CEMA
European Agricultural
Machinery Association

Smart Agriculture Solutions support EU Eco-Schemes

A CEMA contribution to sustainable agriculture

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CEMA aisbl

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Introduction

CEMA is the association representing the European agricultural machinery industry. With 11 national member associations, the CEMA network represents both large multinational companies and numerous European SMEs active in the sector. The industry comprises about 7,000 manufacturers, producing more than 450 different types of machines with an annual turnover of about EUR 40 billion and 150,000 direct employees. CEMA companies produce a large range of machines that cover any activity in the field from seeding to harvesting, as well as equipment for livestock management.

This paper follows several CEMA positions on the future of the EU Common Agricultural Policy (CAP). Herewith we focus on digital transformation and smart farming enabling the EU Green Deal in agriculture. Through Precision Agriculture Technologies (PATs), our industry can deliver an important contribution to sustainable farming practices under the new EU Eco-Schemes. To unleash its full potential, this new instrument needs to support the uptake of technologies enhancing sustainable farming practices all over Europe. Climatic zones together with a large variety of landscapes shape practices and the choice of farm machinery that helps in managing any type of crops - cereals, specialty crops, open-field vegetables, roots crops - or/and animal husbandry activities.

Therefore, at a national and regional levels, the new EU Eco-schemes will need to take into account the specificities of each territory, the diversity of farming practices and farmers' special needs to provide tailored-made support that can enhance PATs uptake to advance a more sustainable agriculture in Europe.

On this occasion we address several questions critical to our industry:

- What are the challenges driving a paradigm shift in EU agriculture?
- How can digitalization support the new EU Eco-Schemes?
- What PATs are most fundamental to deliver on sustainable farming practices?
- How can digital transformation and PATs be promoted by the post-2020 CAP mechanisms?
- What measures can make PATs accessible to all farm sizes in Europe?

The aim of this paper is to answer these questions from the industry perspective aligned with its customers - be it farmers, cooperatives, or contractors.

1. Paradigm shift in EU agriculture

European agriculture is undergoing a fundamental change. The recent COVID pandemic crisis has clearly shown once more the need to build a sustainable and stable agriculture in Europe in conjunction with societal expectations. More traceability and transparency are required from all agri-food chain stakeholders to build consumers' trust, new regulation requirements, and break down a negative spiral of economic, environmental, and societal challenges they are seemingly locked in.

CEMA supports the critical role played by the non-financial tools of the Common Agricultural Policy (CAP) to make the EU agri-food sector more sustainable. When the CAP was launched in 1962, priority had been given to food autonomy, affordable prices for consumers and a sustainable income for farmers. Up to now, the two first CAP goals have been obviously reached but not the third one. Moreover, European farmers are facing increasing economic, ecological, and societal challenges.

First and foremost, farmers feed the world. They also supply renewable energies as well as support the development of plant-based new materials and advanced bio-pharma products. In times of global crises like the COVID pandemic, the agricultural sector is urged to remain resilient and ensure smooth food supplies both regionally and globally. At the same time, agricultural operations, like any other businesses, must generate profit to sustain increasing global competition within and outside the agri-food supply chain, while mastering ongoing structural changes and generational renewal in rural areas.

Agriculture is essential in the fight against climate change and for preservation of environment. Thereby new EU regulations for the use of various agricultural inputs such as crop protection agents, fertilizers and antibiotics have been adopted these past years induced by society's concerns and demands. EU farmers are therefore asked to produce more extensively. These regulations have put many EU farmers in a less-favorable position to compete on their internal market and globally. This is where respective EU polices must foster a level playing field for European agriculture to maintain food autonomy and prevent higher dependencies on imported food mainly regarding fruits and vegetables.

CEMA welcomes a paradigmatic shift in EU agriculture by which the farmer delivers high-quality food, i.e. cereals, fruits, vegetables, meat and dairy, at acceptable prices and serves as an environmental shepherd while receiving an adequate compensation for it. Though EU farmers are already providing substantial ecological services to the public, even more has been envisioned by the EU Green Deal. The Farm-to-Fork Strategy[1] and the Biodiversity Strategy[2] define the following goals to be achieved by the EU agriculture until 2030:

- reduce by 50% the overall use and risk of chemical pesticides;
- reduce nutrient losses by at least 50% and reduce use of fertilizers by at least 20%;
- reduce the use of antimicrobials for farmed animals and in aquaculture by 50%;
- achieve at least 25% of agricultural land under organic farming;
- assign at least 10% of agricultural area to high-diversity landscape features.

[1] EU Farm to Fork Strategy
[2] EU Biodiversity Strategy by 2030

Obviously, to target these ambitious sustainability goals, respective intervention measures within the CAP framework must be introduced. Enhanced post-2020 CAP green architecture requirements, also called Eco-Schemes, will urge EU farmers to adapt their agricultural practices to the environment and climate change challenges. CEMA appreciates that those farmers applying ecologically advanced agricultural practices will be rewarded through the Eco-Schemes funds.

Most recently, the EU Commission has proposed a list of agricultural practices which can be supported by new Eco-Schemes[3].

While this list is not exhaustive and has not yet been fully adopted, it provides a good orientation for each EU Member State to draft their CAP Strategic Plans where specific national targets and intervention mechanisms will be reflected. Among others, organic farming, integrated pest management, agroecology, high nature value farming, carbon farming, precision farming, improved nutrient management and vegetal mulching have been suggested. CEMA calls on the EU Member States to adopt these advanced agricultural practices in their CAP National Strategic Plans.

2. Smart agriculture solutions for new Eco-Schemes

2.1. Digitalization, Precision Ag Technologies and sustainability

CEMA is fully committed to support European farmers on their journey towards more sustainable agricultural practices. In this regard, digitalization will be a key enabler of the EU Green Deal for all sustainability dimensions: economic, environmental, and social ones. Digitalization improves overall competitiveness of agriculture through production optimization in an economically sustainable way (i.e. farmers can achieve more with less inputs), which also supports positive socio-economic trends in rural areas. Along with economic optimization, agriculture becomes more environmentally sustainable through reduced and targeted use and application of fuel, fertilizers, crop agents, and water – just to name a few positive ecological effects.

Digitalization associated with higher sustainably improves public acceptance of agriculture, making agricultural production more transparent and ensuring food availability, safety, and traceability.

CEMA greatly appreciates the fact that digitalization, together with the knowledge transfer and innovation, has been declared a cross-cutting objective of the future CAP. As European farmers, cooperatives and agricultural contractors are preparing for the next stage of farming, the agricultural machinery industry offers a broad range of Precision Ag Technology solutions to enable smart farming practices under EU Eco-Schemes.

[3] List of potential EU eco-schemes

Intelligent, connected farm machines, robotics and applications will have a pronounced positive impact on environment and climate actions linked to Eco-Schemes, such as:

- **climate change mitigation** (incl. reduction of GHG emissions from agricultural practices and animal husbandry);
- **climate change adaptation** (incl. actions to improve resilience of food production systems);
- **protection and improvement of water quality** and reduction of pressure on water resources;
- **soil protection** in the sense of lower compaction and degradation as well as restoration and high fertility by sophisticated nutrient management;
- **protection of biodiversity** (incl. maintenance and creation of landscape features or non-productive areas);
- actions for a **sustainable and reduced use of pesticides**;
- actions to **enhance animal welfare** or address antimicrobial resistance.

Already today, advanced agricultural equipment, digital farming tools, farm data management systems and other advanced technology and PAT solutions for diverse Ag production systems offer significant opportunities to farmers seeking to further sustain their ecological contribution. For instance, the use of crop protection agents and fertilizers is becoming increasingly selective and targeted to the site-specific crop needs in the field. Intelligent solutions for spray applications make it possible to manage dosage precisely over a wide application range and for every location in the field. A more detailed overview of most fundamental PATs enabling sustainable farming practices will be provided in the next chapter.

Meanwhile, PATs uptake by EU farmers remains at a low level as smallholders dominate European agriculture. Two thirds of all EU farms operated less than 5 hectares back in 2016, and only 3% of all farms were larger than 100 hectares (the latter, however, farmed 53% of the total utilized agricultural area)[4]. For smaller farms it remains difficult to use PATs in a profitable way unless they are on a niche high-value production such as vineyards. More than 75% of all EU farms earned less than 25,000 EUR of annual turnover in 2013[5]. Consequently, only a minority of EU farmers can invest into PATs at this stage while a vast majority of EU farmers need to use agricultural contractors' services for accessing digital technologies. Contractor service providers are therefore key partners for closing the modernization gap in smaller farms.

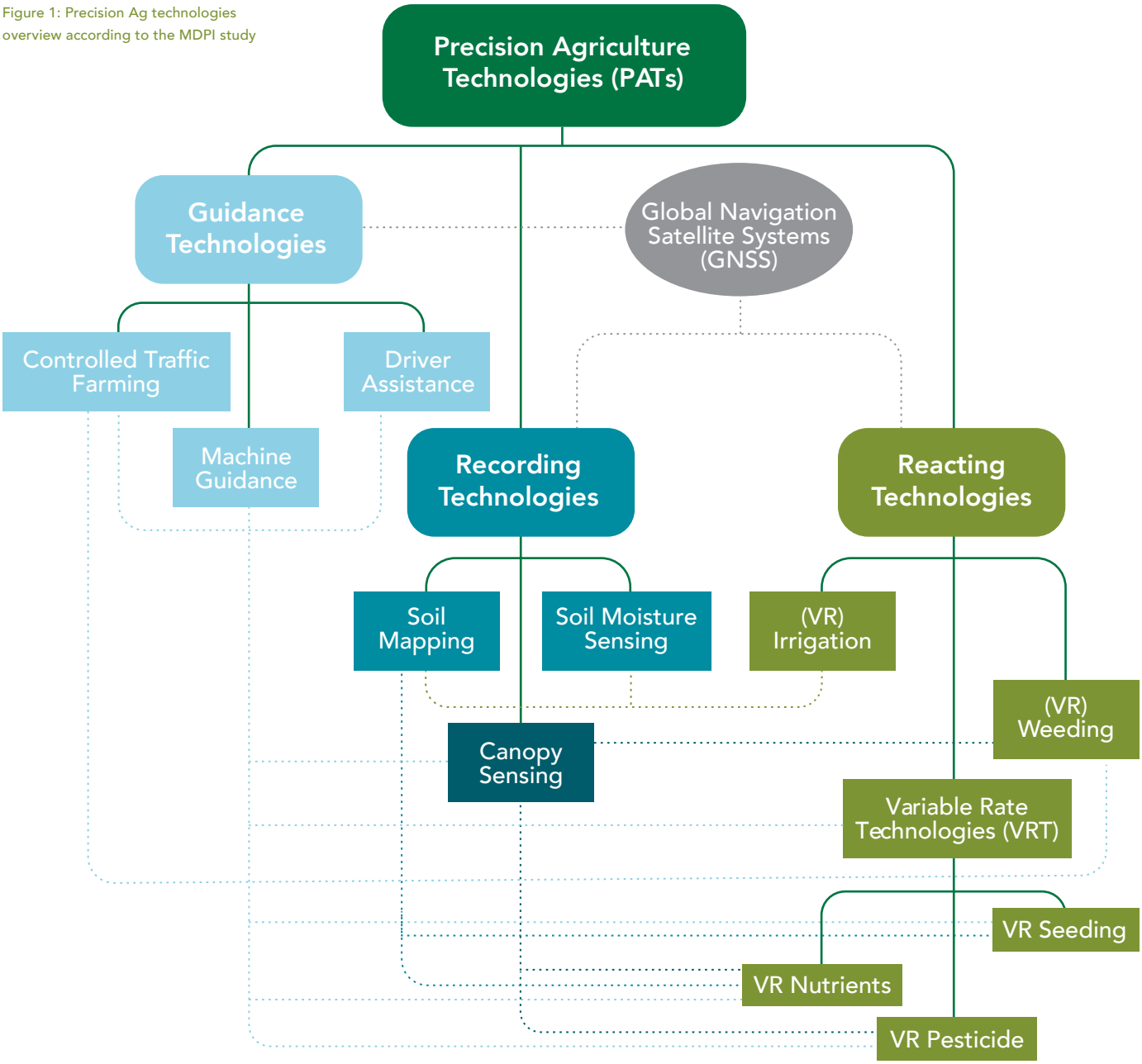
[4] Eurostat data - 2018 edition

[5] Own calculations based on the Eurostat data - 2020 edition.

2.2. Overview of most fundamental Precision Ag Technologies

An overview list of available Precision Ag Technology examples can be seen in the graph below from the MDPI study[6]. This graph is very similar to CEMA's perception of what the generic and most fundamental PATs to be promoted by the CAP are:

Figure 1: Precision Ag technologies overview according to the MDPI study



[6] MDPI Study 2017: Balafoutis A., Beck. B., Fountas S. Precision Agriculture Technologies Positively Contributing to GHG Emissions Mitigation, Farm Productivity and Economics. Sustainability 2017, 9, 1339.

In CEMA's opinion, generic and most fundamental PAT solutions which support new EU Eco-Schemes could be divided in two high-level categories:

- Guidance systems,
- Variable rate applications and nutrient sensing

Below we share some important PAT examples for these two high-level categories and refer for more details to our earlier position paper[7].

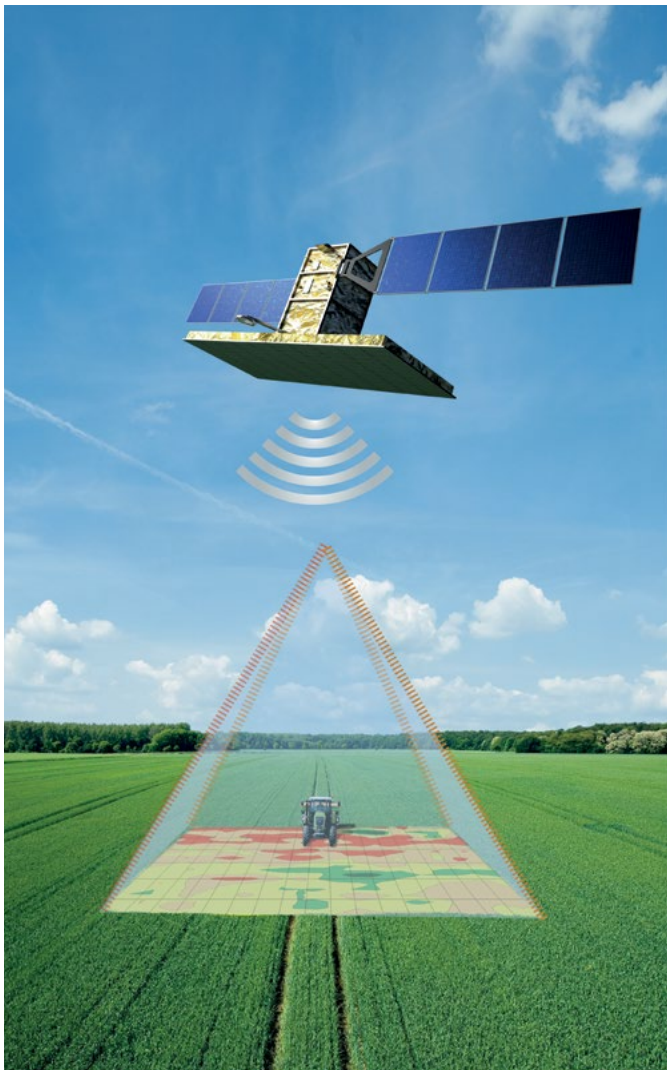
2.2.1 Guidance systems

Guidance systems form the generic technology of precision agriculture. They can be used by all kinds of equipment (tractors, combine harvesters, sprayers, planters etc.) and for most agricultural applications. Guidance systems focus on precise positioning and movement of the machinery with the support of the Global Navigation Satellite System (GNSS).

Guidance systems allow:

- Automatic steering
- Precise machinery movement between plant rows
- Precision drilling, sowing, planting
- Precision spraying
- Mechanical weeding
- Field mapping

Guidance technology maximizes the machinery drive and substantially reduces overlapping during soil preparation (Figure 2).



Source: courtesy of CEMA Member

[7] CEMA Position Paper (2017): Smart Agriculture for All Farms

Field mapping allows a very fine imagery of the soil conditions and respective settings for precision spraying (Figure 3). PATs reached such a granular level that it is possible to seed different plants simultaneously. Precision harvesting is also enabled by GPS technologies (Figure 4).

The most tangible benefits of guidance technologies are coming from:

- reduction of overlapping by increasing pass-to-pass efficiency leading to lower fuel consumption;
- reduction of all agricultural inputs (seeds, crop protection agents, fertilizers, water);
- positive impact on farmers work and fatigue, as due to reduced overlaps, increase in field speed and in length of operator's working day.

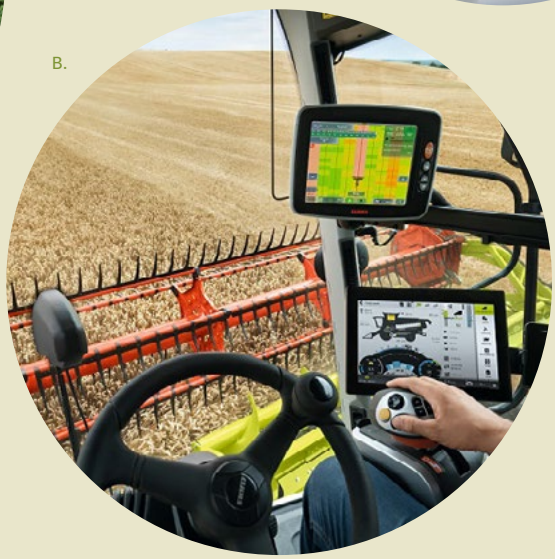
Figure 2:
Soil preparation and precision headland-turns

Figure 3: Digitalized field and precision spraying

Figure 4A and B:
Precision harvesting driven by guidance system

A.

B.



Source: all images courtesy of CEMA Member

2.2.2 Variable rate and nutrient sensing technologies

A. Variable rate technologies

Variable rate technologies (VRT) or variable rate applications (VRA) have features that allow to vary the rate of application to specific needs of plants – which depend for instance on the yield variability within the same field. Consequently, a geo-referenced field prescription can be implemented for variable rate application (Figure 5). VRA technologies are mostly used for spraying water, pesticides, herbicides, fungicides, inorganic and manure fertilizers.

Selective spraying is possible if a disease sensor and a controller are available with the VRA system (Figure 6). The technology presented on the graph below allows from 20% up to 80% fungicide reduction.

Nowadays, it is a major characteristic for all variable rate technologies:

- for herbicides savings are in the range of at least 20-30%[8];
- for mineral fertilizers savings can reach 40%[9] with a major impact on GHG emissions.

[8] Kempenaar, C., Been. T., Booij, J. et al. (2017) Advances in Variable Rate Technology Application in Potato in the Netherlands. Potato Research 60, pp. 295–305.

[9] MDPI Study 2017: Balafoutis A., Beck. B., Fountas S. Precision Agriculture Technologies Positively Contributing to GHG Emissions Mitigation, Farm Productivity and Economics. Sustainability 2017, 9, 1339.

Figure 5:
Variable rate application on geo-referenced fields

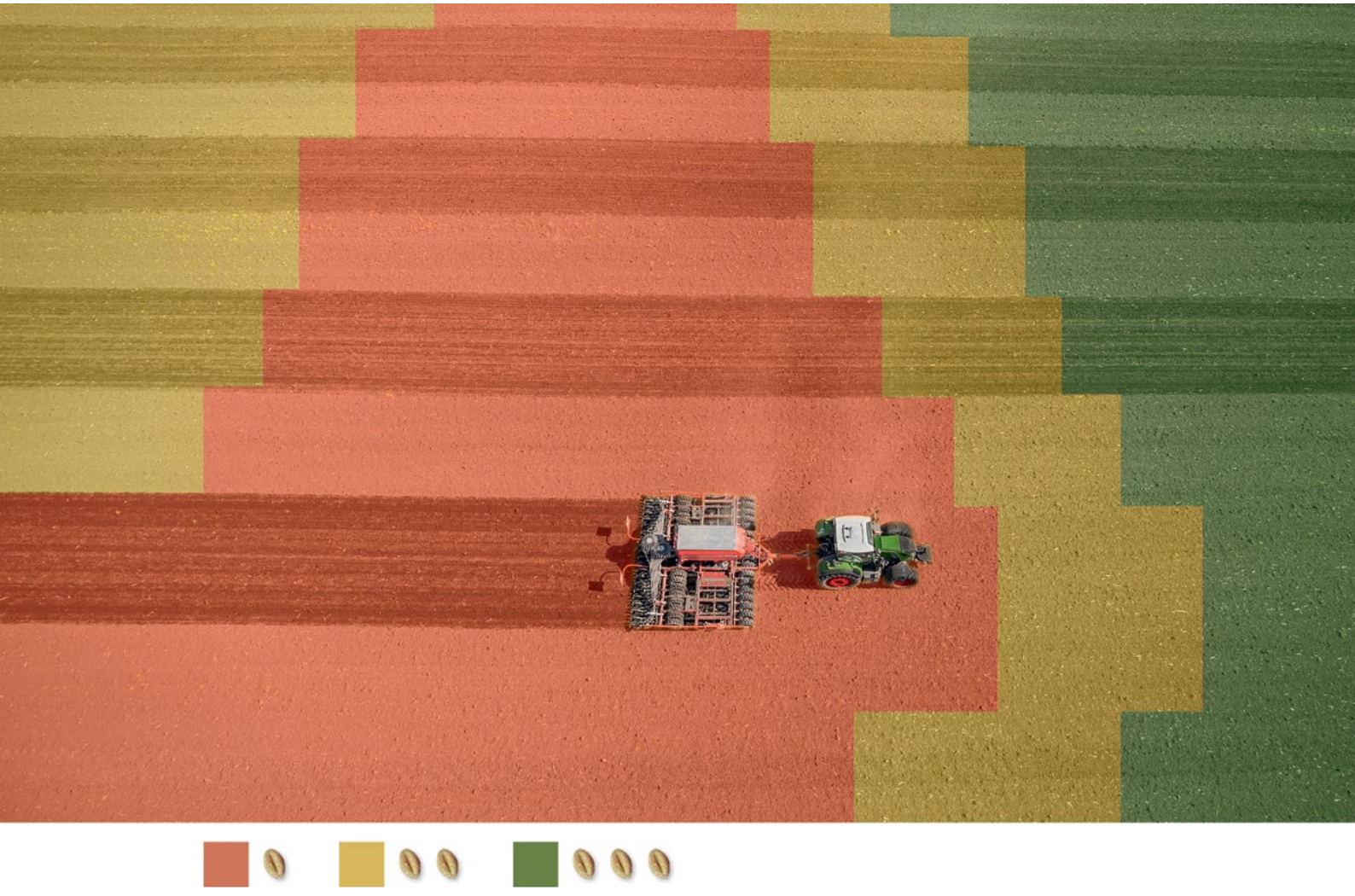
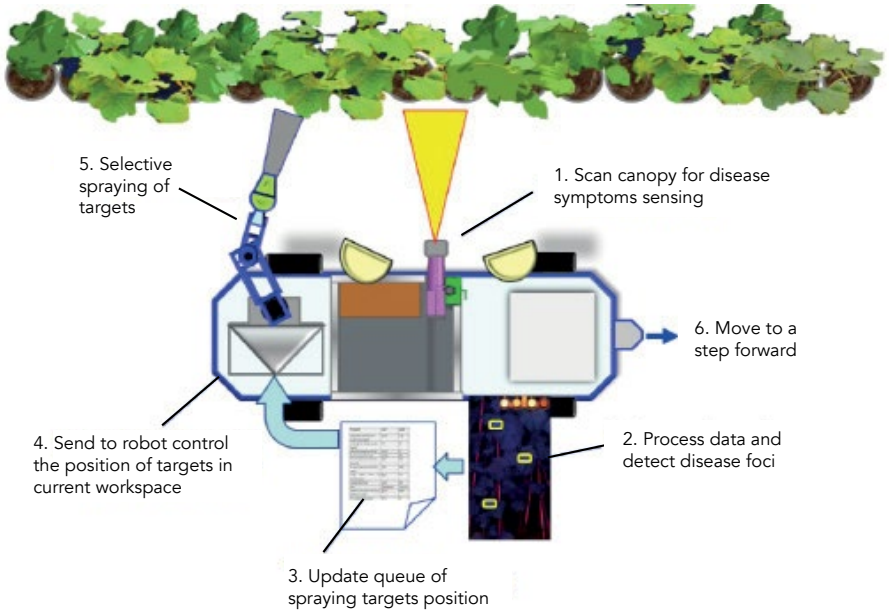


Figure 6: Selective spraying for disease control
Fungicide reduction 20-30% (max 80%)

Source: Prof. J. De Baerdemaeker, STOA study, Precision agriculture and the future of farming, presentation made at the European Parliament, August 30th, 2017



B. Nutrient sensing technologies

Surplus nutrients in the soil (especially nitrogen) result from excessive application rates and/or low plant uptake. This has pronounced negative impact on freshwater resources, human health, and marine life in coastal areas. Nitrogen surplus is not distributed equally in Europe. Obviously, there is room for implementing better regional nutrient management schemes and using manure as an alternative fertilizer to mineral fertilization.

Until now, the technical challenge was to transform manure from waste to valuable organic fertilizer, one of the reasons being the variance of nutrients in manure.

Figure 7: Precision manure tank equipped with nutrient sensing technology
Source: courtesy of CEMA Member

In a near past, success of manure fertilization was up to chance. No manure sensing technology to precisely apply the slurry with a nutrient target and limit rate in kg/ha was available. Nowadays, nutrient sensing technologies automatically control the desired nutrient application rates on the go as accurately as never before.

Combined, variable rate and nutrient sensing technologies can substantially contribute to the environmental policies implemented in the EU to decrease nitrogen emissions from agriculture, noticeably the Nitrates Directive limiting mineral and organic fertilizer application to 170 kg nitrogen /ha/ year[10].

For all the reasons mentioned above, CEMA is of opinion that guidance systems, variable rate and nutrient sensing technologies are the most critical PATs to be promoted by the CAP and the National Strategic Plans, so that they can be accessible to all farms.

[10] EU Commission: The Nitrates Directive

Going forward, developments in Precision Ag space around data collection, sensor technology and Artificial Intelligence will allow to decide more precisely which treatment each single plant on a field should have. This is where emerging technologies based on the high-resolution cameras and Artificial Intelligence will play a crucial role.

2.3 Precision Technologies for Livestock Management

Next to increasingly producing agricultural crops though PATs, closing nutrient cycles at livestock farms is critical to improve the efficiency of the nutrient utilization of livestock, reduce fodder losses when feeding and make sure manure is properly treated and consequently applied through PAT at the fields. This is the aim of using "indoors/outdoors" robotic applications powered by digital solutions at livestock farms.

Linking automated, robotized solutions through farm management software offers great potential for collecting data through sensors on the robots, processing this data through algorithms into decision support information for the farmers, which is then used by the robots again. Whereas the uptake of robotics combined with digital solutions in new investments in the milking process doubled in Germany within the last 10 years to more than 80% in 2020, the adoption of automated PAT applications in the area of feeding and manure remains persistently below 1%[11].

The major reasons behind this low uptake are: the cost of the investment and the unawareness of the potential these new innovative applications have in improving livestock management as well as their positive impact on sustaining farms profitability.

Including precision livestock technologies under the eco-schemes will support the uptake of automated and digital solutions at livestock farms that enhance more sustainable practices and further circularity. These technologies increase animal welfare, improve farmers' working conditions and sustain farm revenues. The adoption of precision livestock technologies will certainly help to ensure there is a next generation of farmers, securing farms' succession and thereby preventing depopulation of rural areas.

Improving circularity by closing nutrient cycles through automated feeding and manure treatment

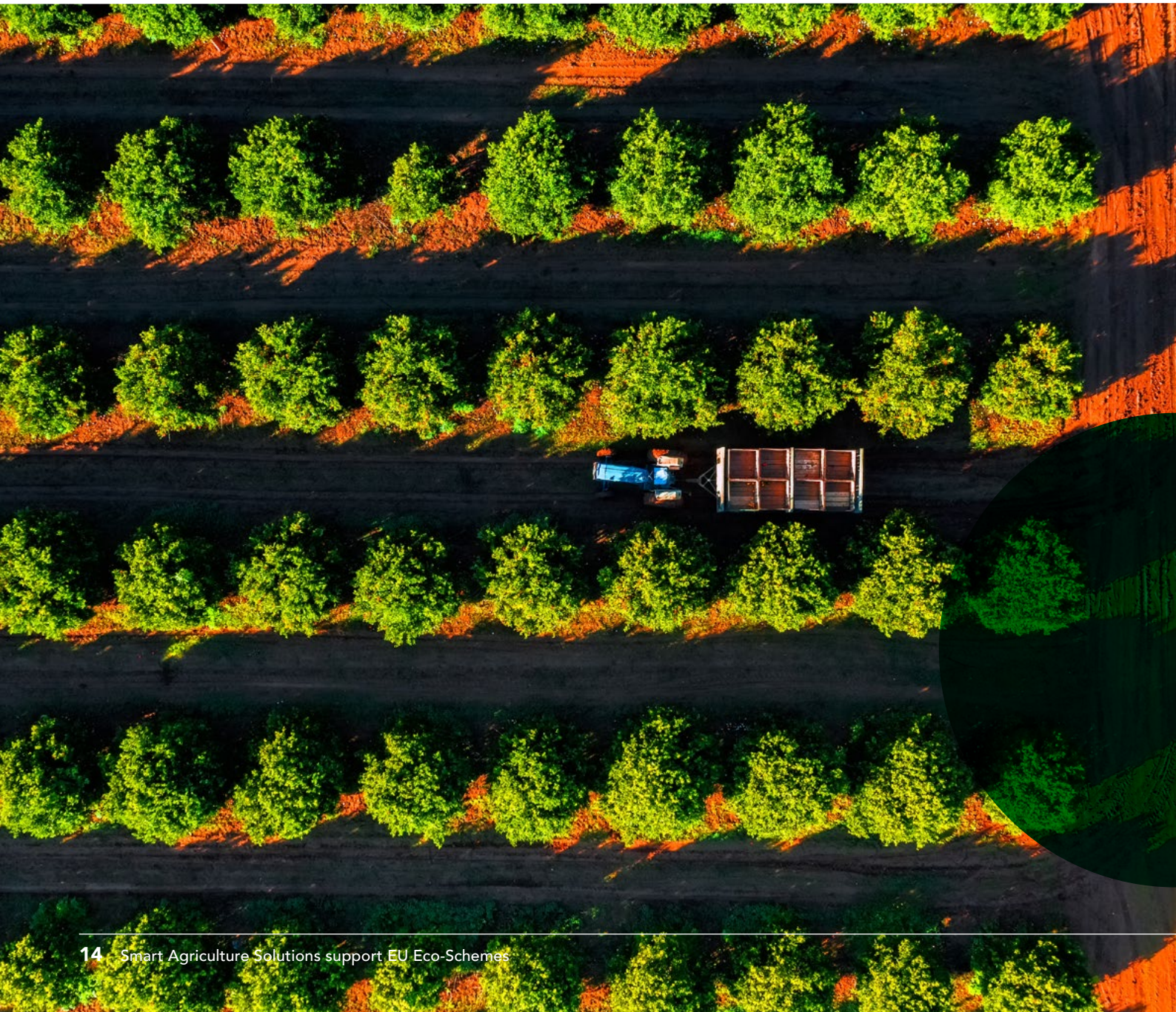
Source: courtesy of CEMA Member

[11] Source: VDMA Agricultural Machinery Association

3. Opportunities for smart agriculture solutions implementation

New EU Eco-Schemes resulting from the Farm to Fork Strategy and the Biodiversity Strategy need a high level of digital transformation and Precision Ag Technology to be successful. Therefore, modern farm machines and smart farming solutions should become an integral part of EU agriculture.This is where the post-2020 EU budget framework within and beyond CAP could help increasing PATs uptake by bringing broadband and 5G connectivity to rural areas, everywhere.

It is also critical to allocate sufficient EU funds into research & innovation programs in the Precision Ag space to speed up the next generation technology maturity and its broader implementation in the field. Moreover, education, training and extension service opportunities for farmers are as important triggers of PATs uptake as technology availability and good connectivity in rural areas.



Looking ahead, we consider CEMA members' technology solutions to be an important enabler of sustainable European agriculture. CEMA is committed to further develop existing and emerging PATs to support the diversity of agriculture and farming practices across Europe. PATs should be accessible to all farm sizes and applicable in different farming settings (organic, conventional, arable crops, vegetable open-fields, specialty crops and also for animal husbandry).

We understand that it is crucial to lower the threshold (the size of the farm) at which modern PATs will be taken up. It should not be for large scale Ag operations only. We are committed to further develop our solutions and help make them usable for all farm sizes and production types of farms. In this regard, we explicitly call on individual EU Member States to adopt adequate support mechanisms for modern PAT solutions in their national CAP Strategic Plans. This can be only achieved by considering a clear connection between the use of PATs and delivering on new Eco-Schemes. Also, dedicated farm investment programs in CAP Pillar II can be an important enabler of PATs uptake. There is a room for improvement to noticeably increase farm investment support at the Member State level.

Most critically, as it was mentioned before, smaller farms with an annual turnover below 25,000 EUR usually cannot afford smart technologies on their own and must rely on agricultural contractors' support. However, contractor services have been excluded from the CAP funding so far. Since the current CAP framework provides more flexibility to Member States, they should consider designing their national CAP Strategic Plans in such a way that EU farmers of all sizes can access the PATs provided by agricultural contractors. Jointly with CEETTAR, CEMA has already proposed to set up a new and innovative incentive in the form of a "smart technologies voucher" to be allocated to farmers and European contractor services should be considered under the CAP framework to make smart farming accessible to smaller farms to be released by contractors[12]. If necessary, CEMA members would be willing to work closely with the EU institutions and individual Member States to help them design and implement "smart technologies voucher" programs in practice.

At CEMA, we are keen to ensure the value of our technologies through machine optimization, job optimization, and agronomic optimization. Today, we are significantly more engaged with farmers' agronomics than in the past, to help them produce in a more sustainable way.

[12] CEETTAR-CEMA (2019): Joint position on the Support of Precision Farming & New Technologies Uptake

Conclusions

In conclusion, we would like to underline the critical role smart technologies could play to adopt sustainable farming practices under the new EU Eco-Schemes. Future European agriculture can only move forward through digitalization and higher Precision Agriculture Technologies uptake. PATs improve farmers' ecological and economic outlook, increase the attractiveness of the agricultural sector for the younger generation, and help re-building consumers' trust.

To fully leverage the potential of PATs, European agriculture needs adequate CAP support mechanisms at the level of the EU and individual Member States:

- The proposed new EU Eco-Schemes should encourage the use of smart agriculture technologies by all EU farms - regardless of their size and production orientation;
- Targeted farm investment programs in CAP Pillar II should be enhanced as well;
- European agricultural contractors' services in Precision Agriculture space should be included into the CAP to make smart farming accessible to smaller farms;
- Within and beyond CAP: Precision Agriculture research & innovation, education, training and extension services, and better connectivity in rural areas are pivotal for the next generation of agriculture.

CEMA calls on individual EU Member States to broadly adopt new Eco-Schemes along with the above-mentioned support mechanisms for sustainable farming solutions in their national CAP Strategic Plans.