

**BIOVERSITY
INTERNATIONAL**

NUTRITION STRATEGY

2011-2021

**Resilient food and
nutrition systems:
Analyzing the role of
agricultural biodiversity
in enhancing human
nutrition and health**

Bioversity International undertakes, encourages and supports research and other activities on the use and conservation of agricultural biodiversity, especially genetic resources, to create more productive, resilient and sustainable harvests.

Bioversity International's aim is to promote the greater well-being of people, particularly poor people in developing countries, by helping them to achieve food security, to improve their health and nutrition, to boost their incomes, and to conserve the natural resources on which they depend. Bioversity International works with a global range of partners to maximize impact, to develop capacity and to ensure that all stakeholders have an effective voice. Bioversity International is part of the Consultative Group on International Agricultural Research, which works to reduce hunger, poverty and environmental degradation in developing countries by generating and sharing relevant agricultural knowledge, technologies and policies. This research, focused on development, is conducted by a Consortium of 15 CGIAR centres working with hundreds of partners worldwide and supported by a multi-donor Fund.



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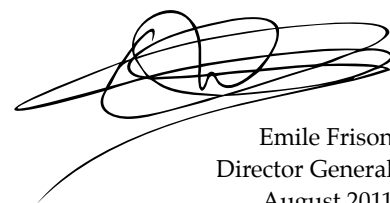
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FOREWORD

The world faces an enormous challenge of ensuring that the global community has access to a safe and nutritious diet, while simultaneously combating the rising number of health problems related to overnutrition such as obesity and diabetes. Agriculture and the global food system are capable of playing a key role in addressing this challenge, yet agriculture needs to be designed with nutrition in mind. The recent food price volatility crisis, climate change and the rise in cost of petroleum-based inputs shine a light on factors that contribute to the unsustainable nature of our agricultural system. But within these challenges lie opportunities to change the way we do business at the same time as making an important contribution to better nutrition security for the future. There is also a clear recognition that the agriculture, health and nutrition sectors will make considerable advances in nutritional security when working together. The time to act is now, building upon the momentum to improve nutrition around the world with examples such as the 1000 Days and Scaling Up Nutrition movements.

Bioversity International is the leading research organization dedicated to the use and conservation of biodiversity in agriculture and is part of the Consortium of International Research Centres of the Consultative Group for International Agriculture Research (CGIAR). The CGIAR has a new institutional model designed to improve its delivery of research results in a rapidly changing external environment, as well as a new strategy that includes one important outcome that focuses on nutrition and health. During the 40 years of the CGIAR's existence, the organization has provided innovative research and impacts that have helped to change lives on a large scale. The CGIAR, we expect, will be even more efficient in providing crucial solutions to the problems faced by smallholder farmers globally. We are determined to build on past accomplishments and expertise in order to ensure this result. This nutrition strategy presented here defines the initial ten-year road map for a comprehensive research programme that will provide increased insight and evidence that can be used to improve nutrition in more sustainable agricultural systems for smallholder farmers and their beneficiaries.

We are excited by the task ahead and we believe we can meet the challenge we face. We aim to show that agricultural biodiversity, underutilized crops and local and traditional foods can be powerful tools to combat poverty and malnutrition while preserving healthy ecosystems. With this innovative strategy, we seek to build on Bioversity's experience in agricultural research and in the conservation of genetic resources in order to provide an efficient and life-changing service to smallholder farming communities across the globe. This strategy will be used to channel and focus our efforts but it will retain an inherent flexibility as we seek to improve and expand it. We see this as the beginning of a new and exciting journey during which we hope that the work we do benefits our partners, the larger development community and, most of all, the communities who are our beneficiaries.



Emile Frison
Director General
August 2011

EXECUTIVE SUMMARY

One of the world's greatest challenges is to secure adequate food that is healthy, safe and of high quality for all, and to do so in an environmentally sustainable manner. Burdened by the growing demands of an ever-increasing human population, it remains unclear how our current global food system can sustain itself. This challenge is further compounded by climate change, ecosystems and biodiversity under stress, population growth, increased urbanization, social conflict and extreme poverty. For these reasons, there has never been a more urgent time for collective action to address food and nutrition security on a global scale.

Redirecting the global agricultural system as the supplier of the world's food in order to ensure better nutrition is crucial so that we can operate from a better understanding of our global agricultural system. It is imperative that research and development start to think about new and sustainable approaches to improving the quality and variety of food produced and consumed around the world. The role that agriculture plays in dietary diversity and nutrition outcomes is central, and nutrition must be front and centre as a major outcome and goal of agriculture and production systems, as a potential avenue to improving dietary diversity, food quality and human health as well restoring or preserving ecosystems.

One area that requires further understanding is the role of agricultural biodiversity in improving dietary diversity and quality. Agricultural biodiversity—the diverse traits exhibited among crops, animals and other organisms used for food and agriculture, as well as the web of relationships that bind these forms of life at ecosystem, species, and genetic levels—is the basis of the food and nutrient value chain and its use is important for food and nutritional security.

Bioversity International's nutrition research over the past several years has focused on the role and impact of traditional foods on dietary diversity and livelihoods. The research agenda is being expanded under Bioversity's 2011-2021 Nutrition Strategy to develop strong methodological and empirical evidence on how agricultural biodiversity contributes to dietary diversity and nutrition with downstream livelihood and ecosystem benefits. The new strategy focuses on food and nutritional system approaches to improving human nutrition and health. The major goal of the strategy and subsequent programme is to promote the use of agricultural biodiversity within food production systems and provide nutritionally-rich food sources that contribute to dietary diversity and, potentially, better nutrition and health. Our major focus is in rural and peri-urban communities in the developing world.

The strategy has four major objectives:

1. To strengthen the evidence base for the role of biodiversity in nutrition and health and the means of incorporating agricultural biodiversity, specifically, into food and nutritional systems approaches;
2. To ensure the production of more nutritious foods through commercial pathways that reflect agriculturally biodiverse practices and cultural preferences;
3. To determine which agricultural biodiversity practices and delivery systems work on the ground in development programmes to improve nutritional security;
4. To mainstream the role of agricultural biodiversity into public health and nutrition policy and practice by sharing evidence and providing local solutions.

Bioversity International will ensure that the role of agricultural biodiversity is monitored, evaluated and enhanced within food and nutritional systems of different communities that adhere to different socio-cultural traditions within diverse agro-ecosystems in a range of economic and political situations. There will also be a focus and emphasis on the preservation, conservation and sustainable use of agricultural biodiversity and protection of ecosystems in the developing world, because these provide communities with the resources for productive and resilient food and nutritional systems. We hope that through this nutrition strategy and Bioversity International's global research agenda that we can provide useful evidence, tools and products for use by governments, development programmers, value chain and food sector actors, academic and research institutions, health and agriculture workers, farmers and communities.



Stevie Mann / Bioversity

CHAPTER ONE

THE GLOBAL MALNUTRITION CHALLENGE

The global malnutrition burden and addressing the challenge

One of the world's greatest challenges is to secure adequate food that is healthy, safe and of high quality for all, and to do so in an environmentally sustainable manner (Pinstrup-Andersen 2009). With the growing demand of an ever-increasing human population, it remains unclear how our current global food system will sustain itself. Compounded with climate change, ecosystems and biodiversity under stress, population growth and urbanization, social conflict and extreme poverty, there has never been a more urgent time for collective action to address food and nutrition security globally.

This burdened food system impacts the most vulnerable people, as statistics clearly show. There are currently an estimated 925 million people suffering food and nutrition insecurity (FAO 2010a). However with food price increases, these estimates may now be conservative. In addition to those who are hungry, there are also 195 million children under five years of age who are stunted in their growth (UNICEF 2009) and of those children, 90% live in just 36 countries (Black et al. 2008). Malnutrition takes its toll; it is responsible for 35% of all child deaths and 11% of the global disease burden (Black et al. 2008). Micronutrient deficiencies, known as hidden hunger, undermine the growth and development, health and productivity of over two billion people (Micronutrient Initiative 2009). At the same time, an estimated one billion people are overweight and another 300 million are obese in both the developed and developing world (WHO 2006), which contributes to the risk of non-communicable diseases such as diabetes and heart disease. With over-nutrition, many countries and urban communities in the developing world are experiencing the nutrition transition—going from undernutrition to obesity related to insufficient exercise, sedentary lifestyles and unhealthy diets (Doak et al 2005; Popkin 2008).

The global community has responded to the malnutrition crisis by focusing on interventions that aim to impact 90% of the global population burdened by stunting and that largely address inadequate dietary intake, disease burden and poor childcare practices (Bhutta et al 2008). There has been a particular focus on the window of opportunity, specifically, the first 1000 days of a child's life from the nine months in utero to two years of age (Barker 2007; Golden et al 2009; Victora et al 2008). This window is critically important because nutritional setbacks during this time can result in irreversible losses to growth and cognitive potential and can reduce educational attainment and earning potential (Martorell et al 1994; Shrimpton et al 2001; Victora et al 2008). The Scaling Up Nutrition Framework for Action (SUN), recently endorsed by more than 100 global partners and policy makers, highlights the need for early childhood and maternal nutrition-specific interventions (Bhutta et al 2008), which aim to:

- Promote good child-feeding and hygiene practices;
- Provide micronutrient supplementation for young children and their mothers;
- Support the provision of micronutrients through food fortification;
- Treat acutely malnourished children with therapeutic feeding.

While highlighting core interventions, the four aims listed above will be further strengthened with a multi-sectoral approach that incorporates nutrition-sensitive interventions from other sectors, such as agriculture, education and social protection that address underlying causes of malnutrition. However, practical operational strategies for localizing and applying sensitive interventions must be further clarified and defined as to how such interventions impact nutritional outcomes. Some suggested agriculture-related nutrition-sensitive interventions include (UNSCN 2010):

- Agricultural extension services promoting better crop diversity and biodiversity for improved nutrition;
- Integrated agro-forestry systems that reduce deforestation and promote the sustainable exploitation of nutrient-rich non-timber forest products;
- Integrated farming systems exploiting the synergies of horticulture, aquaculture and small livestock rearing to reduce waste and expenses on agricultural inputs and increase food production diversity;
- Improved household food production and livelihoods (i.e. diversification of household food production for self-consumption in order to improve the nutritional quality of the family diet);
- Education and communication for development and social marketing strategies that strengthen local food systems and promote cultivation and consumption of local micronutrient-rich foods;
- Improved post-harvest management (food storage, transformation, handling and processing) to reduce losses in terms of quantity and nutrient content, which also contributes to nutrition security.

While the underlying determinants of malnutrition have been well understood for decades, the design, testing and scaling of more holistic multi-sectoral packages that combine child and maternal care and disease control with these nutrition sensitive, and largely agriculture-focused approaches, have been limited in their development and implementation. With the tools and knowledge that are currently at our disposal, there is a renewed global focus on interventions that address the root causes of food and nutrition security—both under and over-nutrition—as part of a wider multi-sector approach, which should include agriculture.

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

Agricultural systems vary across the world spanning large-scale monocrop landscapes to smallholdings of farmers who typically live on less than two hectares of land. Smallholder farmers often work marginal lands without the tools, knowledge and resources to improve production, yet in places such as sub-Saharan Africa, 90% of farmers are subsistence smallholder farmers. In the developing world, the majority of smallholder farmers are

net food buyers and rural households make up a substantial majority of the world's 900 million-plus hungry (FAO 2009). Because these individuals buy more than they sell, their access to affordable, nutritious food is an issue.

It is necessary to understand how our agricultural system can promote positive nutrition outcomes. Big drivers of trends in food consumption globally are the private sector, markets, processed food and diet shifts. Research and development practitioners must start thinking about new and sustainable approaches to improving the quality and variety of food produced and consumed around the world and to develop innovative new roles that agriculture can play that will improve dietary diversity and nutrition outcomes. To do this, nutrition must be a central goal of agriculture and production systems and be recognized as a potential avenue to improving dietary diversity, quality and health as well as a means of restoring and preserving ecosystems. But one size does not fit all and this approach must ensure that agriculture - the backbone of food production - is tailored to respond adequately to the diverse conditions of major agro-ecological, socioeconomic and epidemiological situations.

Agricultural biodiversity as a potential tool for improving nutrition security

Agriculture is the bedrock of the food system and biodiversity is important to food and agricultural systems because it provides the variety of life (Tansey and Worsley 1995). Biodiversity

includes the variety of plants, terrestrial animals and marine and other aquatic resources (species diversity), along with the variety of genes contained in all individual organisms (genetic diversity), and the variety of habitats and biological communities (ecosystem diversity). Biodiversity is essential for humanity, providing food, fibre, fodder, fuel, and medicine in addition to other ecosystem services.

Agricultural biodiversity refers to the biological variety exhibited among crops, animals and other organisms used for food and agriculture, as well as the web of relationships that bind these forms of life at ecosystem, species, and genetic levels. It includes not only crops and livestock directly relevant to agriculture, but also many other organisms that have indirect effects on agriculture, such as soil fauna, weeds, pests and predators.

FAO (2010b) estimates that of a total of 300,000 plant species, 10,000 have been used for human food since the origin of agriculture. Out of these, only 150-200 species have been commercially cultivated of which only four—rice, wheat, maize and potatoes—supply 50% of the world's energy needs, while 30 crops provide 90% of the world's caloric intake. Intensification of agricultural systems has led to a substantial reduction in the genetic diversity of domesticated plants and animals. Some on-farm losses of genetic diversity have been partially offset by conservation in genebanks (Millennium Ecosystem Assessment 2008). Even so, the implications of this loss of agricultural biodiversity for the biodiversity and quality of the global food supply are scarcely understood, especially from the perspective of nutrition.



Agricultural biodiversity is the basis of the food and nutrient value chain and its use is important for food and nutritional security (Frison et al 2006), where it can potentially act as:

- A safety net against hunger;
- A rich source of nutrients for improved dietary diversity and quality;
- A basis for strengthening local food systems and environmental sustainability.

Agricultural biodiversity furthermore includes species with under-exploited potential for contributing to food security, health, income generation, and ecosystem services. Terms such as underutilized, neglected, orphan, minor, promising, niche, local and traditional are frequently used interchangeably to describe these potentially useful plant and animal species, which are not mainstream, but which have a significant local importance as well as a considerable global potential for improving food and nutrition security. Even so the research of Bioversity International and others reveals that the major causes of neglect and underuse of these important species are often related to factors that include poor economic competitiveness with commodity cereal crops, a lack of improved varieties, enhanced cultivation practices, inefficiencies in processing and value addition, disorganized or non-existent market chains as well as a perception of these foods as being “food of the poor” (Jaenicke et al 2009).

Interspecies and intraspecies variability represents a considerable wealth of local biodiversity and, with a better understanding of their contributions and use, could have potential for contributing to improved incomes, food security and nutrition. They also have considerable potential for enhancing adaptation to global climate change. Some of these species are highly nutritious and have multiple uses. For example, some are strongly linked to the cultural heritage of their places of origin, while some are highly adapted to marginal, complex and difficult environments and have contributed significantly to diversification and resilience of agro-ecological niches. Many such species are collected from the wild or are produced in traditional production systems with little or no external inputs (Padulosi et al 2011; Bharucha and Pretty 2010).

The role of agricultural biodiversity in improving dietary diversity and dietary quality is an area that requires further understanding. The lack of diversity is shown to be a crucial issue, particularly in the developing world where diets consist mainly of starchy staples with less access to nutrient-rich sources of food such as animal proteins, fruits and vegetables. Dietary diversity is a vital element of diet quality and the consumption of a variety of foods across and within food groups and across different varieties of specific foods more or less guarantees adequate intake of essential nutrients and important non-nutrient factors. Research has demonstrated a strong association between dietary diversity and diet quality and nutritional status of children (Arimond and Ruel 2004; Kennedy et al 2007; Rah et al 2010; Sawadogo et al 2004). It is also clear that household dietary diversity is a sound predictor of the micronutrient density of the diet, particularly for young children (Moursi et al 2008). Studies have also shown that dietary diversity is associated with food security and socioeconomic status, and links between socioeconomic factors and nutrition outcomes are well documented (Arimond and Ruel 2004; Hoddinott and Yohannes 2002; Ruel 2003; Thorne-Lyman et al 2010; World Bank 2006; World Bank 2007).

It is essential to understand how the global agricultural system and the benefits derived from agricultural biodiversity influence the drivers of global dietary consumption patterns, nutrition and health status in particular in the developing world.





Millennium Promise

CHAPTER TWO

NUTRITION FRAMEWORK FOR ACTION

Bioversity International is a leading research for development organization dedicated to the use and conservation of biodiversity in agriculture as a means to combat poverty and malnutrition and to enhance the sustainability of agriculture. The purpose of Bioversity is to research how the use of biodiversity in agriculture can:

- Improve sustainable agriculture;
- Deliver better nutrition;
- Increase smallholder farming incomes.

Bioversity International looks forward to a world in which the global population is well-nourished and in which successive generations use, value and conserve biodiversity in sustainable agricultural production systems to maximize options for future adaptation.

Overarching goal

The 2011- 2021 Nutrition Strategy focuses on food and nutrition system approaches to improving human nutrition and health. The major goal of the strategy and subsequent programme is to promote the use of agricultural biodiversity within food production systems in order to provide nutritionally rich food sources that contribute to dietary diversity and, potentially, better nutrition and health. Our major focus is on rural, peri-urban and urban communities in the developing world.

Bioversity International's nutrition research over the past several years has focused on the role and impact of traditional foods on dietary diversity and livelihoods. The research agenda is now expanding to develop strong methodological and empirical evidence on how agricultural biodiversity contributes to dietary diversity and nutrition with downstream benefits for livelihoods and ecosystems.

There will be a particular focus on the role of local and traditional foods (LTFs) and neglected and underutilized species (NUS) amongst rich ecosystem and landscape sources of agricultural biodiversity for nutrition security.

Bioversity International will ensure that the role of agricultural biodiversity is monitored, evaluated and enhanced within food and nutrition systems of different communities living by various socio-cultural traditions within diverse agro-ecosystems in a range of economic and political arrangements. There will also be a focus and emphasis on the preservation, conservation and sustainable use of agricultural biodiversity and on the protection of ecosystems in the developing world, which, in turn, can provide communities with the resources for productive and sustainable food and nutrition systems.

Key research questions

There are important, yet unanswered, questions about agricultural and ecosystem biodiversity and its role in improving dietary diversity and quality and which will help to ensure nutrition security and increased health benefits. We hope that through this nutrition strategy and Bioversity International's global research agenda, answers to key research questions will become available and will provide clarity for governments, development programmers, value chain and food sector actors, academic and research institutions, health

and agriculture workers, farmers and communities. These key research questions include:

- How does on-farm agricultural biodiversity contribute to household consumption and to dietary diversity and quality?
- How can we link agricultural diversity to improved nutrition and health outcomes and benefits and do these links have an impact?
- Can agricultural biodiversity be scaled for commercial use while maintaining biodiversity and ecosystems and improving human health?
- What does agricultural biodiversity imply for peri-urban and urban markets and what do trends in urban markets imply for potential success of agricultural biodiversity?
- How can we better use and promote local knowledge of agricultural biodiversity to improve the health of households?
- What new tools and methodologies can be created and validated that measure agricultural biodiversity associated with dietary patterns?

Women: biodiversity's most vital asset

Women produce 60-80% of the food that is consumed locally in developing countries (Nagayet 2005; World Bank 2009). Women are the keepers of food culture in their communities and play a vital role in conserving and using biodiversity in their farming systems (World Watch Institute 2011). Non-staple minor crops as well as animal husbandry offer women the opportunity to increase nutrition and income security for their families (Herforth 2010).

Objectives of the strategy

The Nutrition Strategy is divided into two categories with two sub-objectives each:

Research and evidence-oriented:

- To strengthen the evidence base for the role of biodiversity in nutrition and health and the means of incorporating agricultural biodiversity into food and nutrition systems approaches;
- To ensure that the production of more nutritious foods through commercial pathways reflects agriculturally biodiverse practices and cultural preferences.

Development and policy-oriented:

- To determine which agricultural biodiversity practices and delivery systems work on the ground in development programmes to improve nutrition security;
- To mainstream the role of agricultural biodiversity as a standard consideration in policies and practices regarding public health and nutrition by sharing evidence and by providing local solutions.

Target beneficiaries

Bioversity's work will mainly focus on agro-ecosystems that have agricultural biodiversity potential in areas with a high burden of malnutrition in developing, transition and middle income countries. The key priority countries will be drawn from the 36 countries where 90% of the world's stunted children live and which either have a functioning agricultural system or the potential for improving their agriculture, as well as countries with readiness to accelerate action in nutrition (SCN 2009).

The beneficiaries of the strategy will include:

Rural smallholder farmers in the developing world.

At least half of the world's food-insecure people are smallholder farmers living in poverty. Many of these farmers are women, who are disproportionately poor and vulnerable to malnutrition, which affects not only themselves but their children as well. Although women and children remain the most vulnerable to the consequences of malnutrition, beneficiaries of Bioversity International's work will include entire smallholder household families.

Populations living in urban and peri-urban settings without access to diversity.

With the world's population expected to grow significantly in the next 30 years and many more people migrating to urban centres, there will be a need to increase the nutritional quality and environmental sustainability of food production and to ensure that food distribution and access is more equitable. Sustainable agricultural intensification complemented with improvements in the nutritional quality of foods will need to be considered with the growing needs of the global urban population. Working with private sector and value chain actors will be essential to ensure that peri-urban and urban consumers have access to affordable foods coming from agriculturally biodiverse food systems.

Communities at risk of traditional food system loss.

These communities have derived a subsistence base from the natural resources available in specific ecosystems. Some of these ecosystems and traditional food systems are threatened or in transition. These beneficiaries, include farmers, pastoralists, forest communities and fisher folk, who are some of the most nutritionally vulnerable, particularly in poverty stricken, food-insecure communities.

Implementing the strategy

Objective one:

To strengthen the empirical evidence of agricultural biodiversity's role in nutrition and health.

The major objective of this research will be to generate a better understanding of the links among agricultural biodiversity, diet quality, and nutrition and health, as well as the overall role of nutrition within agricultural systems. By establishing a robust set of interdisciplinary projects in relevant agro-ecological systems, research will determine the main drivers of agricultural biodiversity and the role of agrobiodiverse practices and landscapes in dietary quality and diversity, and in health and nutrition outcomes for rural communities.

Together, the two major research components will reinforce evidence of the vital role and impact of agricultural biodiversity

and local traditional foods in improving diets and, by extension, human health and nutrition. Bioversity International will explore the interactions of these two components at individual, household, and community levels.

Component one: Agricultural Biodiversity in Diets, Health and Nutrition. To describe and define the role of agricultural biodiversity in diets, health and nutrition, including the nutritional value, usage and consumption patterns of foods derived from agriculturally biodiverse landscapes, and their impact on human nutrition and health outcomes.

Large-scale evidence is necessary in order to chart the impact of agricultural biodiversity on health in diverse developing world settings. Another under-researched area is the impact of a long-term approach towards diversification of nutrient-dense crops and the effects of such diversification on deficits in micronutrients and other important health factors in global communities. For many populations, LTFs and NUS, wild foods, and biodiversity in particular plant species like lesser-known grains and legumes, leafy green vegetables, tubers, crop wild relatives and forest fruits play an important role in traditional diets and, in some cases, income generation. However, little is known about nutritional value, use and consumption patterns for most traditional plant foods, and their subsequent impact on human health, chronic under-nutrition, over-nutrition and risks of non-communicable diseases.

This component of Bioversity International's research will address the gap in empirical evidence that links conservation and use of agricultural biodiversity to improved nutrition and health outcomes. With this in mind, the research will:

- Develop and apply research tools to understand the composition and consumption of foods from agricultural biodiversity (local, traditional, NUS, varieties of major staples);
- Assess the effectiveness of the use of agricultural biodiversity use on dietary diversity and quality;
- Assess the impact of agricultural biodiversity and local and traditional foods on nutrition and health outcomes;
- Determine how agricultural biodiversity and local and traditional foods can mitigate the nutrition transition;
- Define the linkages between the conservation of genetic resources on farm and in genebanks and the benefits to human health through characterization of nutrients and health-promoting non-nutrients of plants;
- Quantify the cost of and access to diets sourced from agrobiodiverse systems.

Component two: Nutritional anthropology and sociology of agricultural biodiversity. To explore food sovereignty and the socio-cultural and traditional roles of foods sourced from agricultural biodiversity in communities and households, and to understand why we eat what we eat, the right to high-quality foods, and the role of traditional food systems in those decisions.

Supporting the use of biodiversity within traditional and indigenous food systems and local cuisines and diets may provide a buffer against the decline of healthful dietary behaviours. The anthropology of food is the study of eating habits, that is, the ways in which individuals or groups of individuals respond to social and cultural pressures and how and why they choose, consume and make use of certain specific aspects of the food supply including nutrition (Garin 2001; Guthe and Mead

1945). It is essential to understand the way food supplies are affected by changes in market structure, public policies, family composition, household income, and women's roles, along with the socio-cultural, behavioural and political and economic factors related to food and nutrition. Understanding inequities in food access and how cultural contexts influence food production, allocation and use are all critical to creating better nutritional outcomes. Sadly, these factors are often overlooked.

Food sovereignty concerns what Via Campesina, an organization representing smallholder farmers around the world, describes as the "right of peoples to define their own food, agriculture, livestock and fisheries systems, in contrast to having food largely subject to international markets" (Via Campesina 2007). It is an important concept which should be taken into account in efforts to improve nutrition in less-developed countries (de Schutter 2011). It is crucial, in order to achieve long-term food security and adequate nutrition, that the production and distribution of food in developing countries remains, at least in large part, under the control of local populations and national institutions. Although international markets are essential in providing an efficient alternative to the local production of food, especially staple commodities, they cannot be seen as the sole method of feeding people. The concept of food sovereignty ensures that food is produced locally, according to national or regional customs, preferences and tastes, by taking advantage of local crops and varieties and sustaining a biodiverse agricultural paradigm. This not only helps empower local people, allowing them to choose how to produce food as well as what food to produce, but also helps generate valuable income for smallholder farmers and national enterprises.

Research in this component will focus on understanding why we eat what we eat and the role of traditional food systems in those decisions. In this component, Bioversity International will:

- Analyze and document the knowledge, practices, and value of traditional food culture both within households and at the community level as well as safeguard or improve upon these cultures;
- Assess how urbanization, migration and the availability of new foods are changing food decisions and choices, particularly towards traditional food and diets;
- Promote education and knowledge of agricultural biodiversity in traditional health and nutrition practices;
- Strengthen food sovereignty principles in the context of agricultural biodiversity and nutrition for local communities without sacrificing self-reliance and income generation.

Objective two:

To ensure that the production of more nutritious foods through commercial pathways reflects agriculturally biodiverse practices as well as cultural and consumer preferences.

The links between what is produced on the farm, the consumer who buys that food, and the income received by the producer does not stop at production (Hawkes and Ruel 2010). Food is stored, distributed, processed, retailed, prepared and consumed in a range of ways that affect the access, acceptability and nutritional quality of foods for the consumer. Value chains are thus fundamental to consumption, dietary and nutrition perspectives and not only in terms of the supply of foods. Little emphasis has been given to how consumers can play a role in

influencing value chains and how changes in the demand for specific local foods can influence the processes and outputs of value chains. There has also been little attention to how actors along the value chain can be better informed on enhancing the nutritional value of local foods. Food and nutrition systems need to be rethought by creating new business paradigms that demonstrate the value of biodiversity while promoting improved diet and nutrition outcomes.

The research undertaken in this objective aims to understand the role markets and value chains play in improving nutrition and dietary diversification both directly, through an increase in the production of nutritious foods sourced from biodiverse systems, and indirectly, through an increase in income for smallholder farmers. Similarly, smallholder farmers can diversify their diet and improve their nutritional status either by producing more biodiverse foods directly or by accessing more nutritious and diverse foods in markets through a rise in their disposable incomes. The research will emphasize understanding the role that nutritious LTFs and NUS play in creating demand for biodiverse products from rural and urban consumers and in boosting disposable income for smallholder farmer producers.

Component one: Consumer demand, knowledge and access as drivers for smallholder farmers to produce and consume more nutritious, diversified foods. To improve our understanding of how local and international consumer behaviour can increase the demand for nutritious food produced by smallholder farmers and how smallholder farmers, as net buyers of food, can access nutrient-rich foods sourced from agriculturally biodiverse farming systems in informal and formal markets.

It is essential to understand how consumer demand for nutritious foods sourced from agriculturally biodiverse systems drives up production of these products among smallholder farmers in developing countries. It is also important to understand the reverse - how increased production of nutritious foods sourced from agricultural biodiverse landscapes can increase knowledge of and demand for these foods. Research in this objective will look at how consumer knowledge, demand for and access to nutritious foods sourced from biodiverse settings can ensure visibility and accessibility through nutrition-sensitive value chains and other market mechanisms in diverse settings.

In this component Bioversity International will work in partnership with value chain actors in order to:

- Seek to understand how markets can be more diversity-friendly for consumers and to understand what drives consumer preferences for nutritious LTFs sourced from biodiverse systems;
- Define the role of women in decision-making regarding nutrient-rich local food purchases and intra-household distribution within the household;
- Characterize media outlets that disseminate information, promote access and increase knowledge of and demand for nutritious LTFs by urban consumers;
- Develop, test, and evaluate new tools to increase awareness, improve access to information, and boost knowledge of nutritious LTF products among consumers;
- Create and apply research tools to analyze what specialized nutritious products (e.g. therapeutic foods and complementary foods) could be developed, promoted,

accepted and scaled for vulnerable populations and at what cost? The research will consider available local foods and underutilized crops sourced from biodiverse systems.

Component two: Agricultural biodiversity as a mechanism for boosting disposable income for smallholder farmers, allowing them to access more nutritious foods. To strengthen our understanding of how agricultural biodiversity and the production of LTFs and NUS can lead to a rise in disposable income for smallholder farmers. What mechanisms could help apply the use of this additional income to more nutritious commodities for the household?

Agricultural biodiversity can help smallholder farmers improve their economic situation in three separate ways: by reducing production costs, by increasing their income from these products and by reducing the volatility of their income. Agricultural biodiversity is especially important because it can contribute to a decrease in the need for petroleum-based inputs such as fertilizers and pesticides and reduce the depletion of natural resources. That said, the main reasons for smallholders to grow and sell local and traditional foods are not yet clear from a nutritional perspective because the role of such foods in improving incomes and ensuring market demand needs further research. Another important factor will be to understand how agricultural biodiversity can be scaled for commercial use while maintaining biodiversity and ecosystems and improving human nutrition and health.

With this component Bioversity International, working in partnership with value chain actors, will:

- Define the mechanisms and incentives available to smallholder farmers to increase their incomes and competitive advantages by producing nutritious LTFs sourced from agrobiodiverse systems;
- Determine how women farmers can be linked in as producers and processors of nutrient-rich foods along the value chain or as ingredient suppliers to commercial manufacturers of specialized, local, commercial products for nutritionally vulnerable populations;
- Identify ways to link smallholder farmers and the nutritious products sourced from agrobiodiverse farms to peri-urban and urban consumers, with a detailed analysis of the trends in peri-urban markets that determine potential success of agricultural biodiversity;
- Collect and preserve traditional knowledge of smallholder farmers relating to the production, storage and marketing of nutritious products from agrobiodiverse systems.

Objective three:

To determine best practices and delivery systems for agricultural biodiversity in nutrition and health development programmes.

This objective seeks to understand how to integrate and implement agricultural biodiversity tools and methodologies in order to positively impact nutrition development programmes and food assistance on the ground. Bioversity will undertake operations research on delivery system approaches used by development agencies on food systems approaches in different regional agro-ecosystem hubs through rigorous monitoring and evaluation. The ultimate goal is to ensure that dietary quality and diversity and, ultimately, health and nutrition outcomes improve through integrated development work.

Component one: Integration of agricultural biodiversity in development programmes. To design, collaborate, monitor and evaluate development programmes that implement agricultural biodiversity with agriculture and nutrition interventions and generate evidence of the health and nutrition benefits and cost effectiveness of these programmes.

A new generation of food security and development programmes, which integrate nutrition and health goals has risen to the forefront. Currently there is limited evidence documenting the operational issues, impact and cost effectiveness of these new programmes and few have integrated these biodiverse agricultural practices (Fanzo and Pronyk 2010). Similarly, community-based agriculture programmes designed to improve human nutrition and health have rarely been scaled up successfully (Bushamuka et al 2008; Iannotti et al 2009). Research in this area is needed to inform the design of new programmes through the collaboration of agriculture, health and nutrition experts who effectively integrate interventions and foster synergies through an agricultural biodiversity lens.

In this component, Bioversity International, in partnership with development workers, will:

- Develop best practices that allow development programmes to use agricultural biodiversity to provide nutritional and dietary benefits to their target groups;
- Define the added role of local and traditional foods and ingredients in the development of specialized and therapeutic food products for complementary feeding programmes for children under two, for nutritional therapy programmes aimed at HIV/AIDS patients and for acute malnutrition treatment programmes;
- Identify the ways that foods sourced from agriculturally biodiverse landscapes can be incorporated effectively into school meal programmes and school garden projects;
- Demonstrate the cost effectiveness and health impact of locally-produced, nutritious foods distributed in food aid and assistance programmes as well as in other food-based social safety net programmes.

Component two: Value of agricultural biodiversity in food and nutrition systems. To assess the added value of agricultural biodiversity when integrated with other components of a food system approach such as ecosystem services, water and sanitation, health care, education, infrastructure and agriculture production systems.

This research component will focus on qualifying and quantifying the added value of agricultural biodiversity within food and nutrition systems. A food and nutrition system is the sum of the actors and processes involved in transforming raw materials into foods and nutrients into building blocks for better health outcomes, all of which function as a system within the constraints of biophysical and socio-cultural contexts. Robust food systems can address underlying causes of food and nutritional insecurity by integrating agriculture, healthcare, water and sanitation, ecosystem services, gender empowerment and education, all of which are crucial for long term human development. These systems involve people, who as consumers are the central focus of the work. They ensure that environmental integrity, economic self-reliance and social well-being are maintained and emphasized. A healthy food and nutrition system is accessible, safe, sustainable and resilient. It ensures that links are made between food production and food

consumption (Sobal et al 1998). There is also an additional role for biodiverse non-agricultural sustainable ecosystems that are important in dietary diversity and quality for local populations. This component will undertake research to understand and address the added value of agricultural biodiversity for nutrition and diets amidst the complexities of food systems in environments with vastly different diets, cultures, traditions, livelihoods, vulnerabilities and levels of marginalization.

In this component and in partnership with development professionals, Bioversity International will:

- Quantify the added value of agricultural biodiversity in food systems by characterizing the essential nutrients necessary, the requirements of different populations and age groups, the nutrient gaps and what kinds and combinations of food provide key nutrients to fill those gaps;
- Examine the nutrient profiles of foods sourced from non-crop biodiverse systems including livestock, fish and forest product food systems;
- Assess effective on the ground integration of agricultural biodiversity practices within water and sanitation and public health sector programmes;
- Analyze the role of women in managing nutrition within food systems while conserving ecosystems.

Objective four:

To mainstream the role of agricultural biodiversity into public health and nutrition policy and practice by sharing evidence and providing local solutions.

Starting at the local scale

Successful cases of promotion of food biodiversity at local and national levels can be scaled up regionally through the development of educational methods that address the conservation of agricultural biodiversity, sustainable development, traditional food culture and nutrition and health. Compilation of best-practice case studies and success stories will also be pursued to promote models and options for mainstreaming biodiversity into food systems across developing regions and agro-ecosystems.

While a few organizations have been actively involved in promoting food-system approaches, generally they have suffered from lack of convincing evidence without providing a local context. As a consequence, there remains insufficient evidence to support well-defined, scalable agricultural biodiversity interventions that might be linked to improvements in outcomes for maternal or child health. Not surprisingly, this translates to a rather ineffective environment for policy and mainstreaming, which might lend support to these food-based approaches. Bioversity International will undertake the sharing of its experience and knowledge in research for development to guide and support policy at international, national and local levels.

Bioversity's nutrition programme, through its assessment of nutritional and livelihood benefits from local food products derived from the rich agricultural biodiversity in the developing world, will certainly contribute to international efforts to address global food concerns such as the response to soaring food prices across the globe, food sovereignty, the effect of globalization of diets on health and the need to promote the effective conservation and use of this globally significant resource. Through the establishment of cross-sectoral policy platforms to promote the mainstreaming of biodiversity, the programme will create synergies with relevant global initiatives and provide linkages with national programmes and policy frameworks. Bioversity International share the evidence gathered with partners, governments and organizations for mainstreaming and integration into larger public health and agriculture policy forums and large-scale programming.

In this component, Bioversity International will:

- Strengthen international development initiatives that incorporate agriculture biodiversity linked food system approaches in food and nutrition security, global health and social protection policies and programmes;
- Promote conservation of agricultural biodiversity and its role in improving nutrition security in national nutrition and agriculture plans and policies.

It will be essential to advocate the importance of biodiversity on healthy diets and to educate the scientific community, the general public and practitioners in health and agriculture on evidence as it becomes available.

With this in mind, Bioversity will:

- Increase public awareness of the importance of nutrition and health;
- Organize and participate in international, regional and national meetings with action outcomes that target Bioversity's beneficiaries;
- Publish research findings in high impact, peer-reviewed journals as well as in popular outlets including high profile newspapers and influential blogs;
- Mainstream nutrition into sectors that are not typically accustomed to considering nutrition in their research, policy or practice.



Dominic Sansoni / World Bank

CHAPTER THREE

DELIVERING
THE STRATEGY

Bioversity International will undertake thorough research and analysis of food and nutrition systems and how they function in different settings. The aim is to better understand the challenges and identify the opportunities, pinpointing the gaps that can be addressed to improve system resiliency.

Research and policy partnerships

To carry out this research, Bioversity International will assemble a diverse team of scientists and practitioners from different disciplines including nutrition, public health, ethnobotany, economics, ecology, agronomy and anthropology. Most of the nutrition focus will be in sub-Saharan Africa and South Asia, where food system experts are staffed in Bioversity's regional offices. As the programme diversifies and grows, Bioversity International will continue to boost its nutrition research capacity.

Bioversity International works in collaboration with partners to ensure that research results are then translated into better development practices and policies that can have an impact across multiple sectors. An integrated global framework for enhancing the conservation and use of agricultural biodiversity for dietary diversity, nutrition, health and sustainable development requires working towards further collaboration and convergence of priorities among agriculture, health, business and environment. Bioversity International will work with research organizations and universities in the developed and developing world. Work will also be expanded within the CGIAR reform process to ensure better collaborations within the CGIAR system on joint research initiatives. The research Bioversity International undertakes will involve the UN system and will complement their work at country and global levels. Bioversity International will ensure that the ultimate beneficiaries of our work, including communities, farmers and women, are involved in every facet of the research. Bioversity International will also ensure that the knowledge gained as result of this programme of research will be shared with the Scaling Up Nutrition movement for incorporation into country-scale plans.

Partners will include:

United Nations agencies – Bioversity International will continue to contribute within the United Nations Standing Committee on Nutrition and will work to direct biodiversity and nutrition objectives in support of convergent policies in relation to climate change, food insecurity and poverty. We will also contribute at a global level to food and nutrition security issues and work in line with the Scaling Up Nutrition framework, the Committee on World Food Security and the United Nations High Level Task Force on the Global Food Security Crisis.

FAO and the Convention on Biological Diversity (CBD) – Implementation of the CBD's Cross-cutting Initiative on Biodiversity for Food and Nutrition (Decision VIII/23, CBD COP-8, Curitiba, Brazil, 2006) has enabled collaboration with FAO, the CBD Secretariat and other organizations to offer space for furthering policy linkages with other sectors and the new joint Sustainable Diets Initiative.

CGIAR – Bioversity International's efforts are congruent with its participation in the CGIAR's Agriculture and Health Research Platform and within the CGIAR reform process. Bioversity

International will work together with other CGIAR centres to carry out the ambitious CGIAR Research Programme on Agriculture for Improved Nutrition and Health.

Academic and research institutions – Bioversity International will ensure that empirical evidence is built in partnership with academic and research institutions with the capacity for rigorous research that amplifies and complements the CGIAR's own work. Academic and research bodies have a vast capacity for robust research projects and Bioversity will contribute to their agenda by providing increased knowledge and science to the agriculture and nutrition landscape.

Value chain actors – Bioversity International will partner with private sector actors and stakeholders in order to promote agricultural biodiversity, the use of local foods and their role in boosting smallholder farmer income. These actors include farmers, processors, post harvest handlers, media outlets, food industry and retail experts who understand that markets and business enterprise are essential to the research and creation of new delivery systems for nutritious foods. Bioversity International will work with national and regional governments, farmer associations and cooperatives as well as with small and large private sector companies in order to sustain initiatives aimed at boosting the production and distribution of nutritious and biodiverse foods.

Plant and animal genetic resource centres – Bioversity International will partner with research institutes that work with plant and animal genetic resources as well as with breeders, botanists and botanical gardens to ensure that agricultural biodiversity expertise is woven into our nutrition work.

Development agencies, governments and non-governmental organizations – Bioversity International will work with development practitioners on the ground to ensure that our operations research fills identified gaps in developing countries and makes an impact on development objectives and outcomes. We will work within development initiatives such as school feeding programmes, voucher and cash-based programmes that facilitate food access, mother and child health and nutrition programmes and homestead food production projects as the operations arm of research on agricultural biodiversity practices. Bioversity will also ensure that research results will be shared with the Scaling Up Nutrition movement for incorporation into country plans. Bioversity will also work with agricultural extension and community health workers to ensure that best practices and research results are translated into concrete benefits to households and communities alike.

Farmer groups, cooperatives and associations as well as movements whose aim is to sustain and protect the livelihoods of smallholder farmers and indigenous people – Bioversity International will work with local farmer cooperatives and associations to make sure that research is carried out in ways most valued and understood by farmers. Bioversity will also collaborate with international movements and institutions that share the same core values and aspirations aimed at improving the nutrition and the capabilities of smallholder farmers in developing countries. Movements and cooperatives that seek to protect and sustain smallholder farmers, indigenous populations and agricultural biodiversity will also be important to Bioversity International's work.

Building capacity

In response to a global mandate to assume a role leading and coordinating activities that promote the conservation and use of agricultural biodiversity, Bioversity International aims to strengthen the capacity of developing countries to undertake biodiversity and nutrition research across disciplines. It recognizes that to achieve long-term impact and the global potential of this strategy will demand an improved capacity for promotion, social marketing and education about local food biodiversity, nutrition and ecosystem health at national, regional and global levels. Bioversity will leverage its global network of nutrition leaders to pursue capacity building with:

Academics and universities – Bioversity International will work with academia and research institutes in the developed and developing world to promote food systems learning, courses and programmes of study in institutions of higher education.

Individuals – Bioversity International will assist in the training of future nutritionists, agronomists and other professionals on food-based approaches in innovative academic programmes, non-academic certification programmes, government training courses and other curricula using new methodologies and tested capacity building tools.

Communities – Bioversity International will work in collaboration with farmers and local communities on improved agricultural biodiversity practices that focus on nutrition and engage community health workers and agriculture extension workers, anthropologists and ethnobotanists in new methodologies, interventions and approaches to link agriculture and nutrition.

Methods, tools and technology

Methods

A variety of methods and tools will be used to build evidence, perform operations research and monitor, evaluate and assess impact. Qualitative and quantitative operations research will be undertaken.

The qualitative methodologies will include focus groups, interviews with key informants and actors along the value chain and in particular women consumers. It will include participatory and rapid appraisal tools including mapping, seasonal calendars, Venn diagrams, proportional piling and direct observation.

The quantitative methodologies will include surveys for dietary and market assessments, rapid assessments of vulnerability, mapping exercises, biological measures for serum micronutrients and anthropometry in order to assess nutritional impact. Research designs will include randomized control trials as well as cross-sectional, retrospective, prospective and case control studies. Ecological studies will also be performed to assess consumption patterns and will include local knowledge and trends.

Operations research, also known as delivery system research, is concerned with finding out which interventions, strategies or tools can enhance the quality, effectiveness or coverage of agriculture, nutrition and health programmes in which more analytical research is being carried out. It will involve a variety of descriptive processes, such as cross-sectional analyses, case

control studies and retrospective or prospective cohort analyses (Zachariah et al 2009).

Development programme study designs will include adequacy, plausibility and probability methodologies. Adequacy methodology measures the expected change of nutrition status as programmes are implemented. Programme performance is evaluated and status is assessed before and after the interventions. Plausibility methodology assesses whether the programme seemed to have an effect above and beyond external factors and influences. Probability methodology is used to measure whether a programme had an impact, and checks for potentially confounding elements by making use of randomization and control groups.

Tools and technology

In conducting the research outlined in this strategy, a wide variety of tools and technology will be used, including livelihood tools for assessing physical, financial, social, natural and human capital. Vulnerability assessments and mapping will be monitored with geographic information systems and the Food Insecurity and Vulnerability Information and Mapping System (FIVIMS). Other methods based on food security, human development, food sovereignty and rural development will be considered.

Market mapping will focus on access to markets, outcomes related to food access and availability, trader and focus group interview guides, market location mapping exercises and prices. Local market assessments will include food availability lists, seasonality, prices and preferences.

Food security tools such as the household hunger scale, household food insecurity access scale, months of adequate household food provisioning and the coping strategy index (FAO and FANTA-2) will be used.

Other dietary and consumption tools to be used in the research will include infant and young child feeding surveys from the World Health Organization (WHO), women's diet quality tools (see Ruel et al 2010 and other papers in that supplement), household dietary diversity scores from Food And Nutrition Technical Assistance (FANTA), consumption and composition indicators from FAO, such as their International Network of Food Data Systems and the new International Micronutrient Assessment and Planning Programme (WHO). Linear programming methods will be used to select diets based on local foods that satisfy a set of nutritional constraints while minimizing the total energy content of the diet, with costs assessed using tools such as Save the Children's cost of diets tool (Chastre et al 2007; de Pee et al 2010).

Nutritional assessments including anthropometry to assess children's nutritional status as well as biochemical analyses of micronutrients will be essential to measure the impact of interventions or research on nutrition and health outcomes.

Agriculture, ecosystem and biodiversity tools will be employed on-farm and in landscapes and will include a species richness index (defined as the number of identified and previously described edible species, either plant or animal, per farm), as well as a species diversity index, a species evenness index and individual species-area relationships. Access surveys will include assessments of access to seed diversity, technology and markets.

Other areas to be developed include the nutritional functional diversity at the farm level, nutritional composition at subspecies level and cultural preferences for species and subspecies.

Technology such as mobile phones, satellite positioning systems and food enrichment technology will also be used.

CGIAR Research Programme

The CGIAR is committed to reducing poverty and hunger, improving human health and nutrition and enhancing ecosystem resilience through high-quality international agricultural research, partnership, and leadership. The CGIAR's Research Programme on Agriculture for Improved Nutrition and Health, directly and strategically supports this commitment.

Agricultural production will need to increase if the world is to meet the food needs of a growing population from a finite resource base. How agriculture develops to do this will have consequences for the health and nutrition of people. The CGIAR Research Programme is designed to support the overall CGIAR agenda by improving our understanding of how agriculture can better accentuate the benefits and mitigate the risks of agricultural development for human health and nutrition. The lessons learned are intended to serve the entire CGIAR agenda within agro-ecological production systems and along food value chains.

The CGIAR Research Programme emphasizes two groups of people. The first is those people who are left behind by socioeconomic development, who suffer from high rates of malnutrition and agriculture-associated diseases and who rely on aid and development support. The second group is made up of poor people who live in dynamically intensifying and changing systems in which this type of research can help to direct agricultural development towards more beneficial approaches.

Aspects of Bioversity's nutrition strategy fit well within the new CGIAR Research Programme and specific components and objectives of the proposed work will have substantive contributions to make to the overall CGIAR Research Programme.

Objectives one and three fit well with Component one of the CRP, on nutrition-sensitive value chains, while Objectives three and four fit well within Component four of the CRP, on programmes and policies.

Monitoring and evaluation

Bioversity International will monitor and evaluate the implementation of this strategy on an annual basis with an external Scientific Advisory Council. The purpose of the Council is to provide Bioversity with expert, independent advice on nutritional science policy and strategy and to advise on matters concerning agricultural biodiversity, food and nutrition security, diet quality and diversity and the role of ecosystems in well being. Members are appointed as independent scientific experts on the basis of their specific skills and knowledge. (See chapter four for details of the Council members.)

Monitoring and evaluation will be an integral element of the research agenda within each objective of the strategy and a logical framework for the proposed research is outlined on the following page.

Over the years Bioversity International will demonstrate clear, realistic, measurable and rational pathways needed to achieve impact, in collaboration with our partners. Bioversity International will be accountable for the provision of inputs, for carrying out activities and for producing both lower-order and higher-order outputs. Subsequently, we will share responsibility with partners for the research outcomes generated, and engage together in the delivery of the development outcome. We give high importance to identifying partners that can share responsibility for achieving the research outcomes and that will play an important role in the delivery of the development results.

Priority setting

Objectives one and two, with a focus on evidence building, will be the major priorities in the first five years and through the life of the strategy. Objective three will be the focus of years six through nine, while Objective four will be the focus of years seven through ten. All of the objectives will be targeted in key priority countries and specific agro-ecosystems. We plan to ensure that each objective and the different components are addressed as part of holistic research projects on similar sites because the various components together will define the nutrition and livelihoods impact. Each component may require distinct partnerships, tailored research approaches, methods and programme designs. Key priority countries will include the 36 countries where 90% of the world's stunted children live, where agricultural systems are fully functioning or that have potential for improvement, as well as countries that are ready to accelerate action in nutrition (SCN 2009).



D. White

Logical framework for the strategy

NUTRITION ACTIVITIES

Research and evidence-oriented outputs Objectives one and two

- Research tools to characterize ABD and consumption and composition of local foods developed and implemented
- Effectiveness of ABD on DD and nutrition outcomes assessed
- Linkages between agriculture and the nutrition transition assessed
- Knowledge, practices and value of traditional food culture documented
- Food sovereignty principles in the context of ABD and nutrition defined and documented
- Local consumer preferences and role of women in food purchasing documented
- Value chain media outlets to disseminate information and knowledge defined
- Tools for specialized local products and education developed
- Income incentives for farmers to produce nutritious local foods characterized
- Nutrition access pathways of SHF linked to urban markets documented
- Role of women as producers and processors of nutritious food documented

Scaling out

Outcomes resulting from the use of outputs by target groups

- Deployment of ABD for improving nutrition security utilized in rural communities
- Development of nutritionally rich foods sourced from ABD systems in value chains and accessed by rural and urban populations

Changes:

- Improved evidence of the links of agriculture to public health
- Increased presence of LTFs from biodiverse systems in value chains and accessible to urban populations

Development- and policy-oriented outputs Objectives three and four

- Best practices for ABD and nutrition linkages for development programmes developed
- Usage of LTFs in specialized foods and school meals for development programmes defined and documented
- ABD sourced commodities integrated into select food aid baskets
- Nutrient gap and ABD added value quantified
- Nutrient profiles of non-crop ecosystems identified and documented
- Role of women in food systems approaches characterized
- Research tools to measure added value and impact of ABD in public health programmes developed
- Nutrition development programmes integrated with agricultural practices redefined

Scaling out

Outcomes resulting from the use of outputs by target groups

- Tools and best practices used for development programmes and policies
- Food development assistance and school meals effectively integrating ABD
- Nutrient gap analysis and profiles deployed for use in developing countries

Changes:

- ABD better integrated into national, regional and global nutrition, and public health development programmes and policies
- Improvements made in multi-sectoral food system approaches to tackling malnutrition

Scaling up

Outputs communicated and disseminated to policymakers and other stakeholders

Adoption of outputs by target groups at regional and national levels

Adoption of outputs by target groups at local level

EXPECTED IMPACT

Overall goal

To promote the use of agricultural biodiversity within food production systems and provide nutritionally rich food sources that contribute to dietary diversity and potentially better nutrition and health

Indicators to be monitored

- Scientific public health and nutrition articles with ABD components and data
- Procurement programmes sourcing ABD for specialized nutrition products
- School meal programmes and garden projects with ABD practices embedded
- National nutrition policies with ABD interventions embedded
- Development agencies working on public health programmes integrating ABD increased
- Joint agriculture and nutrition strategies implemented in Developing Countries



Jessica Fanzo / Bioversity

CHAPTER FOUR

SCIENTIFIC
ADVISORY
COUNCIL
FOR NUTRITION

Martin W. Bloem, MD, PhD

Chief, Nutrition and HIV/AIDS Policy, Policy Strategy and Programme Support Division

United Nations World Food Programme

Dr Martin W. Bloem is Chief for Nutrition and HIV/AIDS Policy and UNAIDS Global Coordinator at the World Food Programme in Rome, Italy. He holds a medical degree from the University of Utrecht and a doctorate from the University of Maastricht and has joint faculty appointments at both Johns Hopkins University and Tufts University. Martin has worked and lived in several countries in Asia including Bangladesh, Thailand and Indonesia. He has more than two decades of experience in nutrition research and policy. Bloem acted as Senior Vice President and Chief Medical Officer of Helen Keller International prior to his appointment at WFP and has devoted his career to improving the effectiveness of public health and nutrition programmes through applied research. His work has led him to participate in task forces convened by leading non-governmental organizations such as the UN Standing Committee on Nutrition (UNSCN), the United Nations International Children's Emergency Fund (UNICEF), the United States Agency for International Development (USAID), and the World Health Organization (WHO).

Barbara Burlingame, PhD

Senior Officer and Leader of the Nutrition Requirements and Assessment Group

Food and Agriculture Organization of the UN

Dr Barbara Burlingame is Senior Officer and Leader of the Nutrition Requirements and Assessment Group at FAO. Her areas of responsibility include food composition, human nutrition requirements, dietary and nutritional risk assessments, the cross-cutting initiative on biodiversity for food and nutrition as well as the provision of nutrition advice to FAO member nations and the Codex Alimentarius Commission. Since 1995, she has been the director of INFOODS, the International Network of Food Data Systems and since 1998 she has been the editor of the international, peer-reviewed Journal of Food Composition and Analysis. She chairs the International Union of Nutritional Sciences Food Data Task Force and is a member of several scientific advisory boards. She has authored many scientific papers and UN publications, and several book chapters and reference books and been awarded the New Zealand Royal Society's Science and Technology Medal. Dr Burlingame studied at the University of California, Davis, and obtained a BSc in Nutrition Science and Environmental Toxicology. She did her postgraduate work in New Zealand at Massey University where she obtained a PhD. From 1987-1998, she worked for the New Zealand Institute for Crop & Food Research. She has been at FAO since 1998.

Fabrice DeClerck, PhD

Division of Research and Development

Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)

Fabrice DeClerck is a Belgian landscape and community ecologist with a faculty appointment at CATIE in Costa Rica. His primary research activities focus on the biodiversity and ecosystems in human-dominated landscapes of Mesoamerica. DeClerck holds an adjunct research fellowship with Tropical Agricultural Programmes at Columbia University and consults on the role

of biodiversity and conservation in achieving the Millennium Development Goals (MDGs). He leads research projects on biodiversity conservation and ecosystem functioning in cattle and coffee agricultural systems, looking at how biodiversity and functional diversity can be managed to increase the provisioning of ecosystem services and poverty alleviation. His current work is focused on how the position of agroforestry systems affects the capacity of these systems to provide ecosystem services. DeClerck's research also looks at how functional diversity can predict ecosystem function, including models of loss of functional diversity with agricultural intensification and the contribution of functional agrobiodiversity to human nutrition. DeClerck was a postdoctoral fellow with the Earth Institute at Columbia University where he actively investigated and wrote on the role of ecology in poverty alleviation. He also maintains an active theoretical ecology research agenda on the relationship between tree species richness and carbon storage in a tropical forest of Panama.

Glenn Denning, PhD

Professor of Professional Practice

School of International and Public Affairs, Columbia University

Glenn Denning is a professor of Professional Practice in International and Public Affairs, and Associate Director of the Centre for Globalization and Sustainable Development at the Earth Institute of Columbia University. He helped establish The MDG Centre, East and Southern Africa in Nairobi, Kenya and served as its first Director from 2004-2009, during which he provided leadership to the centre's agenda in agriculture and rural development and its support to the African Green Revolution. He previously held senior management positions at the International Rice Research Institute and the World Agroforestry Centre and has lived and worked in Asia and Africa for more than 30 years. Denning served on the UN Millennium Project Hunger Task Force (2004-2006) and is a member of the Senior Steering Group of the UN High Level Task Force on the Global Food Security Crisis. Dr Denning holds agricultural science degrees from the University of Queensland, a PhD from the University of Reading, and an MPA from Harvard University's Kennedy School of Government.

Charlotte Dufour, MSc

Food Security, Nutrition and Livelihoods Group, Nutrition and Consumer Protection Division (AGN)

Food and Agriculture Organization of the UN

Charlotte Dufour works as Food Security Nutrition and Livelihoods Officer in the Nutrition and Consumer Protection Division of FAO. After obtaining a BA in Human Sciences from Oxford University and an MSc in Public Health Nutrition from the London School of Hygiene and Tropical Medicine, she spent ten years working on nutrition and food security in Afghanistan with Action Contre la Faim Groupe, URD, FAO, the Afghan Ministry of Agriculture, the Ministry of Public Health and other development partners. Dufour has undertaken assignments in Ethiopia and Laos. Since 2010 she has been working on the FAO project Supporting Food Security, Nutrition and Livelihoods in Sub-Saharan Africa.

Boitshepo “Bibi” Giyose, PhD

Senior Food and Nutritional Security Advisor

The New Partnership for Africa’s Development (NEPAD) Secretariat, South Africa

Boitshepo “Bibi” Giyose is a Senior Food and Nutritional Security Advisor to NEPAD’s Planning and Coordinating Agency for the African Union. Before joining NEPAD, Giyose worked for UNDP/UNAIDS Botswana as the regional project coordinator for strengthening the United Nations response to HIV/AIDS in small-population African countries. She has also worked as the regional coordinator for the Commonwealth Regional Health Community Secretariat for East, Central and Southern Africa, as a nutritionist for the Government of Botswana and as a private nutrition consultant. Giyose serves on the Global Horticulture Board and on the Advisory Committee of the Collaborative Crops Research Programme of the McKnight Foundation. She is also a member of the Scaling Up Nutrition Transition Team and a Technical Advisory Group Member of USAID’s Nutrition Collaborative Research Support Programme. Alongside her numerous engagements, Dr Giyose writes a weekly column on food, nutrition, and health matters for the Botswana newspaper, Mmegi. She holds an MSc in International Nutrition from Cornell University and a BSc in Nutrition and Dietetics from Appalachian State University, where she was awarded a Distinguished Alumna Award in 2007. She was selected as Policy Scholar for the US-based School Nutrition Association and was appointed a delegate of the Global Child Nutrition Foundation’s Legislative Action Committee in January 2011.

Anna Herforth, PhD

Nutrition Specialist Health, Nutrition and Population

The World Bank

Anna Herforth holds a PhD in international nutrition from Cornell University, an MSc in food policy from Tufts University and a BSc in plant science from Cornell University. She has worked with academics, non-profit organizations, CGIAR centres and the UN, contributing to nutrition policy and programmes in Africa, South Asia, and Latin America. In each region she has spent considerable time with agricultural and indigenous communities. Currently Herforth is a Nutrition Specialist at the World Bank, working on nutrition as a multi-sectoral issue related to agriculture and the environment.

CJ Jones, PhD

Kenya Country Manager

Global Alliance for Improved Nutrition

Dr CJ Jones is Country Manager for the Global Alliance for Improved Nutrition (GAIN). Since 1989, she has lived and worked in both east and southern Africa, during which time she has held a variety of high-level private-sector positions including technical consultant on privatization in Zambia, lead local consultant for the privatization of Zambia Consolidated Copper Mines, founding director of the Lusaka Stock Exchange and of the African Plantations Corporation and director of several Zambian commercial banks. At the same time, she established her own investment company and developed a reputation for business management and business opportunities at the cutting edge of African industry and for raising significant new foreign investment capital. Since 2007, Jones has worked at the

interface between public and private sector investment in East Africa and is currently working with GAIN to put key public health interventions related to nutrition into effect. For example, GAIN’s Kenyan food fortification programme, which will reach 27 million Kenyans, and the Maternal and Infant Young Child Nutrition (MIYCN) initiatives are two that are working directly with industry to produce nutritious infant foods and make them available to mothers in low-income groups. An Australian citizen, Dr Jones was born in rural Australia and received her professional qualifications from Sydney University and Wollongong University. Jones is also a qualified educator with postgraduate qualifications in education, administration and finance.

Anna Lartey, PhD

Associate Professor

University of Ghana

Anna Lartey is an Associate Professor and former Head of Department in Nutrition and Food Science at the University of Ghana. Dr Lartey attended the University of California, Davis, as a Fulbright scholar and received her PhD in nutrition in 1998. She received her BSc from the University of Ottawa, Canada, completed a dietetic internship at Kingston General Hospital in Canada and received her MSc from the University of Guelph, Canada. Lartey’s research focuses on maternal child nutrition in sub-Saharan Africa and she has published extensively on the topic. She was Co-Principal Investigator for WHO’s Multicenter Growth Reference Study in Ghana and is the Principal Investigator for Ghana in the International Lipid-based Nutrient Supplement study taking place in three African countries (Malawi, Burkina Faso and Ghana). Lartey won the University of Ghana’s award for best researcher in 2004. She has served on several WHO expert consultations on child nutrition and currently leads the Ghana delegation to the Codex Committee on Nutrition for Special Dietary uses (CCNFSDU), where Ghana chairs the electronic working group to revise the Codex Guidelines on Formulated Supplementary Foods for Older Infants and Young Children. She is a graduate of the African Nutrition Leadership Programme and chaired the Africa Nutritional Epidemiology Conference for the years 2006-2009. She holds the International Development Research Centre Canada Research Chair in Nutrition for Health and Socio-Economic Development in Sub-Saharan Africa. She is currently the President-elect of the International Union of Nutritional Sciences.

Cheryl Palm, PhD

Senior Research Scientist

Tropical Agriculture Programme of the Earth Institute, Columbia University

Cheryl Palm is a Senior Research Scientist in the Tropical Agriculture and Rural Environment Programme of the Earth Institute at Columbia University where she is also the Science Director of the Millennium Villages Project. A tropical ecologist focusing on land use change, Dr Palm received her PhD in soil science from North Carolina State University after completing her Bachelors and Masters degrees in zoology at the University of California, Davis. She served as Principal Research Scientist of the Tropical Soil Biology and Fertility Programme in Nairobi, Kenya from 1991-2001. She has served on the faculties of North Carolina State University and Colorado State University and also spent a year as visiting scientist at the University of

California, Berkeley. She was elected a Fellow of the American Society of Agronomists in 2005 and is currently the chair of the International Nitrogen Initiative. Dr Palm's research focuses on land use change, degradation and rehabilitation and ecosystem services in tropical landscapes. She led a major effort to quantify carbon stocks, losses and net greenhouse gas emissions following slash and burn and alternative land use systems in the humid tropics in the Brazilian and Peruvian Amazon, Indonesia and the Congo Basin. She has spent much of the past 15 years investigating nutrient dynamics in farming systems of Africa, including options for land rehabilitation. Her most recent work includes the Millennium Villages Project, an integrated approach to achieving the MDGs in rural sub-Saharan Africa. The approach combines evidence-based interventions and community-based participation. The team is currently working with the Millennium Villages sites to develop carbon offset projects for carbon sequestration in degraded landscapes that will provide additional ecosystem services and benefit local communities.

Marie Ruel, PhD

*Division Director, Food Consumption and Nutrition Division
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Marie T. Ruel was appointed Division Director of IFPRI's Food Consumption and Nutrition Division in 2004. Before that, from 1996 until her current appointment, she served as Senior Research Fellow and Research Fellow in that division. Since joining IFPRI, she led the multi-country programme on Challenges to Urban Food and Nutrition and the global regional project on Diet Quality and Diet Changes of the Poor. Prior to IFPRI, Ruel was head of the Nutrition and Health Division at the Institute of Nutrition of Central America and Panama/Pan American Health Organization (INCAP/PAHO) in Guatemala. Dr Ruel received her PhD in International Nutrition from Cornell University and her MSc in Health Sciences from Laval University in Canada. Dr Ruel has worked for more than 20 years on issues related to policies and programmes to alleviate poverty and child malnutrition in developing countries. She has published extensively on topics such as maternal and child nutrition, food-based strategies to improve diet quality and micronutrient nutrition, urban livelihoods, food security and nutrition and the development of indicators of child feeding and care practices. She has served on various international expert committees, such as the National Academy of Sciences, the International Zinc in Nutrition Consultative Group and the International Micronutrient Advisory Group of Experts established by WHO.

Roger Sodjinou, PhD

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Roger Sodjinou is the chief of Nutrition for UNICEF in Chad. Prior to joining UNICEF, Sodjinou served as Regional Nutrition Advisor for the Millennium Villages Project in West and Central Africa. He has worked in Benin, Mali and the Democratic Republic of Congo for different NGOs, including Christian Aid and Concern Worldwide. Dr Sodjinou received an MSc in nutrition from Wageningen University in the Netherlands

and a PhD in nutrition from the University of Montreal, Canada. He has extensive research experience in the field of international nutrition and has published many scientific papers in peer-reviewed journals.

Jeff Waage, PhD

*Director
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Dr Jeff Waage is the director of the London International Development Centre (LIDC) and a professor at the School of Oriental and African Studies. He has served CAB International, an intergovernmental agricultural development organization, as a manager of its sustainable agricultural research and training programmes through centres in Africa, Asia, and Latin America. Dr Waage taught at Imperial College in London for 10 years and also headed its Agriculture and Environment Department. He has worked extensively with UN organizations and the World Bank as well as on panels of the United Kingdom's Research Councils and Office of Science, particularly in sustainable agriculture, bioinvasions and emerging disease threats. He has a special interest in interdisciplinary studies and recently established Leverhulme Centre for Integrative Research on Agriculture and Health, which he chairs. He received the Order of the British Empire for his contributions to science. A graduate of Princeton University, he earned his PhD in ecology from Imperial College.

Patrick Webb, PhD

*Dean for Academic Affairs and Professor, Friedman School of
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Dr Patrick Webb was the Chief of Nutrition at WFP until August 2005, a member of the Steering Committee of the United Nations Standing Committee on Nutrition and a member of the Millennium Project Task Force on Hunger reporting to Jeffrey Sachs and Kofi Annan (from 2003 to September 2005). He spent six years living in Africa (Ethiopia, Niger, The Gambia) and many more years working in remote parts of Asia and Latin America on programme implementation and evaluation. His wide range of experiences include being a first responder on the ground after the 2004 tsunami in Aceh, Indonesia, working in North Korea overseeing the 2004 national health and nutrition survey, working at ministerial level in Kenya, Haiti and Ethiopia on the reformulation of national food and nutrition policies, negotiating UN positions at the World Food Summit in 1996, overseeing the preparation and endorsement of the Delhi Declaration on maternal and child nutrition (2003), evaluating protracted relief and rehabilitation operations in West Africa (2008), serving on expert panels for UNICEF and WHO and advising the Bill and Melinda Gates Foundation on agricultural policy and global nutrition strategy. Formerly a Research Fellow at the International Food Policy Research Institute, Dr Webb has consulted for the World Bank, WHO, FAO, CARE, USAID's Office of US Foreign Disaster Assistance, UN Development Programme, UNICEF and OXFAM. He has is an honorary Professor at the University of Hohenheim in Stuttgart, Germany and is currently Principal Investigator for USAID's global food aid quality review.



Martina Tagliaferri

CHAPTER FIVE

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Jessica Fanzo / Bioversity

CHAPTER SIX

GLOSSARY

HUNGER

In its common use **hunger** describes the subjective feeling of discomfort that follows a period of not eating. Even temporary periods of hunger can be debilitating to longer term human growth and development. **Acute hunger** is when food lack is short term and caused by sudden shocks to the food system, such as drought resulting in famine, whereas **chronic hunger** is a constant or recurrent lack of food. Reducing hunger levels places the emphasis on the quantity of food and refers to ensuring that a minimum caloric intake is met.

NUTRITION

Nutrition refers to a diet's quality. A diet rich in macronutrients (fat, carbohydrate and protein) and some micronutrients (vitamins and minerals) has been proven to improve birth weight, growth, and cognitive development and decreases child mortality.

MALNUTRITION

Malnutrition is a broad term commonly used to describe people who are malnourished if their diet does not provide adequate calories, protein, fat and micronutrients. It can also refer to individuals who are unable to fully utilize the food they eat due to illness. A lack of essential micronutrients (essential vitamins and minerals) often results in **hidden hunger**, where the signs of malnutrition and hunger are less immediately visible, and which can result in the nutrition disorder of **undernutrition**. Although a lot of the focus regarding malnutrition centres on undernourishment, **overnutrition** is also a disorder of malnutrition in which individuals consume excess calories, make poor food choices, or do not have access to high quality food. One of the major long-term determinants of malnutrition is poverty, a factor that holds true in developed and developing countries.

ACUTE MALNUTRITION

Global acute malnutrition, or **wasting**, is defined as low weight for height or the presence of oedema. It can be moderate acute malnutrition (MAM) or severe acute malnutrition (SAM). It occurs as a result of recent rapid weight loss, malnutrition, or a failure to gain weight within a relatively short period of time. SAM is the most dangerous form of malnutrition and if left untreated, can result in death. Wasting occurs more commonly in infants and younger children. Recovery from wasting is relatively quick once optimal feeding, health and care are restored. Wasting occurs as a result of deficiencies in both macronutrients (fat, carbohydrate and protein) and some micronutrients (vitamins and minerals).

CHRONIC MALNUTRITION

Chronic malnutrition, commonly referred to as **stunting**, is a failure to grow in stature, which occurs as a result of inadequate nutrition over a longer period. It measures chronic deprivation, with inadequate food intake, poor health and poverty, which results in poor child growth. Stunting of children under five years of age is a strong indicator of hunger and of endemic poverty, one of hunger's determinants. Global and country stunting is often much more prevalent than undernutrition and wasting and more accurately reflects nutritional deficiencies and sickness that occurred in the most significant times of a child's growth.

FOOD SECURITY

The 1996 World Food Summit stated that "**food security** exists when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life". The achievement of food security depends upon three distinct but interrelated processes (USAID 1992). The first is food availability, ensuring that a sufficient quantity and diversity of food is available for consumption from farm, marketplace or elsewhere. The second is food access, which refers to households having the physical and financial resources required to obtain food. The third is food utilization, having the capacity and resources necessary to use

food appropriately in order to support healthy diets. This includes access to safe drinking water and adequate sanitation, knowledge of food preparation and the basic principles of good nutrition, proper child care, illness management and so on.

NUTRITION TRANSITION

Increased consumption of unhealthy foods compounded with increased prevalence of overweight in middle-to-low-income countries is typically referred to as the **Nutrition Transition**. It occurs in conjunction with the Epidemiological Transition and has serious implications in terms of public health outcomes, risk factors, economic growth and international nutrition policy. Nutrition transition may result in malnutrition not simply from a need for food, but from the need for a high-quality diet. Foods rich in vitamins and minerals such as fruits, vegetables and whole grains have been substituted by foods heavy in added sugar, saturated fat, and sodium. This trend, which began in developed, industrialized countries, has spread to developing countries. These developing countries are now stressed with the double burden of malnutrition - hunger alongside the health problems associated with overnutrition, such as obesity, diabetes and stroke.

AGRICULTURAL BIODIVERSITY

Agricultural biodiversity includes ecosystems, animals, plants and microorganisms related to food and agriculture. Today most crop species and domesticated livestock are the result of thousands of years of human intervention, including selective breeding and other farm practices. Agricultural biodiversity provides food and raw materials. Moreover, every plant, animal and microorganism plays its part in the regulation of essential ecosystem services, such as water conservation, decomposition of waste, nutrient cycling, pollination, pest and disease control, climate regulation, erosion control, flood prevention, carbon sequestration and many other ecosystem-oriented factors (CBD, 2010).

LOCAL AND TRADITIONAL FOODS

There is no universally accepted definition of **local foods** or **traditional foods**. Traditional foods are generally from a particular culture, available from local resources and culturally accepted. Other aspects that have to be factored in to a consideration of traditional foods include sociocultural meanings, techniques for acquisition and processing, use, composition and nutritional consequences (CINE 2006). In this strategy we use local and traditional foods to refer to plants and crops, fruits, non-timber forest products, livestock, fish, hunted game, wetland species, wild or gathered foods and insects.

AGRO-ECOSYSTEMS

Agro-ecosystem describes a conceptual model of an agricultural system (crop, farm or whole economy), which relates its functions to its inputs and outputs. An agro-ecosystem encompasses land used for crops, pasture, and livestock, the adjacent uncultivated land that supports other vegetation and wildlife, the associated atmosphere, and the underlying soils, groundwater and drainage networks. Ecosystems services are ecological processes and functions that sustain human wellbeing (Daily 1997).

SUSTAINABLE DIETS

Sustainable diets are diets with low environmental impact and which contribute to food and nutrition security as well as to a healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable, nutritionally adequate and safe and healthy while also optimizing the use of natural and human resources.



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