New Horizons for the Transitioning of our Food System: Connecting Ecosystems, Value Chains and Consumers

Discussion paper by NewForesight and Commonland with contributions from The Boston Consulting Group

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Introduction

The authors and contributors to this report feel that despite the groundbreaking work that has been done over the past decades, the transitions within our food systems as part of healthy ecosystems are not proceeding fast enough.

A transition towards sustainable food systems will be an essential prerequisite to meet the Sustainable Development Goals. In this report, we will argue that such a food transition is not only a challenge, but offers significant opportunities for businesses, farmers, society, all being part of biodiverse ecological systems. These opportunities can be captured if we change our core approach to sustainability from fragmented, reductionist efforts to combat negative impacts towards programmes offering holistic long term solutions while capturing *net positive* business opportunities with multiple returns.

In this report, we will sketch an initial outline of what these holistic approaches could look like. The main aim of this report is to trigger decision makers in business, government and society to form coalitions, apply such holistic approaches and drive systemic change in our food systems at scale using an ecosystem approach. The authors, and their respective organizations, are committed to contribute to coalitions and to engage with decision makers and practitioners to make the food transition a reality.

About the Authors

New Horizons for the Transitioning of our Food System has been prepared by a joint team from NewForesight and Commonland with contributions from The Boston Consulting Group. They have done this on their own initiative, without sponsorship from any outside organization. The NewForesight team consists of Wouter-Jan Schouten, Lucas Simons, Niko Wojtynia, Bart Vollaard, Matthijs Maas, and Silvana Paniagua. The Commonland team consists of Michiel de Man, Jenneke Bijl-Segers and Willem Ferwerda. The Boston Consulting Group team consists of Anthony Pralle and Marty Smits.

In addition, we are grateful to the following people for their valuable insights, views and other input: Willem Lageweg, Barry Parkin (Mars), Lucian Peppelenbos (IDH), Matthew Reddy (WBCSD), Roland Sieker (Unilever), Pier Vellinga (Waddenacademie), Jochem Verberne (WWF), Henk Westhoek (PBL) and Bruce Wise (IFC).

About NewForesight Consultancy

NewForesight Consultancy (est. 2008) is a strategy consulting firm specialized in solving complex sustainability challenges and turning them into opportunities for all. NewForesight thinks about future-proof agriculture holistically, grounded in our extensive experience in transforming agro-commodity markets. We have worked with more than 25 industry platforms and NGOs, over a dozen government- and multilateral agencies, as well as front-running companies in all major agro-commodity sectors. The wealth of experience and insights from our diverse team, combined with frameworks and models which we have validated and perfected using real world application, allow us to shape systems that incentivize sustainable behavior.

About Commonland

Commonland (est. 2013) is an international foundation, founded by a group of experts, investors and a business school. Commonland believes that landscape restoration based on ecosystem science offers large untapped opportunities for sustainable economic development. To demonstrate this potential, the foundation develops and supports a pipeline of landscape restoration projects that are based on business cases. Multidisciplinary teams actively involve investors, companies and entrepreneurs in long-term restoration partnerships with farmers and land-users. Commonland's restoration approach combines and connects natural and economic landscape zones. This holistic framework delivers 4 returns®: returns on inspiration, social capital, natural capital and financial capital.

About The Boston Consulting Group

The Boston Consulting Group (BCG) is a global management consulting firm and the world's leading advisor on business strategy. We partner with clients from the private, public, and not-for-profit sectors in all regions to identify their highest-value opportunities, address their most critical challenges, and transform their enterprises. Our customized approach combines deep insight into the dynamics of companies and markets with close collaboration at all levels of the client organization. This ensures that our clients achieve sustainable competitive advantage, build more capable organizations, and secure lasting results. Founded in 1963, BCG is a private company with 85 offices in 48 countries.

Executive Summary

1. Fixing our agro-food systems based on healthy ecosystems is a fundamental pre-requisite to meeting the Sustainable Development Goals (SDGs).

2. In doing so, four *brutal facts* about today's food systems need to be addressed:
   a. malnourishment of half of the world population;
   b. radical and pervasive poverty for more than 75% of all farmers globally, with massive migration from rural areas to cities;
   c. environmental degradation: today's food system exceeds most planetary boundaries and is the main driver behind biodiversity loss, while contributing to a quarter of greenhouse gas emissions;
   d. large-scale food waste.

3. Addressing these facts is not only a challenge. There is tremendous, as yet untapped value in fixing our food systems, from soils to plate. This offers significant opportunities for businesses, farmers, society and the planet. Front running organizations that appreciate the urgency; recognize these far-reaching opportunities; and get this transition right, will be rewarded with faster growth and value creation.

4. The transition towards *net positive* food systems depends on the articulation and implementation of a transition agenda, at three interrelated levels:
   a. Production Landscapes: driving the development of strong rural economies and local communities on resilient landscapes based on net positive and restorative agroforestry- and agriculture production models;
   b. Value chains: growth of net positive business models, allowing companies to differentiate based on quality (e.g. taste, nutrition) as well as their ability to sustain ecosystem functions and positive social impacts;
   c. Consumer end markets: enabling and incentivizing consumers to make healthy and sustainable choices.

5. The opportunities at these three levels can be captured if we change our core approach to sustainability from fragmented, reductionist efforts to combating negative impacts, towards long-term holistic programs. Such programs should connect actions at the three levels.

6. Many positive initiatives have been established in recent years, which can underpin these transition agendas. To catalyze the transition and achieve impact at scale, there is a need to form *coalitions of committed* frontrunners on the path towards net positive food systems using an ecosystem approach.

7. These coalitions need to focus on transforming specific combinations of interrelated agri-landscapes, value chains and consumer markets. It is crucial that these coalitions appreciate the importance of – and invest in – collaborative learning as a first step to identify and capture the opportunities for growth and value creation.

8. The authors and their respective organizations are prepared to contribute to such coalitions and to engage with practioners and decision makers in order to make the food transition a reality.

Why: facing the brutal facts about our food systems

The role of agriculture in sustainable development

Improvements in agricultural and (agro)forestry productivity have been a key driver of social and economic development throughout human history (cf. Manning, 2004; Davies, 2003). This crucial role of agriculture and food production is still prevalent in our time. Increasingly agriculture and other forms of landuse poses a huge threat for our global ecosystems, causing deforestration and overexploitation. In 2015 the Sustainable Development Goals (SDGs), have been adopted unanimously by the 193 member states of the United Nations. At least nine of the SDGs require as a fundamental precondition the existence of agriculture and food systems that are structurally sustainable, while the remaining eight SDGs are at least indirectly related. Increasingly scientists are convinced Food is in fact connecting all SDGs. c.f. Stockholm Resilience Center 2016b).

Figure 1: nine SDGs which can only be achieved if food systems are structurally sustainable

It is clear that the world's food- and agricultural systems have significant impacts on the socioeconomic, environmentaland cultural fabric of the world. However, as with most highly complex systems, advances in one dimension can have adverse effects in other dimensions. This is certainly the case for ecosystems that form the basis of all wealth creation, as the services ecosystems provides flow from natural capital and are an investor's primary asset. The next section will explore four alarming outcomes of this system as it has been operating over the past decades.

Four disturbing facts about food and agriculture

Despite significant increases in agricultural output since the 1960s (Wik, Pingali and Broca 2008), the world's agricultural system continues to exhibit four major shortcomings: high prevalence of malnutrition that threatens to undo advances in public health; many rural populations being stuck in poverty; an overstepping of planetary boundaries; and severe inefficiencies that result in food waste.

Malnutrition. Today, 22% of the population of least developed countries and 19% of sub-Saharan Africa are undernourished (World Bank 2016). There are an additional 1.2 billion suffering from micronutrient deficiencies (i.e. living on a diet lacking in iron, vitamins or other micronutrients such as iodine). Moreover, these conditions are likely to be further exacerbated by the 'hunger-risk-multiplier' of climate change (FAO, 2015; Chin & Kingham 2016). On the flip side, rising living standards, increasingly inactive lifestyles and diets increasingly rich in sugar and fat have led to a situation where overweight and obesity leads to more deaths than hunger and undernourishment: in 2014, 1.9 billion humans were overweight (and a third of those, obese). Taken together, over half of the world population of 7.4 billion is malnourished, with detrimental effects to socioeconomic development both in the developing world (where productivity is hampered by hunger) and the developed world (where the healthcare- and economic effects of obesity put a strain on the welfare state). As such, what is arguably the primary purpose of the agro-food system – to provide nutrition for the world – is not being adequately fulfilled.

Rural poverty. A condition for the proper functioning of the agricultural system is that the farmers and other agricultural workers who are directly responsible for food production can make a decent living. While there is no single standard for what constitutes a viable livelihood, we consider an annual value-added[1] of at least USD5,000 to be a minimum threshold that is needed to generate at least US$2[2] of disposable income per family member per day, and to still have funds available to invest in sustained and improved productivity of the farm. Currently, almost all agricultural workers (94%) generate less value added than USD5,000 a year, with the world average sitting just under USD2,000 (cf. Fig. 2). We categorize this demographic as being caught in a "poverty trap" – a trap of low wealth that is virtually impossible to exit because of exclusion from financial markets and an inability to reduce consumption and engage in even a modest savings strategy (Tittonell, Giller 2012; Carter, Barrett, 2006). This is compounded by rural abandonment, the mass exodus of rural populations to urban areas. This not only makes life in cities more crowded and less sustainable, but also causes rural areas to lose their communities, human capital and social safety net.

[1] Value added is a measure of economic output that sums the value of all final sales (including for export) of goods and services in a sector. Dividing this figure by the number of workers in agricultural sectors is a close proxy for the average annual income of a worker in that sector.

[2] $1.90 per person per day (2011PPP) has been the World Bank poverty line since 2015 (World Bank, 2015).

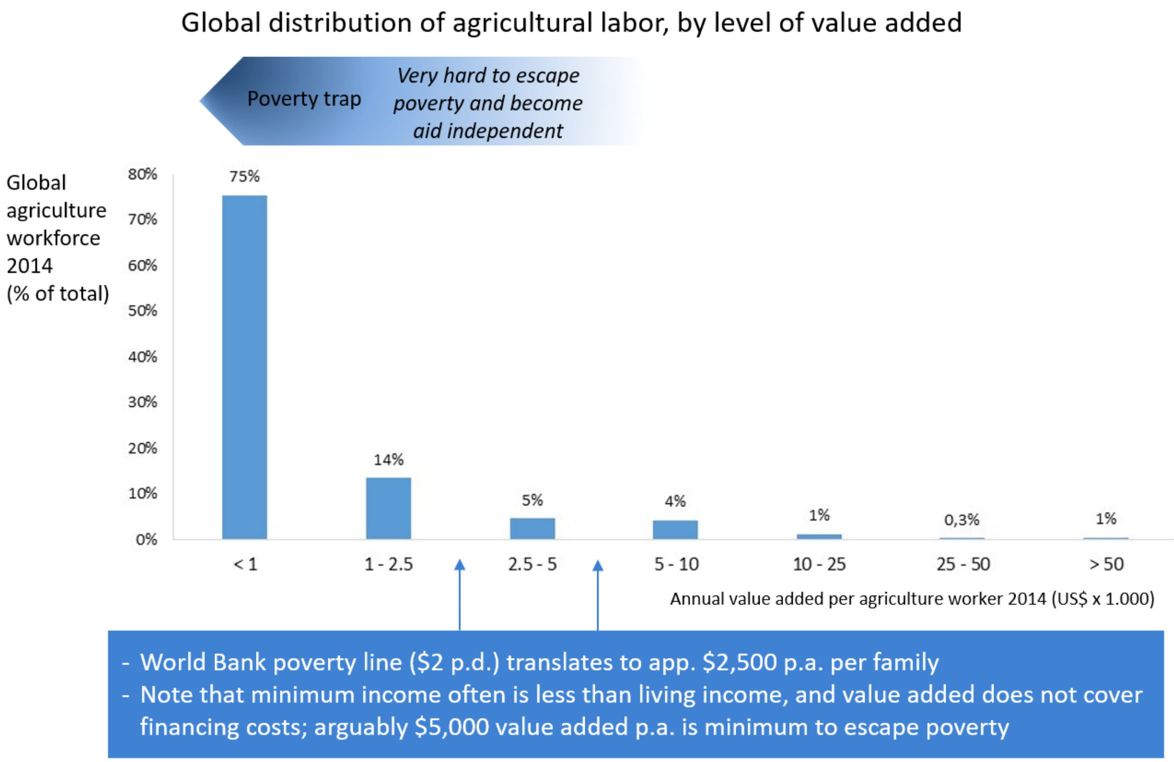


Figure 2: distribution of farmers and other agriculture workers over value added categories. Source: NewForesight analysis of World Development Indicators (World Bank)

Planetary boundaries. Agriculture relies on the world's ecosystems and biodiversity more than any other sector. Without biodiversity, the right climatic conditions, nutrients, functional soils and water systems, these systems will lose their resilience over time and crops cannot grow and become vulnerable to plagues. This process is called ecosystem degradation. It is therefore a great paradox that the agricultural and forestry systems undermine their own viability by pushing the boundaries of what the natural world can bear. A holistic framework for determining these boundaries has been developed by Rockström et al. (2009) and published as "Planetary Boundaries: Exploring the Safe Operating Space for Humanity." Crossing the thresholds of the boundaries that Rockström describes will likely lead to catastrophic consequences for the earth's ecosystems. Recent in-depth mapping of biodiversity across different global biomes has estimated that for 65% of the terrestrial surface, land use and related pressures have caused biotic (ecosystem) integrity to decline by at least 10% (Newbold et al. 2016)—the previously proposed safe limit. Under a business-as-usual scenario, considerable further losses are predicted for the coming decades (Newbold et al., 2015) – a process which, it is estimated, would rapidly erode the resilience of ecosystem functions (Oliver, et al. 2015, Isbell, et al. 2011). According to The Economics of Ecosystems and Biodiversity (TEEB) of the United Nations Environmental Programme (UNEP), ecosystem services are worth over US$21–72 trillion annually – comparable to the World Gross National Income of US$58 trillion in 2008. Furthermore, a recent report by the Netherlands Environmental Assessment Agency (PBL), commissioned by the UN Environmental Program (UNEP) and the International Resource Panel, illustrates how food production contributes to the overstepping of planetary boundaries. (Sukhdev 2008)

The most prevalent impacts of agriculture on our planet, related to the planetary boundaries are summarized in figure 3.

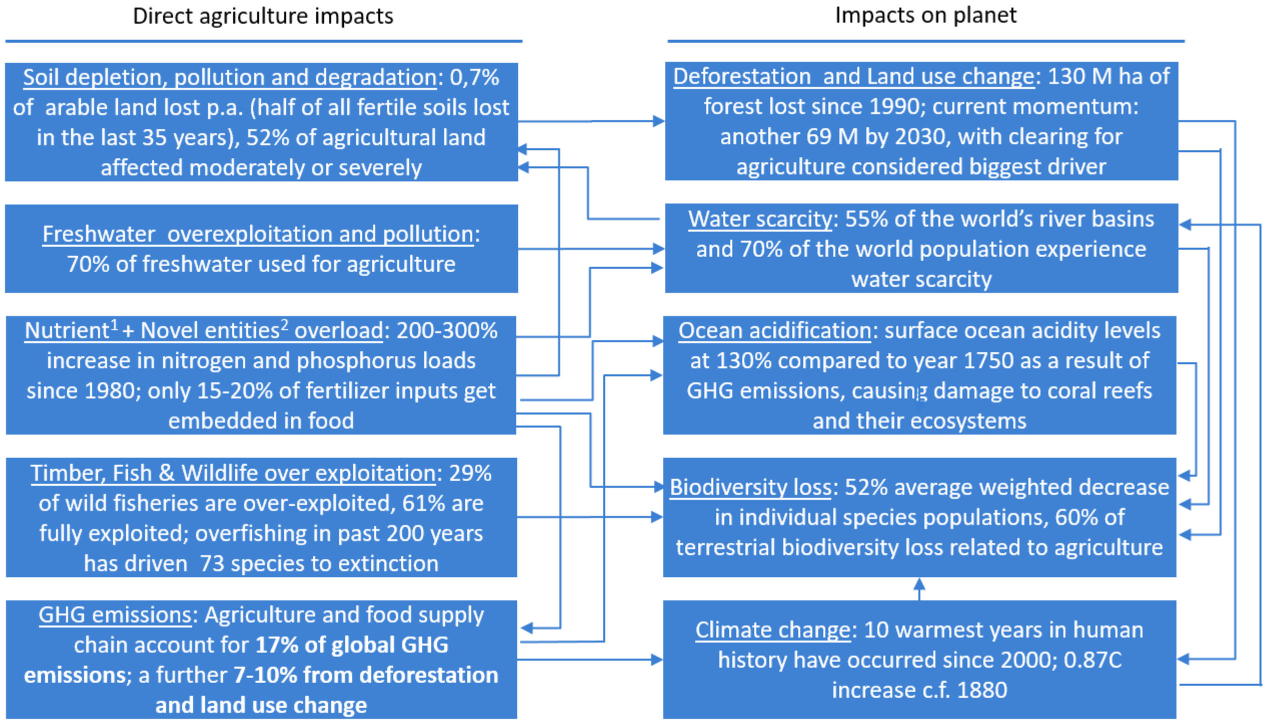


Figure 3: Pathways along which global food systems exceed planetary boundaries Sources: (Stockholm Resilience Center 2016a; Steffen et al. 2015; UNEP 2016; WWF & Metabolic 2016; WWF 2014; De Vos, et al 2015. Hoekstra & Mekonnen 2011. NewForesight Analysis)

Food waste. 1.3 billion metric tons of food, or between 30% and 40% of food produced globally, is wasted every year. This food accounts for 28% of agricultural land use, and is equivalent to 38 times the blue water footprint of US households. (Fresco and Poppe, 2016; FAO 2013, 27; Hoekstra & Mekonnen 2011) Generally speaking, more food is wasted proportionally by consumers in Europe, North America and Asian OECD countries, whereas in developing regions the majority of food is lost between the farm and retail stages. In developed countries, the main causes of food waste are food safety legislation, food appearance, quality standards and sheer abundance, whereas in developing countries the main causes are poor harvesting-, processing-, storage- and transport technologies as well as poor management (FAO 2011).

The interrelation between these facts and the SDGs

The historical example of the Green Revolution (cf. Pingali 2012) has shown that tackling these disturbing facts in isolation (focusing on just one or two of the issues at a time) will not address the fundamental dysfunctionalities of the global agricultural and food systems as part of global ecosystems, and that in fact the pursuit of more sustainable food and agriculture along just one dimension risks not only negative externalities which affect the environment and segments of rural populations, but also eventually risks undermining its stated aim of increasing food availability and reducing hunger. Along these lines, it is not hard to imagine how the currently predominating drive for ever-higher yields, or maximisation of Return of Investments per hectare, through input use and land clearance and pollution, as well as the trend of increasing meat consumption, causes ecosystem degradation, water depletion and GHG emissions on a scale that could eventually have disastrous effects on long term agricultural productivity. In fact, agriculture and food production already contributes to a quarter of global greenhouse gas emissions, and over the last 20 years, biodiversity loss, ecosystem degradation, urbanization and conversion of pastures have led to a loss of over 132 million hectares of arable land, offsetting the 130 million hectares of arable land created in that same period by deforestation. The United Nations Environmental Programme (UNEP), UN Convention to Combat Desertification (UNCCD) and World Resources Institute (WRI) estimate that there are 2 billion hectares of severely degraded land suitable for rehabilitation through forest and landscape restoration. Of that, 1.5 billion hectares are suited to mosaic landscape restoration, in which forests and trees are combined with other land uses, including agroforestry, and smallholder agriculture. (World Resources Institute 2014) As such, the amount of available arable land has effectively plateaued, despite the pressures for more land because of ongoing population growth and more demanding diets. In this light, a variety of institutions (including the IMF and US Environmental Protection Agency) have predicted an overall global reduction in agricultural productivity of up to 28% in the major food-producing region of Africa (EPA, 2015; Cline, 2008:24).

> "the pursuit of more sustainable food and agriculture along just one dimension risks (…) negative externalities, affecting the environment and segments of rural populations, [as well as] undermining its stated aim of increasing food availability and reducing hunger"

What: systemic changes for a sustainable food system

Having discussed the problems of our present-day food system, and before evaluating the opportunities which can be created through a change in our food system, we now first turn to the question of what changes must actually be achieved where.

To identify opportunities and intervention points for systemic change across both the social and environmental dimensions of the food system, it is useful to distinguish three levels in the value chain, at which specific interventions can leverage systemic change. These are: (I) within the agricultural and/or agroforestry production landscape; (II) throughout the agro value chain; and (III) at the level of consumer end markets.

Operationalizing change at these levels can help address six root causes (see Fig. 4) which presently lock in the unsustainable food system, drive the four disturbing facts, and inhibit any isolated efforts at change. We will now discuss these three levels, and their associated root causes, in turn.

> "Operationalizing change at these levels can help address six root causes which currently lock in the unsustainable food system "

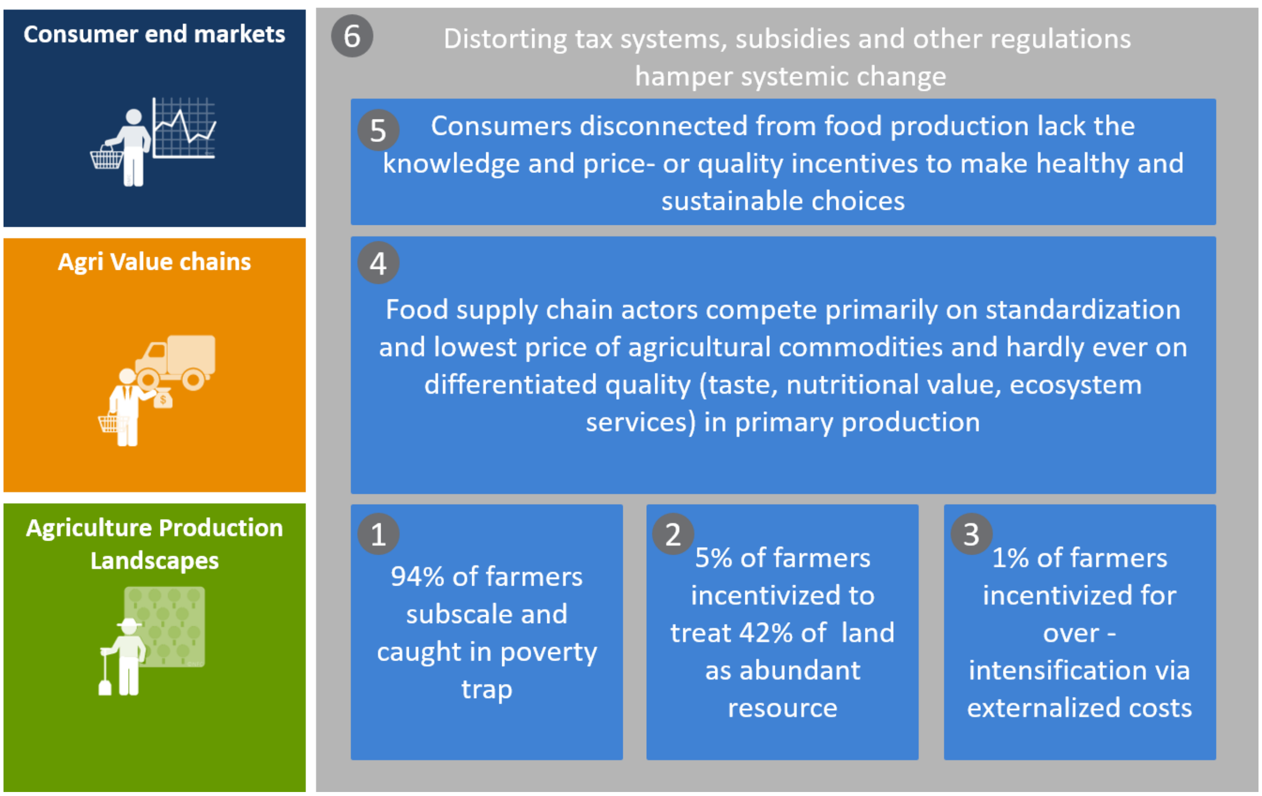


Figure 4. Six Root Causes that need to be addressed to achieve systemic change.[3]

[3] Ecosystem services are "the benefits people obtain from ecosystems" (Millennium Ecosystem Assessment, 2005). Within this, one can identify habitat services and ecosystem functions, as "a subset of the interactions between ecosystem structure and processes that underpin the capacity of an ecosystem to provide goods and services" (de Groot, et al. 2010:19), such as sustained production capacity, carbon sequestration, freshwater and biodiversity.

Agricultural Production Landscapes

The first set of opportunities can be found at the level of agricultural production landscapes. Appropriate interventions at this level can drive the development of strong rural economies and prospering local communities in resilient natural landscapes, laying the foundations for a net positive food system grounded in restorative agricultural production models and interacting with conservation areas.

However, designing appropriate interventions requires understanding the highly distinct sets of challenges which are faced by different archetypes of agricultural production areas around the world. To understand these challenges, we have examined both socio-economic and environmental conditions within these areas. In terms of socio-economic performance, we in particular highlight agricultural systems which are susceptible to generating poverty traps, by studying trends in a range of proxy indicators which include the agricultural value-added per FTE worker and per hectare, as well as the ratio of hectares to farm worker. On the environmental axis, we have studied trends in ecosystem degradation or changes in forested land over time (1990-2013); agricultural freshwater usage (as percentage of renewable freshwater reserves); nitrogen emissions from agriculture (in Kg CO2 equivalent per ha), and the number of endangered species (per 1000sq km), to enable the identification of areas where careless or over-intense agricultural practices have inflicted a heavy drain on the local environmental carrying capacity and biodiversity. On the basis of the unequal global distribution in per-country average farm size and land productivity (value-added per hectare), we distinguish three archetypes of agricultural production landscapes: poverty traps, land abundant areas, and intensive-agriculture systems (see Fig. 5), which in their geographic distribution largely trace patterns of economic development (see Fig. 6), and which each require a differently tailored set of solutions.

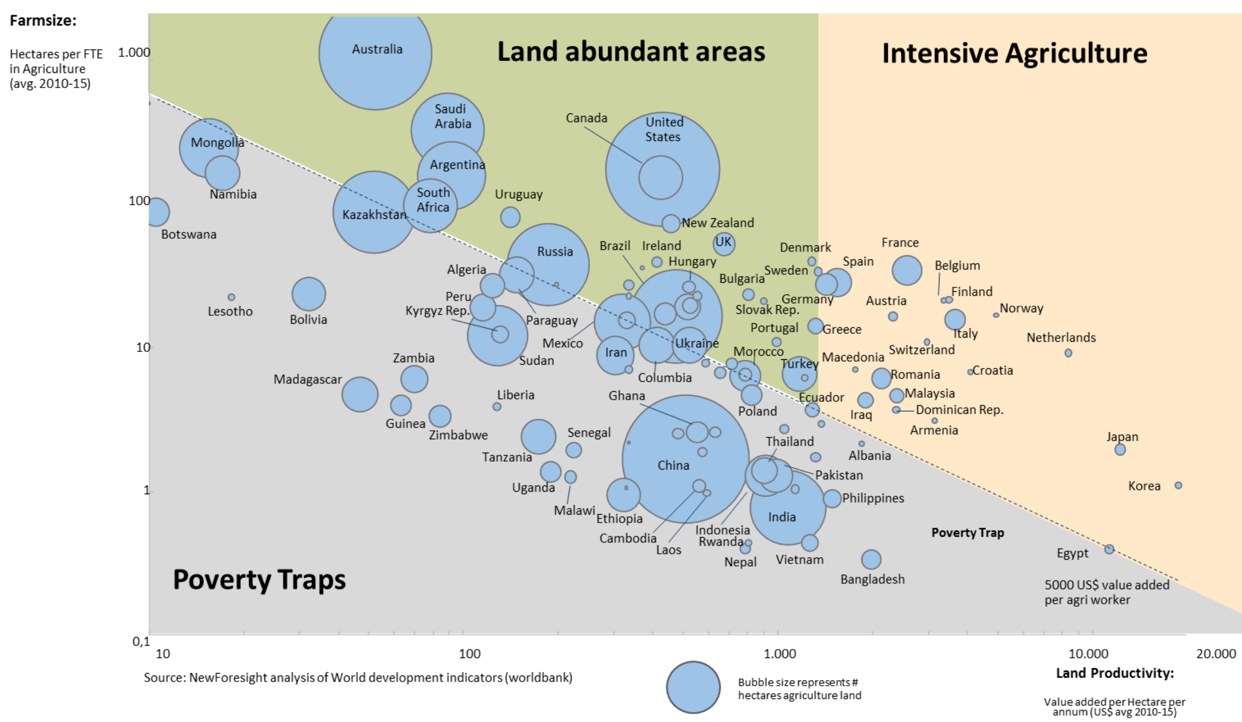


Fig. 5. Farm size and $ value added per hectare segment three archetypes of agriculture. Source: NewForesight analysis of World Development Indicators (World Bank).

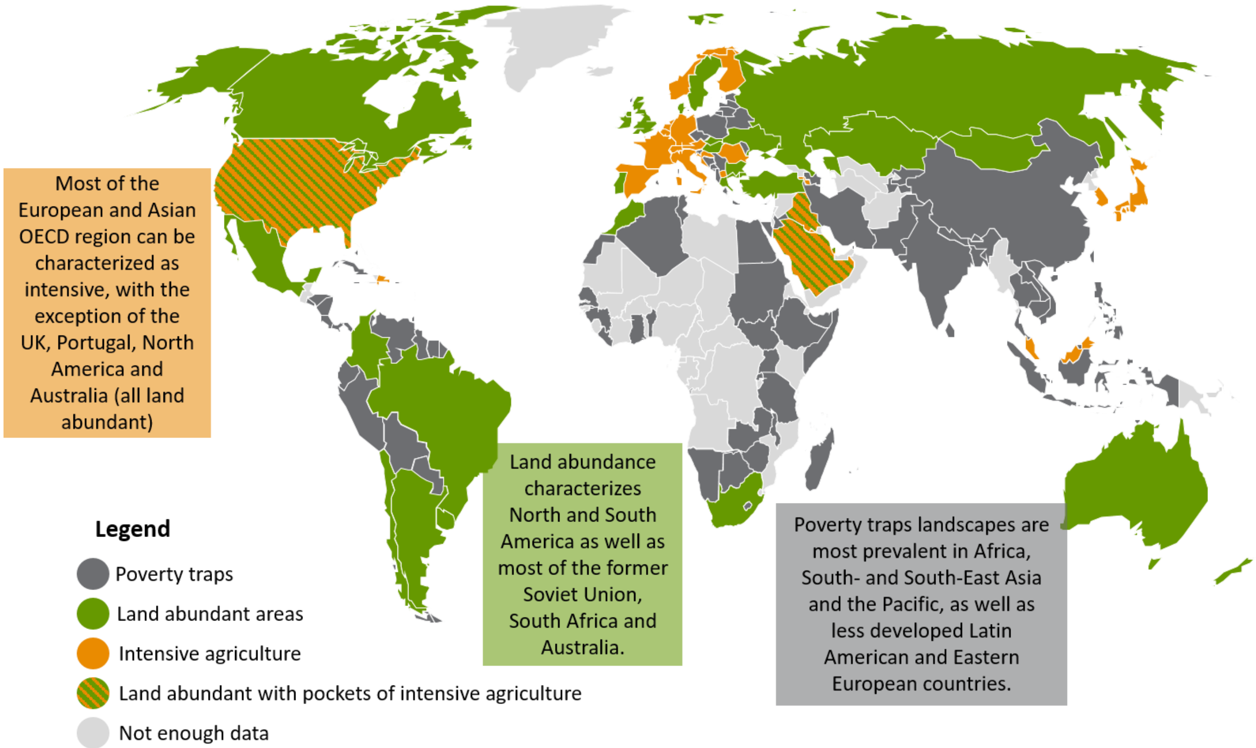


Fig. 6. Global distribution of agricultural archetypes follow patterns of economic development. Source: NewForesight analysis of World Development Indicators (World Bank)

Poverty Trap areas are the most prevalent of the archetypical production systems around the world, despite all the agricultural mechanization and development of the 20th century. This type of agriculture is found in most of Africa, many areas of China, India and Indonesia, amongst other Asian countries (see Fig. 6), and is characterized by a growing population caught in a vicious cycle of poverty, who are highly dependent on their farms for basic subsistence.

The lack of any savings forces these populations to resort to poor farming practices, leading to high deforestation and huge biodiversity loss, soil degradation and water depletion. Poverty trap areas employ more than 94% of all global agricultural workers and are responsible for feeding three-quarters of the world's population, yet they add only 55% of agricultural value, and give particularly low incomes to farmer- or farm workers. The farmers stuck in poverty trap landscapes constitute a rapidly growing population—from 733 million in 1980, to over 1 billion today, and projected to rise to 1.5 billion by 2050—with the consequence that arable land per agricultural worker has actually fallen over the last 30 years. In terms of natural resources, poverty trap agriculture involves 56% of global agricultural land, and 78% of freshwater used in farming—water which is often used at unsustainable rates relative to the degree of renewable freshwater available. The problems of these communities are compounded by high incidence of child labor, lack of education, and gender inequality; the fragmentation of land as a result of local inheritance practices;[4] as well as insecure provision of the land tenure rights which often prove a key condition for stewardship.

[4] These social issues in particular originate in, and are reinforced by, failing or absent policy and regulatory environments in which these agricultural value chains are embedded. Specifically addressing and improving these enabling environments is therefore a key precondition to transforming the value chains and, with them, the food system. The role of such enabling regulatory and tax environments will be discussed shortly.

On the basis of our analysis of socio-economic and environmental indicators, which highlights inefficient agricultural practices, ecosystem degradation, lack of professionalization, and low socio-eocnomic mobility as problems, we associate possible solutions for poverty trap areas with:

- Encouraging ecological intensification—an approach based on a more efficient use of natural resources and processes (biodiversity, water, soils, nutrients) in agricultural production methods, in order to minimize negative ecological impacts of agriculture (A4I, 2015);
- Promote the restoration and, where appropriate the rewilding (re-introducing natural processes and native species to improve ecosystem health) of degraded land, to reverse deforestation;
- The professionalization and growth of 600 million farmers (small holders);
- Generating alternative livelihoods for 850 million; providing the growing population in these areas with alternative employment options (indirectly enabling the aggregation of currently-fragmented farming plots, and encouraging professionalism and economies of scale)
- Encouring stewardship via ownership of land by farmers
- Increase the number of protected areas and built ecological corridors within large agrosystems, containing biodiversity gene pools *(mosaic landscapes)*

Land abundant areas: these areas which are common in Australia, Canada, large parts of the US, Brazil and Russia, (see Fig. 6) are characterized by agricultural practices which are modern, but which under-utilize agricultural land (in productivity terms) because of the large availability of arable land. This over-supply of land—with 5% of global agricultural employees working 42% of the world's land, feeding 20% of the world population but generating 30% of value added—creates perverse incentives, leading to high deforestation and degradation of soil and loss of biodiversity. Insofar as land-abundant areas suffer environmentally from deforestation, monocropping and soil degradation, possible solutions for these areas include:

- Promoting more diversity in cropping patterns at field and landscape scale;
- Ecological intensification of livestock farming
- Restoring degraded (pasture) land to arable land or areas to support mainly natural functions; restoring pasture land through rotational grazing

Intensive agriculture areas: in this mode of agriculture—common in many European countries, Japan, Korea, some areas in the US and the Middle East and emerging in China (see Fig. 6)—advanced agricultural practices and technologies are used to ensure that yields are maximized. As a result, 1% of the world's agricultural workers, working on just 2% of the world's land, are able to 'punch above their weight', feeding 6% of the world population and generating a staggering 15% of agricultural value added. However, such productivity does not come without a price, as this emphasis on maximizing yields creates high externalized costs in the shape of large inputs, nutrient overload, eutrophication and the steady decline of biodiversity in these countries as well as an indirect impact of driving unsustainable practices of animal feed production in land abundant areas. Solutions for intensive agriculture areas accordingly include:

- Ecological optimization[5], in order to utillize the full intrinsic potential of a natural production system without causing environmental externalities.
- Value growth which differentiates on taste and nutritional value instead of sheer yields;
- Increase the number of protected areas and ecological corridors

[5] *Ecological optimization* is regenerative, low- or zero input agriculture, and often based on intercropping and mix of perrenials / annuals.

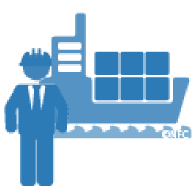
Making such changes throughout agricultural production landscapes constitutes a precondition to addressing the disturbing facts of entrenched poverty, migration and loss of rural communities, malnourishment, and the draining of planetary operating boundaries.

Agro-value chains

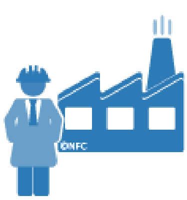
The second element of systemic change interventions must focus on realigning the incentives and business logic of actors throughout the (industrial) agro value chains. These solutions must contend with the fourth root cause which is that food supply chain actors at present continue to compete primarily on lowering the prices of agricultural commodities, and hardly ever on differentiated quality (e.g. taste, nutritional value ecosystem services) in the agricultural step of the value chain. Accordingly, the aim of interventions in food value chains is to nurture the growth of net positive business models that do compete on, and deliver, such differentiated qualities in order to secure a positive social and ecological footprint. The specific implementation of such a change carries different cadences for different actors throughout the value chain:

"The aim of interventions in food value chains is to nurture the growth of net positive business models that do compete on, and deliver, […] differentiated qualities."

Input suppliers need to shift from a business logic that focuses on patented concepts (seeds, chemicals, fertilizers), standardization, and high sale volumes (for sales efficiency), to a logic which recognizes sustainable business opportunities, by supporting farmers to restore and optimize soil (carbon, biodiversity) and ecosystem health in order to derive and secure reliable long term value and sourcing. In addition, input suppliers can emphasize the delivery of low-volumes of precision inputs, and diversifying and tailoring inputs to specific local needs and conditions. While there is certainly a degree to which some input suppliers seek to adhere to these principles, few currently manage to do so at scale (as this requires a systemic view on soil, ownership and production) .



Traders & Primary processors need to shift from a paradigm emphasizing standardization in the pursuit of efficiency and lowest prices—with associated low margins—towards business opportunities which support farmer communities in restoring and optimizing the health of their ecosystem and strengthening their rural economies. This is aided by differentiating on (preferably free) access to local varieties, and incentivizing local processing and marketing.



Consumer products producers currently focus on standardization of input, and driving down sourcing costs. Branded manufacturers currently operate on a >50% gross margin, with 10-20% operating profit, and emphasize global standardization for efficiency upstream, and downstream differentiation for value added. A more sustainable business model instead would highlight and market the differentiated qualities such as flavor and nutritional value, as well as the genetic diversity,ecological and social added value of sustainably produced food.

Retailers currently emphasize low price perception and high volumes in order to compete on costs and therefore are drivers of biodiversity loss, but could instead promote differentiated taste and nutritional value of sustainable diets at true price, and maximize local sourcing, while communicating on restoring species diversity. Local sourcing can have material benefits of reducing 'food miles', i.e. the distance food needs to be shipped, and therefore GHG emissions, and psychological benefits of increasing consumers' association with the production landscape they are most familiar with.

Successful interventions at this level can help both directly, in addressing the disturbing fact of *food waste* (particularly the major nutrient losses incurred in processing in developed countries), but also indirectly, as changes at the level of agri-value chains can contribute to facilitating conditions, rallying resources, and opening up opportunities at the level of agriculture production landscapes and the level of consumer end markets, thereby helping address the other three disturbing facts of our current agro-food system (*malnutriton, rural poverty and planetary boundaries*). Governments play an important facilitating role, as we explore further below.

Consumer end markets

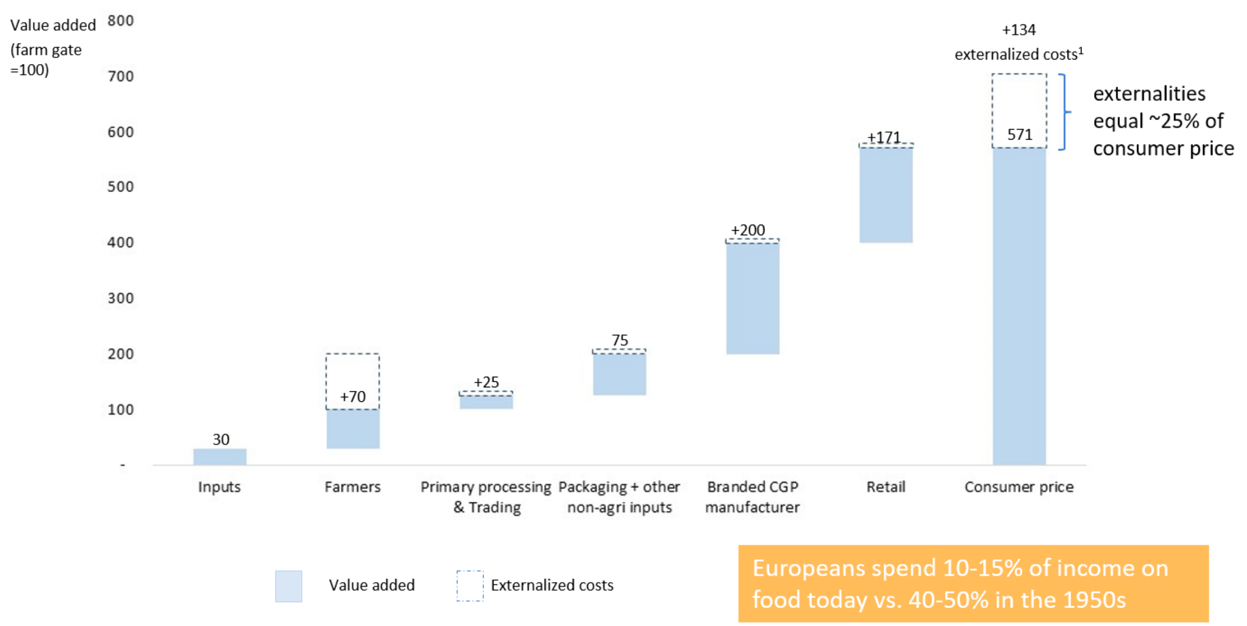


Fig. 7: Externalization of social and environmental costs (source: Trucost, Annual reports of processors, traders, FMCG producers and retailers.)

Moving along the chain, the final intervention is situated at the level of consumer end markets. This relates to the fifth root cause, which is the fact that systemic change remains prohibitively difficult so long as consumers remain largely disconnected from the production process. Main underlying factors which compromise consumer's ability to demand sustainable food production include:

- **A general lack of awareness** of the issues constraining our food system and its relations to our ecosystem;
- **A lack of coherently integrated food**, agriculture, and land-planning policies that are based on an ecosystem approach. Short-term maximation of RoI / ha is still the norm.
- **Little experience** with differentiated culinary quality of locally produced or nutrient rich food;
- **Uncertainty** over the meaning, reliability or credibility of a rapidly multiplying menu of sustainability certifications;

- **Increasing urbanization**—with 80% of the world's population living in cities by 2050 (de Wilde, 2015; Fresco and Poppe, 2016)—which will drive intensified consumer demand and value chain concentration, while diminishing even further consumer contact with primary production areas.[6]

A lack of awareness causing a lack of incentives of the externalized social and environmental costs of this production process blinkers consumer behavior, distorts consumer prices, and hampers sustainable choices, as consumers lack the knowledge and price- or quality incentives to be aware of them. This dynamic is particularly problematic, given that the costs of these externalities can amount to as much as one quarter of the consumer price (as illustrated in Figure 7). It is because these large externalities are often not priced in, that unsustainable food choices are often materially cheaper, and thereby able to capture a large market share, with accredited or 'conscious' varieties of those products relegated to a status of seemingly more expensive niche or 'luxury' products.

Addressing these dynamics is critical to resolving issues such as global malnourishment—not just in terms of food insecurity; but also in terms of addressing the problems posed by overweight and obesity as a result of unhealthy diet choices.

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To achieve these required game changes, we can make different interventions at different markets:

In developed markets, it is important to emphasize interventions and initiatives which aim at shifting consumption patterns and habits, away from 'empty calories' and meat[7], towards locally produced, high-nutrient food; it can help support or subsidize pilots for urban farming practices, catalyzed through 'citizen science' innovation. It can seek to raise awareness over the *true price* of production, and foster a willingness to pay these higher prices (up to ~ 25% higher than the artificially deflated prices common today); and it can involve initiatives to reduce food waste. All of these require a transparency, regarding the impact of our choices on food production processes; increased awareness of nutritional value & taste differentials, and clear warnings or even prohibitive measures against non-sustainable choices.

In developing markets, emphasis should likewise be put on reducing empty calories, and managing and mitigating the (impending) growth in consumption of animal proteins as well as encouraging restorative methods of livestock keeping. Initiatives likewise can emphasize investments in local supply chains in order to ensure the availability and affordability of sustainable, locally produced diets.

[6] Though this latter trend could also be counteracted by developments in 'urban agriculture'.
[7] As well as being a relatively unhealthy source of protein, meat and red meat in particular has a higher ecological foodprint (in terms of grams of carbon dioxide equivalents per kilocalorie of food energy) than fish or white meat. (Scarborough et al. 2014; Fresco and Poppe 2016)

Enabling environment: regulation, taxation and subsidies

At each of these three levels—in agricultural production landscapes; through agro value chains, and across consumer end markets—a maelstrom of distorting tax systems, subsidies and other mis-specified regulations can create perverse incentives which hamper systemic change. This is the sixth and final root cause that was identified above. Sometimes the disturbance is the inadvertent result of policies—for instance, EU legislation on food quality sometimes results in unnecessary additional food waste. Such cases occur because externalities are not taxed, and because subsidies reward or even encourage unsustainable practices, and distort the competitive position of these practices within global commodities markets—amplifying their adoption as other parties willing to adopt sustainable options find themselves unable to compete. Conversely, regulations often hamper innovation, for instance in business models to improve sustainability. Finally, competition and antitrust laws sometimes complicate useful collaboration to end unsustainable practices, prohibiting or hampering modes of knowledge exchange or discussion, and slowing down broad sector-wide initiatives.

Solutions at this level should include:

- Rule out practices which fail to meet minimum standards;
- Calculate in externalities (on average 25% of consumer price) of unsustainable business models, by raising taxes on biodiversity loss/gain, GHG emissions, chemical inputs, soil and freshwater depletion, irresponsible sourcing from poverty trap areas; consumption of unsustainably produced food;
- End distorting volume based subsidies for inputs and for agri-production;
- Use the generated funds to co-invest in public-private partnerships for ecosystem restoration and sustainable community development (land stewardship based on local farm ownership); pay for ecosystem services that cannot be sold to private sector; co-invest in pre-competitive R&D towards net-positive business models; lower taxes on labor;
- Provide more space for bottom-up policy development, and design of effective subsidies and incentive architectures, to enable governmental policies to play a role in facilitating and catalysing long-term restorative efforts.
- See an increase of protected areas and ecological and forestry corridors as part of an integrated landscape approach that will benefit long term agricultural production and community building.

"regulations often make it too hard to introduce and trial innovative business models which improve sustainability"

Why now: the potential value of opportunities

Macro Outlook: continuous improvement and sufficient speed catalyze sustainability

Improvements in both socioeconomic and ecological dimensions are clearly necessary to address the disturbing facts of our food system summarized above. We contend that such improvements are not only possible but entail largely untapped opportunities for farmers, value chain players and consumers. Our analysis shows that the following long term objectives can be set in order to meet the SDGs:

- ✓ Sufficient nutritious food is accessible for everyone in 2030: dangerous over- and undernutrition are eradicated;
- ✓ The number of farmers living on less than $2,500 a year is reduced to below 600 million by 2030, and to 0 by 2050[8];
- ✓ Deforestation and conversion of wetlands is halted by 2020, and land is converted back to nature (“rewilded”) where possible;
- ✓ Double the value added by agriculture to the global economy; grow farmer incomes in all areas;
- ✓ Generate 400 million viable livelihood opportunities outside of agriculture by 2030, and 850 million by 2050, in order to generate broad economic growth which can help primarily agrarian societies transition to more diverse and resilient economies;
- ✓ Food systems operate within planetary boundaries, globally and locally, and agricultural soils and agroforestry systems act as carbon sinks.

> “We contend that positive change in these dimensions is possible, necessary and a great opportunity for farmers, value chain players, and consumers”

Backcasting on the basis of these targets, it becomes clear that in order to achieve a truly sustainable food system transformation, a certain minimum viable rate of improvement is necessary across different indicators (see Table 1), and across the three archetype production areas.

Required annual improvements	Poverty trap areas	Land abundant areas	Over intensified areas
Productivity growth per hectare	1,2%	1,0%	-0,2%
Reduction of food waste		-1,0%	
▲ value added per hectare	2,7%	2,4%	1,0%
▲ hectares for agriculture	0%	-1,4%	0%
▲ number of farmers	-1,6%	-0,1%	-0,5%
▲ nutrient load per hectare	tbd[2]	tbd[2]	-2,5%
▲ freshwater usage per hectare	tbd[2]	tbd[2]	tbd[2]
▲ biodiversity & ecosystem functions	tbd[3]	tbd[3]	tbd[3]

Table 1: required annual improvements within different landscape archetypes, to achieve the necessary change. Source: NewForesight Analysis of World Development Indicators (World Bank)[9]

[8] While this amount may seem high at present for some of the poorest regions, and low for more developed regions, we consider it a minimum to achieve an income above the World Bank poverty line of $1.90 a day (considering the case of a farmer and three dependents) (cf. World Bank, 2015).

[9] Notes in table: (2) Required improvements for nutrient load can be increase in many poverty trap areas while a decrease in pockets of intensive farming within land abundant areas is required; (3) specific local targets need to be set, and an appropriate measurement methodology needs to be developed.

Extrapolated over ten to thirty years, realizing these annual changes amounts to a momentous turnaround in our food systems. While meeting these rates will acquire a turnaround from the trends of the past thirty years, existing cases confirm their viability. A particularly encouraging example of this can be found in the restoration of the Löss Plateau in Central China. The Plateau was once one of the country's most fertile regions; however by the mid-'90s sustained overgrazing and intensive tilling of the soil had led to extremely high erosion rates, leaving the land unproductive and the farmer population destitute, with annual incomes dropping below $70.

Restoration of Löss Plateau

Ecololgical Restoration at the Löss Plateau in China. The Plateau in September 1995 (top) and September 2009 (bottom). *Photo: Kosima Liu, EEMP, China; in: The Permaculture Research Institute (2012); World Bank (2007).*

In response, in 1994 the World Bank initiated the Löss Plateau Watershed Rehabilitation Project, an erosion control and livelihood diversification program. In less than two decades, this effort managed to restore a significant portion (roughly the size of Belgium) of the plateau (see Images 1 & 2). This natural restoration led to massive improvements in socio-economic conditions for local farmers: employment rates rose by 17 percentage points in a matter of years, food security drastically improved (as annual per capita grain output increased from 365kg to 591kg); farmer incomes nearly tripled, and nearly 2,5 million people were lifted out of extreme poverty. Environmental impacts were equally impressive: sediment outflow into the Yellow River was reduced by more than 100 million tons per year (an 80% reduction), and perennial vegetation cover increased from 17% to 34% (World Bank, 2007).

The economic opportunities of a transition to a sustainable food system

Changing our food system is not just possible, but also bears significant economic potential at all levels. Starting with the ecosystems which sustain life on earth but also bear the brunt of unsustainable agriculture, it is estimated that the annual benefit of restored, healthy ecosystems is between $1,010 and $129,200 per hectare per year. Tropical forests, an ecosystem category that has been particularly affected by intensive and extensive agriculture in South America and South Asia, provide $7,000 per hectare per year. Restoring these ecosystems at scale is costly, but the benefits can outweigh these costs by a factor of up to 75, as is the case of grassland ecosystems (Strassburg & Latawiec 2014).

Farmers benefit most from a more sustainable food system through increased productivity and saving costs by smarter and more efficient resource use. Analyses of smallholder farming systems in "poverty-trap commodities" such as cocoa and cotton show that farmer incomes can multiply when production practices are professionalized[10] and incomes are diversified. Sustainable intensification of rice production can boost incomes of 140 million Asian rice farmers and their families – in the Philippines alone producers stand to gain $750 million. Furthermore, the transition of 400 million agricultural livelihoods to secondary and tertiary sectors of the economy by 2030 will raise the prospects of economies and societies in less economically developed countries. Indeed analyses suggest that only modest yield increases in under-utilized areas, combined with efforts aimed at waste reduction, can deliver sufficient food by 2050, even for a projected global population of 10 billion (see Fig 8).

[10] Based on internal NewForesight analysis.

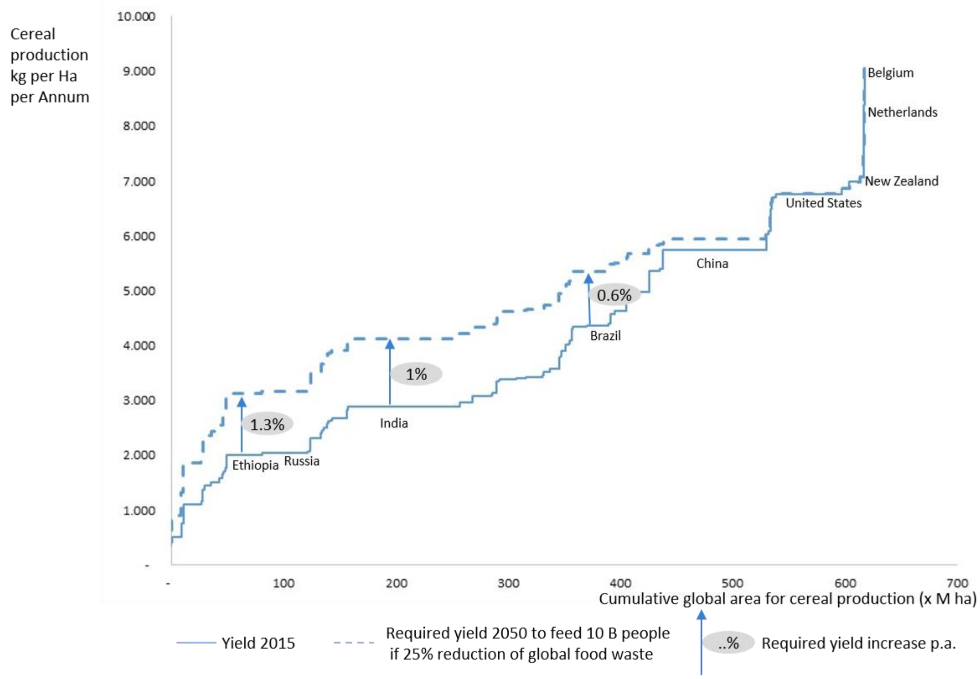


Fig. 8. Required growth in global cereal production, to feed world population by 2050. Source: NewForesight analysis on the basis of World Development Indicators (The World Bank).

In the agricultural value chain, we observe growing returns for producers, retailers and processers who capitalize on the trend for sustainable products. A study of the US retail market shows that responsible consumer products account for two-thirds of market growth in groceries, with an average price premium of over 20% (Smits, et al. 2014). Actors further down the value chain, such as traders and primary processers, can benefit from realizing the untapped potential of the production landscapes they are active in and producing more sustainably: Cargill for example is expanding its organic chicken feed business in the USA, as well as starting production of non-GM soy and maize (Bunge, 2016).

Recent studies indicate that companies which measure sustainability performance in order to identify progress towards explicit sustainability goals, on average outperform their peers on the stock market (E.g. Eccles et al. 2012), and generally experience lower volatility. They can also draw parallels with the past experience of the energy sector, noting that slow adopters in the energy transition saw fierce negative momentum in shareholder returns, in order to make the point that in the long run, participation in a sustainable food system transition is not a luxury, but a business necessity; and that such a transition, once it occurs, is likely to leave laggards and slow adopters in the dust.

Consumers on the face of it have to merely pay more when the 25% of externalities present in food value chains are priced into the final product price.[11] From a macroeconomic point of view however, the other side of this coin is a potential 25% rise in value added in food and agriculture sectors. In addition, there are myriad direct (health and taste) and indirect (ecosystem services and improved public health) benefits of consuming responsibly.

[11] We give further depth to this topic in the next chapter.

How: a call for holistic transformation approaches

Need to accelerate

In order to capture the opportunities and to achieve the systemic changes described in the previous chapters acceleration is needed. In spite of significant investments, most transition efforts today are still seem to be in a 'fire fighting' mode, characterized by:

- **Fragmentation**: many small, competing initiatives and isolated projects
- **Narrow scope & lack of holistic approach:** progress is measured on short timespans, and relative to competitors; transformation approaches focus on optimizing only a few dimensions, potentially at the cost of others; projects focus focus on only one link in the agrofood system, whether production landscapes, supply chain, or consumers—rather than trying to work with all three.
- **Brittle:** sustainability claims are based on marginal improvements
- **Focus on inputs and processes** rather than on outcomes;
- **'Cause inflation':** risk of losing credibility and being accused of greenwashing

As a result of these features, we are in a situation where all of today's efforts on sustainability combined are rowing against the current, do not take sufficient advantage of the private sector's transformative potential, and as such are unlikely to be able to turn the tide in time to achieve the necessary and structural changes which we have identified. Indeed, at the current rate of change, it would take 50 to 100 years to reach sustainable aid-independent livelihoods for the average farmer[12]—by which time we would have irreversibly exceeded planetary boundaries for a long time.

From reductionist to holistic approaches

The above desribed piecemeal 'fire fighting' approach is clearly not sufficient. What is instead required is a shift beyond reductionist thinking, towards a holistic, business driven approaches to drive systemic changes with sufficient speed and at scale. More specifically this requires four shifts, in:

- ***Ambition level**:* From 'less negative impacts' to 'net positive'

- ***Scope of efforts**:* From 'supply chain' scope company by company and commodity by commodity to 'full systems', i.e. landscape + relevant value chains from soil to plate'

- ***Breadth of solutions**:* From 'dogmatic one size fits all' to 'diversity of pathways'

- ***Tools**:* From focus on 'implementing (certification) tools and process changes' to focus on 'driving impact on sustainability outcomes'

To achieve food system transformation requires moving landscapes, value chains and consumer markets in the right direction with sufficient momentum, guided by these four principles.

[12] Based on NewForesight analysis.

Current state of the art

In recent years many strong initiatives have taken shape that fit with this shift of approach. Some of those are shown in Figure 9. A few of the examples are described in more detail in the text boxes on the next pages, each one illustrating one of the four required shifts in approach. The following and last section of this paper outlines our vision of how these initiatives can be scaled up, accelerated and/or replicated.

Fig. 9. Examples of initiatives or organizations that can lead to change at scale.

Net Positive aspiration

More than just reduce the negative impact that our food system has in its current form, and more than merely striving for zero impact, we advocate a net positive impact approach and -aspiration for agricultural and food sustainability. In the following paragraph we sketch a possible net positive vision for the farm and farmer, for food value chains, and for consumers in the year 2050.

In agricultural production landscapes, we envision that farmers are able to break out of their 'poverty traps' to become professional entrepreneurs who generate not just a living wage, but also enough of a surplus to re-invest in their farm—to ensure that farmers are thriving, not merely surviving. These are farmers who choose to farm, living in flourishing communities where many more sectors besides primary production exist and offer employment and economic returns. In these areas, and within land-abundant agricultural production landscapes, the ecosystems that provide the basis for farming are utilized in consideration of the regenerative potential of soils, water and biodiversity; soil degradation, deforestation, water depletion and biodiversity loss are ended and reversed. Animal feed is produced on marginal (grass-)land or from by-products / side streams of food production for humans. All primary production systems are fully circular on energy, nutrients and carbon.

Throughout the value chain, all produced biomass is valorized as food or biomaterials or is brought back to soils at the place of production. Lastly, in consumer end markets all over the globe, nutritious food is available in sufficient quantities, affordable for all segments of society, and preferred over less healthy and less sustainable options.

Box 1. Net Positive Aspirations

Beyond tools and towards outcomes

The prevailing paradigm in many agricultural commodity sectors is to certify increasing volumes according to voluntary sustainability standards, in the hope of thereby creating sustainable production across the board in that sector. This approach is inherently limited in that certification schemes often only set a minimum standard that would not qualify a sector as fully sustainable even if it were 100% certified (c.f. Molenaar et al. 2015). It is also an approach that is on the whole limited in its uptake: a recent study commissioned by the WWF shows that even among members of the Consumer Goods Forum, relatively few companies have made concrete commitments to sustainable sourcing of commodities that were prioritized by the WWF as having a critical impact on ecosystems. (WWF & NewForesight 2016)

A number of leading chocolate companies and cocoa traders have broken with this trend. These front-runners of the cocoa sector have formed Cocoa Action, an initiative embedded within the World Cocoa Foundation that strives to create a West African cocoa sector that offers profitable livelihoods and quality of life for farmer communities. Importantly, these companies – in cooperation with local governments – focus on outcomes and see tools such as sustainability standards or a results framework as supporting tools. While eventually their work needs to go beyond cocoa for a truly sustainable West African agricultural sector (see below), this initiative must be lauded for having taken a challenging step towards goal-orientation and impact.

Box 2. Cocoa Action

Designing multiple returns pathways for landscape restoration (4 returns)

Landscape restoration offers large untapped opportunities for sustainable economic development. To demonstrate this potential, Commonland develops landscape restoration projects which are based on- and sustained by viable business cases, largely evolving around regenerative agriculture and agroforestry systems. Its approach actively involves investors, companies and entrepreneurs in long-term restoration partnerships with farmers and land users. Long-term commitments are critical, as it takes approximately 20 years – or one generation – to restore a landscape, depending on the type of ecosystem. Commonland has developed a practical holistic approach to involve business and local land managers in landscape restoration based on sustainable business models that generate 4 returns® (Ferwerda, 2015). These are:

(i) Return of inspiration,
(ii) Return of social capital,
(iii) Return of natural capital,
(iv) Return of financial capital.

These 4 returns result from an integrated landscape planning, based on 3 zones: a natural zone, a combined zone and an economic zone (ibid.) Within the *natural zone* of the landscape to be restored, investments should focus on restoring soils, water and biodiversity functions, such as CO_2 capture, improvements in soil and water quality and and availability, restored biodiversity. Direct economic opportunities mainly derive from forestry, hunting and tourism. In the *combined zone* of the landscape, investments should focus on restoring the landscape through agroforestry and regenerative agriculture, providing significant additional economic returns to the land managers and investors, as well as soil, water and biodiversity benefits. Finally, investments opportunities in *economic zone* of the landscape are related to sustainable intensified agriculture (including horticulture and acquaculture) and related value-adding activities such as local processing and marketing. Additional returns come in the form of new business models and novel collaborations.

Box 3: Designing Multipe Returns Pathways for Landscape Restoration (4 returns)[13]

Diversity of Solution Pathways: the Circular Dairy Economy

A recent discussion paper prepared jointly by FrieslandCampina and Circle Economy for the Word Dairy Summit presents insights into the potential of circular dairy farming from a Dutch perspective. It identifies three archetype pathways towards circularity which can achieve a net-positive impact on the planet and communities over time. In line with their current state and the issues that the Dairy sector is facing, it is clear that each of these pathways faces its own challenges, and there is not one silver bullet solution, but a need to explore many possible pathways:

1. **Optimized grazing** seeks to maximize the productivity of the available land through a mix of biological and technological approaches to circularity; in this situation, inputs are reduced, land is fully used and productive, circularity is improved at a local and regional level, and strong productivity is achieved (~ 15,000kg milk/ha/y). This sytem plays to the strengths of the Dutch dairy industry, and helps soil biodiversity, but it cannot fully close nutrient and carbon cycles, and requires significant improvements over business-as-usual. Improved governance and revenue models promoting ecosystem services are needed for farmers to progress and achieve circularity.

2. **Extensive grazing** primarily builds on biological processes and organic farming to close the soil-plant-animal-nutrient cycle locally. It is characterized by minimal inputs, high biodiversity, stables with low cow density. This pathway promotes full circularity and 'net positive' restoration, but it has lower (though still higher than global average) productivity (~ 7,500kg milk/ha/y). It also significantly depends on improved governance (e.g. taxing of externalities of conventional farming) and improvements in revenue models.

3. **Intensive high-tech** emphasises technological solutions to close key cycles; farms require significant inputs, and have a high cow density and are stable-based; these farms have advantages in terms of productivity (up to 30,000kg milk/ha/y), and can potentially achieve full circularity, but this system is still in the early development stage and technology scale-up is needed before it is clear how it can compete with other pathways. Issues to be addressed include animal welfare, consumer perception and longterm competitiveness with new, 'animal-less', industrial systems.

Box 4: Diversity of Solution Pathways: the Circular Dairy Economy (Source: Circle Economy, 2016)

[13] Note: these zones are not to be confused with the three types of agricultural landscapes we define earlier. Instead, what distinguishes these zones is that they are all located *within* one landscape that is to be restored.

The next horizons: our call to action

The examples above (Box 1-4) illustrate the tremendous untapped value in fixing our food systems based on an ecosystem approach. To accelerate the transition we see a need to scale up these kind of examples and form coalitions of committed players around holistic transition agendas. At an aggregated level, Figure 10 illustrates what such a holistic agenda could look like.

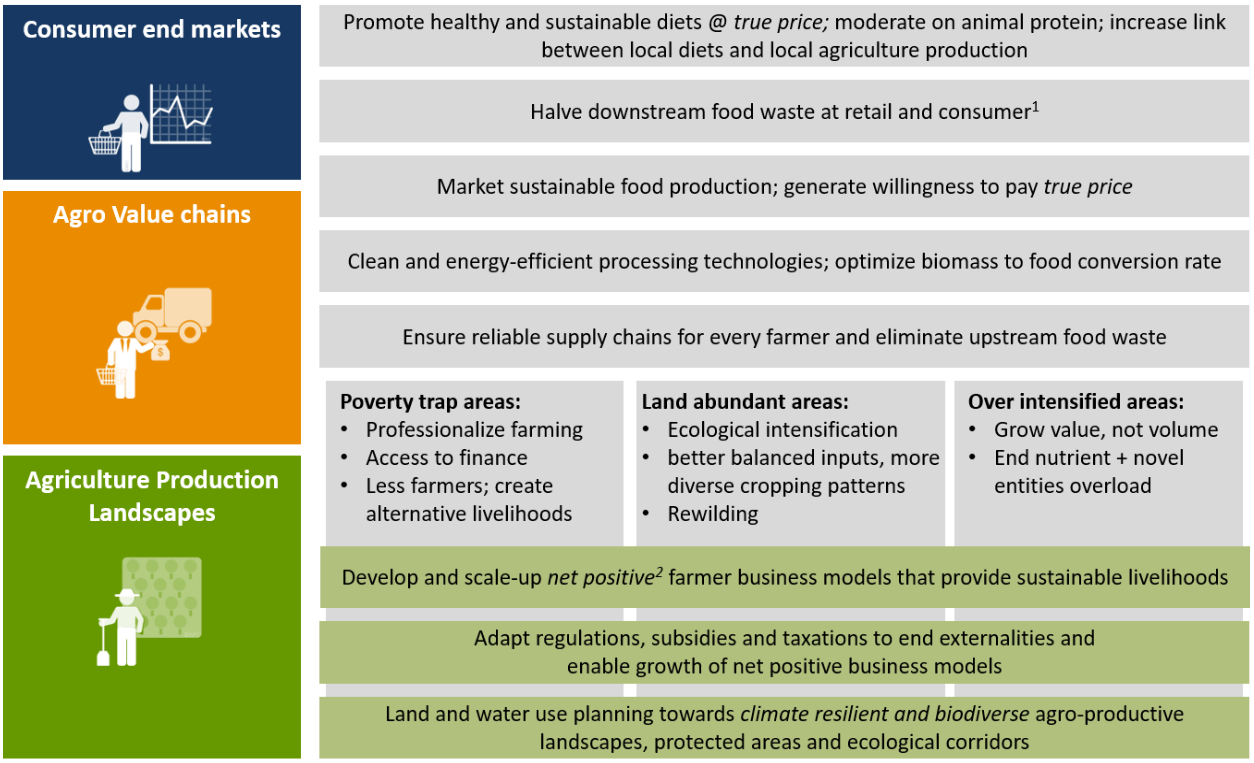


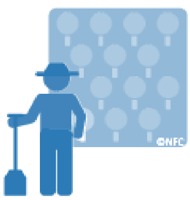
Fig. 10. A holistic transition agenda across three levels, with specific roles and targets for different stakeholders,

How can such a transition be grounded, iterated, and accelerated? Different players will have to take on crucial roles:

- Retailers in co-creation with governments and food producers, need to take on the challenges and opportunities in consumer end-markets.
- Producers and retailers for their private label products, need to lead the way in transforming the value chains, including working with farmers to create net positive farmer business models that are based on differentiation rather then commoditization.
- Governments in co-creation with businesses should lead the way in land and water use planning towards *net* positive and climate resilient landscapes
- Governments need to adapt regulations, subsidies and taxations to enable all the other parts of the agenda, as described in our chapter on the 'enabling environment' of food system change.
- Scientific institutes and NGOs have crucial enabling roles to play in all areas.

We suggest that all of these actions need to be undertaken through focused *coalitions of the committed*, as no one can go it alone. While shaping the membership of these coalitions, actors should be open to engaging a range of stakeholders, including government bodies; key businesses within the relevant global supply chains; farmers, companies, NGOs, finance institutions and other initiatives which represent or implement the state of the art in sustainable food production. However, while the membership of these coalitions should therefore be in principle open to a wide range of actors, it is important to emphasize members' commitment and a deep institutional understanding of the necessity and opportunities involved in holistic change. A smaller but committed coalition may achieve more through intervening at specific leverage points, than a broad coalition which involves everyone, but which does not move because certain partners still remain unconvinced or do not have 'skin in the game', and can focus on a specific supply chain where they can effect change at a landscape level.

We are committed to contribute to coalitions that develop and execute these type of holistic transition programs at scale. The text boxes below illustrate what type of programs we suggest. These are only a few early examples for illustration. As we have argued throughout this paper, there is tremendous untapped value in fixing our food system from the ground up, and it is therefore of critical performance, both for long-term business viability, and for our common future, that companies and other stakeholders across the food sector adopt sustainability as a pillar of their business strategies. Taking these actions in order to kick-start a holistic and sustainable transition in our food system may well be one of the most valuable achievements we can make, or fail to make, in the coming decades.



Agricultural value-chains within The Netherlands

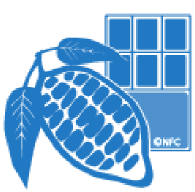
Interventions in The Netherlands could aim at establishing restorative agricultural production in the Dutch Delta landscape; fostering net-positive local value chains (especially with regards to dairy, meat, and horticulture); promoting sustainable and healthy diets amongst consumers and citizens; on the basis of these interventions, developing transferable and repeatable transition models for application to other areas across the world.

Box 5: Coalition Agendas in agricultural value-chains within The Netherlands

Olive landscapes in Spain

Spanish olive tree production landscapes would benefit from interventions to establish and promote restorative production models and multi-cropping, as well as competitive business models for value chains of olives and all other crops that fit a restorative vision for these landscapes.

Box 6: Coalition Agendas in Olive Landscapes in Spain



The Cocoa Value Chain

Interventions in the global cocoa value chains could aim at expanding the Cocoa Action approach beyond cocoa for the relevant landscapes (such as Ghana and Cote d'Ivoir), in order to develop credible transition paths to end poverty traps, build vibrant rural economies and establish restorative agriculture production methods in these landscapes. This would enable the establishment of competitive business models for all relevant value chains from these landscapes.

Box 7: Coalition Agendas in the Cocoa Value Chain

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