Towards an inclusive and sustainable economy

Hans van Meijl, Ruerd Ruben and Stijn Reinhard

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Preface

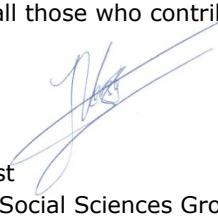
Wageningen University & Research aims to play a catalytic role in the analysis of critical issues facing global society, such as the provision of adequate and safe food, climate change, the development of a circular economy, the protection and utilisation of biodiversity, and poverty reduction. At the same time, our goal is to strengthen international debate in these areas.

We believe that it is crucial to develop new insights and solutions related to sustainable food chains and healthy & safe food in Europe and the wider world. These insights and solutions are then developed in dialogue with society by working in multidisciplinary teams and by encouraging cross-pollination between fundamental & applied research and between university & research institutes.

One of the major challenges facing global society today is the provision of food, water, energy, healthcare and other resources & services in a world characterised by increasing population, mounting environmental stresses and rising inequality. There is a need for circular and resilient food systems which close material flow loops in the entire supply chain from farmers to consumers and back. This should be done in a resource-efficient manner that includes all relevant actors.

This position paper summarises insights by Hans van Meijl, Stijn Reinhard and Ruerd Ruben from Wageningen Economic Research into what has been dubbed the inclusive and sustainable economy. Therefore, five overarching challenges, five scoping issues, and five beneficial economic principles are discussed. In addition, the authors formulate five key insights regarding feasible research strategies and five challenges for both businesses and policy makers to contribute to the transition towards an inclusive and sustainable economy. These insights were also shared at the annual Agrodebat in January 2017.

In compiling this paper the authors had conversations with many of their colleagues within Wageningen University & Research. We would like to extend our gratitude to all those who contributed.



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The need for change: five overarching challenges

The major challenge of the 21st century will be to feed a growing world population in a sustainable and inclusive manner which strengthens resilience to climate change and incorporates concerns for planetary security. This can be broken down into five smaller, interconnected overarching challenges.

I. Supporting global food and nutrition security for healthier diets

The main challenge faced by the global food system is to sustainably feed a growing population, which may well rise to more than nine billion people by 2050. This requires more food to be produced through improved efficiency in the use of natural resources. Furthermore, people will be comparatively wealthier on average in 2050 and the majority will live in cities. Demand for food, in particular protein from animal sources, is expected to increase proportionally more than the population. More crops such as soy will need to be cultivated in order to feed the growing herds of livestock.

Although undernourishment has been on the decline in both relative and absolute terms, nearly 800 million people are still affected by chronic hunger today. Acute famines have become rare, and are mostly caused by civil war, catastrophic policies (as demonstrated in Zimbabwe and North Korea), poor logistics infrastructures, extended periods of extreme weather (el Niño and la Niña) or natural disasters. Nearly two billion people suffer from micronutrient deficiencies and more than two billion people are overweight or obese – in other words, around half of the current global population currently suffers from food-related problems. This coexistence of food insecurity, undernutrition and overweight & obesity is known as the triple burden of malnourishment.[1]

Around 50% of population face food-related problems

While the planet could, technically speaking, easily feed ten billion people or even significantly more, that does not in itself guarantee access to food for poor people. It is even more complicated to ensure access to nutritious and healthy food. The majority of chronic diseases such as type 2 diabetes, cardiovascular diseases, certain types of cancer and obesity (which is itself related to diseases like diabetes) are lifestyle-related. People in the rich world consume more meat

[1] IFPRI (2016) Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030. International Food Policy Research Institute, Washington D.C.

and processed foods than is advisable, and most populations eat insufficient amounts of fruit and vegetables to get the dietary fibre they require.

Tackling this challenge requires fundamental changes in agri-food systems. In the past production could be increased by cultivating new land (in North and South America, for instance). While there are still areas that could be brought under the plough today, this cannot in itself solve the problem. Instead, production per hectare needs to increase, less food must be wasted in the supply chain and a healthier diet is requested. This requires technical innovations such as precision agriculture, climate-smart farming and new breeding techniques.[2]

Standardised food quality management systems

Moreover, there are challenges in the way food production and distribution are currently organised, with specialisation and trade – i.e. the locating of food production in the most favourable places, with trade compensating for imbalances between countries and continents – increasingly being set against demands for more locally integrated food systems. In all cases, there is a need for standardised food quality management systems that can safeguard food quality and safety. Social, scientific, technical and institutional innovations must be paired with appropriate investments to help feed future populations.

II. Mitigating and adapting to climate change to improve the resilience of food systems

The 2015 United Nations Framework Conference on Climate Change (COP21) agreed that the world's governments should act to keep the temperature rise linked to climate change below two degrees Celsius compared to pre-industrial levels, and preferably 1.5 degrees at most. Global emissions have to be reduced radically: in fact, to reach the 1.5-degree target, negative emissions of greenhouse gases (GHG) are needed. In general mitigation efforts must be pursued at a global level, while adaptation policies require intervention at national and local levels. These are problems that cannot be left to the free market to solve. Regulatory interventions by the state and a certain amount of multi-country policy coordination are indispensable.

[2] M.K. van Ittersum, L.G.J. van Bussel, J. Wolf et al., (2016) Can sub-Sahara Africa feed itself? In: *Proceedings of the National Academy of Sciences of the United States of America* (*PNAS*) 113 (52): 14964-969.

With a share of 24%, agriculture, forestry and other land use (AFOLU) is a key contributor to global emissions.[3] Agriculture alone represents around 10%. About half of the emissions from agriculture relate to agricultural soils (mainly nitrous oxide), one third to enteric fermentation (and the release of methane) and one sixth to manure management. The AFOLU sectors are unique in that the mitigation options include removing GHGs and reducing emissions through the management of land and livestock.

Agriculture alone generates around 10% of global emissions

Although COP21 stated that any actions taken must not endanger food production, this does not imply that agriculture and food systems have no role to play in mitigating climate change. Moreover, they will also need to adapt to changes in rainfall, temperatures and CO_2 levels. There are supply-side and demand-side mitigation opportunities within these land-based sectors. On the supply side, emissions from land-use change (LUC), land management and livestock management can be reduced. Other supply-side options include carbon sequestration in soils & biomass and substituting biomass for fossil fuels/energy to reduce emissions from energy production. GHG emissions could also be decreased on the demand side by reducing losses and waste of food, changing diets and adapting wood consumption.

While there are a wide range of technologies for climate-smart agriculture and resilient food systems, the incentives for further development and adoption are scarce. Future energy prices and their influence on agriculture, food production and non-food biomass use in general remain very uncertain, and this does not stimulate the adoption of innovations. Climate-sensitive agricultural policies can assist producers, processors and retailers to innovate.

Agriculture and food policies have to be in line with climate policies

Economic policy instruments such as CO_2 trading could play an important role in making the food chain more climate-smart. It is unlikely, however, that energy and climate policies alone can solve the issues at hand. Agricultural and food policies have to be in line with climate policies, enabling the agri-food sector to play an active role in mitigation and adaptation to climate change by enhancing capacities for risk management and investment in innovations.

[3] IPCC - Climate Change (2014) Mitigation of Climate Change, Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

III. Reducing dependence on non-renewable resources towards a circular food economy

According to the European Environment-State and Outlook report (SOER, 2015)[4], total resource use in the EU has declined by 19% since 2007, less waste is being generated and recycling rates have improved in nearly every country. Resource use efficiency, producing more of a given service while using less natural resources is part of the EU 2020 vision of 'smart, sustainable and inclusive' growth.

Energy is central to our economy. Simply maintaining our standard of living at its current level requires a huge amount of energy. Although its growth is generally quite slow, the EU remains one of the largest economies in the world, with a GDP per capita of €33,000 for its more than 500 million consumers. The EU is also the world's largest trading block and trader of manufactured goods and services.

EU imports more than 50% of its energy consumption

Europe is also largely dependent on the rest of the world for its energy needs: the EU imports more than half of all the energy it consumes. Its total energy import bill is more than one billion euros per day, and import dependency is particularly high for crude oil (more than 90%) and natural gas (66%). The burning of fossil fuels accelerates climate change, which is why it is crucial to take up the challenge of diminishing reliance on scarce natural resources to power economic growth. Since hydrocarbon-containing natural resources are in limited supply – and it would take millions of years to replenish stocks – the sustainable use of renewable energy resources is both a question of strategic policy and a civic priority. This requires a reduction in the irresponsible and unsustainable use of renewable and non-renewable natural resources, while resource conservation efforts are increased. However, currently, fossil energy subsidies are projected to be US$5.3 trillion in 2015, or 6.5% of global GDP, according to a recent IMF study. Most of this comes from countries setting energy taxes below levels that fully reflect the environmental damage associated with energy consumption.[5] Such subsidies favour non-renewables in particular.

[4] http://www.eea.europa.eu/soer (2015)

[5] IMF (2015) IMF Survey: Counting the Cost of Energy Subsidies ;See http://www.imf.org/external/pubs/ft/survey/so/2015/NEW070215A.htm

Agri-food sector uses 17% of gross energy

With 17% of the EU's gross energy consumption (equivalent to about 26% of the EU's final energy consumption) in 2013, the agriculture and food sector is a major consumer of energy (JRC 2015).[6] The primary sector is the most energy intense phase of the food system, accounting for nearly one third of the total energy consumed in the food production chain. In 2013, only 7% of the energy mix in food production and consumption consisted of renewables, compared to 15% in the economy at large.

Energy efficiency – reducing the amount of energy required to provide and consume products and services – should become a no-regret way of economising on primary energy use. For example, insulating homes would allow buildings to use less heating and cooling energy to achieve a longer lifecycle (this would have the added benefit of addressing both short-term and long-term concerns). Primary energy use could also be made more efficient by reducing losses and waste in the food value chain while recycling secondary products for alternative use.

Another option is to introduce low-carbon technologies through affordable, cost-effective and resource-efficient technologies aimed at decarbonising the energy system and supporting the functioning of circular systems that enable a more sustainable use of energy. Promising innovations in this area include photovoltaic systems, concentrated solar power, wind energy, tidal power, hydro power, geothermal energy, renewable heating and cooling, energy storage, bioenergy, biofuels and alternative fuels, and carbon capture & storage.

IV. Managing natural ecosystems to ensure sustainable food production

In addition to climate change, today's agriculture and food system faces major challenges related to the environment (land use change and biochemical cycles) and loss of biodiversity. The chemical revolution of the 20th century has encouraged the creation of agricultural systems based on high inputs of energy, fertilisers, pesticides and antibiotics. Although these have brought considerable productivity gains, the excessive use of inputs has also damaged ecosystems (water, soil and air quality, and ultimately human health). While it is true that significant progress has been made in reducing biocide and fertiliser use and

[6] JRC (2015) Energy use in the EU food sector: State of play and opportunities for improvement, JRC Science and Policy Report. European Union, Brussels.

improving water quality, the responsible use of agrochemicals without long-term residual effects remains a key challenge.

Agriculture is highly water-dependent

Water is expected to become scarcer in many parts of the world as a result of climate change and due to heavy demands by agricultural and, to a lesser extent, industrial and domestic consumers. Farming makes inefficient use of water, accounts for around 70% of water consumed in the world today, and contributes to water pollution from excess nutrients, pesticides and other pollutants.[7] Agriculture is therefore highly water- dependent, making it increasingly vulnerable to water pollution and subject to risk as the competition for water increases. Irrigation, which is already applied in many areas, has to be carefully organised to avoid waste and prevent or mitigate soil salinity and erosion. Water governance and water pricing are generally deployed to ensure efficient water use and equitable water distribution. There is also increasing evidence that adequate water management can help mitigate climate change, as shown in the peat regions of the Netherlands, among others. This is a good example of the interconnections between water-food-land and climate.[8]

Intensive land use and monocultures without proper soil management exacerbate problems such as depletion of organic matter and soil biota, compacting caused by heavy machinery, soil erosion, and the spread of certain bacteria, fungi and weeds. Appropriate soil management practices can be supported through long-term resource use contracts, and other food value chain agents can play a facilitating role by setting prices and purchasing conditions which encourage sustainable practices.

The same holds true for issues related to biodiversity and landscape & nature management. Industrial farming systems have come to be seen as being diametrically opposed to a healthy environment and biodiversity. There is a growing appreciation for the role of pollinators, trees, birds and other animals & plants, and their benefits for agriculture are increasingly valued. Maintaining biodiversity requires certain areas to be set aside and protected, which can be made possible by intensive farming in other regions. There is also growing public

[7] OECD (2014) Climate Change, Water and Agriculture: Towards Resilient Systems, OECD Studies on Water. OECD Publishing, Paris.

[8] Wageningen Research focuses on the interplay between water, land, food, energy and climate. See e.g. www.sim4nexus.eu.

support for conserving traditional cultural landscapes that result from mixed farming. This might be supported with incentives for delivering ecosystem services that can also accommodate resource-efficient integrated farming systems.

V. Enhancing agri-food competitiveness to support inclusive growth

Incentives for agri-food investments

Competitiveness is an important building block in a sustainable economy. Policies should be formulated to shape incentives for agri-food investments, and to support the performance of small and medium-sized farms and companies that represent the backbone of the agri-food economy. Public policies should facilitate innovation for the purpose of creating new markets and motivate innovators to improve existing markets.

Income disparities have been widening across the world. In OECD countries, the average income of the richest 10% is now about 9.5 times that of the poorest 10%, up from 7 times 25 years ago.[9] Income gains accrued disproportionately to top earners between 1976 and 2007, with the highest-earning 1% taking home 47% of total income growth in the United States, 37% in Canada, and 20% in New Zealand, Australia and the United Kingdom.[10]

The labour income share has fallen from 72% to 64% in the 1960-2013 changing the functional distribution of income in favour of capital. Technical progress has become biased against labour, especially against low-skilled workers.[11] New technologies and globalisation link up with global markets, making it possible for workers in developing countries to engage into global markets and consumers, without having to relocate themselves. This trend increased at the same time, the inequality within nations. This so called labour-versus-labour problem - pitting the interests of workers in advanced nations against the interests of workers in developing countries – becomes increasingly important. Economists point out that this is, in reality, largely a labour-versus-capital problem as technical progress and globalisation favour profits for corporations and the

[9] OECD (2013a) Crisis Squeezes Income and puts Pressure on Inequality and Poverty. OECD Publishing, Paris.
[10] OECD (2014) Jobs, Wages and Inequality. OECD Publishing, Paris.
[11] ILO & OECD (2015) The Labour Share in G20 Economies, International Labour Organization Organisation for Economic Co-operation and Development. Report prepared for the G20 Employment Working Group Antalya, Turkey, 26-27 February 2015.

owners of capital over earnings of workers.[12] They state that this trend can only be changed by (1) human capital investments to boost labour income, (2) system of taxes and profit sharing to break equivalence of technical change and falling labour share (change rule of the game, i.e. competition policies, bargaining power of labour), and (3) multi-country policymaking to harmonize policies and take into account the interest of all nations.

Income disparities are widening

The high levels of inequality in the world and in Europe have become a source of political and social tension, not least between cities and the countryside. Tackling the differences in income between rural and urban areas starts with allowing farmers to earn a decent income. This implies equitable access to finance, technical knowledge and markets. International and regional trade regimes are thus becoming increasingly relevant for the sustainable competitiveness and inclusiveness of the agri-food sector.

Public policies for stimulating and scaling innovative and entrepreneurial agri-food activities should be based on in-depth knowledge of the factors that support the innovation cycle. These include individual influences (skills, habits) as well as participation in business networks and broader societal platforms that enable knowledge exchange and improve risk management. Business incubators and challenge funds managed by impact investors are becoming key players in enhancing competitiveness.
Rural development also benefits from a level playing field between countries and regions involved in the agri-food sector. Many rural areas suffer from low incomes and hidden underemployment. Increased exports of agricultural and food products are sometimes promoted as a strategy for generating additional revenues and employment. Food standards can initially be considered as a barrier to trade, but also tend to support quality upgrading processes. Other useful ways to enhance competitiveness in local markets include co-investment models.

[12] Stockholm Statement (2016) Towards a Consensus on the Principles of Policymaking for the Contemporary World, 15 November 2016.

2

Towards an inclusive sustainable economy: five scoping issues

Dealing with the challenges we identified in the previous section requires a transition to an inclusive and sustainable economy. In this section, we focus on contributions to this transition made by concepts from the circular economy and bioeconomy.

Given that the lead time for arriving at solutions to key social and technological challenges can be very long, there is a need for a framework to structure long-term analytical and innovation capacity. Such a framework would provide guidance to the innovators, decision-makers and scientists involved in formulating consistent and coherent long-term strategies to realise the vision of an inclusive and sustainable economy. Small steps can already be taken today. As there is confusion regarding the concepts and terms used with regards to the inclusive and sustainable economy: we start by describing the 'sustainability' and 'inclusiveness' dimensions, including their relations to the circular economy and bioeconomy concepts, and then introduce a guiding conceptual framework.

I. Sustainability

The ability to sustain

Sustainable development is a well-accepted concept for European policy. It is anchored in the Treaty of the EU and our policies. When defining this concept, it is important to first take a close look at the word itself. It consists of two parts, namely 'sustain' and 'ability'. At its core the concept of sustainability therefore stands for the ability to sustain. By definition, an unsustainable activity cannot continue indefinitely.

The concept of sustainability is essentially a moral declaration as to what should be done. It is often used in conjunction with other terms, like sustainable development or sustainable growth. Perhaps the most widely used definition of sustainable development is that of the Brundtland report.[13] "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

A key aspect of sustainable development is the idea of limitations on economic development and growth. Satisfying the needs of a growing population while ensuring social equity and respecting environmental limits is at the very heart of the concept. This is often formulated in terms of the triple bottom line: people, planet and profit.

[13] WCED (1987) Our common future. Report of the World Commission on Environment and Development. G.H. Brundtland, (Ed.). Oxford University Press.

II. Inclusiveness

Inclusiveness is becoming a widely debated concept in international fora. The World Economic Forum discussed the importance of inclusive growth during their recent events.[14] The OECD defines inclusive growth as economic growth that creates opportunity for all segments of the population and distributes the dividends of increased prosperity, both in monetary and non-monetary terms, fairly across society. In sociology, inclusiveness is often defined as the provision of certain goods, such as employment, adequate housing, health care, education and training to a wide range of individuals and groups in society. This is closely related to ensuring social equity.

Meeting the needs of all

The concept of inclusiveness is bound to the concept of sustainability: satisfying human needs while ensuring social equity are core elements of sustainability. This is supported by the Brundtland Report, which states that sustainable development requires meeting the basic needs of all. This refers particularly to meeting the essential needs of the world's poor, and extending the opportunities to satisfy their aspirations for an improved quality of life. A world in which poverty and inequity are endemic will always be prone to ecological and security problems (popular unrest, migration and geopolitical crises), and inclusiveness can be a remedy to this.

Inclusiveness is often considered in conjunction with other concepts, such as an inclusive economy or inclusive growth. This focuses specifically on achieving high levels of employment, modernising labour markets and fighting poverty to build a cohesive society. As such, it implies the coupling of inclusiveness and sustainability, and makes inclusiveness more than simply a political choice.

III. Circularity

At its core, a circular economy is characterised by a circular, closed flow of materials, where waste from one process becomes an input in another. Circularity is an approach to sustainable development based on the reduction, reuse and recycling of raw materials and energy (also referred to as the three R's). Raw materials, including natural resources, nutrients and water, are important in the context of agriculture and food & non-food use of biomass. The circular economy is expected to promote a more resource-efficient and competitive economy, while reducing environmental impact.

[14] WEF (2016) Does inclusive growth matter? See: https://www.weforum.org/agenda/2016/01/why-does-inclusive-growth-matter/

New model of industrial organisation

Besides a reform of production processes, this approach requires a reform of consumption activities by increasing the lifespan of consumer goods through repair, reuse and upgrading. A fundamentally new model of industrial organisation is needed for a circular economy to deliver actual transformative change. This looks to delink resource consumption from economic growth in order to meet essential needs and aspirations for an improved quality of life among the world's population. This delinking needs to go beyond incremental efficiency gain. If it is not it still contributes to some societies becoming more sustainable than others. A cross-sectoral approach is probably needed to support a circular approach in the economy. We therefore welcome the interests in the Dutch Topsectors to seek for cross-overs (e.g. Topsector Agri-food working with Topsector Water).

IV. Bioeconomy

The concept of the bioeconomy has been hailed as an important part of the solution to overarching challenges like climate change, food security, resource scarcity, energy security and employment generation. However, there seems to be no consensus concerning what a bioeconomy actually implies.[15] The meaning of the concept has not yet been settled and the research field is still young. We use the relatively broad and generic definition of the EC (2012): 'The bioeconomy encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy.[16] It includes agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries.'

This refers to more than just the basic building blocks for materials, chemicals and energy being derived from renewable biological resources instead of from non-renewable resources like fossil fuel.[17] The broader definition includes traditional biobased sectors like agriculture, forestry, food and wood. While the bioeconomy is traditionally strongly linked to sustainability and circularity, it can also disregard them and instead focus on short-term economic gains.

[15] Bugge, M.M., T. Hansen and A. Klitkou (2016) What Is the Bioeconomy? A Review of the Literature. In: *Sustainability 8*: 691.
[16] EC (2012) Innovating for sustainable growth, A bioeconomy for Europe. Brussels.
[17] McCormick, K., and N. Kautto (2013) The Bioeconomy in Europe: An Overview. In: *Sustainability 5*: 2589-2608.

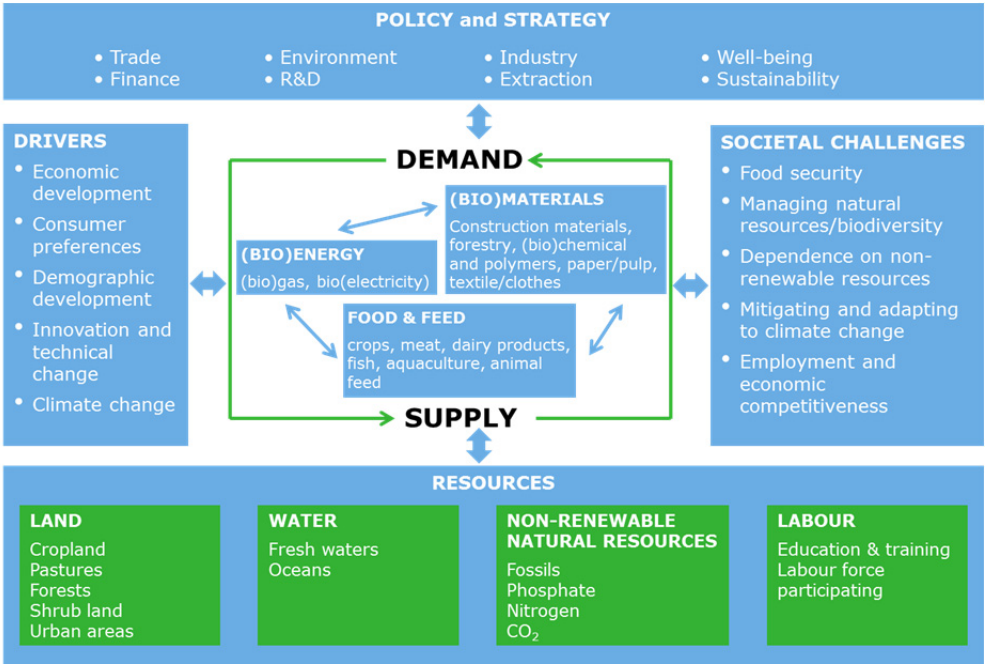


Figure 1 *Systems analysis framework for an inclusive and sustainable economy*

V. An inclusive and sustainable economy framework

In order to formulate a functional and comprehensive overview for assessing the complex economic interactions of an inclusive and sustainable economy linked to the circular economy and bioeconomy, we developed a conceptual system analysis framework based on a supply-demand concept which brings together the building blocks (drivers, impacts, responses) for analysing the impacts, trade-offs and synergy effects that accompany a transition to an inclusive and sustainable economy (see Figure 1).

Interactions and feedback effects

The demand for renewables comes from an interlinked system of food, wood, energy, chemicals and non-market services. The inclusive and sustainable economy framework identifies and analyses the most important interactions and feedback effects between the circular economy & bioeconomy and other sectors (e.g. the fossil fuel and energy industries), taking into account

developments in system drivers (e.g. economic development, innovation and technical change) and resources (e.g. land, water, non-renewables and labour).

Impacts are measured in relation to the five societal challenges linked to the circular and bioeconomy strategies (as outlined in Section 1): ensuring food security, managing the sustainability of natural resources (including non-market ecosystem services), reducing dependence on non-renewable resources, mitigating and adapting to climate change, and creating jobs & maintaining competitiveness in Europe. Taking the impact of the circular economy and bioeconomy on socioeconomic and environmental indicators as a starting point, we can implement policy and strategic management measures to influence the demand and supply system drivers for meeting the targets of key strategies, such as the circular and bioeconomy strategy, and other policies.

Supporting coherent policy-making

This system analysis framework supports coherent policy-making within the full complexity of an inclusive and sustainable economy, and can be used for monitoring and scenario analyses to identify trade-off and synergy effects. It connects actions with the objectives of policies and strategies to help create an economy that is inclusive and sustainable. The framework also supports the decision-making and strategies of all sectors and stakeholders in the circular economy and bioeconomy, including governments, research communities, commercial & industrial organisations and NGOs. The framework also supports the food-water-energy-climate nexus approach as it (i) reduces trade-offs, (ii) builds synergies and (iii) improves governance across sectors.[18]

[18] Dodds, F. and J. Bertram (eds.) (2016) The Water, Food, Energy and Climate Nexus; Challenges and an Agenda for Action. Earthscan Studies in Natural Resource Management. London/New York.

Five economic principles beneficial to an inclusive and sustainable economy

Economics is the study of how scarce resources are allocated to satisfy human needs or desires. In that sense, economics adds value to the analysis of an inclusive and sustainable economy in relation to the five overarching challenges. The food-water-energy-climate nexus is an important pillar of this. The focus of this section is on five key economic insights which are often overlooked in a more technology-driven analysis. A few basic economic assumptions will be explained first, followed by an introduction of the five economic principles.

Basic economic concepts

One of the fundamental concepts of economics (the invisible hand of Adam Smith) is that, in a perfect market, the actions of consumers and producers over time naturally converge to the most efficient allocation of goods and services, leading to the highest possible utility for society. The mechanism behind this 'invisible hand' is the law of supply and demand, which states that the price of a good or service will tend to be determined by the interplay between supply and demand (supply equalling demand when equilibrium is reached). All else being equal (ceteris paribus), increased supply will cause prices to fall and vice versa.

Goods have economic value only if they are scarce – meaning there is not enough for everyone to have all they want. This leads to an analysis of the trade-offs: benefits come at a certain cost. In a market, these trade-offs occur among producers and consumers. Due to the scarcity of resources, the production and consumption of additional goods and services come at a cost. The law of diminishing marginal returns stipulates that more of the same has progressively less economic value, that is, the satisfaction which any individual gains from consuming one additional unit of a good or service will tend to be smaller than for the unit preceding it. Economic efficiency is achieved by putting natural and human resources to their most valuable use – meaning their greatest economic value relative to their economic costs.

But the interplay of supply and demand will only lead to the highest possible utility for society if certain conditions are fulfilled, including the following:

- There are a large number of consumers and producers in the market
- All goods and services are owned by a producer or consumer
- Product homogeneity (every unit of the product is the same as every other)
- People have freedom to choose, and decide on their needs and wants for themselves (consumer sovereignty)
- Producers and consumers have perfect knowledge, and know the value of things before they are bought or sold

If the key conditions for a perfect market are not present, the invisible hand will not lead to an optimal solution from an economic efficiency perspective. Imperfect market conditions can be compensated by economic policy. Even where markets deliver on efficiency, they have no natural propensity to deliver on inclusiveness and equity.

Government has a role in areas where markets do not work well (e.g. environment and health) and where there are clear inclusivity imperatives (e.g. woman empowerment, protection of vulnerable group, and excessive wealth and income inequality).The concept of an inclusive and sustainable economy includes resources which lack adequate markets to manage supply and demand. This can induce the underdelivery of services and/or excess demand, or even overexploitation.

I. Internalising external effects

In economics, an externality is a cost or benefit that affects a party which did not choose it. Externalities create indirect effects on the consumption and production opportunities of others, as prices of products do not take them into account. Those who suffer from negative externalities do so involuntarily, while those who supply them do so at no cost. The effects are the opposite for positive externalities. Neoclassical welfare economics asserts that this leads to differences between costs or returns to the individual and costs or returns to society as a whole, potentially causing inefficient market outcomes. This involves the underproduction of goods or services that entail positive externalities and overproduction of those linked to negative externalities. This is why externalities are one of the main reasons that governments intervene in the economic sphere.

An example of negative externalities is the fact that there are no incentives to reduce the production of an environmentally detrimental good that can be disposed of freely (e.g. greenhouse gases). To obtain an optimum, a Pigouvian tax can be applied on emitters which is equal to the marginal social damage.[19]

Coase argued that externalities are reciprocal in the sense that both the person causing the externality and the person suffering its effects have opportunities to reduce it (Coase 1960).[20] In specific circumstances, social costs could be accounted for by negotiating property rights (e.g. emission permits) with the objective of reducing CO_2 emissions, for instance. Well defined property rights, low transaction costs, and an absence of uncertainty or asymmetric information (where one side knows more than the other about a transaction) are conditions required to make bargaining solutions feasible. If these conditions are not fulfilled, the optimal course of action may be government intervention in the

[19] Pigou, A.C. (1920) The Economics of Welfare. Macmillan, London.
[20] Coase, R. (1960) The Problem of Social Cost. In: Journal of Law and Economics, Vol. 3, No. 1, pp. 1–44.

form of institutional frameworks that allow for proper bargaining among parties involved in externalities.

Lack of clear property rights often a fundamental obstacle

The lack of clearly defined property rights is often a fundamental obstacle to market-based, solutions related to so-called global public goods. Many global environmental goods are both nonrival – consumption by one individual does not reduce the opportunity for others to consume it – and nonexcludable – whoever produces or maintains the public good, even at a cost, cannot prevent other people from enjoying its benefits. Therefore, additional efforts are requires to guarantee their sustainable management.

Environmental economics deals with analysing and finding solutions to externality-related issues. Clean air, clean water, biodiversity and a sustainable stock of fish in the open sea are largely nonrival and nonexcludable goods. Lack of well-defined property rights, high transaction costs and problems related to uncertainty make it difficult to internalise costs and benefits though bargaining. Uncertainty or incomplete information about who is responsible for damages or contract restrictions leads to moral hazard as decision-makers maximise their benefits by inflicting damage on others without bearing the consequences.

GHG emissions are most complex externality problem

Greenhouse gas (GHG) emissions are the most pressing and complex externality problem today. Private bargaining solutions are unfeasible as the atmosphere is a global public good, with benefits that accrue to all. Identifying and agreeing on policies for the internalisation of the social costs of GHG emissions at a global level are extremely difficult given the cost to specific individuals & firms and the difficulties linked to the global enforcement of such policies.[21]

An emissions trading system could provide incentives for producers to reduce carbon dioxide emissions. The internalisation of external effects requires that CO_2 emissions be carefully monitored, and producers who diminish them, for instance by carrying out CO_2 sequestration, can receive a corresponding payment. Since the contribution of CO_2 to climate change is a global problem, it would be best to set

[21] Tirole, J. (2008) Some Economics of Global Warming In: *Rivista di Politica Economica*, 98 (6): 9–42.

up a global permit market, although most economists feel that a global CO_2 tax would be better suited to the complexity of the problem. In a similar vein, water pricing can be used to provide incentives for farmers to reduce the amount of water consumed. This works well in water basins where water is scarce.

Innovation is an example of a positive externality and an important pillar of economic growth. Knowledge is a nonrival good in the sense that its use by one person does not compete with its use by somebody else. Most innovations therefore have positive spillover effects on the rest of the economy as other firms or people can use the knowledge produced to enhance their utility or performance. This is one of the reasons that there tends to be underinvestment in innovation, as those who produce it do not receive an appropriate reward for all the benefits. Governments can assign intellectual property rights (IPR), which is more feasible for innovations and inventions than for basic or general research (it is difficult to define IPR). Governments could also subsidise basic research to ensure that a sufficient amount is produced.

High prices may induce innovation. Public policies can stimulate environmental innovations in order to ensure that substitutes are available in the future for environmentally detrimental practices that are common today (e.g. the development of energy substitutes). Climate-sensitive agricultural policies may assist producers, processors and retailers in early innovation. If, however, policy makers tend to overlook the potential for innovation in the long run, and underestimate alternative solutions for problems that are foreseen, this may delay the transition towards an inclusive and sustainable economy or a circular economy.

II. Pricing and environmental nudging

It is increasingly acknowledged that regulation and subsidies may have side effects. It can therefore be another option to apply other instruments, like policies focused on information (labelling) and market transparency (e.g. information about the environmentally friendly behaviour of neighbours and peers).

Consumers are unaware of externalities linked to products

In case of imperfect or asymmetric information, the optimal solution may not be attained in the market. Consumers are unaware of the externalities linked to a product, and can therefore not estimate or take into account a quality like its environmental effects when making their purchasing decisions. To address this issue, market agents can agree to stimulate the provision of

environmental information on goods, e.g. a label reflecting the external effects (i.e. true price). For example, true pricing provides information on social and environmental externalities that can affect a consumer's decision to buy a product independently of market mechanisms. This can enable consumers to align their decisions in the supermarket with their preferences as citizens.

Public policies that try to encourage the adoption of environmentally friendly innovations (like LED lights, smart energy meters or hybrid cars) may stimulate consumers' choices towards an inclusive and sustainable economy. Subsidies are an instrument that is often applied to stimulate early adoption, and tend to be reduced once a certain level of penetration is reached. Another option is to legally restrict use of the old technology: traditional light bulbs that are not energy efficient are being phased out, for instance.

Nudging can alter people's behaviour in a sustainable way

Besides information and subsidies that persuade customers to knowingly change their behaviour, principles from behavioural economics can also be applied. This entails consumers being 'nudged' to adjust their behaviour in line with sustainability objectives. The basic idea of nudging is to make acceptance the default response but with an opt-out option, which results in more people agreeing to deployment of environmentally sound technologies. Nudging can alter people's behaviour by changing their social or physical environment in subtle ways that unconsciously trigger the desired behaviour – in this case, selection of the more sustainable option.

III. Substitution and indirect effects

Many non-renewable resources may soon be depleted if the current extraction rate continues, potentially leading to an economic downturn. Forecasts include the Club of Rome report 'The limits to growth', which already warned about shortages in resources such as copper in 1972 and urged policy makers to take action to remedy the situation. No specific policies were ultimately required, as copper was gradually replaced by other products instead, its use being reduced drastically enough that the predicted shortages never materialised. This demonstrates that a reduction in the quantities of finite resources can be compensated by innovations that draw on human and intellectual capital (Solow, 1986).[22]

[22] Solow, R.W. (1986) On the intergenerational allocation of natural resources. In: *The Scandinavian Journal of Economics* 88 (1) 141-149.

Likewise, a non-renewable resource that is traded on a market will become more expensive as it becomes scarcer, making substitutes more attractive. In theory, firms can anticipate this price increase and explore substitution possibilities in good time. In the case of copper, a substitute (fibreglass) was found, and the expected depletion did not occur. In a similar vein, a high oil price will stimulate renewable power and energy saving options (in which energy is substituted for energy efficient glazing). Moreover, new extraction techniques will become profitable, expanding the extractable oil reserves. Substitution is frequently underestimated in forecasting analyses.

Substitution is frequently underestimated in forecasting analyses

A related principle derived from the field of economics is that the price effect caused by substitution can penetrate (often unexpectedly) into different markets in other parts of the world economy. For instance, the substitution of renewable biomass for non-renewable fossil resources first decreases the demand for fossil resources and induces a lower fossil resource price. This lower price leads to higher fuel consumption in other markets, which partly offsets the initial reduction in fossil fuel consumption and GHG emissions. This is called the rebound effect.[23]

Moreover, this substitution increases the demand for biofuels and leads to indirect land use change (ILUC), with biofuel crops substituted for food crops. ILUC is the change in land use outside a feedstock's production area needed to replace the supply of that commodity and that is induced by changing the use or production quantity of that feedstock. This effect increased land under cultivation in Brazil, which may have caused additional clearing of tropical forests. The transition to environmentally friendly biofuels in European has therefore had environmentally unfriendly effects in South America, which were largely unforeseen while implementing the European policy. Substitution and indirect effects can be quantified by economic partial and general equilibrium models.

[23] Hochman G., D. Rajagopal, D. Zilberman (2010) The Effect of Biofuels on Crude Oil Markets. In: *AgBioForum* 13
Drabik, D., H. de Gorter (2011) Biofuel Policies and Carbon Leakage. In: *AgBioForum* 14:104; Rajagopal, D., G. Hochman, D. Zilberman (2011) Indirect fuel use change (IFUC) and the lifecycle environmental impact of biofuel policies. In: *Energy Policy* 39:228.

IV. Risk management and natural ecosystems

Natural capital – defined as the world's stock of natural assets, including biodiversity and natural resources – provides a wide range of services (often called ecosystem services) which are critical to human life. As markets cannot be set up for all types of natural capital, its value cannot be fully captured by market prices. Resources and environmental effects that are not traded on a market require a policy intervention for an efficient equilibrium to be reached. In the case of natural resources, there is a trade-off between their value on the one hand and the cost of measures required to preserve them, including foregone economic activities, on the other. Economics lets us compare the two.

Costs and benefits of natural capital can be calculated

Cost-benefit analysis (CBA) is usually applied in order to calculate whether a project allows for the optimal provision of a public good such as natural capital. It compares the total costs for society with the associated benefits, and can be used for projects where important parts of either the costs or the benefits are not adequately represented by market prices, or are not traded through markets at all. The use value (related to an economically productive use of nature areas) and non-use value of natural capital are estimated by valuation studies and then incorporated in a CBA.

The risk of disasters affecting natural capital can be managed through protective or adaptation measures (flood protection, drought prevention). The optimal amount and composition of these measures can be computed in a CBA by comparing the costs of the measures with the value to society of the reduced risk. For instance, the costs of dyke reinforcement are compared with the expected damage avoided thanks to the dyke. The optimal flood protection system in an urban area can therefore be more costly than one in a rural area. Dykes (a public good) are far more cost effective when provided by the government than by private actors. A different attitude towards public spending means that far more dykes are built in the Netherlands than in the USA, say, making coastal cities in the latter (New Orleans and New York, for instance) more prone to floods.

V. Inclusive and green growth

GDP growth needed to invest in societal objectives

GDP growth is needed, not as an end itself but just as a means to create the resources needed to achieve a range of societal objectives, which include a better environment, improved health, education, employment, security, as well as consumption. Wellbeing is multidimensional and not just income (e.g. nutrition, health, local environment, climate change education, jobs). GDP growth in itself will not lead to inclusiveness. Inclusiveness is a challenging concept as its definition incorporates concepts of equity and fair distribution. Equity and fairness are not automatically produced by markets and economic theories. Additional institutional mechanisms (other than social prices) have to be designed in order to ensure a fair distribution of jobs, material wealth, food, health, education, and so on.

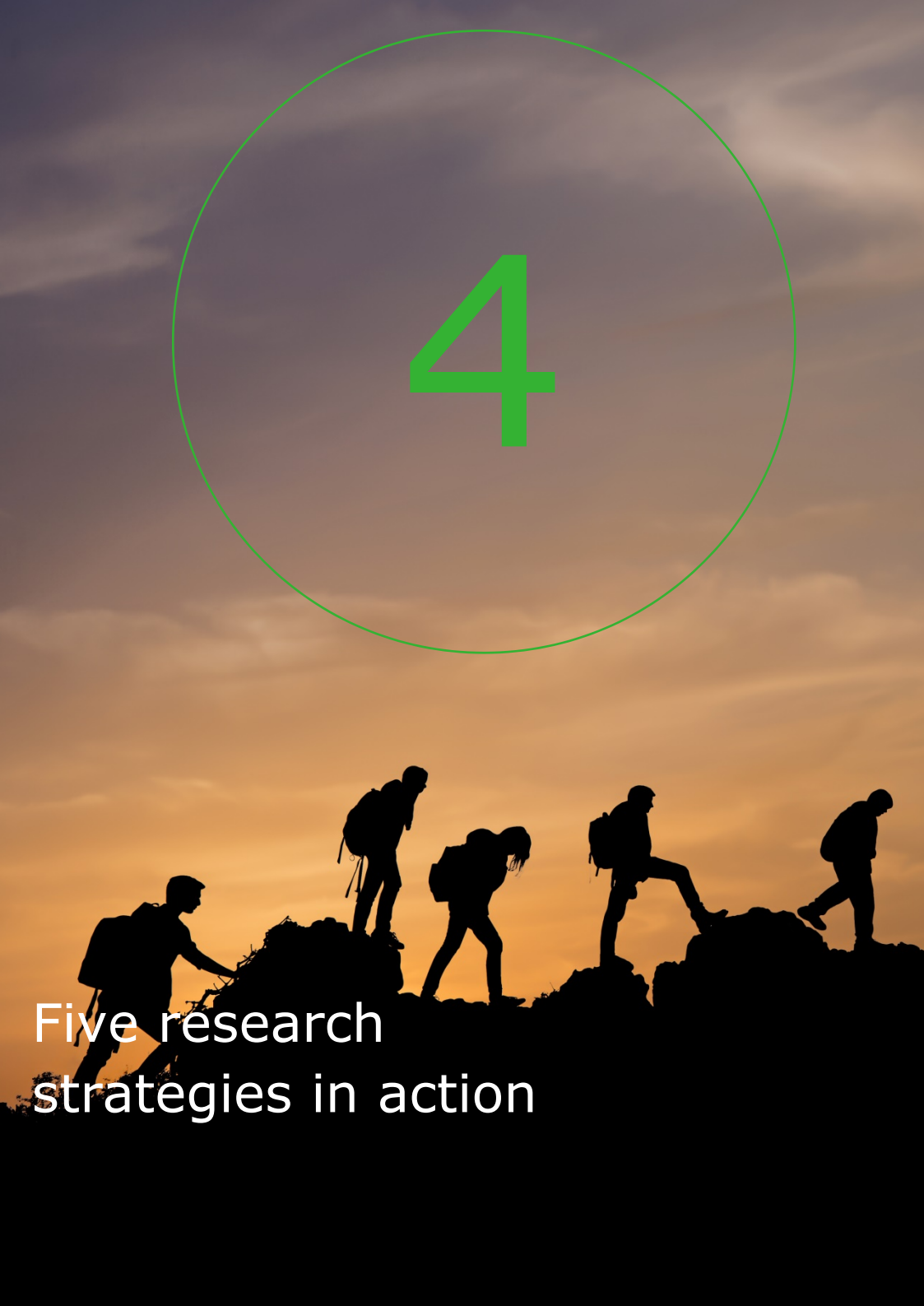
The concept of inclusive green growth underscores the need to assess and weigh trade-offs and complementarities between and among stakeholders, and emphasises the crucial role of governance in implementing an inclusive growth agenda. Greening the economy can be an engine of growth. Green growth means fostering economic development while ensuring that natural assets continue to provide the environmental services on which our well-being relies. It focuses on the synergies and trade-offs between the environmental and economic pillars of sustainable development. It seeks to spur investment and innovation in ways that give rise to new, more sustainable sources of growth and development.

New accounting frameworks take into account changes in environmental assets when calculating economic performance indicators. Green GDP measures the loss of biodiversity and costs caused by climate change, quantifying and calculating the environmental consequences of growth. Several difficult choices must be made when valuing biodiversity, which is why the United Nations has formulated a System of Environmental-Economic Accounting (SEEA).[24] Ensuring that economic growth is sustainable in the long run requires more than flow measures such as GDP: changes in inclusive wealth stocks, such as natural capital, also need to be quantified and embedded in national accounts.

[24] See http://unstats.un.org/unsd/envaccounting/seea.asp. SEEA adopts the general principle of SNA – System of National Accounts.

At the micro level, a major problem for many African smallholder farmers is that their farming system cannot survive a prolonged drought period or a series of failed seasons. In line with inclusive green growth principles, these farmers can be supported through enhanced access to innovative tools and methods for managing farm risks. This includes both asset building (e.g. soil conservation to enhance water holding capacity) for enhancing resilience and access to coping mechanisms (insurance facilities). Such a policy mix improves the food security and livelihoods of smallholder farmers. In a similar vein, focussing on reduced post-harvest losses and waste enhances the material flow of food and creates additional employment upstream in the value chain.

4



Five research strategies in action

In order to generate key insights regarding feasible policy strategies and to support the analysis of appropriate leverage points for upscaling and for anchoring market innovations that contribute to sustainable and inclusive agri-food systems, Wageningen Economic Research focuses on five main issues in our research agenda. In this section, we provide insights into this agenda, where we are and where we think we have to go.

I. Monitoring and accounting

The regular market economy does not incorporate information on greenhouse gas (GHG) emissions, non-renewable resources, natural capital and inclusiveness (see section 3). Helpful tools to provide direct insights into the current gaps between market-based outcomes and more sustainable and inclusive target results include regular monitoring of the sustainability performance of agri-food chains – as in the energy monitor horticulture, our work with the Dutch Dairy Association (NZO) on the sustainable dairy chain[25] - or the EU project FLINT to collect sustainability data on 1000 farms in the European Farm Accountancy Data Network – as well as more inclusive procedures for measuring the true cost of agri-food commodities.[26] This also enables the benchmarking of the performance of public and private entities in terms of improving sustainability and inclusiveness.

In line with the system analysis framework for an inclusive and sustainable economy as described in section 2.V, it is recommended that an overall conceptual structure for an inclusive and sustainable economy be developed in such a manner that the different societal goals and inclusiveness and sustainability (people, planet, profit) targets related to the five societal challenges are linked in a coherent manner. Indicators (metrics) for sustainability and the often neglected inclusiveness dimensions should be developed together with stakeholders and implemented for this purpose.

The value of environmental and social externalities can be assessed in order to allow it to be taken into account in decision-making. Monitoring is needed at both macro and micro levels.

Monitoring needed at macro and micro levels

[25] Wageningen Economic Research, Energiemonitor Nederlandse Glastuinbouw; NIZO-Wageningen Economic Research: www.duurzamezuivelketen.nl/en

[26] Baltussen, W. and A. de Blaeij (2015) Valuation of livestock eco-agri-food systems: poultry, beef and dairy. TEEB for Agriculture & Food expert Workshop, Brussels.

At the macro level, the measuring of the short and long-run progress of economies should involve analyses of flow measures such as GDP as well as of inclusive wealth stocks such as natural capital. National accounting systems have to be adapted to measure not just flows of good and services but also stocks of natural capital. Valuation should start at the micro level, and be scaled to include potential macro feedback loops.

At the micro level, monitoring should support benchmarking between firms that stimulates learning behaviour and innovations. There is a need for more accurate quantification and communication about the sustainability of products. The challenge is to work collaboratively (between government and supply chain), developing a science-based approach that promotes better understanding, standardisation and informed decision-making. Developments in ICT (like the Internet of Things or use of GPS information) will make monitoring easier and cheaper in the coming years.

More about our projects and publications on www.wur.eu/ise

>> Energy monitor Dutch horticulture
>> Monitor sustainable dairy chain
>> FADN | European sustainable data collection
>> FLINT | Farm Level Indicators for New Topics in Policy Evaluation
>> Valuation of livestock eco-agri-food systems
>> The Sustainability Consortium
>> Internet of Food

II. Improving resilience through uncertainty management

Adequate insights into the uncertainties that affect changes in production, transformation & exchange processes and developments in consumption practices may help to convince public, private and civic parties to engage in environmental upgrading and inclusive value chain development programmes. There are different tools for assessing the environmental risks of investment activities and for providing insights into the distributional effects of market interventions. These can be used to facilitate policy debates on different strategies towards inclusive and sustainable agri-food systems.

Current thinking on risk is changing

The current thinking on risk and uncertainty is clearly changing, moving towards a balance between coping and mitigation strategies. Moreover, attention is shifting towards strategies for dealing with shocks and for increasing resilience at different system levels (plot, farm, chain, region, country, world). This implies that due attention is given to linkages and feedbacks between systems, and known unknowns among system connections and sensitivities. Powerful new interactive and dynamic tools, including multi-agency simulation, complex adaptive systems, Bayesian networks and fuzzy cognitive mapping, have become available for these dynamic analyses.[27]

In the field of policy research, we focus on more and better insights into the dynamics of different risk factors (species, households, regions, climate, diseases) and the opportunities for enhancing resilience. Ex-ante investments in increasing plant and animal resilience and controlling soil-borne diseases are receiving increasing attention. In addition, resilience management in the agri-food chain and agrologistic networks is focusing more on increasing adaptive capacities to improve quality management and reduce losses. In a similar vein, landscape and ecosystem management approaches that include elements of biobased and circular economics are likely to be better at reducing disaster risk and enhancing popular participation in governance. Moreover, experiences with insurance against plant and animal diseases and rainfall variability can be used to promote investments and innovations which will mitigate various disasters.

Since energy subsidies favour non-renewables in particular, assessments have to include their long-term impact on climate change, and farm behaviour if subsidies are eliminated. Cost-benefit analyses (CBA) can help compare continuing trends (with intensive use of coal, gas, oil) and the long-term costs of climate change with the cost of measures taken in the near future to mitigate climate change, including extreme climate events.

[27] Kunreuther, H., S. Gupta, V. Bosetti, R. Cooke, V. Dutt, M. Ha-Duong, H. Held, J. Llanes-Regueiro, A. Patt, E. Shittu, and E. Weber (2014) Integrated Risk and Uncertainty Assessment of Climate Change Response Policies. In: *Climate Change 2014: Mitigation of Climate Change*. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

More about our projects and publications on www.wur.eu/ise

>> Phosphate recovery: A study of economic chances and opportunities
>> The economic feasibility of seaweed production in the North Sea
>> Understanding growers' decisions to manage invasive pathogens at the farm level
>> The nature of agroparks: synergy versus risk
>> How do farmers react to varying water allocations? An assessment of how the attitude to risk affects farm incomes

III. Analysis of scenarios

Policies and strategies must be implemented to ensure consistency across the five societal challenges and to maximise synergies and minimise trade-offs over time. Since there are often different ways to set up and maintain inclusive and sustainable agri-food systems, we frequently rely on scenario analysis to assess alternative policy options. This is a process of analysing possible future outcomes (sometimes called 'alternative worlds') assuming different variables such as climate change and socioeconomic developments. In other words, the scenario analysis, which is a major projection method, does not try to paint an exact picture of the future. Our current use of agricultural scenario analysis focuses mostly on agricultural trade (Agricistrade), fisheries and aquaculture (SUCCESS) and food security strategies (FoodSecure), and these analyses have recently been expanded to also include nutritional outcomes (SUSFANS) and resilience to climate change (adaptation and mitigation in AgMIP, MACSUR and SIM4NEXUS).[28]

Projecting food systems performance and coherence

In order to assess the state of the inclusive and sustainable economy over time, models are needed to project food system-related supply and demand, taking into account complex market interactions and the impact of a wide array of drivers of change as well as policies on a whole range of sustainability and inclusiveness outcomes (see 1.V). To support coherent policies related to the Paris Climate Agreement or the Sustainable Development Goals and the overarching challenges, the modelling

[28] See: www.agricistrade.eu, www.foodsecure.eu, www.susfans.org, www.success-h2020.eu, www.agmip.org, www.macsur.eu, www.sim4nexus.eu.

frameworks that are currently used for national, European and global policy making need to be enhanced:

- To cover the full extent of the food nexus, agricultural and food-oriented models have to be expanded or linked to energy, climate, land and water modules (SIM4NEXUS). A link to water in particular is lacking despite its crucial importance: the restricted availability of water in the future is expected to greatly affect yields. The nexus requires that market mechanisms at the macro level be connected with biophysical information. The grid level is appropriate for linking biophysical data to economic and agricultural data.
- Optimal support for climate change requires a long-term scenario analysis (up to 2050 or 2100, AgMIP). Key modelling challenges include land-based mitigation options (afforestation, bioenergy) and ways to implement adaptation scenarios.
- Food and nutrition security implies that the availability of food, the stability of supply and the access and consumption of food should be quantified (FoodSecure). Where access to food is concerned, both income and expenditure at the household level should be taken into account: high prices have positive income and negative expenditure effects for (rural) food producers but only a negative expenditure effect for (urban) food consumers. The consumption of food should be measured with nutrient and health indicators (SUSFANS).
- Inclusiveness implies that the effects of structural policies on living standards are taken into account in a multidimensional way. As with access to food, distributional effects are crucial, and effects on the middle class and the poor have to be assessed. In addition to income, living standards depend on jobs, the availability of education and health.
- Behaviour and policy response should be enhanced based on micro studies and econometric evidence (see also the next section).
- Interactions between the micro and macro levels (coupling of models, attention for changing macro environment in micro level research and changing behaviour at the micro level in a macro environment) should be kept in mind.

More about our projects and publications on www.wur.eu/ise

>> Agricistrade | Exploring potential for agricultural and biomass trade with the EU
>> FoodSecure | For policies that matter
>> SUSFANS | Metrics, Models and Foresight for European Sustainable Food And Nutrition Security
>> SUCCESS | Strategic Use of Competitiveness towards Consolidating the Economic Sustainability of the European Seafood sector
>> AgMIP | The Agricultural Model Intercomparison and Improvement Project
>> SIM4NEXUS | Sustainable Integrated Management for the nexus of water-land-food-energy-climate for a resource-efficient Europe
>> Macroeconomic outlook of sustainable energy and biorenewables innovations
>> Socio-economic and environmental impacts of reducing food loss and waste

IV. Incentives for change

The identification of feasible instruments for ensuring that agri-food systems are sustainable and inclusive requires better insights into the responsiveness of producers and consumers to market incentives (prices, taxation) and non-market instruments (regulation, information). Robust approaches for impact analysis have become available to assess welfare and sustainability effects under different market and policy conditions.[29]

Behavioural insights into people's responses

Research that relies on behavioural economics uses interactive models and gaming methods from related sciences to establish insights about human cognitive processes and social interaction and to explore the implications of these findings for behavioural responses to economic stimuli. The most fertile interdisciplinary approaches in recent decades have included insights from psychology, but sociology, anthropology, ecology, biology and other fields also interact with economics in useful ways. Behavioural economics is deeply rooted in experimental findings and lab-in-the-field experiments, and generates accurate insights into people's responses to incentives, contributing to better and more effective policy design.

[29] A.J. Dietz, R. Ruben and J. Verhagen (2004) The Impact of Climate Change on Drylands: With a Focus on West Africa. Kluwer, Dordrecht.

For the transition to an inclusive and sustainable economy, we need insights into system interactions and the likely responses of agents (producers, consumers) to market and policy incentives. Economic outcomes are not always optimal in a biophysical sense. For instance, the market might respond to waste reduction in supply chains with lower farm gate prices. In such cases, there is a need for price incentives to align multiagency interests. In certain agri-food sectors, the mainstreaming of sustainability standards or fairness criteria along the supply chain is promoted (see 3.II). Moreover, nutrition and health considerations are increasingly held up as arguments for the taxation or public regulation of the sugar, salt or fat content of food items.

More about our projects and publications on www.wur.eu/ise

>> Improving sustainability in coffee and cocoa
>> The Sustainability Consortium
>> Smart Consumer Awareness: Sustainable food consumption through sustainability information

V. Interaction with stakeholders for social innovation

Direct interaction between stakeholders is considered critical for understanding and influencing the likelihood of behavioural change. Policy interventions that pursue improved sustainability or more inclusiveness need to overcome social behaviour dilemmas. Open innovation approaches make these dilemmas transparent and provide insights into opportunities for bargaining to overcome such dilemmas through information exchange (ICT) and by reducing uncertainties (risk sharing).

Socially inclusive and responsible innovation

Traditionally, technology has been leading in innovations. This may, however, result in the non-acceptance of a given innovation by society, or non-implementation of a given technology due to legislation not being adapted accordingly or when the technology is considered too radical or highly controversial. There is a need for *socially inclusive and responsible innovation* based on the idea that corporate competitiveness and sustainable growth depend on societal appreciation for technological innovations. Key to such societal appreciation is to open up innovation processes through the engagement of organised stakeholders and the public at large. The societal incubator is a specific methodology that caters to the need for social intelligence about uncertainties and

the unknowns generated by innovation processes (as developed and used in ongoing EST-Frame European projects and in CIMULACT).[30]

Cultural and social contexts differ, as do histories. This leads to different aspirations in various societies and also plays a role in determining what will work and what will not. Values and culture are not just important in themselves, they also affect how an economy performs. A society in which people have trust in one another does better than one in which people do not. While there are broad policy principles, there has to be space for diversity and context-specificity of policy integrating social norms and mindsets.

Visions are not predictions: they do not tell us what the future will be like but how it could look like. Such visions consider the future as something that we can shape, rather than something that is fully set in stone. A structured approach for stakeholder interaction has to be further developed with core components such as participatory multi-criteria analyses (pMCA), transformative scenario planning (TSP) and citizen vision workshops that promote social imagination.

More about our projects and publications on www.wur.eu/ise

>> Societal incubator
>> EST-frame | Development of tools for social impact assessment and technology evaluation
>> CIMULACT | Citizen and multi-actor consultation on Horizon2020

[30] See: http://estframe.net and http://www.cimulact.eu

5 MAJOR CHALLENGES

Agri-food competitiveness

Climate change

Renewable resources

Natural ecosystem

Global food & nutrition

TOWARDS AN INCLUSIVE AND SUSTAINABLE ECONOMY

HEALTHIER DIETS

RESILIENT AGRI-FOOD SYSTEMS

BIO-BASED CIRCULAR ECONOMY

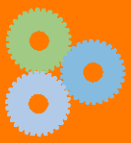
SUSTAINABLE AGRI-FOOD PRODUCTION

INCLUSIVE GROWTH

5 RESEARCH STRATEGIES

Monitoring & accounting

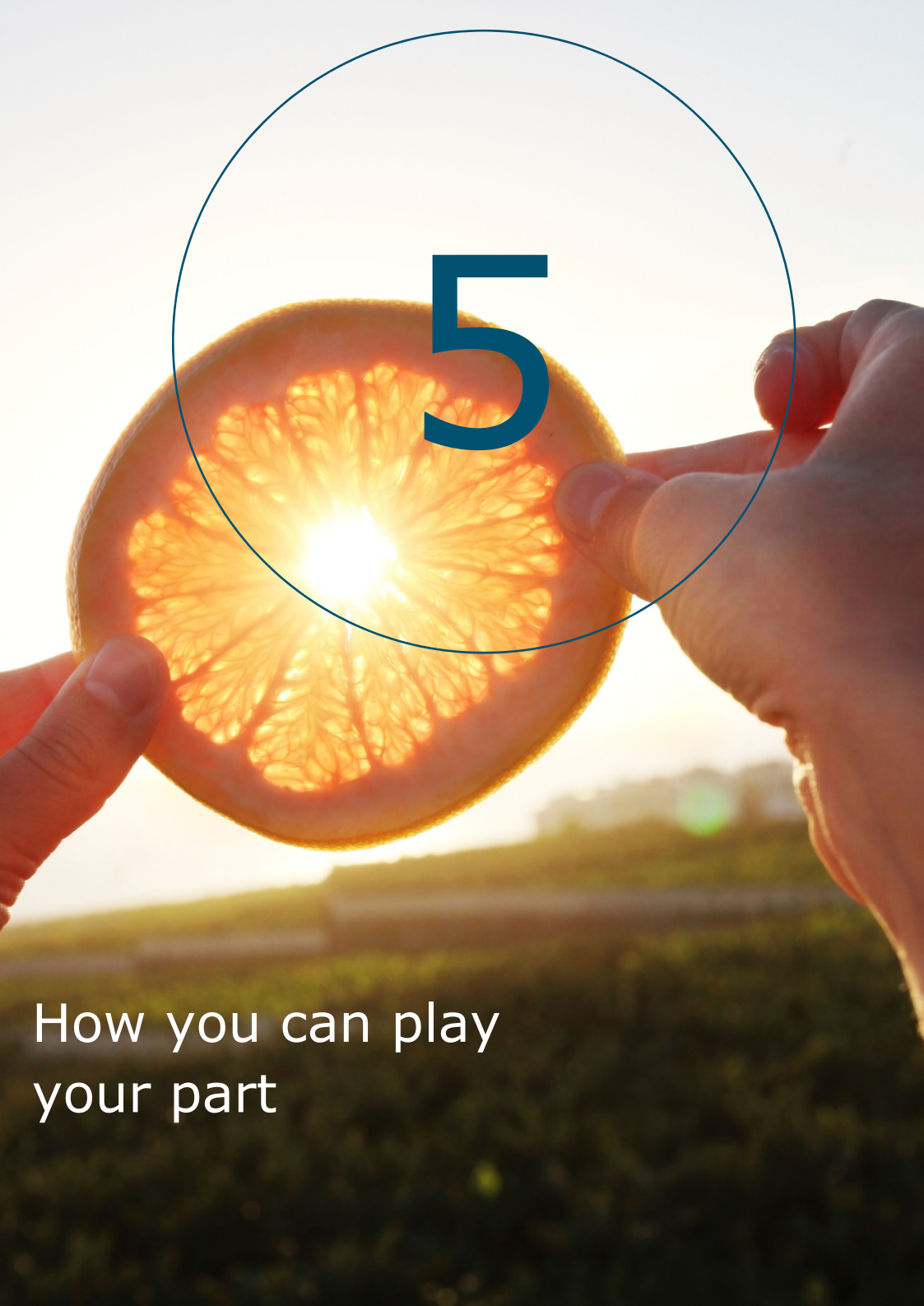
Uncertainties management for resilience



Scenario analyses

Incentives for change

Stakeholder interaction for social innovation


5
How you can play
your part

In addition to our research agenda outlined in section four, Wageningen Economic Research aims to challenge businesses and policy makers to contribute to the transition towards an inclusive and sustainable economy. Below we give five suggestions for ways in which both these groups could break the cycle of traditional thinking and make changes which have a long-lasting impact.

Businesses

Embed sustainability in your DNA

Create business value by making inclusiveness and sustainability a core value of your company. Inclusiveness will lower the social risk to your business while a sustainable approach reduces your environmental and resource risk profile. This in turn enhances your firm's competitive advantage in the medium and long term. Ensure that inclusiveness and sustainability flow through the veins of your company, stimulating employees to elaborate ideas which implement these aspects in every area of their work.

Ensure customers pay the true price

Nudge consumers into sustainable behaviour and include externalities in the price of your products (true pricing). It is good for the market to acknowledge the sustainable character of your products and production processes. In addition labelling procedures are required to enable consumers to make healthy and sustainable choices.

Know your impact

Monitor the inclusiveness and sustainability of your products. Monitor the dependence of your firm and products on natural resources (relevant for e.g. shareholders) and emissions to the environment (relevant for e.g. corporate social responsibility and legislation). Natural Capital Protocol is an example of a tool to incorporate natural resources into decision making. Demand this transparency from your suppliers too.

Reduce your dependency

Reduce risk by lowering your dependency on (non-renewable) natural resources (water, nature, etc.). For instance, increase resource use efficiency at the site level if its availability is determined locally. Initiate a process together with competing users to optimise local consumption and protect future use. Reduce this resource dependency in your supply chain as well in order to strengthen corporate resilience.

Use your waste well

Think biobased and circular! There should be no such thing as waste across the entire chain of your business. Go fully circular to reduce your dependency on purchased materials. Analyse how waste can be used productively within both your supply chain and region. A biobased strategy will serve as a trigger to substitute non-renewable for renewable materials. Substitution possibilities are often underestimated and price changes may well make substitutes attractive sooner than expected (the cost-effectiveness of solar power being a good example).

Policy makers

Create sustainable incentives

Create incentives for firms to increase and steer their innovation capacity towards inclusiveness, sustainability and resilience. Guiding education and public research in the desired direction is useful to create an overall societal critical mass for a turning point towards an inclusive and sustainable economy. In addition to market forces, policy is required in order to enable an encompassing transition and to stimulate investment in knowledge towards the social optimum. This is needed as due to positive externalities related to knowledge creation the private sector will underinvest in R&D.

Internalise external effects

Quantify external effects such as ecological and social costs, make them transparent and develop policies such as carbon pricing and price rises on unhealthy goods to internalise them. It is primarily the role of governments to ensure that the price mechanism works properly. For the economy is to be moved onto a truly sustainable foundation governments need to correct distortions in the pricing systems regarding freshwater, climate change, health and natural resource depletion. Be aware that substitution and indirect effects might mean that the impact and distribution outcomes are different than expected. Guaranteeing inclusiveness is a major challenge as it incorporates equity and fair distribution. As the market will not achieve a Pareto optimum for inclusiveness, additional support mechanisms are required.

Shift taxation towards resources, capital and emissions

Shift taxation from labour to resources (to stimulate the circular economy), capital (for the inclusive economy) and emissions (for sustainability). This will strengthen the ‘polluter pays’ principle within the market mechanism, create

suitable incentives to substitute resources and induce innovation towards an inclusive and sustainable economy.

Stimulate development of an overarching research framework

Select policy options based upon scientific research. Stimulate further design and implementation of the system analysis framework for an inclusive and sustainable economy, which is currently in its infancy (see figure 1, section 2.V). More insights into system interactions at different spatial levels and the likely responses of agents to market and policy incentives are for coherent policy analysis.

Activate all

Enable inclusive multi-stakeholder governance to stimulate a shared vision of the desired inclusive and sustainable economy, socially inclusive and responsible innovation systems, regional processes for sustainable landscape management of natural resources, and context specific policies for integrating specific norms, values and mindsets.

About the authors

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Ruerd Ruben (1954) is Research coordinator on food security and value chains at Wageningen Economic Research and professor of impact assessment at Wageningen University & Research. His research concerns the prospects for smallholder participation in tropical food value chains, the effectiveness of rural cooperative organisations and the impact of certification in value chains. He coordinated interdisciplinary research programmes on food security and sustainable resource management in sub-Sahara Africa. Previous to his current role, he was director of the Independent Policy and Operations Evaluation (IOB) department at the Netherlands Ministry of Foreign Affairs and professor in Development Effectiveness at the Centre for International Development Issues (CIDIN) of Radboud University Nijmegen.

Stijn Reinhard (1961) is senior water economist with Wageningen Economic Research. For his thesis on modelling water quality he received the Wageningen University thesis award. From the American Agricultural Economics Association, he received a best dissertation award for his dissertation on the econometric estimation of economic and environmental efficiency of Dutch dairy farms. He edited the Resources for the Future book 'Water Policy in the Netherlands'. Stijn has led many impact assessment projects. The costs and benefits of the Soil Strategy were assessed commissioned by the EU. For the Dutch Ministry of Infrastructure and Environment cost-effective measures for the Marine Framework Strategy Directive were analysed.

Wageningen Economic Research

To improve the quality of life, we analyse and design effective incentives and policies

Wageningen Economic Research, formerly known as LEI Wageningen UR, contributes to the mission of Wageningen University and Research *to explore the potential of nature to improve the quality of life* by supporting the analysis of opportunities and responses for transitions towards integrated agro-food systems and sustainable inclusive growth. Given today's global challenges we dedicate our knowledge and expertise to identify, assess and create solutions for providing healthy and safe food for everyone that is produced in a sustainable way.

Wageningen Economic Research carries out applied scientific social and economic research for government bodies, companies and societal organisations. Our strengths are to analyse current systems and to develop new insights through an interactive approach based on market intelligence, unique models and data, sector and domain expertise and in interaction with a wide variety of stakeholders. We ensure that the latest scientific knowledge in the field is applied. We explore and explain, so that you can enhance your policy or strategy, thus laying the foundations for 'earning' more value for your organisation, your clients and partners, the environment, citizens and society.

Explore

We identify and analyse trends in regions, countries and markets and assess possible development pathways. The horizon of our studies ranges from short term to several decades, depending on the client's question. We combine expertise on the sector and state-of-the-art scientific knowledge with data from a wide range of sources. This results in unique and innovative insights for business opportunities and policy strategies.

Explain

We explain what has happened, what is happening, and what may happen by measuring, monitoring, modelling and predicting the effects of government and company policies, of (inter)national market reforms and value chain upgrading, on competitiveness, food security, health, the environment and climate change. We provide insights for our clients, showing why and how these events take place and what are the likely implications. We use clear indicators and transparent change models and are able to look at results at the company, sector and country levels, considering all possible effects and likely influences.

Enhance

Based on insights obtained from explorations, we present concrete options, scenarios and strategies for improvement of policies and business designs. This may enhance the impact of policy instruments and marketing strategies on product standards, supply chain performance, consumer choices and a sustainable environment. This enables our clients to work more efficiently and to operate more effectively in the complete agro-food system and to create sustainable inclusive growth.

Earn

The insights and opportunities for improvements provide a basis for 'earning'. We consider earning not only as financial gain, but also as the creation of added value for organisations, communities, consumers and society. We work with companies to develop and implement innovative and sustainable business models and with governments to design and monitor sustainable inclusive policies. We challenge entrepreneurs to look at their processes, companies, chains and markets in a different way and we challenge governments to make an integral assessment of their policies. In complex transition processes, we also consider social acceptance and societal embedding.

www.wur.eu/economic-research

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The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Within Wageningen University & Research, nine specialised research institutes from the Wageningen Research Foundation and Wageningen University have joined forces to help answer the most important questions in the domain of healthy food and living environment. With approximately 30 locations, 5,000 employees, and 10,000 students, Wageningen University & Research is one of the leading organisations in its domain worldwide. An integrated approach to problems and the cooperation between various disciplines are at the heart of the unique approach of Wageningen.