Transition to sustainable food systems: the Dutch circular approach providing solutions to global challenges

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This report evaluates how the Dutch Ministry's focus on circular agriculture can support the SDG impact of Dutch international aid and investment programmes in less developed countries. Using examples of recently applied and planned interventions in a range of developing countries, the report illustrates the value of adopting a food system approach to find sustainable solutions to achieve a sufficient, healthy and resource-efficient food supply. The report concludes by listing characteristics of circular agriculture that promote interventions to support improved food system outcomes.

Key words: food systems, transition, sustainability, sustainable, circular agriculture, SDG

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Preface

In its Vision document 'Agriculture, nature and food: valuable and connected' the Dutch Ministry of Agriculture, Nature and Food Quality (LNV) calls for a transition towards circular agriculture. This call is in response to the challenges the sector faces: farmers, growers and fishermen are feeding the world, but the way this is done on a global level is not sustainable. Transition is necessary in agricultural practices and consumer behaviour in the Netherlands. In addition, the Ministry believes the knowledge and innovations that the Netherlands acquires in circular agriculture can help developing countries to improve their farming performances and make food systems in these countries more sustainable. According to the Ministry's Vision document, circular agriculture is an important strategy to contribute to Sustainable Development Goals (SDGs). This report evaluates how circular agriculture can support the SDG impact of Dutch international aid and investment programmes in less developed countries.

This study was commissioned and financed by the Dutch Ministry of Agriculture, Nature and Food Quality (LNV). The study was directed by Geert Westenbrink (EAI, LNV) and Patricia Wagenmakers (SK&I, LNV) and Jan Verhagen (Wageningen UR). We would like to thank the Steering Committee for the constructive collaboration and for their valuable comments and suggestions on the final draft version of this report. We give special thanks for the pleasant and helpful way in which they have guided the research.

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Executive summary

According to the Vision document of the Ministry of Agriculture, Nature and Food Quality (LNV), the Dutch agrifood sector will contribute to Sustainable Development Goals (SDGs) by becoming the global leader in circular agriculture. In academia, government and practitioner circles the food system approach is increasingly used as a concept to understand and shape transformative action towards a sustainable food future. How does circular agriculture relate to the food system approach? And is circular agriculture sufficient to make a meaningful contribution to the global challenges summarised in the SDGs? With the agricultural counsellors and LNV staff working in the area of food security as the main target group of this report, differences and communalities between both approaches are highlighted and it is argued that both can support the SDG impacts of Dutch international aid and investment programmes. Using examples of recently applied and planned interventions in a range of developing countries, the report illustrates the value of adopting a food system approach to find sustainable solutions to achieve a sufficient, healthy and resource-efficient food supply.

The report's key messages are summarised as follows:

- Tackling the global challenges summarised in the SDGs calls for a food system approach: a focus on increasing production to combat hunger and poverty does not solve the problem, and promoting production efficiency in many cases adds to ecological stress rather than reducing it.

- Interventions aimed at changing behaviour that contribute to achieving SDGs need to be socially, economically *and* environmentally sustainable: a systems approach calls for solutions that benefit all three sustainability dimensions simultaneously.

- Circular agriculture is a useful means to contribute to improved natural resource efficiency. Generally the concept's focus is on enhancing environmental sustainability. The food system approach highlights the importance of the socio-economic context, and helps to clarify the trade-offs between intervention strategies and system outcomes in all three sustainability dimensions.

- To ensure that projects promoting circularity address social, economic *and* environmental sustainability *simultaneously*, the interventions proposed should take a food system view. This implies that in project evaluations (ex-ante and ex-post):
  1. a positive contribution is made to at least one sustainability dimension without compromising the other two;
  2. trade-offs and synergies are identified;
  3. technological interventions and behaviour change are linked;
  4. a multi-stakeholder process is followed;
  5. upscaling options and issues are considered; and
  6. alternative interventions are worked through.

1 Introduction

The Vision document of the Ministry of Agriculture, Nature and Food Quality (LNV) states that the transition to circular agriculture will benefit the international position of the Dutch agrifood sector (LNV, 2018: 31-32). LNV expects the transition to circular agriculture will 'give impetus to agri-innovations in the Netherlands'. Next, the knowledge that the Netherlands acquires in circular agriculture can help developing countries to improve farming performances and make food systems in these countries more sustainable. Moreover, as a major importer of agrifood products, the Ministry claims the Dutch agrifood sector will be able to 'exert an influence on the sustainability of cultivation in other parts of the world and thus have a favourable leverage effect on international environmental and nature-related goals and biodiversity'. In the Ministry's Vision document circular agriculture is presented as an important strategy to contribute to Sustainable Development Goals (SDGs). With regard to its international role, the Ministry's focus lies on 'supporting people that are vulnerable to malnutrition, on strengthening economic perspectives for farmers and rural entrepreneurs and on making food systems more sustainable'.

The European, International and Agro-economic Policy (EIAP) directorate of the Ministry of LNV is responsible for policy formulation on food and nutrition security (FNS) and international agri-business. This directorate is challenged to implement the Ministry's vision on circular agriculture in an international context. The main route to do so is by contributing to the Dutch food security policy in which the Dutch government (Ministry of Foreign Trade and Development Cooperation and the Ministry of LNV) summarises her contribution to achieving the UN SDGs via aid, trade and investment promotion policies. As Table B.1 in the Textbox below indicates, the role of agriculture and food is at the heart of the UN SDG 2030 Agenda.

This report addresses the question how the concept of circular agriculture relates to other pathways towards sustainable agriculture, and whether the scope of circular agriculture is sufficiently broad and deep to meaningfully contribute to SDGs. In particular, this report relates circular agriculture to the food system approach. In academia, government and practitioners' circles the food system approach – which widens the attention from the activities in the food system to its socio-economic, environmental and health outcomes – is increasingly used as a concept to understand and shape transformative action to enhance FNS, and to contribute to SDGs (e.g. UNEP, 2016; GLOPAN, 2016; HLPE, 2017; FAO, 2017a; Serraj and Pingali, 2018). This approach allows to include feedback loops: results (outputs) of a measure taken 'to solve a problem' are routed back as inputs as part of the chain of cause-and-effect that forms a circuit or loop. Systems thinking broadens the perspective when seeking solutions for the root causes of problems such as poverty, malnutrition and climate change.

The objective of this report is to explain how circularity is linked to the analytical framework of the Food System Approach, and to show that circular agriculture can help improve food system outcomes if measures applied entail features that make them 'food system outcomes enhancing'. With the agricultural counsellors and LNV staff working in the area of food security in non-OECD countries as main target group of this report, the cases and examples used relate to situations in those countries, and how farming perspectives and food system outcomes in developing countries can be improved by applying circular agriculture principles.[1] The report's main message is that in order to ensure that policy measures and/or investments promoting circularity are socially, economically *and* ecologically sustainable, interventions should take a food system lens.

[1] This means that the report focuses on the way Dutch knowledge can help developing countries to make their local food system more sustainable. At the same time, it is well noted that food consumption and production decisions around the globe are highly connected through international trade relations. The above mentioned aspect of how Dutch policy impacts on national primary production practices and on its internationally operating value chains may exert influence on the sustainability of production in other parts of the world is very well recognised but not fully addressed in this report.

Box 1. Sustainable Development Goals and the role of agriculture

Agriculture plays an important role in taking up the 17 global challenges of sustainable development. Table B.1 indicates how and what agriculture may contribute to achieving each of the goals. According to its 2019 Food security policy note the Dutch SDG policies remain concentrated on SDG 2 - eradicating hunger and reducing malnutrition - yet with the understanding that parts of SDG 2 (nutrition, agriculture, ecological sustainability) are closely related to and linked with all other 16 SDGs. The Dutch Food Security policy objectives are threefold: 1) increased productivity; 2) improved nutrition security; and 3) more ecological sustainable use of natural resources.

Table B.1 *Global challenges summarised in the 2030 Agenda on sustainable development and the linkage of SDGs with agriculture and rural development (as indicated by FAO)*

No	SDG (short title)	Red flag raised by FAO
1	Reduce poverty	Almost 80% of poor people live in rural communities
2	Zero hunger	815 million people hungry
3	Good health and well-being	Good health starts with nutrition
4	Quality education	Nutritious food is critical to learning
5	Gender equality	Women produce half of the food but have much less access to land
6	Clean water and sanitation	Sustainable agriculture has the potential to address water scarcity
7	Affordable and clean energy	Modern food systems are heavily dependent on fossil fuel
8	Decent work and economic growth	Agricultural growth in low-income economies can reduce poverty by half
9	Industry, innovation and infrastructure	Agriculture accounts for a quarter of GDP in developing countries; targeted interventions needed aimed at diversifying employment in non-agricultural activities
10	Reduced inequalities	Land reforms can give fairer access to agricultural land
11	Sustainable cities and communities	Rural investments can deter unmanageable urbanisation
12	Responsible consumption and production	One third of food produced is lost or wasted
13	Climate action	Agriculture is key in responding to climate change
14	Life below water	Fish gives 3bn people 20% of daily animal protein
15	Life on land	Forest contain over 80% of the world's terrestrial biodiversity; sustainable approaches to natural resource management
16	Peace, justice and strong institution	Ending hunger can contribute greatly to peace and stability
17	Partnerships for the goals	Partnerships helps raise voice to the hungry

Source: based on FAO http://www.fao.org/sustainable-development-goals/en/

2 Global challenges to achieve future food security and their regional manifestation

The global challenges summarised in the SDGs are huge, so where should the Dutch policy and business activities to promote circular agriculture focus on to make a most meaningful contribution? In addition to highlighting the main challenges, this chapter depicts how global food security and sustainability challenges manifest itself in different countries and continents. This shows that planned interventions call for a thorough understanding of the local context of food systems operations. This brief overview may help guide Dutch policy and/or businesses to focus their activities in terms of geography and issues that need to be addressed most urgently in order to contribute to improved future food security, livelihood and environmental sustainability in a specific country or region.

2.1 Challenges to sustainably feed the world

Although today's world food production is enough to feed everyone, more than 800 million people face chronic hunger, whereas half of the present world's population is either malnourished or obese. At the same time, an estimated one third of all foods produced are ultimately not being eaten or (re-)used, thus lost and/or wasted.[2] In order to meet the needs of a growing world population counting close to 10 billion people by 2050, food production has to increase by an estimated 50% compared to current levels (FAO, 2017a). The production of increasingly nutritious food requires significantly more land and other inputs like minerals, water and energy. Yet, the natural resource base necessary to contribute to the global food needs is deteriorating, ecosystems are under stress and biological diversity is declining around the globe. Climate change may have significant impacts on food production, through its consequences of changing rainfall patterns, drought and flooding and the geographical distribution of pests and diseases. As about three-quarters of the extreme poor live in rural areas, of which most are dependent on agriculture for their livelihoods and food security, food production is extremely vulnerable in regions where farmers lack the financial means to invest in adaptation and/or mitigation strategies.

The majority of the extreme poor live in Sub-Saharan Africa (SSA) and South-Asia (SAS), regions that are prone to desertification (especially in SSA), flooding and decrease of freshwater availability (particularly in SA). According to IPCC projections, climate variability and change will compromise agricultural production and access to food in many countries in the world, most significantly in the SSA and SA regions (IPCC website). Moreover, in these regions most of the global population growth[3] will happen. The African population – 1.3 billion in 2018 – is expected to have doubled by 2050, meaning that half of the world's population growth takes place in the African continent. Asia's population will grow by another 0.7 billion, mainly in already densely populated countries like India and China (UN World Population Prospects. 2017 Revision). Current features of the African population – the median age is 19.4; 60% of the population is below 25 years old – and its rapid growth challenges many African governments with regard to providing adequate public infrastructure (much of which is already at a deficit), jobs and food that will keep pace with the rising number of citizens. Asia comprises a full 30% of the world's land area with 60% of the world's current population. Overall the population growth in the Asian region is slowing down. However, land pressure is already enormous, with more land claims due to population and income growth leading to further pressures on the regions' natural endowments. Increasing food production through either converting land to agriculture or intensifying

[2] This is an estimate released in FAO, 2013. More recent estimates (in FAO, 2019, forthcoming) suggest that food losses amount to around 14% of global food production (in value terms). Food losses are higher in low-income countries than in high-income countries. Estimates to monitor food waste reduction in the framework of the SDGs are still under development, but evidence from a series of ad hoc studies show that levels of food waste are higher in high-income countries.

[3] UN DESA 2017 projects global population to grow from the current 7.6bn up to 9.8bn by 2050.

the use of existing agricultural areas will most likely result in additional environmental damages (e.g. declining soil fertility, water pollution), loss of biodiversity and increased vulnerability to climate change impacts. Food import dependency rates are significant in many SSA and SAS countries and are projected to increase over the next decades (ADB, 2016).

2.2 Regional manifestation of global challenges

As natural resource endowment, climatic change impacts, population pressures and economic prosperity differ around the globe, different places around the world face food system challenges at different levels of intensity. Consequently, the type of policy and the priority given to interventions necessary to improving food system outcomes depends on a thorough understanding of the root causes of the adverse food system outcomes in their local or regional context. To illustrate this, below we describe one major challenge that is highly relevant – though not exclusive – to a particular region, and to which governments have indicated to plan action in order to improve food system outcomes.

Middle East and North Africa: climate change and water scarcity
The Middle East and North Africa (MENA) region is considered the most water-scarce region of the world.[4] Disputes over water lead to tension within communities, and unreliable water services are prompting people to migrate in search of better opportunities. Water investments absorb large amounts of public funds, making such investments part of the debate how public money should be spend. As the regions' population continues to grow, per capita water availability is set to fall by 50% by 2050, and, if climate change affects weather and precipitation patterns as predicted, the MENA region may see more frequent and severe droughts and floods.[5] The region is already highly dependent on imports of basic food items such as grains (wheat) and sugar, and a further reliance on international markets is a high socio-economic and political risk.[6] Increasing food self-sufficiency in the region depends on a wide range of interventions, related to implementing technical innovations, promoting rural investments and applying policy reforms (among which regional cooperation is a necessary condition in the implementation of the UN 2030 SDG Agenda, especially in the context of an uncertain future involving climate change; see UN ECA, 2018 and Durrell, 2018). Governments in the region have declared improved water management a priority in their approach to face food insecurity and climate change (e.g. national plans of Morocco, Egypt, Jordan).

Southeast Asia: environmental pressures magnified by rapid urbanisation and shifts in diet
South-East Asia is an economically emerging, densely populated region, with rapid urbanisation and shifts in diets towards more resource-intensive and high emission products like (poultry) meat, fish/aquaculture and dairy (animal products), alongside processed and packaged foods.[7] Agricultural productivity (in terms of kg/ha and output per animal) has increased due to more capital (mechanisation) and input (e.g. fertilisers and feed) use, and will need further acceleration in order to keep pace with population, welfare and urbanisation developments (OECD, Agricultural Outlook 2018). The intensification of agricultural practices causes environmental and social problems, such as increasing water use creating scarcities, mineral depletion to groundwater, water pollution due to excess manure disposal and expropriation of land (e.g. forest converted to agricultural land; see UNEP, 2016; ESCAP, 2018). The incidence of wastewater and food waste is particular high compared to, for instance, Europe (ESCAP, 2018). While aquaculture has a long history in the region, rapid expansion has occurred in response to increasing demand domestically and internationally, reducing food insecurity and poverty. However, further development is limited by shortage of good quality of

[4] See World Resource Institute water stress maps on https://www.wri.org/our-work/topics/water
[5] https://www.futurewater.eu/projects/mena
[6] Recent (2007/2008, and 2011/2012; years with high price peaks) experiences reiterate that in times of food scarcity, trade rules become biased towards the interests of exporting regions. As a result, delivery contracts for grain were breached and the food security situation in developing countries was severely affected. Sharp increases in staple food prices contributed to civil unrest and the toppling of regimes in the Middle East and North Africa (Rutten et al., 2013; Bureau, 2013).
[7] In Vietnam, for instance, per capita meat consumption tripled over the last 25 years with other Southeast Asian countries like Indonesia, Malaysia and Thailand showing similar growth rates in the past (Hansen, 2018). More important is that OECD-FAO projections estimate meat consumption growth to continue to overall levels 20-30% higher in ten years' time (2018-2027 (OECD-FAO Agricultural Outlook, 2018).

feed, water pollution and other environmental degradation problems (FAO, 2009; Bush and Marschka, 2017; FAO, SoFA, 2018). A series of World Bank reports on agricultural pollution in East Asia (with focus on China, Vietnam and the Philippines) highlight the need for improved waste management in the livestock and aquaculture in order to combat environmental problems that are the result of diets shifts and increased animal production (e.g. Cong, 2017; Dingh, 2017).

Sub-Saharan Africa: hunger and malnutrition due to low agricultural productivity
Food and nutrition imbalances in Sub-Saharan Africa (SSA) are huge and lead to increasing dependency on food imports (IFPRI, 2018). Most people likely to require emergency food assistance in 2019 are in this region (FEWS.net, Food assistance Outlook Brief, March 2019). Slow growth of per capita food production in SSA is due to low productivity growth in agriculture, which has its root causes in the lack of input use (combined with appropriate technologies) and in unfavourable natural (e.g. low soil fertility) and climatic (high temperatures, erratic rainfalls) circumstances affecting the agro-ecological potentials negatively (Benin, 2016; IFPRI, 2015). Due to the many factors limiting productivity growth, easy answers are non-existent. Nin-Pratt (2016) argues that in most SSA countries the agro-ecological conditions for the expansion of a package of high-yielding cereal varieties and fertiliser are limited, and even when these conditions are met, differences in relative prices and in economic and institutional constraints will require different technological packages adapted to the needs of the different countries. Nin-Pratt recommends to target yield-enhancing technologies (including research and development) at indigenous (arable and tree) crops, and – as he also points at agricultural productivity growth trends in the region – to study what works well in one area can be used as the basis for formulating best-fit, location-specific agricultural policies, investments, and interventions in similar areas. In the same vein – that is, looking for tailored local solutions that reduce technological and socio-economic constraints – a large group of WUR researchers contributes to an international network identifying regions with greatest potentials for investments in yield increasing technologies, taking into account current available soil and water resources, and climate change challenges (i.e the Global Yield Gap Atlas, see http://www.yieldgap.org). Farmers' knowledge on how to use resources efficiently (both in agronomic and economic terms) appears to be a key factor in explaining the difference between the potential and actual farms' yield. Moreover, as Wageningen research continuously highlights, in order to close yield gaps, technological solutions must go hand in hand with lifting social and economic constraints (e.g. Achterbosch et al., 2014; Van Berkum et al., 2018).

Latin America: loss of biodiversity as the result of agricultural intensification and land use change
Latin America is one of the world's leading food producing and exporting regions. It has enormous natural wealth, a flourishing agricultural industry and a family farming sector that is fundamental for the food security of its population. However, the expansion of agricultural and food production in recent decades has been due largely to forest area conversion into agricultural land. Because of deforestation, environmental problems such as aridity, erosion and the loss of biodiversity caused by habitat damage, have become a major concern whereas deforestation is one of the causes of climate change, leading to the paradox that deforestation is putting food security at risk (CEPAL, 2015). Mitigation of deforestation is undertaken by international coalitions of businesses, civil society organisations and governments, among others in the context of round tables (reference to RTRS) and in deforestation-free supply chain covenants (IDH website). Deforestation is caused by a myriad of interconnected, interdependent and often socio-economic processes. Hence, reducing deforestation requires strategies to change the mechanisms that result in expansion of agricultural land at the cost of forest area, and at the same time provide local communities sufficient opportunities for building sustainable livelihoods. Investment in agricultural research, intercropping and agroforestry are ways to achieve higher yields and higher efficiency on existing agricultural land. In addition, socio-economic factors need to be included in assessing the potential success of measures aiming at conserving biodiversity as part of pathways mitigating climate change impacts on future food security (CEPAL, 2015; Manners and Varela-Ortega, 2017).

2.3 Solutions to global challenges require a holistic view

The above-mentioned issues at play in the different regions in the world offer many opportunities for Dutch government and businesses to support local activities building sustainable livelihoods. A circular agriculture approach could help to increase water efficiency (e.g. in MENA countries), reducing environmental pressures (e.g.in South East Asian countries), improve soil fertility (in SSA) and land-saving agricultural practices (e.g. in Latin America). However, the challenges described above also indicate that solutions are to be found in a combination of technological and socio-economic innovations, preferably in a participatory process of stakeholders. In short, solutions call for a systemic, holistic approach.

A sustainable food system lies at the heart of the UN SDGs. As a large part of the global population is still dependent on agriculture for jobs and livelihood, the food and agricultural sector is considered to be crucial for building economic growth and reducing poverty. Moreover, agricultural development can address a number of social needs including education and job opportunities (UN SDG website). The EAT-Lancet Commission (2019) emphasises the key role food and agriculture plays in achieving the SDG, claiming that food is the single strongest lever to optimise human health and environmental sustainability on Earth. However, producing healthy diets sustainably requires a transformation of the global food system, for which the group of renowned experts call on to implement five strategies. Among these is the appeal to reorient agricultural priorities from producing high quantities of food to producing healthy food. Another strategy is to sustainably intensify food production to increase high-quality output. A third route is to at least halve food losses and waste in line with SDGs.[8] The latter is also part of the 'menu of solutions' for building a sustainable food future, proposed by the World Resource Institute (2018), HLPE (2014) and FAO (2019, forthcoming). Circularity is a major aspect of this latter route.

Contemporary literature on enhancing food and nutrition security underlines that many food security challenges are complex problems whose solutions are contested and which transcend disciplinary, divisional and institutional boundaries. Challenges result from interactions across different scales and levels and require integrated actions taken by all stakeholders at local, national and global level, by both public and private actors and across multiple fronts (agriculture, health, environment, education etc). This requires a more holistic approach towards tackling the causes of food and nutrition insecurity and unsustainable food production. A food system approach is a way of thinking and doing holistically, by considering the food system in its totality, taking into account all the elements, their relationships and related effects. Such an approach broadens the framing and analysis of a particular issue as the result of an intricate web of interlinked activities and feedbacks (FAO, 2018a). The food system approach is further explained in the next chapter, in addition to the circular agriculture principles, which allows for showing how the two relate and can be useful in building a sustainable food future.

[8] The two strategies not mentioned in the main text are: Seek international and national commitment to shift toward healthy diets, and, Strong and coordinated governance of land and oceans.

3 The added value of food systems and circular agriculture approaches in addressing global challenges

3.1 The food systems approach

Food systems analysis aims to identify how different types of policy incentives or business investments/innovations influence the relationships between multiple stakeholders (input providers, farmers, traders, public officials, processors, retailers) that could lead to adjustments in the interactions of different components (consumption, distribution, value chain, production). Improving the food system performance is the ultimate goal of the mentioned intervention types (Ruben et al., 2018).

The food systems approach describes the different elements in our food system and the *relationships* between them. It looks on the one hand at all the activities relating to the production, processing, distribution and utilisation of food, and on the other hand at the *outcomes* of these activities in terms of food security (including nutrition), socio-economics (income, employment) and the environment (biodiversity, minerals, water, climate, soils). Figure 3.1 presents the components of the socio-economic and environmental drivers[9] and uses arrows to show the direction of the feedback mechanisms between the system components.

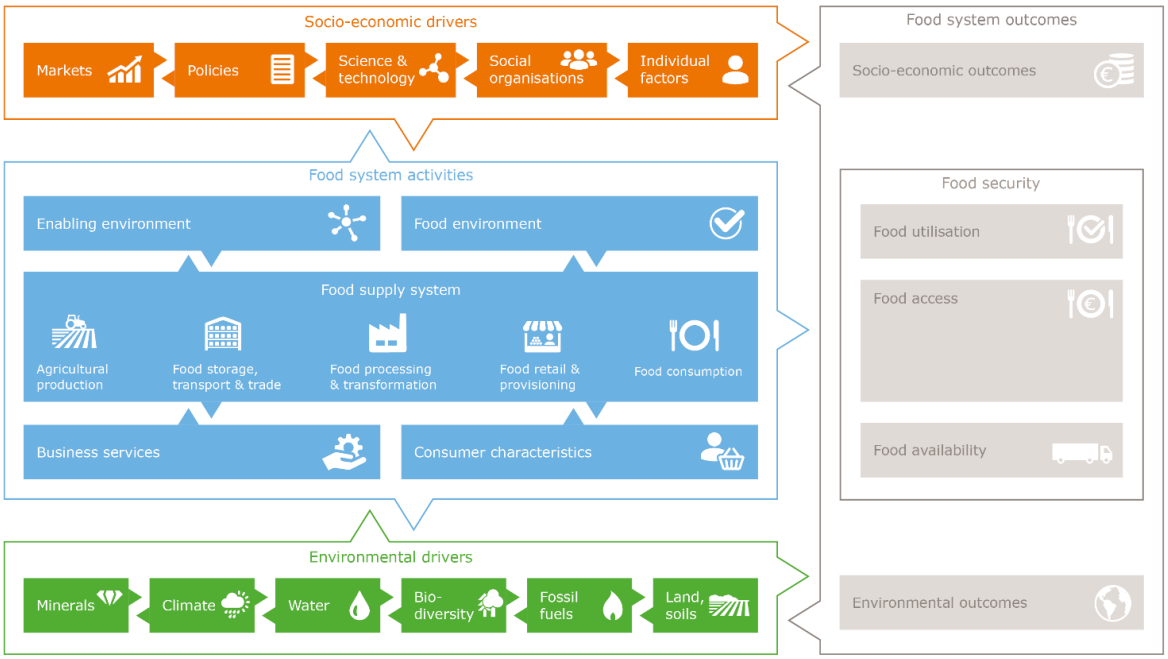

Figure 3.1 *A way of mapping the relationships of food system activities to its drivers and outcomes*
Source: Van Berkum et al., 2018.

[9] Drivers of change are factors that are regarded as exogenous to the change process. Thus population growth, economic/macro-economic growth and urbanisation are key socio-economic drivers of changes in the food system. Ecological or environmental drivers are natural factors or factors affected by human intervention which directly or indirectly bring about a change in the ecosystem. Climate change, soil nutrients and land use are major environmental drivers.

A defining feature of systems thinking is that it views the behaviour of a system as an interplay of interacting subsystems, in which *feedback* plays a key role, rather than as a simple chain of cause-effect relationships. This also distinguishes food systems thinking from other approaches such as farming systems, sector or chain approaches, in which interventions are often (though not exclusively) designed to make optimum use of the means of production (natural resources, labour, capital). This usually involves applying technological innovations at the level of family businesses, sectors and/or chains, with the focus on raising productivity and profitability. Although those approaches also show market and environmental impacts of interventions, they tend to pay insufficient attention to feedback from the socio-economic system and/or ecosystem to the farm, sector or chain. Food systems thinking steps back, as it were, from the place where the intervention occurs, thereby providing an opportunity to include feedback from outcomes outside the activities that relate directly to food production and consumption. Again, the wider perspective the food system approach offers for finding sustainable solutions for a sufficient supply of healthy food is the value of the approach.

Applying a food systems approach framework showing where the main interactions and feedback between the subsystems occur, produces a number of useful insights:

- It maps out opportunities for a more efficient use of natural resources (beyond one product and/or one value chain).
- It highlights the important role of the food system's socio-economic context.
- It shows the implications of the food system for health, malnutrition, livelihood and the environment.
- It helps to shed light on the *trade-offs* between different intervention strategies.
- It sheds light on *non-linear processes* and feedback loops in the food system.

This list of useful insights reflects the advantage of using a food system approach. The merit of using the concept of circular agriculture – and of other approaches as well - is measured by considering its attention to the system's socio-economic context and its involving of wider implications of interventions on health, (mal)nutrition, environment, trade-offs and feedback loops in a food system. Differences between and communalities of the two approaches will be further explained in the following subsections.

3.2 Circular agriculture

Circular agriculture is an ecological concept that is based on the principle of optimising the use of all biomass. Circular agriculture is aimed at closing the loop of materials and substances, and reducing both resource use and discharges into the environment. Circular economy – the economic counterpart of the ecological circularity concept – stands against the linear economic model of 'take-produce-consume-discard' and entails three economic activities, to be referred to as the 3Rs: reuse, recycle and reduce existing (used) materials and products. What was earlier considered as waste or surplus becomes a resource that is (re-)valorised (see Figure 3.2).

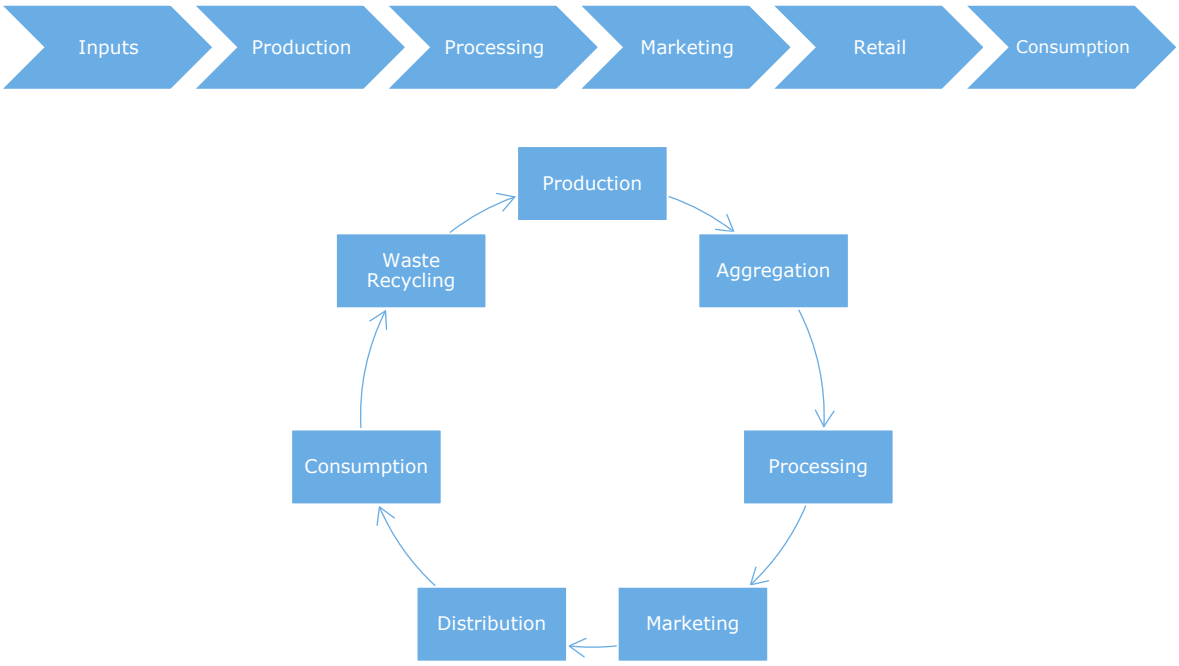

Figure 3.2 *A linear (top panel) and circular (bottom panel) food system*
Source: Ruben et al. (2019).

Circular economy in a food system context implies reducing the amount of waste generated in the food system, through the re-use of food, utilisation of by-products and food waste, and nutrient recycling by farmers and processors. However, circularity – understood as increasing efficient use of raw materials (including minerals and other natural resources) – could also be improved by changes in diet toward more diverse and resource efficient food patterns (Jurgilevich et al., 2016). Moreover, avoidance of food waste and surplus is also a consumption issue relating to consumer food competences and skills. Also, the utilisation of by-products such as biomass for energy or other industrial applications is a wider-economy issue depending among others on fossil fuel prices. This hints to the advantage of using a food system lens in identifying pathways towards circular agriculture: indeed, to achieve the objective of narrowing or closing cycles of natural resources requires insights into the potential contributions of all stages of agri-food supply chains, and also needs to include interactions of agriculture with other sectors in the economy. Above all, to change behaviour, closing cycles of natural resources has to be economically beneficial to actors involved. For designing transition pathways towards more circularity, the policy, law and regulation context affecting the value chain actors' behaviour towards efficient resource use need to be well understood.

3.3 The added value of food systems and circular agriculture approaches in addressing global challenges

Both the food systems approach and the concept of circular agriculture have recently gained firm ground, but are relatively new approaches in a long line of conceptual thinking about sustainable agriculture. Table 3.1 shows the key characteristics of the two new approaches and other approaches often applied in research that aim at sustainable agriculture. This comparison shows that both the food systems and the circular agriculture concept offer a more comprehensive approach to sustainable agriculture than sustainable intensification, climate-smart agriculture and landscape approaches (see Appendix 1 for a more detailed description of the three latter approaches). Not only do these two approaches cover more different levels of scale, they also include more different actors in their intervention strategies. Moreover, they go beyond the focus on the production level, to also include the food consumption, processing and trade activities, and their interactions and interdependencies as well.

Table 3.1 *Comparison of contemporary most prominent approaches to sustainable agriculture*

	Key publications	Core objective	Scale of interventions	Actors involved in interventions	Type of interventions
Farming Systems Approach	Shaner et al., 1982 FAO, 1995 Collinson, 2000	Improve overall farm performance	Local	Farmers, extension, NGOs	Efficiency measures, farm diversification
Sustainable intensification	Reardon et al., 1995 Pretty, 1997 Struik et al., 2017	Increase farm productivity with less resources	Local	Farmers, extension, private sector	Precision farming, Integrated Pest Management
Value Chain Approach	Kaplinsky and Morris, 2003; Vermeulen et al., 2008; DCED, 2016	Linking farmers to markets	Local, Regional, Global	Farmers, extension, private sector, NGOs	Grouping farmers & supporting local processing
Food Systems Approach	Ericksen, 2008 Ingram, 2011 UNEP, 2016 HLPE, 2017	Find synergies and leverage points in the food system	Local, Regional, National, Global	Farmers, extension, private sector, government, NGOs, consumers	Numerous options along the value chain, in the food environment and across food system drivers
Climate-smart agriculture	FAO, 2009 FAO, 2013 Lipper et al., 2018	Mitigate and create resilience to climate change	Local, Global	Farmers, extension, private sector, government	Drought resistant crops; integrated production systems
Landscape Approaches	Sayer et al., 2013 PBL, 2015 FAO, 2017b	Develop cross-sectoral solutions at landscape level	Local, Regional	Farmers, private sector, NGOs, government,	Watershed management; peri-urban forests
Circular Agriculture	Ward et al., 2016 Jurgilevich, 2016 WUR, 2018	Minimise food waste and increase resource efficiency	Local, Regional, National	Farmers, private sector, government, consumers	Recycling waste materials; food waste reduction

To further elaborate the advantage of the food system and the circular agriculture approach, Table 3.2 provides an overview of how the different sustainable agriculture approaches cover the different elements of the food system, as described in Van Berkum et al. (2018). This overview shows that the food systems approach covers all aspects of the food system, from the food systems activities in and around the value chain, to the outcomes of these activities and the socio-economic and environmental drivers of the activities in the food system. Other approaches clearly pay less attention to at least a number of system activities and drivers of system changes. The consequence is that those approaches are less useful in the search for interventions that make food systems more future proof.

Table 3.2 *Comparison of sustainable agriculture approaches on their coverage of the food system*

	Farming Systems Approach	Sustainable intensification	Value Chain Approach	Food Systems Approach	Climate-smart agriculture	Landscape Approaches	Circular Agriculture
Value chain							
Agricultural production	■	■	■	■	■	■	■
Food storage, transport & trade			■	■			■
Food processing & transformation			■	■			■
Food retail & provisioning			■	■			■
Food consumption			■	■		■	■
Food system activities							
Enabling environment		■	■	■			
Business characteristics		■	■	■			
Food environment				■			■
Consumer characteristics				■			■
Food system outcomes							
Socio-economic outcomes				■		■	■
Food security outcomes	■	■	■	■	■	■	■
Environmental outcomes				■	■	■	■
Socio-economic drivers							
Markets	■	■	■	■	■		■
Policies		■		■	■		■
Science & Technology		■		■	■		■
Social organisations			■	■		■	
Individual factors				■		■	
Environmental drivers							
Minerals	■			■			■
Climate				■	■	■	■
Water	■			■	■	■	■
Biodiversity	■			■		■	
Land, soils	■			■	■	■	

The conclusion from the above comparison of analytical approaches is that the food systems approach is the most comprehensive one in covering the different parts of the food system, followed by the circular agriculture approach. Due to their broad scope, these two approaches offer the widest range of opportunities for interventions in the food system, with the aim to enhance its sustainable outcomes. Table 3.3 provides the basic principles of both approaches in addressing the global challenges to food and nutrition security as they were presented in the previous chapter.

Table 3.3 *Linkages of food systems and circular agriculture approaches to global challenges*

	Food systems (FS) approach	Circular agriculture (CA) approach
Climate Change and Water Scarcity	• Points attention to the importance of environmental drivers for the functioning of the food system • Points at tipping points and reinforcing loops in the system that speed up certain processes (e.g. climate change, desertification) that affect food production, and subsequently impact food security and social sustainability of the system	• Shows opportunities for reducing greenhouse gas emissions through the closing loops of material, energy and water flows • Helps identify opportunities to recover and re-use water streams to reduce water pressures
Urbanisation and Shifting Diets	• Points attention to the role consumer behaviour and food environments play in changing urban diets • Identifies opportunities for innovations in urban food provision that improve access to nutritional food and reduce the impact on the environment (e.g. protein transition, aquaculture), whereas consequences for food supply activities are considered	• Shows opportunities for creating urban food systems in which material and nutrient cycles are shortened and used more efficiently (e.g. urban farming, vertical farming) • Points to possibilities to recycle urban food waste and nutrients
Productivity, Hunger & Malnutrition	• Shows which systemic behaviours create reinforcing loops of underinvestment, low productivity, hunger and malnutrition (e.g. poverty trap) • Helps identify leverage points for interventions that increase farmer productivity, efficiency in the value chain, and improve livelihoods and food security, including reflections on environmental impacts of interventions proposed	• Shows opportunities for using underutilised resources at farm level, as well as benefitting from waste recycling elsewhere in the supply chain • Points to possibilities to improve resource efficiency in order to contribute to increased productivity and improved livelihoods
Deforestation & Decreasing Biodiversity	• Shows how deforestation is putting food security to risk, and the importance of biodiversity to sustainable food systems outcomes • Helps identify synergies between measures aiming at increasing food and nutrition security and protecting the environment	• Shows opportunities for food production systems to improve resource use, reducing environmental pressure • Points to possibilities to reduce pressures to land conversion by optimising the use of existing (land and other) resources

4 Food systems and circular agriculture in practice

Given the benefits of the food systems and the circular agriculture approach, as presented in previous chapter, this chapter illustrates how these approaches can be applied in practice to real-life challenges. The cases selected are either interventions that took place in the past or plans for interventions in the future. The cases highlight that impacts of interventions promoting circularity promise to be more sustainable if social, economic *and* environmental trade-offs are explicitly taken into account. Note that the structure of the chapter follows the global challenges highlighted in Section 2.2. In each subsection, an example illustrates how the challenge is addressed, and how the (proposed) solution contributes to improved food system outcomes, *or* could increase its impacts by also taking into account trade-offs and/or opportunities to create synergy. Each subsection can be read independently from others in this chapter.

4.1 Climate change and water scarcity

4.1.1 The challenge: water scarcity in Morocco and Mexico

Two-thirds of the global population (4.0 billion people, of which 1.0 billion live in India and another 0.9 billion live in China) lives under severe water scarcity at least 1 month of the year (WRI).[10] Morocco and Mexico are among the countries with significant water stress. In both countries, LNV-funded KvM-proposals[11] are developed addressing the water scarcity problem while seeking for Dutch investment opportunities in food and agricultural production in these countries. This is the reason why this section uses examples of these two countries.

Morocco is a water-scarce country confronted with dwindling groundwater reserves and a strong dependence on rain-fed agriculture. Only 15% of total agricultural land is irrigated (USAID, 2019). Climate projections suggest reduced precipitation and a sharp decline in water resources availability. Morocco is expected to enter a situation of extreme water stress in less than 25 years (World Bank, 2017).

Agriculture employs 40-45% of the Moroccan working population, making it the largest employer in the country. Horticulture forms a key component of Morocco's agricultural sector, with olives, tomatoes, almonds and oranges featuring in the top 10 of the country's agricultural output (FAO, 2019). Other important horticultural products grown in Morocco are potatoes, string beans, grapes, apples, strawberries, onions, melons and mandarins. Recurrent droughts form a serious problem for Morocco's horticulture. On average, drought occurs in Morocco every third year, creating a volatility in agricultural production that is the main constraint on expansion in the sector.

In Mexico, the northwest and central part in particular face water shortages during substantial periods of the year (Mekonnen and Hoekstra, 2016). Moreover, large parts of Mexico are facing basin closure, characterised by the overexploitation of surface water and groundwater, and increasing water scarcity. Climate change is a large contributor to the growing water scarcity in Mexico, due to less and erratic rainfall over the year, contributing to periods of significant water deficits. In 2011, Mexico had what was described as its worst drought on record. More than 1.7 million cattle died of starvation or thirst – and at least 2.2 million acres of crops withered across at least five states. Climate change is expected to lead to 40 to 70% decline in Mexico's current cropland suitability by 2030.[12] This means Mexico could potentially lose over half its workable farms in less than 12 years. Recent reports are indicating

[10] See https://www.wri.org/publication/aqueduct-country-and-river-basin-rankings
[11] The Ministry of LNV uses the KvM (Kansen voor Morgen) instrument for pre-competitive research intended to crank-up further Dutch agribusiness investments abroad.
[12] www.climaterealityproject.org, February 15, 2018.

that Mexican migration to the USA is partly driven by vulnerability to climate change (Oppenheimer, 2010; FAO, 2018b).

4.1.2 Case studies: Morocco potato value chain development and Mexico hydroponic greenhouse production integrated with aquaculture

In Morocco, a LNV-funded KvM project is planned, linking up expertise from Wageningen University & Research, the Dutch Potato Organisation, and one of the country's leading universities, Université Hassan II in Rabat, to help develop a sustainable potato value chain. Potatoes fit in a healthy and sustainable diet as this crop is known for its health and nutrition benefits, and requires less water than other staple foods like wheat and rice. By sheer weight, the potato is now Morocco's third biggest crop, after sugar beets and wheat, and second only to tomatoes among exported vegetables. Production of fresh potatoes is concentrated along the Atlantic Coast north and south of Casablanca, where a modified Mediterranean climate provides very favourable growing conditions. Potatoes are also grown in high, rugged parts of the Atlas mountains, at elevations of more than 3,000 metres. The average Moroccan consumes about 42 kg of potatoes a year.

This project aims on minimising the use of natural resources (in particular water) while providing farmers income and healthy products for local and export markets. The project investigates the impact of activities in the potato value chain on the SDGs and their underlying targets and indicators. The project also envisages to give recommendations how to further enhance impacts on a regional scale.

A KvM project application addressing the water scarcity problem in Mexico is about the integration of three production systems: hydroponics greenhouse cultivation, aquaculture and the production of microalgae (for improved protein and fatty acid content in fish feed). Major aim of the project is to increase biomass production per litre of water. The integration of the three production systems is to reduce water waste (in terms of quantity and quality) which is also expected to reduce environmental impacts of using available water sources more intensively in the surrounding of the spot where the project will take place. According to the plan, increased efficiency of water resources will allow local production of high quality vegetables and farmed fish in central Mexico. The main aim of this KvM project is to research the technical options of integrating the three production systems in the Mexican context, with increased water efficiency and GHG reduction as goals. The research is about to start in 2019, and would be mainly a desk research that is taking into account local-specific circumstances as the case is linked to a large scale vegetable producer, willing to expand the scale and scope of his business. The next step (following the desk research) would be to initiate upscaling into a commercial pilot plant.

4.1.3 Addressing water scarcity using a food system approach

Taking a food systems perspective, addressing water scarcity starts with identifying root causes of the problem. One is climate change that leads to a reduction in *water supply.* Other factors cause increasing *water demand*, such as population growth and associated rising demand for food, feed, fibre, and energy, whereas changing diets (due to urbanisation and income growth) towards more meat, fish, fruits and vegetables promotes water-intensive agricultural cultures. Food systems solutions focus on addressing these root causes by, for instance, improved water management, for example by implementing climate-smart agriculture, water-efficient drip irrigation and optimising water recycling systems for growing urban populations. At the same time, food system type of solutions also point at possible interventions elsewhere in the system: for instance, water use in the agricultural sector is addressed by promoting the consumption of less water-intensive crops. It is this wider perspective that a food system approach brings in, triggering the discussion which options are most sustainable in all its dimensions simultaneously.

A food system perspective also forces to take the socio-economic context into account. A basic element in addressing water scarcity is the governance of water allocation, via (water) markets, government policies or a mixture of both. Governments play a key role in targeted policy responses to market failures that impede the efficient allocation of water. Ensuring water prices and user rights that reflect water availability within sustainable limits is a prerequisite to any coherent policy to managing

droughts in agriculture. Over-allocation of water rights and lack of incentives to reflect the scarcity cost of water leads to structural water deficits and chronic water shortages, mechanically increasing exposure and vulnerability to drought risks. Properly designed water allocation systems would include the use of economic instruments and weather and hydrological information systems, whereas public policies to foster efficient water management could also include innovation and education, and insurance and compensation against drought (and flood) risks (OECD, 2017). These insights point at socio-economic drivers (see the top line of boxes in Table 3.1) to be important possible leverage points for solutions when addressing water shortages.

A food system perspective also allows for taking into account feedback mechanisms in the system that reinforce or dampen the consequences of an intervention. An example of such a feedback mechanism is the way in which water use permits to water-intensive agriculture is influencing local water availability to competing users, which in turn may increase water scarcity problems to all users in a region. Consequently, regional employment and livelihood consequences, with impacts on food demand and food security, will emerge as well.

Circular agriculture approaches bring another perspective to the challenge of water scarcity, namely by identifying opportunities for re-using water sources or storing water for later use. Rain harvesting methods and hydroponic systems could be opportunities that emerge from this perspective helping retaining and re-using water streams in order to reduce water scarcity.

The two Dutch KvM projects foreseen in Morocco and Mexico are useful contributions to help reduce water scarcity in the specific location they focus on. As indicated above, water management is affected by institutional frameworks (government water right allocations, water pricing), weather, information and education (e.g. to initiate behavioural change), and the political economy of balancing competing claims on water. Seen through a food system lens, the KvM projects need to address a number of additional questions that would give insights on possible impacts on other water users, and on the broader regional socio-economic and ecological effects of the project investment. For instance, when increased water efficiency in potato and vegetable/fish farming results in more demand for these products, production expansion may ultimately result in more water use and negative environmental outcomes. Including such feedback mechanisms in proposed KvM projects would allow to assess its full potential to contributing to positive food system outcomes. And, a food system intervention should also consider alternatives: what about an intervention affecting food consumption patterns with less water use in agriculture as a result? Food systems thinking may results in an intervention somewhere else in the system (e.g. on consumer level) which the effect that production becomes more resource efficient. Food system thinking hence provides an opportunity when analysing the outcomes of policy interventions to include feedback from outcomes outside the activities that relate directly to food production and consumption.

4.2 Urbanisation and diet change

4.2.1 The challenge: urbanisation, diet shifts and environmental pressures in South-East Asia

In 2010, 42% of Southeast Asia's population lived in cities (ISEAS, 2010). By 2050, nearly 63% of the total population of Southeast Asia is expected to live in urban areas (IIED, 2016). Not only is urbanisation profoundly changing urban-rural relations, it is also shifting patterns of food consumption. Consumers spend less of their food budgets on staples, and more on dairy, meat and fish. This increasing demand for protein has a large impact on the structure of rural agriculture in the region.

As urbanisation and related dietary shifts further accelerate the demand for protein in Southeast Asia, the importance of livestock production, aquaculture and fisheries for the region is growing. While the rapid expansion of Asia's livestock sectors has ensured increased supplies of animal source foods for Asia's growing and more affluent population and helped to reduce micronutrient deficiencies, this trend has also brought with it risks of environmental degradation and zoonosis, loss of biodiversity and

acceleration of climate change through livestock-associated emission of greenhouse gases (FAO, 2016). The two cases in Vietnam below show how in that country the livestock and aquaculture have found way to reduce the environmental pressures by re-using and recycling manure and water respectively.

4.2.2 Case study: biogas production from livestock waste streams, Vietnam

In Vietnam, food demand has increased rapidly as population and incomes have increased, and food consumption patterns have shifted. The past decade has seen very high levels of growth in the consumption of meat (especially pork), milk, and eggs—growth rates higher than those experienced by any country in the region (Jaffee et al., 2016).

Intensification has been Vietnam's response to this surge in demand, especially in pig and poultry production, and this pattern has given rise to environmental problems. Intensification of livestock farming from big farms often produce wastes much more than their capacity to recycle them for use as fertilisers and biogas. As a result, inappropriate dumping of wastes and lack of waste treatments before discharging into surrounding environment have caused varying degrees of localised water, soil, and air pollution and have had a negative impact on public health, especially in or near densely populated areas.

Today, biogas is the most popular technology in rural areas that helps mitigate environmental problems caused by animal wastes. It converts waste into energy for home consumption. Biogas digesters have been used in Vietnam for several decades, but in the past 10 years, the technology developed more strongly owing to the government's financial assistance programmes providing incentives for more farmers to adopt this technology (Dinh, 2017).

In 2009, the government granted up to 25% of the cost for the construction of a new biogas digester, then reduced it to 10% in 2011 and 2012. As a result, a total of 500,000 biogas digesters have been built in the whole country in that period, of which 176,000 biogas digesters have been financed by the four main sources/projects, namely SNV-Netherlands, LIFSAP the Quality and Safety Enhancement of Agricultural Products and Biogas Development Project (QSEAP), and the Low Carbon Agricultural Support Project (LCASP).

Biogas digesters have a positive impact on different outcomes. First, they improve health and reduce pollution by providing an anaerobic environment in which the manure from intensive livestock production can be stored. Second, the biogas digester produces effluents, that can be safely used as feed for fishponds or as fertiliser for agricultural crops. The actual use of the biogas (how it is applied, to whom, its costs of application, etc.) depends on local circumstances and agreements of agents involved. Third, the biogas produced by the digester can be used for cooking and generating electricity. However, biogas digesters also have some limitations, such as requiring significant land area, regular maintenance and high initial investment (Dinh, 2017).

4.2.3 Case study: sustainable fish farming in the Mekong delta, Vietnam

Not only meat consumption witnessed rapid growth, also demand for fish has been growing rapidly in Vietnam: consumption of protein from fish and seafood increased more than 75% between 1990 and 2011, and continued increasing since. Production in the region experienced robust growth during 2004–2014 with an average annual growth rate of 3.8%. Over that period, aquaculture achieved much higher annual growth (6.1%) compared with capture fisheries (1.6%). Aquaculture is an important source of high protein food for people worldwide; more than 50% of all fish consumed globally is farmed fish (FAO, 2018).

However, for aquaculture to become a sustainable option for ensuring food security, disease and feed issues must be tackled. Diseases result in loss of income, waste of inputs, water pollution and irresponsible practices like the excessive use of antibiotics. Feed is most often the biggest cost in aquaculture production, but it is often used inefficiently. Feed often consists of marine ingredients

such as fish oil and fish meal, which may be caught through illegal, unreported and unregulated practices, such as overfishing or illegitimate labour practices on vessels (IDH, 2017).

Within the context of Southeast Asia, the largest producer of farmed fish is Vietnam, where aquaculture contributes to 65% of total fisheries exports. In recent decades, Vietnam's aquaculture sector has grown tremendously, but future growth is threatened by the environmental impacts of production, its dependence on wild fish as feedstock, and competition for space where it operates (Hong et al., 2017).

IDH Sustainable Trade Initiative, based in the Netherlands, has been strongly involved in making the Vietnamese aquaculture sector more sustainable. Through its Aquaculture Program it is currently developing *aquascapes*, geographical areas where aquaculture farmers are connected through proximity, jurisdiction or by using the same water. In these aquaculture areas, IDH strengthens partnerships to develop joint strategies that tackle diseases and feed-related issues. IDH has also been involved in sustainable certification for implementing more responsible practices at farm level. This resulted in 35% ASC certification of Vietnam farmed pangasius within 1.5 years. The implementation of sustainability standards in pangasius and shrimp mitigated negative environmental impact and maximised social benefits (IDH, 2019). Recent studies show that the environmental impact of aquaculture farms can be further reduced by using urban food waste streams as feed for the farmed fish, reducing the need to use fishmeal from whole fish or soybean meal (Wing et al., 2018).

4.2.4 Addressing the environmental impact of dietary shifts with the food systems approach

Dietary shifts towards more protein lead to expansion of livestock, aquaculture and fishery activities, which are in turn associated with negative impacts on the environment, such as loss of biodiversity, increased GHG emissions, overfishing and water pollution. Food system approaches focus on reducing these environmental impacts by decreasing the environmental pressures associated with the transition towards protein-richer diets, and seeking solutions that optimise socio-economic and environmental outcomes simultaneously. They would therefore focus on production systems which offer the most affordable proteins with the lowest environmental impact.

The two cases presented above both show circular agriculture practices with multiple benefits in terms of environmental, social and economic impacts. Regarding the biogas application of manure, a waste stream is used for energy, which is extremely useful in itself but what is done with remaining nutrients from the manure is not known. Regarding fish farming, the opportunities to use waste streams as feed are not explored. This implies that there are alternative pathways to be explored for reducing negative environmental pressures and increasing socio-economic (job, income, etcetera). When searching for these opportunities a food system lens would be a most useful tool, as it ensures the attention to the socio-economic context and livelihood implications of an intervention. Moreover, food systems approaches involve a broad range of stakeholders to solve the issues (perceived negative effects, trade-offs and so on) together, working on the most important leverage points for change in the food system. For the issue of sustainable protein production in Southeast Asia, this means creating partnerships between private sector, government and civil society to develop joint strategies to reduce the environmental burden of the shift to more protein-rich diets.

4.3 Low productivity and the poverty trap

4.3.1 The challenge: closing the yield gap in African countries

Although increased over the last decades, agricultural (land, labour and total) productivity is generally low in many African countries (Benin, 2016).[13] With a rapidly growing population, low agricultural productivity has resulted in an increasing food import dependency of many African countries. Low

[13] For instance, for maize – the most produced cereal in the world – the average yield worldwide is approximately 5.5 tonnes/hectare/year, whilst production in Africa stagnates at around 2 tonnes/hectare/year (FAOstats).

agricultural productivity growth has it root causes in low input use, which is partly the result of low income and financial capacities to purchase inputs like fertiliser, plant protection products and quality (e.g. insect-resistant, drought-resistant) seeds. Improved access to those inputs and more efficient use of available ones would then be routes to increased production per hectare, better earnings and enhanced livelihoods. Possible trade-offs with environmental objectives, though, should be taken into account, in order not to compromise environmental outcomes of a (much) more intensive use of chemical inputs in agricultural practices.

A Dutch-financed project CASCAPE (2012-2015)[14] has contributed to positive yield increases in Ethiopia by providing expertise and training on scaling-up of evidence-based best practices. The project served the Ethiopian government and its agricultural sector by identifying under which circumstances farmers are prepared to take up innovations. Practices promoted were evaluated by taking their effects on environmental and social sustainability into account. In its collaboration with government, private sector, NGOs and research institutes, the project was able to directly involve around 18,000 farmers via organised field days. In evaluating the impact of the project, the CASCAPE team underlined that to increase the food security in Ethiopia, much more is needed than improving agricultural practices and increasing yields. Systematic changes are required, such as making sure that farmers have access to credit, to markets, knowledge, labour and land. It is in the realm of the national government, in the first place, to initiate and steer such changes, which are largely in the area of the food environment, that is in improving the enabling environment of the sector to produce more resource efficient and enhance its earning capacity.

4.3.2 Case study: closing urban-rural food and nutrient loops in Ghana

Quite a different pathway was followed in and around Accra (Ghana) to help farmers to improve their yields. In May 2017 an alliance of public and private partners launched a compost plant in Accra where garbage from the city is used to produce organic fertiliser that is to be sold to farmers in the vicinity of the country's capital city (IWMI, 2017). With the establishment of the plant, two challenges are covered in one blow: waste that threatens human and environmental health is recycled and the farming community is helped with an affordable nutrient-rich organic fertiliser, which is used to improve the generally poor soil fertility of their lands. As demonstrated by extensive field trials, the fertiliser produced improves the yields of common grains, like maize and rice, as well as vegetable crops, including okra, tomatoes, pepper, cabbage and lettuce. Results have not come overnight: the final product (i.e. the organic fertiliser), technical process and public-private business approach resulted from more than a decade of research (with major inputs from CGIAR IWMI) and organisational efforts with financials support through grants from partners in France, Switzerland and other countries, including the Bill & Melinda Gates Foundation, governments of Canada, the UK and Ghana as well as the CGIAR Fund.

The production of the organic fertiliser is claimed to offer multiple benefits, including new jobs, better human health, a cleaner environment and more nutritious diets, with less dependence on imported food and chemical fertiliser. As such, the project shows to positively contribute to all three (i.e. social, economic and environmental) sustainability dimensions of the food system.

4.3.3 Closing the yield gap using a food system lens

Taking a food systems perspective on the challenge of low (land and/or labour) productivity compels to seek for the root causes of the problem. Such reasons are limited access to inputs (among others seeds, fertilisers, feed, credits), unfavourable natural (e.g. low soil fertility or rainfall) and climatic conditions, or other causes that can be found in the socio-economic domain. Food systems solutions then focus on addressing these root causes, for example by implementing targeted subsidy or credit programmes in order to ease access to inputs, by improving cultivation and management skills (e.g. resulting in crop and animal health improvements) or encouraging demand (that may lead to increased sales and/or better margins, feeding back to investments in more productive production methods).The factors acting as constraints to productivity growth are many, and hence the possible

[14] See https://www.wur.nl/en/show/cascape-1.htm

pathways to alleviate the constraints are numerous. A thorough diagnosis and understanding of problems and constraints is therefore particularly critical, and should, preferable, result in addressing the primary constraint to agricultural productivity.

For instance, access to water can be a primary constrain for agricultural production which results in unpredictable yields and frequent crop failure. With simple yet effective water-harvesting technologies (e.g. pans, dams and water buffers) farmers are able to cultivate their plots more than once a year and increase their yields. In addition to increasing their land productivity, farmers may grow high-value crops that enable them to generate greater income. Smallholders' productivity growth may be limited by the lack of market opportunities that results in production not reaching the market and being lost, either by not being harvested or in a post-harvest stage. Enhancing marketing and post-harvest handling is hence a sine-qua-non of benefitting from higher productivity at farm level, and can be achieved by the establishment of cooperatives or associations, in which farmers organise and finance the purchase of inputs, storage, transport and selling to the market. Social organisation (and the incentive to organise oneself) is then a major driver of transition. The storyline in this paragraph clearly shows the many interdependencies within the food system affecting the eventual outcomes of an intervention or innovation that initiates a change. A focus on closing material flows or re-use of resources – principles of circular agriculture – do not catch these interdependencies by definition.

The use of more inputs in order to achieve higher production per hectare or per animal may have serious trade-offs with the objective to preserve natural ecosystem services. The World Resource Institute argues that creating a sustainable food future need spurring technological innovations, and points at many opportunities such as 'crop traits or additives that reduce methane emissions from rice and cattle, improved fertiliser forms and crop properties that reduce nitrogen runoff, solar-based processes for making fertilisers, organic sprays that preserve fresh food for longer periods, and plant-based beef substitutes. A revolution in molecular biology opens up new opportunities for crop breeding '(WRI, 2018: 2). However, this requires quite some R&D efforts to accomplish. There are also opportunities to use available techniques and practices to improve resource efficiency in a context that might not be so obvious on first sight, as the Accra case about using urban food waste for improved soil fertility in rural area around the city, as described above, illustrates. The wider perspective that a food system approach offers to find solutions that fit local circumstances best and avoid negative trade-offs is the great benefit of using that analytical framework for closing yields gaps.

4.4 Deforestation and biodiversity losses

4.4.1 The challenge: reducing land use change in order to prevent biodiversity losses in South-America

Brazil, Peru and Bolivia – countries where the rainforests of Amazon occur – are among the countries that are most affected by deforestation. Other countries losing forest rapidly are Indonesia, Russia, Mexico, and Nigeria (FAO, 2018c). The dynamics of land use change is a highly complex process with many actors involved, with drivers that are directly and indirectly related to deforestation. While extraction of wood is a direct deforestation activity, this releases land to be used as extensively cultivated grasslands for the expansion of cattle raising, that in turn is being taken over in time by arable crops like soybean (Latin America), palm oil (Indonesia) or other crops (such as avocados in Mexico). Forests and trees make vital contributions to both people and the planet, bolstering livelihoods, providing clean air and water, conserving biodiversity and responding to climate change (FAO, 2018c). The deforestation process therefore reduces the world's natural capital in the form of these common goods.

4.4.2 Case study to regenerate degraded agricultural land?

Following the round tables on soy, palm oil and other commodities, international coalitions of businesses, civil society and governments have made important steps in mitigating deforestation during the last 10-15 years. Important examples are the covenants signed by multinationals individually and business coalitions to go for deforestation free supply chains (e.g. IDH website).

However, deforestation has not stopped, resulting in the FAO calling for further coordinated policies across different ministries and international support if sustainable development is to be realised (FAO, 2018c). Specifically targeted at the Brazil Amazon, the Zero Deforestation Working Group (ZDWG, 2017) states that there is 15-20 million hectares of degraded land available on which productivity can increase significantly with improved land management measures. The working group's measures proposed claim to result into inclusive growth (more people earning a better income) and significant environmental gains.

It seems worthwhile to study suggestions like those made by the ZDWG in order to formulate KvM projects to support the more productive use of already degraded agricultural land in countries affected by deforestation. In the Brazil Amazon, expansion of extensive livestock agriculture is one of the key factors driving deforestation in the region. Evidence shows that it would be possible to increase the average productivity of livestock from 80kg to 300kg per hectare per year with the adoption of an average level of technology, e.g. by adopting good agricultural practices and pasture maintenance, including rotational grazing and no-till farming (Garcia et al., 2017). This intensification of livestock production would significantly reduce the pressure on the Amazon forests, as it would allow to increase livestock production for 26 more years on the already deforested areas without the need of expanding livestock into forested areas.

4.4.3 Food systems solutions to deforestation and associated biodiversity loss

Possible solutions to prevent forest to be converted to agricultural land is to invest in land saving agricultural methods and technology. The World Resource Report (2018) proposes a number of improvements in crop and pasture productivity that are the key for boosting output on existing agricultural land. For instance, in quite a number of countries current practices in livestock systems show great potential to improve productivities, either through improved food quality, breeding and health care (WRI, 2018:23-25). In addition, the use of existing land for double cropping and/or integrated livestock and arable cropping in a mixed crop-livestock farming practice is another way to increase yields, as are measures revitalising degraded soils (by improving soil and water management), and planting existing cropland more frequently (doubling cropping). Measures proposed would result in more production on existing land, reducing the pace of deforestation and saving biodiversity and greenhouse gas emissions. Basically these methods fit in the sustainable intensification approach that is associated with producing more on existing land by using resources more efficiently (see Appendix 1 for a more extensive explanation of this approach). However, WRI also calls for demand-reducing measures and actions to protect and restore natural ecosystems to complement interventions to boost productivity on existing land in order to achieve the goal of net-zero expansion of agricultural land. Measures like reducing post-harvest losses and food waste, avoiding competition from bioenergy for food crops and land, and reducing demand for animal-based foods,[15] therefore, also importantly contribute to combatting deforestation for agricultural purposes. In brief, a package of simultaneously applied measures will be most effective in reducing biodiversity losses and deforestation, while at the same productivities are improved.

[15] For every food calorie generated, animal-based foods—and ruminant meats in particular—require many times more feed and land inputs, and emit far more greenhouse gases, than plant-based foods (WRI, 2018 :15).

5 When does an intervention contribute to improved Food Systems outcomes?

The cases discussed in the previous chapter show that Dutch-financed projects aiming at increasing resource use efficiency through either re-use, recycle or reduce natural resources could learn from other initiatives in which social and economic impacts of a primarily technical intervention are explicitly taken into account. Resource efficiency and circularity promoting interventions are more likely to deliver positive social and economic effects as well, if these interventions entail features that make them 'food system outcome enhancing'. Such features were raised already several times in the previous chapters as being important for making interventions contribute to a more sustainable food future. Table 5.1 summarises these in one overview.

Table 5.1 *Characteristics of interventions that fit into a food system approach*

Focus on system outcomes and ensure that the intervention provides social, economic and ecological gains simultaneously
Identify trade-offs and synergies
Understanding key drivers of systems change and intervention points for change and transition
Link technological interventions with behavioural change
Involve private, public and/or civic agents
Include multiple products, value chains and/or spatial scales
Identify alternative solutions

The characteristics listed in Table 5.1 may be rather obvious as well as general. Therefore it may help to indicate how these features can be included in the stage of project design as well as in monitoring and evaluating the project during and after its execution. A nuance in advance is that most Dutch-financed projects through the involvement of a locally-based Dutch agricultural counsellor are relatively small in terms of budget, and therefore limited in scope. Such projects cannot include the broad spectrum of activities that would be necessary to initiate 'systemic change'. This may even hold for Dutch country programmes (via a Dutch embassy or DGIS). Yet, important is that each project – small and large(r) – should at least contribute to systemic improvements, either via a practical application or by offering important insights about how such transitions could be achieved.

Focus on food system outcomes

Food systems provide multifaceted outcomes and in order to make a change towards a more future proof system, an intervention should contribute positively – or, at least, do no harm – to all the three dimensions of sustainability. The intervention proposed should help to enhance at least a number of food system performance dimensions simultaneously. Table 5.2 below suggests some indicators that could be used to measure (ex-ante and ex-post) impacts of an intervention. The list is not complete or excluding; what is important is that the project evaluation covers indicators from each of the three (social, economic and environmental) sustainability dimensions of the food system.

Table 5.2 *Indicators proposed to measure results of Dutch food security projects taking up circularity*

Reduce malnutrition, nutrient deficiency, obesity	Inclusive/sustainable growth	Ecologically sustainable systems
Improved food intake	Increased productivity/income	Improved eco-efficient use of farmland
Improved access to appropriate food	Improved access to markets	Improved watershed/landscape mgmt
Resilience of nutritional situation	Resilience of farming enterprise	Improved agro-ecological resilience
No. lifted out of undernourishment	No. doubling productivity/income	Hectare converted to sustainable use

Source: Based on BuZa/LNV Food security programme 2014-2018.

Identify trade-offs and synergies
Interventions may have a positive socio-economic outcome (e.g. improving income generation) for some of the stakeholders involved, or a positive socio-economic effect may go hand-in-hand with negative environmental consequences (e.g. water pollution). Trade-offs among stakeholders and between sustainability objectives need to be considered and to be taken into account. In case trade-offs occur, alternative or additional measures may be considered. The principle is that interventions are designed to improve at least one of the three sustainability dimensions without compromising another.

Understanding key drivers of system change
Solutions will only last if root causes of a problem (e.g. low productivity due to lack of access to inputs) and conflicting interests of stakeholders are addressed. This implies understanding *key drivers* of systems change *and intervention points for change and transition.* Before starting an intervention, a thorough analysis of the root cause(s) of the problem is required, including the identification of (private, public and civic) actors/agents that can help to deliver improved food system outcomes (the 'ultimate' goal of the intervention). Seeking partnerships to work on circularity and sustainable food production and consumption is always a valuable strategy that helps to have greatest impact. Next, at an early stage of considering an intervention, alternative solutions to achieve the change or transition should be considered in order to decide on the best way to achievable maximum results. As indicated above, not all these elements (root cause identification, partnership building, considering alternative solutions) may be feasible in a small project. Yet, again the main challenge is to ignite an intervention or promote an investment that is targeted in time, space and number of stakeholders involved without losing the view of the larger perspective, that is to contribute to each of the three dimensions of sustainability.

Combine technical solutions with behavioural change
For a successful lasting impact *technological* interventions need to be linked to *behavioural change.* A technical solution proposed is only accepted by stakeholders if they see they will benefit from using the opportunity offered. In the current situation, incentives to use the opportunity are apparently too weak; otherwise stakeholders would respond to new technologies. Hence, the success of a technical innovation depends strongly on the socio-economic and cultural context in which stakeholders choose how to respond to innovations. This implies that projects should follow a multidisciplinary approach, with different expertise involved.

Consider options for upscaling
Most interventions start with a small-scale support activity focused on one product or value chain, a limited number of stakeholders and in a local or region situation. Yet, challenges – those summarised in the SDGs – result from interactions across different scales and levels and require integrated actions taken by all stakeholders at local, national and global level. A project's (ex-ante) evaluation should consider options for upscaling local solutions to larger spatial areas, if it wants to make a change and contribute to a more sustainable food production system.

Consider alternative solutions
There may be more options than the one chosen to tackle a problem. The food system perspective offers a broader view on possible alternative solutions: for instance, in addressing behavioural change in other segments of the value chain than where the problem is supposed to be fixed, the problem may be less or can even be solved more effectively and efficiently. The process of seeking for the intervention with greatest impact also implies that partnerships with 'unexpected, non-traditional' partners should be considered.

Transition towards circular and sustainable requires behaviour change of actors in the system. Such change is initiated by policy measures and/or by business investments that provoke behavioural responses. It is beyond the scope of this report to further detail the options and form of such innovations and how a process of systemic change can be initiated. Here it is enough to refer to some of the literature that has been used for this report – see reference list section. Moreover, a search on the internet may lead the interested reader to numerous relevant sites. Some of these are the Food

and Business Knowledge Platform website[16] and the Wageningen UR website (www.wur.nl) on which a range of food system projects are presented.[17] Also Termeer's paper on how to bring about a transition toward circular agriculture is a must-read for those interested in the governance of transition processes (see Termeer, 2019).

[16] https://knowledge4food.net
[17] such as https://www.wur.nl/nl/project/Food-Systems-for-Healthier-Diets-4.htm

6 Main findings and messages

Addressing the global challenges of feeding a growing population sustainably calls for a food system approach. Circular agriculture offers opportunities to keep products and materials in use and regenerate the globe's ecological systems. For a successful transformation towards a circular food system the attained resource use efficiency has to be socially, economically *and* ecologically sustainable.

The report's key messages are summarised as follows:

- Tackling the global challenges summarised in the SDG needs a food system approach: a focus on increasing production to combat hunger and poverty only does not solve the problem, and promoting production efficiency in many cases add to ecological stress instead of reducing it.

- Interventions aiming at changing behaviour that contribute to achieving SDGs need to be socially, economically *and* environmentally sustainable: a systems approach seeks for solutions that benefit all three sustainability dimensions simultaneously.

- Circular agriculture is a useful means to contribute to improved natural resource efficiency. Generally the concept's focus is on enhancing environmental sustainability. The food system approach highlights the importance of the socio-economic context, and helps to shed light on the trade-offs between intervention strategies and the system outcomes on all three sustainability dimensions.

- In order to ensure projects promoting circularity will address social, economic *and* environmental sustainability *simultaneously*, interventions proposed should take a food system lens. This implies that in project (ex-ante and-post) evaluations:
  1. a positive contribution is being made to at least one dimension of sustainability without compromising the other two;
  2. trade-offs and synergies are identified;
  3. technological interventions and behaviour change are linked;
  4. a multi-stakeholder process is followed;
  5. upscaling options and issues are considered; and
  6. alternative interventions are thought through.

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Appendix 1 Description of sustainable agriculture approaches

A1.1 Sustainable intensification

Sustainable agricultural intensification is associated with producing more on existing land by using resources more efficiently (e.g Struik and Kuyper, 2017). Yet, experts have divergent views on what sustainable intensification (SI) entails, due to the vague nature of the term 'sustainable' (see Pedersen and Snapp, 2015). Some see SI as too narrowly focused on (primary) production, or even as an outright contradiction in terms (See study of IIED: http://pubs.iied.org/pdfs/17283IIED.pdf). In response to such criticism Garnet et al. (2013) argue that SI should be seen as part of a multi-pronged strategy to achieving sustainable food security rather than an all-encompassing solution. Moreover, the authors claim SI denotes a goal but does not specify a priori how it should be attained or which agricultural techniques to deploy. In the authors' view, the merits of diverse approaches – such as conventional, 'hightech', agro-ecological, or organic – should be rigorously tested and assessed, taking biophysical and social contexts into account.

In the debate on pros and cons of SI for African agriculture, experts gathered in the Montpellier Panel (2013) position the SI-concept as a practical approach for African farmers to cope with food insecurity. The panel defines sustainable intensification as 'the goal of producing more food with less impact on the environment, intensifying food production while ensuring the natural resource base on which agriculture depends, is sustained and indeed improved, for future generations.' The panel underlines that success requires being prudent in input use and efficient in seeking returns, among others via reducing waste and avoiding unnecessary use of scarce inorganic and natural inputs. The panel emphasises that none of the components of their paradigm for SI is new, yet that the way in which they are combined as a framework towards appropriate solutions to food and nutrition challenges is the innovation. Rephrasing the approach as 'making farming precise' the Panel indicates that the concept's principles may apply to African smallholders as well as to farmers in the industrialised world.

The Montpellier Panel's outline of sustainable intensification is a variety of practical activities, many of which can be generated by farmers themselves. They consist of three parts:

1. *Ecological intensification*: the utilisation and intensification of processes to create sustainable forms of crop and livestock production (e.g. intercropping).
2. *Genetic intensification*: the concentration of beneficial genes within crop varieties and livestock breeds, by existing methods and new game-changing technologies (e.g. developing drought-tolerant maize).
3. *Socio-economic intensification*: the process of developing innovative and sustainable institutions on the farm, in the community and across regions and nations as a whole (e.g. better access to reliable markets, knowledge, grain-banks, etc.).

Sustainable intensification would be achievable for African smallholder farmers, the authors claim, as it builds on many of the traditional practices in the region including. Examples mentioned are 'micro-dosing' by which smallholder farmers use the cap of a drinks bottle to measure out small amounts of fertilisers, boosting yields significantly while keeping costs down for farmers and reducing the risk of fertiliser runoff into waterways; combining mixed field and tree crops, such as nitrogen-fixing varieties; harvesting and managing scarce water for supplementary irrigation; and promoting regeneration of diverse natural species in common lands. However, African smallholders may face many barriers to sustainably intensifying their incomes, their production and their nutrition. Examples of such barriers are their limited access to the inputs of intensification such as credits, which may be caused by insecure land rights, and a lack of access to better knowledge, skills and output markets. Hence, without the creation of an appropriate enabling environment, sustainable intensification will not help deliver improved livelihoods. Struik and Kuyper (2017) confirm that sustainable intensification requires more than 'removing agronomic barriers', as it is (also) 'about societal negotiation, institutional innovation, justice, and adaptive management', and therefore sustainable intensification

requires radical transformations in the social and economic organisation of agriculture. Both authors also make a plea for at least two alternative framings of sustainable intensification: one referring to the need for 'de-intensification' in high-input systems to become more sustainable and one referring to the need to increase (a clever combination of) inputs and thereby improve yields where there are currently large yield (and often also efficiency) gaps.

A1.2 Climate smart agriculture

The most commonly used definition of climate-smart agriculture (CSA) is provided by the FAO, which defines CSA as 'agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals' (FAO, 2013). In this definition, the principal goal of CSA is identified as food security and development while productivity, adaptation, and mitigation are identified as the three interlinked pillars necessary for achieving this goal.

Illustrated by several examples Campbell et al., argue that SI and CSA are closely interlinked and highly complementary concepts. The main differences between the two concepts is their focus, which is in an SI approach (mainly) on productivity enhancing practices by increasing nutrient use efficiency, whereas the focus in CSA is on outcomes related to climate change adaptation and mitigation. The CSA examples in Campbell et al. consistently turn out to be cases of SI as the agricultural practices result in higher yields on existing land with less environmental impacts. For instance, intercropping of banana and coffee is a mixed culture that increases productivity of both crop. Furthermore, banana intercropping can contribute to mitigation through storing an additional 15–30 tonnes of carbon per ha in the soil. Another example refers to livestock diet intensification through agroforestry One way in which livestock production can be intensified is through feeding the leaves of trees such as *Leucaena leucocephala*, which is widely grown in the tropics. At the same time, the use of agroforestry trees can increase carbon sequestration. Widespread adoption of this option has substantial mitigation potential, because intensified diets would considerably reduce the number of ruminants needed to satisfy future demand for milk and meat. Other examples presented by FAO[18] are drought-tolerant maize, farming catfish intensively, and rainfall forecasts. As all these examples show, sustainable intensification is a cornerstone of CSA, as increased resource use efficiency contributes to both adaptation and mitigation via effects on farm incomes and reduced emissions per unit product.

A1.3 Landscape approach

Landscape approaches are associated with a spatial perspective when discussing competing claims on natural resources such as land and water and assessing potential trade-offs of productive land uses with environmental and biodiversity goals (PBL, 2015). The idea of landscape approaches is to find cross-sectoral solutions as this will lead to synergies that are better than the sum of sector-specific solutions. Landscape approaches have gained prominence in the search for solutions to reconcile conservation and development trade-offs, yet more recently there has been a shift from conservation-orientated perspectives toward increasing integration of poverty alleviation goals (Sayer et al., 2013). The term 'landscapes' has been defined in various ways, but contemporary literature indicates it entails a combination of physical, biological and social relationships, implying that the concept is defined in broader terms than simply as a physical space. In presenting ten principles to guide the process of decision making in landscape contexts, Sayer et al. (2013) emphasise that the integration of agricultural and environmental priorities will require a people-centred approach: finding solutions imply the participation of multiple stakeholders (with diverse interests and values) in a mutual understood and negotiated process of change that is helped by good governance. Another principle is to address multiscale issues (outcomes at any scale are shaped by processes operating at other scales) and feedbacks affecting outcomes of proposed interventions. Landscape approaches imply shifting from project-oriented actions to process-oriented activities, the latter entailing an iterative and

[18] See https://csa.guide/csa/what-is-climate-smart-agriculture.

ongoing process of negotiation, decision-making and re-evaluation, informed by science but shaped by human values and aspirations. In contrasting sectoral or project-based to landscape approaches, Sayer et al. feature the latter as much more complex in setting objectives, planning and monitoring because targets and timelines may move (due to the interactive, bottom-up process of negotiation and decision-making).

Appendix 2 The Ministry's criteria for assessing policy intentions, plans and proposals for operationalising circular agriculture

Interventions (measures, policies, investments, activities and the like) are assessed according to the following nine criteria (Ministry of LNV, 2018:37):

1. do they help to close cycles, to reduce emissions and to reduce biomass wastage throughout the food system?
2. with regard to fisheries, do they contribute to sustainable fish stock management without damaging the natural environment?
3. do they strengthen the socio-economic position of the farmer in the supply chain?
4. do they contribute to the climate task for agriculture and land use?
5. do they enhance the appeal and vitality of the countryside and contribute to a thriving regional economy?
6. do they benefit ecosystems (water, soil, air), biodiversity and the natural value of the farming landscape?
7. has animal welfare been considered?
8. do they contribute to the recognition of the value of food and to strengthening the relationship between farmers and citizens?
9. do they strengthen the position of the Netherlands as a developer and exporter of integrated solutions for climate-smart and ecologically sustainable food systems?

In addition to these assessment criteria, food safety and quality are always applied as baseline conditions.

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