup>, 250 million children are at risk of vitamin A deficiency, a condition that can lead to blindness and early death, 800 000 childhood deaths can be attributed to zinc deficiency each year, 200 million people have goiter, and another 20 million are mentally retarded as a result of iodine deficiency.
21. In the most severely affected countries, individual productivity losses due to malnutrition are equal to 10 percent of lifetime earnings, resulting in gross domestic product (GDP) losses of up to 3 percent each year. In developing countries, one in three children under the age of five in 2010 (171 million children) – is stunted due to chronic malnutrition, 55 million wasted due to acute malnutrition and 104 million are underweight for their age. Close to 10 million children die before their fifth birthday every year as a consequence of malnutrition<sup>3</sup>.
22. The cost of malnutrition includes direct costs, such as lost productivity, lost earnings and the medical costs of treating people suffering from malnutrition and associated diseases, as well as indirect costs, such as

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<sup>2</sup> [www.who.int/nutrition/topics/ida/en/index.html](http://www.who.int/nutrition/topics/ida/en/index.html)

<sup>3</sup> “WHO’s global database on child growth and malnutrition, global and regional trend estimates for child malnutrition for 2010” [www.who.int/nutgrowthdb/estimates/en/index.html](http://www.who.int/nutgrowthdb/estimates/en/index.html)

compromised cognitive and impaired physical development. FAO attributes up to 14 percent of lost productivity and earnings in adulthood to stunting in childhood.

23. While the cost of treating the effects of malnutrition, whether in fiscal, economic or human terms, is high, the prevention of malnutrition is much less expensive. Investing in nutrition, therefore, is not only a moral imperative, it also makes good economic sense as it reduces health care costs, improves productivity and economic growth, and promotes education, intellectual capacity and social development.

### OBESITY

24. Obesity has emerged as the most serious health concern of the twenty-first century and is the leading cause of preventable death. Complications from obesity include cardiovascular risks, hypertension, type 2 diabetes and impaired glucose tolerance, obstructive sleep disorder and orthopedic complications (Barness 2007). Once considered only a problem of high-income countries, obesity rates are rising globally and affect both developing and developed countries. A recent analysis by the International Association for the Study of Obesity estimated that approximately 1 billion adults are currently overweight and a further 475 million are obese. The same study found that 200 million school-aged children were overweight, of which 40–50 million were obese<sup>4</sup>. WHO give similar global figures with one billion overweight of which at least 300 million are obese. For children under five years of age 43 million (6.7 percent) were overweight and obese in 2010<sup>5</sup>.
25. The massive growth in obesity rates in recent years has been largely due to the high levels of dietary energy intakes and reduced physical activity due to poor diet and lifestyle choices. Consumers, particularly in the cities, have come to favour cheap and filling food that is high in fat over fresh fruit, vegetables and unrefined carbohydrates, such as wholemeal bread and brown rice. City dwellers have relatively more sedentary jobs than people in rural areas and expend less physical energy. And as more women join the workforce, they have less time to prepare food and often rely on processed ready-made meals.
26. While data on obesity in the developing world are limited, the highest rates appear to be in the South Pacific. In Nauru, 70 percent of the population is classified as clinically obese, up from only 15 percent in the mid-1960s. In addition, obesity affects 25–50 percent of the population in countries as diverse as China, Colombia, Kuwait and the Philippines<sup>6</sup>.
27. The cost of obesity is staggering: USD 270 billion per year in the USA and USD 30 billion a year in Canada alone. This total USD 300 billion bill results from increased need for medical care (USD 127 billion); loss of worker productivity due to higher rates of death (USD 49 billion); loss of productivity due to disability of active workers (USD 43 billion); and loss of productivity due to total disability (USD 2 billion)<sup>7</sup>. In Britain, obesity now costs the National Health Service USD 6.9 billion annually, and the wider economy USD 6 billion<sup>8</sup>.

### HEALTHY DIETS

28. Poor people tend to eat large amounts of one or two staple foods daily, which can represent up to 70–85 percent of their total energy intake. Poor monotonous diets high in carbohydrates but poor in quality in terms of variety, diversity and nutrient content are often associated with micronutrient deficiencies. People in high-income countries typically have diets that are high in meat and saturated fat and low in fruits and vegetables and whole grains. There is overwhelming evidence to show that this dietary pattern increases the risk of heart

<sup>4</sup> [www.iaso.org/iotf/obesity/obesitytheglobalepidemic/](http://www.iaso.org/iotf/obesity/obesitytheglobalepidemic/)

<sup>5</sup> [https://apps.who.int/hpr/NPH/docs/gs\\_obesity.pdf](https://apps.who.int/hpr/NPH/docs/gs_obesity.pdf)

<sup>6</sup> [www.worldhunger.org/articles/04/global/burslem.htm](http://www.worldhunger.org/articles/04/global/burslem.htm)

<sup>7</sup> [www.usatoday.com/yourlife/health/medical/2011-01-12-obesity-costs-300-billion\\_N.htm](http://www.usatoday.com/yourlife/health/medical/2011-01-12-obesity-costs-300-billion_N.htm)

<sup>8</sup> [www.bbc.co.uk/news/health-14064561](http://www.bbc.co.uk/news/health-14064561)

disease, certain types of cancer, stroke and diabetes. On the other hand, high intakes of fruits and vegetables, legumes, whole grains, and fish have been shown to lower the incidence of chronic diet-related disease and risks, including obesity. The latter pattern of eating is a modern nutritional recommendation inspired by the traditional “Mediterranean” diet consumed in southern Italy, Crete and coastal Greece in the 1960s, which was typically high in plant foods and low in red meat. Diets that are lacking in fresh, seasonal, micronutrient-rich fruits and vegetables are considered by some experts to be risk factors for chronic diseases such as obesity, type 2 diabetes, coronary heart disease, hypertension and cancer. Today, these diseases, formerly associated with affluence, are growing fastest in developing countries. Eighty percent of deaths from diabetes occur in low-and middle-income countries (WHO, 2011). Three-quarters of all adult deaths in Latin America and in the developing countries of Asia and the western Pacific are caused by preventable diet-related diseases<sup>9</sup>.

29. Dietary patterns – the daily combined consumption of foods and beverages – can lead to specific health or disease outcomes. Diets rich in fruits and vegetables, for example, are associated with reduced risk for certain cancers, diets high in saturated fats and energy have been associated with higher incidences of coronary heart disease.
30. Nutrients interact differently when presented as foods. The health value of some bioactive non-nutrients present in fresh foods is not yet fully understood, but it is clear that whole foods provide important benefits that supplements and fortificants of individual nutrients do not provide. While supplements and ready-to-use therapeutic foods certainly provide nutrition in emergencies, they are not considered long-term solutions, and are thus not necessarily compatible with sustainable diets.

## B. THE ENVIRONMENTAL CONSEQUENCES OF FOOD PRODUCTION AND CONSUMPTION

### GLOBAL ENVIRONMENTAL IMPACT OF FOOD SYSTEMS

31. Agriculture and food production have been identified as among the leading causes of environmental pressure (FAO, 2006, FAO, 2009a, UNEP, 2010). Currently, about half of the world’s land is used for agricultural production. Agriculture is a major driver of deforestation and loss of biodiversity, and represents 70 percent of total water use. The FAO projections indicate that the global demand for water withdrawals will increase by 11 percent from a 2006 baseline to 2050 (Bruinsma, 2009). The threats to water security become even more pronounced when climate change, with its implications for water variability and scarcity, and the growing demand for biofuel crops are factored into the equation. By 2050, more than half the world’s population will live in countries with severe water constraints, including China, Egypt, Ethiopia, India, Iran, Jordan and Pakistan (Rockström *et al.*, 2008). Agrochemicals are also an important cause of water pollution. Eutrophication is clearly associated with food production, mostly due to the excessive application of synthetic fertilizers and mismanagement of animal manure (see also the FAO GEA Rio+20 working paper on Availability). Food accounts for between 30 and 40 percent of energy consumption, depending on countries. Producing animal products from vegetal and feed input involves biological processes and associated energy requirements and losses, meaning that 1 calorie of animal product requires the production upstream of more than 1 calorie of plant origin to feed the animal. Increasing demand for livestock products thus has a considerable effect on natural resources, mainly through increased demand on feed.

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<sup>9</sup> [www.who.int/whr/2003/chapter1/en/index3.html](http://www.who.int/whr/2003/chapter1/en/index3.html)

ASSESSING DIETS: CARBON FOOTPRINT

32. Carbon and water footprints have been put forward recently as methods to assess and compare the environmental impacts of agricultural products. So far no consensus has been reached on how to conduct studies on water footprints (UNEP, 2010). Thus most of the studies using lifecycle analysis for agricultural products concentrate on greenhouse gas emissions. However, there are no studies that quantify greenhouse gas emissions from the global worldwide food system (Garnett 2011). A European Commission study (2006) estimated that 31 percent of the EU's GHG emissions were associated with the food system.
33. It is generally estimated that half to two-thirds of the greenhouse gases emissions induced by food production and consumption are caused by the agricultural production stage. A recent Finnish study confirms this estimation (Yrjö Virtanen *et al.*, 2010), however the relative contribution of the pre-farm, on-farm and post-farm stages vary considerably depending on the product. For example, in ketchup production in Sweden using Mediterranean tomatoes, agriculture accounts for 14 percent of emissions, transformation 41 percent, packaging 24 percent, transport 9 percent and consumption 12 percent (Andersson 2000). Therefore studies which limit themselves to assessing emissions on the farm, risk giving a false idea of the actual impact of individual products when consumed, which can in turn distort the impact of actual diets on the environment, especially in developed countries. Emissions at the production stage vary widely, as shown for example in an analysis of the dairy sector (FAO, 2010a). Emissions at consumption stage are less studied for two main reasons: i) many life-cycle assessment studies are undertaken for industrialized food producers in order to improve their processes, which is the main purpose of the methodology, and ii) it is extremely difficult and costly to conduct studies at consumer level because it necessitates accounting for the diversity of consumers' behaviour and situations, which both have a strong impact on emissions. A Swedish study (Sonesson *et al.*, 2005a) underlines the importance of consumer transport to buy food and of wastage in the global lifecycle analysis. Analysis of the impact of various preparation modes for meatball (Sonesson *et al.*, 2005b) and chicken (Davies and Sonesson, 2008) shows the implications of the various stages and the importance of emissions at household level. Particularly important is the energy efficiency during conservation and cooking stages. For instance, for some frozen products, even containing beef, post-production stages can represent more than half of the total emissions (Büsser and Jungbluth, 2009).
34. According to the rare studies on the issue, transport represents only a small part of global food emissions, even if it does vary considerably, depending on the products considered. Transport emissions are estimated to be in the range of 11 percent of total food emissions. This figure takes into account transport at every stage, including the delivery of livestock feed, and of this 11 percent, 6 percent are caused by the consumer's travel to purchase food (Weber 2008). This last result mainly reflects the relative inefficiency of post-retail food transport compared to pre-retail. To illustrate the point, it has been estimated that taking the car for 10 km to buy 1 kg of Kenyan beans emits more GHG than it takes to bring them in the United Kingdom by plane (Smith *et al.*, 2005). Globally it has been estimated that as much energy is required to transport 5 kg of food by car for 1 km, as is required to transport it for 43 km by plane, 740 km by truck, 2 400 km by train or 3 800 km by boat (Brodt, 2007). These are global figures. For fresh products transported by plane, the emissions arising from transport can be significant. A study points out that the carbon footprint of 1 kg of fresh pineapple transported by plane from Zambia to Europe would be ten times its impact in jelly transported by boat (Plassmann *et al.*, 2009).
35. Food losses and wastage can increase the emissions intensity of products, particularly when they occur at the end of food chains after having embedded transport and conservation emissions. It is especially of concern as consumption of fragile products (fresh vegetables, dairy products, meat, fish, frozen products) is increasing and thus the emissions caused either by their loss or by their preservation (plane transport, fridges) are likely to become increasingly important.

36. A comparison of the impact of different foods requires consideration of quantity and quality marker nutrients, along with the resource inputs used in producing these nutrients and bringing them to consumers. Just as no single food is able to provide adequate nutrition, no single nutrient indicator, e.g. energy (calories) content, is able to provide a coherent picture when calculating carbon footprints.
37. Another way to assess the impact of diets is to compare meals, balanced from a nutritional point of view. This approach, adopted by a Finnish project on the environmental consequences of consumers' daily food choices, follows the idea that lunch is a "nutritional whole, in which changeability of components is restricted" (Kurppa *et al.*, 2009). In comparing lunch plates with half vegetables, a quarter protein and a quarter carbohydrates, the study found emissions per lunch plate varied from 570g CO<sub>2</sub> to 3.8 kg CO<sub>2</sub>. The main impact was from livestock products, but also from greenhouse vegetables. Based on its results, the study presented four global recommendations: moderate consumption of livestock products in favour of vegetable sources of proteins such as legumes, eat seasonal products, avoid waste, avoid shopping by car.

### ENERGY INTENSITY

38. The global food system provides consumers, particularly in developed countries, with convenience, abundant choice, and year-round availability of fresh produce. However, such benefits come at a price: they are very energy intensive. Energy intensity – the total energy input per total food energy output – is commonly used to determine the energy efficiency of food production. In recent decades, agricultural development has led to increased yields, but also to less efficient energy use (Schneider and Smith, 2009).
39. A number of factors influence the energy intensity of production and the resulting environmental impacts along the food chain. In developed countries, the use of energy in the food system typically amounts to 12 to 20 percent of the total energy consumed nationally (Carlsson-Kanyama, 2004). Energy is used during crop, livestock and fish production, either directly or indirectly as embedded energy in input manufacturing and transport (Woods, 2010). Energy also plays a crucial role in processing and packaging, distribution and transportation and last, but not least, consumption.
40. Energy intensity at the production stage has decreased in the last 20 years in OECD countries, while it has increased in developing and newly-industrialized countries, especially China and India. The use of fertilizer and heavy machinery has intensified in developing countries over the past few decades, while developed countries' use of such inputs has declined since the mid-1980s. (Schneider and Smith, 2009). This is partly due to the fact that industrialized countries have adopted improved crop varieties, more efficient machinery and irrigation systems as well as improved input management. Such measures significantly increase energy efficiency per kilogram of output. However, they do require significant capital investment and are therefore out of reach for most farmers in poor countries.
41. Although it has received relatively minor attention, recent figures from the developed world indicate that the consumption stage of the food chain is the least energy efficient of all. Food consumption involves storing, preparing, serving and eating food, either at home or in a restaurant. A study (Canning *et al.*, 2010) found that food processing and consumption together accounted for about 60 percent of total 2002 food-related energy flows in the USA, up from 55 percent in 1997. This was partly due to the increasing use of technologies such as refrigeration, but also because households and restaurants have come to rely more heavily on processed foods which use high energy consumption technologies for production. Similar results were shown by a 2000 Swedish study, which found that household energy use for cooking and storing food was 28 percent of the total energy used and that processing contributed another 25 percent (Carlsson-Kanyama, 2004).

**FOOD LOSSES AND WASTE**

42. Food losses are staggering. About one-third of the food produced for human consumption is lost or wasted every year, amounting to about 1.3 billion tonnes annually (FAO, 2011a). Reducing food losses and food waste is highly relevant to efforts to combat hunger, raise income and improve food security in the world's poorest countries. Food losses and waste also represent a waste of resources used in production, transformation and transport, such as land, water, inputs and energy, especially at the end of the food chain, considering that food gradually embeds emissions of transport and conservation.
43. Food losses and their distribution along the food chain – occurring at the production, harvest, post-harvest and processing phases – are very different, depending on the regions and the products. It is especially a challenge in developing countries, due to poor infrastructure, low levels of technology and low investment in food production systems. Food loss during harvest and during storage translates into lost income for small farmers and into higher prices for poor consumers. It becomes obvious that reducing losses could have an "immediate and significant" impact on their livelihoods and food security. Food waste is more of a problem in industrialized countries, often caused by both retailers and consumers throwing away perfectly edible foodstuffs.
44. Overall, on a per capita basis, much more food is wasted in the industrialized world than in developing countries. It is estimated that the per capita food waste by consumers in Europe and North America is 95-115 kg/year, while this figure in sub-Saharan Africa and south/southeast Asia is only 6-11 kg/year (FAO, 2011a).
45. Global differences between regions for the same type of products indicate the potential for improvement (FAO, 2011a). Losses of cereals are approximately 50 percent higher in Europe than in sub-Saharan Africa. Loss of milk is twice as high in sub-Saharan Africa than in Europe.
46. The distribution of the losses along the food chain also vary between regions. For instance, in Africa, cereals are lost in the first stages while in Europe, they are lost mostly at the consumer stage: consumer-level losses are 25 percent in Europe and 1 percent in Africa. For fruits and vegetables, the differences between regions are also striking. In Africa processing and distribution are the weak links, while in Europe most losses occur at production and consumption stages. This pinpoints areas where investments could be helpful and show possibilities of improvement.
47. Food losses and waste represent also a waste of resources. The resources used to produce, transform, preserve, transport lost or wasted food are effectively used in vain.

**Box 2: The case of fish**

Fish is a highly perishable food. Post-harvest losses in small-scale fisheries are among the highest for any commodity in the food production system. Fish loss due to spoilage is estimated at 10 to 12 million tonnes per year, accounting for around 10 percent of total production from capture fisheries and aquaculture. Post-harvest loss occurs in various forms. Physical fish loss is caused by poor handling and preservation or by discarding by-catch. Nutritional losses can occur from poor handling and processing. This is particularly true for low-molecular water-soluble vitamins and minerals, which are susceptible to leaching. High temperatures during smoking, cooking, or drying, direct sunlight and pH extremes also can destroy proteins, fatty acids and vitamins. The processing of large quantities of fish catches for livestock and aquaculture feed can be considered a "loss" for human food security. The sustainability of fisheries is an issue of paramount importance for human nutrition. The Report of the FAO/WHO consultation on fats and fatty acids recommended an intake of long chained, highly polyunsaturated fatty acids – those found primarily in fish – that cannot meet the requirements of the world's population. Harvesting nutrients, particularly fatty acids, from fisheries' waste would help solve the problem.



48. The more food that is wasted, the more energy that is wasted and the higher the unnecessary emission of greenhouse gases. In Sweden, agriculture accounts for between 10–12 percent of the total emissions of greenhouse gases, while nearly a quarter of agricultural food products are discarded (Politiken, Aftenposten, Svenska Dagbladet, 2010). In the UK, food waste results in 14–15 million tonnes of CO<sub>2</sub>-e being emitted while in Australia, household food waste represents about 5.25 million tonnes of CO<sub>2</sub>-e emissions, equal to all emissions from the manufacture and supply of iron and steel in the country (Baker, 2009). It is estimated that fully 10 percent of global greenhouse gas emissions result from the production of food that is never eaten (Stuart, 2009).
49. Food waste now represents the single largest component of the solid waste reaching municipal landfills and incinerators in many developed countries (Hall, 2009). In the USA, less than 3 percent of the 34 million tonnes of food waste generated in 2009 was recovered and recycled<sup>10</sup>. In Australia, half of all municipal waste going to landfills is comprised of organic waste, most of which is household waste (Baker *et al.*, 2009).
50. When food is disposed of in a landfill, it becomes a significant source of methane as it decomposes. When emissions from decomposing food in landfills combine with emissions from the production and transport of food, the effective emissions are even greater. According to the US Environmental Protection Agency, landfills account for more than 20 percent of all methane emissions in the USA. And the UK's Department for Environment, Food and Rural Affairs found that the 6.7 million tonnes of food sent to landfills from UK homes each year represent 15 million tonnes of CO<sub>2</sub> (Hogg, 2007). Landfill leachates can also cause considerable groundwater pollution.
51. And from a global point of view, consumption of foods and nutrients above requirement levels also represents a waste of resources, particularly high consumption of animal products which puts additional pressure on already scarce resources.

## C. TRENDS TOWARDS 2050

### TRADITIONAL FOOD SYSTEMS ARE THREATENED

52. Traditional food systems are based on a rich array of cereals, legumes, vegetables, indigenous fruits and animal-source foods that are cultivated and gathered from uncultivated lands or the forest (e.g. leafy plants, roots, berries, small rodents, and insects) and from aquatic environments (e.g. fish, frogs and snails). They are often threatened by deforestation, environmental degradation and climate change. Traditional food systems are also threatened by economic and cultural changes, leading to the erosion of traditional food resources and knowledge. This began during the period of European colonization, but has been accelerated by agricultural technology, urbanization, the introduction of foreign foods and cultures, commercialization and globalization (Johns, 2003).
53. In recent years, reduced access to land and natural resources, globalization and the westernization of diets and lifestyles have dramatically affected the role of traditional foods in the lives of small farmers and indigenous societies (FAO/CINE, 2009). The perception of traditional food as old-fashioned or destined for the poor has had a negative impact on their consumption, especially by young people. Studies have linked these changes to a wide range of negative consequences, including food insecurity, poor health, nutrition deficiencies, ecosystem deterioration and cultural erosion. The consequences of this shift in production and consumption patterns are significant. It generally goes with a shift towards foods which are often highly refined and processed, have higher concentrations of saturated fats, salt and sugar and are lower in micronutrients. Yet these foods are attractive, they

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<sup>10</sup> [www.epa.gov/osw/conserve/materials/organics/food/fd-basic.htm](http://www.epa.gov/osw/conserve/materials/organics/food/fd-basic.htm)

often come ready to eat and are easy to prepare and also often tend to be inexpensive, a major appeal since many small farmers come from low-income households.

54. Today, only about 150 plant species are grown commercially around the world and global crop production concentrates on 12 plant species.<sup>11</sup> Although farmers have domesticated at least 5 000 plant species over time, the industrial food chain uses only 3 percent of them (ETC, 2009). Only three crops – maize, wheat, rice – supply the bulk of human energy needs. This dependence on a limited number of crops goes with many local food plants being abandoned or neglected. In a similar vein, although farmers have domesticated 40 livestock species over time, the food industry has focused its attention on just five species – bovines, chickens, pigs, sheep and goats (FAO, 2008). Likewise, nearly two-thirds of global fish consumption comes from only a few groups – finfish families, marine crustaceans and bivalve molluscs (FAO, 2011). As a result, these groups are overexploited and endangered, while ocean trawlers discard a large portion of their annual catch because it does not contain the preferred species. In industrialized countries, discard rates range between 9–15 percent of marine catches (FAO2010). By contrast, coastal and inland fishers use a far greater range of species and discard very little.
55. The importance of wild food resources is often underestimated as they are only rarely included in food availability estimates. ETC (2009) estimates that about 15 percent of the annual food supply of rural farmers in developing countries comes from uncultivated lands, yet wild foods are only rarely included when global food availability is considered. Scoones *et al.* (1992) identified several other examples, such as:
- farmer communities in Borneo that gather nourishment from over 800 different plants and more than 100 species of ground fauna, along with hundreds of bird species; only a third of their diet comes from cultivated crops;
  - Kenyan farmers draw a quarter of their annual food supply from the wild, rising to almost half during the dry months;
  - farmer women in Uttar Pradesh, India, who derive nearly half of their income from forest species;
  - the Mende of Sierra Leone who gather more than half of their food from forests, streams and fallow fields.
56. During staple crop shortages, in some parts of Africa, wild resources provide up to 80 percent of household food needs (FAO, 2008).
57. Threats to traditional food systems can endanger food security and nutrition of vulnerable populations.

### CHANGES IN FOOD SYSTEMS, LED BY GROWING URBANIZATION

58. Today, half the world's population lives in urban areas and that number is climbing rapidly. Almost all population growth over the next decades will be urban. Urbanization is particularly rapid in sub-Saharan Africa and East Asia, which have urbanization rates greater than 4 percent and 3 percent respectively (Kearney, 2010). By 2050, about 70 percent of the global population of 9 billion is expected to live in cities, which will have important consequences on consumption patterns and food chains (Foresight, 2011; Esnouf, 2011). Most urban consumers are net buyers, meaning that they buy more than they sell, often purchasing everything that they eat. This gives them an important influence on the structure and orientation of food systems, an influence that will grow as their numbers increase. In addition, consumption patterns in the peri-urban and rural areas tend to mimic those in urban areas, giving the cities an even greater authority over local food systems.
59. Urbanization drives profound modifications in diets. It facilitates access to richer products, often imported, which replace traditional foods. With a greater intake of animal products, diets become poorer in fibre and in many micronutrients and higher in energy and fat. This leads to a higher caloric intake which, combined with the fact that

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<sup>11</sup> Maize, rice, wheat, soybeans, potatoes, sweet potatoes, banana and plantain, sorghum, cassava, millets, sunflowers and canola.

urban people have usually lower energy demanding jobs than rural people and thus burn fewer calories, causes obesity.

60. Developed countries place growing importance on information and logistics technologies, and food safety and quality standards. Food systems are increasingly linked from producer to consumer with an increasingly dominant role played by highly concentrated agro-industrial firms and retailers. These trends are expected to expand to developing countries, along with the expansion of supermarkets and hypermarkets (OECD, 2011).
61. To feed the cities requires the gathering of supply in sufficient quantities that meet more stringent quality standards set by retailers and consumers, which would usually exclude smallholder producers. Companies tend to delist suppliers who do not meet expectations in terms of volume, quality and delivery. Farmers wishing to supply supermarkets must accept to deliver fresh products, often every day, and they must accept the fact that buyers will consider part of their produce as of unacceptable quality (FAO, 2005).
62. Adequate transport infrastructure and forms of organization are needed to ensure access to market for smallholders. Establishing groups and associations of smallholder farmers or fishers can facilitate their meeting the quantity, quality and timing goals of food processors and food retailers. Membership in such groups also improves returns to the farmers and fishers and can help them access training, information, technology and financial support.
63. Increasing urbanization, the growth of the middle class, rising per capita income, the growing distances between home and the workplace, and an upsurge in the number of working women are all factors that lead to a growing demand for processed food products that meet stringent quality and safety requirements. This offers new opportunities provided that adequate means are available to establish the processing technologies and industrial operations needed to deliver compliant products.
64. As food chains become longer, the risk of losses in quantity and quality increases, as does the consumption of energy for conservation, transformation, packaging and transport. Longer food chains also require the establishment of quality and traceability standards to satisfy the requirements of richer and more informed consumers.
65. Adapting food systems to increased urbanization requires important transformations which provide considerable opportunities in the frame of a green economy.

### AN INCREASING DEMAND

66. Demand for food is directly driven by the increase of total population and changing patterns of consumption. These are influenced by income and various factors such as urbanization, education, culture.
67. Demand is set to increase significantly towards 2050 because of population growth. Income growth in low-income countries and emerging economies will drive demand even higher (Foresight, 2011). There will be a shift to high-status and non-seasonal foods, including more meat consumption, particularly in countries with rising income. It is projected that by 2050, 2.3 times more poultry meat and between 1.4 and 1.8 times more of the meat of the other livestock products will be consumed as in 2010 (FAO, 2009a). According to FAO's estimations (FAO, 2009a), increase in consumption of livestock products will cause a 553 million tonne increase in the demand for feed, which represents half of the total demand increase for coarse grain between 2000 and 2050.
68. Food price has an increasingly different effect on demand depending on countries. In high income countries, food prices have steadily declined, relative to income, thanks to competition on price, subsidies for agricultural production, and a low level of integration of negative externalities in costs. In poor countries, food is still a very important part of most household budgets. For example, the budget share of food expenditure is about 70 percent in Tanzania and 45 percent in Pakistan against an average of 10 percent in the USA (HLPE, 2011).

69. Increased demand for agricultural products for food, feed, and non-feed uses such as biofuels is a driver of price increase (HLPE, 2011). As incomes increase, food demand becomes less sensitive to price changes and, as income is increasing in most of the world, global food demand is becoming less and less sensitive to price changes. Price increase will not reduce global demand but it will have disproportionate effects on the poor (HLPE, 2011).
70. Given the interactions among various factors, projections are inherently uncertain and can be used only to identify trends (Foresight, 2011, GEA Availability, 2011). The FAO baseline projection (Bruinsma, 2009) of an increase of 70 percent in 2050, business as usual, has been widely cited and commented (Grethe *et al.*, 2011). Other authors have attempted to describe various scenarios. For instance Agrimonde (2009) describes a business-as-usual scenario, Agrimonde 0, with an increase of global demand of calories of 83 percent, and a scenario Agrimonde 1, where the increase is 28 percent. This last scenario supposes radical changes in consumption patterns and behaviours and in worldwide distribution of food, including a decrease of 25 percent of the per capita consumption in OECD countries between 2000–2050, without any income reduction, and a slowdown in the increase of per capita consumption in emerging countries. It would require radical changes in consumers' behaviours, reduction in waste, and implementation of efficient public policies to promote more balanced and healthy diets. Another study (Erb *et al.*, 2009) compares various scenarios based on diets – “western high meat”, “current trend”, “less meat”, and “far less meat”, concluding that it would probably be possible to feed the world with organic crops and an organic livestock system with a very equitable distribution and an average daily intake of 2 800 kcal per capita with 20 percent of protein from animal origin. The “western high meat” diet, with 44 percent of protein intake of animal origin would also probably be feasible, but only with a cropland expansion of 20 percent, intensive yields and intensive livestock production.
71. Business-as-usual projections point to a considerable increase in demand, driving increasing impacts on resources. Alternative scenarios show how impact on resources is dependent on the evolution of diets (Agrimonde, 2009, Erb *et al.*, 2009, Grethe *et al.* 2011).

### III. IMPROVING THE SUSTAINABLE EFFICIENCY OF FOOD SYSTEMS

#### A. PRESERVING THE DIVERSITY OF TRADITIONAL FOOD SYSTEMS

72. The food systems of indigenous peoples show the value of diversified diets based on local plant and animal species. In many developing countries, the rural and peri-urban poor collect and manage uncultivated medicinal plants, vegetables, nuts, fruits, and fungi on common lands. These plants provide irreplaceable nutrients and are essential for food security, especially in the weeks and months leading up to harvest when family food stocks are at their lowest (ETC, 2009).
73. The use of indigenous plant and animal diversity can make an important contribution to nutrition, environmental sustainability and the protection of biodiversity. There is ample evidence that a diverse diet based on local foods can supply significant amounts of macro- and micronutrients and ensure household food and nutrition security (Frison *et al.*, 2006).
74. Countries, communities and cultures that maintain their own traditional food systems tend to consume foods involving a higher diversity of crops and animal breeds. They are also less likely to exhibit a high prevalence of diet-related diseases. Unfortunately, food consumption data on wild, indigenous and traditional plant and animal foods are limited and fragmented. Dietary assessment surveys have generally been designed to capture information on the habitual intake of generic foods, rather than detailed information at the taxonomic level of species, subspecies and variety or breed. The corresponding compositional data are rarely available. It is also widely believed that survey participants are not able to recognize foods at the taxonomic level below species, although evidence exists that this belief is not accurate.
75. Producing a range of diverse crops and varieties buffers yields. Total harvests may be lower in a diversified production system but they are more stable from year to year. This suits small farmers in rural areas, who seek to minimize risk – ensuring that there is some food for their families – rather than to maximize productivity.
76. Climate change provides a strong argument for favouring diverse production systems, including indigenous crops. Farming systems will definitely have to adapt as weather patterns change. The most diverse systems – those that have and use the most diversity – are likely to be the most adaptable. Crop diversity provides the key for adaptation: the genetic resources that can be used by plant breeders and farmers to adapt food crops to climate changes, ensuring they are productive while withstanding new pests, diseases and climate conditions. Using a range of local crops and varieties can also help adapt to climate change by maintaining ecosystem resilience. In the Pacific islands of Tuvalu, domestically grown food remains the main source of nutrition, with *pulaka*, (a root similar to taro) playing an important role as staple crop. However, increasing saltwater intrusion has destroyed more than 60 percent of *pulaka* pit plantations in Tuvalu, and the remaining 40 percent remains highly sensitive to saltwater intrusion. It is assumed that an absolute destruction of *pulaka* crops is imminent in the near future for all islands of Tuvalu – possibly in the next decade – which would increase dependence on imports and have important nutritional consequences. To avoid it, the National Adaptation Plan of Tuvalu plans to introduce a salt-tolerant *pulaka* species in the region (Tuvalu, 2006).
77. Another benefit of traditional food systems relates to the sense of national pride and identity that arises when people come to understand and appreciate the value of their traditional native foods.

### Box 3: Reconnecting with food traditions

Today, many NGOs are working to stimulate demand for traditional food as well as to increase local capacity for traditional food production.

Over the past decade, Bioversity International has worked with farmers, NGOs, universities, hospitals, national research institutes and supermarkets across sub-Saharan Africa to improve livelihoods and nutrition by increasing the production and consumption of leafy vegetables. Approximately 900 species of leafy vegetables grow in sub-Saharan Africa. Rich in important micronutrients, such as vitamin A, iron and zinc, these plants were once a fundamental part of people's diets and culture. Then along came foreign crops such as cabbage and kale. Because of their exotic origins, these new crops acquired a special status and, gradually, people stopped growing traditional leafy vegetables in their gardens, and began to grow the fashionable – though less nutritious – modern crops instead.

**In Kenya**, Bioversity International and its partners focused on conservation, capacity building and raising awareness of the nutritional and culture values of traditional vegetables. Demand for leafy vegetables in Kenya now outweighs supply, with an astonishing 1 100 percent increase in sales in just two years. Incomes have increased too, particularly where farmers have been successfully linked to markets, with women, the main producers of leafy vegetables, the main beneficiaries. In almost 80 percent of households surveyed, it was the women who kept the cash from the sale of leafy vegetables and who decided how it would be spent – mostly on more and better food and schooling for the children (Bioversity International, 2010).

**In Marrakech**, the Global Diversity Foundation is restoring a school garden with the help of the staff and students of the Lalla Aouda Saadia School. The garden, which features both ornamental and edible plants, draws on Morocco's rich cultural history. The project, which aims to reach 1 300 schoolgirls, will provide nutritious food for the students while teaching them about the environment and food traditions. The students take part in field research by interviewing Marrakech herbalists about important cultural recipes.<sup>12</sup>

**In the Federated States of Micronesia (FSM)**, a shift from traditional to imported foods over the past three decades has brought serious health problems to the region. Prior to the 1970s, there were no documented instances of vitamin A deficiency in FSM. By 2000, over 50 percent of all children under the age of five were deficient in vitamin A, a condition that often leads to childhood blindness and early death. The Island Food Community of Pohnpe initiated a "Let's Go Local" campaign to promote important elements of nutrient analysis and conservation. It is particularly concerned with promoting foods that are rich in provitamin A carotenoids, especially beta-carotene. It has seen a significant increase in the consumption of indigenous bananas, taro and green vegetables in the target communities.<sup>13</sup>

## B. FOOD-BASED APPROACHES TO NUTRITION SECURITY

78. Food-based approaches are activities that increase availability and consumption of food through for example increasing food production, enabling greater access to and knowledge of healthy diets, dietary diversification and food fortification. They focus on improving diets in quantity as well as in dietary quality in terms of variety,

<sup>12</sup> <http://tinyurl.com/6k6367p>

<sup>13</sup> [www.islandfood.org/index.htm](http://www.islandfood.org/index.htm)

diversity, nutrient content and safety of foods. The importance of providing support for established food-based systems that ensure consumption of a variety of micronutrient-rich foods is clear both for the prevention and control of micronutrient deficiencies as well as for improving nutrition in general. Food-based approaches, by promoting the production and adequate consumption of foods for a healthy diet, are a viable, cost-effective and sustainable solution to ensure food and nutrition security and, by doing so, to achieve the nutrition-related Millennium Development Goals (MDGs).

79. Food-based approaches to nutrition security include any activities that preserve or fortify the nutritional value of food and support the consumption of nutritional foods. Such activities may take place at any point along the food chain, from seed selection, production, harvest, storage, processing, preservation and meal preparation through to consumption. Food-based approaches include incorporating enhancers of micronutrient absorption into food and reducing absorption inhibitors. They include integrating small-scale horticulture and raising small animals in order to increase dietary quality in terms of variety, diversity, nutrient content and food security. They also include food fortification, including biofortification. Food-based approaches are the vehicle for narrowing the “nutrition gap” which is the space between what foods are readily available and what foods are needed for a healthy diet. Such approaches are needed to ensure that nutritionally vulnerable people are able to consume the appropriate quality and quantity of food (Thompson B., 2010).
80. In addition to its intrinsic nutritional value, food has social and economic significance which, for many people, especially those living in developing countries, is commonly mediated through agriculture and agriculture-related activities that sustain rural livelihoods. The multiple social, economic and health benefits associated with successful food-based approaches that lead to year-round availability, access and consumption of nutritionally adequate amounts and varieties of foods are clear. The nutritional well-being and health of individuals is promoted, incomes and livelihoods supported, and community and national wealth created and protected.
81. Food-based strategies were often overlooked as governments, researchers, the donor community and health-oriented international agencies sought approaches for overcoming micronutrient malnutrition such as supplementation programmes that had rapid start-up times and produced quick and measurable results. Although many lives have been saved and much suffering has been avoided as a result of these efforts, food based approaches are gaining increased attention.

#### AGRICULTURE-BASED INTERVENTIONS TO IMPROVE NUTRITION SECURITY

82. Agricultural development programmes that aim to increase the production of staple crops are essential for food security, yet, alone, they are insufficient for alleviating hunger and malnutrition. Efforts to improve food security must be joined by efforts to improve nutrition security. Narrowing the nutrition gap will require increasing the availability of and access to the foods necessary for a healthy diet and ensuring that people actually eat them.
83. The following interventions have been developed with both yield and nutritional goals in mind<sup>14</sup>. Each aims to boost the production or consumption of high quality and diverse foods. While none of these interventions will narrow the gap on its own, each represents a useful step:
  - agricultural extension services offer improved inputs to communities, including seed and cultivars that ensure greater crop diversity, animals for small livestock and poultry ventures and fish for marine fisheries and aquaculture;

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<sup>14</sup> Thompson, B. Investing in Food Security – Nutrition. In FAO’s Agricultural Department’s Briefing Kit, November 2009, [www.fao.org/fileadmin/templates/ag\\_portal/docs/i1230e00.pdf](http://www.fao.org/fileadmin/templates/ag_portal/docs/i1230e00.pdf)



- agricultural extension services provide nutrition education at the community level;
- research and development programmes selectively breed plants and livestock to enhance their nutritional qualities;
- subsidy programmes increase the availability of fertilizers supplemented with micronutrients;
- research and development focuses on reducing post-harvest losses through improved handling, preservation, storage, preparation and processing techniques.

In addition to being compatible with traditional development objectives, each intervention can be adapted to a wide range of countries, agro-ecological zones and food typologies.

84. In the warm, arid and semi-arid tropics, the introduction of drought-tolerant cultivars with high micronutrient levels should be a priority. These zones are also good candidates for the involvement of agricultural extension services to promote the consumption of local or indigenous plants and animals as well as food staples. For example, intercropping cereal crops with drought-resistant legumes, such as cowpea or pigeon pea, improves both nutrition and food security: the former through increased protein intake, the latter through increased nitrogen fixation and, subsequently, higher yields.
85. A common problem in the warm sub-humid tropics is the inability of farmers to get hold of the fertilizers they need to overcome soil nutrient deficiency, either because the fertilizers are not available or because the farmers cannot afford them. Although fertilizer use is typically associated with increasing production, enhancing the micronutrient and trace element (iodine, zinc, iron) content of crops by applying enriched fertilizers and managing soil acidity may also improve nutritional security. Micronutrient-enriched fertilizers have particular potential where input subsidy schemes already reach large numbers of farmers.
86. While production and food security goals in the warm humid tropics are often met, diets may still be nutritionally deficient. In Ghana, for example, dietary energy supply meets requirements but the share of protein and lipids in people's diets is lower than recommended. This is at least in part caused by lack of access to markets due to poor infrastructure. Yet, there are many agriculture-based interventions that could improve nutrition outcomes in this zone. These include small livestock production projects to provide an accessible source of fat, protein and essential micronutrients, providing dietary diversification advice such as cereal-legume mixing to maximize protein availability, and horticultural training to improve the availability of micronutrient-rich vegetables and fruit. Horticulture also has the potential to increase incomes through the sale of fruits and vegetables, given access to markets. Selective breeding to increase the protein content of cassava – a central component of diets in this zone – could increase macronutrient intake. Aquaculture also offers income opportunities to small producers and provides a valuable source of high quality protein and essential micronutrients<sup>15</sup>.
87. These interventions all represent excellent investment options and have the capacity to increase women's roles in managing productive assets and their access to services, technology and income generating opportunities. As shown by the World Bank (2007), the resources and income flows that women control wield disproportionately positive impacts on household health and nutrition.

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<sup>15</sup> Aquaculture's Role in Improving Food and Nutrition Security, In Combating micronutrient deficiencies: food based approaches. FAO/CABI publication. [www.fao.org/docrep/013/am027e/am027e00.htm](http://www.fao.org/docrep/013/am027e/am027e00.htm)

## ENHANCE AGRICULTURAL BIODIVERSITY FOR BALANCED DIETS

88. The role that agricultural biodiversity can play in nutrition is well acknowledged. However, there is a need for even broader dissemination of scientific evidence on the connection between the two. Recent studies have shown that nutrient values may vary greatly among different varieties of the same foods. For example, sweet potato cultivars can differ in their carotenoid content by a factor of 200 or more; the protein content of rice varieties can range from 5 to 14 percent by weight, and the provitamin A carotenoid content of bananas can be less than 1 µg/100 g for some cultivars up to 8 500 µg/100 g for others.
89. Nutrient content in crop types varies due to environmental and processing influences such as feed, soil, sunshine, time of harvest, storage conditions, fortification. Differences in recipes and local food traditions also can have an impact on nutrient content. Breeders need to be aware of the nutritional composition of existing cultivars and factor in nutrient content when improving agronomic traits such as yield and disease resistance or sensory characteristics such as flavour, texture and appearance.
90. In recent years, consumption of animal products has increased due to the growth in emerging economies and urbanization. Today, animal products contribute 15 percent of the energy and 25 percent of the protein consumed globally (FAO 2009a). In addition, they provide a wide range of micronutrients such as iron and zinc in highly bioavailable forms, vitamin A, vitamin B12 and calcium, all of which are vital, but particularly during the critical developmental stages of young children and pregnant women.
91. Fish are a major provider of animal protein and micronutrients for many coastal populations and an affordable source of essential nutrients in many poor areas. Fish contribute at least 30 percent of animal protein intake for 1 billion people and at least 15 percent of animal protein intake for 2.9 billion more. Fish provide a unique source of essential fatty acids, such as DHA and EPA, which contribute to optimal brain development and the prevention of coronary heart diseases. They are also a valuable source of micronutrients that are easily absorbed by the body. These include most minerals – such as calcium, iodine, zinc, iron and selenium – as well as the vitamins D, A and B complex (FAO/WHO, 2011).
92. Food biodiversity is seldom included in nutrition programmes or interventions. This is largely because insufficient data exist on the nutrient composition of many crop varieties and animal breeds, and resources are scarce for generating these data for use in food consumption studies and nutrition programmes. Farmers and consumers are often not aware of the higher nutrient values of certain plant cultivars compared with others, and so do not grow or consume them. Indicators, tools and methodologies for measuring and monitoring biodiversity-related food composition and consumption have been developed by FAO and will be critical to evaluating the contribution that food biodiversity can make to sustainable diets. Relevant, reliable and up-to-date food composition data are also of fundamental importance in disciplines such as food science, plant breeding, food product development, trade and marketing, and food regulation.

## C. IMPROVING SUSTAINABLE EFFICIENCY OF FOOD CHAINS

93. At the global level, agrifood systems are undergoing rapid changes which impact the food losses in the supply chain. Trends in diet composition, towards a higher percentage of highly perishable food items such as animal products, fruits and vegetables, lead to an increased risk of loss, in both quality and quantity terms, as well as to an increased risk of wastage once the product has reached the final consumer. The increasing distances between the places where food is produced and where it is consumed lead to longer and more complex supply chains within which losses and wastage levels can be high if infrastructure is inappropriate or chains are poorly coordinated. While the growing number of supermarkets offers the consumer a wide range of diverse foods, it also increases the risk of wastage, as not all perishable products can be sold before expiration, an issue

exacerbated by increasing consumer food safety and quality concerns. At the final stage in the chain where food is consumed (at homes, restaurants and other food service businesses) significant quantities of food are wasted when left to deteriorate or when discarded even though still fit for consumption.

### REDUCING FOOD LOSSES

94. Food losses occur all along food chains, but there also are techniques available to reduce them.
95. Improving the availability and effectiveness of storage in developing countries will reduce post-harvest losses and improve food safety. Storage accommodates delays and constraints in logistics and ensures the availability of food throughout the year. It both reduces seasonal gluts on the market and enables farmers and producers to delay sales until the lean season when they can command higher prices. Storage also enables farmers, producers and traders to get credit using their food stocks as collateral. The availability of adequate storage facilities becomes particularly critical during emergency and rehabilitation situations when the food and nutrition security of the population may be at greater risk than under normal circumstances.
96. For instance, household metallic silos for conservation of cereals or tubers are actively promoted by organizations such as FAO and various NGOs. Metallic silos in Afghanistan have reduced storage loss from 15–20 percent to less than 1–2 percent. Their fabrication is local, creating jobs, small enterprises and possibilities of diversification. They enable farmers to preserve food, therefore making them less vulnerable, either as sellers or buyers, to price fluctuations on local markets.
97. For fresh products, cold storage can be an option but its cost and energy inefficiency make it a less appropriate solution in certain contexts. In some cases, a better option might be to encourage the production of fresh foods locally. In others, solar refrigeration might be a technically and economically feasible option.

### DEVELOP LOCAL PROCESSING

98. Processing reduces post-harvest losses, and allows food to be preserved and transported more energy efficiently when realized locally. Preservation also contributes to more balanced diets throughout the year, enabling food to be consumed in more convenient and nutritious forms. Food processing operations increase and diversify incomes and provide employment and entrepreneurial opportunities in both rural and urban areas. Food processing is also an excellent method for women in rural communities to generate income and employment.
99. Small-scale processors have to contend with increasingly strict industry standards and – in global markets – with tough competition from large manufacturers in developed and transition countries. To compete, processing enterprises will need environmentally friendly technologies and the ability to use them effectively. They will also need to have the capacity for providing quality and safety assurance and expertise in business management and marketing. Potable water, electricity and waste disposal facilities must be available on site. A supporting infrastructure in the form of roads, warehouses and information and communication technologies must also be available to underpin processing operations and facilitate links between processors and input and output markets.
100. Many developing countries lack the regulatory and institutional frameworks needed to support the food-processing sector. These frameworks are critical. Regulatory frameworks are needed to protect intellectual property rights and to control the registration of enterprises, land tenure, foreign and domestic investment, contracts, operation of commodity markets and employment of personnel. Institutional frameworks are needed to set and enforce quality, safety and other standards and to support research and training.

### DEVELOP SUSTAINABLE PACKAGING

101. Packaging has an important role to play in reducing food loss and a clearer understanding of its protective and marketing functions can help to promote its use. Advances in packaging not only lead to better food quality and safety but can also help enhance the livelihoods of small producers by attracting better market share and value through increased visibility (FAO, 2011b).
102. In developing countries, the food packaging industry has limited solutions for meeting international market requirements and a relative lack of domestic demand for packaging materials. This results in low investment by the packaging industry, which in turn, limits the ability of manufacturers to enhance product quality to meet the standards of increasingly discriminating consumers, both in domestic and international markets.
103. Improving traditional technologies or importing new ones may help expand the packaging industry in developing countries. Relaxing packaging regulations, for example on the use of recycled materials when they pose no threat of contamination, may assist in the development of the industry while being good for the environment. Innovations in food packaging can play an important role in reducing food losses and improving food safety and quality. For instance, active and intelligent packaging extends the shelf life of food and provides information on its freshness and intelligent or smart packaging can monitor and communicate information about food quality (Brody *et al.*, 2008).

### IMPROVE ENERGY EFFICIENCY

104. There are options for achieving greater energy efficiency at every stage of food chains. Each link along the food chains, until consumption, has potential to improve energy efficiency – in transport, conservation, transformation and cooking. However there could be trade-offs between reducing losses and reducing energy consumption, especially for fresh perishable products whose consumption is increasing, such as meat, dairy products, fish, fruits and vegetables. The analysis shall therefore encompass the whole food chain in order to consider all impacts and all potential solutions. For instance, transforming fresh products transported on long distances into less perishable products can reduce losses and emissions induced by conservation and transport as slower more energy efficient transportation means can be used.
105. Some 2.7 billion people – almost half of humanity – rely on traditional biomass for cooking and heating and more than two billion people depend on wood energy for cooking and/or heating<sup>16</sup> particularly in households in developing countries. Solid biomass represents the only domestically available and affordable source of energy. Private households' cooking and heating with fuelwood represents one third of the global renewable energy consumption<sup>17</sup>. There are many ways to increase efficiency and sustainability of fuelwood and charcoal production and consumption patterns. However, these are often not applied by the local population due to uncertain or unfavourable legal, political or social framework conditions.
106. Charcoal is the fuel of choice of urban dwellers in developing countries. Its consumption increased strongly in Africa (+29.8 percent) and Asia (+10.2 percent) and at global level (+8.9 percent) between 2004 and 2009 (Lanly, 2003). Main drivers are the increasing rate of urbanization in developing countries as well as the high prices for fossil fuels such as kerosene, LPG and natural gas. In many parts of the world, charcoal production is managed in a sustainable fashion. However, in developing countries, fuelwood collection and charcoal are often not sustainably managed and are estimated to be responsible for 8 percent to 11 percent of the global deforestation.

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<sup>16</sup> UN Foundation [www.sustainableenergyforall.org/about](http://www.sustainableenergyforall.org/about)

<sup>17</sup> [www.fao.org/forestry/energy/en/](http://www.fao.org/forestry/energy/en/)

107. Coppicing, involving cutting trees back periodically to stimulate growth can reduce the pressure on tree and forest resources, on the production side. This process yields fuelwood and can be even carbon-negative, since each time a tree is coppiced, some of its root mass dies to compensate for the loss of photosynthetic surface. Integrating and intensifying food and energy production has the potential to improve food and energy security in rural villages and also at national level.
108. Many people use polluting stoves or three stone fireplaces which contribute to severe respiratory problems notably for women and children. The World Health Organization (WHO) estimated that “every year, indoor air pollution is responsible for the death of 1.6 million people<sup>18</sup>”. Clean cooking stoves offer a significant improvement of indoor air quality reducing respiratory problems and saving lives, improving livelihoods of women, by reducing time spent for fuel collection and reducing climate relevant emissions, such as CO<sub>2</sub> and black carbon emissions (soot). FAO works with the Global Alliance for Clean Cook stoves<sup>19</sup>, a new public-private partnership that calls for 100 million homes to adopt clean and efficient stoves and fuels by 2020. The Alliance partners with public, private and non-governmental organizations to help overcome the market barriers that currently impede the production, deployment and use of clean cook stoves in the developing world.
109. More than 200 million Africans eat fish regularly, most often smoked or dried (FARA, 2007). The traditional production of smoked fish and, sometimes dried bivalves, requires extensive use of wood, which is often supplied by mangroves. It is estimated that over 200 000 ha of mangroves were lost between 1990 and 2007, due to the combined demands of construction, smoked fish and agricultural activities. Traditional fish smoking also impacts on human health because it exposes people to toxic fumes and excessive heat. The Chorkor oven – introduced in the late 1960s – decreases fuelwood consumption by more than half and reduces the danger of smoke inhalation and burns.<sup>20</sup> The quality of the smoked food is also superior. Additional improvements to smoking kilns have further improved food safety by reducing the presence of polyaromatic hydrocarbons, especially benzopyrenes (Nndiaye, 2007).
110. Integrated food-energy systems can produce food and energy at the same time. Farmers can save money using these integrated systems because they do not have to buy costly fossil fuels for their energy needs, nor chemical fertilizer if they use the slurry from biogas production. Combining food and energy production can also reduce deforestation. Simple systems such as agroforestry or biogas can be easily up-scaled. More complex systems require high levels of knowledge and skills to implement them. A recent study by FAO and the Policy Innovation Systems for Clean Energy Security (PISCES) of 15 bioenergy initiatives in developing countries found that such initiatives bring real and sustainable benefits to poor communities in rural areas. The study also shows that environmental and social risks are minimized when such initiatives are small-scale and participatory (FAO-PISCES, 2009, FAO, 2010b).

### FOOD SAFETY AND TRACEABILITY

111. Every step along the supply chain is susceptible to contamination of food products. Poor or unhygienic handling of foods, inadequate cold storage systems, poor road systems that delay the delivery of perishable products, unhygienic processing equipment or packaging that does not adequately protect its contents: any one of these factors can result in the delivery of spoiled or unsafe food to markets – if it reaches the markets at all. And the longer the supply chain, the more likely it is that a problem will occur along the way.
112. Some have voiced the concern that by raising the bar for the safety and quality of food and agricultural products traded globally, international requirements will create new challenges for developing countries that want to maintain their exports or enter new markets. For example, it is often difficult for exporters in

<sup>18</sup> [www.who.int/mediacentre/factsheets/fs292/en](http://www.who.int/mediacentre/factsheets/fs292/en)

<sup>19</sup> <http://cleancookstoves.org/>

<sup>20</sup> [www.fao.org/bestpractices/content/06/06\\_02\\_en.htm](http://www.fao.org/bestpractices/content/06/06_02_en.htm)

developing countries to comply with international standards and requirements imposed by importing countries. Others believe that WTO's Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) Agreements, which address health-related trade restrictions, have created new opportunities for developing countries, many of which rely heavily on food and agricultural production to generate economic development and reduce poverty through trade. Indeed, some countries and sectors have successfully expanded their exports of high-value and value-added food and agricultural products with spectacular results.

113. Traceability – the ability to follow the movement of a food through specified stage(s) of production, processing, and distribution (Codex Alimentarius, 2008) – can be used to track products up and down the value chain. Traceability has become an integral element of national and regional food laws across the globe and is a fundamental component of the EU Rapid Alert System for Food and Feed.
114. Establishing preventive approaches and safe food practices at every point along the food chain is essential. The assurance of safe food requires following an integrated risk-based approach at all stages by which food passes to reach the consumer, including feed production, primary production, food processing, storage, transport and retail sale.
115. To this end, national assessments are needed to identify existing capacities and gaps in food safety processes. It is recognized that this can be a significant challenge, especially in many developing countries where food safety competes with several other important priorities for national attention and resources. Nevertheless, many governments now recognize the benefits of robust, multistakeholder discussions and, in some cases, collective decision-making in order to achieve sound food safety policies and programmes. Civil society, the private sector and other non-state actors have a stake in food and nutrition security and have much to contribute towards ensuring the effectiveness and safety of food chains.
116. Governments need to be able to demonstrate to their own populations as well as to their trading partners that they can guarantee a safe food supply. The need for public awareness about food safety and quality issues, particularly in developed countries, has never been higher. Consumers are growing more selective about the food they buy. They want safe food as a minimum but they also want a greater choice of food. Consumers' increasing demands are transforming the food and agriculture sectors.

## IV. SUSTAINABLE CONSUMPTION DRIVER OF THE GREEN ECONOMY

### A. HARNESSING FOOD DEMAND INCREASE

117. Rich consumer's growing demand for food products has a major impact on natural resources and drives prices increases which have a disproportionate effect on poor consumers. Poorest countries absorb a larger proportion of the quantitative adjustment necessary to balance supply and demand (HLPE, 2011). This is due to unequal repartition of elasticity of food demand to prices between countries: the richer countries have the lowest elasticity to price, meaning that they have more capacity to increase their food spending to maintain food consumption levels when prices go up. It appears that the difference in food price elasticity in the poorest and richest countries is increasing over time, and progressively puts a higher burden on the poorest countries in the global quantitative adjustment. This is why the High Level Panel of Experts on food security and nutrition (HLPE), in its report on price volatility to the Committee on World Food Security (CFS), recommends to curb the growth of global demand, including by reducing food waste.
118. In all scenarios where demand's increase is slowed compared to business as usual, consumers' behaviour is the driving factor (Agrimonde 2009, Erb *et al.* 2009, Grethe *et al.* 2011). Concerns for a more healthy and balanced diet and for a more sustainable way of life is leading to a shift towards "sustainable diets".

### B. REDUCING FOOD WASTE

119. Abundance and consumer attitudes lead to high food waste in industrialized countries. Unlike in the developing world, people in rich countries can afford to waste food. In Europe and the USA, many restaurants serve buffets at fixed prices, a practice that encourages people to fill their plates with more food than they can actually eat. Retail stores offer large packages and "buy one, get one free" bargains. Likewise, food manufactures produce oversized ready to eat meals (Stuart, 2009).
120. Public awareness and education on the extent and impact of food waste could help change people attitudes and, eventually, their behaviour with regard to wasting food. Voluntary initiatives such as "Stop wasting food" in Denmark or "Waste not want not" in the UK<sup>21</sup> give guidance to consumers on how to avoid wasting food by shopping according to daily needs of households, through promoting better household planning and shopping patterns in order to move from impulsive to rational food shopping and consumption patterns. Governments, through ministries of health, education, industry and trade, have programmes on how to combat unhealthy eating habits leading to food wastes in countries especially those with high levels of obesity. For instance, in 2000, the UK government created the Waste & Resources Action Programme (WRAP), a government-funded, not-for-profit company that advises people how to reduce waste and use resources efficiently. In 2007, WRAP launched the "Love Food, Hate Waste" campaign and returned food waste to the forefront of the news and onto the public agenda. Opportunities could be explored to raise consumer awareness of food wastes by including information of losses and wastage as part of a labelling system or as information on strategic consumer food items. Public programmes should include a dialogue with the private sector, which plays an important role in influencing consumer choices in regards to shopping, preparation, consumption and waste.
121. High standards for appearance lead to food waste. Large portions of harvests are rejected by supermarkets in industrialized countries due to rigorous standards concerning weight, size, shape and appearance of foods.

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<sup>21</sup> [www.lovefoodhatewaste.com/about\\_food\\_waste](http://www.lovefoodhatewaste.com/about_food_waste)



Even though some rejected crops are used as animal feed, food originally aimed for human consumption is wasted. High appearance standards also seriously affect the fruits and vegetables produced in developing countries for export to industrialized countries. Consumers could be questioned and offered a broader quality range of products in the retail stores. In addition, selling produce closer to the consumers, e.g. in farmers' markets, without having to pass the strict quality standards set up by supermarkets on weight, size and appearance would possibly reduce the amount that is rejected (Stuart, 2009).

122. Unsafe food is not fit for human consumption and therefore is wasted. Failure to comply with minimum food safety standards can lead to food losses and, in extreme cases, have an impact on the food security of an entire country. Food must be produced, handled and stored in accordance with food safety standards. This requires the application of good agricultural and hygienic practices by all food chain operators.
123. Industrialized country attitudes that "disposing is cheaper than using or reusing" leads to food waste. Industrialized food processors lines often trim food products to achieve a standard shape and size and then throw away the trimmings. Food is also lost when processing results in products in the wrong weight, shape or appearance or damaged packaging. In a standardized production line, these products often end up as waste (Stuart, 2009; SEPA, 2008). Both commercial and charity organizations could arrange to collect, sell or use "substandard" products that are still safe and have good taste and nutritional value.
124. There are also solutions to be found in the way products are marketed. Large quantities on display and a wide range and supply of product brands cause food waste in industrialized countries. Retail stores typically order a variety of food types and brands from the same manufacturer to get good prices. Consumers also expect a wide range of products to be available to them. Having a large quantity of products increases the likelihood of some of them becoming outdated before they are sold, and thereby wasted. This is a particular problem for small retail stores (SEPA, 2008).
125. Inadequate market systems cause high food losses in developing countries. Wholesale and retail markets in developing countries are often small, overcrowded, unsanitary and lack cooling and storage equipment. There may also be limited room for handling loading, unloading and ripening food (Kader, 2005). Marketing cooperatives provide a central point for assembling commodity produce from small farmers and preparing it for transportation to markets and other distribution channels. The marketing cooperatives reduce food losses by increasing the efficiency of these activities. Although the development of wholesale and retail markets should preferably be done by the private sector as commercial enterprises, local governments and marketing cooperatives can be instrumental in establishing and improving market facilities
126. In addition to reducing food waste *per se*, actions such as donating food, recycling, and converting organic waste into compost, animal feed or energy can all play a role in decreasing landfill emissions from food waste – although this would require safeguards against food safety risks. Grassroots movements have been taking a stand against food waste for years.
127. Until now, a lack of infrastructure has hindered large-scale efforts to reduce food waste. Recently, however, there have been some positive signs of change which may influence other actors along the food chain. In 2009, Wal-Mart, the world's largest retailer, announced its goal to eliminate the landfill waste generated by its 4 400 USA stores by 2025.<sup>22</sup> Two years later, the company confirmed that it had successfully diverted 80 percent of the waste from its California operations from landfills. Achieving a similar reduction in landfill waste across the country would help Wal-Mart prevent more than 11.8 million metric tonnes of carbon dioxide emissions every year. In 2010, Imperial College London formulated a plan to redirect food waste from the College's three

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<sup>22</sup> [www.greenbiz.com/news/2011/03/18/walmart-cuts-landfill-waste-80-percent-california](http://www.greenbiz.com/news/2011/03/18/walmart-cuts-landfill-waste-80-percent-california)

restaurants from landfills to their newly designed composting unit. The unit turns the waste into compost, which is used to enhance the green spaces of the campus.<sup>23</sup>

128. In 1999, the European Union laid down strict requirements for landfills to reduce their negative impacts on the environment, particularly on surface water, groundwater, soil, air and human health. The enforcement of the so-called Landfill Directive is expected to reduce the amount of organic material in landfill sites across the continent to 35 percent by 2016.
129. Recently, a Joint Declaration against Food Waste by representatives of universities and civil society was presented to the United Nations and the European Parliament. The declaration contains proposals for the sustainable use of food and calls for a commitment to the global reduction of food waste by at least 50 percent by 2025. It also suggests that reduction of food waste should be a new target within UN Millennium Development Goal 7: to ensure environmental sustainability.

### C. PROMOTING SUSTAINABLE DIETS

130. FAO defines sustainable diets as “those diets with low environmental impacts that contribute to food and nutrition security and to healthy lives for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable, nutritionally adequate, safe and healthy, while optimizing natural and human resources” (FAO, 2010c).
131. In the early 1980s, the notion of “sustainable diets” was described by Gussow and Clancy (1986) to recommend diets healthier for the environment as well as for consumers. The concept of “sustainable diet”, borrowed from “sustainable agriculture,” refers to diets that minimize waste of natural resources and encourage consumption of local and seasonal products. With the food globalization process and the increased industrialization of agricultural systems that pays no attention to the sustainability of ecosystems, the sustainable diet's concept was neglected for many years. Recently, the interest on sustainable diets has again been raised by international scientific societies, institutions and governments (Esnouf *et al.*, 2011).
132. Consumer choice is strongly influenced by income, social and cultural factors, education and physical access to food. Major marketing campaigns by the private sector also can play a significant role, targeting particular sectors of society, for example women and young people. Information campaigns and labelling that promote awareness of the implications of food choices for nutrition, health and the environment can contribute to sustainable diets.

#### INFORMING THE CONSUMER ON NUTRITIONAL VALUE OF FOODS

133. National food-based dietary guidelines (FBDG) should counsel the need to reduce the consumption of highly processed energy-dense foods that have fewer health benefits than do fruit and vegetables or fresh fish. In addition, national guidelines should promote reducing the consumption of meat and dairy products and less reducing food wastage by consumers. The biological effects of food and food patterns can be greater than the sum of the parts but, to be effective, FBDG must take a number of factors into account: food/health patterns; relative comprehensiveness of the food-based versus the nutrient-based approach; practicality of the proposed goals for the guidelines; nutrition labelling that leads consumers to an over-simplified view of foods; shifting paradigms on the nutritional basis for diseases and health.

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<sup>23</sup> [www.nextgenerationfood.com/news/imperial-college-works-to-reduce-food-waste/](http://www.nextgenerationfood.com/news/imperial-college-works-to-reduce-food-waste/)

134. The study of energy balance and metabolism, and of macro- and micronutrient physiology is already well established and has now evolved to take account of non-nutrient components in food. As far as energy is concerned, the next generation of FBDG can take account of both the lower limits of energy intake and the ways that energy balance can be achieved, with the emphasis placed on strategies to either decrease the energy density of diets or to increase energy expenditure. In this way, concerns about chronic energy deficit and excess body fat can be addressed through FBDG.
135. Micronutrient-rich foods are recognized as having an important contribution in to make to preventing deficiency disorders and to improve host defences to communicable diseases and may play a role in avoiding non-communicable diseases. Therefore, the formulation of FBDG in all food cultures with varying health patterns should take all nutrients into account. The development of informed dietary guidelines can help counteract the simplification of diets and the over-consumption of meat, and promote the consumption of a variety of foods, including local and traditional foods, as sources of food-biodiversity and good nutrition. However, the 2007 United States National Institutes of Health (NIH) panel concluded that “the present evidence is insufficient to recommend either for or against the use of multivitamins and minerals by the American public to prevent chronic disease”.

#### INFORMING THE CONSUMER ON ENVIRONMENTAL AND SOCIAL IMPACT OF FOOD

136. There are increasing social expectations and consumer demands for more information about the environmental and social impact of food, which is also very symbolic of consumption as a whole even if it represents, in developed countries, a small and decreasing part of household budgets.
137. Public information can be dispensed through general communication, such as the “Guidelines for climate-friendly food choices” released in 2009 by the Swedish authorities which recommend that citizens reduce their meat and rice consumption as a way of reducing greenhouse gas emissions. Recommendations also include eating seasonal, locally-produced fruits, vegetables and berries, avoiding bottled water, soda and palm oil. This is also an aim of the Finnish project on the evaluation of the carbon footprint of meals mentioned earlier (paragraph 36).
138. France has adopted a very ambitious law which would made mandatory information on the environmental impact of every product, including food.
139. NGOs periodically communicate about the environmental or social impact of certain products, often in relation to their origin, which is successful in raising awareness on a particular issue. It is said that NGO actions played a role in the evolution of the Brazilian beef industry and the reduction of deforestation.
140. Most of the information conveyed to the consumer about food is communicated by producers, either individuals or brands and by retailers. This information can be conveyed directly, in markets or in small shops where personal contact creates confidence. However, in longer food chains, information has to be transmitted all along the chain. In that case it sometimes includes only information about initial stages or gathers information about all the transformation process. To answer consumer demand, there are a growing number of private standards, implemented by industrials and retailers, sometimes with the involvement of NGOs. Most of them concern either social or environmental issues, or some environmental issue such as biodiversity or climate change. There is for instance a growing number of carbon footprint schemes (OECD, 2009).

#### D. OPENING CONSUMER CHOICES

141. Consumer choice can play a leading role in Greening the Economy, by selecting certain types of products, according to their place of origin, process of production, or producers. By accepting to pay a little more for these qualities, consumers can both drive sustainable production and create value for small producers. By

selecting and by accepting to pay more, they also acknowledge more symbolic and economic value to food, thus harnessing demand and reducing waste while adding value for producers.

142. In many developed countries, consumers have lost the daily perception of food being produced by farmers, using natural resources and managing landscapes (Sissons, 2001) . This is largely due to globalization and increased consumption of transformed products. There is now a trend to rediscover the link of food to its area of production, to the people who produce it and the way they produce it. This trend manifests itself in various forms: growth of local markets, development of geographical indication schemes, voluntary sustainability standards, including fair trade and organic. All of these also convey the image farming and farmers and of the cultural and social values associated to food production and consumption.

### LOCAL FOOD

143. The newfound growth in local food systems suggests that significant demand exists for locally produced foods (USDA, 2010). Interchangeable terms such as “local food,” “local food system” and “(re)localization” refer to food produced near its point of consumption (Peters *et al.*, 2008).

144. In countries such as the USA, the growing interest in local foods has been sparked by a number of social movements:

- the environmental movement encourages people to consider the environmental dimensions of their food choices, based on their advocacy of the sustainable management of resources;
- the food security movement seeks to enhance access of all consumers to safe, healthy and culturally appropriate food;
- the anti-globalization movement challenges the dominance of large food corporations;
- interest in local foods also reflects an increasing interest by consumers in supporting local farmers and in better understanding the origins of the food they eat (Ilbery and Maye, 2005; Pirog, 2009).

145. The emphasis of local food systems is on geographical location rather than on origin. In the USA, according to the definition adopted by the 2008 US. Farm Act, the total distance that a product can be transported and still be considered a “locally or regionally produced agricultural food product” is less than 400 miles from its origin, or within the state in which it is produced.” However, defining a system as local, based on market arrangements, including direct transactions between farmers and consumers and sales by farmers to restaurants, retail stores, and institutions is well recognized (Martinez, 2010). Direct sales of local foods to consumers can take place in farmers’ markets, fish landing sites or local fish markets, through community-supported agriculture organizations, on-farm sales, and “pick your own” operations and even through direct sales from food-processing operations.

#### Box 4: Direct sales in the USA

According to the 2007 USA Census, 136 800 farms, or 6 percent of all farms in the United States, sold USD 1.2 billion worth of farm products directly to consumers (USDA, 2010). The number of farmers’ markets around the country rose to 6 132 in 2010, a 16 percent increase from 2009, according to USDA’s Agricultural Marketing Service. In 2005, there were 1 144 CSAs in operation, and by 2010, an online registry estimated that the number exceeded 2 500 (Local Harvest, 2010). Popular Web sites facilitate online purchases of local food. Consumers can learn about the producers, link to their Web sites and place orders, which are paid through Internet payment sites such as PayPal.<sup>24</sup>

<sup>24</sup> One example is the [www.farmersonlinemarket.net/index.cfm/](http://www.farmersonlinemarket.net/index.cfm/).

146. As food companies strive to grow or maintain their market share, the mainstream distribution channels for food products are changing as more and more supermarkets install local food sections in their stores (Smith, 2009). In the USA, several leading retailers, such as Wal-Mart, Safeway and Publix, have recently announced local food initiatives. Kenyan supermarkets are struggling to keep up with the demand for African leafy vegetables in the wake of a major promotional campaign launched by Bioversity International in 2000.
147. Retail food cooperatives are another distribution channel for local foods. These organizations are owned and operated by their consumer members who receive price discounts. Co-ops routinely stock products in bulk and are committed to purchasing organic and locally grown foods. A growing number of restaurants exclusively offer local foods and are willing to have a more limited menu in order to offer in-season products that they believe their customers will prefer.
148. Farm-to-school programmes are an important part of the institutional market for locally grown produce. School food authorities buy fresh produce directly from local farmers or sponsor school garden projects or field trips to nearby farms as part of a nutrition education curriculum. The supporters of such programmes believe that they provide many benefits to both students and small farmers (Joshi and Azuma, 2009). The National Farm to School Network, a collaboration of groups that support farm to school programmes, estimated that there were 2 051 farm to school programmes in the USA in 2009, twice as many as in 2005.
149. In the Brazilian Zero Hunger programme, prioritization of direct purchase for school meals from social organizations or settlers of the agrarian reform, indigenous people, quilombolas and women also participates in the main programmes for the development of family, traditional and peasant farmers in situations of social and economic vulnerability (Moreira 2010).
150. As of 2009, 284 hospital facilities in the USA, including several private corporate hospitals, had signed the Health Care Without Harm Healthy Food Pledge to increase offerings of fruits and vegetables, along with minimally processed foods. The pledge also obligates the hospitals to identify and adopt sustainable food procurement, including purchasing local foods, and to promote and educate their patients about healthy foods (USDA, 2010).<sup>25</sup>
151. Environmental benefits of local systems are often presented as a transport issue, as “food miles”. Such a presentation is totally misleading. First because GHG emissions is only one of the environmental impacts of food systems. Second because transport represents a small part of them, and half of the transport emissions are caused by consumers (see 34). In fact, the global impact of food production is linked to the efficiency of the food chain as a whole. Being local does play a role, mostly for fresh products, and most of the local systems are adding value, both symbolically and economically in terms of providing food and induced benefits. These include:
- greater availability of more nutritious local fruits and vegetables;
  - reduction of food safety risks as a result of decentralized production (Peters *et al.*, 2008);
  - conservation of farmland by allowing residential communities to be established on farms in urbanizing areas (Ikerd, 2005);
  - provision of incentives for small farmers to stay in rural areas, instead of moving to the cities without employment (de Schutter, 2011);
  - development of a sense of pride and social cohesion in a community;
  - protection of agricultural biodiversity (Goland and Bauer, 2004).

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<sup>25</sup> For more detail, see: [www.noharm.org/us\\_canada/issues/food/signers.php/](http://www.noharm.org/us_canada/issues/food/signers.php/).

152. Research has found that expanding local food systems in a community can increase employment and income (USDA, 2010). It also can have a positive impact on overall economic activity through import substitution and localizing processing activities.
153. However, expanding local food systems may be difficult for local food producers who most often run small-scale farms and cannot easily meet demands for high volumes while ensuring consistent quality, timely deliveries, and out-of-season availability (Shipman, 2009; Abate, 2008; Gregoire *et al.*, 2005). It may also be difficult for small growers to scale-up production, because much of their time is spent away from the farm selling their products.
154. In developing countries, high levels of poverty, unemployment and food insecurity often prompt urban migration, yet these conditions persist for rural people who settle in the cities. Poor urban households spend up to 80 percent of their income on food, making them extremely vulnerable when food prices rise or their incomes fall. Urban and peri-urban agriculture (UPA) – the production, processing and marketing of food in and around cities – can contribute to hardier urban food systems, while providing significant additional benefits, thus increasing food security. Growing a wide range of fruits and vegetables in and around cities increases the access of the urban poor to fresh, nutritious produce. By diversifying urban income sources (from production, processing, value-addition and marketing), UPA enhances the resilience of livelihoods to economic downturns and food price hikes and contributes to the economic development of cities. The relative proximity of urban markets to the production site allows for a daily supply of produce with lower transport and storage expenses and reduced post-harvest losses. UPA also creates employment for the jobless.
155. UPA can also contribute to a safe environment and a healthy community. Linking waste management to agriculture (e.g. by recycling organic waste materials as mulch or compost) helps keep the urban environment clean, reduces health hazards from waste, and boosts the production of fresh food. Because UPA eliminates the need to transport produce from distant rural areas, it can generate fuel savings and reduce carbon dioxide emissions and air pollution. Moreover, UPA lowers city temperatures by using available land for green surface including shade trees and fruit trees. When appropriately practised on greenbelts, it also can stabilize environmentally fragile lands, such as hillsides and riverbanks, thus preventing landslides and flooding. Finally, UPA provides an innovative approach to urban development and an example of good governance in action.

#### QUALITY ASSOCIATED TO THE PLACE OF ORIGIN

156. Some agricultural and food products are distinguished from one another by certain characteristics, qualities or reputations resulting essentially from their geographic origin. This differentiation can be attributed to the unique local features of the product, its history or its distinctive character linked to natural or human factors such as soil, climate, local know-how and traditions, which all are covered by the term "*terroir*". These products of origin-linked quality can increase food security, inasmuch as they contribute to rural development and the preservation of food diversity, while also offering consumers a wider choice. Indeed, thanks to the link between such products and their areas of origin, they can help preserve local resources, maintain traditions and strengthen the organization of local stakeholders.
157. Strengthening the ties among local stakeholders, places and agricultural and food products is a major step towards sustainable rural development. These relations are based on local capacities to create value within a global market, while remaining anchored in a specific place. Origin-linked products have specific quality attributes that are inseparably linked to the places where they are produced and that build up a reputation over time, associated with a geographical indication (GI) that identifies them.
158. These differentiated products can thus meet a specific and remunerative demand. Consumers are increasingly concerned with the specific attributes of agricultural and food products, particularly in terms of their culture,

identity and means of sustainable production. Moreover, such products can contribute to biodiversity preservation, cultural heritage protection, sociocultural development and rural poverty reduction.

159. The identity of GI products as differentiated origin-linked products reflects the unique combination of local natural resources (e.g. climate, soil, local animal breeds and plant species, traditional equipment) and cultural assets (traditions, know-how and skills) often handed down from generation to generation in a given territory, thus establishing specific links between the product, local stakeholders and the territory.
160. An origin-linked product can become the pivotal point of a specific-quality virtuous circle within a territorial approach, meaning that its promotion as a GI product can have positive effects that are reinforced over time, allowing preservation of the agrifood system and related social networks. This, in turn, contributes to economic, sociocultural and environmental sustainability (FAO, 2010d).

#### **Box 5: Nakornchaisri Pummelo (Thailand)**

The pummel, a tropical or near-tropical fruit native of Southeast Asia, is the principal ancestor of the grapefruit. It flourishes naturally at low altitudes close to the sea, but because of its restricted cultivated areas, its production is often overshadowed by that of grapefruit. It is well-known to be a luscious fresh fruit and is more popular than grapefruit for many consumers in the Far East. It is claimed that the Nakornchaisri pummelo's (Thailand) quality attributes stem from human intervention through specific farming traditions and production skills, coupled with unique geographical conditions. Nakornchaisri pummelo is sought out by discerning consumers and growers who are willing to pay a high market price. In 2005, the Nakornpathom Chamber of Commerce established a GI for the fruit, to identify the product and to protect and promote its market value.

GIs can be a very important determinant for higher market prices. For export, purchasing price and fruit quality, Nakornchaisri pummelo have been used as a benchmark for fruit from other regions. Although supply from other regions of the country is increasing, consumers currently are willing to pay a higher price for fruit claimed to come from the GI-designated area of Nakornchaisri. Traders rely mainly on consolidators to ensure the origin of the area of production, thanks to the trust that has been established through a long-term working relationship between exporters and consolidators (RAP, 2010).

#### **VOLUNTARY SUSTAINABILITY STANDARDS**

161. There is a growing number of voluntary sustainability standards, generally focused on a single dimension of sustainability. An ecolabelling fisheries scheme promoted by the Marine Stewardship Council (MSC), an international NGO, is an environmental standard for sustainable and well-managed fisheries and uses a product label to reward environmentally responsible fishery management and practices. It is now increasingly adopted by retailers worldwide. Other NGOs such as the Rainforest Alliance are involved in development of various standards and certification programmes, including sustainable agriculture, forestry and tourism.
162. Good Agricultural Practices (GAP) standards have recently been developed by the public and the private sector. Many countries have developed national GAP programmes, with the objective of improving the basic agricultural practices in the country, such as the Chile GAP, China GAP, Kenya GAP, Viet Nam GAP, SALM in Malaysia.



163. Integrated Pest Management (IPM) programmes set standards developed by producer organizations (usually in a participatory manner) to reduce use of pesticides in farming systems. The standards developed are then integrated into other schemes, or used as an extension method with a local certification system. The focus of these programmes is often on local markets, depending on market opportunities.
164. Fair trade is seen as international trading relationships that offer more favourable terms of trade to producers than conventional trade. This permits them to develop a socially and environmentally sustainable production system. In 2001 the main actors adopted the following definition for fair trade: “Fair Trade is a trading partnership, based on dialogue, transparency and respect, which seeks greater equity in international trade. It contributes to sustainable development by offering better trading conditions to, and securing the rights of, marginalized producers and workers – especially in the South.” New fair-trade certification systems have been developed by various actors, including importer groups (e.g. Bio-équitable by French importers) and certification bodies (e.g. IMO and Ecocert). In addition, public authorities in some countries have started establishing regulations for fair trade (e.g. France and in the European Union).

### ORGANIC AGRICULTURE

165. The market for organic products is still relatively small (2 percent of global retails), but growing significantly worldwide, thus providing trading opportunities for developing countries. Consumer attitudes to organic foods are complex, often linking food to health, the environment, ethics and identity. Some consumers also believe that organic foods are more nutritious and are ready to pay higher prices (Kearney, 2010). The global organic market size was USD 55 billion in 2009, a threefold increase from USD 18 billion in 2000, with double-digit growth rates each year, except in 2009, when it still grew by 5 percent in spite of the financial crisis. Growth is expected to pick up again, due in part to increasing organic conversions in developing countries (China, India) (FIB and IFOAM, 2011). Many governments in both developed and developing countries have announced their objectives of increasing organic farming practices. However, while there are significant government subsidies in developed countries, there is little financing for organic farming in developing countries. More pro-active measures are required in developing countries to promote organic farming and to overcome obstacles to production, marketing and trade.<sup>26</sup>
166. The first problem is the absence of, or grossly inadequate, public-sector financial or technical support for organic agriculture.<sup>27</sup> This is in contrast with the situation in some developed countries, where subsidies are provided to agriculture in general, including to organic farmers. Another major problem involves the difficulties faced by developing-country producers in adherence to standards for organic foods. This is not so much an issue at the national level, but is a major problem for potential exporters. At the local market in Asian developing countries, the personal guarantee of organic farmers (and in producer-consumer partnerships) is usually considered sufficient, a common practice in small towns and villages across Asia (UNCTAD, 2004). However, compliance with many standards and certification systems is needed when the organic foods are to be exported. As UNCTAD (2004) points out, it is important to find a balance between the need for harmonization for trade and fair competition, and the need to take account of local and regional conditions and requirements.
167. A related constraint on exports is the lack of assured markets and price premiums. Developing country exporters face obstacles in the form of certification costs, technical standards and sanitary and phytosanitary

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<sup>26</sup> Many of the points that follow are made in UNCTAD (2004), Trading opportunities for organic food products from developing countries; UNCTAD (2008), Best practices for organic policy; UNCTAD and UNEP (2008), Organic agriculture and food security in Africa.

<sup>27</sup> UNCTAD (2008) notes that the early drivers of organic farming in developing countries are NGOs and the private sector, with governments rarely playing any role in the early stages.

requirements. Also, the organic vegetable and fruit markets in developed countries tend to rely on locally produced foods, which is a barrier to exports from developing countries.

168. The lack of marketing networks and partners is another major problem facing potential exporters in developing countries. They need to design marketing strategies, seek more direct links to retailers in importing countries and create partnerships. This could begin with fair trade organizations, which are helping small producers to benefit from trade.
169. UNCTAD (2004) has proposed steps to reduce certification costs in developing countries, including development aid to assist governments in poor developing countries to meet certification standards of developed countries, and encouraging countries with large potential to set up their own national standards and national certification systems.
170. To overcome the expense of third party certification faced by small farmers in developing countries, schemes have been developed such as participatory guarantee systems and group certification. These alternatives are more accessible to smallholder farmers in developing countries, but also can provide the quality assurance that consumers need, and should therefore be further promoted (Lim, 2011).

## E. EMPOWERING SMALLHOLDERS TO ACCESS GLOBAL MARKETS

171. Over the past couple of decades, income growth and rising populations in developing countries have greatly expanded the demand for high-value food products (HVFPs), including meat, dairy products and a wide variety of fruits and vegetables. A rapid growth in urbanization has exposed people to new food options and urban lifestyles have led to increased purchases of prepared foods.
172. As the domestic demand for HVFPs has grown in developing countries, so too have the net exports of HVFPs – including fruits, vegetables, poultry and fish – to industrialized countries. The export of fish has become a major growth industry in recent years, often exceeding the combined value of net exports of coffee, tea, cocoa, bananas, and sugar. Today, the HVFP sector has a dynamic global market presence. The challenge is to ensure that small-scale farmers in developing countries are able to participate in this rapidly growing sector and that artificial advantages benefiting large domestic enterprises do not drive them out of business.
173. Small-scale producers face many challenges. These include being able to anticipate market demand for products and to find the right market niche. Markets can be volatile and staying on top of demand requires gaining access to timely and accurate information, often a difficult task in developing countries. Many small-scale producers lack the technical capacity to, for example, process a high quality product while complying with food hygiene and quality requirements, and meeting customer demands. They may also lack the human capacity to negotiate and fulfil contracts with buyers.
174. Small-scale participation in the livestock and fisheries sectors can be problematic. Investment in technologies for ensuring the required quality standards and controlling animal diseases is often beyond the means of independent small-scale producers, effectively keeping them out of export markets since private quality standards disease-free certification is often required for export. Without proactive development support and policies to keep smallholders involved, large-scale livestock and fish sectors will dominate export markets, while a static smallholder sector will compete for the low end of the domestic market.
175. The establishment of marketing cooperatives and contract farming schemes has proven to be an effective strategy for supporting small-scale producer involvement in HVFP markets. The commitment of governments to facilitating smallholder production and the active participation of smallholder farmers in the management of smallholder schemes are key success factors.

### Box 6: Private initiatives and public-private partnerships

**Cote d'Ivoire.** A public-private partnership involving Kraft Foods and cocoa producers in Cote d'Ivoire helped six Ivorian cooperatives, representing over 2 000 farmers, gain the Rainforest Alliance Certified (TM) seal. The seal attests that the cocoa products meet rigorous international standards, increasing their appeal among customers seeking green goods and services. The project trained nearly 6 000 farmers in sustainable production practices and almost 6 000 tonnes of cocoa were certified, for which the farmers received a total of USD 1.2 million as price premiums.

**Viet Nam.** The multinational dairy company, Royal Friesland Campina, has established 39 collection points throughout Viet Nam where farmers can sell their milk directly to the company. The collected milk passes through one of three cooling centres before being transported for processing under the Dutch Lady brand. The company also helps local farmers improve and increase their milk production by, for example, advising on matters of hygiene. By the end of 2006, there were about 2 300 farmers participating in the programme and they supplied more than 90 tonnes of fresh milk per day.

**Kenya.** Starting in 1989, Frigoken, a company of the Aga Khan Fund for Economic Development, began providing a number of services to Kenyan bean farmers, including price guarantees, seeds, quality control, processing, transport and marketing. The company works with a network of small, individually owned plots. Beans are cultivated throughout the year, guaranteeing a steady income to farmers. Today, Frigoken is the largest exporter of processed green beans from Kenya, accounting for over 80 percent of total exports. Most of the beans are sold on European markets under well-known brand names. The company currently provides direct employment to over 2 700 people, most of whom are women, and supports over 20 000 small-scale farmers in rural areas of Kenya.

**Colombia.** The Federación Nacional de Cafeteros de Colombia was founded in 1927 as a non-profit business association to promote the production and exportation of Colombia coffee. Best known for its Juan Valdez marketing campaign, the Federation currently represents more than 500 000 local farmers and small producers. The Federation promotes fair trade and ensures that farmers are able to receive reasonable benefits. Today, Colombia is the largest producer of coffee in the world.

**India.** SABMiller's investment in the "Progress through Partnership" programme provides rural smallholder Indian barley farmers with access to the beer manufacturer's supply chain. Farmers receive a preferential price by selling directly to SABMiller rather than going through agricultural middlemen. These higher prices translate into a real income hike for the farmers involved in the programme. In the 2008–2009 growing season, farmers earned approximately 10 percent more than they had the year before. In addition, all 8 000 member farmers receive technical advice and assistance from trained agriculturists.

## V. CONCLUSION: TOWARDS IMPROVED FOOD SYSTEMS AND SUSTAINABLE DIETS

176. The environmental, economic and social impacts of food systems vary widely, depending on the products and resources concerned and the countries where they occur. Improving food systems for sustainable diets, while stemming the degradation of ecosystems and the erosion of biodiversity, is a huge challenge. It requires programmes and policies that support ecologically balanced food production, distribution, supply and consumption. It requires identifying leverage points in supply chains that can be used to direct the choices and behaviour of consumers towards more sustainable diets, including encouraging shorter chains based on locally produced food. This approach taps into the green economy by connecting the nutritional wellbeing of the individual and the community to the environmental sustainability of feeding the planet. It promises a major contribution to the achievement of the MDGs on hunger and environmental sustainability.
177. Improving food systems for sustainable diets worldwide requires worldwide action, because food systems are both local and global, because they have local and global environmental, economic and social impacts. Global increase of demand for food and feed has a huge impact on the environment. Overconsumption causes wastage, overweight and obesity, but also drives price increases and represents a major cause of hunger and malnutrition.
178. Restoring balanced diets is not only indispensable for individual human health, it is also essential to restore a balanced consumption worldwide, to protect ecosystems and natural resources. Sustainable diets are key to sustainable production and consumption of food.
179. To progress towards sustainable diets, nutrition has to be integrated as a core concern of every policy directed to food systems. Agricultural policies and programmes should be designed at every level to improve diets, not only on quantity but on quality, nutrient content and food safety, and on diversity, taking account of the nutritional value and complementarities of productions. This will require more knowledge on the nutritional value of species and varieties, and of the interactions both in the field and in diets. It will also require integration of nutrition as an integral part of knowledge dissemination, education and extension. Preserving nutritional qualities all along food chains needs to be a primary concern. Informing and educating consumers should involve not only governments but also agro-industry and retailers.
180. Demand tends to be presented as an external, exogeneous variable, on which no control is possible. But this is not true. Demand is influenced by policy choices, including the issue of biofuels (HLPE, 2011). In developed countries where spending on food is low compared to incomes, there might be a margin to integrate negative externalities in the cost of food, as well as for the reorientation of distortive subsidies towards sustainable production (Foresight, 2011, Grethe *et al.*, 2011, McMahon, 2011, HLPE, 2011).
181. Reducing losses and waste and increasing overall efficiency of food chains can go a long way towards increasing food availability and reducing environmental impacts. It will necessitate a holistic approach, involving governments and all actors along food chains. In developing countries, better organization of economic actors and development of appropriate practices and technologies can add value at every stage while increasing availability to consumers. In developed countries, consumer behaviour is key to reducing waste at consumer level and to addressing some of the losses which are provoked by anticipation of consumers' supposed wishes. Raising awareness through information and communication should involve all stakeholders concerned.
182. Voluntary standards on sustainability can play a key role in enhancing sustainable consumption as a driver of sustainable production. However, making them effective requires more accurate tools to assess sustainability

and transparency, and comparability in the way the information is communicated. Mutual recognition of schemes should be pursued, as this will facilitate their adoption by the various actors and reduce costs.

183. Acknowledging the true value of food – nutritionally, symbolically and economically – is a major driver towards more sustainable diets.
184. To satisfy the needs, in quantity, quality and diversity while preserving fragile resources, requires considerable changes in food systems. This includes working towards greater resource and nutritional efficiency at every stage, from agricultural production to consumption. It requires empowering consumers, by giving them choices and means to exert them, including accurate and comparable information on nutritional value and environmental impacts of food. When all are taken together, they can improve sustainability of diets by harnessing demand, improving health and preserving resources while creating value for producers. It requires enabling policies and the strong involvement of the private actors.
185. Achieving these aims requires the involvement of all actors concerned. FAO and UNEP have formed a joint Sustainable Food Systems Programme to improve resource use efficiency and reduce the pollution intensity of food systems from production to consumption, while at the same time addressing issues of food and nutrition security. The programme brings together a broad coalition of stakeholders concerned, including governments, food and fish producers, agro-industry, retailers and consumers. This action is emblematic of the necessity for a very strong involvement of all stakeholders, including the private sector, supported by public policies, to achieve the necessary transformation of food systems.
186. The Green Economy will go a long way to facilitate the needed transformations of the food systems towards sustainable diets. Transforming food systems is at the very centre of the Green Economy, considering their impact on natural resources, on human well-being and the importance of the sector in rural economies and in developing countries.

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