

Technical Brief

Metrics of Sustainable Diets and Food Systems

Jessica Fanzo, Bruce Cogill and Federico Mattei

Summary

Bioversity International is working with partners to undertake a new and important research agenda to describe, measure and influence policy and programmes on sustainable diets and food systems with the ultimate goal of improving nutrition and health. Particular focus will be given to the development of metrics to reflect the multiple dimensions of a healthy and sustainable diet. There is an urgent need to research and advance innovative strategies to better understand, measure and promote sustainable diets, emphasizing the positive role of food biodiversity in human health and nutrition. Looking forward, we need a future where food systems or food environments are constructed around human needs, but with a view to sustainability, where low carbon, accessible, culturally relevant and nutritionally adequate food is the norm.

The research agenda will:

- Address gaps in our understanding of what constitutes a sustainable diet
- Build on the example of the Mediterranean Diet
- Understand the need to value biodiversity and nutrition plus other dimensions
- Propose new research on describing, measuring and promoting sustainable diets
- Identify a process for developing indicators and guidelines aimed at measuring the sustainability of diets worldwide

Background

Presently, 868 million people suffer from hunger - in spite of the Millennium Development Goal No. 1 to halve hunger by 2015 - and another 2 billion suffer from micronutrient deficiencies (Food and Agriculture Organization of the UN (FAO), 2012a; Micronutrient Initiative, 2009). At the same time, over 1.4 billion people, worldwide, are overweight and obese (World Health Organization (WHO), 2012). Dietary transition has been both a boom and a threat to the health and wellbeing of populations everywhere. Diets low in quality but high in energy contribute to the escalating problems of obesity

and nutrition related non-communicable diseases. Recent trends show an alarming increase in these problems in low, middle and high income countries, highlighting the inadequacy of current food supply, dietary patterns and lifestyle, and environmental changes.

The current global agricultural system is producing enough food, in aggregate, but access to and consumption of sufficient food that is culturally acceptable, affordable and nutritious is more challenging. Projections for the next 10 to 50 years further strengthen the need to improve the quality and environmental sustainability of the diet, especially given the challenges imposed by climate change and increasing population growth with a rising appetite for environmentally costly animal source foods (Rosen et al. 2012; UN Environment Programme (UNEP), 2012). What is needed, however, is food sourced from functional food systems that contribute to a healthy diet that is appealing, flavourful, sustainable and accessible at a reasonable cost.



FAO (2010) estimates that of a total of 300,000 flowering plant species, 10,000 plant species have been used for human food since the origin of agriculture. Out of these, only 150 to 200 species have been commercially cultivated with rice, wheat, maize and potato flour supplying 50 percent of the world's food energy needs and 30 crops providing 90 percent of the world's food energy intake.

Intensification of agricultural systems has led to a substantial reduction in the genetic diversity of domesticated plants and animals in agricultural systems. Some of these on-farm losses of crop genetic diversity have been partially offset by the maintenance of genetic diversity of seed and animal genebanks and the reservoir, albeit diminishing, of crop wild relatives. In addition to the extinction of species, the loss of unique populations has resulted in the erosion of genetic diversity (contained in those species and populations) (Millennium Ecosystem Assessment, 2008). Yet the implications of this loss for the biodiversity and quality of the global food supply is scarcely understood and measured from nutrition and dietary perspectives. A recent publication from the Chicago Council highlights the impact of the food environment directly and indirectly on human health (Nugent et al., 2011).

Agricultural intensification, poverty, population pressures, urbanization and lifestyle changes have changed food production and consumption in ways that profoundly affect diets, leading to an overall reduction in seasonality and concentration of staple food sources. In addition, the alarming pace of biodiversity loss and ecosystem degradation together with climate change and resource extraction, and the negative impact of this on farming systems, livelihoods and health, make a



compelling case for re-examining food systems from an environmental sustainability and public health perspective.

Much less is known about what people eat and their behaviours around choice and demand for foods. What is known is that eating is strongly influenced by behaviours determined by culture, media and information. Consumption patterns and their consequences are a function of income, as well as lifestyle. Changes to the food system include where food is purchased and eaten, attitudes towards specific foods, taste, and effect of marketing. Collectively, these changes are driving populations towards a more homogenous, less diverse diet. Yet, we recognize the importance of diversity both in what is grown and what is eaten. Studies have also shown that dietary diversity is associated with food security and socio-economic status, and links between socio-economic factors and nutrition outcomes are well known (Arimond and Ruel, 2004; Hoddinott and Yohannes, 2002; Thorne-Lyman et al., 2010).

There has also been an emerging movement towards foods and food choices based on values, ethics and concerns for the health and well being of the consumer and the environment (Carlson, 1962; Nestle and Neshiem, 2012). This has been echoed by support for measuring 'food miles', 'carbon costs', 'slow foods', 'organic foods', 'fair trade' and more recently, efforts to tax and restrict portion size along with the sale and marketing of 'obesogenic foods' and foods containing high amounts of sugar, salt and saturated fats (De Schutter, 2011; PLoS

Box 1

Healthy Diet

A key feature of a healthy diet is dietary diversity – consuming a variety of foods across and within food groups to ensure intake of essential nutrients. Fruits, vegetables, quality carbohydrates, nuts, fish, healthy vegetable oils and modest amounts of dairy products are emphasized. Sugar, trans fats, processed meats and foods should be limited. (Nugent et al., 2011)

Sustainability

Sustainability implies a state where the needs of the present and local population can be met without diminishing the ability of future generations or populations in other locations to meet their needs or without causing them harm to environment and natural assets. (Foresight, 2010)

Medicine, 2012).

Looking forward, we need a future where food systems or food environments need to be constructed around human needs but with a view to sustainability where low carbon, accessible, culturally relevant and nutritionally adequate food is the norm. There is an emerging study in this area around econutrition (Blasbalg et al., 2011; Deckelbaum et al., 2006; Lang and Rayner, 2012), ecosystem services (DeClerk et al., 2011, Eshel and Martin, 2009) and sustainable diets (FAO/Bioversity International, 2012b; Macdiarmid et al., 2012). The need to look at diet, food insecurity and poverty in multi-dimensional ways is emphasized in these studies and reports.

The June 2012 Rio+20 follow-up and the post 2015 United Nations Millennium Development Goal agenda make strong calls to position nutrition, biodiversity and sustainable diets as key elements to global progress. The Common Vision statement from the Rio+20 meeting *The Future We Want* argues for sustainable development "...and the promotion of economically, socially and environmentally sustainable future for our planet and for present and future generations" (UNa, 2012). The objectives of the United Nations 'Zero Hunger Challenge' (UNb, 2012) are also relevant for sustainable diets which include: achieving 100 percent access to adequate food all year round; to end malnutrition in pregnancy and early childhood; to make all food systems sustainable; to increase growth in the productivity and income of smallholders, particularly women; and to achieve a zero rate of food waste.

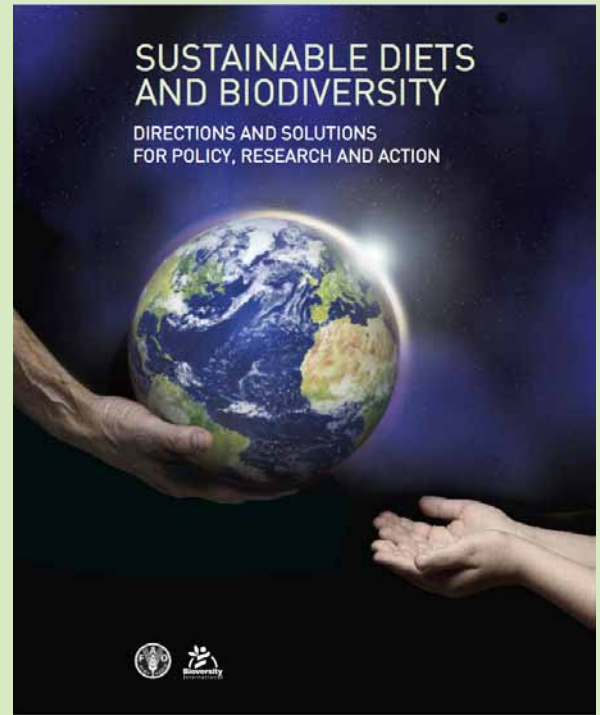
The commitment to sustainable development and the elimination of poverty and food insecurity



Box 2

Definition

Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to 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, safe and healthy; while optimizing natural and human resources. (FAO/Bioversity International, 2012)



requires an understanding of what is meant by sustainable diets for different populations and contexts, how these diets can be assessed within our global food system, and how we can achieve environmental sustainability in our consumption patterns and dietary goals. It is hoped that through a better understanding and measures of sustainable diets, innovative strategies emphasizing the positive role of biodiversity, ecosystem services and sustainable production systems on human health and nutrition can be promoted.

Objectives of the research agenda

There is a need to develop and promote innovative strategies for understanding, measuring and promoting sustainable foods and diets with an emphasis on the positive role of food biodiversity in human health and nutrition. Despite calls for action from policymakers, consumer groups and consumers, the evidence base for which steps to take is lacking. There is a call for researchers to improve and contribute to the evidence base by evaluating the impact of interventions that

incorporate both health and environmental sustainability objectives into food security initiatives (Clonan and Holdsworth, 2012).

The agenda is the first in a series of collaborations and discussions that will examine the current approaches to defining and measuring a healthy and sustainable diet, define the determinants and promote evidence to improve diets globally (see Box 1 for definitions).

The research has several objectives:

- To identify approaches used to describe a sustainable diet, through specific, measurable, achievable, realistic and time based descriptors.
- To explore options on how to measure a sustainable diet, in a systematic and reproducible way.
- To characterize what are the key determinants for a sustainable diet and how these determinants can be measured in a spatio-temporal way in perhaps a suite of indicators and a consolidated index.
- To generate the evidence on how these determinants create opportunities as well as challenges to what is a sustainable diet for the future.
- To inform policy and programmes to improve dietary quality, nutrition and health.

These objectives will better define sustainable diets, determine what others are doing in this area, and approach its measurement with a roadmap to develop and test a suite of indicators and an multi-dimensional index or score. We are not starting

from scratch. There are initiatives under way that are trying to improve food and nutrition security, diets and agricultural productivity, and in the last decade, there have been important reports and contributions that have put agriculture, the future of food and nutrition security at the forefront of development issues. It is hoped that key evidence and information, defined and recommended based on this research, as well as with other initiatives, can be synergized and communicated and promoted to governments, policy makers, large-scale programmes and consumers.

This work has begun to:

- Address gaps in our understanding of what constitutes a sustainable diet.
- Build on the example of the Mediterranean Diet.
- Understand the need to value biodiversity and nutrition plus other dimensions.
- Propose new research on describing, measuring and promoting sustainable diets.
- Identify a process for developing indicators and guidelines aimed at measuring sustainability of diets worldwide.

Defining and Measuring Sustainable Diets

There are several landmark papers that have examined the food system from a sustainable lens (Barilla Center, 2010; Foresight Project, 2011; Nugent et al., 2011; Millennium Ecosystem Assessment, 2009; Sustainable Development Commission, 2009). The Sustainable Development

Figure 1: Determinants of the Food System (adapted from Nugent et al., 2011)



Figure 2: Spider diagram of the dimensions of sustainable diets



Commission suggested that a definition of sustainable diets take into account climate change (which includes greenhouse gas emissions), nutrition, biodiversity, water use, soil conservation, animal welfare, fair trade, seasonality, taste and local identity. In 2010, FAO and Bioversity International held an international symposium on Sustainable Diets (FAO, 2012b), which resulted in the development of a consensus definition of Sustainable Diets (see Box 2 for definition). The definition lays out the multiple dimensions of what is a sustainable diet. The challenge is to operationalize this definition into measurable, robust and useful indicators to guide policies and programmes.

Defining sustainable diets is important yet more work is needed on what constitutes a sustainable diet from environmental, biological, cultural and health standpoints, at the global, regional, local and individual levels. A healthy diet requires the right nutrients and bioactive health components in the right amounts. The implication of what we eat involves more than just the known constituents of food. The sustainability implication of the diet remains elusive and undefined. There is a need to assess what quantifies or qualifies a sustainable diet that can be benchmarked over time. This

includes better measures and indicators on how food is produced, processed, marketed and consumed that represent sustainable diets. Finally, these indicators need testing, further debate and most importantly, a negotiation among users and disciplines so that the best that our scientists and researchers have to offer can be reflected in the work.

One place to start is to understand the key drivers or determinants of a sustainable, culturally relevant, cost-effective food system that incorporates the best of local and exotic foods and ingredients in terms of dietary diversity, dietary quality, good nutrition and health. However, how can those drivers be measured and elucidated to ensure environmental sustainability and the health of ecosystems, while ensuring dietary diversity and quality for humans is not compromised? It is not enough to examine the relationships of these determinants, but we need to better understand how to promote diversity to mitigate the negative impacts of dietary transition while highlighting the positive effects of improving the efficiency and sustainability of food systems.

By breaking down the food system into compartmentalized areas of production, consumption and nutrition, we can begin to partially define those determinants, construct measures and

indicators, and identify opportunities and tradeoffs. It is crucial to rethink how food is produced, processed, marketed and consumed (Beddington et al., 2012; FAO, 2012b; UNEP, 2012) (Figure 1).

Creating an Index for Sustainable Diets

One way to drive guidance and actions is by creating a 'score card' or 'index'. For example, the multi-dimensional poverty index is a measure that incorporates a range of indicators that capture the complexity of poverty. In examining the food system, and the determinants on what constitutes a sustainable diet, something like the Multi-Dimensional Poverty Index (MPI) (Alkire and Foster, 2011), is relevant and can be used as an example of what could be developed, allowing for comparisons across countries and regions. The USDA Healthy Eating Index (USDA, 2012) is another example. The index is a measure of diet quality that assesses conformance to federal dietary guidance. The primary use of the index is to monitor the diet quality of the food consumed in the U.S. including the low-income subpopulation.

The Livewell Project from the World Wildlife Fund in the United Kingdom is an example of a collaborative effort stretching across disciplines to identify ways of measuring and promoting sustainable diets (Macdiarmid et al., 2011). A subsequent article based on the Livewell project provides an example of action points based on an analytical approach to meeting nutritional adequacy and healthy environmentally sustainable consumption for the UK (Macdiarmid et al., 2012).

Work undertaken as part of the study of the Mediterranean Diet and reported in the FAO/ Bioversity International (2012b) publication on Sustainable Diets highlights both the complexity and need for action. A recent Discussion Paper from the CIHEAM group collated an extensive list of over 60 indicator categories from four thematic areas (CIHEAM/FAO, 2012). The combination and interpretation of these indicators requires more work including conceptualization of what the indicators mean, their purpose and the feasibility of operationalizing them for different contexts.

What is clear, however, is that often the composite indices mask more than they reveal. For a measurement system for sustainable diets to be successful, it will require a two-step process of developing a suite or dashboard of indicators that form the basis for a composite score or index. While we strive to develop these composite scores for communication, monitoring and advocacy purposes, the absence of context and detail often

renders the composite score/index less than useful.

In Figure 2, the theoretical spider diagram illustrates four dimensions of sustainable diets including nutritional adequacy, environmental sustainability, cultural acceptability and low cost of urban poor (red) and the rural poor (blue). In this example, the rural poor have a more sustainable diet with higher scores in the four dimensions but each dimension could be better. It is assumed that these four dimensions have several indicators that measure specific determinants and are weighted. Scores from 0 to 6 have been hypothesized, with the higher the number being a better score. The target, in blue, is scoring higher in all four dimensions and the give and take of urban versus rural poor is emphasized or deemphasized within each dimension. This model is based on the multidimensional poverty index.

Priorities and Recommendations for Action

The UK Sustainable Development Commission (2009) suggested that there are areas of positive impact on the environment including: reducing meat and dairy consumption, reducing consumption of food and drink of low nutritional value, and reducing food waste. There were also recommendations to increase the consumption of seasonal, field grown fruit and vegetables, consume fish from sustainable stocks, and increase consumption of foods produced organically, however these recommendations are contentious and the evidence



remains unclear or incomplete.

In a similar vein, the Chicago Council (Nugent, 2011) suggested the following recommendations: reduce stunting, achieve balance in consumption of animal based foods, increase access to fresh fruits and vegetables, provide for nutritional needs of target groups consistent with food availability and life cycle health risks.

The Foresight Project (2011) has clear actions for policymakers that impact diets. These include: spread best practices, invest in new knowledge, make sustainable food production central to development, work on the assumption that there is very little new land for agriculture, ensure long-term sustainability of fish stocks, promote sustainable intensification, include the environment in food system economics, reduce waste, improve the evidence base upon which decisions are made and develop metrics to assess progress, anticipate major issues with water availability for food production, work to alter consumption patterns, and empower citizens.

The direction and motivation for these recommendations continues to challenge us to think beyond the current economic and development models of innovation and agricultural intensification. We need to develop the metrics needed to guide the policy choices outlined above and put measures to some of these recommendations and priorities, similar to what was done with the Millennium Development Goals and the Multi Dimensional Poverty Index. Recommendations are critically important, but measures, thresholds and targets should be proposed, negotiated and set for goal attaining at the global, regional and at least, country level.

References

Alkire, S. and J. Foster (2011). Counting and multidimensional poverty measurement. *Journal of Public Economics* 95: 476–487

Arimond, M. and MT. Ruel (2004). Dietary diversity is associated with child nutritional status: evidence from 11 demographic and health surveys. *Journal of Nutrition* 134 (10): 2579–2585.

Barilla Center (2009). Double Pyramid: healthy food for people, sustainable food for the planet. Barilla Center for Food and Nutrition. Parma, Italy.

Beddington, J., Asaduzzaman, M., Clark, M., Fernandez, A., Guillou, M., Jahn, M., Erda, L., Mamo, T., Van Bo, N., Nobre, CA., Scholes, R., Sharma, R., and J. Wakhungu (2012). Achieving food security in the face of climate change: Final report from the Commission on Sustainable Agriculture and Climate Change. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org/commission

Blasbalg, TL, Wispelwey, B., and RJ Deckelbaum. (2011). Ecnutrition and utilization of food-based approaches for nutritional health. *Food and Nutrition Bulletin supplement* 32 (1): S4-13.

Carlson, R. (1962). *Silent spring*. Houghton Mifflin, Boston, MA.

CIHEAM/FAO (2012). Towards the Development of Guidelines for Improving the Sustainability of Diets and Food Consumption Patterns in the Mediterranean Area.

CIHEAM International Seminar The Sustainability of Food Systems in the Mediterranean Area: Session 1 Food Systems and Sustainable Diets: The Mediterranean Diet as a Pilot Study. Bari Italy. Accessed on 19 October 2012 at <http://www.fao.org/docrep/016/ap101e/ap101e.pdf>

Clonan A. and M. Holdsworth (2012). The challenges of eating a healthy and sustainable diet. *Am J Clin Nutr*;96: 459–60.

Deckelbaum, RJ, Palm, C., Mutuo, P. and F. DeClerck (2006). Ecnutrition: Implementation models from the Millennium Villages Project in Africa. *Food & Nutrition Bulletin*, 27(4): 335-342.

DeClerck, FAJ., Carter Ingram, J. and C. Rumbaitis del Rio (2012). Introduction to Integrating Ecology and Poverty Reduction (Chapter 1) in: *Integrating Ecology and Poverty Reduction: The Application of Ecology in Development Solutions* (edited by Jane Carter Ingram, Fabrice DeClerck and Cristina Rumbaitis del Rio) Springer, New York.

DeClerck, FAJ., Fanzo, J., Palm, C. and R. Remans (2011). Ecological approaches to human nutrition. *Food and Nutrition Bulletin Supplement* 32 (1): S4-13. De Schutter, O. (2011) "Report submitted by the Special Rapporteur on the right to food, Olivier De Schutter" http://www.srfood.org/images/stories/pdf/officialreports/20120306_nutrition_en.pdf

Eshel G., and Martin, PA. Geophysics and nutritional science: toward a novel, unified paradigm. *Am J Clin Nutr* 2009;89 (suppl):1710S–6S.

Fitzpatrick, TB., Gilles JC., Basset, GJC., Borel, P., Carrari, F., DellaPenna, D., Fraser, PD., Hellmann, H., Osorio, JS., Rothan, C., Valpuesta, V., Caris-Veyrat, D. and AR. Fernie (2012). Vitamin Deficiencies in Humans: Can Plant Science Help? *The Plant Cell*, Vol. 24: 395–414.

Foley JA., Ramankutty, N., Brauman, KA., Cassidy, ES., et al. (2011). Solutions for a cultivated planet. *Nature* Vol. 478: 337–342.

Food and Agriculture Organization of the United Nations (FAO) (2010). The Commission on Genetic Resources for Food and Agriculture (CGRFA) Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture (PGRFA). Rome, Italy. Food and Agriculture Organization (2012a). State of Food Insecurity. Rome, Italy.

Food and Agriculture Organization of the United Nations (FAO)/Biodiversity (2012b). Sustainable Diets and Biodiversity. Barbara Burlingame and Sandro Dernini

(eds). Food and Agriculture Organization and Bioversity International. Rome, Italy.

Foresight (2011). The Future of Food and Farming. Final Project Report. The Government Office for Science, London.

Hoddinott J. and Y. Yohannes (2002). "Dietary diversity as a food security indicator." (Discussion paper 136) International Food Policy Research Institute (IFPRI). Washington, D.C.

HLPE (2012). Climate change and food security. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.

Lang, T. (2010). Crisis? What crisis? The normality of the current food crisis. *Journal of Agrarian Change* 10: 87–97.

Lang, T. and G. Raynor (2012). Ecological public health: the 21st century's big idea? *BMJ* 345:e5466

Macharia-Mutie, CW., Diego Moretti, Natalie Van den Briel, Agnes M. Omusundi, Alice M. Mwangi, Frans J. Kok, Michael B. Zimmermann and Inge D. Brouwer (2012). Maize Porridge Enriched with a Micronutrient Powder Containing Low-Dose Iron as NaFeEDTA but Not Amaranth Grain Flour Reduces Anemia and Iron Deficiency in Kenyan Preschool Children. *J. Nutr.* 142: 1756–1763.

Macdiarmid et al. (2011). Livewell: a balance of healthy and sustainable food choices. Commissioned by the World Wildlife Fund. Available online at: http://assets.wwf.org.uk/downloads/livewell_report_jan11.pdf

Macdiarmid, JI., Kyle, J., Horgan, GW., Loe, J., Fyfe, D., Johnstone, A. and G. McNeill (2012). Sustainable diets for the future: can we contribute to reducing greenhouse gas emissions by eating a healthy diet? *Am. J. Clin. Nutrition.* 96(3):632-9

Micronutrient Initiative (2009). Investing in the future, a united call to action on vitamin and mineral deficiencies, Global Report. Micronutrient Initiative. Ontario, Canada. Millennium Ecosystems Assessment (2009). Available online at: <http://www.maweb.org/en/index.aspx>

Nestle, M. and M. Nesheim (2012). Why Calories Count: From Science to Politics. University of California Press.

Nugent, R. (Chair) (2011) Bringing agriculture to the table: How agriculture can play a role in preventing chronic disease, The Chicago Council on Global Affairs.

PLoS Medicine Editors (2012). PLoS Medicine Series on Big Food: The Food Industry Is Ripe for Scrutiny. *PLoS Med* 9(6): e1001246. doi:10.1371/journal.pmed.1001246
Rayner, G. and T. Lang (2012). Ecological Public Health. Earthscan/Routledge. Available online at: <http://www.routledge.com/books/details/9781844078325/>

Rockstrom, J., Steffan, W., Noone, K., Persson, A., et al. (2009). Planetary Boundaries: Exploring the Safe Operating Space for Humanity *Ecol. Soc.* 14(2)

Rockstrom, J., Steffan, W., Noone, K., Persson, A., et al. (2009). A safe operating space for humanity *Nature* Vol. 461, 472-475.

Rosen R., Meade B., Shapouri S., D'Souza A. and Rada N. (2012). USDA International Food Security Assessment, 2012-22. US Department of Agriculture, Washington DC. Available online at: <http://www.ers.usda.gov/publications/gfa-food-security-assessment-situation-and-outlook/gfa23.aspx>

Sustainable Development Commission (2009). Setting the table: Advice to Government on priority elements of sustainable diets. London.

Thorne-Lyman, AL., Valpiani, N., Sun, K., Semba, RD., Klotz, CL., Kraemer, K. et al. (2010). Household dietary diversity and food expenditures are closely linked in rural Bangladesh, increasing the risk of malnutrition due to the financial crisis. *J Nutr* 140, 182S–188S.

World Health Organization (2012). Available online at: <http://www.who.int/mediacentre/factsheets/fs311/en/>

UNa (2012). The Future We Want. Our Common Vision Document adopted at Rio+20. Available online at: <http://www.un.org/en/sustainablefuture/>

UNb (2012). Zero Hunger Challenge. Available online at: http://un-foodsecurity.org/sites/default/files/EN_ZeroHungerChallenge.pdf

UNEP (2012). Avoiding Future Famines: Strengthening the Ecological Foundation of Food Security through Sustainable Food Systems. United Nations Environment Programme (UNEP), Nairobi, Kenya. Available online at: <http://www.unep.org/publications/ebooks/avoidingfamines/>

USDA (2012). Healthy Eating Index (HEI). Center for Nutrition Policy and Promotion, USDA. Available online at: <http://www.cnpp.usda.gov/healthyeatingindex.htm>

Support for this publication comes from the Daniel and Nina Carasso Foundation and the CGIAR Research Program on Agriculture for Nutrition and Health. For more information, contact Bruce Cogill at b.cogill@cgiar.org. 30 November 2012.

Citation: Fanzo, J., Cogill, B., and F. Mattei (2012). Metrics of Sustainable Diets and Food Systems. Bioversity International, Rome, Italy.



RESEARCH
PROGRAM ON
Agriculture for
Nutrition
and Health

