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AGRICULTURAL INNOVATIONS FOR A SUSTAINABLE ECONOMIC GROWTH

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AGRICULTURAL INNOVATIONS FOR A SUSTAINABLE ECONOMIC GROWTH

Peter Button
VICE-SECRETARY GENERAL, INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS (UPOV)

A Agriculture was one of the first - and perhaps the most important - human innovations. Human civilization is based on agricultural innovation and the sustainable economic growth that it has provided over centuries.

By the Bronze Age, there was full dependency on domestic crops and animals, with wild resources contributing a nutritionally insignificant component to the usual diet. By the Middle Ages, sophisticated systems of irrigation were developed and a scientific approach to farming was adopted1 and by the early 1800s, agricultural practices had so improved that yield per land unit was many times that seen in the Middle Ages . Nowadays, agriculture relies on innovations in machinery, cultivation techniques, communication technologies, transport, meteorological data, market data and in many other areas.

Whilst innovation in agriculture is extensively documented, it is perhaps not so common to hear about the role of farmers, as such, in innovation. However, it is enthusiastic and successful uptake of innovation by farmers that has driven advances in agriculture.

The first time that I saw a mobile telephone was in the hands of a farmer – well at that time it was the size and weight of a concrete block, so it was not entirely in the farmer's hands with the base remaining solidly rooted to the floor of his farm vehicle. The first time that I came across the use of satellite technology in a work situation was on a farm.

These are good demonstrations that farmers are natural and enthusiastic adopters and adapters of innovation. This is a conclusion that is not only limited to farmers in developed countries. For example, cell phones are changing African agriculture by providing farmers with access to market prices, micro-insurance, crop data and weather information.

This edition of F@rmletter aims at providing a deep analysis on how innovation can benefit agriculture. Giving the increasing number of people inhabiting the world, agriculture has to find new ways to feed the planet and its population. Innovation will be a solution for the growing need of food and the challenges that will result from a higher production and consumption.

Agriculture is faced with the unprecedented challenge of providing food security and economic development in the rural sector at a time of climate change and the evolving needs of a growing human population. Today, that challenge is greater than yesterday - and tomorrow it will be greater than today. History has taught us that, in the face of such challenges, innovation in agriculture is essential. The tremendous progress in agricultural productivity in various parts of the world is largely based on improved plant varieties, combined with improved farming practices, and future food security will continue to depend on the development of new varieties.

Going back to the beginning, the basis for agriculture was the domestication of crops and, in recent times, farmers have been just as enthusiastic about innovations in plants as they were when agriculture was born. It is difficult to list all the benefits that new plant varieties can bring, but they can include: higher yield; resistance to pests and diseases; tolerance to stresses (e.g. drought, heat); greater efficiency in the use of inputs; improved harvestability and crop quality. New plant varieties also offer diversity of choice to farmers that can improve their access to national and international markets.

To take us into the twenty-first century, a recent study on the economic, social and environmental value of plant breeding in the European Union (EU) assessed the contribution of plant breeding in the years 2000 to 2013.

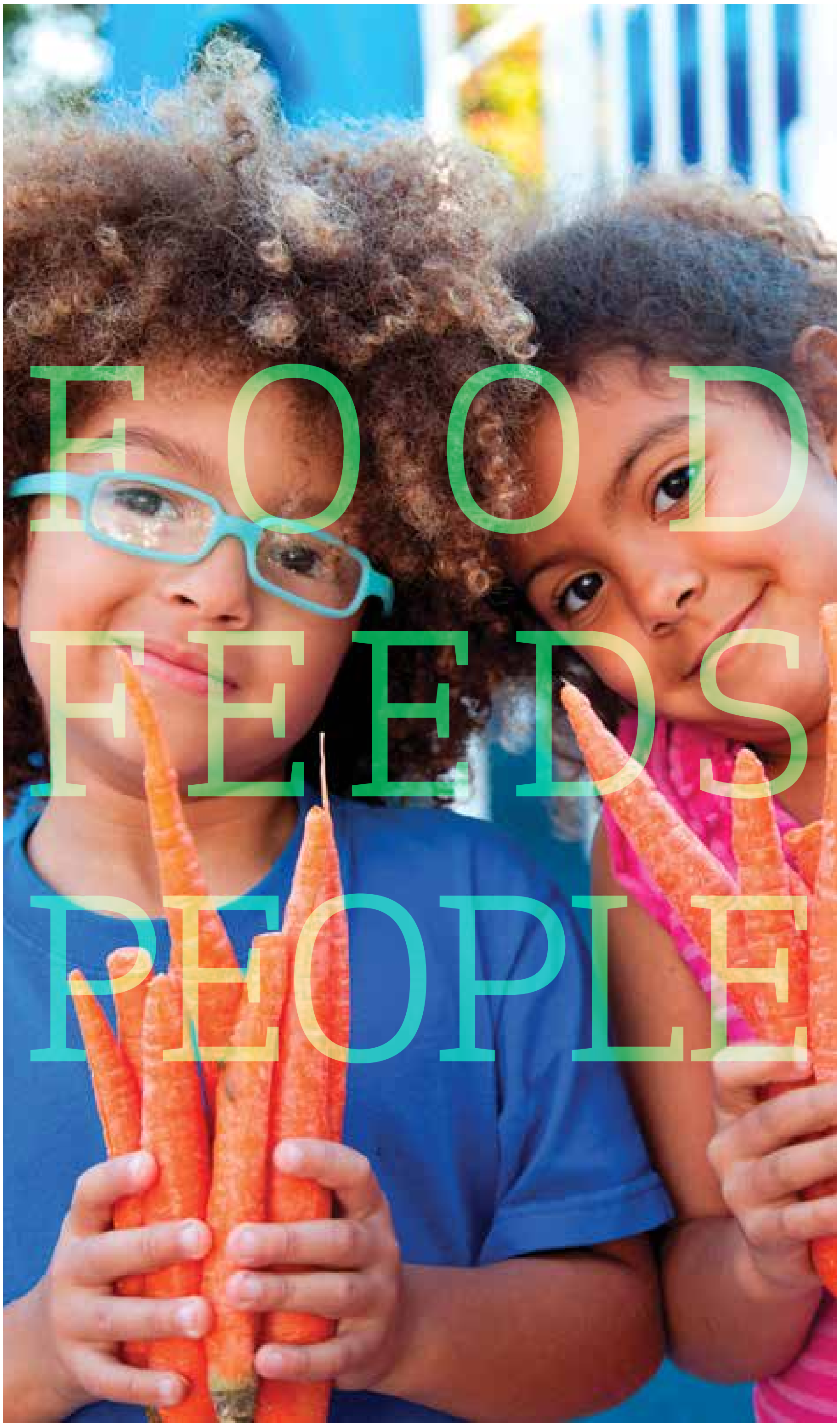
Some of the key findings were that the additional agricultural GDP contributed by plant breeding amounted to EUR 8.2 billion and that, without plant breeding, the EU would have moved from being a net exporter to being a net importer in all major agricultural crops (including wheat and barley).

The study also reported that, without plant breeding, an additional 18 million ha of arable land outside the EU would be needed to meet the needs of the EU: equivalent to the arable land of Belgium, the Netherlands, Ireland, Portugal and Spain.

In conclusion, innovation was the source of agriculture and since that time farmers have driven innovation and enthusiastically adopted technologies in a way that has delivered sustainable economic growth.

Innovation will continue to be an essential tool to meet the challenge of providing food security and economic development in the years ahead.

INNOVATION IN AGRICULTURE:
a greater productivity and sustainability



WRITTEN BY **Confagricoltura Study Center**

The increases in production and crop yields have declined significantly over the past decade; according to FAO, they will further reduce, despite the strong growth of the world population (9.1 billion in 2050) and the current 800 million people who suffer from hunger or are undernourished.

To meet the needs of food in the planet, it will be necessary to increase agricultural production by at least 40%.

This objective can be achieved through:

- The increase of the yields of crops,
- The cultivation of arable land but currently unused,
- Combatting wasteful phenomena and soil desertification.

Furthermore, forests need to be protected. Reducing the intake of water, the pollution produced mainly from farms and the use of agricultural chemicals and chemical fertilizers is a must.

The solution of this difficult equation is entrusted in research, in technology that will result in a timely, comprehensive share of innovative solutions to farms.

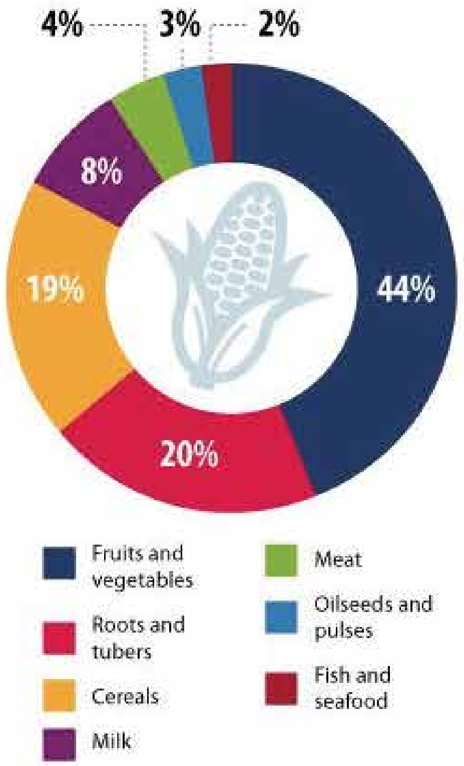
Food feeds people...and peace among peoples. We must consider agriculture the top priority in the global economic governance!

FEEDING THE WORLD

Can the world adequately feed the population of more than 9 billion people expected by 2050 in a manner that advances economic development and reduces pressure on the environment?

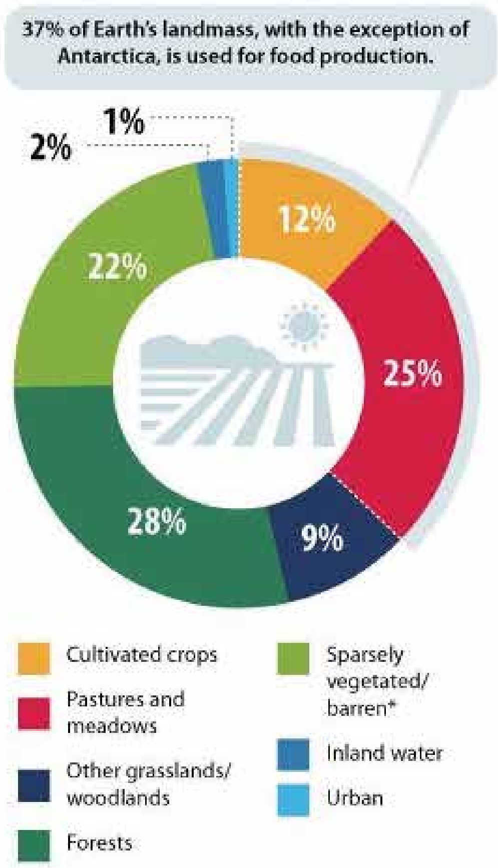
GLOBAL FOOD LOSS AND WASTE BY COMMODITY, 2009

LOSS AND WASTE BY WEIGHT
(100% = 1.3 billion tons)



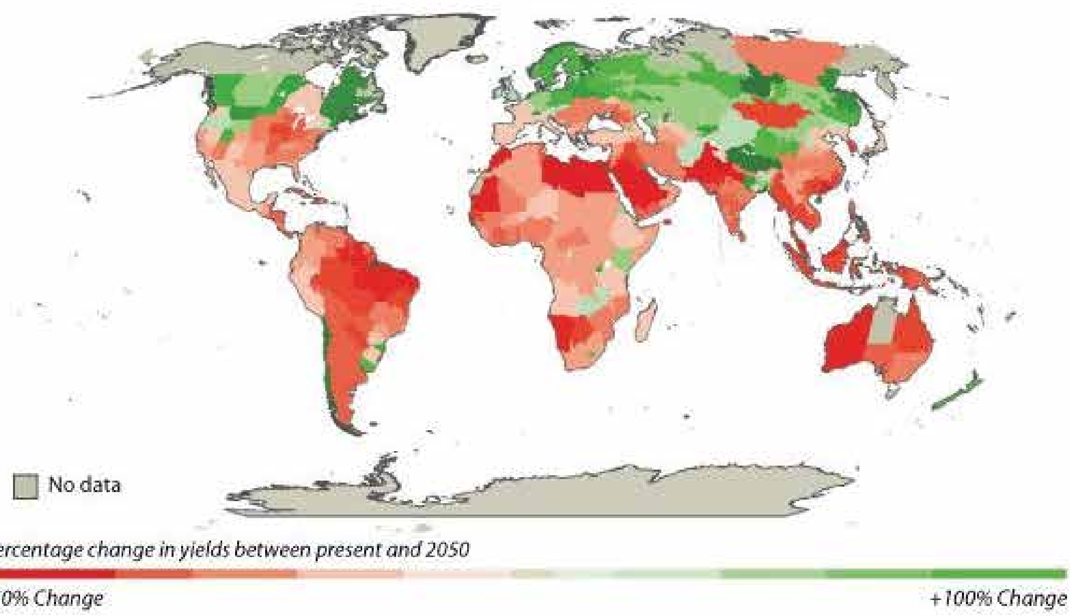
FOOD PRODUCTION

(100% = 13.3 billion hectares)



*Permanent ice cover, desert, etc.
Note: Figures may not equal 100% due to rounding.

CLIMATE CHANGE IS PROJECTED TO AFFECT CROP YIELDS



SOURCES: WORLD RESOURCES INSTITUTE, WORLD BANK, UNITED NATIONS R.TORO/©LIVESCIENCE.COM

A CELEBRATION OF SCIENCE AS AGRICULTURE'S ALLY

WRITTEN BY **Farming First**

Our agricultural landscape is more complex than ever. When a farmer sows a seed or catches a fish, they rely on a whole host of interconnected systems and actors to bring food to their families, earn a living and preserve the natural resources on which we all rely.

Science and innovation are key to helping us overcome so many global challenges – from developing life-saving medical procedures to breakthroughs in communication technology. Today, one of the most colossal challenges we face is empowering the world's 570 million farmers to produce enough to feed our population of nine billion by 2050. As farmers are faced with ever-dwindling natural resources, a changing climate and lack of access to vital information and markets, science is stepping in to provide solutions.

The global sustainable agriculture coalition, Farming First, of which WFO is an active supporter and Steering Committee member, has teamed up with the CGIAR Consortium of international agricultural research centres, to showcase a **collection of 28 stories** that celebrate scientific discoveries and innovation in action.

The case studies and videos are arranged into five areas of intervention, where science can contribute.

1. Managing natural resources

In Indonesia, satellite mapping systems by Digital Globe, **are helping** the World Resources Institute (WRI) track land change in forest areas. Nirarta Samadhi of WRI Indonesia, speaks of how he can no longer take his son to fish in the zones he fished in as a boy, as fires are damaging the environment. "Digital Globe provides a clear image of what is happening on the ground. With that type of high resolution image we can analyse it, and develop a better policy," he comments.

2. Sharing knowledge and best practices

Honduras is the second poorest country in Latin America. But **effective training** on pest management practices, from one of 120 technical experts that visited farmers at home, has doubled the income of over 2,000 families. Strawberry farmer Emiliano Dominguez was been able to increase the land he farms six times over thanks to the innovative partnership between CropLife Latin America and the United States Agency for International Development (USAID). CropLife had the cutting edge pest control knowledge, and USAID had the infrastructure to deliver training at scale – the public private partnership proved to be an ideal match.

3. Improving the inputs farmers use

In Asia, where most of the world's rice is grown, about 20 million hectares of rice land is prone to flooding. In response, scientists have developed a **"flood tolerant" rice variety** that can withstand being submerged for two weeks. Scientists at the International Rice Research Institute (IRRI) scoured rice's rich diversity for a gene that gives flood tolerance. After the gene (called SUB1) was found, it was bred conventionally into popularly grown rice varieties in rice-growing countries in Asia.

Farmer Nakanti Subbarao of Andhra Pradesh, India, was one of the first to adopt Swarna-Sub1 in his community. After seeing that he recovered 70 per cent of this rice after three weeks of flooding, he distributed Swarna-Sub1 seeds to his fellow farmers in Maruteru, which led to coverage of 800 ha in his village, and its nearby areas during the wet season of 2009. Scuba rice is spreading fast in several countries over the last few years, and currently grown by more than five million farmers in Asia.

4. Building resilience to shocks and stresses

A new initiative being pioneered by scientists at the International Water Management Institute is **channelling surplus surface water** from flood-prone rivers, to a modified village pond. Brick structures in the pond allow the water to flow swiftly down below ground, where they infiltrate the local aquifer. This water can then be pumped back up again during the dry season. With floods being a common occurrence across the Ganga basin, researchers hope that the scaling up of this intervention would help in effectively protecting lives and assets downstream, boosting agricultural productivity and improving resilience to climate shocks at the river basin scale.

5. Improving access to markets

In Cambodia, traditional wood-burning stoves used to smoke freshwater fish typically result in low profits and emissions harmful to the environment. To improve this process and fetch higher prices from buyers, many young women engaged in this livelihood **are taking part in the Cambodia HARVEST programme**, funded by the United States Agency for International Development (USAID), that provides a new, fuel-efficient alternative. Eco-friendly stoves designed by the programme use 30 per cent less wood while smoking fish 15 per cent faster than conventional models. The end product is of a higher quality and ensures greater market access.

These are just some of the latest innovations that are bringing the world's farmers one step closer to taking on the task to feed the world whilst protecting the planet, and lifting themselves and their communities out of poverty. Explore many more stories on the Farming First website, with the online resource: "Celebrating Science and Innovation in Agriculture".

farmingfirst.org/science-and-innovation

CONSERVATION AGRICULTURAL PRACTICES IN SOUTH AFRICA:

Promoting and advancing the uptake of sustainable and regenerative practices, with a specific focus on dryland maize and extensive beef production

Nic Opperman
DIRECTOR NATURAL RESOURCES, AGRISA

Worldwide there is consensus that resource-intensive and negligent farming production systems, still widely practised in South Africa, has unsustainable elements which, with continued promotion and application, endangers global capacities to respond to the food security concerns (FAO 2008). For example, ploughing and removing crop residues after harvesting leave the soil naked and vulnerable to wind and rain, resulting in gradual, often unnoticed erosion. Similar to tire tread wear on your car - unless given the attention and respect it deserves, catastrophe is only a matter of time. Erosion also puts carbon into the air, contributing to climate change.

In South Africa, crop production systems based on intensive and continuous soil tillage have led to excessively high soil degradation rates in grain producing areas. This adds to the growing problems relating to profitability and poverty in some of the rural areas. According to Le Roux et al. (2008), the average soil loss under annual grain crops in the country is 13 ton ha-1yr-1. This is much higher than the natural soil formation rate and implies, for example, we are losing almost 3 ton ha-1yr- 1 for every ton of maize produced every year. For farmers to have a better chance of survival and if sustainable and economically viable agriculture and food security are to be achieved, the paradigms of agriculture production and management have to change. The same applies to beef production – a myriad of different land use and cattle management methods are applied, some much more sustainable than others when measured in terms of the demands placed on the environment to support the production of beef. This will be a topic of consideration later in this document.

When considering maize production, there is general agreement among key role players, such as government, research institutions and producers' organisations, that these outcomes will be achieved through the adoption and implementation of conservation agriculture (CA). CA is seen as an alternative system that promotes sustainable and climate-smart agricultural intensification, through which farmers can attain higher levels of productivity and profitability (i.e. 'green prosperity') while improving soil health and the environment. Box 1 displays a definition of CA and how the sustainability of crop production could be increased and intensified through a transition from conventional, highinput, tillage-based practices (stage 1) to regenerative CA systems (stage 5 and 6), and even low-input
organic systems (stage 7). Box 2 summarises why CA is essential.

Ample evidence from the last three decades now exists of the successes of CA under many diverse agro-ecological conditions to justify a major investment of human and financial resources in catalysing a shift, whenever and wherever conditions permit it, towards CA (Gassen & Gassen 1996, Calegari et al. 1998, FAO 2001, Derpsch 2003, Pretty et al. 2003, Smith et al. 2008, Thierfelder & Wall 2010, Nangia et al. 2010, Smith et al. 2010, Modiselle et al. 2015).

BOX 1 DEFINING CONSERVATION AGRICULTURE (CA)

CA (see also Annexure 1) is an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. CA is characterised by three linked principles (FAO 2004, 2013), namely:

- continuous minimum mechanical soil disturbance,
- permanent organic soil cover, and
- diversification of crop species grown in sequences and/or associations.

CA principles are universally applicable to all agricultural landscapes and land uses with locally adapted practices. CA enhances biodiversity and natural biological processes above and below the ground surface. Soil interventions, for example mechanical soil disturbance, are reduced to an absolute minimum or avoided. External inputs, for example agrochemicals and plant nutrients of mineral or organic origin, are applied optimally and in ways and quantities that do not interfere with, or disrupt, the biological processes. CA facilitates good agronomy, such as timely operations, and improves overall land husbandry for rain-fed and irrigated production. Complemented by other known good practices, such as the use of quality seeds, and integrated pest, nutrient, weed and water management, CA is a base for sustainable agricultural production intensification. It opens increased options for integration of production sectors, such as crop-livestock integration and the integration of trees and pastures into agricultural landscapes. CA approaches are furthermore underpinned by the full participation of farmers and rural people in all processes of problem analysis and technology development, adaptation and extension. This is with the objective to promote more equitable access to productive resources and opportunities, and progress towards more socially and environmentally-just forms of agriculture.

CA, with ongoing planting of cover crops, results in increased agricultural productivity and soil quality. This is measured by an increase in soil organic matter (SOM) which is linked to soil organic carbon (SOC) (Ruehlmann & Körschens 2009). An increase in the latter leads to improved water-use efficiency and available water capacity resulting in higher yields.

Stage	1	2	3	4	5	6	7
Type of farming system	Conv. tillage	Min. or reduced tillage	Conv. no tillage (NT) (Direct seeding equipment using tines). Production system lacks adequate soil cover and sound crop rotations. High use of external inputs	Conv. zero tillage (ZT) (Direct seeding equipment using discs). Production system lacks adequate soil cover and sound crop rotations. High use of external inputs	CA_{HEI} (NT or ZT using high quantities of external artificial inputs (i.e. fertilizer, herbicides, pesticides). Production system has adequate soil cover and sound crop rotations.	CA_{LEI} (NT or ZT using low quantities of external artificial inputs (i.e. fertilizer, herbicides, pesticides). Production system has adequate soil cover and sound crop rotations.	Organic CA (ZT using no external artificial inputs (i.e. fertilizer, herbicides, pesticides). Production system has adequate soil cover and sound crop rotations.

Sustainability gradient

SOURCE: ADAPTED FROM BLIGNAUT ET AL. (2014).

This will lead to large and demonstrable savings in machinery and energy use and in carbon emissions, a rise in soil organic matter content and biotic activity.

It will also reduce carbon emissions, ensure less erosion, increase crop water availability and thus resilience to drought, improve recharge of aquifers and reduce the impact of the apparent increased volatility in weather associated with climate change. It will reduce production costs, lead to more reliable harvests and reduce risks especially for smallholders.

The latter point has been the basis of the low external input conservation agriculture (CALEI) concept (see CA stage 6 in Box 1). While obviously beneficial to the large-scale commercial farmer, CALEI is especially attractive if not essential for the household food security of the approximately 3 million smallholder families in South Africa. It simply means that the adoption and application of CALEI could sustain yields (and household food supply) on acceptable high levels with a minimum amount of external inputs, that is only those external inputs which are accessible (available and affordable) to smallholders.

Because of the multiple benefits that both CA systems (stages 5 and 6) generate in terms of yield, sustainability of land use, income, timeliness of cropping practices, ease of farming and eco-system services, the area under CA systems has been growing exponentially in many countries, largely as a result of the initiative of farmers and their organisations (Derpsch 2008, Derpsch et al. 2010).

In South Africa, the total area under CA is still small relative to areas farmed using tillage (stage 1). There is, however, an upswing in the number of innovative farmers (commercial and smallholder) practising CA successfully, which has been greatly influenced by key research and development initiatives having had significant success in promoting it among farmers. Key examples of these initiatives are described by Smith et al. (2008), Smith et al. (2010), and Smith & Visser (2014). Figure 1 depicts the spread of CA adoption among grain producers in South Africa, and the Western Cape and KwaZulu-Natal are clearly regions of high adoption. It should be noted that many farmers are converting to various stages of reduced to no tillage (stages 2–4), mostly because of economic/financial considerations (Knot 2014). This could be seen as a first step in a phased approach towards CAHEI.

BOX 2 WHY CA? A MOTIVATION

1. The increasing cost-pressure and declining gross margins of farming enterprises using conventional tillage, as seen in model outcomes below (CV - stage 1).
2. The decline and collapse of soil quality and soil ecosystem services. At this stage competitive yields are not feasible without the use of inorganic fertilizer, but declining yield trends in some areas show that the effect of this practice is reaching its limit and that soil ecosystem services should be restored to regain soil productivity, reduce risk and increase profitability. Soils can be rebuilt or recuperated with CA through quality application of all its principles.
3. The impact of climate change on weather patterns, water regimes, biodiversity and ecosystems services will put pressure on farmers to adapt their farming systems and management styles to increase their resilience and sustainability.
4. A growing awareness, knowledge and self-organisation among farmers (as stewards of the land and natural resources), scientists and agribusiness to use and promote sustainable agricultural practices. The networking of these key actors creates so-called innovation platforms, which are ideal structures to promote and scale out CA.
5. A need to improve the resource use efficiency and competitiveness of farming practices relies on healthy soils, healthy biodiversity and innovative farmers.
6. The need to rebuild the status and image of farming, which has been severely damaged by a negative environmental footprint and poor socio-economic conditions. CA innovation platforms have the ability to generate or contribute to considerable social capital in rural societies, which could have several positive socio-economic spin-offs to the benefit of the society as a whole.

Sustainable maize production

Conservation agriculture (CA) as a farming practice is characterised by minimum soil disturbance, permanent soil cover and crop rotation (Hobbs 2007, Kassam et al. 2009) with either high or low use of external production inputs (see Box 1). Conventional agriculture (CV), on the other hand, tills the soil, removes soil cover (Amelia et al. 2009) and is highly dependent on external production inputs (see Box 1). A list of a number of indicators that can be used, either individually or in combination, to measure, monitor and compare CA success and adoption is provided in Box 3.

For the purpose of this study an attempt was made to assess commercial dry-land maize production and its accompanying environmental demand and costs under CV and CA systems. A system dynamics approach was used to model the transition from CV to CA systems in four maize producing regions in South Africa, namely Western Free State (WFS), Eastern Free State (EFS), KwaZulu-Natal (KZN) and North West (NW) over a 20-year period.

Four region-framed production and environmental sub-models were therefore constructed that make provision for the unique farming characteristics of both CV and CA systems in the studied regions. Table 1 displays some of the production data that informed the modelling. The data was obtained from a number of sources (e.g. farmer interviews, Department of Agriculture, Forestry and Fisheries, OVK, Grain SA, Novon, Pannar and Profert) and was verified by experts through Grain SA channels.

In modelling the transition from CV to CA systems, the relationships between soil organic matter (SOM), soil organic carbon (SOC) and water holding capacity (see Table 2) were used to inform changes in yield. In addition, the data from Table 1 was used to (i) model CA systems' gradual yield increases (due to improved soil health) over a 20-year period (see Table 3), whereby (ii) cost reductions are phased in over a 10-year period.

FIGURE 1 DISTRIBUTION OF CA ADOPTION AMONG GRAIN PRODUCERS (CIRCA 2014/5)
SOURCE: PERSONAL COMMUNICATION: SYBRAND ENGELBRECHT, MAIZE TRUST (2015)

BOX 3 MEASURING CONSERVATION AGRICULTURE

The following is a list of indicators that can be used either individually or in combination to measure CA success and adoption:

1. return on investment with regard to yield (t/ha)
2. levels of (reduced) external production inputs: measured in R/ha and/or kg/ha/yr for fertilisers, herbicides, pesticides and lit/ha/yr for fuel use
3. soil health measurements – chemical
   a. Balanced ratio of certain micro and macro nutrients, pH, acidity level, etc. (see also Soil Health Tool below)
4. 4. soil health measurements – biological
   a. Soil Health Tool (SHT Index), and/or
   b. Microbial genetic diversity (DNA Sequencing), microbial functional diversity (BIOLOG assay), carbon cycling (Solvita CO2 respiration, soil enzymes), nitrogen cycling (part of SHT), soil biomass (microbial biomass, earthworm populations) and key species (Mycorrhiza, pathogens)
5. soil health measurements – physical
   a. Soil organic matter (SOM) and soil organic carbon (SOC) build-up with regard to an appropriate baseline (consider different Soil C fractions, e.g. active or labile fractions)
   b. Aggregate stability
6. water use efficiency (WUE) measured in terms of kg/mm rainfall or evapo-transpiration
7. reduced riskiness (combination of yields, WUE and return on investment linked to knowledge and management levels)
8. soil loss (ton/ha/yr) through soil loss modelling and field observations
9. number of CA farmer groups, such as study groups, clubs, etc. (measured by impact survey)
10. number of CA awareness events, such as farmers' days, conferences and cross visits
11. number of farmers adopting CA per region (adoption rate)
12. number of no-till planters sold per region per year
13. number of infestations by pests or other forms of invasive alien organisms per season per region

TABLE 1 PROFILE OF MAIZE PRODUCTION SYSTEMS (2013/2014)

Region: production system	Plant population	Growing season rainfall	Fertilizer	Pesticide	Herbicide	Diesel	Yield	Variable cost	Overhead cost	Total cost	Income	Net income
	'000/ha	mm	kg/ha	l/ha	l/ha	l/ha	t/ha	R/ha	R/ha	R/ha	R/ha	R/ha
NW: CV	19.0	550	367	0.3	4.7	79.3	3.65	5 921.20	1 776.36	7 697.57	5 521.10	-2 176.47
NW: CA	24.7	550	162	0.0	2.93	49.7	8.30	5 656.93	1 551.36	7 208.29	12 554.83	5 346.54
WFS: CV	18.5	492	418	0.1	7.5	89.2	5.4	6 807.29	2 064.66	8 871.95	8 168.20	-703.74
WFS: CA	24.0	492	165	0.0	5.25	44.4	7.3	5 812.81	1 767.44	7 580.25	11 042.20	3 461.94
EFS: CV	27.7	700	436	1.7	3.7	67.0	4.2	7 087.12	2 142.63	9 229.75	6 353.05	-2 876.70
EFS: CA	36.0	700	173	0.0	3.25	41.9	10.5	6 141.00	1 859.86	8 000.86	15 882.62	7 881.76
KZN: CV	42.0	800	400	0.7	3.0	68.7	8.4	8 178.00	1 652.60	9 830.59	12 736.34	2 905.75
KZN: CA	54.6	800	150	0.0	3.35	47.0	12.0	7 057.56	1 537.45	8 595.01	18 151.56	9 556.55

TABLE 2 SOM, SOC, AWHC AND YIELD RELATIONSHIPS

Change in soil organic matter	Change in soil organic carbon	Change in available water holding capacity	Change in yield
	Ruehlmann & Körschens (2009)	Reicosky (2005), Hudson (1994)	Lal (2010)
1.0%	0.58%	3.7%	2.76%
1.5%	0.87%	5.6%	4.14%
2.0%	1.16%	7.4%	5.52%
2.5%	1.45%	9.3%	6.91%
3.0%	1.74%	11.1%	8.29%
3.5%	2.04%	13.0%	9.67%
4.0%	2.33%	14.8%	11.05%
4.5%	2.62%	16.7%	12.43%
5.0%	2.91%	18.5%	13.81%

TABLE 3 TARGET YIELD AFTER 20 YEARS FOR CA SYSTEMS

Regions	CV avg. yield (actual)	CA yield (potential)	Target yield after 20 yrs	Production % change p.a.	Yield growth
	t/ha	t/ha	t/ha & (% of CA pot.)	%	%
NW	3.65	8.30	4.15 (50%)	0.26%	13.7%
WFS	5.40	7.30	5.48 (75%)	0.03%	1.5%
EFS	4.20	10.50	7.88 (75%)	1.67%	87.6%
KZN	8.42	12.00	9.60 (80%)	0.26%	14.0%

The environmental component, which quantifies and monetises the GHG emissions associated with the use of fertilisers, herbicides, pesticides and diesel in CV and CA systems in the various regions was informed by the emissions data contained in Table 4. For the CA systems the probable soil carbon sequestration in the various regions was also estimated.

TABLE 4 EMISSION FACTORS FOR VARIOUS PRODUCTION INPUTS

	Units	CO_2e emission factors and price	Data source
Direct Diesel	$KgCO_2e/l$	2.6769	Defra (2012)
Indirect Diesel	$KgCO_2e/l$	0.5644	
Indirect fertilizer	$KgCO_2e/Kg$	2.25	
Indirect pesticide	$KgCO_2e/l$	0.97	
Indirect herbicide	$KgCO_2e/l$	0.76	
Damage cost of CO_2	R/tCO_2e	120	National Treasury (2013:15)

Based on the assumptions provided above, Figures 2 and 3 show the net present values (NPVs), which express a future string, or time series, of financial values in today's terms, of both the CV and CA systems in the four maize producing regions. All the figures depict a very large monetary benefit of adopting CA systems, with or without the incorporation of positive externalities. In Figures 2 and 3 it can be seen that the viability of maize production improves in all regions with the adoption of CA systems but the potential is more so in the Eastern and Western Free State1.

This is as a result of cost reduction owing to lower input use, increases in yields, less emissions into the environment and carbon sequestration. While Figure 4 show improvements in the financial viability of CA systems versus CV, North West CA systems remain negative (see value at the end of the simulation period) indicating that the investment is not economical without even more adaptation and diversification. (It is, however, worth mentioning that the NPV for CA systems is by far better than that of not adopting CA; i.e. CV NPV = -R16 billion while that of CA-friendly systems is about -R3 billion.) The NPVs of CA maize production in all other regions are positive indicating CA-friendly systems to be good investments. Maize production is most economical in KwaZulu-Natal, followed by Eastern Free State and then Western Free State.

The outcomes of this study demonstrate that the transition from CV to CA systems has the potential of not only reducing costs, increasing yields, increasing net farm income, but also ecological benefits too. This is through lower GHG emissions, lower input use and carbon sequestration. Maize farmers should therefore be encouraged to adopt CA systems to improve the profitability of their farms (more so in Eastern Free State, Western Free State and North West – see Table 1 and Figure 4) and also to reduce the environmental load of maize production (see Table 5).

FIGURE 2 NPVS WITHOUT EXTERNALITIES

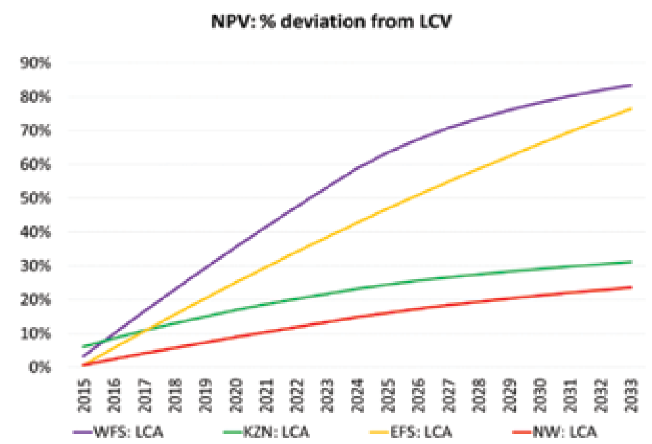


FIGURE 3 NPVS WITH EXTERNALITIES

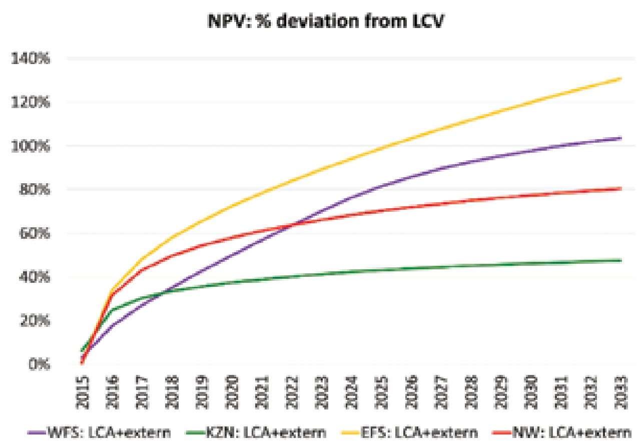


FIGURE 4 NPVS OF CV AND CA-FRIENDLY SYSTEMS

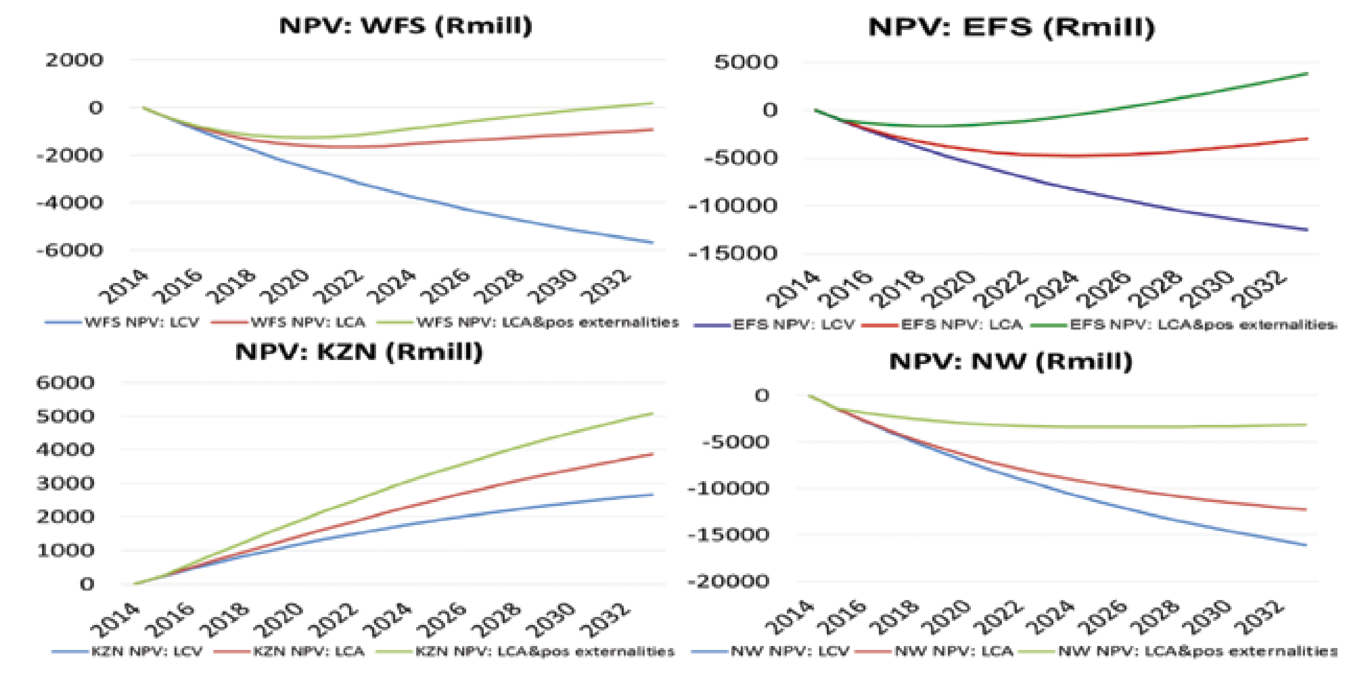


TABLE 2 SOM, SOC, AWHC AND YIELD RELATIONSHIPS

Region	CV total CO_2e emissions	Total net CO_2e emissions saved through adopting CA*
	ton/ha/yr	ton/ha/yr
NW	1.087	10.705
WFS	1.235	1.326
EFS	1.204	13.613
KZN	1.126	11.532

* TOTAL NET CO2E EMISSIONS SAVED THROUGH ADOPTING CA = CV CO2E EMISSIONS - CA CO2E EMISSIONS + CO2 SEQUESTRATED. IT IS AN AVERAGED VALUE OVER THE MODELLING PERIOD (20 YEARS) DUE TO THE FACT THAT THE CA EMISSION VALUES ARE TIME VARYING (I.E. CA EMISSION VALUES GRADUALLY REDUCE AS A CV FARMER TRANSITION TO CA-FRIENDLY SYSTEMS OWING TO GRADUAL REDUCTION IN FERTILISER, DIESEL, HERBICIDE AND PESTICIDE USE).

To up-scale CA, several barriers have to be overcome.

These include a change in mindset based on tradition and prejudice, the lack of knowledge on how to do it, the availability of adequate and appropriate machines, the availability of adequate and appropriate herbicides, and adequate and appropriate policies to promote adoption. Derpsch and Friedrich (2009:14), states it as follows:

These barriers must be overcome by politicians, public administrators, farmers, researchers, extension officials, agriculturalists and university professors.

With adequate policies to promote Conservation Agriculture/No-till, it is possible to obtain what is called the triple bottom line, economic, social and environmental sustainability, while at the same time improving soil health and increasing production.

The wide recognition as a truly sustainable farming system should ensure the growth of this technology to areas where adoption is still small as soon as the barriers for its adoption have been overcome.

The widespread adoption also shows that No-tillage cannot any more be considered a temporary fashion, instead the system has established itself as a technology that can no longer be ignored by politicians, scientists, universities, extension workers, farmers as well as machine manufacturers and other agriculture related industries.

Sustainable beef production: a static farm-level perspective

Extensive beef production is often not considered within the context of conservation agriculture since it does not comprise a tillage component, at least not directly. That does not imply that various beef production systems cannot be considered and evaluated from a sustainability perspective. Here we consider 12 different typical farm-level extensive beef production systems (see Table 6). Farms 1–3 represent typical average, good and bad commercial operations, Farms 4–6 represent typical average, good and bad emerging farmers' operations, Farms 7–9 represent typical average, good and bad communal farmers' operations and Farms 10–12 represent typical average, good and bad nationalyear period. level operations. While the data has been derived from actual data and verified by industry experts, they represent typical farms and not actual farm data.

TABLE 6 DIAGNOSTIC SPECIFICATION OF DIFFERENT EXTENSIVE BEEF PRODUCTION SYSTEMS*

	Calf mortality	Unproductive animals	Calf birth weight	Calf age at marketing	Market weight	Income	Fodder consumption	Average daily gain	Avg. feed conversion ratio (calves)
	%	%	kg	Days	kg	(R/calf)	% of weight	(kg/day)	(kg feed for kg meat)
Farm 1	10%	73%	40.0	244.0	220	4 400	2.8%	0.74	4.95
Farm 2	5%	62%	45.0	213.5	220	4 400	2.8%	0.82	4.56
Farm 3	15%	86%	35.0	305.0	220	4 400	2.8%	0.61	5.90
Farm 4	10%	80%	35.0	305.0	190	3 230	3.0%	0.51	6.66
Farm 5	5%	70%	35.0	305.0	200	3 400	3.0%	0.54	6.53
Farm 6	15%	94%	30.0	305.0	180	3 060	3.0%	0.49	6.42
Farm 7	20%	134%	25.0	549.0	190	3 230	3.2%	0.30	11.46
Farm 8	15%	126%	30.0	457.5	200	3 400	3.2%	0.37	9.94
Farm 9	30%	146%	25.0	732.0	180	3 060	3.2%	0.21	15.51
Farm 10	15%	103%	30.0	335.5	190	3 230	3.0%	0.48	6.95
Farm 11	10%	95%	35.0	244.0	220	3 740	3.0%	0.76	5.06
Farm 12	20%	117%	27.5	366.0	180	3 060	3.0%	0.42	7.49

* FARMS 1–3 REPRESENT TYPICAL AVERAGE, GOOD AND BAD COMMERCIAL OPERATIONS, FARMS 4–6 REPRESENT TYPICAL AVERAGE, GOOD AND BAD EMERGING FARMERS' OPERATIONS, FARMS 7–9 REPRESENT TYPICAL AVERAGE, GOOD AND BAD COMMUNAL FARMERS' OPERATIONS AND FARMS 10–12 REPRESENT TYPICAL AVERAGE, GOOD AND BAD NATIONAL LEVEL OPERATIONS.

The environmental demand of the farm-level life-cycle of producing a market-ready calf for the different farm production systems have been estimated based on the following assumptions:

- GHG emissions per year: Based on Du Toit et al. 2013 (valued @R120/t (National Treasury 2013:15))

	Bulls	Cows	Heifers	Oxen	Young oxen	Calves
Commercial	2.83	2.32	1.90	2.24	1.29	1.29
Communal	2.10	1.83	1.57	1.82	1.04	1.02

- Water use: 3 litre per kg dry fodder use (RPO & NERPO 2014) (valued @R2/m3 – own calculation based on Blignaut et al. 2008)
- Fodder (grazing): 2,8–3,2% per day of body weight (valued @ R871/ton – own calculation based on Dept. of Agric. Limpopo (2010) – adjusted for inflation)
- Price of calf (live-weight):
- Class A: R20/kg
- Class B: R17/kg

Based on these assumptions, the environmental demand per farming system can be estimated and the results are displayed in Table 7.

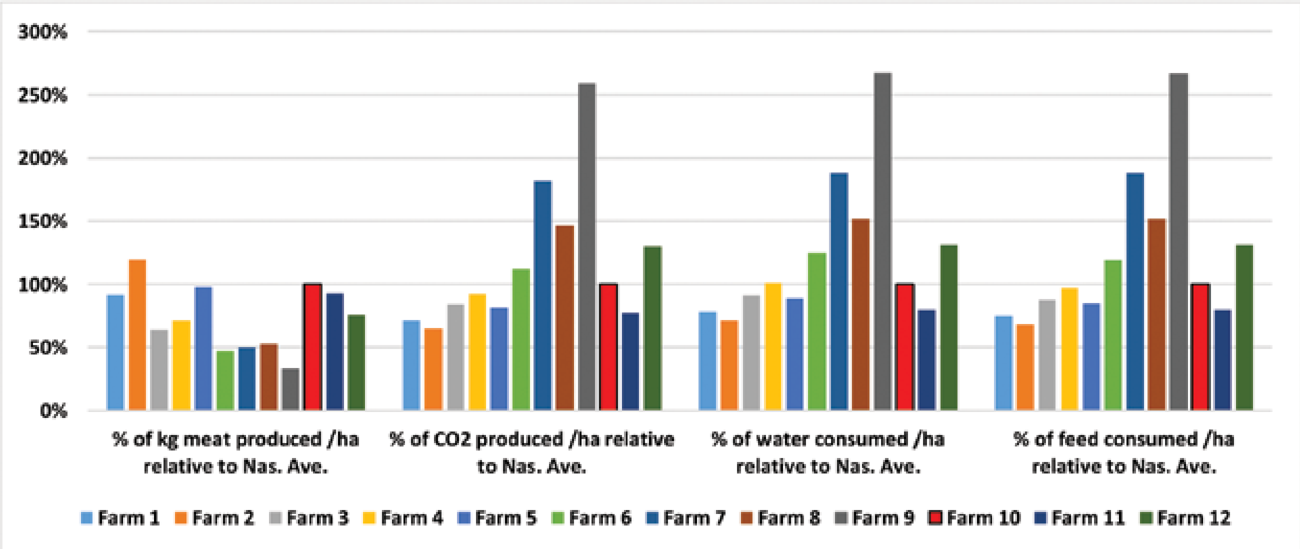
TABLE 7 ESTIMATED TOTAL FARM-LEVEL LIFE-CYCLE ENVIRONMENTAL DEMAND PER FARMING SYSTEM*

	Total CO_2equiv.	Total water consumption	Total feed consumption	Total environmental demand	Income hectare	Net income	kg meat @ market age /ha	kg CO_2 / kg meat @ market age	lit water / kg meat @ market age	kg feed / kg meat @ market age
	ton/ha/yr	l/ha/yr	kg/ha/yr	R/ha/yr	R/ha/yr	R/ha/yr	kg meat/ha	ratio	ratio	ratio
Farm 1	0.394	2 869.1	797.7	747.8	351.9	-395.95	17.6	22.4	163.1	45.3
Farm 2	0.465	3 402.4	945.8	886.3	457.4	-428.92	22.9	20.3	148.8	41.4
Farm 3	0.323	2 341.5	651.3	610.8	246.3	-364.45	12.3	26.2	190.1	52.9
Farm 4	0.394	2 879.4	800.8	750.5	232.5	-518.06	13.7	28.8	210.6	58.6
Farm 5	0.477	3 457.8	963.7	903.5	318.1	-585.35	18.7	25.5	184.8	51.5
Farm 6	0.319	2 353.4	652.4	611.1	154.2	-456.98	9.1	35.1	259.5	71.9
Farm 7	0.544	3 756.9	1 087.0	1 019.6	162.8	-856.82	9.6	56.8	392.4	113.5
Farm 8	0.460	3 197.6	925.8	867.9	171.3	-696.61	10.1	45.7	317.3	91.9
Farm 9	0.514	3 543.6	1 024.6	961.2	107.9	-853.29	6.3	81.0	558.1	161.4
Farm 10	0.599	3 993.4	1 157.0	1 087.6	325.7	-761.90	19.2	31.2	208.5	60.4
Farm 11	0.428	2 952.1	854.2	801.3	301.7	-499.64	17.7	24.1	166.4	48.1
Farm 12	0.590	3 968.2	1 146.9	1 077.7	246.8	-830.91	14.5	40.6	273.3	79.0

* FARMS 1–3 REPRESENT TYPICAL AVERAGE, GOOD AND BAD COMMERCIAL OPERATIONS, FARMS 4–6 REPRESENT TYPICAL AVERAGE, GOOD AND BAD EMERGING FARMERS' OPERATIONS, FARMS 7–9 REPRESENT TYPICAL AVERAGE, GOOD AND BAD COMMUNAL FARMERS' OPERATIONS AND FARMS 10–12 REPRESENT TYPICAL AVERAGE, GOOD AND BAD NATIONAL LEVEL OPERATIONS.

The relative difference in the productive efficiency and environmental demand among the 12 farming systems, derived from Table 7 and expressed relative to Farm 10 (the national average production system), is shown in Figure 5.

FIGURE 5 COMPARISON OF THE PRODUCTIVE EFFICIENCY AND ENVIRONMENTAL DEMAND AMONG 12 DIFFERENT FARMING SYSTEMS, WITH FARM 10 (NATIONAL AVERAGE) = 100



The above analysis is based on a static farm-level assessment of the environmental demand of different production systems. Next we consider a dynamic country-level assessment.

CLIMATE INFORMATION FOR FOOD SECURITY AND LONG-TERM RESILIENCE

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Katiuscia Fara,
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As climate change increases the frequency of extreme weather events, and the risk of hunger and malnutrition, helping governments, farmers, pastoralists and vulnerable communities to better manage climate risks is instrumental to their long-term resilience and food security.

The 795 million hungry people in the world also live in disaster-prone areas bearing the brunt of floods and droughts, as well as the current impacts of one of the worst El Niño events in history.

One of the most powerful tools to help vulnerable and food insecure communities successfully manage and build resilience to climate shocks is timely and reliable climate and weather information. Climate services is the provision of information that is tailored to the needs of specific users (such as farmers, food security analysts or governments) so that they can take the action needed to manage climate risks. While advances in science and technology have increased available climate knowledge, in many countries information is unavailable, difficult to access, or not easy to understand, and therefore not useful to guide the decision-making that matters to people and their lives.

Climate Services for governments and rural communities

The **World Food Programme** has **extensive experience** in using, developing and translating climate information for governments and other humanitarian and development actors. Our emergency preparedness and response team collaborates with world-renowned research and modelling centres to provide the latest immediate and seasonal weather hazard information to support government and humanitarian actors in deciding appropriate action. WFP's food security analysts translate climate and weather information into early warnings of drought events and potential production shortfalls. Coupled with detailed analyses of household vulnerability, WFP and partners use this information to assess how droughts or floods will affect people's food security, to ensure humanitarian and government actors can plan an early response.

Together with partners, **WFP is working on climate services for vulnerable, food-insecure rural communities**. Examples of climate services include weather forecasts and early warning systems to guide people on how to prepare for a major storm, information on migration routes for livestock during a drought or flood, sharing ideas on better food storage options for an unusually wet season, or on suggested crops to plant in drier long-term conditions under climate change.

Helping farmers and pastoralists in Malawi and Tanzania access climate information

In Malawi and Tanzania, WFP is part of the **GFCS Climate Services for Action Africa Project,** a multi-partner pilot initiative focusing on climate services for health, food security and disaster risk reduction. An example of WFP activities under the initiative is the provision of tailored weather and climate information to pastoralists and farming households to help them enhance their food security and livelihoods. Agro met advisories - information on weather observation and forecasting, and agricultural sensitivities to expected weather- are reaching these communities, farmers and pastoralists through a number of integrated activities, including radio programmes, mobile phone (SMS and audio) and the training of agricultural extension workers on how to interpret and communicate climate information to rural audiences. Given the dramatic effects of El Nino, agricultural intermediaries, pastoralists and farmers have welcomed access to additional information in the two countries.

Training farmers on climate and weather data, and crop and livelihood options

In both Tanzania and Malawi, WFP, **CCAFS** and the **University of Reading's Walker Institute**, are training agricultural extension workers, "intermediaries", on how to access, understand and communicate complex climate information to farmers and pastoralists. To build capacity and ensure sustainability, WFP has partnered with the national meteorological services and other key local and national stakeholders.

Based on the University of Reading's **PICSA (Participatory Integrated Climate Services for Agriculture)** approach, the training helps intermediaries support farmers to take decisions through a participatory process by providing them with weather and climate data, the skills to interpret it, a menu of livelihood, crop and livestock options that best fits their needs and the expected weather, and participatory tools to use at different stages of the process - before, during and after the season. While intermediaries provide information and guidance, it is ultimately the farmer who makes a decision.

Many different groups can be targeted with climate services, with the information provided becoming an additional asset to people's toolbox of resilient-building activities. After completing a training of trainers, which took place in Malawi in July 2015, and in Tanzania in September 2015, agricultural extension workers targeted communities in which WFP already had a presence to work with farmers well ahead of the planning season and apply what they had learned.

WFP and partners then organized a two-day Planning and Review session in both countries. During these sessions, intermediaries provided feedback and received guidance on the challenges they had faced when working with farmers, such as language barriers when translating technical terms, calculating probabilities, participatory budgets, etc. The Planning and Review days were timed to coincide with the issuing of the seasonal forecast. Thanks to the work done by the National Met Services, a downscaled seasonal forecast was produced for the different districts (Balaka District in Malawi and Kondoa, Longido and Kiteto in Tanzania) and communicated to the intermediaries.

In Malawi, the seasonal forecast predicted a delayed onset of rains in some districts, as well as below average rainfall from October to December 2015, and prolonged dry spells between February and March 2016. The Met Services also communicated that strong El Niño Southern Oscillation (ENSO) conditions had developed over the tropical Pacific and that there were indications that these conditions were likely to continue up to March 2016. In Tanzania, the forecast predicted above to normal rainfall. However some areas, such as Kiteto, experienced below normal rainfall at the end of 2015.

The intermediaries then returned to their farmer groups and discussed the seasonal forecast with them and whether this brought a need to review the planning done for the season. Intermediaries continued working with the farmers, communicating weekly weather alerts produced by the Met Office, and helping them optimise their decisions into and after the season.
When people have digestible information, they can take better decisions to manage their lives. After receiving a training from an extension worker in September 2015, Joyce, farmer from a village near Dodoma, Tanzania, said: "Today was a good day because we got training on how the weather changes and how this can result in less harvest, and what we should do when this happens. When we see the weather indicates less rain we should select seeds that comply with the weather of less rain."

Radio and SMS

In both Malawi and Tanzania WFP is also working with Farm Radio Trust on a radio programme intended to provide farmers with additional information on climate and weather forecasts and implications to their farming and agricultural practices.

A radio programme is broadcast for thirty minutes twice a week. Farmers are provided with radios so that they can listen to this programme in a group. They are encouraged to interact with the radio show and experts by sending questions via SMS or by calling in, and to discuss lessons and agree on next steps afterwards, as well as follow-up with each other on progress achieved. In Malawi, beneficiaries found the programme on climate adaptation strategies particularly useful as, together with the forecasts, it helped them to decide to plant sweet potatoes after experiencing dry spells at the start of the season.

On their mobile phones, farmers also receive SMS alerts on agro-climatic information. Additionally, they have access to a hotline for further information where an agent – a trained agriculture extension worker - assists them with any problems they may be encountering, and links them up to both agricultural and climate experts when necessary.

More information on the impact of this climate services project will be available in coming months.

WFP Climate Services Innovations

In addition to this programme in Tanzania and Malawi, WFP has been scaling up other innovations, such as:

The **R4 Rural Resilience Initiative** which builds climate change adaptation and resilience into safety nets. Climate information is used to help determine weather index insurance payouts in case of drought in Ethiopia, Senegal, Malawi and Zambia.

The **Food Security Climate Resilience (FoodSECuRE)** Facility where climate information is also used to trigger funding for early action. This ground-breaking tool releases funds based on a forecast before a disaster occurs. FoodSECuRE also ensures funds are available during and post-disaster, so that resilience-building activities continue over time.

The **Livelihoods, Early Warning and Protection project (LEAP)** - In Ethiopia, WFP has been working with the Government on the "LEAP" software which uses agro-meteorological data to trigger food assistance in case of a drought so that families receive support before they are forced to take desperate measures. LEAP has also been used by WFP's partners to help pastoralists identify fresh grazing areas for their livestock, using vegetation maps.

Link to climate services video: https://www.youtube.com/watch?v=drTwhopaCj4

About the World Food Programme

WFP is the world's largest humanitarian agency fighting hunger worldwide, delivering food assistance in emergencies and working with communities to improve nutrition and build resilience.

Each year, WFP assists some 80 million people in around 80 countries. Working with governments, international partners and local communities, WFP has expertise in developing and delivering large-scale climate resilience innovations.

These innovations help communities who are the most food insecure, most at risk and with the least capacity to prepare for, respond to and recover from climate-related disasters so that food security is no longer an elusive goal for them.

Follow WFP on Twitter **@WFP** and **@RC共hoularton**.

AGRICULTURE AND INNOVATIONS AS A SOLUTION TO THE GROWING NEEDS AND NEW CHALLENGES

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WFO FACILITATOR OF THE WOMEN'S COMMITTEE
MTK FINLAND MEMBER OF THE BOARD

Agriculture as a part of the whole bioeconomy is underutilized source for the economic growth in many countries. The good examples and wide discussion is needed to show how agriculture and forestry can be an engine for the sustainable economic growth.

Finland is searching economic growth from bioeconomy and it has been set as one of the priorities of the current national government. It's important to define what bioeconomy includes. In current discussion it's often limited to biomass-based energy, which is very narrow definition. The wider definition could be found from the following: "By 2030 the world needs 50 % more food, 45 % more energy and 30 % more water. The solution is bioeconomy." (www.biotalous.fi).

Despite of our cold climate Finland has high ambitions to be a society which is energy-efficient and low carbon. This requires sustainable use of renewable natural resources and recycled materials. Bioeconomy is described as an economy which can turn the biological natural resources into food, energy and other products and services. The goal is economic growth and new jobs without impoverishing of ecosystems. This is not possible without innovation, cooperation, education and use of technology.

New innovations are needed to improve cooperation and to find new ways to work. One interesting innovation is the production symbiosis between bioeconomy enterprises, as in the Knehtilä farm in Finland (www.knehtilantila.fi/in-english). The farm was rewarded as the WWF Baltic Sea Farmer of the Year Prize in 2015. The farm uses precise and innovative techniques in organic farming and at the same time it is creating new activities benefitting not just the farmers but also the society. The farm also provides meeting facilities, country shop and café.

The current project, called Palopuro agro-ecological symbiosis, is aiming to develop a cooperative food production system based on energy and nutrient self-sufficiency. (http://blogs.helsinki.fi/palopuronsymbioosi/english/) There's a lot of possible actors in the symbiotic process, e.g. in this case crop farm, egg farm, bakery, berry and vegetable farms, bio gas plant, bio coal plant and horse farms. The products are the food, but also bioenergy, biomass, feed etc. The bio gas plant waste is going to be processed as the bio coal and organic fertilizer to be used in the fields. The idea is to reduce the amount of waste and increase the total efficiency of the processes. The project is run by the Helsinki University and Natural Resources Institute Finland and funded by the Ministry of Environment

The European Union Bioeconomy Strategy addresses the production of renewable biological resources and their conversion into vital products and bioenergy. In the strategy they notice that bioeconomy is diverse and fast-changing part of the economy and there is a need for common strategy to get best results. There are many projects and political processes around the bioeconomy strategy. Many of them have direct impacts on farmers and forest owners and therefore it's important to involve them to the discussion.

One example of the new possibilities of agriculture in the bioeconomy is the ecosystem services. The agriculture and forestry is not only producing food, feed, fibers and energy, but also a lot of invisible good is created at the same time: e.g. landscape, fresh air, refreshing nature, carbon sequestration and water filtration. There's a need for recognizing and valuing the farmers' and forest owners' role in these processes. Too often there's black-and-white view that only conservation is good and efficient production is not taking into account the nature.

Societies are dependent on many land use factors and rural services. These are not possible to be served to the society only through conservation, but also sustainable production must be involved. We must spread the message what is farmers' and forest owners' role in the ecosystem services.

Nature does not need human but we need nature to produce food, fibers, energy and give us shelter. Therefore the farmers' and forest owners' role must be recognized.

AGRICULTURAL INNOVATIONS FOR A SUSTAINABLE ECONOMIC GROWTH: what about young?

Virginia Cravero
ITALIAN YPARD REPRESENTATIVE

Proposed Sustainable Development Goal (SDG) 8 is to "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all." Sustainable development supports the idea that solving the world's most challenging development issues takes an evolving combination of economic, social, and environmental considerations and goes beyond borders. Economic growth is not enough on its own, and coordination at scale is needed. The inclusion of these concepts under SDG 8 is a promising sign that the way the development community views economic growth is advancing to take a more inclusive and holistic approach (Sisko, 2015).

Reading through the sub-goals for SGD 8, it is possible to see an evident trend in the inclusion of youth as a means to the overall achievement of the goal. For example (Sisko, 2015):

- Sub Goal 8.5 states, "by 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value."
- Sub Goal 8.6 states, "by 2020, substantially reduce the proportion of youth not in employment, education or training."
- Goal 8.b notes, "by 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labour Organization."

More than 3 billion people — nearly half of the world's population — are under the age of 25, and almost 90 percent of young people live in developing countries. For that, this population is the future for promoting sustainable development, particularly economic development.

Likewise, it is pleased to see that the SDGs prominently include youth to reach their overall goal for sustainable economic growth and adequate employment for all (Sisko, 2015).

The international development community hopes that the more youth are support and engage in developing their own economies, the more they will be invested in ensuring economic sustainability. In other words, capitalizing on and leveraging young people's drive and motivation are essential to ensuring their participation in and the sustainability of economic development (Sisko, 2015).

To achieve sustainable economic growth, also agricultural innovations take an important part of this process. Innovation includes the process through which exploration of new practices can be put into social or economic use. It comes through stakeholder interaction, and requires individual, organisational and institutional capacities. It is more than new technology – it equally involves new organisational and institutional arrangements (KIT, 2015).

The quest for innovation – be it through optimising farm practices or improving access to markets – brings with it a need for a variety of agricultural services. Research and advisory services are perhaps the most well-known agricultural services. These services need to cater to a wide range of farmers and other value-chain actors, in an efficient and effective manner (KIT, 2015).

Young are doing impressive progress concerning agricultural innovation. One example is Dr. Govaerts, 35, currently serves as Associate Director of the Global Conservation Agricultural Program at the International Maize and Wheat Improvement Center (CIMMYT) (Forgrave, 2014). In developing his vision to help poor farmers increase food production from their existing farmland, Dr. Govaerts was inspired by the great agricultural scientist and World Food Prize Founder Norman Borlaug's credo: "Take It to the Farmer." To that end, Dr. Govaerts was instrumental in framing the Mexican government's major initiative known as the Sustainable Modernization of Traditional Agriculture (MasAgro), and, in June 2014, he assumed leadership of the entire program, with responsibility for coordinating the evolution of related projects in Latin America (Forgrave, 2014).

The component of MasAgro that Dr. Govaerts originally developed and has successfully led is named "Take

It to the Farmer." It focuses on integrating technological innovation into small-scale farming systems for maize and wheat crops, while minimizing detrimental impacts on the environment. Under this extension-style program, farmers on over 94,000 hectares switched to sustainable systems using MasAgro technologies, while farmers on another 600,000 hectares are receiving training and information to improve their techniques and practices (Forgrave, 2014).

Dr. Govaerts has used creative and innovative approaches in applying science to improving farming systems, to focus on farmers as development catalysts, and to restore a sense of pride among farmers and those who serve them," Quinn said. "Using cell phone technology and social media, YouTube videos and educational events, his work has led to impressive achievements in the adoption of his integrated technologies by farmers, policy changes at the governmental level, and institutional alignment for the implementation of conservation agriculture" (Forgrave, 2014).

Dr. Govaerts' research and field application in conservation and sustainable agriculture has focused on the benefits of improving long-term soil quality in both irrigated and rainfed regions through leaving surface residues on the land and reducing tillage activities while diversifying crops. Evidence gathered during his research has shown that when farmers used this method, crop yields increased on average in the rain fed areas by 30 to 40 percent and production costs fell by 10 percent in irrigated systems, resulting in a positive impact on household income (Forgrave, 2014).

Another valuable example is Julius Ko Hagan, University of Cape Coast, Ghana who developed a chicken breeds that can be highly productive in the hot and humid environments of the tropics. Presenting a paper on behalf of his country to the world's most eminent animal breeders and geneticists at a conference in Brazil, he would like to impress on students in secondary school and those enrolled in agricultural colleges and universities that agriculture is the mainstay of African economies, yet it is a barely exploited area and as a result presents today's students with numerous opportunities (Engelhard, Francis, & Ghezae, 2014).

As we saw with these two examples, young are everyday more interested on innovations applied to agriculture leading to sustainable economic growth of their own countries. Innovations in agriculture are thus a valuable way to attract young into the agricultural systems. For that, it is important to sustain young people through scholarships and prizes in order to increase their willingness to participate.

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DIGITAL CARBON DISRUPTION: USING TECHNOLOGY TO LOWER EMISSIONS AND BOOST INNOVATION

The development and expansion of digital technology over the past decade has created business models that are not only changing customer experience and consumption habits, but are doing so in inherently resource efficient ways. This is causing a carbon disruption that's not only better for the planet, but better for the bottom line.

http://bit.ly/1SE8qur

ETHIOPIA: SUPPORTING FARMERS THROUGH NEW TECHNOLOGY

Small scale farming is threatened by natural disasters such as drought, diseases, land degradation and soil infertility because of the eviction of nitrogen from soil. Over grazing, wind and the expansion of farm land due to population growth further aggravate the situation. These days, to improve soil fertility the nation spends huge amount of hard currency for the importation of chemical based fertilizers like Urea. The price of the fertilizers is expensive that causes inflation.

http://bit.ly/1SEC8zb

7TH INTERNATIONAL CONFERENCE ON AGRICULTURAL STATISTICS - MODERNIZATION OF AGRICULTURE STATISTICS IN SUPPORT OF THE SUSTAINABLE DEVELOPMENT AGENDA

6 /10/2016 - 28/10/2016 - Rome, Italy - ICAS VII is organized by the Italian National Institute of Statistics, in close collaboration with the Food and Agriculture Organization of the UN (FAO). The Conference focuses on bringing together research and best practices in the field of agriculture statistics, in response to the changing needs and opportunities for agricultural statistics.

http://bit.ly/1Ww0Tvt

RETHINKING GLOBAL FOOD SECURITY COLLABORATIVE APPROACHES TO SUSTAINABLE AGRICULTURAL INNOVATION - GFIA 2016

6/02/2016 - 17/02/2016 Abu Dhabi / Parallel General Session 3 - Horticulture (17 February 2016)
Innovative agro-logistics to reduce post-harvest losses from farm to fork. The session will present case study material from Egypt, Morocco, Benin and Nigeria and will also include recommendations to optimise agro-chains.

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