



CHAPTER 1

TEEB FOR AGRICULTURE & FOOD: BACKGROUND AND OBJECTIVES

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SUMMARY

Chapter 1 introduces 'The Economics of Ecosystems and Biodiversity for Agriculture and Food' (TEEBAgriFood) and its mission statement, within the context of the wider TEEB initiative. It highlights the need to fix food metrics by applying a holistic systems approach and evaluating the impacts and dependencies between natural systems, human systems and agriculture and food systems. Further, it explores the rationale and objectives of the Scientific and Economic Foundations report based on the extent of positive and negative externalities in 'eco-agri-food systems' and the lack of a coherent, universal framework, thus setting up the narrative and outline for the rest of the report.

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CHAPTER 1

1.0 KEY MESSAGES

- Chapter 1 sets the scene for the *Foundations* report, i.e. why we need a project on The Economics of Ecosystems and Biodiversity for Agriculture and Food ('TEEBAgriFood'), and specifically why we need a report on *Scientific and Economic Foundations*, and how this report interfaces with the wider TEEB Initiative.
- A short answer is that we need to fix food metrics, and we need to start this by interrogating evidence from the science and economics literatures.
- The longer answer – and the mission statement of TEEBAgriFood – is as follows: The TEEBAgriFood study is designed to: i) provide a comprehensive economic evaluation of the eco-agri-food systems complex, and ii) demonstrate that the economic environment in which farmers operate is distorted by significant externalities, both negative and positive, and a lack of awareness of dependency on natural, social, human and produced capitals.
- The 'eco-agri-food systems complex' is a collective term encompassing the vast and interacting complex of ecosystems, agricultural lands, pastures, inland fisheries, labour, infrastructure, technology, policies, culture, traditions, and institutions (including markets) that are variously involved in growing, processing, distributing and consuming food.
- TEEBAgriFood adopts a systems approach: It is neither possible nor sensible to isolate impacts and dependencies of primary agricultural production (within the farm gate) from the rest of the eco-agri-food system if we are to find truly sustainable and equitable solutions to the agri-food challenges we face.
- Chapter 1 sets out the structure of the report, with four chapter clusters: i) outlining the systems approach; ii) evidence that a change in metrics is required (from agriculture, human health, and ethics perspectives); iii) defining and setting out examples of how we change metrics via the TEEBAgriFood Evaluation Framework; and iv) how change might be brought about – the Theory of Change.
- The TEEB initiative is ideally situated to operationalize the Theory of Change as it has, for a decade, focused on the economic invisibility of the costs of biodiversity loss and the degradation of ecosystems, and no industrial sector is more reliant on well-functioning ecosystems than the agriculture sector.
- TEEB has championed valuation in its widest form, and thus has eschewed and criticized the commoditization of nature. It has also successfully led to values being recognized, demonstrated and captured in a range of decision-making contexts – for national and sub-national government, for businesses and for consumers and citizens.

CHAPTER 1

TEEB FOR AGRICULTURE & FOOD: BACKGROUND AND OBJECTIVES

1.1 TEEB: GENESIS, SCOPE, ACHIEVEMENTS & EVOLUTION

Across the world, we are building a better understanding of the ramifications of environmental change on human livelihoods. Much of this awareness has been gained after tipping points have been reached or as a result of catastrophic events such as flooding, drought, fire and famine. 'The Economics of Ecosystems and Biodiversity' (TEEB) was originally created to help answer the call to make the values of nature more visible so that decision-making and policy outcomes can be informed by a better understanding of our impacts and dependence on the natural world.

As the world's population grows, so does the need for more resilient food and agricultural systems that address human need while minimizing environmental damage and further biodiversity loss. TEEB is focused on how we can make the values of nature visible to support a transition to agriculture systems that are truly sustainable and benefit both human and environmental health.

1.1.1 Brief history of TEEB

Inspired by the Stern Review on the Economics of Climate Change (Stern 2007), which revealed the economic inconsistency of inaction with regard to climate change, Environment Ministers from the governments of the G8+5 countries¹ agreed at a meeting in Potsdam, Germany in 2007 to "initiate the process of analysing the global economic benefit of biological diversity, the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation". Aiming to address the economic invisibility of nature, TEEB emerged from that decision.

Although the underlying problem of the economic invisibility of environmental damage in climate change is similar to the problem of economic invisibility where loss of biodiversity is concerned, the solutions are very different. To avoid catastrophic climate change, the world needed, and still needs, to reduce greenhouse gas emissions; the task is massive but progress can be charted through the single, universal metric of carbon dioxide equivalence. Where in the world carbon savings are made is important in terms of equity, but in the end it is global emissions measured in carbon dioxide equivalents that matter.

Biodiversity is very different from this perspective in that it is the living fabric of our planet including all its ecosystems, species and genes, in all their quantity and diversity. It is therefore neither intellectually nor ethically appropriate to attempt to reduce this complexity to any single indicator or numeraire. Ethics, social context, ecology and geography matter to both the costs and benefits of action – in other words, people and places are intrinsically important in the context of TEEB. The costs and benefits are also more diverse, from the protection and preservation of water flows through to the pollination of crops as well as links to cultural identity. There is no single target or metric, but multiple benefits which all need to be considered. Combined, these factors implied that, as well as the need to have a global analysis as per the Stern Review, TEEB would only be relevant if it also targeted decisions and decision-makers more directly at the scales and in the contexts in which they were operating.

Furthermore, TEEB also differs from the Stern Review (and the wider climate change discourse) in that the effects of climate change on nature and on human livelihoods are real and potentially catastrophic but do not emerge from within. TEEB is concerned with the why and the how of valuing nature in and of itself, and understanding the incentives for action (and inaction) in many different contexts by a whole range of decision-makers: policy makers at national and local levels, communities, businesses, and society at large. As such, it is also about valuing something that we all cherish, and on which all of our lives depend. This has also meant that TEEB has, since its inception, distanced itself from any calls to commoditize nature: *our living planet is most definitely*

¹ The G8+5 includes the heads of government from the G8 nations (Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States), plus the heads of government of five emerging economies (Brazil, China, India, Mexico and South Africa).

not for sale. TEEB is concerned with valuing nature's contribution to people, in all its disparate forms.

With this focus in mind, TEEB aims to provide a bridge of valuation knowledge and expertise between the multi-disciplinary science of biodiversity and ecosystem management and the interconnected arenas of policymaking in the international, national and local government domains as well as in business management. In this context, the original phase of the project (2007-2011) developed outputs specifically for these audiences as well as web-based material aimed more directly at citizens and consumers.

The TEEB Synthesis Report (TEEB 2010) collected this work from the original phase where it was presented at the Convention on Biological Diversity's Conference of the Parties in Nagoya, Japan in 2010. The influence of the TEEB studies (and the process of bringing authors and stakeholders together to produce them) was visible both in the decisions made in Nagoya and the work which followed. TEEB was officially welcomed by the Parties in the context of the new Strategic Plan for Biodiversity 2011-2020, as well as featuring explicitly in decision text around incentive measures and business engagement. It is notable that of the 20 international biodiversity targets for 2020 agreed at the meeting (the Aichi Biodiversity targets), target 2 aimed to address the underlying drivers of biodiversity loss requiring that *"by 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems."*

The TEEB initiative was originally scheduled to conclude with the Synthesis Report in 2010, however, the decisions of the 193 countries represented in Nagoya reflected both the need and desire for countries both to deepen their understanding of the connections between nature and the wellbeing of their people, and to ensure these connections are captured. Several countries announced their intention to carry out TEEB country studies and their interest in implementing TEEB recommendations. TEEB revealed that the drivers of biodiversity loss were widespread throughout our economies and societies, and the benefits of addressing these drivers went far beyond biodiversity alone, to include human health and livelihoods, water use and climate stability. TEEB stimulated demand to re-orientate our economic compass, and therefore officially entered an implementation phase of work aimed to put theory and into practice across a range of different areas. This included encouraging the world of business² to co-create and publish formal and universal guidance

on measuring, valuing and reporting corporate impacts and dependencies on nature (TEEB 2012; Natural Capital Coalition 2016).

TEEB's initial phase catalysed activities to make the impacts and dependencies of societies and public/private interests more visible in order to contribute to better policy and decision-making outcomes, at a number of levels:

- **National** - countries started conducting baseline ecosystem assessments to include Natural Capital in their national accounts;
- **Local and regional** – ICLEI, an international organisation focusing on local government, actively promoted TEEB tools and decision-making plans for the management of regional and municipal biodiversity and ecosystems;
- **Business** - some businesses (such as Puma) started to examine the impacts and dependencies on ecosystems and biodiversity along their supply chain.

TEEB's priorities have also evolved in the context of the wider international discourse in this space, a key element of which has been the emergence of the 2030 Agenda for Sustainable Development and the associated Sustainable Development Goals (SDGs) – see **Box 1.1**.

Critically, a common feature of both the work to date in the implementation phase of TEEB and the emerging approach to development and doing business in a world committed to meeting the Sustainable Development Goals are the interconnections and interdependencies between social, economic and environmental problems and achievements. It is therefore also clear that the pursuit of solely private profit or value as measured by markets, which neglect both positive and negative social and environmental externalities and impacts, cannot be relied upon to deliver effective or efficient solutions. Further, there is an economic incentive for those agents from both the public and the private sector that benefit from the status quo to lobby for it to be maintained.

2 "TEEB for Business" (TEEB 2011) led to the creation of a "TEEB for Business Coalition" comprising business, institutional & government stakeholders, which was re-named the "Natural Capital Coalition" in 2013 and in 2016 published the "Natural Capital Protocol".

Box 1.1 TEEBAgriFood and the Sustainable Development Goals (SDGs)

The SDGs are a series of 17 internationally agreed, universally applicable goals that are recognized as indivisible and cover issues across the spectrum of development from poverty, food security and water security, through equity, health, access to decent work, peace and a stable natural environment. In an article, *The Guardian* (2017) linking the SDGs to food and agriculture, TEEB Study Leader Pavan Sukhdev outlines some of the challenges of implementation.

Indivisibility is key to the success of the SDGs as progress on one goal might be contingent on another, and this requires systems thinking. SDG 2 on zero hunger is perhaps most closely linked to TEEBAgriFood, but the fact that fish provide the main source of animal protein (and essential micronutrients) to more than one billion people globally implies that achieving SDG 2 also requires addressing SDG 14, on conserving and sustainably using the oceans. As Rockström and Sukhdev (EAT 2016) note, we are already using around 40 per cent of available land for growing food, a figure that is projected to rise to 70 per cent under a 'business and usual' scenario. How can achieving SDG 2 under this pathway then be compatible with achieving SDG 15 concerning life on land? The authors also note that the agri-food system also contributes over one-fourth of greenhouse gas emissions, so again achieving SDG 13 on climate change depends on how we tackle our goal of ending hunger, improving food security and improved nutrition. Our food choices also make a critical contribution to the global burden of disease, linking SDG 2 to SDG 3, the latter aiming to ensure good health and well-being. More broadly, global trends in shifts in the 'food plate' also do not auger well for achieving SDG 12 on responsible consumption and production. The analysis above points to the need for a 'joined up' approach and the application of systems thinking, i.e. not focusing on the delivery of kilocalories as the unifying performance metric of the agri-food sector, and this a core tenet of TEEBAgriFood.

Figure 1.1 The SDG 'wedding cake' (Source: EAT 2016)

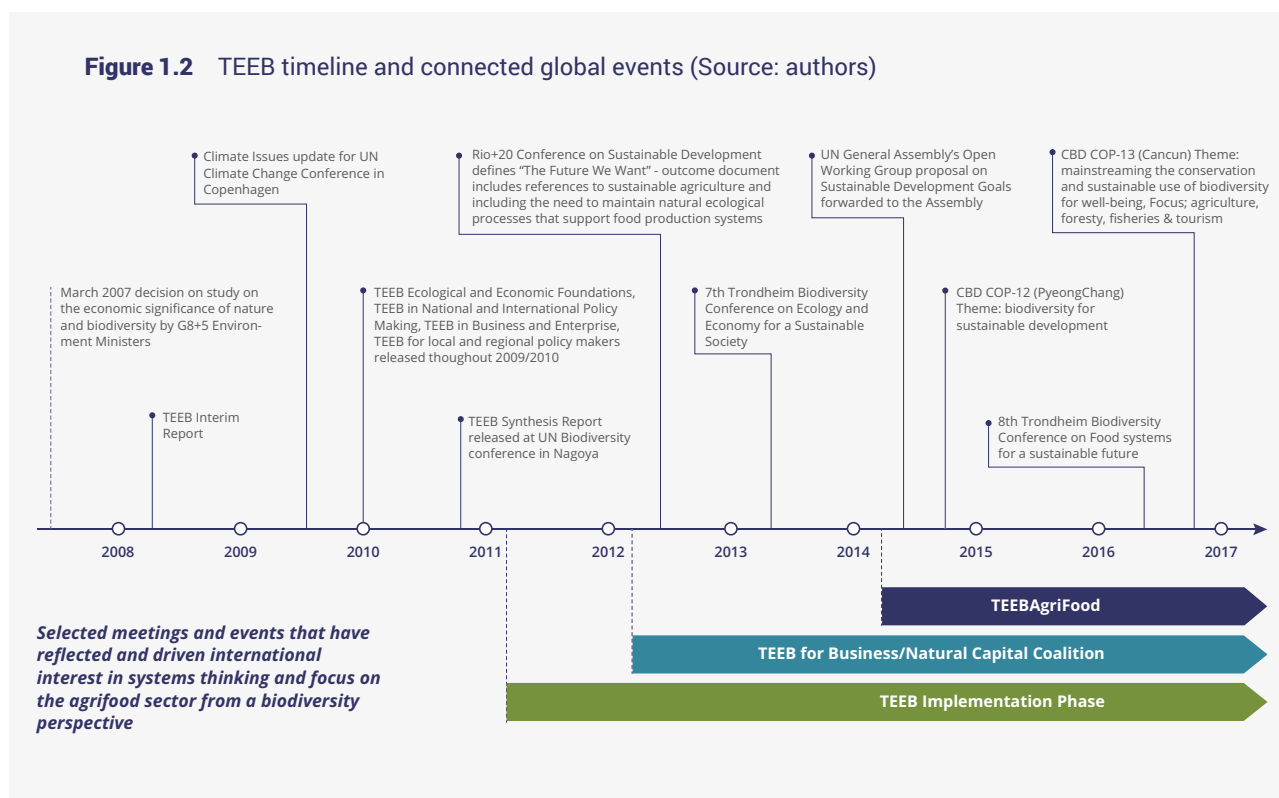


Rockström and Sukhdev further note that the delivery on the full range of SDGs is based first on achieving 'biospheric' or ecological goals (6, 13, 14, 15), i.e. it is a necessary but not sufficient condition of achieving social goals (such as SDG 1 on poverty and SDG 10 on reduced inequalities) and economic goals (such as SDG 8 on good jobs and economic growth) that we have resilient and stable ecosystems. This is reflected in their 'wedding cake' structure (see **Figure 1.1**). TEEB rests on a central tenet that ecosystems and biodiversity are primary and we must search for incentive mechanisms and achieve the enabling conditions to make them our core concern.

The focus of the current implementation phase of TEEB (2013 onwards) has included both demand-driven efforts to help build capacity for TEEB-style analysis of policy issues (at national, regional and local scale, as well as for businesses) alongside strategic interventions internationally to catalyse further efforts - reflecting the awareness of those involved in TEEB that it is not the only initiative in this space. TEEB developed (and continues to develop) a community of practice. The TEEB for Business Coalition (now the Natural Capital Coalition) was one of

the first initiatives to develop from an initiative undertaken by the TEEB Study Leader and other key stakeholders in the TEEB for Business Report (TEEB 2012a) as set out in **Figure 1.2**. The Natural Capital Coalition was established to engage key stakeholders from business, government and civil society in open source collaboration in order to raise awareness and provide a leading-edge forum to shape the future of business thinking and action on 'natural capital', i.e. the critical role of properly functioning ecosystems in delivering economic prosperity.

Figure 1.2 TEEB timeline and connected global events (Source: authors)



Key work areas in the current implementation phase of TEEB have included business, water and wetlands, natural capital accounting, oceans, and of course TEEB for Agriculture and Food (henceforth 'TEEBAgriFood') – the subject of the current volume.

1.1.2 The emergence of demand for 'TEEB for Agriculture & Food'

The agri-food sector featured in the earlier phase of TEEB. The range of outputs in this earlier phase were all built on the same foundations – the academic underpinnings from both the scientific and economic perspective, brought together in *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations* (TEEB 2010b). This publication explored the values of biodiversity to agriculture, the trade-offs between different ecosystem services in agricultural systems, the cultural values of agricultural landscapes, as well as ideas of resilience and the potential value and the livelihood and environmental benefits of genetic variation in crops and crop wild relatives. The way that we produce and consume food and manage agricultural landscapes also featured in the TEEB publications developed for businesses (TEEB 2012a), for public policy makers at national level (TEEB 2011) and at local and regional level (TEEB 2012b), and in three of the 10 key recommendations in the TEEB Synthesis Report (TEEB 2010a). In short, the original TEEB studies (2007-2012) sought to highlight the depth of existing knowledge with respect to the interconnections between nature and food production.

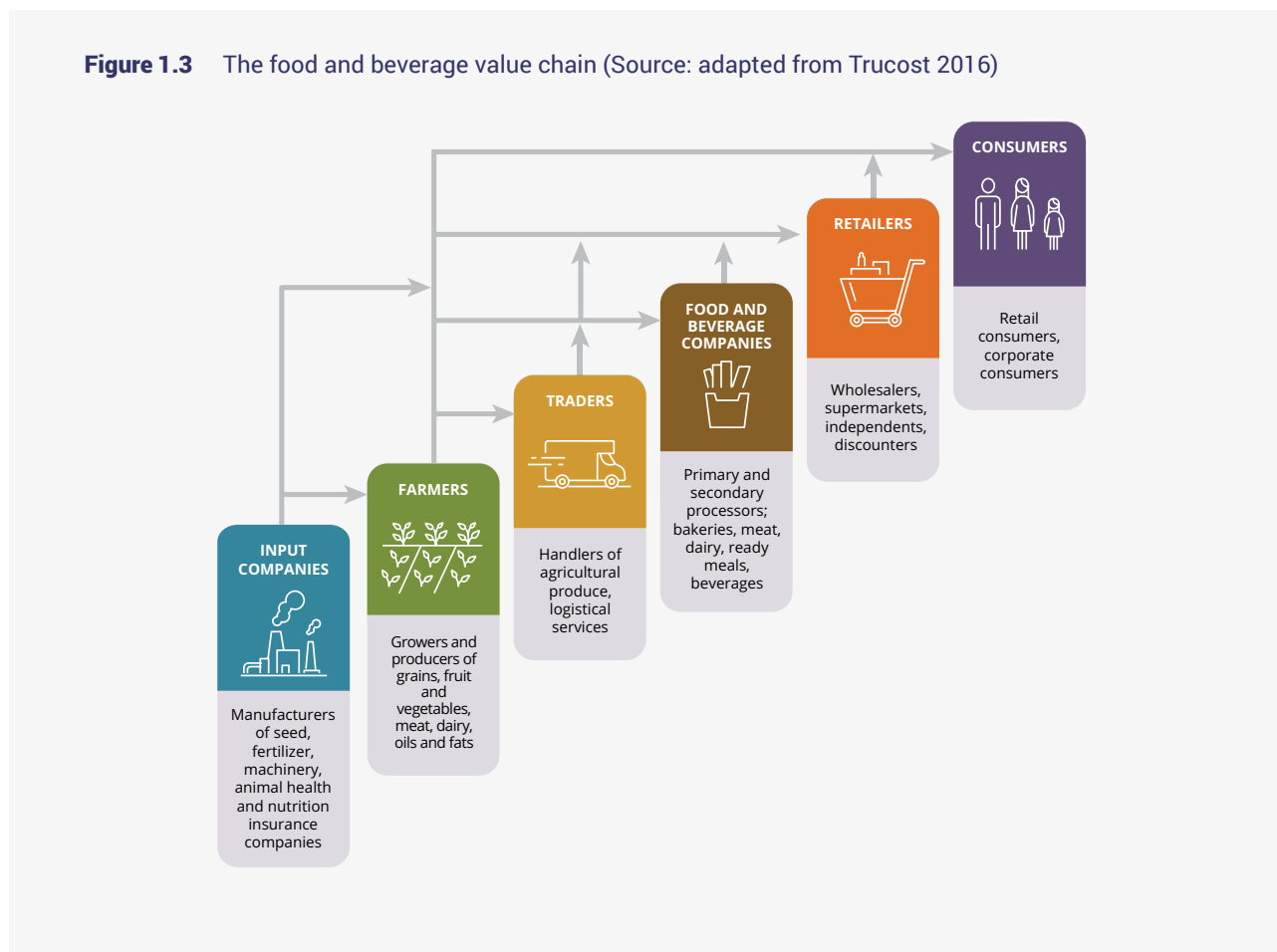
Although the agri-food sector did feature in the earlier phase of TEEB, the remit of TEEB was to 'correct the economic compass' by presenting appropriate ways of recognizing, demonstrating and then capturing the value of nature. Thus the earlier phase of TEEB considered the entire economy with its many industrial sectors. For an assessment of the eco-agri-food systems complex (as opposed to just the agri-food sector), a comprehensive understanding of all impacts and dependencies across the system, including externalities is required. This is the aim to which TEEB AgriFood seeks to contribute.

1.2 RATIONALE AND OBJECTIVES OF TEEBAGRIFOOD

1.2.1 TEEB AgriFood mission statement

The TEEB AgriFood study is designed to: i) provide a comprehensive economic evaluation of the eco-agri-food systems' complex, and ii) demonstrate that the economic environment in which farmers operate is distorted by significant externalities, both negative and positive, and a lack of awareness of dependency on natural, social, human and produced capitals.

Figure 1.3 The food and beverage value chain (Source: adapted from Trucost 2016)



1.2.2 What is the eco-agri-food systems complex?

Agriculture is an *economic sector*. It typically encompasses areas of economic activity beyond farm operations to include farm-related activities, such as processing, manufacturing and transport, so we may refer to it as the agri-food sector. There is a *value chain* in the sector, as set out in **Figure 1.3**, and there are systemic economic interlinkages and economic cross-dependencies in this value chain.

This economic system is underpinned by complex *ecological and climatic systems* at local, regional and global levels. Biodiversity and ecosystems – the study of which is at the heart of TEEB – underpin the delivery of economic output from this sector. Overlaying these natural systems are *social systems* influencing inter alia: i) the composition of our food plates (i.e. what we eat), ii) how we go about sourcing, purchasing, storing, cooking, and consuming food, and then discarding the food waste, iii) our attitudes and behaviours towards farmers and the land that is used for agricultural production, and iv) the way that cultural norms and values are transmitted between and across generations.

These three systems (economic, ecological and climatic, and social) interface and interact with each other, and that is why we refer to the ‘eco-agri-food systems complex’.

In terms of a definition, as set out in the TEEBAgriFood Interim Report (TEEB 2015), the eco-agri-food systems complex is a collective term encompassing the vast and interacting complex of ecosystems, agricultural lands, pastures, inland fisheries³, labour, infrastructure, technology, policies, culture, traditions, and institutions (including markets) that are variously involved in growing, processing, distributing and consuming food.

1.2.3 Why is there is a need to examine the externalities of eco-agri-food systems complex?

This question was tackled in depth in the TEEBAgriFood Interim Report and later summarized in an article for the journal *Nature* (Sukhdev *et al.* 2016). This article sets out the shortcomings of current patterns of crop and livestock production and of processing, transport and consumption with respect to what is required by society as a whole -

³ Marine fisheries are out of scope of TEEBAgriFood.

the delivery of sufficient, healthy, nutritious food that does not damage nature.

The current eco-agri-food systems complex impacts both on human health and on the natural environment in detrimental ways; it is now the source of 60 per cent of terrestrial biodiversity loss, 24 per cent of greenhouse gas emissions, 33 per cent of soil degradation and 61 per cent of the depletion of commercial fish stocks (UNEP 2016). For example, failures in access and distribution contribute to the fact that 800 million people in developing countries consume less than the 2,100 kilocalories of food recommended by the World Food Programme whilst at the same time 1.9 billion people in the developed world consume more than 3,000 calories a day (FAO 2015). This imbalance also has wider ramifications. The impact of undernutrition across Africa and Asia is estimated at 11 per cent of Gross Domestic Product (GDP) annually (IFPRI 2016). Similarly, one in four adults are now overweight or obese, with obesity behind many of the chronic diseases that are sweeping the globe, from type 2 diabetes to heart disease. The World Health Organization has estimated the direct costs of diabetes alone at more than US\$827 billion per year globally (WHO 2016).

The TEEBAgriFood Interim Report reflects on the role that agriculture plays in providing employment for around 1.3 billion people in a world that is already short of around 200 million jobs (ILO 2015). One billion of these jobs are in small-holder agriculture (less than 2 hectares) so it is important to address how society could provide alternative livelihoods for as many as 500 million more people if the concentration and mechanization of agribusinesses continues.

These are impacts on a global scale, yet in spite of the fact they are all connected to the same process (producing and consuming food), they have not yet been evaluated as an entire system, using a systems approach.

From a human health perspective, the Global Panel on Agriculture and Food Systems for Nutrition (2016) includes a call to scientists, governments and donors to work out how to craft and sustain food systems to provide nutritious diets for all. The report authors highlight that SDG 2 (zero hunger) and SDG 3 (good health and wellbeing) cannot be achieved with piecemeal action: “the trends are so large and so interconnected that the entire system needs overhauling” (Haddad *et al.* 2016, p.31). The emergence of initiatives such as The Food and Land-Use Coalition (FOLU), the International Panel of Experts on Sustainable Food Systems (IPES-Food) and the High Level Panel of Experts on Food Security and Nutrition (HLPE), each of which aims to bring together change agents in this space, shows that decision-makers understand the need for change and are ready to act.

Similarly, the emergence of the planetary health agenda, which is building a better understanding of the ramifications of environmental change on human livelihoods, pushes the need for more resilient food and agricultural systems that address both undernutrition and overnutrition, reduction of waste, diversification of diets, and minimization of environmental damage. The impacts arising from feedbacks in the system from our current behaviour are likely to be profound. The Lancet Commission on Planetary Health’s report (Whitmee *et al.* 2015) estimated climate change will result in 250,000 additional deaths between 2030 and 2050, that soil degradation leads to the loss of 1–2 million hectares of agricultural land every year, and that by 2050 40 per cent of the world’s population could be living in areas under severe water stress. The connections to food systems are clear, especially in terms of some of the identified solutions for a healthier planet - reducing food waste, halting deforestation, using water more efficiently and supporting healthier, lower environmental impact diets.

The need to bring together the environment, human health and human development agendas is increasingly evident. This is illustrated neatly by the impact of Kate Raworth’s recent book *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist* (Raworth 2017) which aims to define both an environmentally-safe and socially-just space for humanity and assess how economies need to change to achieve this. This builds on the notion of planetary boundaries and the safe operating space within which human systems can operate, with its accompanying environmental limits. Juxtaposing this with factors which can cause human deprivation can be useful in assessing options to allow people to thrive within the limits of the planet. This thinking is very much embedded within the holistic approach advocated in this current TEEBAgriFood report.

Irrespective of the particular socio-economic, cultural and ecological context in which a particular eco-agri-food system is situated, there are always positive and negative externalities and impacts across the entire value chain, i.e. from production, through processing and transport, to final consumption. The question is thus not whether such externalities and impacts exist but rather their extent, which agents in society are affected, and whether we can promote a decision-making environment in which the positive impacts flourish and the negatives are mitigated.

1.2.4 Why should TEEB be examining the externalities of eco-agri-food systems?

The demand for a TEEB study on eco-agri-food systems was based on at least three key propositions: i) the extent of the positive and negative externalities (i.e. non-compensated impacts on third parties) of the agri-food sector are likely larger than that of any other sector; ii) the

approaches applied to date have been inadequate owing in part to the lack of a coherent, universal evaluation framework that includes these disparate externalities along with useful metrics; and iii) the TEEB community can develop, communicate and operationalize such an evaluation framework; and thereby contribute significantly to the integrity and functioning of ecosystems and to improving human livelihoods.

With respect to the first of these - the extent of externalities in the agri-food sector - an important report entitled “Natural Capital at Risk: The Top 100 Externalities of Business” (Trucost 2013) intended to help reveal the business case for further private sector engagement with the issue of natural capital and to help prioritize actions. It examined a wide range of impacts of business on the natural environment – the effects of which tend not to be reflected in the market prices of associated financial transactions (hence termed ‘externalities’).

The report looked at different types of non-market impacts on natural capital across different sectors and in varying regions of the world. The top 100 – ranked by the estimated monetary value of the impacts – were presented in the report. Whilst the research was open about the limitations in its the valuation approach, the magnitude of the figures highlighted the need for attention. The top 100 externalities had an estimated cost of around US\$4.7 trillion per year in terms of the environmental and social costs of lost ecosystem services and pollution. Crucially, in the context of TEEB AgriFood, 11 out of the top 20 externalities were related to agri-food sectors, ranging from the land impacts of cattle ranching in South America, to the water use impacts of wheat production in East Asia and corn production in North Africa.

In 2014, the Natural Capital Coalition (formerly the TEEB for Business Coalition) launched the Natural Capital Protocol, which provides a framework to help businesses begin to explore their relationship with nature. Reflecting the frequency with which agri-food sectors appeared in the top 100, a food and beverage sector supplement was released in 2016. The Protocol highlights from a business perspective the interconnections across agriculture and food systems and the varying degrees of resulting horizontal and vertical integration, underscoring the need to look system-wide to understand how to drive change. The supplement itself provides practical details and applied examples to help businesses in the food and beverage sector think about and take account of their impact and dependencies on natural capital in their decision making and planning.

What the “Natural Capital at Risk: The Top 100 Externalities of Business” and the food and beverage supplement tell us is that there is a need to tackle the externalities in the sector, and that TEEB AgriFood is not alone in recognizing this need. TEEB AgriFood offers a unique

value-addition in this space in that the TEEB AgriFood Evaluation Framework (hereafter ‘Evaluation Framework’ or ‘Framework’) presented in Chapter 6 of this report is both *comprehensive* and *universally applicable*, and applies a *systems perspective* (described in Chapter 2).

There are myriad externalities and impacts – both positive and negative – created in the production and consumption of food. The Evaluation Framework is designed to be comprehensive. For instance, there is a focus not just on the impacts and dependencies between the agri-food sector/ecosystems and biodiversity but also on the agri-food sector’s contribution to human health outcomes. This has also meant that the TEEB community of practice has been extended for TEEB AgriFood to include academics, policy-makers, civil society groups etc. operating in the human health and nutrition fields.

A challenge, which is perhaps unique to the agri-food sector, is the extent of the heterogeneity within and across food systems. The Natural Capital Protocol’s food and beverage sector guide is targeted at business. In many ways, all agribusinesses are firms of one kind or another but small-scale producers are unlikely to have the same objectives and constraints as large firms. One size does *not* fit all in this sector. TEEB from its inception has championed the ‘GDP of the Poor’ therein flagging the particular dependence of the poorer segments of society on well-functioning ecosystems, and thus developing and applying a universal Evaluation Framework that is applicable to scenario analysis for small-scale producers. But equally the Framework must be (and indeed is) applicable to large-scale agribusiness.

Systems thinking is central to TEEB AgriFood. It is not possible or sensible to isolate impacts and dependencies of primary agricultural production (within the farm gate) from the rest of the eco-agri-food system if we are to find truly sustainable and equitable solutions. Issues cut across current commodity production systems and across spatial and temporal scales. Analyses will need to be context-specific. TEEB AgriFood sets out and illustrates a comprehensive system-wide analytical lens that can be used to examine different issues given this need.

It is recognized that TEEB engages substantially with the issues around agriculture and food. The TEEB AgriFood Interim Report (TEEB 2015) was noted by the 13th Conference of the Parties of the Convention on Biological Diversity in Cancún in December 2016 in the context of a decision focused on “actions to enhance the implementation of the Strategic Plan for Biodiversity [agreed in 2010]”, which specifically highlights efforts with respect to mainstreaming the integration of biodiversity within and across sectors. Recognition is growing that problems of biodiversity loss cannot (and should not) be tackled by conservationists alone, but rather by society at large including the business community.

This report builds substantially on the TEEBAgriFood Interim Report (TEEB 2015), focusing on developing the Framework and analysis on which transformations can be based. It is therefore both timely and urgent – it is essential that such a change in how we look at our food systems is adopted and used quickly.

1.3 STRUCTURE OF THE REPORT

The aspiration of the TEEBAgriFood *project* is to change the way that we produce and consume food, so as to reflect the hitherto invisible positive and negative externalities and impacts in the eco-agri-food systems complex. This *report* – the ‘Scientific and Economic Foundations’ report – focuses on the need to ‘make the case’ for this new paradigm. As such, this report contributes to the aspiration of the TEEBAgriFood project but needs to (and will) be complemented by: i) other reports targeted at specific change agents, ii) projects where change is tested and implemented at corporate, regional, national and supra-national levels, and iii) communications and outreach.

Following this Introductory chapter, the report is divided into four segments, as per Section 1.3.1 through Section 1.3.4 below. **Figure 1.4** provides a schematic representation of the entire eco-agri-food systems complex – the visible and invisible flows of agricultural production. This figure is used below to illustrate the rationale for the chapter ordering and the narrative thread of the report.

1.3.1 The lens through which we analyse the eco-agri-food systems complex – the systems approach

Chapter 2 lays out the foundation for using systems thinking as a guiding perspective in TEEBAgriFood. This is required so as to understand the relationships across multiple sectors, disciplines and perspectives, thereby embracing holism and avoiding reductionist, ‘silo’ thinking. Systems theory emphasizes circular flows with both negative and positive dynamic feedbacks between the economy, the environment and human social systems. Applying a systems approach requires looking at feedbacks across the entire value chain from ‘agricultural production’ through to ‘household consumption’ via ‘manufacturing & processing’ and ‘distribution, marketing and retail’, while analysing multifarious impacts and dependencies (c.f. **Figure 1.4**).

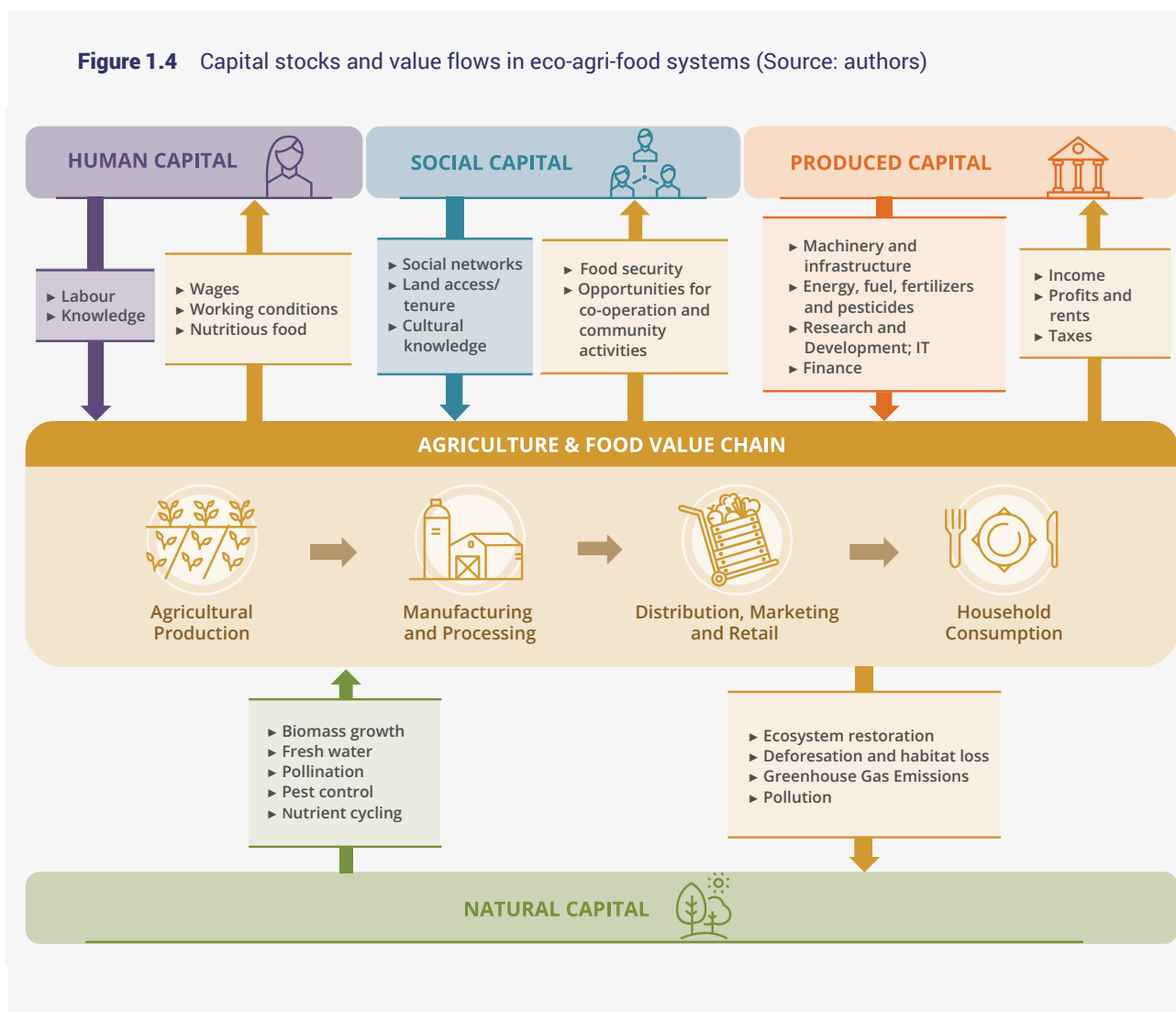
1.3.2 Evidence that we need to change the eco-agri-food systems complex

Since the metric commonly used to assess on-farm economic performance has (and continues to be) yield/hectare, agricultural systems research has focused on irrigation, breeding, machinery etc. – the visible inputs to the agricultural system in the schematic. These include – with reference to **Figure 1.4** – ‘labour’ (from human capital), and ‘manufacturing and infrastructure’ and ‘energy, fuel, fertilisers and pesticides’ (from produced capital). TEEBAgriFood aims to *change food metrics*. Chapter 3 sets out the available scientific data and evidence not just on the visible flows in **Figure 1.4** but also those that tend to be invisible, with a particular focus on the flows coming from natural capital. Some flows can be visible or invisible depending on circumstances. For instance, agri-tech consultancies market their ‘knowledge’ (from human capital) to large-scale commercial producers in ‘manufacturing & processing’, but local indigenous knowledge of crop varieties – although critical to maintaining resilient social communities – might remain invisible.

The TEEBAgriFood assessment acknowledges and explores the heterogeneity across agricultural systems and finds that positive and negative externalities and impacts are pervasive across all eco-agri-food systems, and further across the value chains in which these systems are situated.

‘The way we produce, process, distribute, and consume food (as well as how we deal with its disposal) impacts human health and nutritional security, which in turn (with reference to **Figure 1.4**) impacts on the availability of ‘labour’ and on the types of ‘social networks’. Chapter 4 focuses on this subject, looking across the entire value chain. Six of the top 11 risk factors driving the global burden of disease are diet related. The quality of life for billions of people is impacted by malnutrition. Across the food system, people can additionally be impacted via work-related injuries (or death) or toxin/pathogen exposure. Coupled with these direct food system impacts are indirect impacts that are felt now and will be felt in future generations. The food system can be either an enabler of food and nutrition security, livelihood procurement, and environmental sustainability, or it can be a disabler. We can develop food systems that allow a large number of individuals to secure a livelihood through the food system or one in which large numbers of food system workers are systematically exploited. This chapter explores a number of endpoints in various food system strategies and suggests a strategy for exploration, mitigation, change, and ultimately transformation of our global food system to one in which health – human, ecosystem, and community – is the norm for 9-10 billion people.

Figure 1.4 Capital stocks and value flows in eco-agri-food systems (Source: authors)



All of the choices that we make vis-à-vis food - as individual consumers or citizens, as farmers, as fiduciary agents of agribusiness corporations, as part of sub-national, national or global policy-making - have an ethical dimension. In an equitable food system, all people have meaningful access to sufficient healthy and culturally appropriate food, and the benefits and burdens of the food system are equitably distributed. This is the focus of Chapter 5. The overall objective of this chapter is to identify key aspects of social equity of the world's food systems in order to provide pathways and indicators that can be used to assess the impacts of food systems in equity outcomes.

Chapter 3, Chapter 4 and Chapter 5 collectively provide evidence that: i) the wrong metrics are being used to assess the eco-agri-food systems complex; ii) applying today's metrics leads to outcomes that degrade the ecosystems and biodiversity that agricultural systems depend on, and negatively impact on human health; and iii) these burdens fall disproportionately on the poorer

segments of society. Chapter 3, Chapter 4 and Chapter 5 express the *need for a change in the metrics*. Chapter 6, Chapter 7 and Chapter 8 set out TEEBAgriFood's *proposal for such a change* in the form of the Evaluation Framework.

1.3.3 The TEEBAgriFood Evaluation Framework: a tool to assess the eco-agri-food systems complex

Chapter 6 sets out the Framework. The Framework highlights all relevant dimensions of the eco-agri-food value chain and pushes policymakers, researchers, and businesses to include these in decision-making. These dimensions include social, economic, and environmental elements as well inputs/outputs across the value chain. The Framework therefore establishes all of "what should be evaluated".

Guiding principles are that the Framework is comprehensive (covering all elements), universal (be applicable to all decision-making contexts), and supports

multi-criteria assessments (e.g. production, consumption, greenhouse gas emissions, fertilizer use, health impacts and decent work).

Whereas Chapter 6 is concerned with what to value, Chapter 7 turns to “*how* to carry out the evaluation.” The chapter makes the distinction between (and presents examples of) methods for the *economic valuation* of ecosystem services and disservices in both monetary and non-monetary terms, *evaluation* methods, and *modelling* tools and techniques. Policy-makers are unlikely to rely solely on the outcomes of an economic valuation study, but such information can be an important component in decision-making. Valuation results might be used as *an input* to an evaluation approach such as Cost Benefit Analysis or Multi-Criteria Analysis, which may be informed by (for example) Systems Dynamics modelling. Chapter 6 provides an illustrative example of integrated modelling in Kilombero, Tanzania to help explain the distinction between valuation, evaluation and modelling.

One of the guiding principles for the Framework as mentioned above is universality. The objective of Chapter 8 is to provide case study examples of five clusters of possible applications: i) agricultural management systems; ii) business analysis; iii) dietary comparison; iv) policy evaluation; and v) national accounts for the agriculture and food sector.

The examples in Chapter 8 illustrate not only how a published study fits into the Framework but also *equally how it does not*. We argue that the broad methodological approaches required to apply Framework testing do already exist (and are presented in Chapter 7) but, as with any paradigm shift, the data and results from studies that pre-date the Framework are not adequate for a full Framework application. Thus gaps are to be expected.

The aim of Chapter 9 and Chapter 10 is to explore what has to change in order for us to realize this paradigm shift – for the Framework to become the new orthodoxy.

1.3.4 How do we change the eco-agri-food systems complex?

Chapter 9 on the theory of change seeks to explore how attempts to redirect the eco-agri-food systems complex might be perceived from the perspectives of key actor groups, suggesting avenues to escape ‘path dependencies’ that lock in unsustainable practices. What form might such path dependency take? It may be the case that individual farmers or agribusinesses see the benefit of a transformative shift in the way that food is produced and, were they all to *collectively and simultaneously* agree to shift behaviours, they could then operationalize this transformative change. But concerted and coordinated actions are required in such instances,

and there are strong corporate (and sometimes cultural) forces that dissuade these farmers and agri-businesses from shifting from the dominant orthodoxy. They are ‘locked into’ an unsustainable path dependency.

Chapter 9 explores pathways towards sustainability. Information alone often fails to motivate change. Manipulation of data has led consumers to doubt scientific results, serving special interests at the expense of public benefit. The chapter sets out a range of actor-relevant theories of change. These include consumer advocacy (e.g. the threat of boycotts and reputational risk), product certification, promoting institutional and societal learning, developing strategic alliances etc.

Part of the impetus for the transformative shift discussed above will likely come from TEEBAgriFood aligning itself with on-going initiatives and processes, be they global agreements or business-led initiatives, and demonstrating the value-added of the Framework. This is the subject of Chapter 10. Such global initiatives include the Right to Food, the Aichi Targets, and (as discussed earlier in **Box 1.1**) the 2030 Agenda and its Sustainable Development Goals. Linking TEEBAgriFood to business platforms is important in that they support learning and, if linked to citizen representation, can enhance accountability.

1.4 THE TEEB APPROACH: REPLICATING THE SUCCESS OF EARLY TEEB WORK FOR TEEBAGRIFOOD

It is the belief of those who have been involved with TEEB throughout its development that the initiative’s success and longevity are not solely due to the compelling narrative behind the work, but also its delivery approach.

TEEB work is not only deliberately open and transparent, but also reliant on the communities of practice that it aims to foster and develop. Through open and widely publicized calls for evidence, both the original TEEB work and TEEBAgriFood reached out to this community to gather evidence and to encourage further development and uptake of best practice.

Change cannot be realised without developing a community that connects researchers and decision makers across different sectors. This is a critical element of the way TEEB works. It is our hope that the reader of this

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report will be inspired to become part of this community, which is not just focused on knowledge generation, but the connection of this knowledge to those who can influence change.

TEEB's governance structure is also supportive of this. The TEEB initiative is coordinated through the TEEB office situated in UN Environment and geographically based in Geneva, Switzerland. The overall TEEB initiative is guided by a high-level independent Advisory Board with members spanning government, business, academia and civil society, and TEEB Study Leader and UN Environment Goodwill Ambassador Pavan Sukhdev. It is also supported by a Coordination Group, including those working directly on the TEEB work programme and policy makers from supporting countries. This helps to ensure links to ongoing international policy processes and to see that TEEB responds to and is relevant in the context of international demands.

As it is a major new undertaking, the TEEBAgriFood study also has its own Project Steering Committee (chaired by Alexander Mueller, the TEEBAgriFood Study Leader), whose members are more substantively engaged in the TEEBAgriFood work, providing support in various forms including expert contacts, direct input and guidance and peer review. Summaries of the governance structure and work to date on this project are readily available via the agriculture and food section of the TEEB website <http://www.teebweb.org/agriculture-and-food/>.

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