iPES FOOD

INTERNATIONAL PANEL OF EXPERTS
ON SUSTAINABLE FOOD SYSTEMS

THE NEW SCIENCE OF SUSTAINABLE FOOD SYSTEMS

Overcoming Barriers to Food Systems Reform

MAY 2015

Introduction

Over recent years, and particularly since the global food price spikes of 2007-2008, the scientific and policy communities have trained their attention on multiple problems within global food systems. These range from persistent undernutrition to burgeoning obesity rates, from land evictions to agriculture's soaring environmental footprint, from dwindling fish stocks to mounting food waste. Not only have political initiatives proliferated in response to these challenges, but so too have the expert panels, scientific assessments and research projects aiming to generate knowledge about these problems. However, despite the mobilization of the political and scientific communities around various food systems issues, the task remains incomplete. There has been a tendency to address the problems as individual pieces of the puzzle, and to overlook the power relations that play a major role in shaping these systems. And crucially, the knowledge of those affected by food systems problems has not been fully harnessed in framing the problems and diagnosing the solutions.

The challenge, therefore, is to produce a joined-up picture of food systems and their political economy, and to do so in ways that reach across the scientific disciplines, and reach beyond the traditional bounds of the scientific community. The opportunity to generate robust food systems knowledge around a nexus of science, policy and practice must now be seized. To accelerate the shift towards sustainable food systems, a new science of sustainable food systems is needed. This paper traces out the contours of a new analytical framework for sustainable food systems (Section 1). It then describes the principles of transdisciplinary science that must be applied in order to generate the types of knowledge that can support the transition to sustainable food systems (Section 2). Finally, it considers previous and ongoing attempts to address sustainable food systems at the interface of science, policy and practice, in order to identify where initiatives have succeeded, where challenges remain, and how these energies can be harnessed and combined to support the transition to sustainable food systems (Section 3).

01 A new analytical framework for sustainable food systems

The sustainable food systems framework proposed here enables an understanding of specific food systems problems as the component parts of wider systemic problems, and as functions of particular logics and dynamics running all the way through a food system. Such a framework can help to identify synergies and leverage points for implementing solutions aimed at strengthening the resilience and sustainability of food systems as a whole. This analytical lens seeks to illuminate the following aspects:

- Webs of complex interactions and feedback loops in food systems;
- Broad constellations of policies with the capacity to affect food systems;
- Power relations and the political economy of food systems;
- A multi-scale and holistic understanding of sustainability, as the benchmark of food systems reform.

1.1 WEBS OF COMPLEX INTERACTIONS, SYNERGIES AND FEEDBACK LOOPS

A discussion of *food systems* refers to the **web of actors, processes, and interactions** involved in growing, processing, distributing, consuming, and disposing of foods, from the provision of inputs and farmer training, to product packaging and marketing, to waste recycling. A holistic food systems lens is concerned with how these processes interact with one another, and with the environmental, social, political and economic context (Ericksen et al., 2014). **The food systems lens also brings to light reinforcing and balancing feedback loops, tensions between the different components and flows of food systems, and interactions that are cyclical, multilayered and multi-scale.** It is a way of thinking about the world that seeks to identify the linear and non-linear relationships between the different components of the system.

> For example, the decision by a supermarket to stock corn-fed chicken would typically be explained in terms of price signals: expanding selling opportunities due to consumer demand for this product line ***downstream***, and relatively low commodity prices ***upstream***. However, these elements cannot be neatly separated from one another when a whole web of interactions and feedback loops are considered. For example, **consumer demand is affected by price incentives, and consumers are not encouraged to think about the impacts of their choices as *taxpayers***, for whom the social and environmental impacts of industrial farming methods will ultimately be costly.

Moreover, the firms moving to respond to this 'demand' may in fact have played a crucial role in *cultivating* such demand in the first place, e.g. through **marketing campaigns** about the benefits of corn-fed chicken, or by **producing surpluses** of corn that must be offloaded. From a food systems perspective, price signals are still a driver of interactions between the different actors in this web, but simplistic dichotomies fall away. **Decisions cannot be neatly categorized as *demand-driven* or *supply-driven*; actors at the center of the web may influence what occurs *upstream* and *downstream*** – or at different outlying parts of the web - rather than merely responding to exogenous signals.

1.2 BROAD POLICY CONSTELLATIONS

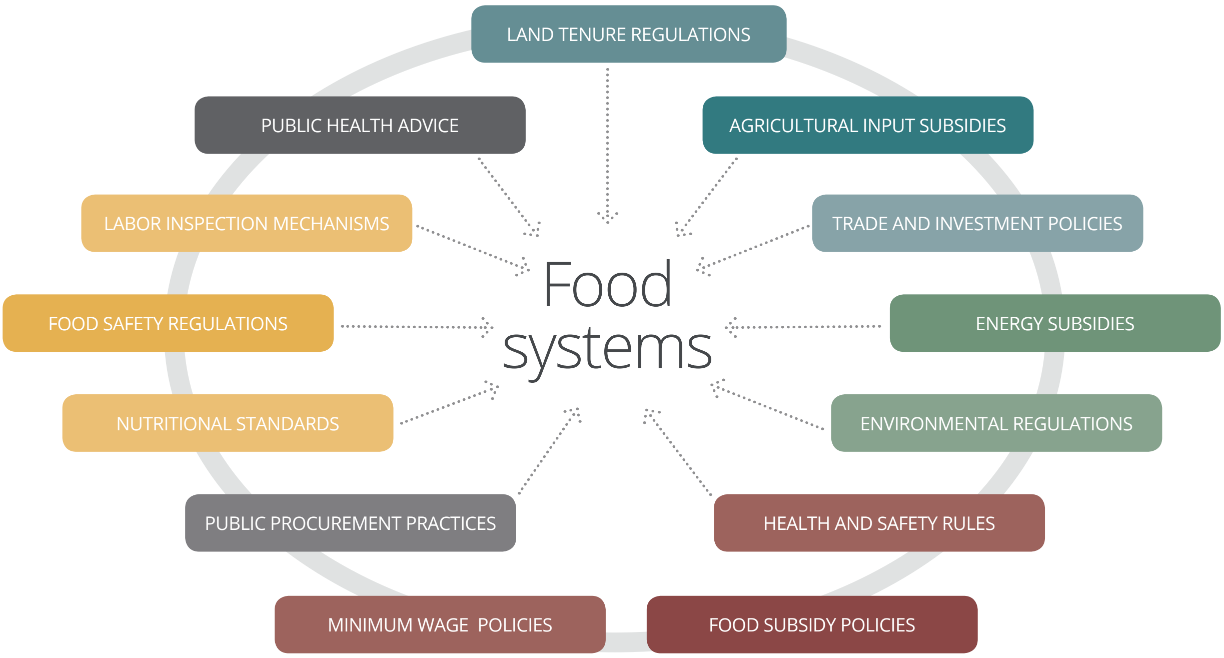
Food systems refer not only to market transactions, but also to the web of institutional and regulatory frameworks that influence those systems. The question of government intervention must no longer be treated as a limited set of exogenous influences that can simply be turned on and off with predictable effects.

From a food systems perspective, the types of policy intervention in question extend far beyond grain stockholding or setting agricultural price floors. A whole host of other policy domains must be accounted for: agricultural input subsidies, trade and investment policies, occupational health and safety rules and labor inspection mechanisms, nutritional standards, land tenure regulations, energy subsidies, environmental regulations, public procurement practices, food safety regulations, social policies to provide subsidized food to poor communities or guarantee minimum wages to farmworkers, and different ways of informing and influencing consumer behavior.

> Returning to the example used above, if the chicken is packaged and sold as individual fillets, this may be because plastic packaging can be used plentifully due to energy policies that subsidize fossil fuel extraction, or because of health advice about light and dark meat that has influenced consumer habits. Furthermore, the decision by a processor to focus its operations on chicken fillets may be influenced by low trade barriers and differential food safety rules that allow cheaper cuts of the chicken to be sold in some countries and not others, while these perceived preferences among processors and retailers may drive farmers' choices to raise particular breeds of chicken under particular conditions.

The potential for constellations of policy incentives to fundamentally reorient production patterns is perhaps most clearly reflected in the emergence of **'export commodity' sectors** in various regions and countries, in response to **trade openings** and **export-led agriculture policies**.

Some of the potential policy influences on food systems



The regulatory frameworks surrounding **food safety**, and the consumer concerns underpinning them, are another key factor in shaping contemporary food systems. At the beginning of the 20th century, in Western Europe, food and water poisoning (bacterial or chemical) was a major cause of mortality (See for instance Satin, 2007). Improved hygiene, technologies and medicine have all but eradicated theses pathologies in the most affluent countries. Yet they remain a major source of concern in large parts of the world, with additional risks from misuse of modern processed foods (infant formulas, frozen foods, etc). Meanwhile, consumers in the global North are increasingly anxious about additives, preservatives and 'chemicals in food' (Gaskell et al, 2011). The distrust of consumers toward food producers and food regulators, and the political and regulatory responses to that distrust, are therefore key factors in establishing dynamics within modern food systems, and must be central to a holistic food systems analysis.

1.3 POLITICAL ECONOMY AND POWER RELATIONS

Power imbalances, often stemming from economic inequalities, are also a key factor in the way food systems operate. Power relations at the **intra-household** and **community level**, and particularly those formed along gender lines, can be just as crucial as economic factors in determining the way that food systems function. The entitlements approach (Sen, 1999) transforms the question of access to food from a purely technical question, to be addressed with the tools of economics or agronomical science, into a political question, in which social justice, accountability and non-discrimination take centre stage. Power imbalances must therefore be brought to light if we are to move beyond the assumptions, for instance, that individuals will access sufficient food at a given household income level; that health and nutrition advice provided in schools will reach girls and boys equally; or that people will be able to make genuinely independent choices to adopt one set of farming techniques and technologies over another.

The power held by private corporations is also a key factor in establishing dynamics within food systems, and influencing the governance of those systems. Growing concentration in the agri-food sector over recent decades has put increasing power in the hands of large agribusiness firms, whose networks span multiple countries and continents. Food systems analysis must acknowledge the resulting shifts in the locus of power and decision-making, from **farmers** to **retailers** and **traders**, and from the **state** to the **corporate entities** whose power within the food supply chain and intergovernmental policy regimes is growing (Lang and Barling, 2012). When up to 90% of the global grain trade is controlled by four agribusiness firms (Murphy et al., 2011), a change in sourcing policy by a big player may become de facto regulation across the sector.

Powerful actors can also influence the direction of policy in other ways. **Over recent decades, the focus of agriculture and food policy in many countries has been to encourage producers to deliver large volumes of commodities for global supply chains, an approach that responded to the incentives created by international trade and investment policies.** The multinational agribusiness firms that have thrived under these conditions have also played a key role in maintaining them, e.g. by using their increasing economic power to lobby policymakers to pursue trade policies that bring them economic benefits (Holt-Giménez and Shattuck, 2011). These power relations can be consolidated by a set of more **indirect influences** exerted on decision-making by private actors, e.g. through **political campaign donations**, or by funding **research, teaching** and **public outreach programs** that encourage particular research and development pathways, or particular ways of framing the question of food systems reform. This may explain the prevalence of export-led agricultural policies around the world, despite the fact that around 85% of food is grown and consumed in the same country or eco-region (ETC Group, 2009). Agribusiness firms are not the only actors capable of exerting these influences, of course. Over recent years, **philanthropic foundations** have taken on an increasing role in spearheading and financing a range of initiatives, political forums and knowledge processes surrounding food systems (McGoey, 2014).

These examples illustrate three challenges facing food systems reform. **First, the different components of modern food systems have co-evolved so as to become mutually reinforcing: each component is difficult to reform alone, and collectively, these intertwined and entrenched interests represent an increasingly powerful roadblock to reform.** For instance, **export-oriented policies** led by governments have both encouraged and been stimulated by the **bulk production of major tradable commodities**; and the major players dominating the system often appear to have gained an ability to either block or absorb any emerging alternative.

A second challenge concerns the task of food systems analysis itself. Such analysis should bring to light the diverse and differential influences of actors on decision-making – **the political economy and knowledge politics** of food systems. It should therefore move beyond simplistic dichotomies between the **governors** and the **governed** of food systems, or between holders of **economic** and **political power**. The power relations lens reinforces the need to train our attention on food systems as a whole, and on the broader political and economic systems in which they are embedded, in order to capture the webs of self-reinforcing power and influence that create **systemic dynamics** and **systemic lock-ins**. These factors should not merely be seen as inconvenient obstacles to robust economic modelling of food systems. Rather, **detailed assessments of the power relations, the knowledge politics and the political economy of food systems, from the national to the global level, must take center stage**.

The third challenge concerns the difficulties in engaging the actors currently holding dominant positions in the food systems in this transformative process. Can these actors be brought into the science-policy process without their power being used to set the terms of analysis, and to narrow the analytical lens onto a more compartmentalized set of questions? **Moreover, can seed, agrichemical and agrifood corporations, as well as the large retailers, viably be engaged in re-imagining a future where business might be sustained, rather than exponentially expanded to meet shareholder profit demands, and where assumed market and scale efficiencies may need to be questioned?** These questions must be asked in order to ensure that engagement with powerful actors is undertaken in ways that do not perpetuate current power imbalances, but instead allow them to be challenged in critical and constructive ways.

1.4 A MULTI-SCALE AND HOLISTIC UNDERSTANDING OF SUSTAINABILITY

Sustainability must serve as the benchmark for food systems reform, and to reflect the nature of food systems, it must be defined at the appropriate **scales** and **dimensions**. First, sustainability should not simply be assessed by taking into account the contribution of food systems to **global warming** or the crossing of **planetary boundaries** (Rockström et al., 2009), but should also be observed at the **sub-global levels**, where changes may occur that affect global equilibria (Steffen et al., 2015). For instance, food systems collectively -- considered at the global level -- account for about one third of total man-made greenhouse gas emissions: **field-level practices** represent approximately 15 per cent of this total, in the form of nitrous oxide (N2O) from the **use of organic and inorganic nitrogen fertilizers**, methane (CH4) from flooded rice fields and livestock, and carbon dioxide (CO2) from the **loss of soil organic carbon in croplands** and, due to intensified grazing, on pastures; in addition, the production of **fertilizers, herbicides** and **pesticides**, the **tillage**, **irrigation** and **fertilization**, and the **transport**, **packaging** and **conservation** of food require considerable amounts of energy, resulting in an additional 15 to 17 per cent of total anthropogenic greenhouse gas emissions attributable to food systems (Vermeulen et al., 2012; HLPE, 2012). Those impacts are important to measure, and to understand, in order to drive reforms towards modes of food production and consumption that mitigate climate change.

Other environmental impacts of food systems, however, should be assessed at different geographical scales, and often at the regional scale of the 'foodshed'. For instance, the impacts of **shifts in land-use** on the biophysical climate regulation is to be considered at the level of **forest biomes**, and the use of freshwater by agricultural systems affects major **river basins** in different world regions, with impacts on sustainability that are therefore not simply to be ascertained at the global level (Steffen et al., 2015).

Second, the sustainability of food systems should extend beyond environmental dimensions. **The 'sustainable diets' concept now emerging at the global level points the way towards the type of holistic definition that is sensitive to these dimensions.** At the International Scientific Symposium, *Biodiversity and Sustainable Diets*, held on 3-5 November 2010 at the FAO Headquarters, sustainable diets were defined as "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, 2010). Many of these dimensions cannot be objectively observed. **What constitutes an optimal and equitable use of resources, or a culturally acceptable dietary offering, requires a normative assessment that must be subject to deliberation** (see Section 2). This process can ensure that a requirement of ***political sustainability*** - the legitimacy of the governance of food systems and of the policies that guide them – is met alongside the dimensions of **economic, social** and **environmental sustainability**, as envisaged by the Brundtland Report (Brundtland, 1987).

02 The new transdisciplinary science of sustainable food systems

If a new analytical framework for sustainable food systems is to be employed, how should such an analysis proceed? **To train our attention on food systems as a whole, and to devise broad benchmarks for sustainability, the boundaries dividing scientific disciplines from one another must be dismantled. Furthermore, the siloes around knowledge itself must be definitively removed.** If we are to redress power imbalances, and forge agreement around concepts such as sustainability, efforts must be stepped up to ensure that knowledge is co-produced with social actors.

- Dismantle boundaries between the disciplines
- Remove siloes around knowledge
- Co-produce knowledge with social actors

Indeed, the knowledge generated and held by **farmers, fishers, forest-dwellers, food industry workers, cooperatives, consumer groups, civil society movements, indigenous populations** and a whole range of other practitioners is one of the greatest untapped resources in the quest to reform food systems. **What is needed is not merely a transmission of knowledge from scientists to policymakers, but rather a multi-directional flow of knowledge between the worlds of science, policy and practice, with each part of this nexus informed by the other two.** This means building on the positive developments towards *transdisciplinary science* that have emerged over recent decades (Jahn et al., 2012).

Previously, the scientific knowledge generated within academic disciplines was presumed to allow experts – clearly distinguished from social actors - to understand the problems those actors encountered. Their methodologies were based on the assumption of a physical world understood in Newtonian terms, with fixed and predictable causal relationships. The path from research to policy and practice was unidirectional, and the findings were considered universally applicable. However, these approaches have been prised open in recent decades, with a growing emphasis placed on working across the disciplines. Even more importantly, **scientists have realized the need to work in close collaboration with social actors, and to rely on the specific kinds of knowledge that such actors embody.**

> In the fields of agriculture and rural development, pioneering approaches such as the **Participatory Rural Appraisal** (PRA) placed a new emphasis on data processing 'on site', by researchers working in conjunction with those whose livelihoods were being appraised (Chambers, 1994). Meanwhile, attempts to understand complex social-ecological systems, and to measure the extent to which **human activities** can affect **existing balances within ecosystems** - what P. Crutzen has dubbed the emergence of the **"anthropocene"** (Crutzen 2002) - have defied traditional scientific approaches, spurring new forms of collaboration. Insights from the **social sciences**, e.g. on social norms, the complex motivations of individual and institutional actors, and path dependencies in policies, have increasingly featured alongside the biophysical and chemical data of **natural scientists** in attempts to trace out pathways to sustainability and resilience – henceforth understood in **ecological** *and* **social** terms (Adger, 2000).

The challenge is now to apply these approaches systematically to the analysis of sustainable food systems elaborated in Section 1, in order to forge a new *transdisciplinary science of sustainable food systems* that fully taps the innovation and knowledge emanating from the world of practice. This methodological transition is key for five reasons in particular:

→ Single discipline approaches are inappropriate for social-ecological systems.

Emerging transdisciplinary approaches are a way of linking different sources of knowledge to one another in order to better acknowledge the **complexity of social-ecological systems** (Kasemir et al., 2003; Scholz 2011). This approach is particularly apt in relation to food systems due to the combination of factors -- **natural, institutional** and **regulatory**, and linked to **individual choices** and **socio-cultural relations** -- that play a role in shaping such systems. Social-ecological systems require social scientists -- economists, political scientists and sociologists -- to collaborate with agronomists and biophysical scientists to provide an adequate description of today's challenges. **Crucially, they also require scientists to collaborate systematically with social actors beyond the traditional bounds of knowledge-creation, whose actions and choices shape these social-ecological systems.**

→ Normative benchmarks and ethical choices cannot be defined by scientists alone.

Scientists can identify the human consequences of certain development pathways; they can **compare scenarios**; and they can identify **ecological tipping-points**, beyond which non-linear and unpredictable developments will occur. However, the normative valuation of these various development pathways, and the significance for policy-making of risk and uncertainty, require a grounding in ethical foundations that must be commonly reached with social actors.

> For instance, whereas much emphasis has been placed in recent years on the need to increase agricultural production in order to cope with growing demand, other voices call for reducing wasteful consumption and inefficiencies in the food system, and for limiting the competition for land use. In some cases there are clear trade-offs to be made: in low-income food-deficit countries for instance, policymakers may face a dilemma between securing **access to food at a low price** for end consumers via imported foodstuffs, themselves subsidized by affluent countries' taxpayers, or providing the right incentives for **local food producers** to invest and **sell on local markets**.

Throughout most of the 1970s and 1980s, this dilemma often led governments anxious to ensure their political stability to prioritize the needs of the urban populations: this is what M. Lipton famously called the **"urban bias"** (Lipton, 1977). Similarly, under current market conditions, highly divergent pathways may present themselves to policymakers with equal urgency, according to the different logics and values underpinning them. For example, governments may face a dilemma between supporting larger and smaller production units. The former purportedly delivers the requisite **economies of scale** in order to meet the demands of **global supply chains**; the latter may satisfy **other metrics of efficiency** (e.g. nutrient production per unit of land) and be better-placed to adopt **environmentally resilient** agroecological techniques.

Such dilemmas can sometimes be addressed by adequately **sequencing** efforts, for instance by gradually reducing dependency on imports while simultaneously investing to strengthen the potential for domestic food production. Alternatively, they can be tackled through the **coordinated combination of different reforms**, e.g. by combining the internalization of social and environmental costs of conventional agriculture with social policies to protect the purchasing power of poor households. However, this alone will not suffice. **The setting of normative benchmarks will often be inevitable, and must not be done on the basis of evidence produced by scientists acting alone. Instead, it must stem from a process that reaches out systematically beyond the scientific community to encompass various competing visions of *what the problem is*, as well as engaging in joint deliberation on how to rank preferences and prioritize different values.**

As explained in Section 1.4, **the concept of *sustainability* must itself be fleshed out through collaborative efforts in order to reach a strong, collective vision of sustainable food systems to serve as the ultimate goal of reform proposals**. Furthermore, this process may not lead to a single view establishing primacy. A key part of this social deliberation may be to accommodate **different *versions* of sustainability** that prioritize different dimensions and specific qualities of ecological integrity, social equity and health, in accordance with particular contexts and the priorities of different social groups (Leach et al., 2010).

➔ Methodologies embody specific assumptions that must be subject to deliberation.

The choice of scientific methodologies is guided by certain implicit assumptions that scientists rely upon. These must be considered in the context of the knowledge politics described in Section 1.3, whereby powerful actors can impose their own preferred methodological framing as the norm. ***Methods of calculation*** that might have been self-evident in the past are increasingly seen as embodying choices that are political and ethical: the assessment of global rates of undernourishment (Lappé et al., 2013) or the measurement of agricultural outputs (Carletto et al., 2011), for instance, have become highly controversial. ***Conceptions of sustainability*** also are rife with such choices. Exercises such as modelling the average sustainable ecological-resource footprint per capita entail political and ethical decisions such as how to challenge the over-consumption of the rich while allowing the poor to escape their state of under-consumption, and whether animals should be considered as a resource, or as agents deserving of their own resource share (Dedeurwaerdere, 2014).

Furthermore, the ***building of scenarios*** involves a range of assumptions. For instance, economic modeling typically assumes rational-economic thinking aimed at utility maximization, all too often ignoring other crucial factors for explaining human behavior: **social norms and habits**, **beliefs rational and irrational**, biases and **heuristics in reasoning**, variable attitudes towards **risk**, and concerns of **relative not absolute status**. Analysis should take into account the full range of motivations of actors, rather than presenting an oversimplified view of their reasons to act, if it is to provide reliable indicators of what effects might ensue from the introduction of new incentives.

Scientists must therefore make explicit the assumptions and ethical choices embodied in the methodologies they choose, allowing these to be challenged and subject to deliberation. And as we move from findings of fact to prescription, it is especially important to involve the viewpoints of the actors concerned, to ensure that such prescriptions will be both **informed by real-life experience** and **legitimate**.

➔ Proposals must be based on context-specific and adaptive knowledge in order to succeed.

Policy proposals and the scientific evidence underpinning them will only be relevant to the needs of reform if they fully take into account the contexts in which they are meant to be implemented. However, these contexts are both diverse and changing. Therefore, the representation of reality on which policy proposals rely should be open to challenge through deliberative processes. The goal should not be to narrow down to a single agreed representation of reality, given the inevitable plurality of views, and the benefits of keeping this diversity of viewpoints alive. Indeed, the knowledge most useful for sustainable and resilient food systems must be ***resilient*** itself, in that it can be tested and adapted for multiple, evolving local circumstances (Anderson, 2015).

The relevance and legitimacy of any assessment of food systems therefore depend on the establishment of processes including ***mechanisms for self-correction***, i.e. feedback loops allowing for policy revision that can be activated by social actors when unintended and undesirable consequences of existing policies are perceived. The form of scientific rigor that should be aspired to is one that results from each perspective acknowledging its own limitations, and the need to be complemented by other perspectives in an iterative mode of knowledge production.

Moreover, any policy proposals derived from food systems analysis will only be successfully implemented if they are perceived as **legitimate** and **feasible** both by those to whom they are addressed, and by the intended beneficiaries. Such legitimacy in turn depends on the **context-specificity** of the proposals, and the **involvement in shaping them** of those who know that context best. It also depends on such proposals addressing not only the **symptoms**, for instance high rates of stunting among children or growing incidence of obesity, but also the **causes** of the problems identified, including in particular the political economy of food systems (see Section 1.3). **In short, legitimate policy proposals must go beyond 'quick fixes' in order to lead food systems to a sustainable trajectory, and must be underpinned by scientific processes that involve social actors both *ex ante* and *ex post*.**

➔ Social actors hold unique knowledge that can catalyze change.

Involving actors from outside the traditional bounds of the scientific community in devising food systems reform is essential, in order to tap the experiential knowledge that scientists may not hold. **Agroecology provides a striking illustration of why this matters, and of how different forms of knowledge can be combined.**

> A wide range of agroecological practices that scientists now study and endorse are based on traditional practices in agricultural societies, refined over generations. Similarly, knowledge of which policies are likely to be effective in promoting workers' rights is held by practitioners who have spent decades in this arena; ignoring their perspectives may overlook the best options available.

Furthermore, research conducted in conjunction with social actors as equals (e.g. participatory action research and on-farm research) is more likely to catalyze changes in practice, because such research will result in the co-construction of solutions by scientists adopting an "external" perspective, and social actors who possess a unique "experiential" knowledge from within the system. **Leaving out social actors in the stages of framing, conducting, and analyzing research means leaving untapped the potential of the knowledge they possess; and it means limiting the transformative potential of that research.**

Until new, transdisciplinary scientific practices develop further, science, policy and practice will continue to inhabit worlds apart: policy-makers and social actors will continue to compete for legitimacy, both will continue to ignore warnings from the scientific community, and scientists will continue to deplore that their prescriptions fall on deaf ears. Food systems reform requires not only the coming together of different natural and social sciences for an improved understanding of food systems as complex social-ecological systems, but also advancing novel participatory assessment and research approaches leading to a co-production of knowledge.

The respective roles of scientists and of social actors are not to be confused, of course. Co-construction of problems and of solutions should not blur the boundaries between various sources of knowledge. What is required is synergy and complementarity, rather than a fusion of perspectives. What emerges must be a science that documents the array of innovations arising from real-life practice, enriches these examples with scientific experimentation and insight, and transposes that knowledge into policy-relevant forms. Bringing the worlds of science, policy and practice together in this way allows the knowledge of farmers and other practitioners to be fully tapped. It yields problem framings and normative visions that reflect negotiated political and ethical choices. And it allows policy proposals to be identified that are both relevant and perceived as legitimate.

03 Knowledge revolutions and persistent paradigms: surveying the landscape of food systems initiatives

The landscape of scientific initiatives aimed at supporting the transition to sustainable food systems has developed considerably over recent years, no doubt in response to the multiple pressing challenges these systems are facing. However, these initiatives vary widely in the extent to which they address food systems as a whole, rather than focusing on specific segments. There is also a wide spectrum in terms of their openness to different actors, framings and sources of knowledge, and therefore their scope for establishing a genuine interface of science, policy and practice.

Table 1 groups together a series of science-based initiatives engaged in producing or spreading knowledge with relevance to food systems. We categorize these initiatives firstly (vertical axis) in terms of the specific **policy areas** and **disciplines** they are focused on, and secondly (horizontal axis) according to their different **organizational forms**. However, this categorization is loose, and is not intended to imply a strict typology for food systems initiatives. Purely national initiatives, and single university research institutions, are not included in this sample. Nor are primarily *political* initiatives such as the Millennium Development Goals and Sustainable Development Goals, the Zero Hunger Challenge or the Scaling Up Nutrition initiative, given that the discussion below is primarily concerned with research and knowledge creation.

TABLE 1. (p.13)
Initiatives establishing a science- policy-practice interface for food systems reform

**ESSP includes the four major global environmental change programmes: Diversitas, the International Geosphere-Biosphere Programme (IGBP), the World Climate Research Programme (WCRP) and the International Human Dimensions Programme on Global Environmental Change (IHDP)*

3.1 TOWARDS A NEW POLITICS OF KNOWLEDGE

There are clear signs that new and encouraging dynamics are emerging among these initiatives, particularly in terms of open and participatory methods. In 2008, following six years of work across a multistakeholder platform, the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) examined the impacts of agricultural knowledge, science and technology on the reduction of hunger and poverty, the improvement of rural livelihoods and human health; and equitable, socially, environmentally and economically sustainable development. Questions of nutrition, livelihoods and human health were included within the multi-thematic framework on the basis that food production is embedded in processes of **social and economic differentiation, trade regimes** and other factors shaping the conditions faced by farmers (Scoones, 2009).

One of the most remarkable characteristics of the IAASTD process is that it sought to accommodate different actors, framings and sources of knowledge in transdisciplinary spirit, starting from the creation of a multi-stakeholder bureau. It achieved genuine openings in terms of the design, process and results, placing equal emphasis on local/traditional knowledge and formal research (Dedeurwaerdere, 2014; Scoones, 2009). This process was highly experimental, entailing a divergence of views not only on the specific solutions needed, but also on the type of solutions and type of methods that would be needed to encompass them (Scoones, 2009). It was designed to address and accommodate competing frames, and to prevent one side of the argument from appropriating the 'science' label for itself.

Furthermore, concerns about the inclusiveness of **economic scenario modelling** were

TABLE 1

	EXPERT PANELS & COMMITTEES	SCIENTIFIC ASSESSMENTS & ASSESSMENT BODIES	RESEARCH PROGRAMMES, CONSORTIA & UMBRELLA NETWORKS	COMMUNICATIONS & RESOURCE SHARING PLATFORMS
NUTRITION, DIETS & PUBLIC HEALTH	Commission on Ending Child Obesity (ECHO) of WHO, 2014-2015	Access to Nutrition Index (ATNI) expert group & independent advisory panel, 2013-	EAT research consortium, 2014-	EAT Stockholm Forum, 2014-
	Lancet-UiO Independent Panel on Global Governance for Health		CGIAR research programme: Agriculture for Nutrition and Health, 2012-	
	Global Panel on Agriculture and Food Systems for Nutrition (GLOPAN), 2013-2016			
AGRICULTURE, FOOD SECURITY, HUNGER AND RURAL DEVELOPMENT	High Level Panel of Experts (HLPE) of the Committee on World Food Security (CFS), 2009-	State of Food and Agriculture (SOFA), 1947- & State of Food Insecurity (SOFI), 1996- by FAO	Research Program on Climate Change, Agriculture and Food Security (CCAFS-CGIAR), 2011-	Chicago Council Global Food Security Symposium, 2009-
	Montpellier Panel – Agriculture for Impact, 2010-	World Hunger Series (WHS), 2006- by WFP	Sustainable Development Solutions Network (SDSN) - Food and Agriculture Thematic Group, 2012-	Sustainable Food Systems Programme (SFSP) by FAO/UNEP, 2014-
	Food Security Strategy Group, hosted by Aspen Institute, 2013-	Agricultural Outlook 2014-2023 by FAO/OECD	Global Environmental Change and Food Systems (GECAFS) research project, 2001-2011	Sustainable Agriculture Initiative Platform, 2002-
	International Commission on the Future of Food and Agriculture, 2003-	The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), 2002-2008		Pastoralist Information Hub, launched by FAO/EU, 2015-
	International Planning Committee for Food Sovereignty, 2003-			
CONSERVATION ECOSYSTEMS & BIODIVERSITY	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services' (IPBES), 2012-	The Economics of Ecosystems & Biodiversity (TEEB), 2007-2010, & TEEB-AF (Agriculture and Food), 2012-	Future Earth, 2012-2022, emerging from Earth Systems Science Partnership (ESSP)*	
		Millennium Ecosystems Assessment (MA), 2001-2005		
CLIMATE CHANGE, ENERGY & RESOURCE USE	International Resource Panel (IRP), hosted by UNEP, 2007-	Intergovernmental Panel on Climate Change (IPCC), 1988-	Earth System Governance Project, 2009-2018	Food Climate Research Network (FCRN), 2005-
		World Resources Report (WRR) by World Resources Institute (WRI), 2010-		
		Global Environment Outlook (GEO) by UNEP, 1997-		

heard, leading ultimately to these tools being discarded (Scoones, 2009; Feldman and Biggs, 2012). And when clashes over different framings and worldviews ensued, for example in relation to genetically modified crops, this did not mean placing those topics off the table. Indeed, **these difficulties helped to forge an understanding and acceptance that fundamental contestation over the *framing* of issues should be recognized as a normal part of scientific research.** The IAASTD process brought to light the need to make these framing assumptions "front-stage, not just back-stage" (Scoones, 2009: 568), to avoid "black-boxing" uncertainty (Scoones, 2009: 548), and to draw increased rigour from the scrutiny applied to scientific assessment. As such, the IAASTD process raised, and at least partially addressed, the need to engage the competing normative expectations and ethical constructs of social actors, in order to problematize and prioritize around sustainable food systems.

The advances in the IAASTD process built on the steps taken by the Intergovernmental Panel on Climate Change (IPCC) in terms of integrating different sources of knowledge into global scientific assessments. One such advance, echoed in IAASTD, was to accommodate 'grey literature', e.g. from NGOs, within the IPCC's assessments. While such sources must be handled according to specific procedures, and in spite of controversies that have ensued, this has been an important step in acknowledging the need to look beyond peer-reviewed articles in scientific journals in order to capture the various ramifications of complex phenomena such as climate change, considered not only from the perspective of top-of-atmosphere radiative forcing but also from the perspective of the human impacts of climate change and of the mitigation strategies required.

In this regard, the Millennium Ecosystem Assessment (MA), conducted in 2001-2005, was a precursor. By opening the analytical door to real-life social impacts and context-specific realities, the MA allowed **market-based solutions** to be questioned on the grounds of **global inequality** and impacts on ecosystem services. Mechanisms enabling the rich to pay the poor to sequester carbon and protect ecosystems may have satisfied **market efficiency concerns**; however, once other perspectives were sought and their **ethical implications** considered, market prices could not be seen as value-neutral in the common understandings that emerged (Dedeurwaerdere, 2014).

Thus, science for sustainability is gradually reinventing itself. The establishment of the High Level Panel of Experts (HLPE) of the Committee on World Food Security (CFS) bears witness to this transformation. The HLPE emerged in 2009 as a result of wide-ranging reforms to make the CFS, a previously relatively obscure FAO body, into the most inclusive international platform of its type (Gitz and Meybeck, 2011). Rather than basing its analysis on sources of formal scientific standing – and the particular assumptions they embody - the HLPE has opened the door to a wide range of sources, forms and conceptions of knowledge. The panel takes care to "confront diverse scientific points of view at every stage of the process", and exposes the various viewpoints in such a way that all stakeholders can recognize their own position and knowledge without subjecting those views to caricature (HLPE, 2013).

Building on IAASTD's open definitions of relevant knowledge, the HLPE stakes much of its credibility with social actors on a commitment to consider **'social knowledge'** (Gitz and Meybeck, 2011). These steps have not created an agreed knowledge base, but have produced "a stronger understanding of the relationships between competing political measures and their underlying technical and knowledge-based rationale" (Gitz and Meybeck, 2011), thus embodying a transdisciplinary spirit wherein different rationales are recognized.

Evolution in the same direction is also occurring in mainstream research programmes. The

CGIAR's Climate Change, Agriculture and Food Security (CCAFS) platform is centered around an *Integration for Decision Making* module that incorporates **biophysical effects** and **quantifies uncertainties**. It ensures effective engagement of rural communities and other stakeholders, and is grounded in the **policy environment**, thereby exemplifying the modalities of transdisciplinary food systems research (Mauser et al., 2013).

Similarly, the EAT research agenda has only one foot in the formal university institutes constituting its network. Structured as a research and communications platform, the initiative is focused on sparking a transition to sustainable diets via the knowledge and practices it shares. Research is reconceived as a catalytic action that rallies a critical mass of stakeholders to move collectively towards sustainable food systems, with an emphasis on **'transdisciplinary partnerships'**, particularly with the food industry and business sector (Demaio et al., 2015). In this context, **dissemination and usability of the findings are a prerequisite for all activity**. Likewise, the array of projects and consortia under the Future Earth umbrella have unified around the need to produce research with practical applications that can be disseminated (Mauser et al., 2013).

3.2 NARROWING THE LENS

Many challenges remain in order to ensure that these participatory openings are fully exploited, however. **The most ambitious transdisciplinary processes have encountered major obstacles in their attempt to include diverse actors, framings and knowledge types.** Attempts to aggregate or mediate the voices of social actors have been problematic. In the IAASTD process, tensions arose in regard to non-governmental organizations sometimes purporting to convey the voices of poorer farmers and rural communities in the global south, while tending to aggregate views according to preordained priorities (Scoones, 2009).

Here and elsewhere, **geographical balance** has been hard to achieve. The IAASTD ensured some geographical variation, with no more than half of lead and contributing authors for the global report drawn from Europe or North America (Scoones, 2008). However, suspicions of tokenism were hard to dispel, with concerns remaining that attempts to 'reach out' to the global South privileged the engagement of elite actors whose own outlook was already in alignment with dominant views, thus reinforcing hierarchies of knowledge (Scoones, 2009). The IPCC has also struggled to reverse geographical imbalances. The percentage of authors and reviewers from OECD countries was static at 80% and 82% through the Second, Third and Fourth Assessment Reports of the IPCC (Hulme and Mahony, 2010). Questions remain also over how to reconcile **universal standards of quality of science** - in particular transparency, replicability, data quality - with opening up to diverse methodological tools and framings. Finally, transdisciplinary research must confront the need to reduce the "strong **asymmetries in research capacities**, money and power" between different partners (Mauser et al. 2013).

The challenges are equally great in terms of applying a holistic *food systems* lens. **Of the array of initiatives at the science-policy interface, only a handful capture the totality of food systems.** In general, the holistic view established by IAASTD could not be replicated in later assessments with similar aims. To date, exercises attempting to capture the interactions of **food systems** and **environmental change** have been disproportionately focused on **productivity/food production** and its **environmental impacts**; when effects are traced in the opposite direction, they are modelled almost exclusively in terms of **environmental impacts on crop yields**, with questions such as **pests, diseases** and **post-harvest losses** routinely omitted, and **integrated food systems analysis lacking** (Wood et al., 2010). This has led to potential high-leverage interventions for food security and sustainable food systems being overlooked, while a "relative over-investment is made in boosting production potential per se, since that is the factor most readily observed and modelled" (Wood et al., 2010).

This productivity focus may have found a new incarnation in the **'sustainable intensification'** view, now widely adopted as a means of squaring environmental concerns with the imperative to grow more food. As such, some commentators see this approach as perpetuating the productivist ideologies of the **'green revolution'** – and thus the **agronomic knowledge bias** and **agro-industrial political bias** for which that approach has been criticized (Gonzalez, 2004; Holt-Giménez and Shattuck, 2011). Furthermore, these framings may reflect a tendency to prioritize **technological innovations** over **social innovations** in the debate over potential reform pathways. This factor is seen to weigh in at the stage of deciding research topics and investing funding. **A continued belief that technological innovation can substantially offset climate change continues to drive a technology-focused research agenda**, leaving needs such as poverty reduction and ecological sustainability as "consequential, rather than constitutive" (Feldman and Biggs, 2012).

The **'food security'** framing often applied to the problems within food systems may also be vulnerable to this narrowing of the lens. Following the work of Amartya Sen and others, the term evolved by the mid 1990s to cover **'accessibility, affordability and availability'** of food for individuals and households, via own-production, local and global supply (Jarosz, 2011; Maxwell 1996). Definitions used by the FAO brought in the concerns of **'stability'** and **'utilization'** (Shaw, 2007). However, many analyses focused on 'food security' still retain a narrow focus on **raising the food supply** - particularly in the wake of the 2007-2008 global food price spikes (Holt-Gimenez and Shattuck, 2011, Rosin et al., 2012). As such, the **social dimensions** of a *secure* food system that guarantees access to food for all, and is *resilient* in the face of economic or natural shocks, have not been given due attention. In some cases, food security framing has allowed sustainability to be treated as an afterthought. **Adaptation to climate change, shifting consumption and waste practices, and reversing the degradation of ecosystems, have been treated as challenges that sit alongside the primary goal of achieving food security, as if they were not all inextricably connected.** This has allowed a damaging dichotomy to persist, obscuring the fact that "the only food system to be secure is that which is sustainable, and the route to food security is by addressing sustainability" (Lang and Barling, 2012).

Recently, efforts have been made to broaden the focus onto **'food and nutrition security'**, placing greater emphasis on the links between **food intake** on the one hand, and **healthcare** and **sanitation** on the other. However, nutrition questions have frequently been addressed in isolation from the other elements of food systems, ignoring entry points such as the impacts of agricultural subsidies or export-led agricultural policies on nutrition and dietary health impacts (Hawkes et al., 2013; Fanzo et al. 2013). And too often, the health and care sides of the nutrition equation have also been neglected, with 'food security' assumed to be sufficient for delivering 'nutrition security'.

Conclusions

As new initiatives emerge at the interface of science, policy and practice, fragmentation is a major risk. The time, money and attention of policymakers is splintered between the various forums and initiatives, underpinned by their various claims to be the locus of food systems knowledge. The consequences of this **political fragmentation** are made worse by the current **thematic fragmentation**, whereby the focus on its different pieces prevents us from seeing the puzzle in its entirety.

The challenge, then, is for these initiatives to resist the forces pushing towards a narrowing of the analytical lens, and to work together to unify food governance spaces. It is for all such initiatives to internalize a systemic mode of analysis, and to prise open their own framing of the questions, even as they train their attention on specific elements of food systems. In particular, there is scope for renewed attention on the **political economy of food systems**, and the broad **constellations of policies** affecting these systems, in order to ensure that these are not simply dismissed as mitigating factors in a narrative still based around markets and price signals. Nor can any benchmark other than **sustainability**, in its full multidimensionality, be used as the aspirational end-point for food systems reform.

Climate change must be more than a footnote in studies focused on identifying improved nutritional pathways; the viability of rural livelihoods must be a key concern for initiatives centered on environmental change; and independent initiatives must complement the work of initiatives tied to intergovernmental process, and hold those processes to account.

Most of all, these initiatives must recall, reiterate and build on the findings that have emerged from the most holistic and participatory processes to date. Indeed, the answer to fragmentation is for expert panels, scientific assessments and research projects to create common reference points and baselines for sustainable food systems. In this regard, there is much to be learned from the work of the IPCC in cementing an understanding of climate change within the public and political consciousness, as well as establishing clear thresholds (e.g. 450 parts per million of atmospheric carbon dioxide) to guide the considerations of policymakers (Dedeurwaerdere, 2014). Specific thresholds of this type may not be relevant for the transition to sustainable food systems. **However, like for the overarching challenge of tackling climate change, a critical mass of evidence must be attained and transposed into policy recommendations in order to create the momentum for food systems reform.**

Farmers' organizations, scientists concerned about the impacts of climate change or of soil degradation, the healthcare community, anti-poverty advocates, politicians of all stripes who understand the need to reform food systems because of the huge costs imposed on taxpayers today, while others are passed on to the next generation: efforts from a wide range of actors will be needed to transpose that evidence into policy recommendations, and their voices will be all the more powerful for their ability to talk the same language, and to anchor themselves to key common reference points and analytical toolkits. **Food systems initiatives at the interface of science, policy and practice must therefore unify in their diversity, together tracing out pathways to sustainable food systems. In doing so, conscious and continued efforts will be needed to build on the transdisciplinary advances of recent decades. This will ensure that the emerging science of sustainable food systems is informed by the immense knowledge of practitioners, and appropriated by those to whom it seeks to be useful.**

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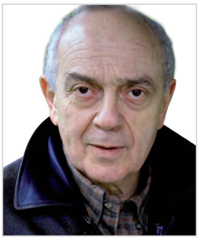

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This is the first report of the International Panel of Experts on Sustainable Food Systems, IPES-Food, an independent panel supported by the Daniel and Nina Carasso Foundation. This report was written by the IPES-Food panel, with the support of Nick Jacobs, IPES-Food Coordinator. Comprising environmental scientists, development economists, nutritionists, agronomists and sociologists, as well as experienced practitioners from civil society and social movements, IPES-Food seeks to inform the global policy debate on reforming food systems. To find out more about IPES-Food, please consult: www.ipes-food.org

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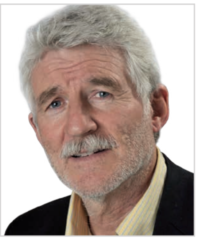

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