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We Manage What We Measure: an Agrobiodiversity Index to Help Deliver the Sustainable Development Goals

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Introduction

Over the past century, farmers and breeders have used genetic diversity to breed high-yielding varieties. The Green Revolution brought new varieties and production methods to developing countries, with significant results. The number of undernourished people diminished from 35% in 1969-71 to 15% in 2010 (FAO, 2011), while global production of major crops increased dramatically, particularly in developing countries, where production went from under 1 billion tonnes to over 27 billion tonnes (idem).

However, these achievements have come at a price. The estimated limitations for keeping the planet safe have been exceeded for two boundaries which are closely related to the effects of modern agriculture: loss of genetic diversity and biochemical flows of phosphorous and nitrogen (Steffan et al., 2016; Rockström et al., 2014).

The second price was that – while the production of major crops increased – nutrition was largely left out of the equation. Today, six of the top 11 risk factors (such as child and maternal malnutrition, high blood pressure, high body mass index and high cholesterol) driving the global burden of disease are related to diet (Global Burden of Disease study 2013, in Global Hunger Index 2014). Around 800 million people suffer from insecure food supplies, nearly 2 billion people are obese or overweight (WHO, 2014; FAO: The State of Food and Agriculture, 2014). At the same time, 2 billion people lack essential vitamins and minerals critical for growth and development, such as vitamin A, iron and zinc (FAO, 2013 it is important to note that often these forms of malnutrition co-exist. In South Asia, the prevalence of wasting among children – at almost 15% – is so severe that UNICEF has declared that it is approaching the level of a critical health problem. Stunting among children in the region has decreased by 37% since 1990, but is still the highest in the world at 63 million. Overweight has risen 120% among children since 1990 – now the second highest in the world.

The third price we paid for the achievements of the Green Revolution was a narrowing of the genetic diversity in our production systems which in turn led to a narrowing of our global diet. From the 391,000 documented plant species, 5,538 have been counted as human food (Royal Botanic Gardens Kew, 2016). Out of these, just three – rice, wheat and maize – provide more than 50% of the world's plant-derived calories.

Our global diets are becoming more homogenized with declining intake of nutritious pulses, fruits and vegetables, (Khoury et al., 2014). The on a global level the production of fruit and vegetables, nuts and seeds falls about 22% short of nutritional needs of the population (Siegel *et al*., 2014). Shortfalls of these nutritious crops are even higher in developing countries. On the other hand, globally we are overproducing meat, while meat production falls short in many developing countries, including in South East Asia (idem).

Sustainable Development Goals

Global leaders created the Sustainable Development Goals because they recognized that the challenges facing our world could not be tackled by developed or developing countries alone, nor by national governments and international agencies alone. Last year, the leaders of all 193 countries of the United Nations signed the Agenda 2030, committing themselves to achieving 17 Sustainable Development Goals (SDGs). The SDGs recognize that global problems are interconnected, and that considering only one problem at a time – for example, looking at food without considering nutrition or sustainable production systems – is no longer an acceptable way forward.

We need to find solutions which find synergies between different sectors so that we can feed the world (SDG 2), while addressing malnutrition (SDG

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3), promoting sustainable production and consumption (SDG 12), adapting to the demands of climate change (SDG 13), and protecting the natural resource base on which all else depends (SDG 15).

Putting Options Back on the Table

In this paper we outline one way to do this – by taking a more systemic look at the elements and activities that interact to provide our food. Food systems are a critical agent of a world transition to global sustainability. At the moment we are 'locked in' to a model of agriculture (IPES Food, 2016), which is both responding to and creating homogenized diets. The narrowing of our diets has also reinforced the narrowing of global research in the vast diversity of crops, leading to reduced interest in improving, commercializing and conserving this diversity. This in turn has led to fewer varieties of seeds on the market in many countries. As a result, farmers have fewer options which closes the cycle back to increasingly homogenized agriculture. It is difficult to break this feedback loop: but current measures – such as yield per hectare, calories produced, percentage of land under modern varieties, number of accessions – do not take the other goals, such as nutrition or resilience or climate adaptation into account. (IPES-Food, 2016).

New metrics are needed that can meaningfully juxtapose dimensions of agricultural biodiversity: nutritious, diverse diets; productive and resilient farms and landscapes; farmers' access to quality, diverse seeds; conservation of agrobiodiversity for current needs and future options. Bioversity International is creating an index, the Agrobiodiversity Index, with this aim in mind.

There is an urgent need to find a way to measure and understand biodiversity in a quick, rapid and less expensive way; we need to go beyond just numbers and influence policymakers' and private sector's actions and decisions on best practices to foster diversity. Expected benefits are to be able to identify and steer opportunities for change towards sustainable food systems, and to be able to better measure and manage progress towards global targets such as the Sustainable Development Goals and the Aichi Biodiversity Targets of the Convention on Biological Diversity. Private companies and finance institutions are also interested in its applicability to measure the sustainability of investments, green bonds and company purchasing policies.

Of the huge, and growing, number of existing datasets collected at different scales across different dimensions, we ask: How to choose those to use in the Agrobiodiversity Index? Which are the salient aspects that need to be measured and compared? For food production we ask: how does agricultural biodiversity add simultaneously to the resilience, productivity and low environmental impacts of food production? For food consumption we ask: how does agricultural and wild biodiversity contribute to healthy, diverse diets? The third dimension asks: how are seed systems organized and supported to deliver the diversity needed for production and consumption? Finally, the fourth dimension asks: How to make sure that a wide enough pool of agricultural biodiversity remains available to serve today's production and consumption needs and those that will arise to cope with changing demands of climate, land integrity and human nutrition?

Within each dimension, we scanned the scientific literature to identify evidence for the most salient aspects of each dimension with respect to agricultural biodiversity.

For consumption of healthy diverse diets, we brought together the scientific evidence that links using food biodiversity to diversification of diets to improved nutrition. We looked at both consumption via own production (or collected from the wild) and food purchases in markets and at the role agricultural biodiversity can play in improving year-round nutrition.

For resilient production systems, we examined the pathways through which agricultural biodiversity drives critical ecological processes (e.g. soil structure maintenance) and allows a landscape simultaneously to provide multiple benefits to people (e.g. nutritious foods, income, natural pest control, pollination, water quality.

We also brought together the uses of agricultural biodiversity to increase resilience to farms, communities and landscapes; and how using it more effectively and more sustainably can help to maintain and increase the flow of services and benefits that agricultural biodiversity provides to communities.

For seed systems, we reviewed the five key functions of seed systems – facilitating access, production and distribution, innovation, regulation and conservation – and examined the evidence for how more diversified seed systems can enhance sustainable food systems.

We assessed what we know about the role policy and regulation can play in ensuring farmers have access to the options they need.

For conservation, our research indicates that many potential benefits of agricultural biodiversity to sustainable food systems are not realized because of poor conservation, lack of information and inadequate or restrictive government policies. We explored the evidence for successful conservation schemes, which safeguard the genetic diversity in places where it has evolved, backs it up in *ex situ* facilities for posterity, and makes it readily accessible and available for use.

In each of these four areas, we not only examined the relevant scientific literature, but we also evaluated the various metrics used in each area, identifying which are efficient and effective measures of agricultural biodiversity. An assessment of the evidence and available metrics provide a starting point for identifying indicators for the Agrobiodiversity Index, which will be tested and validated throughout 2016 and 2017. A resulting book, forthcoming in 2017, will provide an overview of evidence which scholars and practitioners alike will find useful in our joint quest to use agricultural biodiversity in food systems that are sustainable.

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