The Economics of Ecosystems & Biodiversity

TEEB for Agriculture & Food

Towards a Global Study on the Economics of Eco-Agri-Food Systems

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"Agriculture is arguably the highest policy priority on today's global political agenda, in recognition of its widespread impacts on food security, employment, climate change, human health, and severe environmental degradation. This study will build on the earlier successes of TEEB by drilling into the heart of these issues and exploring the latest evidence to paint a global picture of our agricultural and food systems. This body of work will provide a detailed look at their dependency on ecosystems and biodiversity, their impacts on human and ecological well-being and health, and the underappreciated role of small-scale farmers.
I truly see this as being one of the most timely and important research initiatives in the field of sustainable agriculture, and am honoured to be a part of it."

**** This version is a working document. For the final version please visit: www.teebweb.org/agriculture-and-food**

The GOOD

For millennia, agriculture has been the most visible example of human interaction with nature. Through human innovation, generations of farmers have worked with and cultivated nature's soils, water, and biodiversity to create a wealth of knowledge, a wide variety of seeds, breeds and farming practices, developing a huge variety of production systems adapted to different ecological conditions. Agriculture represents our most valuable life support system today. Indeed, the world would be a different place without the benefits that we receive from our agriculture and food systems.

The numbers below demonstrate the ubiquity of agriculture and the benefits it provides, while painting a picture of just how many of us are dependent on agriculture for our livelihoods and well-being, especially those living in rural poverty.

Agriculture employs 1 in 3 people of the world's economically active labour force, or about 1.3 billion people[i]. For the 70 per cent of the world's poor living in rural areas, agriculture is the main source of income and employment.

Smallholder farms (i.e. less than 2 hectares) represent over 475 million of the world's 570 million farms[ii] and, in much of the developing world, they produce over 80 per cent of the food consumed[iii].

Food production systems produce approximately 2,800 calories per person per day, which is enough to feed the world population[iv].

Agriculture supplies the world with over 130 billion litres of bio-fuel every year (105 and 26 for bio-ethanol and bio-diesel, respectively)[v] as global demand increases for its use in transportation, electricity and heating.

Agriculture provides everyday needs not just through food, but through the production of raw materials and natural fibres, including wood, cotton, wool, silk, as well as new emerging developing country markets in bamboo, sisal, jute, abaca and coir[vi].

Agriculture is an integral part of our cultural landscapes, and integral to our cultural identity. They underpin community values, festivity, social cohesion, and tourism, and its landscapes are a location and source of recreation and mental/physical health, providing at times a spiritual experience and sense of place.

The BAD

Agriculture and food production systems today apply a diverse range of methods and practices, ranging between industrial and small-scale, organic and conventional, mixed and monoculture, making it virtually impossible to generalize their 'externalities' (see Box 1) on human and ecological well-being. Still, there are evolving trends, both globally and within countries, that present serious cause for concern.

While current food production systems produce a third more calories that needed, an estimated 805 million people in the world are chronically undernourished, the vast majority of which (98 per cent) live in developing countries[vii]. Furthermore,, over two billion people suffer from nutritional deficiencies such as vitamin A, iron, zinc, and iodine[viii]. Conversely, almost two billion adults in the world are considered overweight, 600 million of whom are obese[ix].

Box 1. What is an 'externality'?

An externality refers to the impact of a transaction or activity on any person or institution that did not explicitly agree to this transaction or activity. Such third-party impacts can either be benefits (positive externalities) or costs (negative externalities)[x].

Eighty per cent of new croplands are replacing tropical forests[xi], a trend resulting in significant biodiversity loss and ecosystem degradation.

Crop and livestock farming produce between five and six billion tons of CO_2 equivalent in greenhouse gas (GHG) emissions each year[xii], mostly in developing countries where the agricultural sector has expanded in recent years.

The agricultural sector utilizes 70 per cent of the water resources we withdraw from rivers, lakes and aquifers, [xiii] raising serious concerns of sustainability and security. A 2012 report[xiv] by the US Director of National Intelligence warned that water availability and use was a source of conflict that could potentially compromise US national security.

Agricultural use of fertilizers has also adversely impacted marine and riverine ecosystems, producing over 400 aquatic "dead zones" worldwide, covering an area of 245,000 sq.km through eutrophication (see Box 2)[xv].

Box 2. What is 'eutrophication'?

Fertilizers provide nutrients, such as nitrogen and phosphorus, to enhance plant and crop growth in agriculture. When excessive amounts of these nutrients reach lakes and oceans due to runoff and wastewater discharge, it provides a food source for blooms of blue-green algae ("cyanobacteria") that, as they die and decompose, depletes water of oxygen and slowly chokes aquatic life, creating "dead zones". This process is known as eutrophication. In addition to fertilizers, runoff from industrial animal production facilities or "factory farms" can also cause eutrophication.

Worldwide, crop diversity in farmers' fields has dropped 75 per cent in the last hundred years[xvi]. Crop diversity can provide insurance to agricultural systems, in the absence of which, our systems are more vulnerable to diseases and pests.

The agricultural sector is the world's largest user of antibiotics, using 70% of all that is manufactured[xvii]. The use of antibiotics, may create resistant strains of microbes in humans, posing serious threat to human health by decreasing our ability to treat various drug resistant microbes[xviii].

By concentrating a large number of animals within small areas, industrial meat production also poses risks to human health. Crowded animal facilities increase the risk of contamination by pathogens, and automated methods of slaughtering and meat processing make it difficult to detect contamination[xix].

Worldwide, crop diversity in farmers' fields has dropped 75 per cent in the last hundred years[xx]. Crop diversity is a 'public good': although it is in society's interests to maintain crop diversity as it has an 'insurance value', it is not in the interest of individual farmers to do so.

The inappropriate **use of antimicrobial drugs in animal husbandry** favours the emergence and selection of resistant strains and leads to the spread of antimicrobial resistance (AMR) The World Health Organisation warns, that AMR is an increasingly serious threat to global public health. „The problem is so serious that it threatens the achievements of modern medicine. A post-antibiotic era— in which common infections and minor injuries can kill—is a very real possibility for the 21st century."[xxi] And it is well known that „in the rearing of animals, the need for antimicrobials can be reduced by improved hygiene measures, management and vaccination".[xxii]

…and the INVISIBLE

Agricultural productivity is dependent on many inputs. Usually we tend to think of these in terms of labor, machinery, technology, fertilizers, pesticides and the like.

Box 3. What do we mean by 'biodiversity', 'ecosystem' and 'ecosystem services'?

'Biodiversity' is described as the sum total of organisms including their genetic diversity and the way in which they fit together into communities and ecosystems.

An 'ecosystem' is defined as the complex of living organisms and the abiotic environment with which they interact at a specified location.

'Ecosystem services' are considered to be the direct and indirect contributions of ecosystems to human well-being.

These critical inputs are considered to be 'visible', in the sense that their value to agricultural systems is recognized and reflected in decision-making agendas at all levels (farmers, industrial sectors, local and national government, and international dialogue).

However productivity of agricultural systems also depends on a range of other "invisible" inputs from nature. These include nutrient cycling, pollination, freshwater flow and purification, and biological pest control etc. These invisible inputs, often termed as services, are treated without value and are often economically *in*visible. It is no surprise that these critical inputs are often taken for granted, rarely reflected in decision-making, and increasingly under threat.

Indeed, FAO summarizes the current status of agricultural production systems in the following way: "…global achievements in production (of food) in some regions have been associated with degradation of land and water resources, and the deterioration of related ecosystem goods and services."[xxiii]

Unfortunately, there are very few incentives for farmers to maintain these ecosystems vital to farm productivity. Instead, farmers are only rewarded on the basis of yields. Maintaining healthy ecosystems, storing carbon, sustainable use of genetic resources, and other non-marketable goods do not generate income for farmers.


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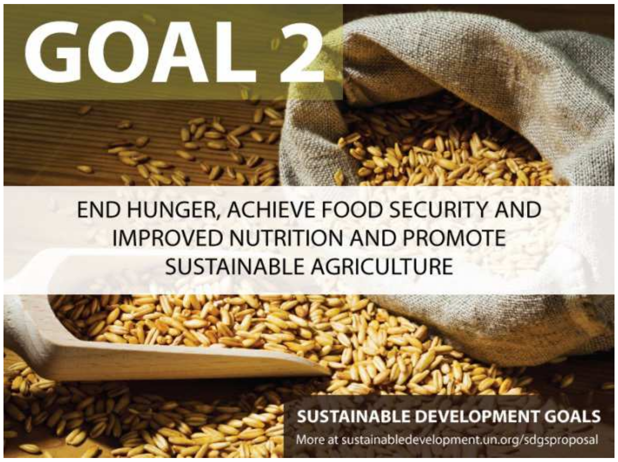
The relationship between ECOLOGICAL, AGRICULTURAL & FOOD SYSTEMS

Providing sufficient nutrition and achieving good health for all seven billion humans on earth, and future generations is one of the main challenges of our time . Our success or failure to surmount this challenge will be determined by our stewardship of ecosystems, agricultural lands, pastures, fisheries, and our management of labor, technology, policies, markets, and food distribution systems. Collectively, we refer to these as "eco-agri-food systems".

Our actions and behaviors at every level – the individual, firm, and society - are not aligned to address the challenges of sustainable agriculture and sufficient nutrition and health for all; indeed, the current system provides us with no incentives to reduce or reverse the alarming rates of ecosystem degradation and biodiversity loss. These issues have been recognized and identified as a key policy priorities for the sustainable development agenda beyond 2015 (e.g. SDGs 2 and 15).



There is a need to better understand these systems and their interrelationships in order to achieve our goals of stewardship of nature and sustainable management of our agricultural systems. We need to do this for three reasons.

Firstly, agriculture is the world's largest employer and plays a critical role in supporting the livelihoods of an estimated 1.3 billion people living in rural poverty[xxiv]. If the responses of governments, businesses, and farmers to significant climate risks and ecological scarcities are not well informed, then we run the risk of significant and potentially devastating upheavals in jobs and livelihoods for decades to come.

Secondly, the impacts on ecological systems will disproportionately hurt the poor , who are the most dependent upon them (see Box 4). We need to recognize these realities and respond with appropriate policies and measures to ensure that subsistence and smallholder farms are supported, improved and sustained in the face of climate risks and ecological scarcities. Smallholder farming is one (important) sub-set of the totality of eco-agri-food systems, and one that must be considered in any study looking at the full range of farming systems and interactions between them.

Box 4. GDP of the Poor

Traditional measures of national income like GDP, which measures the flow of goods and services, can be misleading as indicators of societal progress in mixed economies because of the "invisibility" of many of nature's values. In the original TEEB reports, an adapted measure – the 'GDP of the Poor' - was presented as a new metric that integrates economic, environmental and social aspects, thereby indicating the vulnerability of the rural poor if valuable natural resources are lost. It has been estimated that biodiversity and ecosystem services account for between 40 to 90 per cent of the GDP of the Poor.[xxv]

Finally, we have to recognize that the economic environment in which farmers and agricultural policy-makers operate in is distorted by significant externalities, both negative and positive, and a lack of awareness of our dependency on healthy ecosystems.

Many of the significant impacts of the agricultural sector on ecosystems, soil, water resources, biodiversity, and human health are economically invisible. Therefore they do not get the attention they deserve from governments or businesses who often make decisions based on economic rationale. This information gap must be addressed if we are to ensure our goal of providing sufficient nutrition and good health for all, and generations to come.

TEEB approach to The ECONOMICS of ECO-AGRI-FOOD SYSTEMS

The TEEB approach (see Box 5) with respect to 'eco-agri-food' systems is rooted in economic valuation. Although the services provided by nature are critical to the productivity and health of agricultural and food production systems, they are often invisible in the economic choices we make. Market prices paid for farm produce cover the cost of inputs such as seeds, fertilizers, and seeds, but not the value of bees pollinating crops, or microorganisms cycling nutrients into the soil, the lack of which can cause crops to fail. Likewise, agricultural producers are typically neither fined for causing negative externalities, such as pesticide runoff or soil erosion, nor rewarded for positive ones, such as ensuring groundwater recharge through farm vegetation or preserving scenic rural landscapes. These invisible costs and benefits are missing as key inputs into the economic system in which farmers operate, creating a skewed and incomplete picture.

Box 5. The TEEB approach to valuation

TEEB follows a novel approach to the way in which we value nature. First and foremost, it considers valuation to be a human institution, largely dictated by socio-cultural values, norms, beliefs and conventions. As such, different interpretations of 'value' will exist, none of which should be perceived as either incorrect or invalid.

In order to better analyze and structure the process of valuation, TEEB outlines an approach that involves three different levels of action:

1. *Recognizing value* – identifying the wide range of benefits in ecosystems, landscapes, species and other aspects of biodiversity, such as provisioning, regulating, habitat/supporting and cultural services
2. *Demonstrating value* – using economic tools and methods to make nature's services economically visible in order to support decision-makers wishing to assess the full costs and benefits of land-use change
3. *Capturing value* – incorporating ecosystem and biodiversity benefits into decision-making through incentives and price signals

It should be pointed out here that assigning an estimated value for a particular ecosystem service does not mean that this is 'the price'; TEEB in no way supports the commoditization (or 'selling off') of nature.

For more information on the challenges of valuation and TEEB's responses: , please read:
www.teebweb.org/publication/teeb-challenges-responses/

The TEEB approach aims to address the full range of costs and benefits, both visible and invisible, by embarking on a comprehensive valuation exercise of eco-agri-food systems. Before doing so, however, a few prerequisites must be met.

Estimating the true value added by eco-agri-food systems

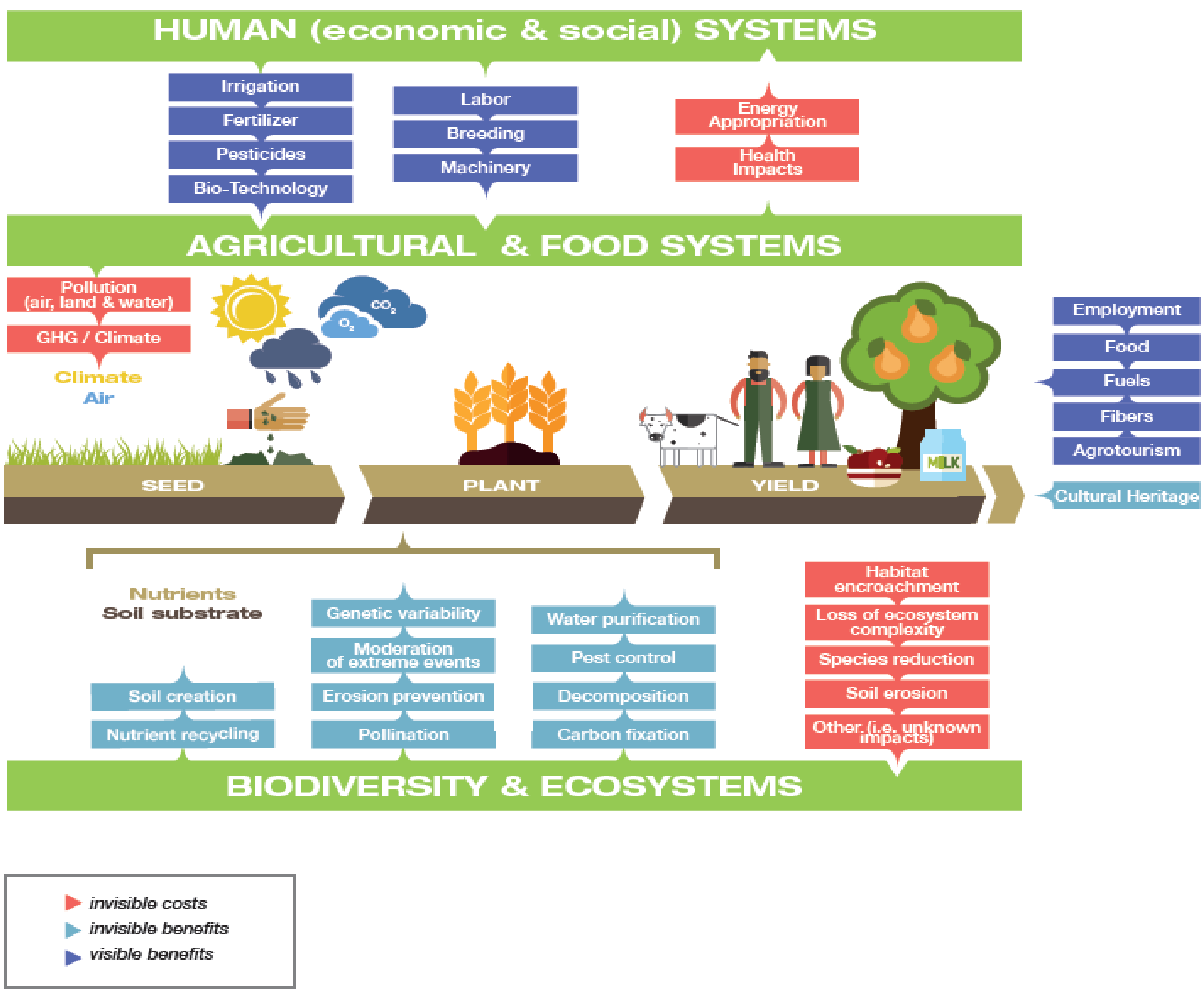
First, there must be clarity about the *appropriate scope and boundary for valuation.* Setting *scope* is about deciding which agricultural sector, geography, agri-business, or products are being considered for valuation. Setting a boundary is about deciding how much of the value chain to include for the specified scope**.**

Such an evaluation needs to consider *all material (i.e. significant) externalities* that emanate from or affect the eco-agri-food systems complex, but are generally missing from policy evaluations, business calculations, and farming decisions due to their economic invisibility. In other words, all material hidden costs and benefits must be revealed and valued in order to support holistic decision-making.

Second, there must be clarity and consistency on *what to value and why*. Social and economic impact is the preferred basis of including - or excluding - various forms of value-addition and externalities. In other words, there must be a widely accepted and consistently followed *valuation framework*. In order to address different kinds of farming systems, ecological and social contexts and geographies, establishing some degree of comparability in measurement across these systems is essential for meaningful conclusions to be drawn.

Figure I below presents our framework for this study, outlining the processes and relationships that characterize eco-agri-food systems. An important element of this framework are the positive and negative externalities which we consider to be 'material' to the discussion. Some striking examples are highlighted in more detail below, demonstrating that their inter-connectivity is real and needs to be thoroughly evaluated in order to shed light on the key research questions for this study.

Figure I. TEEBAgFood framework for analysis



Pesticides and their degradates from agricultural use can flow into air, soils and water, resulting in the accumulation of toxic substances

Annually, the world uses about 3 million tons of pesticides (including herbicides, insecticides, and fungicides), an estimated .1% of which reach the target pests[xxx]. Environmental impacts can include widespread decline of birds, amphibians, and beneficial insect populations[xxxi].

Pesticides can also enter human bodies directly and through food chains. For example, traces of DDT, lindane and dieldrin in fish, eggs and vegetables still exceed the safe range in India[xxxiii]

As many as 25 million agricultural workers worldwide experience unintentional pesticide poisonings each year[xxiii]

Intensive agricultural practices can compact soil, destroy soil structure and kill beneficial organisms within the soil food web

Conventional farming techniques (e.g. ploughing, tilling and harrowing) can make soils susceptible to wind and water erosion. Brazil, for example, loses 55 million tons of topsoil every year due to erosion from soy production[xxxiv].

Unsustainable agricultural practices (e.g. over-cultivation, overgrazing, and overuse of water) can contribute to desertification[xxxv], adversely impacting people, livestock, and the environment.

Today's rate of arable land degradation is estimated at 30 to 35 times the historical rate and, every decade, we are losing at least 120 million hectares of land, an area the size of South Africa, to desertification and drought alone[xxxvi].

It is estimated that some 50 million people may be displaced within the next ten years as a result of desertification[xxxvii].

Agricultural expansion has had a tremendous impact on habitats and biodiversity

Globally, agriculture has cleared or converted 70% of grasslands, 50% of savannah, 45% of temperate deciduous forests, and 27% of tropical forest biome[l, l].

Agricultural expansion is increasingly taking place in the tropics, where an estimated 80% of new cropland is replacing forests[l]. As reservoirs of carbon and biodiversity, this trend is having significant impacts on both.

At farm level, studies show the negative effects of agricultural intensification (e.g. increased use of pesticides, synthetic fertilizers, and reduced use of diversified farming techniques) and land simplification on biodiversity, as measured by plant and bird richness and abundance[l, l].

Soil organisms perform critical functions for cycling of nutrients necessary for plant growth, but current levels of fertilizer use can be counterproductive and limit this function

It is estimated that 60% of the nitrogen and 50% of the phosphorous applied to crops worldwide is in excess[xliii]. Excess nitrogen in soil can lead to less diversity of plant species and reduced production of biomass[xliv]

The agricultural sector can affect water resources by diverting it from other potential uses, or by impairing water quality through use of chemicals and fertilizers

Globally, the agricultural sector consumes about 70% of the planet's accessible freshwater[xxiii], and 60% of this water is wasted via runoff into waterways or evapotranspiration[xxiv].

It is projected that there will be insufficient water available on existing croplands to produce food for the 9 billion people expected in 2050, if current dietary and management trends continue[xxv].

Every year due to eutrophication, a "dead zone" forms around the mouth of the Mississippi River [xxvi], resulting in declines in the shrimp fishery, as well as in other local fisheries in the Gulf region [xxvii]

Crop genetic diversity is useful in managing pests and diseases, as well as enhancing pollination services and soil processes in specific situations

Since the 1900s, some 75% of plant genetic diversity has been lost as farmers worldwide have swapped their multiple local varieties and landraces for genetically uniform, high-yielding varieties [xxxviii]

Agricultural systems create significant amounts of greenhouse gas (GHG) emissions, including CO_2, CH_4, and N_2O

Agricultural systems contribute to GHG emissions in various ways: (i) using fossil fuels in food production, (ii) using energy-intensive inputs (e.g. fertilizers), (iii) cultivating soils and/or soil erosion resulting in the loss of soil organic matter, and (iv) producing methane from irrigated rice systems and ruminant livestock.

The direct effects of land use and land-use change (including forest loss) have led to a net emission of 1.6 gigatons of carbon per year in the 1990s[xxiii, xxiv].

Valuation Methodologies

It should be noted that *valuation methodologies* (which answer the question '*how to value?*') can be many even if the valuation framework is just one; some guidance needs to be provided as to which methodology is appropriate in what context For instance, the economic impact of on water quality attributable to an ecological loss such as deforestation could be measured and valued in terms of an engineering solution (such as the costs of building and operating a water treatment plant instead) or alternatively, it could be measured and valued in terms of lost agricultural productivity across two sets of sites, one with and the other without proximate deforestation. Both are valid in theory, but will give different answers to the same question.

Finally, it may still not be possible to conduct effective valuations because of the lack of readily available data. In such circumstances, the concept of value transfer can be applied, where benefits or costs measured in one context – ecosystem and farming system – can be applied to another geography and socio-economic context.

The Way Forward

"When we talk about agriculture and food production, we are talking about a complex and interrelated system and it is simply not possible to single out just one objective, like maximising production, without also ensuring that the system which delivers those increased yields meets society's other needs [such as] the maintenance of public health, the safeguarding of rural employment, the protection of the environment and contributing to overall quality of life.
[We should] not shy away from answering the big questions. Chiefly, how can we create a more sustainable approach to agriculture while recognizing those wider and important social and economic parameters – an approach that is capable of feeding the world with a global population rapidly heading for nine billion? And can we do so amid so many competing demands on land, in an increasingly volatile climate and when levels of the planet's biodiversity are under such threat or in serious decline?"

HRH Prince Charles, the Prince of Wales
"On the Future of Food" speech, 2011

'**TEEB for Agriculture & Food**' is setting out to answer these "big questions" concerning our agriculture and food systems. This will be achieved by bringing together economists, business leaders, agriculturalists and experts in biodiversity and ecosystem services to systematically review the economic interdependencies between agriculture and natural ecosystems, and provide a comprehensive economic valuation of 'eco- agri-food systems'.

As a first step, a number of sector-specific 'feeder studies' have been commissioned (on rice, livestock, palm oil, inland fisheries and agro-forestry), each focused on assessing the social and environmental externalities of producing a particular agricultural commodity. The studies also look at the dependency of the various production processes on biodiversity and ecosystem services. These analyses are being done to not only include a wide geographical spread of agricultural systems (Figure 2), but also to include varied kinds of production systems (See Table 1 for inland fisheries).

Figure 2. Global mapping of TEEBAgFood 'feeder' studies

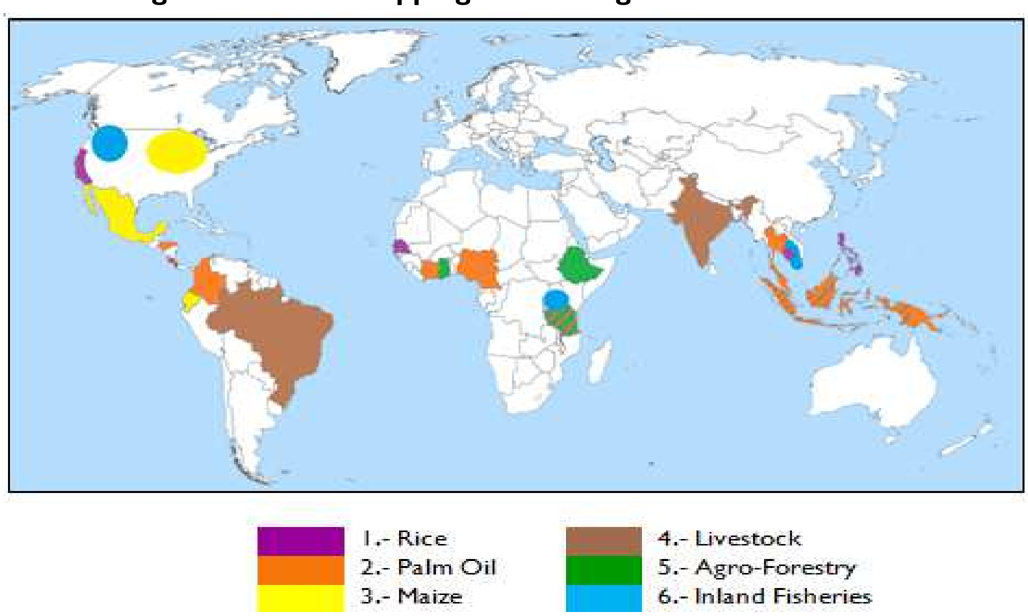


Table 1. Typology of production systems assessed in inland fisheries

Case study area	Production systems and main water management practices assessed
1. Lower Mekong Basin, South-East Asia	Rice fields with fish production: (artisanal fisheries, including floodplain rice-field fisheries). Cage aquaculture in reservoirs Culture-based fishery or Pond aquaculture
2. Lake Victoria, East Africa	Industrial fisheries (Nile perch) Cage aquaculture in lakes
3. Columbia River, USA	Recreational/small-scale fisheries

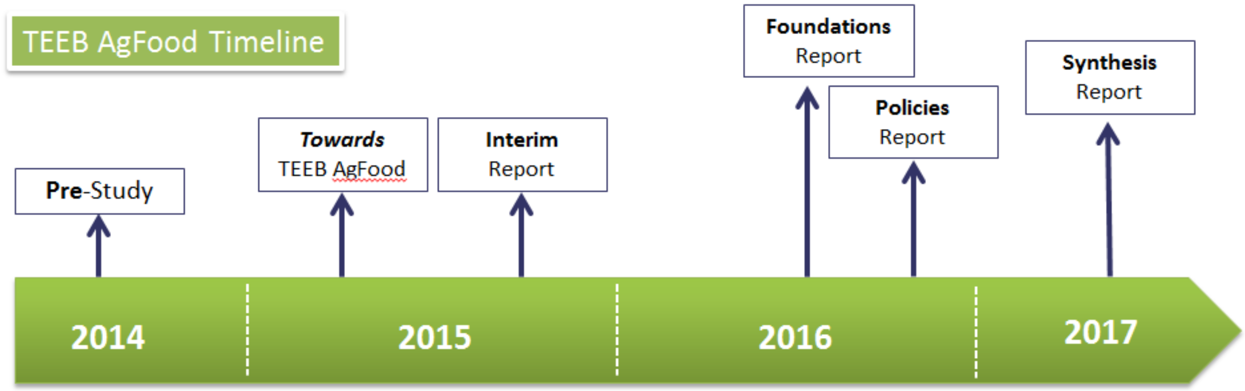
The findings from these sector feeder studies (see Boxes 6, 7 and 8 for preliminary findings) are to be documented in an **Interim Report** due to be published in October 2015. The Interim Report will include not only an assessment of these sectors but also, *inter alia,* the further development of the TEEBAgFood conceptual framework, the role of natural capital accounting, the potential role of agro-ecology in providing a pathway for change, and how the findings from these studies feed into the main body of work for TEEBAgFood .

As the results from the feeder studies trickle in, the process has allowed us to identify a number of methodological challenges and opportunities for strengthening future project activities. First, in addition to data availability and data quality concerns, the issue of mapping ecosystem condition to ecosystem services, and to other economic and social indicators remains a steadfast challenge. This calls for a deeper look into valuation methods, particular as they relate to agricultural externalities.

Second, while the feeder studies look at monocultures, it is important to extend the analysis to more complex forms of food production such as mixed systems. Third, there is also the need to reflect the relationship between different agricultural sectors in the analyses – maize and livestock for example. Lastly, a more comprehensive analysis is needed to understand the life cycle impacts of food production, to include the entire supply chain.

In light of the above, the TEEBAgFood reports that follow the Interim Report are likely to include further sectoral level analysis, new cross-sectoral analysis, and an assessment of methodological approaches that are best suited to accounting for externalities of eco-agri-food systems.

In order to accomplish the above, a **Call for Evidence** will be issued to the wider agri-food community to collect a range of case studies with a broad geographical spread, covering a range of ecosystem services and approaches to their inclusion in decision making. This work would contribute to two reports to be published in 2016.



A **'Scientific and Economic Foundations' report** will address core theoretical issues and controversies underpinning the valuation of the biodiversity and ecosystem services within the agri-food sector. The report will also set a theoretical context for broader assessment of agricultural policies – the ones that allow decision makes to assess the environmental and social impacts of agricultural interventions. It will also include methodological frameworks for sector-level assessments wherein a shift from one production system top another can be evaluated in terms of ecosystem services provisioning and distributional impacts as well.

Building upon the foundations of valuing ecosystem services for agriculture, there is a need to investigate the 'theory of change', i.e. how can these valuations form an integral part of decision-making, and what are the institutional changes required to do so? A **'Policies, Production and Consumption' report** will focus on assessments of different agro-ecological production systems within different socio-economic contexts, extending these to policy reform. Moreover, since TEEBAgFood concerns not only agriculture but entire food systems, the report will also consider food policies, including those targeting distribution, waste and food safety along the entire food chain, from production to final disposal.

The aim of the **Synthesis Report** is to have clearly articulated key messages and policy recommendations arising from the findings of the core reports, written with a broad readership in mind. It will be supported by an extensive communications strategy.

Box 6. Key interim findings from the TEEBAgFood palm oil study

In a preliminary assessment by Trucost (2015), the top eleven palm oil producing countries were evaluated based on their 'natural capital' and 'social capital' costs. These costs were determined by evaluating three main criteria: (i) yield and conversion rate; (ii) quantity and type of inputs; and (iii) the monetary value per quantity of emissions.

Some high-level results* are summarized below. While the full set of findings will be published in the Interim Report, it is clear that production methods and agro-ecological conditions are having a huge influence on the natural and social costs of production. The global market is not reflecting these externalities in an appropriate way.

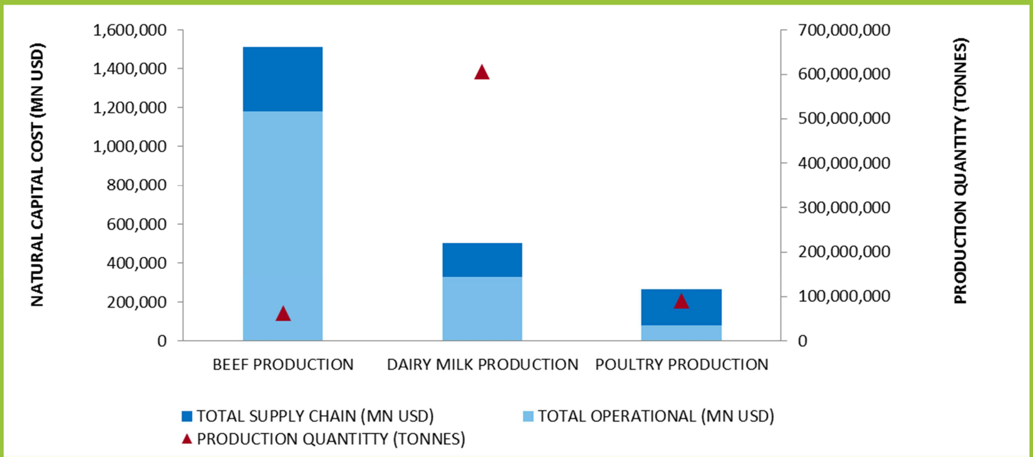
- Palm oil is the world's most consumed vegetable oil with over 56 million metric tons consumed in 2013, a number which is expected to continue to grow as demand is forecast to double over the next 40 years for use in food, cosmetics and biofuels.
- Palm oil and palm kernel oil production generates natural and social capital costs, consisting largely of carbon emissions and their impact on global warming (58 per cent), fertilizer application (23 per cent); palm oil mill effluent emissions (12 per cent); manufacturing of inputs (4 per cent); and pesticide application (3 per cent).
- In total, palm oil and palm kernel oil production in the top eleven producer countries generates natural and social capital costs of US $44 billion per year, ranging between US $271 and US $1,300 per ton, depending on the practices used and the agro-ecological conditions.
- The top two producing countries contribute 66 and 26 per cent (respectively) of the total costs, largely driven by their high production quantity and high intensity (i.e. cost per ton).
- Palm oil production in countries with significantly lower rates of peatland drainage and forest conversion is significantly less costly (difference of $563 per ton).
- Social capital costs in terms of human health, due to the high application of fertilizers coupled with poor access to safe drinking water, amount to roughly $533 per ton of palm oil produced.
- The final study will also present an in depth-study of Indonesia as the main producing country and will also include scenarios based on different production methods.

This study is one of the feeder studies commissioned by TEEB. Please note that the results are preliminary and not yet peer reviewed.

Box 7. Key interim findings from the TEEBAgFood livestock study

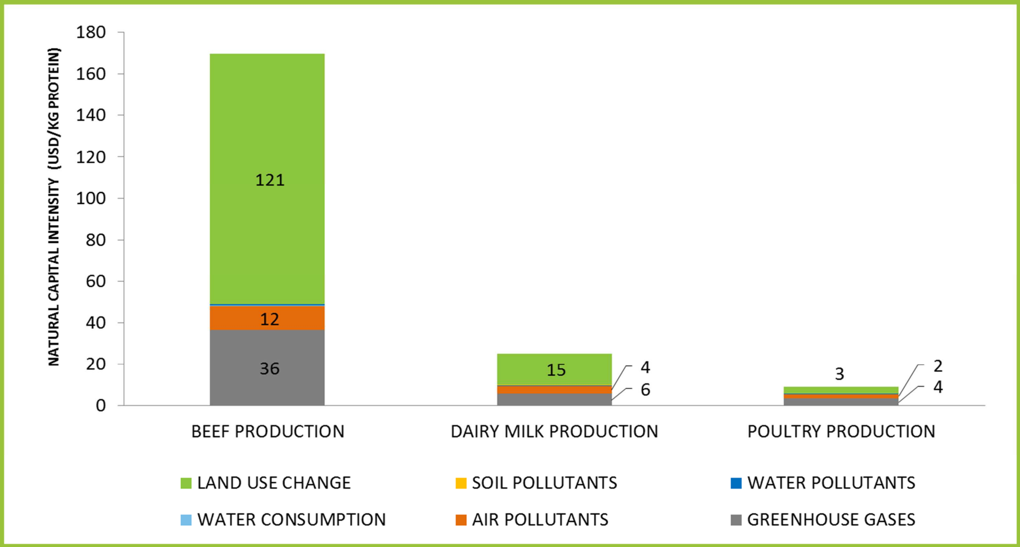
The livestock research team are assessing beef, dairy milk and poultry production. Some key interim findings:

1.- Beef production has the highest impact on natural capital at a global scale. The total natural capital cost of beef production worldwide is approximately three times higher than that of milk production and six times higher than poultry production.



2.- As compared to beef and dairy milk, poultry production has significantly smaller impacts at the farm level, partly due to less land required per animal, and lower GHG emissions, e.g. methane.

3.- In assessing impacts per unit protein produced, poultry production has the lowest impacts due to a combination of the high protein content and low impact on natural capital.



This study is one of the feeder studies commissioned by TEEB. Please note that the results are preliminary and not as yet peer reviewed.

Box 8. Key interim findings from the TEEBAgFood livestock study

A study by FAO (2015) argues that rice production systems deliver various benefits to humans in terms of the provisioning of food, water quality, water quantity, raw materials and climate change mitigation. However, there exist a diverse range of rice production systems and management practices around the world, involving certain trade-offs and/or synergies among the benefits provided. In order to analyse these trade-offs and synergies in more detail, FAO looked at different systems and practices across five different case study regions, namely the Philippines, Cambodia, Senegal, Costa Rica and California (United States).

In the Philippines, for example, traditional rice terracing practices are often used, which are considered to be "feats of landscape engineering for watershed management and water control". Essentially, they capture floodwaters during monsoon periods, and recharge groundwater that may be used during drier periods. Yet these traditional methods are increasingly giving way to more modern forms of production, which might lead to higher yields, yet provide less benefits in terms of water storage. This demonstrates that certain production systems and techniques are perhaps better equipped to maximize synergies and reduce trade-offs than others.

Depending on the conditions of each management practice, these relationships are shown to have either positive, negative or neutral effects on different aspects of rice agro-ecosystems. The next step is to quantify these effects and deliver a detailed biophysical assessment of rice agro-ecosystems that will then build the basis for the monetary valuation exercise to be conducted by project partners, Trucost.

This study is one of the feeder studies commissioned by TEEB. Please note that the results are preliminary and not yet peer reviewed.

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Towards a Global Study on the Economics of Eco-Agri-Food Systems

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'The Economics of Ecosystems and Biodiversity' (TEEB)
is a global initiative focused on "making nature's values visible".
Its principal objective is to mainstream the values of
biodiversity and ecosystem services into decision-making at all levels.
It aims to achieve this goal by following a structured approach to valuation
that can help decision-makers to
recognize the wide range of benefits provided by ecosystems and biodiversity,
demonstrate their values in economic terms and, where appropriate,
capture those values in decision-making.

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NOTES

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