Organic Agriculture and the Sustainable Development Goals

Part of the Solution

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Global agriculture has reached a cross road. Over the last few decades, the agricultural landscape has been transformed by new technologies, boosting agricultural productivity to new heights in order to meet growing global demands. However, these developments have come at the expense of negative environmental and social impacts such as soil degradation, biodiversity loss, water and soil pollution, increasing greenhouse gas emissions etc. (FAO, 2018). Ecosystems all over the world are under pressure, threatening the productive potential of the world’s natural resources and compromising the future fertility of the planet (FAO, 2018). It is clear we need to go down a new path.

With the world's population projected to reach 9.7 billion by 2050 (United Nations, 2019), meeting future food demand is considered a huge global challenge (Borlaug, 2002). In order to prevent the possibility of considerable food scarcity for the growing population, both climate change and global consumption need to be addressed along with strong measures to increase global food supply and availability (Sakschewski, von Bloh, Huber, Müller, & Bondeau, 2014). As quoted by the Food and Agriculture Association (FAO) of the United Nations, these measures must aim to go "beyond producing more with less to balancing the focus on quality and diversity, linking productivity to sustainability and addressing the needs of people" (FAO, 2018).

On the 1st of January 2016, the UN and all its member states officially introduced the 2030 Agenda for Sustainable Development; a plan of action based on 17 Sustainable Development Goals (SDGs) to address the main global challenges of the coming 15 years (United Nations, 2016). Solving these complex challenges and reaching these SDGs requires a holistic, transformative approach, building on the principles of economic, social and environmental sustainability.

This report takes a closer look at the existing literature on how sustainable agriculture can contribute to the accomplishment of multiple SDGs. More specifically, how organic agriculture can contribute to the achievement of the Sustainable Development Goals. The report also looks at the negative impact that agro-chemicals have on the SDG's.

SUSTAINABLE DEVELOPMENT GOALS

“In September 2015, over 150 world leaders adopted a globally relevant, transformative agenda for sustainable development, and committed to work together to achieve 17 core goals by 2030 to benefit the generations of today and tomorrow. The 2030 Agenda presents a paradigm shift in the world’s vision, approach and ambition for development. It is big, bold and complex. It calls on all nations to make our societies more inclusive, equitable, sustainable and responsive in their approach to development and climate change” (FAO, 2018). These sustainable development goals (SDGs) include:

These 17 goals, build on the successes of the Millennium Development Goals. They are interconnected, meaning success in one can directly affect the success of others. As shown in Figure 1 (retrieved from the FAO 2030 Agenda), sustainable food and agriculture play a key role in addressing multiple goals and SDG targets (FAO, 2018).

Figure 1: Food and agriculture at the centre of the SDGs
Source: FAO, 2016

A helpful way of viewing the economic, social and ecological aspects of the Sustainable Development Goals was presented at the 2016 EAT Food forum. Instead of seeing them as separate, still interconnected goals, the authors urged economies and societies to see them as embedded parts of the biosphere (Rockström & Sukhdev, 2016). Through this "wedding cake" chart, the Chairman of the EAT Advisory board, stated that "one must transition toward a world logic where the economy serves society so that it evolves within the safe operating space of the planet" (Rockström & Sukhdev, 2016). Both speakers concluded that in the end, all SDGs are directly or indirectly related to healthy and sustainable food. In line with these findings, this report takes a closer look at how organic agriculture specifically contributes to these SDGs.

Figure 2: SDG wedding cake (Rockström & Sukhdev, 2016)

To keep the document concise , a deliberate choice has been made to investigate a total of eight goals deemed most relevant. These include:

» SDG 6: Clean water
» SDG 13: Climate Action
» SDG 14: Life Below Water
» SDG 15: Life on Land
» SDG 2: Zero Hunger
» SDG 3: Good Health and Wellbeing
» SDG 8: Decent Work Conditions
» SDG 12: Responsible Consumption and production

To assess how organic agriculture contributes, this document will investigate the impact on each SDG from two perspectives: First, a closer look at how organic agriculture helps decrease the negative impact conventional agriculture is having on the goals. Secondly we investigate the extent to which organic agriculture has a positive impact, and contributing to the achievement of the SDG

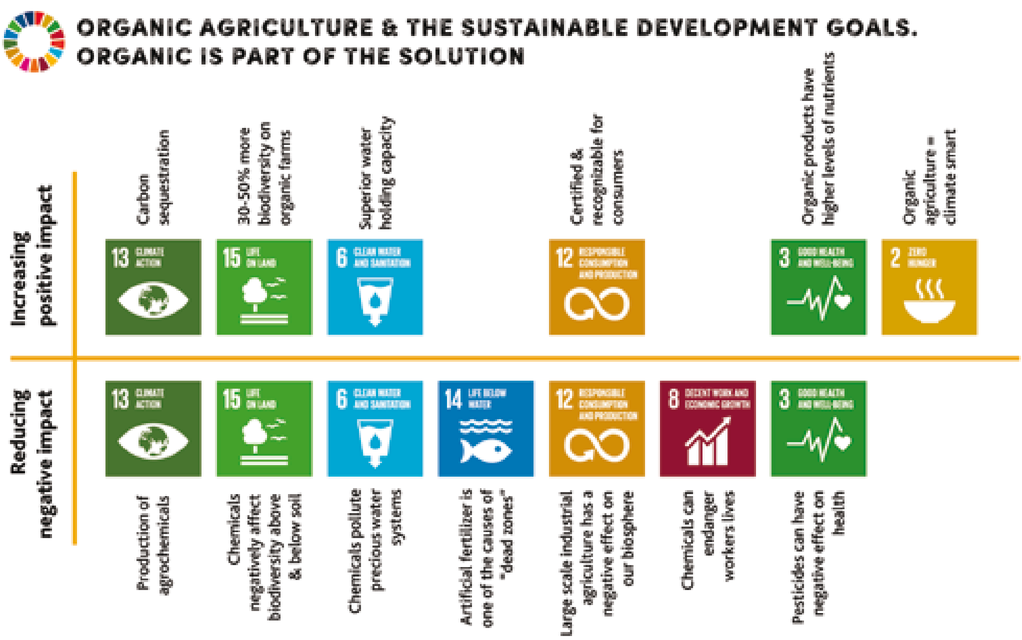

Figure 3: Framework of addressing the impact of Organic Agriculture on the SDGs

ORGANIC AGRICULTURE

In this section we take a closer look at what organic agriculture entails, to remove any ambiguity.

Numerous reports and scientific literature highlight a need for major changes in agriculture, in order to tackle the dual global challenge of, on the one hand, providing enough food to feed the growing population, while on the other hand, minimizing its environmental impacts. (Seufert, Ramankutty, & Foley, 2012). In this quest for more sustainable farming practices, organic farming is often proposed as a solution (Seufert et al., 2012).

Sustainable Agriculture: An ongoing debate:
Despite the concept of sustainability lying at the centre of attention regarding the use of the limited natural resources, one must recognise there exists no consensus on its meaning despite its intuitive appeal (Rigby et al., 2000). In other words, there is no major disagreement that the concepts of sustainable agriculture and organic agriculture are closely related, however there exists discord on the exact nature of the relationship (Rigby et al., 2000). Important to recognise in the entire sustainable agriculture debate, is that this discord could be explained by

the different views held on sustainable agriculture. Generally, one camp suggests that by fine-tuning conventional agriculture, by introducing more careful and efficient farming with new technologies, will reduce or eliminate many undesirable consequences of conventional agriculture (Schaller, 1993). The other camp however argues that more fundamental changes are needed, also requiring a major transformation of societal values (Schaller, 1993). In other words, the side that suggests that only fine-tuning is required, tend to contend that other forms of sustainable agriculture are inherently unprofitable, as they would not be able to nourish the growing population as well as conventional agriculture (Schaller, 1993). However, the other side argues for more fundamental changes in conventional farming and suggests that sustainable farming can be even more profitable, especially if one includes all benefits and costs of sustainable farming. Moreover, they argue that resource conservation, along with environmental protection will enhance, and not reduce worldwide food production (Schaller, 1993). As one could guess, organic agriculture pledges for the second option, while many petrochemical enterprises defend the first option. Now that one of the main roots of discord has been identified, one can move on to the actual definition of organic agriculture.

The role of organic agriculture:

The Food and Agriculture Association (FAO) of the United Nations define organic agriculture as: “a holistic production management system which promotes and enhances agroecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, considering that regional conditions require locally adapted systems. This is accomplished by using, where possible, cultural, biological and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system” (FAO & WHO, 1999).

Organic Agriculture is based on four important principles namely the principles of Health, Ecology, Fairness, and Care. According the global organic organization IFOAM “These principles are the roots from which Organic Agriculture grows and develops. They express the contribution that Organic Agriculture can make to the world. Composed as inter-connected ethical principles to inspire the organic movement -- in its full diversity, they guide our development of positions, programs, and standards”.

Furthermore, it is important to note that there are strict organic standards that are independently controlled.

SDG 15
LIFE ON LAND

The United Nations description for the goal:

"Forests cover 30.7 per cent of the Earth's surface and, in addition to providing food security and shelter, they are key to combating climate change, protecting biodiversity and the homes of the indigenous population. By protecting forests, we will also be able to strengthen natural resource management and increase land productivity.

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At the current time, thirteen million hectares of forests are being lost every year while the persistent degradation of drylands has led to the desertification of 3.6 billion hectares. Even though up to 15% of land is currently under protection, biodiversity is still at risk. Deforestation and desertification – caused by human activities and climate change – pose major challenges to sustainable development and have affected the lives and livelihoods of millions of people in the fight against poverty" (United Nations, 2018).

The current state of affairs:

Loss of biodiversity and global land degradation are continuing at unprecedented rates, causing detrimental change to ecosystems and the natural food chain (IPBES, 2018). In 2018, the Living Planet Report found a catastrophic decline in animal populations over a mere period of 40 years (1970 – 2010), stating that populations of vertebrates declined by an average of 60 percent (WWF, 2018). Similarly, clear evidence shows recent declines in both wild and domesticated pollinators, as well as the plants that rely upon them (Potts et al., 2010). This global trend can result in loss of pollination services, inducing harmful ecological and economic impacts, as pollinators, such as bees and other insects play a vital role to wild plant communities and agricultural productivity (Potts et al., 2010). Insect pollination for example is necessary for 75% of all crops species directly used for human nutrition (Potts et al., 2010) and the economic value represented an estimated 153 billion dollar valuation (9.5 % of the total economic value of world agriculture) worldwide in 2005 (Gallai, Salles, Settele, & Vaissière, 2009).

The role of agriculture:

Amongst the main drivers of this biodiversity decline is agriculture and its often intensive farming practices (WWF, 2018). Diving deeper into the causes, one can find that the agricultural intensification of the past decades also increased the use of agrochemicals, including insecticides and herbicides, resulting in potential habitat degradation within agricultural areas (Potts et al., 2010). Whereas insecticides for example can have a direct effect of death by straight intoxication, herbicides too can have indirect detrimental effects by diminishing floral resource abundance and diversity availability (Gabriel & Tscharntke, 2007; Ollerton, Erenler, Edwards, & Crockett, 2014; Powney et al., 2019). Similarly, two new long-term studies, one from the French National Museum of Natural History and one from the CNRS, found farmland birds populations in France to have fallen by an average of one third in the last seventeen years (Geffroy, 2018), while another German study found a worrying 75% decline in total flying insect biomass over the last 27 years (Hallmann et al., 2017) . Once more, the study argues pesticides to be one of the key drivers of this significant decline, arguing both glyphosates and neonicotinoids to decimate plants and insects, causing food scarcity for the birds (Geffroy, 2018).

A UN Report on the right to food even mentions: "The continued excessive use and misuse of pesticides result in the contamination of surrounding soil and water sources, causing a major loss of biodiversity, destroying beneficial insect populations that act as natural enemies of pests and reducing the nutritional value of food." (UN, 2017)

When we speak about biodiversity it is essential to talk about what is happening below our feet as 25% of biodiversity is found in the soil http://www.fao.org/3/ca2227en/CA2227EN.pdf. According to the UN FAO, intensive crop production has depleted the soil in many countries and as a consequence encourages sustainable agricultural farming practices including organic farming.

Unfortunately, such as with biodiversity above land, land degradation is a pervasive and malign phenomenon occurring all over the world. The latest IPBES report on Land Degradation and Restoration is calling combatting this degradation "an urgent priority in order to protect the biodiversity and ecosystem services that are vital to all life on Earth and to ensure human well-being" (IPBES, 2018). In addition, the report states that land degradation negatively impacts over 3.2 billion people, induces the planet's sixth mass extinction and represents an economic loss in the magnitude of 10% of the annual global gross product. Here again unsustainable agriculture has been put forward as one of the main direct drivers of such land degradation and biodiversity loss (IPBES, 2018). Finally, the report concludes that avoiding land degradation and restoring degraded lands makes economic sense and could result in increased food and water security, increased employment, and avoidance of conflict and migration, subjects that also relate to other Sustainable Development goals.

In assessing the quality of the soil, soil organic matter (SOM) can be seen as "an important 'building block' for soil structure, contributing to soil aeration, and enabling soils to absorb water and retain nutrients" (Turbé et al., 2010). Over a period of 22 years, a study compared the SOM of both organic and conventional farming systems, finding that SOM was signifficantly higher in both the organic animal and the organic legume systems than in conventional agriculture, with a respective increase of 27.9%, 15.1% and 8.6% over the entire period (Pimentel, Hepperly, Hanson, Douds, & Seidel, 2005). The study concluded that "the environmental benefits attributable to reduced chemical inputs, less soil erosion, water conservation, and improved soil organic matter and biodiversity were consistently greater in the organic systems than in the conventional systems" (Pimentel et al., 2005).

The role of organic agriculture:

Overall, linking the loss of biodiversity back to (organic) agriculture, organic farming, due to its lack of pesticides mineral fertilizers and variability in crop rotation is generally found to enhance biodiversity in agroecosystems (Gabriel & Tscharntke, 2007). A claim supported by a vast amount of other studies. (Bengtsson, Ahnström, & Weibull, 2005; Hole et al., 2005; van Elsen, 2000). Similarly, research has found organically managed lands to have 30% more varieties of flora and fauna and 50% more individual plants. (Bengtsson et al., 2005)

Conclusion:

Biodiversity loss and land degradation cause detrimental change to ecosystems and the natural food chain. Amongst the main of this decline is agriculture and its extensive use of pesticides and herbicides. Due to the reduced or non-existing input of mineral fertilizers and pesticides, organic fields tend to enhance biodiversity compared to conventionally managed fields, thus positively contributing to this Sustainable Development Goal.

Figure 4: The UN "Sustainable Development Goals" for the period 2015-2030 (http://sustainabledevelopment.un.org/focussdgs.html), related to ecosystem services and soil functions, as discussed.

		Ecosystem services												
		Provision of food, wood and fibre	Provision of raw materials	Provision of support for human infrastructures and animals	Flood mitigation	Filtering of nutrients and contaminants	Carbon storage and greenhouse gas regulation	Detoxification and the recycling of wastes	Regulation of pests and disease populations	Recreation	Aesthetics	Heritage values	Cultural identity	Relates to soil
	SDG topic	1	2	3	4	5	6	7	8	9	10	11	12	function (Table 2)
1	End poverty in all its forms everywhere	X	X	X	X									1, 5
2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	X		X										1, 2, 4
3	Ensure healthy lives and promote well-being for all at all ages	X							X	X	X	X	X	1, 2, 3, 4, 5, 7
4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all												X	7
5	Achieve gender equality and empower all women and girls													
6	Ensure availability and sustainable management of water and sanitation for all				X	X		X		X				2
7	Ensure access to affordable, reliable, sustainable and modern energy for all	X	X											1, 5, 6
8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	X	X	X										1, 2, 5, 6
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation		X	X										2, 4, 5
10	Reduce inequality within and among countries													
11	Make cities and human settlements inclusive, safe, resilient and sustainable		X	X										2, 4, 5,
12	Ensure sustainable consumption and production patterns	X	X			X	X	X						1, 2
13	Take urgent action to combat climate change and its impacts				X		X							2, 6
14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development													
15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	X	X	X	X	X	X	X	X	X		X	X	1, 2, 3, 4, 5, 6
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels			X						X		X	X	4, 7
17	Strengthen the means of implementation and revitalize the global partnership for sustainable development													

SDG 13
CLIMATE ACTION

The United Nations description for the goal:

“Climate change is now affecting every country on every continent. It is disrupting national economies and affecting lives, costing people, communities and countries dearly today and even more tomorrow. Weather patterns are changing, sea levels are rising, weather events are becoming more extreme and greenhouse gas emissions are now at their highest levels in history. Without action, the world’s average surface temperature is likely to surpass 3 degrees centigrade this century. The poorest and most vulnerable people are being affected the most.

Affordable, scalable solutions are now available to enable countries to leapfrog to cleaner, more resilient economies. The pace of change is quickening as more people are turning to renewable energy and a range of other measures that will reduce emissions and increase adaptation efforts. Climate change, however, is a global challenge that does not respect national borders. It is an issue that requires solutions that need to be coordinated at the international level to help developing countries move toward a low-carbon economy.

To strengthen the global response to the threat of climate change, countries adopted the Paris Agreement at the COP21 in Paris, which went into force in November of 2016. In the agreement, all countries agreed to work to limit global temperature rise to well below 2 degrees centigrade. As of April 2018, 175 parties had ratified the Paris Agreement and 10 developing countries had submitted their first iteration of their national adaptation plans for responding to climate change.

The current state of affairs:
The rapid change in the planet's climate and ecosystems, translating into more frequent and severe weather events such as heat waves, droughts and sea-level rise pose major risks to agriculture and food security (FAO, 2016). In fact, climate change and agriculture are closely linked and interdependent as agriculture is both affecting and being affected by climate change. On the one hand, agriculture, along with its emissions from deforestation due to land conversation account for around 23% of global anthropogenic greenhouse gas emissions, being the most significant contributor to the warming of the planet (IPCC, 2019). On the other hand, changing environmental conditions such as rising temperatures and changing precipitation patterns acutely affect agricultural productivity, with all planet's agroecosystems expected to be severely affected by climate change by 2050 (Scialabba & Müller-Lindenlauf, 2010). Therefore, both the IPCC and numerous other scientists strongly advocate for more resilient and so-called 'climate-proof' agroecosystems.

Mitigation potential of organic agriculture:
Now let's take a closer look at the mitigation and adaption potential of each agricultural model. Starting off with the mitigation potential of organic agriculture. The management of nutrients and pests in organic agriculture can play a valuable role in climate mitigation(Scialabba & Müller-Lindenlauf, 2010). Under organic regulations, synthetic inputs such as mineral and chemical pesticides - which require vast amounts of fossil fuels -are prohibited. This means significant amounts of carbon dioxide emissions are spared (Khanal, 2009). In 2010 for example, researchers estimated the synthesis of nitrogen fertilizers to consume energy of up to 0.4 – 0.6 gigatons of carbon dioxide. This equals as much as 10% of the direct global agricultural emissions and 1% of total human induced greenhouse gas emissions (Scialabba & Müller-Lindenlauf, 2010).These emissions are largely averted by organic agriculture.
On the other hand, organic agriculture generally uses more energy, as this form of agriculture often is more labor intensive and uses more machinery due to practices such as mechanical weed control as an example. Overall, however, reviews and meta-analyses find organic agriculture to be more energy-efficient and is seen as using less energy than their conventional counterparts (Reganold & Wachter, 2016). This is particularly correct when expressed per production area. Expressed per unit product however, this positive effect is less pronounced or not present at all (Mondelaers, Aertsens, & Van Huylenbroeck, 2009).

A second major reason organic agriculture can help with climate change mitigation lies in soils (Scialabba & Müller-Lindenlauf, 2010). The FAO's report on Soil Organic Carbon, highlights the importance of healthy soils. As soils are a major and often forgotten carbon reservoir, containing more carbon than the atmosphere and terrestrial vegetation combined (FAO, 2017). Carbon sequestration - the process of capturing carbon and the long-term storage of atmospheric carbon dioxide trough biological, chemical or physical processes - can play a major role in turning the soil into a net sink of greenhouse gas emissions. Even though the total amount of mitigation is hard to quantify due to its high dependence of local environmental conditions and management practices, research consistently find higher carbon sequestration in organically managed soils than in their conventional counterparts (Scialabba & Müller-Lindenlauf, 2010; Ziesemer, 2007).

A second major reason organic agriculture can help with climate change mitigation lies in soils

Adaptation potential of organic agriculture:
Now let's consider the climate adaptation potential of organic agriculture. Soils rich in organic matter have increased water storage capability, reduce surface run-off and erosion and can sustain a supply of water during periods of drought (IFOAM, 2012). Therefore, organic agriculture tends to provide greater resilience in times of extreme weather events such as water scarcity or heavy precipitations (IFOAM, 2012; Scialabba & Müller-Lindenlauf, 2010).

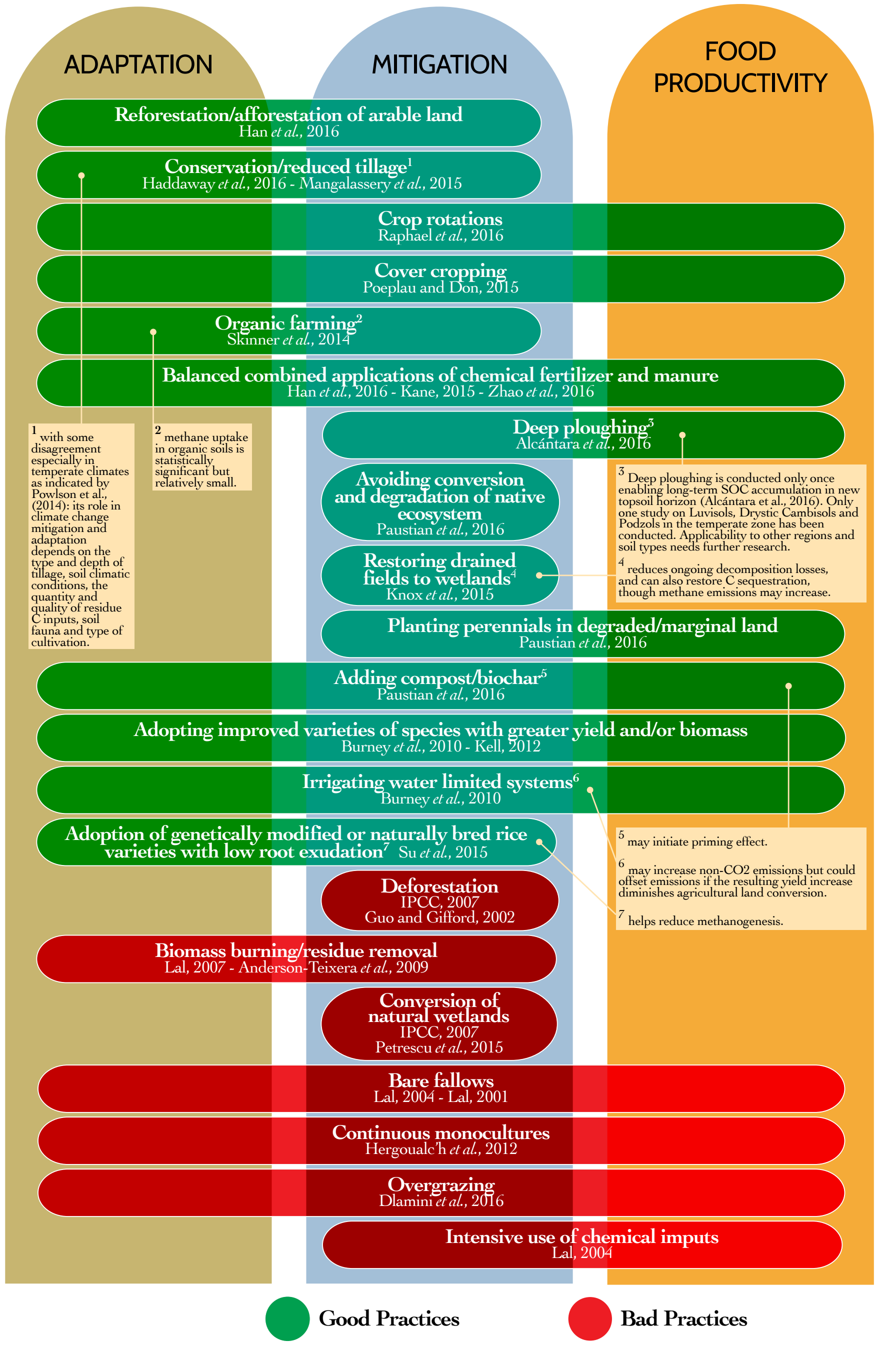

Figure 13 · Suggested and dissuaded management strategies for soil carbon sequestration and their impact on food productivity and climate change mitigation and adaptation.

Colours indicate good (green) and bad (red) practices. Partially adapted and modified from Ogle *et al.*, 2014, and Descheemaeker *et al.*, 2016

The figure (on the right) from the FAO report on Soil Organic Matter shows management strategies that foster SOC for optimal food production, climate change mitigation and adaptation.

Conclusion:

Climate change is both affecting and being affected by agriculture. Through both a less intensive energy input and a greater carbon sequestration potential, organic agriculture can contribute to the mitigation of climate change and thus this SDG. Similarly, organic agriculture also shows potential as a climate adaptive farming system through its increased resilience for extreme weather events.

SDG 14
LIFE BELOW WATER

The United Nations description for the goal:

“The world’s oceans – their temperature, chemistry, currents and life – drive global systems that make the Earth habitable for humankind. Our rainwater, drinking water, weather, climate, coastlines, much of our food, and even the oxygen in the air we breathe, are all ultimately provided and regulated by the sea. Throughout history, oceans and seas have been vital conduits for trade and transportation”.

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"Careful management of this essential global resource is a key feature of a sustainable future. However, at the current time, there is a continuous deterioration of coastal waters owing to pollution and ocean acidification is having an adversarial effect on the functioning of ecosystems and biodiversity. This is also negatively impacting small scale fisheries".

"Marine protected areas need to be effectively managed and well-resourced and regulations need to be put in place to reduce overfishing, marine pollution and ocean acidification".

As organic agriculture prohibits the use of synthetic pesticides, there is little to no risk of synthetic pesticide pollution of ground and surface waters

The current state of affairs:
According to the earth observatory (NASA), both the size and number of marine dead zones, areas where the deep water contains not enough dissolved oxygen to support life, have exponentially grown in the last five decades (Diaz & Rosenberg, 2008). It is no coincidence that dead zones occur close to densely populated areas such as in the Gulf of Mexico or in the Baltic Sea (Diaz & Rosenberg, 2008) as one of the main causes for these dead zones (a process called eutrophication) is the leaching of agrarian fertilizers (UNEP, 2016). Fertilizer-laden runoff encourages explosive algae growth, which when they die off, are decomposed by microbes that are using up the oxygen. This leads to mass killing of fish and other sea organisms. (Diaz & Rosenberg, 2008).

The role of organic agriculture:
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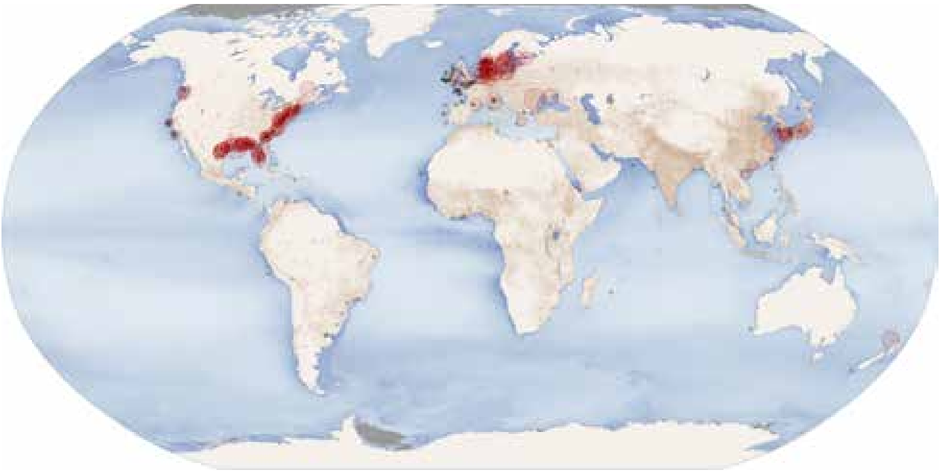

Figure 6: Death zones around the world (Diaz & Rosenberg, 2008).

Organic agriculture can be seen as part of the solution

(Reganold & Wachter, 2016). Consequently when we look at nitrate and phosphorous leaching (the two major causes of eutrophication) the impact of organic farming on dead zones is less compared to conventional agriculture. It is however important to point out that this due to the lower land-use efficiency of organic farming in developed countries this positive effect is less pronounced and in some cases reversed when expressed per unit product (Reganold & Wachter, 2016).

Nevertheless, a study aimed at assessing what agricultural methods could be implemented to reduce nutrient pollution to the Baltic see suggested Ecological Recycling Agriculture (ERA) as a solution. The researchers defined ERA as “an agriculture system based on local and renewable resources, which integrates animal and crop production on each farm or farms in close proximity” (Granstedt, Schneider, Seuri, & Thomsson, 2008). According to the study, application of these agricultural principles throughout the Baltic region could result in the halving of nitrogen losses and minimizing losses of phosphorus (Granstedt et al., 2008).

Since there are a lot of similarities between organic agriculture and the principles of ecological recycling agriculture including crop rotation and a better recycling of biomass and nutrients, organic agriculture can be seen as part of the solution. Nevertheless, more research needs to be conducted in this regard.

Conclusion:
Marine dead zones are an increasingly severe risk for life and biodiversity below water. Amongst its main drivers is agriculture and its fertilizers and pesticides. Organic agriculture tends to leach less nutrients per unit area and resembles the Ecological Recycling Agriculture (ERA) proposed to reduce nutrient pollution in the waters.

SDG 6
CLEAN WATER & SANITATION

The United Nations description for the goal:

Clean, accessible water for all is an essential part of the world we want to live in and there is sufficient fresh water on the planet to achieve this. However, due to economic disadvantages or poor infrastructure, millions of people including children die every year from diseases associated with inadequate water supply, sanitation and hygiene.

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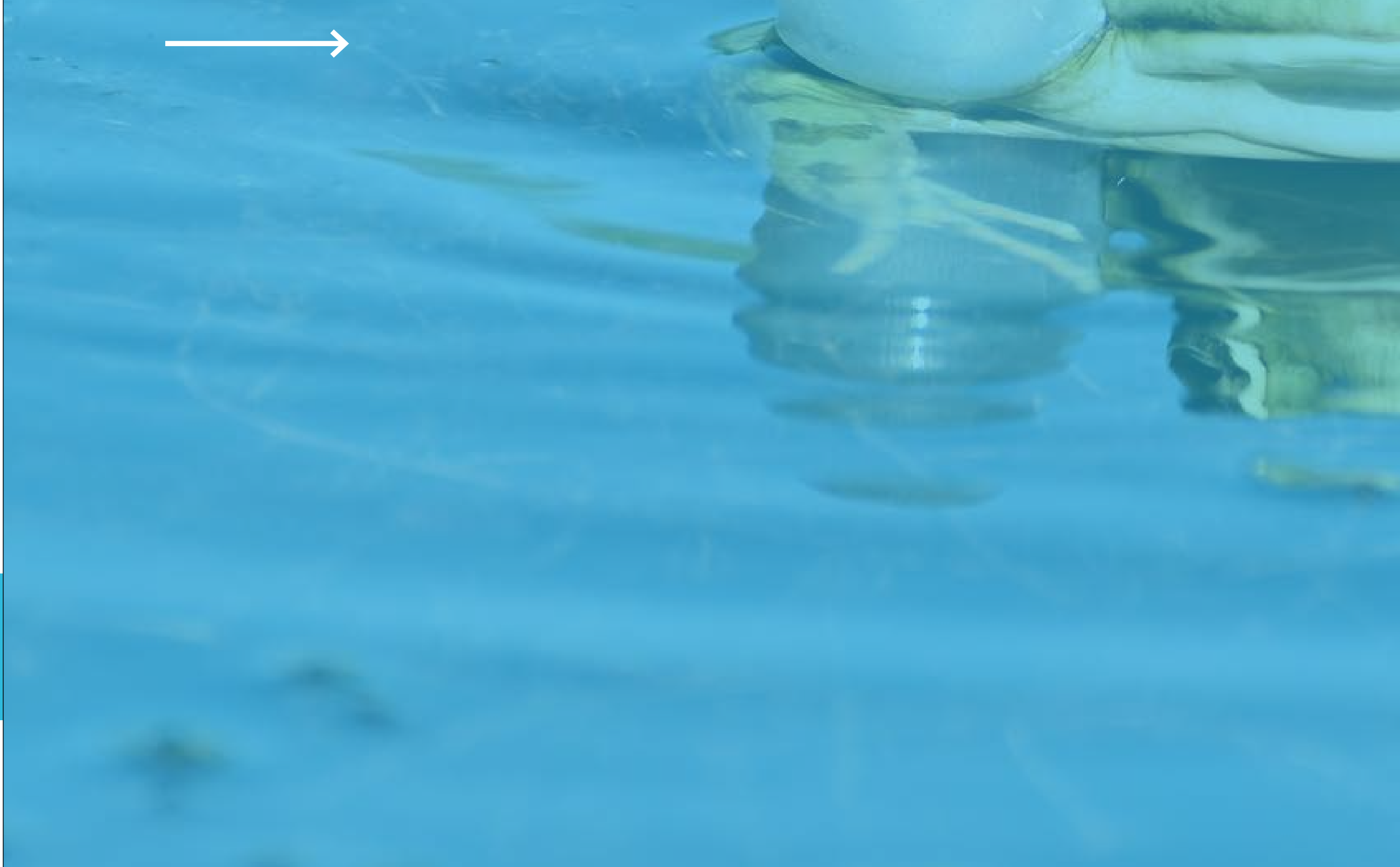

Water scarcity, poor water quality and inadequate sanitation also negatively impact food security, livelihood choices and educational opportunities for poor families across the world. At the current time, more than 2 billion people are living with reduced access to freshwater resources and by 2050, at least one in four people is likely to live in a country affected by chronic or recurring shortages of fresh water. Drought afflicts some of the world's poorest countries, worsening hunger and malnutrition. Fortunately, there has been great progress made in the past decade with drinking sources and sanitation, and over 90% of the world's population now has access to improved sources of drinking water.

To improve sanitation and access to drinking water, there needs to be increased investment in management of freshwater ecosystems and sanitation facilities on a local level in several developing countries within Sub-Saharan Africa, Central Asia, Southern Asia, Eastern Asia and South-Eastern Asia.

The current state of affairs:
Even though bodies of water cover 70% of the Earth's surface, a relatively microscopic 2.5% of that water is estimated to be fresh. Yet, 68% of the freshwater resources remain sealed away in ice sheets and glaciers (Shiklomanov, 1993). This results in less than 1% of the water being directly available for human consumption. To compound this issue, humans have proven to be inefficient water users. Water usage has been increasing at a rate twice as high as population increases (FAO, 2017). The United Nations indicate that 1.8 billion humans will live in areas suffering from water scarcity in 2025.

Global water scarcity does not only result in physical freshwater scarcity, but also the deterioration ofdeterioration of water quality in both developed and developing nations. Diminishing the quantity and quality of safe and available water will undermine economic growth as well as risk the physical and environmental health of billions of people (FAO, 2017).

38% of European water bodies are undergoing powerful pressure from agricultural pollution

The role of agriculture:
Linking this back to the role of agriculture -agriculture accounts for 70 percent of global water abstraction (FAO, 2017). From this immense water usage, two problems arise: Overuse of the existing fresh water

90% of the world's population now has access to improved sources of drinking water

supply as well as deteriorating water quality. Agriculture discharges large amounts of agrochemicals (such as pesticides and fertilisers), organic matter, drug residues, sediments and saline drainage into water bodies (FAO, 2017). Evidence for this can be found from a report from the World Water Assessment Programme (WWAP)). It finds that 38% of European water bodies are undergoing powerful pressure from agricultural pollution (WWAP 2015). This presents alarming risks to aquatic ecosystems, human health and productive activities (UNEP 2016). Water pollution as a result of agriculture also carries a significant financial burden. A report published by the French Government in 2011 estimated the full cost of cleaning all of France's groundwater to cost around 522 billion euros (Maurel 2011). Similarly, the report gauged the treatment costs of water purification from nitrates and pesticides to be 70 euros and 60,000 euros per kilo respectively. Despite the differences this clearly shows a major benefit of reducing water pollutants such as nitrates and pesticides (Maurel, 2011).

The role of organic agriculture:
Linking this back to organic agriculture, one can identify two main ways organic agriculture contributes to this sixth SDG. First, since synthetic pesticides are virtually eliminated in organic agriculture, the trade-off between water pollution and food production is significantly reduced (Pimentel, Hepperly, Hanson, Douds, & Seidel, 2005). Second, organic fields, generally contain more soil organic matter (Pimentel et al., 2005), which causes soil to form stable soil aggregates and therefore a better soil structure (Nichols, 2015). This results in improved capacity of the soil to absorb and hold more water during rainfalls (Nichols, 2015; Siegrist, Schaub, Pfiffner, & Mäder, 1998). Hence, under severe drought conditions - which are expected to be more frequent due to climate change - organic agriculture tends to perform better than its counterparts (Reganold & Wachter, 2016)

Conclusion:
With regards to the clean water supply, agriculture has been linked to both the immense water usage and the deteriorating water quality. Since synthetic pesticides are virtually eliminated in organic agriculture, water pollution is reduced. On another note, organic agriculture generally contain more soil organic matter, thus providing better water holding capabilities and positively contributing to this SDG.

SDG 2
ZERO HUNGER

The United Nations description for the goal:

It is time to rethink how we grow, share and consume our food. If done right, agriculture, forestry and fisheries can provide nutritious food for all and generate decent incomes, while supporting people-centered rural development and protecting the environment.

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2 ZERO HUNGER

Right now, our soils, freshwater, oceans, forests and biodiversity are being rapidly degraded. Climate change is putting even more pressure on the resources we depend on, increasing risks associated with disasters, such as droughts and floods. Many rural women and men can no longer make ends meet on their land, forcing them to migrate to cities in search of opportunities. Poor food security is also causing millions of children to be stunted, or too short for the ages, due to severe malnutrition.

A profound change of the global food and agriculture system is needed if we are to nourish the 815 million people who are hungry today and the additional 2 billion people expected to be undernourished by 2050. Investments in agriculture are crucial to increasing the capacity for agricultural productivity and sustainable food production systems are necessary to help alleviate the perils of hunger.

Soil degradation is one of the most serious threats to the environment and food security

The current state of affairs:
As mentioned in the description above, a profound change of the global and agriculture system is imperative if we want to feed the 9.7 billion projected to inhabit the planet in 2050 (United Nations, 2019). Although there is an ongoing discussion as to whether organic can or cannot feed the world based upon a yield discussion, this certainly does not mean that organic agriculture cannot contribute to the achievement of this SDG (Meemken & Qaim, 2018). In fact, two important points needs to be made. Firstly, the effect of soil degradation is often not considered in the long-term prediction of yield potential. Secondly, major differences in yields gaps can be found between developing and developed countries.

The role of healthy soils:
As more than 95% of the food is directly or indirectly linked to soil (FAO, 2015), one must consider that in order to tackle the zero hunger goal, it is imperative we take into account the health of the soils.

An estimated 10 million hectares of previously fertile land have become ineligible for agriculture due to soil degradation (e.g., erosion), often as a result of mismanagement (Meemken & Qaim, 2018; Pimentel, 2006). According to the Food and Agriculture Organization, an estimated 25% of the soils suffer from a high soil degradation (FAO, 2011), making soil degradation of the most serious threats to the environment and food security (Pimentel, 2006). Linking this back to organic agriculture, "organic practices such as the application of organic matter and the longer and more diverse crop rotations with cover and catch crops can contribute to the reduction of soil erosion and fertility decline"(Meemken & Qaim, 2018). Similarly, meta-analyses endorse the fact that organically managed fields contain higher doses of organic matter and larger and more active soil microbial communities, both key indicators of soil quality (Meemken & Qaim, 2018; Tuomisto, Hodge, Riordan, & Macdonald, 2012). Therefore, even though organically sourced yields are generally reduced with a magnitude of 19-25% (Meemken & Qaim, 2018), organic agriculture can play a key role in the long-term provision of food, as it provides better soil quality, resulting in less farmland loss over time and a better climate-resilience (Scialabba & Müller-Lindenlauf, 2010).

Yields:
With regard to the yield discussion, apart from looking at the role of soil and the consequential short term vs. long term effects, it is also important to look at the difference between developing and developed countries.

Comparing yields is extremely difficult as they are highly contextual and depend on many different variables (Seufert, Ramankutty, & Foley, 2012). Nevertheless, yields from organic agriculture in developed countries tend to be lower than those in conventional agriculture. However, in circumstances where most farmers have limited access to modern technologies and apply modest amounts of agrarian inputs anyways, organic yields can be similar to conventional ones (Meemken & Qaim, 2018). With an appropriate training and a sizeable increase in the use of organic fertilizers, organic yields can even be significantly higher than those collected by low-input conventional counterparts (Bolwig et al. 2009, Ibanez & Blackman 2016, Wollni & Andersson 2014). In addition, the use of organic soil management practices can also reduce yield variability and vulnerability to drought and other weather extremes (Meemken & Qaim, 2018).

Conclusion:
Although organic yields in developed countries tends to be lower, organic agriculture has a major role to play in the domain of zero hunger and food security. As more than 60 percent of Africa's sub-Saharan population consists of smallholder farmers (Goedde, Ooko-Ombaka, & Pais, 2019), organic agriculture

Investments in agriculture are crucial to increasing the capacity for agricultural productivity and sustainable food production systems are necessary to help alleviate the perils of hunger.

SDG 3
GOOD HEALTH, WELL-BEING

The United Nations description for the goal:

Ensuring healthy lives and promoting the well-being at all ages is essential to sustainable development.

Significant strides have been made in increasing life expectancy and reducing some of the common killers associated with child and maternal mortality, but working towards achieving the target of less than 70 maternal deaths per 100,000 live births by 2030 would require improvements in skilled delivery care. Achieving the target of reducing premature deaths due to incommunicable diseases by 1/3 by the year 2030 would also require more efficient technologies for clean fuel use during cooking and education on the risks of tobacco.

Many more efforts are needed to fully eradicate a wide range of diseases and address many different persistent and emerging health issues. By focusing on providing more efficient funding of health systems, improved sanitation and hygiene, increased access to physicians and more tips on ways to reduce ambient pollution, significant progress can be made in helping to save the lives of millions.

The use of pesticide is argued to not only effect the health of the consumer and farmer, but also the health of the local population living close to the fields.

As SDG 3 and SDG 8 are inherently intertwined, the choice has been made for SDG 3 to look at how organic agriculture impacts the health of the consumers, while SDG 8 (Decent Work and Economic Growth) will focus on assessing the health risks for farmers and farm workers in an agrarian context.

Researching how organic agriculture contributes to this third SDG, two main subjects came up, first, the assessment of the nutritional values of organic agriculture and secondly the risks of pesticides for the consumer.

Nutritional value:
Starting off with the nutritional value: Even though demand for organic products is partially driven by the consumer's perception that these are healthier and more nutritious than the conventional counterpart, the scientific community is still divided as to whether there are significant nutritional differences between organic and non-organic foods (Barański et al., 2014). Reganold & Wachter, (2016) for example found 12 out of 15 literature reviews and meta-analyses showing evidence that organic is indeed more nutritious when to comes to higher levels of anti-oxidants, vitamin C, Omega 3 fatty acids and the omega 3 to 6 ratios. Similarly, a study based on 343 peer-reviewed publications, ensuring the papers to be statistically significant, found on average

3 GOOD HEALTH AND WELL-BEING

12 out of 15 literature reviews and meta-analyses showing evidence that organic is indeed more nutritious

substantially higher concentrations of antioxidants in organic products, as well as lower prevalence of cadmium (4 times less) and pesticide residues (Barański et al., 2014). Whether or not these are nutritionally meaningful differences continues to be debated (Reganold & Wachter, 2016a). However, none of the studies did mention organically sourced foods to be less healthy.

Pesticides and health:
On another note, the use of pesticide is argued to not only (potentially) affect the health of the direct consumer or the farmer (See SDG 8), but also the health of the local residents around the fields. Recent findings (von Ehrenstein et al., 2019) suggested an offspring's risk of autism spectrum disorder increases following prenatal exposure to ambient pesticides within 2000 m of their mother's residence during pregnancy, compared with children born in the same agricultural region that were not exposed to pesticides.

Conclusion:
Although debated, organic agriculture could be more nutritious than their conventional counterparts. The fact that no study found organic to be less healthy and the numerous risks of pesticides on human, thus validate that organic agriculture can contribute to this SDG.

SDG 8
DECENT WORK & ECONOMIC GROWTH

The United Nations description for the goal:

Roughly half the world's population still lives on the equivalent of about US$2 a day with global unemployment rates of 5.7% and having a job doesn't guarantee the ability to escape from poverty in many places "Being in employment does not always guarantee a decent living," said Damian Grimshaw, ILO Director of Research. "For instance, a full 700 million people are living in extreme or moderate poverty despite having employment" . This slow and uneven progress requires us to rethink and retool our economic and social policies aimed at eradicating poverty.

Sohel Parvez Haque / Shutterstock.com

A continued lack of decent work opportunities, insufficient investments and under-consumption lead to an erosion of the basic social contract underlying democratic societies: that all must share in progress. Even though the average annual growth rate of real GDP per capita worldwide is increasing year on year, there are still many countries in the developing world that are decelerating in their growth rates and moving farther from the 7% growth rate target set for 2030. As labor productivity decreases and unemployment rates rise, standards of living begin to decline due to lower wages.

Sustainable economic growth will require societies to create the conditions that allow people to have quality jobs that stimulate the economy while not harming the environment. Job opportunities and decent working conditions are also required for the whole working age population. There needs to be increased access to financial services to manage incomes, accumulate assets and make productive investments. Increased commitments to trade, banking and agriculture infrastructure will also help increase productivity and reduce unemployment levels in the world's most impoverished regions.

The current state of affairs:
With an estimated 866 million people, agriculture is the single biggest employer of the planet, yet rural inhabitants, despite producing 80% of the global food, make up for 80 percent of the global poor (CNS-FAO, 2019; ILO, 2018).

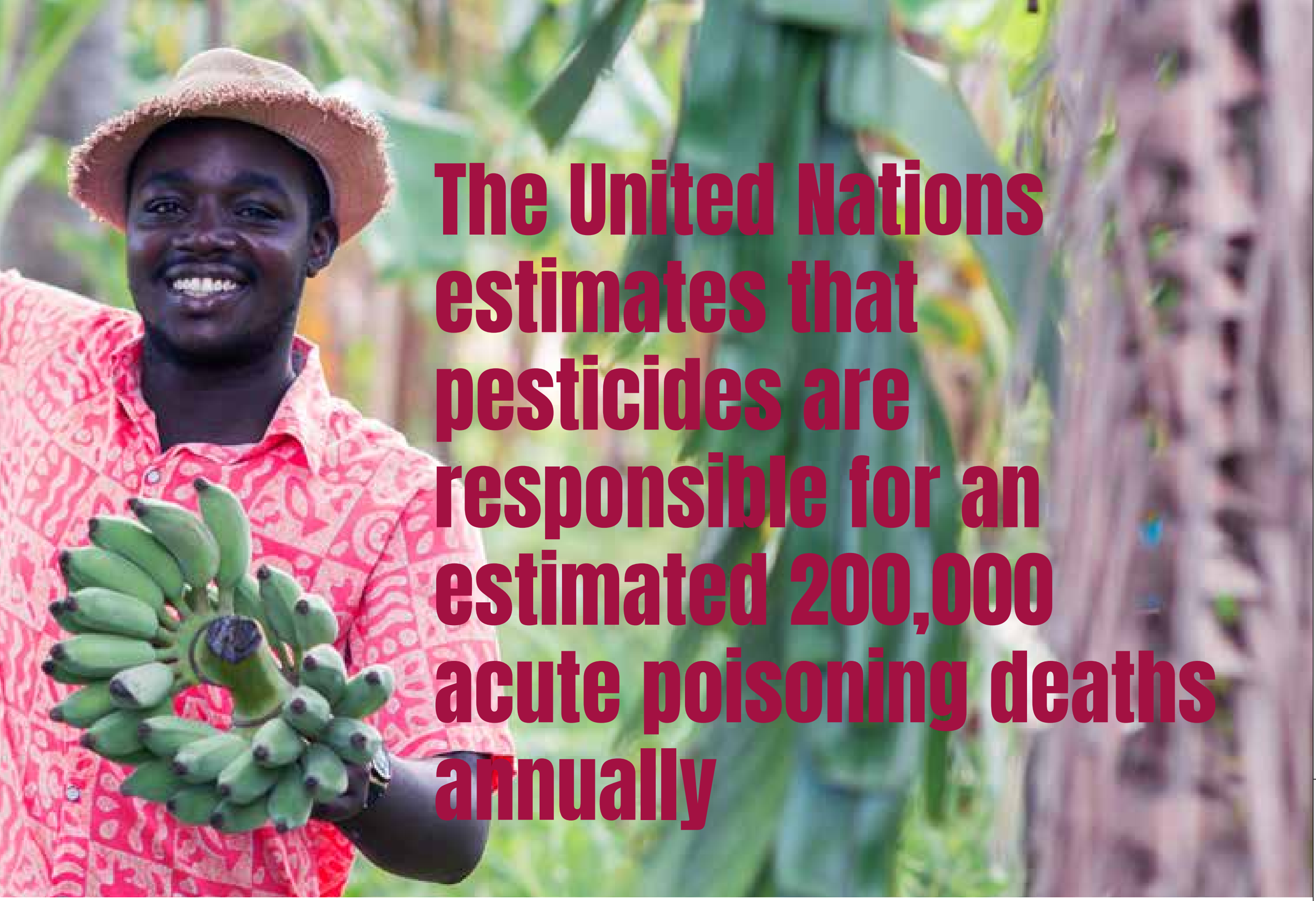
Economic development starts with agricultural progress (Sütterlin et al. 2018) and in this regard when we look at sustainable development goal 8: Decent Work and Economic Growth, it is clear we are talking about sustainable agriculture as a way forward. When it comes to contributing to economic growth as well as improving the work conditions particularly for the rural poor sustainable agricultural practices like agroecology or organic farming can be specifically effective. This is because sustainable agriculture has a positive impact on local economies, promotes resource circulation and reduces dependency on external inputs to name just a few.

The economic role of organic agriculture:
Most certified organic farmers in developing countries produce cash crops (e.g., coffee, tea, cocoa, tropical fruits) for export to rich countries, where consumers pay a significant price premium for certified organic products (Raynolds 2004, Willer & Lernoud 2017). Although the higher price for organic products at the retail level is not always reflected in the price that farmers receive (Minten et al. 2018), most studies find that organic premiums at the farmer level range between 6% and 44% (Beuchelt & Zeller 2011, Bolwig et al. 2009, Ibanez & Blackman 2016, Jena et al. 2017, Jones & Gibbon 2011, Kleemann et al. 2014, Mitiku et al. 2017, Valkila 2009).

Furthermore, apart from a price premium, organic certification can also be associated with indirect economic benefits. In developing countries, certified farmer organizations as well as other players in the supply chain usually offer specific services, such as training, credit, special education programs that help growers to meet stringent certification requirements as well as to produce the quality demanded in international organic markets (Bolwig et al. 2009, Jones & Gibbon 2011). Generally speaking since smallholder

access to such rural services is low, these initiatives by certified organizations can improve the economic situation in a broader way and ultimately result in a higher income (Mitiku et al. 2017, Parvathi & Waibel 2016). It is important to mention however, that the range and quality of services provided is not specified to organic standards and therefore the relevance of such indirect benefits varies (Jena et al. 2012, Meemken et al. 2017a).

Pesticide exposure:
When one looks at SDG 8, apart from economic growth it is also important to look at decent work conditions. In this regard one cannot ignore the impact that pesticides have on farmers and farm workers particularly when one considers that 85% of the global pesticide production is used in agriculture. Although pesticides are developed with the best intention to prevent, remove, or control harmful pests, concerns of the hazards of pesticides towards the environment and human health have been raised by many studies (Kim, Kabir, & Jahan, 2017). The United Nations estimates that pesticides are responsible for an



The United Nations estimates that pesticides are responsible for an estimated 200,000 acute poisoning deaths annually

Sustainable agricultural practices like agro-ecology or organic farming can make a considerable contribution to economic growth and decent work conditions particularly for the rural poor.

estimated 200,000 acute poisoning deaths annually. 99% of the cases occur in developing countries, where health, safety regulations are weaker and less strictly applied (UN, 2017). The findings are supported in a study (Forman & Silverstein, 2012; Kim et al., 2017) that show that chronic exposure of farm workers to certain types of pesticides has been statistically associated with numerous health problems.

Pesticide exposure has been linked with various health issues including cancer, hormone disruption, asthma, allergies, and hypersensitivity (Van Maele-Fabry et al., 2010). There is also evidence regarding the negative impacts that pesticide exposure has on babies including birth defects, reduced birth weight, fetal death, etc. (Baldi et al., 2010, Meenakshi et al., 2012, Wickerham et al., 2012). Even very low levels of exposure may have adverse health effects at early development (Damalas and Eleftherohorinos, 2011). This is because the physical makeup, behavior, and physiology of children make them more susceptible to pesticides than adults (Mascarelli, 2013).

Conclusion:
Pesticide exposure, especially in developing countries, where a significant portion of Europe's import come from, has been linked with many major health risks and thousands of annual deaths. Thus, as organic agriculture prohibits the use of chemical pesticides, along with its often favorable economic conditions, organic agriculture can positively contribute to this SDG of decent work conditions and economic growth.

SDG 12
RESPONSIBLE CONSUMPTION & PRODUCTION

The United Nations description for the goal:

Sustainable consumption and production is about promoting resource and energy efficiency, sustainable infrastructure, and providing access to basic services, green and decent jobs and a better quality of life for all. Its implementation helps to achieve overall development plans, reduce future economic, environmental and social costs, strengthen economic competitiveness and reduce poverty.

→

At the current time, material consumption of natural resources is increasing, particularly within Eastern Asia. Countries are also continuing to address challenges regarding air, water and soil pollution.

Since sustainable consumption and production aims at "doing more and better with less," net welfare gains from economic activities can increase by reducing resource use, degradation and pollution along the whole life cycle, while increasing quality of life. There also needs to be significant focus on operating on supply chain, involving everyone from producer to final consumer. This includes educating consumers on sustainable consumption and lifestyles, providing them with adequate information through standards and labels and engaging in sustainable public procurement, among others.

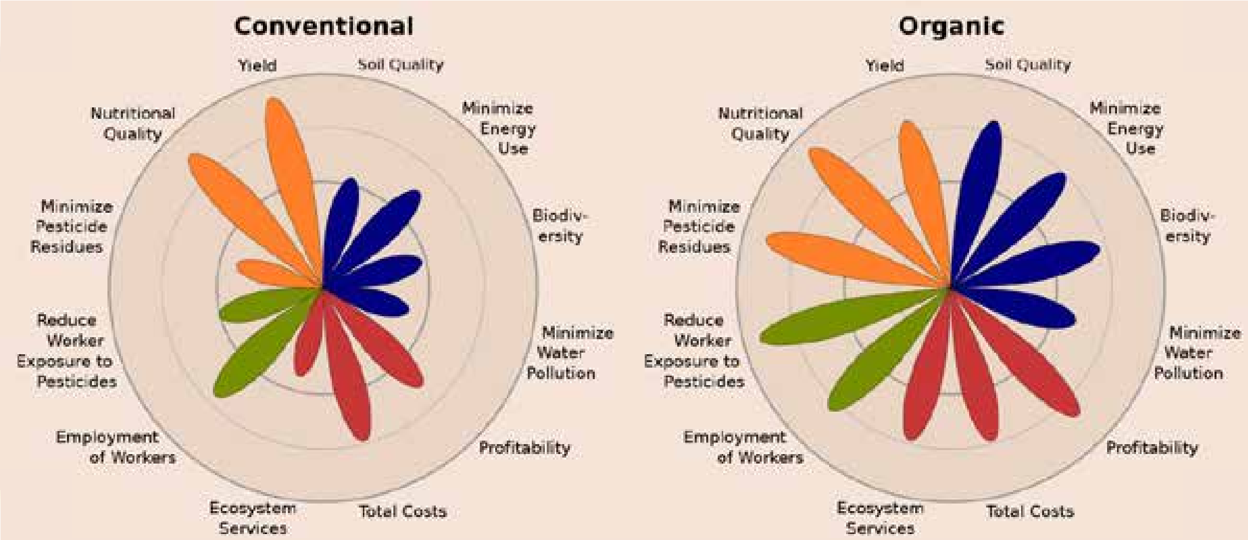


Figure 7: production (orange), environment (blue), economics (red) and social wellbeing (green)
Illustration: John Reganold and Jonathan Wachter

The current state of affairs:
The 12th SDG and the final one that is being analysed in this report can also be seen as summary of all other aforementioned SDGs, specifically when it comes to sustainable production. In an attempt to examine the overall sustainability of organic and conventional agriculture, Reganold et al., (2016) created four key sustainability pillars, including: productivity environmental impact, economic viability and social wellbeing. As can be seen of Figure 7 although organic has slightly lower yields compared to its conventional counterpart, organic agriculture is seen as more profitable and environmentally friendly. Furthermore organic farming systems provide equally or more nutritious foods that contain less (or no) pesticide residues, compared with conventional farming. Moreover, initial evidence indicates that organic agricultural systems deliver greater ecosystem services and social benefits (Reganold & Wachter, 2016).

SDG 12 not only focusses on organic production but also consumption. Certified organic products can be recognized and trusted by consumers thanks to the official EU organic logo (Figure 8). Behind the logo lies a set of regulations that provide a clear framework for the production of organic goods across the EU (European Commission, 2019).

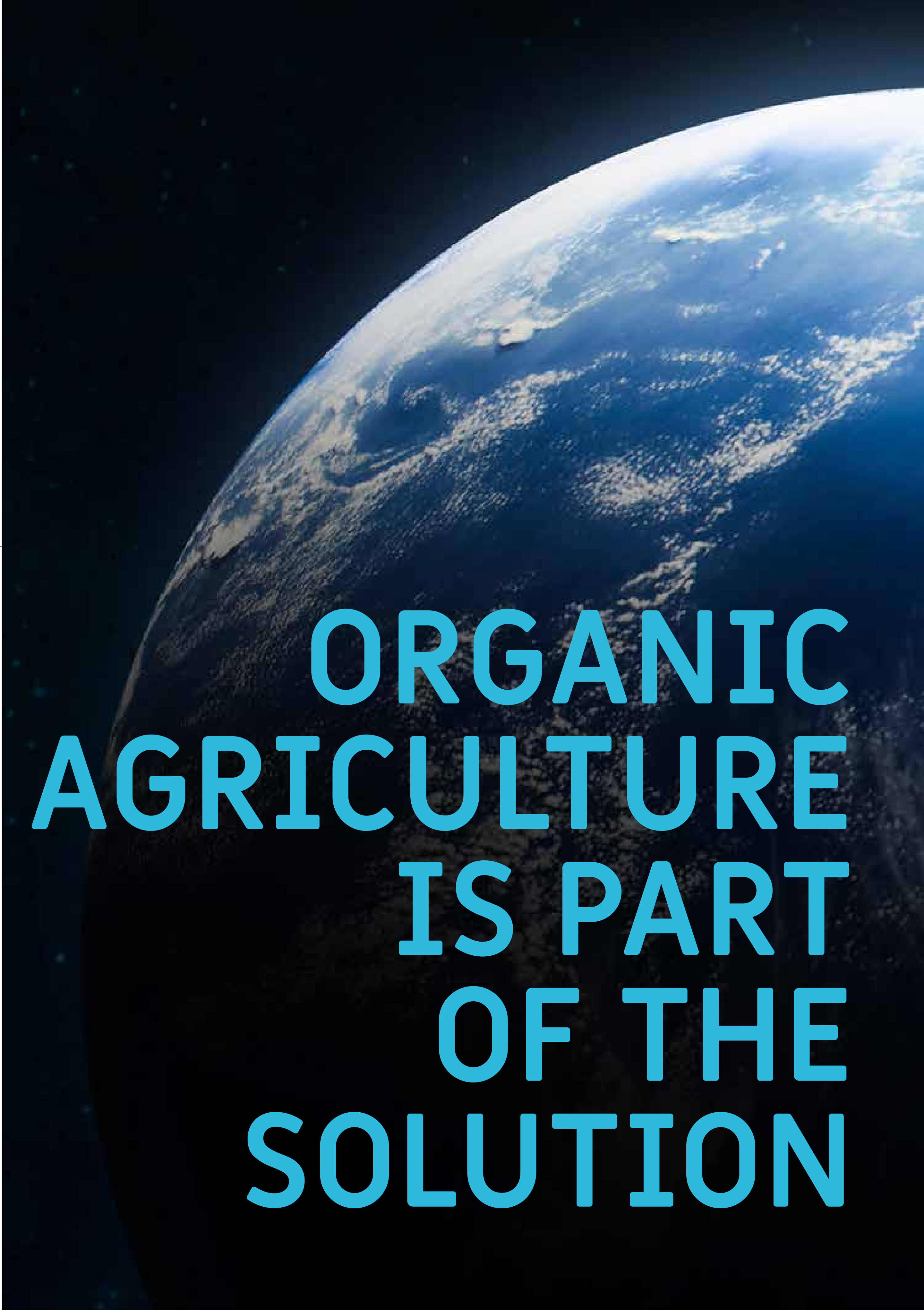
Conclusion:
Assessing the overall production, organic agriculture tends to perform better in most categories and can be seen as a more holistic approach to long-term sustainable food production.

Organic farming systems provide equally or more nutritious foods that contain less (or no) pesticide residues, compared with conventional farming.

Figure 8: Official EU organic logo

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

SDG 12 not only focusses on organic production but also consumption.



ORGANIC AGRICULTURE IS PART OF THE SOLUTION

As mentioned in the introduction, global agriculture has reached a cross road. Over the last few decades, the agricultural landscape has been transformed by new technologies, boosting agricultural productivity to new heights in order to meet the growing global demands. However, these developments have come at the expense of negative environmental and social impacts including soil degradation, biodiversity loss, water and soil pollution, increasing greenhouse gas emissions etc. (FAO, 2018). Ecosystems all over the world are under pressure, threatening the productive potential of the world's natural resources and compromising the future fertility of the planet (FAO, 2018).

In order to face these challenges there is no silver bullet. It is clear however, that a different, more holistic approach that not only focusses on production but also looks at environmental and social aspects, is needed.

In the end, to achieve global sustainable food security we will need different techniques that have been adapted for the local situation. Organic and conventional systems or perhaps a hybrid of the two are all approaches that will play an important role to ensure livelihoods of farmers whilst at the same time reducing the environmental and social costs of agriculture.

To conclude, when we look at the global challenges that food production faces, it is fair to say that organic agriculture can be seen as part of the solution.

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SDG CASE STUDIES


F*CK
PLASTIC
nature &
more

WILLIE OLDENDAAL & MIKE STEKHOVEN
MODDERFONTEIN // SOUTH AFRICA

Willie Odendaal and Mike Stekhoven grow organic lemons, oranges, olives and rooibos tea at their organic and historical farm "Modderfontein', a two hours drive north of Cape Town. Mike acquired Modderfontein in 2001 and began with restoring the historical buildings of the farm and converting it to organic farming practices. Mike: "When people ask me about what organic farming consists of, I tell them that it is basically a holistic way of producing food and at the same time trying to preserve the surrounding landscapes by using systems as close as

COOPEASA
GABRIELLE // COSTA RICA

The Costa Rican cooperation Coopeassa was founded in 1984 when 20 local producers decided to work closely together to improve the living environments of their families. Due to a serious deforestation crisis that Costa Rica was facing in the 90's, a special international project was set up to reforest the area with indigenous trees. The cooperative got involved and from then on, any project that was being conducted had to always carry the environmental component. The first developments towards organic farming practices started in 2007 and in 2010 the cooperative started producing and roasting organic coffee beans.

Due to the fact that the Coopeassa farmers work in a rich biodiverse farming system they are also directly and indirectly preserving water: "Agroforestry helps water systems to regenerate and keep water retention"', Gabriela explains. The cooperative doesn't make use of any irrigation system as they receive enough rain to cultivate their crops. Due to the fact that no residues or artificial fertilizers are being used, the water in the creeks and rivers is far better protected compared to the water supply near conventional farms. In addition, this way of working allows for a higher organic matter content in the soil, which absorbs and keeps water from flowing away".

possible to those that occur in nature". Willie elaborates on how working together with nature saves them great amounts of precious fresh water: "The soil here is rather sandy and therefore we have to build our soils. A healthy soil environment is created by using manure from cows and agro waste material to make compost. This helps to build up soil organic matter which in turn can be seen as fertility agents. The use of compost also helps to minimize soil erosion and therefore nutrient and water loss. The fact that we use high quality compost allows us to save a lot of water. Just to give you an idea, we can easily work with one third less water than our conventional neighbours in the valley". It therefore comes as no surprise that after the drought of 2018 in this region, many conventional growers are choosing to work with compost as a way to lower their water usage.

VERBEEK // THE NETHERLANDS

The three brothers Fons, Leo en Jac Verbeek grow organic tomatoes and other vegetables in their greenhouses. Their business is located in the Maas Valley in the South East of The Netherlands, close to the border with Germany. It's a beautiful area with a varied landscape including forests, moors, streams, swamps and rivers. They work together with nature according to a tailor made 'nature plan', that includes the natural life in and around the greenhouse:

Producing organic means using soil, not rock wool as is used in the production of conventional greenhouse vegetables. No synthetic pesticides or fertilizers are applied, which is beneficial for soil biodiversity. More importantly though, the Verbeek brothers make their own compost out of green waste, using the latest technologies. This has a lot of positive effects the structure and water management of the soil is improved, biodiversity is increased, and the soil becomes very fertile. As compost is also known for increasing carbon sequestration in the soil, it's beneficial for the climate too.

The brothers Fons, Jac and Leo, like many other organic farmers around the world don't experience water as just an input into the agricultural cycle, but as a vital resource that must be protected and enhanced through careful management. Being based in The Netherlands, lack of water is seldom a problem. The drained water that is collected from the greenhouses flows into a small neighbouring stream and runs into the adjoining nature reserve. As chemicals are not part of their farming methods the surrounding waters won't be polluted.

EDDIE REDELINGHUYS ANYTIME - RELIANCE // SOUTH AFRICA

Eddie Redelinghuys and his team grow green, red and black organic grapes in Paarl, near the city of Cape Town. Besides growing grapes, they also produce compost under the name Reliance Compost. Eddie and his family have been growing grapes in this region for more than a hundred years. Back in the 90s, the family started to realize that chemical pesticides couldn't resolve the problems they had with plagues and diseases, and so they started to think about other options, which led to organic farming practices.

According to Eddie, some of the biggest environmental problems South Africa has to face, are the lack of fertile land, soil degradation, and pollution of its rivers and groundwater. One of the main factors causing these problems is the excessive use of chemical fertilizers and pest and disease control agents. Eddie explains: "As a country we need to move away from our dependence on chemicals and move much more towards a natural manner of feeding the soil and subsequently our crops. The solution is high quality organic compost. Our garden refuse is collected monthly on 10 conveniently placed drop-off facilities and landfills around the City of Cape Town. Our green waste is not only the main input for out compost but by using it we are helping to solve a serious environmental issue. We have kept over 10,000,000 m3 of green garden refuse out of already overcrowded landfills since contracting with the city more than a decade ago. This resulted in reducing over 500 000 tons of carbon dioxide gas escaping into the atmosphere, thus mitigating the impacts caused by climate change". Eddie proudly adds that their composting technology has been approved by Credible Carbon as a greenhouse gas emission reduction method.

KRISPIJN
BIOROMEO // THE NETHERLANDS

Krispijn grows a wide range of products in the Noordoost polder in the Netherlands. He specializes in colourful and rare varieties like purple and yellow carrots, wild potatoes, multi-colored beets, horseradish and other culinary varieties.

This area of the Netherlands used to be part of the 'Zuider' Sea, until 1942, when the polder was drained. In the fertile clay ground of the polder, it's possible to grow nearly everything. Like other organic farmers, Krispijn takes good care of the soil as they claim: "Without healthy soil there are no farmers and without farmers there is no food"!

Krispijn illustrates how organic farming methods keeps the water below and around their fields healthy:"Generally speaking we receive ample rainfall in this part of The Netherlands,- so water supply isn't really an issue. In addition, due to the sandy soil and the way we manage it, we have created an effective drainage system, meaning that our fields won't flood. One of the biggest headaches for the local water authorities is that due to conventional farming practices, the rain run-off is often polluted with artificial fertilizers and pesticides polluting the whole water system. Since we do not use these harmful products we are helping to keep the water below and around our fields healthy. There is no pollution and the clayey soil and green cover prevent washing out of nutrients. Because the soil is so healthy, it therefore has excellent water holding properties".

ARD VAN GAALEN
BIOSTEE // THE NETHERLANDS

Biostee is a collaborative project consisting of three organic farms in South-Beijerland, in the Dutch province of 'Zuid Holland'. As the Biostee farms are situated at close distance to the North sea, the land consists of marine clay and is perfect for the cultivation of their crops. Ard illustrates their way of farming as healthy and sustainable: "we work the soil as our parents did, yet we are avoiding the pitfall of using more chemicals in order to survive in the battle against decreasing prices. Farmers have families and require an income, and it is quite understandable that many colleagues are afraid to step out of the chemical circle. As organic growers, we don't use any genetically engineered seeds or crops. This helps ensure a natural and fertile environment for plants. As a result, we have immense diversity on our fields and even sow flower seeds into the borders of our land. I am proud to see barn owls in the attic that love to hunt our organic field mice. The soil and natural environment stay healthy and it results in great products".
The fields of Biostee are just behind the Dutch dikes and a simple phone call to the district water board is enough to have them adjust the groundwater level to ensure the farms have sufficient water: Ard comments: "This is useful but also a responsibility: if we were to pollute the water here, it would flow straight through the river and into the sea. Organic farming does not involve fertilisers or pesticides flowing into the environment"

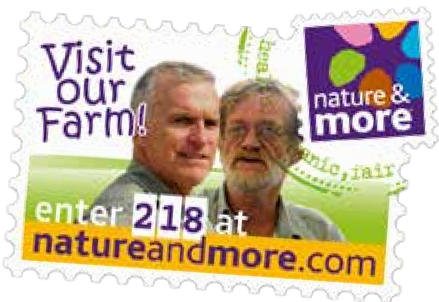
ROB VAN PAASEN // THE NETHERLANDS

The biodynamic greenhouse of Rob and his wife Sandra is situated in a so called Dutch 'polder' in a small village called Oude Leede. The farm could be described as a typical family farm which was originally purchased by Rob's father and later passed on to Rob and Sandra.
The greenhouse of Rob appears to be full of life: ''The herbs and weeds that grow inside and outside the greenhouse, are part of our ecosystem. You often see biodiversity projects with beautiful flowers, but in order to attract native insects from the Netherlands, you need the plants that naturally occur here. Also, if you let weeds flourish, you create enough breeding ground for the insects. For example, I have a rough part full of weeds, and if you look underneath the leaves you will find all kind of beetles. When you have your 'outside' piece of biodiversity well balanced- including pests and insects- they won't come inside the greenhouse.
Besides that, birds also regularly enter the greenhouse and ensure we are caterpillar free. One of the students that was helping out in the greenhouse found a very rare butterfly 'Smerinthus ocellatus' between the cucumber plants, it made me very excited'.
The horses that walk in the grassland outside the greenhouse are included in the 'cycle' as well. Every day we collect a basket with 'waste' peppers and cucumbers and we'll feed the horses with it. We then collect the horse manure, and we sprinkle this among the plant rows for our crops. This will stimulate the crops, and completes the cycle''.

JOHANNES
BLUE CRANE // SOUTH AFRICA

It is a well-known fact that organic farmers choose to farm as much as possible in harmony with nature. It therefore comes as no surprise that organic farms have much more biodiversity in and around the farms compared to their non organic counterparts. A natural biodiversity helps keep things balanced and therefore makes it possible to farm without harmful pesticides, fungicides and herbicides and artificial fertilizers

Johannes de Lange manages Blue Crane, South Africa's major supplier of organic citrus. Johannes: "Here in Kirkwood we have two bee keepers, they love Blue crane orchards because the bees produce more honey and above all are safe as no chemical are sprayed here. Interestingly enough, some bee populations refuse to enter the orchards of conventional citrus growers in Kirkwood. When you wonder through our organic orchards there is lot more life than just bees. We regularly spot rabbits, guinea fowl, other birds, snakes, and even baboons. I am also happy to report that due to our bat houses we see a lot of them. This is good for us as bats eat a tremendous amount of insects (around 600 per night) particularly moths and this is great news for us because the baby caterpillars are bad news for our trees".



ANTHONY // MAVUNO // KENYA

Anthony Ngugi, CEO of Mavuno Organics, grows, sorts, and packs avocados together with around 80 organic farmers to the north of Nairobi. The growers have mixed farms where they grow a wide range of products including avocados, papaya, corn, banana, macadamia nuts and coffee. This wide variety of crops is not only beneficial for the soil it also has a positive effect on the local flora and fauna.

Anthony explains how organic farming has contributed considerably to the region. "The practice of organic farming by our growers has over time brought major

positive effects including an increase in production yields, less dependency on expensive agro chemicals and better market prices". Our avocado farmers are getting 30% more cash compared to conventional markets and now they can afford to buy food they can't produce, ensuring better food security for their families. We are also noticing that the farmers are reinvesting their extra income into their family and their trees. This way we are not only improving the lives of the next generation but are also improving the quality and quantity of the fruits, and that's good news for everyone! In the long term I believe that farms that are practicing organic farming will have more resilience to climate change and have a stronger

ANDRE // GROENHEUWEL FARMS // SOUTH AFRICA

One of the biggest discussions in food today is all about "how we are going to feed more than 10 billion people in 2050". Over the past two decades it has become abundantly clear that the discussion goes beyond just increasing production in the short term. It is much more complex and experts agree that we should address issues such as food waste, food distribution, soil health in the short and long term, biodiversity, fresh water resources, climate impact, less meat consumption as well as reducing agro chemical inputs. On a positive note, all around the world there are great examples of passionate farmers that are creating fertile land by turning desert into orchards and fields in a sustainable manner. They are greening the desert.

Andre Spangenberg runs an impressive citrus farm in Augrabie in the north west of South Africa close to the Namibian border. Although the region in this area is dry and desolate it harbours one of South Africa's major rivers .. the orange river which ensures an ample and continuous supply of fresh water. In order to "green a desert" apart from water you also need another magic ingredient to grow food and that is compost. By applying compost Andre and his team have created a rich soil vibrant healthy soil in perfect for growing organic lemons, grapefruits and oranges. Andre is a great example how we can use waste land to produce healthy nutritious food sustainably and thus he is part of the solution when it comes to feeding a growing global population.

DANIEL & FABIAN // BIO CITRUS // CHILI

The Chilean farmers Daniel and Fabian started to grow organic lemons in 2011, in a beautiful valley two hours south of the capital Santiago. Since studying organic agriculture in college, Daniel was convinced that this form of agriculture was not only future proof .. it just felt right. The two friends started growing organic avocadoes and in 2008 they moved to lemons. Consequently they were one of the first in Chili to export organic lemons.
The employees of Daniel and Fabian enjoy their work in the orchards, which results in a low turnover rate of their employees. Daniel: "Our orchard is very important for the local economy. People come to me all the time, asking for work. They especially like the fact that we don't work with chemicals."

Safety at work is a major focus point for Daniel and Fabian: "The use of agro-chemicals is a big issue in this part of Chile. Recently a television report pointed out that a disproportionately high number of children is born malformed. They were linking this to the use of pesticides. Unfortunately there isn't much organic cultivation in this region yet. We are hoping to make a change in the life of our farmworkers and be an inspiration for others to grow organic".

PIA MARIA // ORIGO // COSTA RICA

When farmers switch to organic farming the motivation to do so is not just a financial decision but often also a personal one. At the Costa Rican farm of Pia Gamboa they grow a wide range of products including organic physalis, corn, beans, broccoli and onions. Growing all these products organically means a more harmonious relationship with the environment and with nature in general. Pia explains that back in 2000, her youngest son Elias Gómez was diagnosed with leukemia: ''At that time the farm was used for conventional farming practices and we were using pesticides. We were really concerned that these chemical methods had caused this disease. After the diagnosis, we therefore immediately stopped using chemicals and switched to organic farming practices. This way of practicing agriculture brings health; not only for our son but everyone else who works in the field and in the production line''

WEIFANG // JENNY // CHINA

Jenny, Wengbo and their team at Weifang Jiahe grow organic ginger in the eastern part of Shangdong Province near Anqiu City, in China. The major activities consist of the production and export of organic ginger. Jenny explains that they are one of the biggest employers in the area, and as organic farming requires more labor input than non-organic farming, more jobs can be given to the local community. This especially applies to women who aren't willing or able to go the city and work there: "At our company we have a female labor union to guarantee the equal rights and interests of these women who are working for us. Each employee is important for us. Everybody receives a regular and recorded health check as we are paying much attention to our employees' physical wellbeing. Furthermore, we are supplying our workers with accommodation if they don't live in the nearby villages. Newly-hired workers receive a complete training on how to work safely in the working field. Most importantly, not having to work with pesticides and herbicides, we can offer all of our workers a safe working environment.

PHALADA // MR SHASTRY // INDIA

Many organic farm owners feel it as their responsibility to provide a safe and healthy environment for their workers, their growers and the families of the growers. This applies for example to Mr. Shastry, the founder and chairman of Phalada Agro Research Foundations in Bangalore, India. Phalada was established in 1999 in the Karnataka province in the South of India. With the vision of helping the local farming community, Mr Shastry and his team decided to go down the 'organic road' with providing end to end solutions in organic farming: "The farmers wanted to break out of a downward spiral where dangerous pesticides and artificial fertilizers were not giving the promised results. Together, we quickly realized that the answer was a completely different form of agriculture, one that focuses on healthy soils and healthy future generations", Mr Shastry claims. One of the mint farmers that Phalada works with testifies: "Organic Farming has helped me keep my family & my fields healthy! My farm now is self-sustainable and I no longer need to depend on expensive chemicals to keep my fields healthy".

ECOSYSTEMS ALL OVER THE WORLD ARE UNDER PRESSURE, THREATENING THE PRODUCTIVE POTENTIAL OF THE WORLD'S NATURAL RESOURCES AND COMPROMISING THE FUTURE FERTILITY OF THE PLANET.

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