Circular Economy Lab & Observatory

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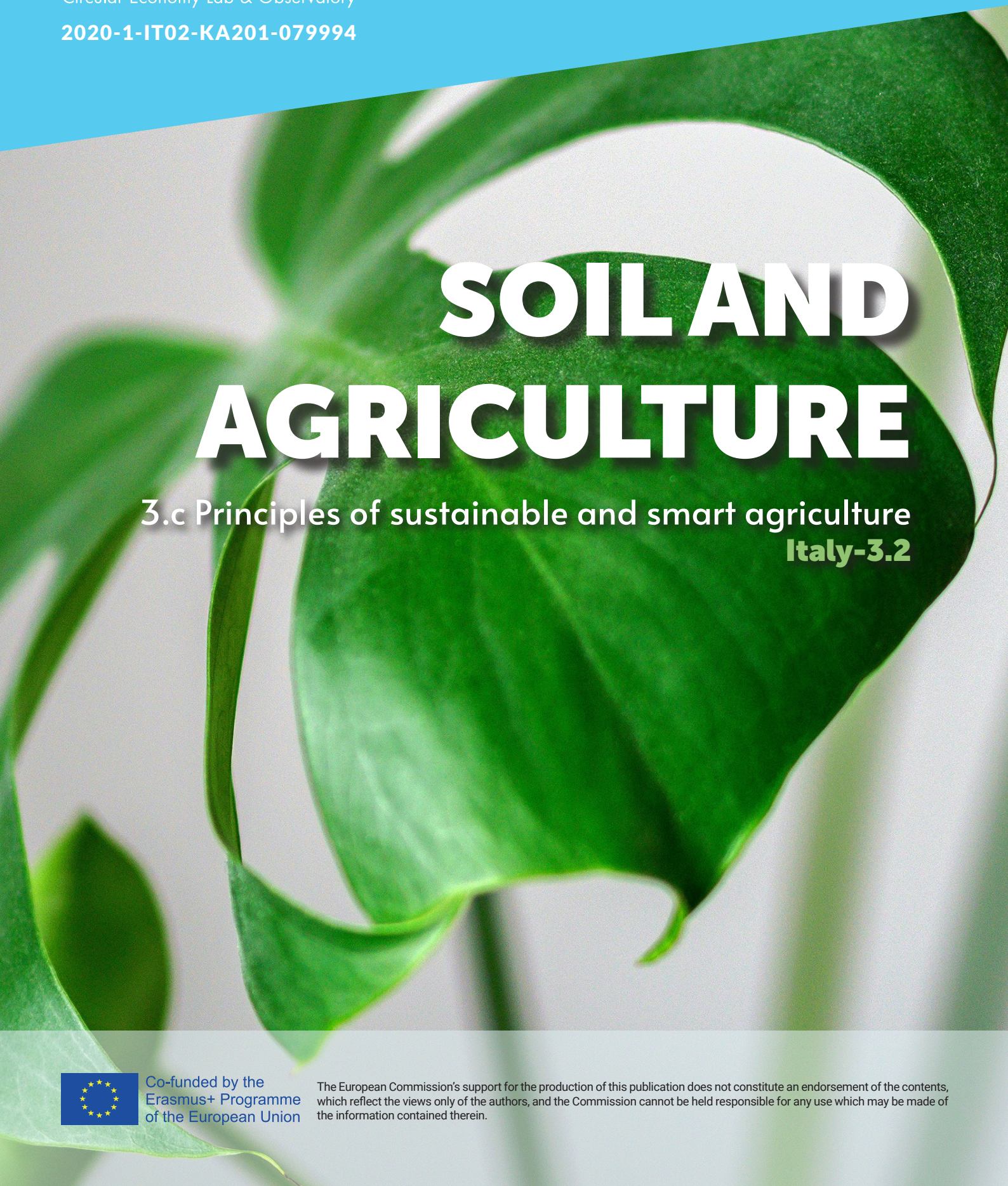

SOIL AND AGRICULTURE

3.c Principles of sustainable and smart agriculture

Italy-3.2

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Introduction

In the last decade, in an increasingly digital world, precision agriculture is adapting a whole series of applications useful to farmers who typically use their perceptual sensory systems to monitor crop health and needs. The new agronomic applications allow us to achieve more accurate diagnosis systems. Thanks to projects, some platforms have been created that can help improve productivity, international agricultural practices and reduce greenhouse gases.

Life in your hands (picture by K. Calabretta)

However, the basic idea of all platforms is that having up-to-date data on weather conditions, crop status and soil conditions available allows immediate and effective operational decisions to be made.

So digital technologies play an increasingly important role in helping farmers become more sustainable. [1]

Sustainable agriculture uses and integrates local natural resources with the aim of: maintaining and improving soil fertility, favours a more efficient use of water, increases the biodiversity of cultivated plant species and animals, protects biodiversity in soils and in the environments; ensuring nutrition for human beings despite the impact of climate change and the increase of the population on earth, respecting water, land and biodiversity. [2]

These are the goals of sustainable agriculture, which can reap the great benefits of emerging technology such as IoT, data analysis and the Blockchain in the so-called Agriculture 4.0. Despite trying to be more sustainable, the agricultural field still has a strong impact on the environment. Among the most critical factors there are: greenhouse gas emissions from farms and the use of pesticides, which harm the biodiversity of territory.

Nature is a good friend (picture by K. Calabretta)

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More and more land is suffering from a serious lack of protection, which consequently becomes unsuitable for agriculture, and also due to continuous pollution, more and more agricultural products and jobs are decreasing.

The constant climatic variations negatively affect the seasons and the crop's yields.

Moreover, there could be the risk of the proliferation of species extraneous to that particular ecosystem, which could lead to further damage to an already fragile soil.

All this could be counterbalanced by some agricultural practices, for example a different rotation of crops in order to save as much water as possible and avoid waste and vary with less intrusive agricultural techniques. [4]

PROBLEM'S DESCRIPTION

Traditional agriculture has had a very negative impact from an environmental point of view. The main problems encountered are:

– Desertification: for the inappropriate use of the water and soil. In general, this phenomenon depends on an intensive exploitation of the soil by a population that is unable to manage it in a sustainable way, both in cases where the land is intended for grazing, and in that in which it is used for industrial purposes. The main consequence is the abandonment of the land due to the loss of fertility. Land take (that is, land used for urban settlements) and soil sealing aggravate this problem.

– Fragile soil: over-exploitation of the soil through deep ploughing and heavy machinery or deforestation, makes the soil very fragile.
Removing the arable layer of the soil creates a problem as it is no longer able to absorb water, generating some tragic consequences:

1. Water is no longer able to infiltrate, increasing the risk of flooding.
2. There is a great loss of organic carbon rich in mineral salts.
3. Evapotranspiration in urban areas is reduced due to the loss of vegetation.

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Lifeless ground (picture by K. Calabretta)

– Water, soil and air pollution: due to polluting products, mainly fertilisers and pesticides. Pesticides (both herbicides and insecticides) can reach surface water and groundwater. Once groundwater is polluted with toxic chemicals, contamination could last for years.
Cleanup may also be very costly and complex, if not impossible. [10] These compounds are toxic for humans and other animals and plants.

They are not only present in water, but also in the soil and in the air. In the soil they reduce the population of beneficial microorganisms and/or impair their functions. Fertilisers often involve the accumulation in the soil of nitrates,or highly polluting nutrients (nitrogen and phosphorus) and the acidification of the soil. Among other causes of water pollution are the discharges of industrial and agricultural activities and the usual human activities. The causes of water pollution reach the seas, through surface aquifers, rivers and lakes.

– Atmospheric pollution: for the emissions of toxic gases present in pesticides and fertilisers, and greenhouse gases. In general, it is estimated that Agriculture, Forestry and Land Use directly accounts for 18.4% of greenhouse gas emissions, where Livestock & manure accounts for 5.8%, and Agricultural soils contributes for 4.1%. [7]

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– Alteration of the ecosystem: elimination of harmless insects but sensitive to poisons (pesticides), therefore flattening of biodiversity.

There are various factors of biodiversity loss such as the destruction, degradation and fragmentation of habitats, in turn caused both by natural disasters and above all by profound changes in the territory by man.

Ground ready to be cultivated near industrial sites (picture by K. Calabretta)

POSSIBLE SOLUTIONS

To contribute to the growth of sustainable agriculture, Greenpeace collaborates with farmers and rural communities. According to the environmental association there are 7 principles for sustainable agriculture.

Among these, the most significant are: control of the food chain by consumers and producers - nowdays the corporations are basically in charge of it; meat consumption should be reduced, as well as the land use for bioenergy production (it should be considered as the last option, priority are crops for human consumption); promote nature's diversity during all steps of the supply chain; promote suitable farming practices and eliminating those that consume and contaminate the soil;contrast of pests and weeds using biological control and organic practices, without or with the minimun amount of chemical pesticides, that could be dangerous for ecosystems and human health (both consumers and farmers). [9]

Other possible solutions and strategies to the problems listed above can be:
– protect natural resources. The Earth provides us with everything we need in the form of natural resources to grow food and live a healthy life. These resources are land, water, animals and plants. Without water and land, food could not be grown, and we will have difficulty growing healthy and nutritious food if the water is polluted or if the soil has been stripped of all the rich minerals that make it fertile.

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If we want to be able to continue growing safe and nutritious food for all, we must protect our natural resources; [5]

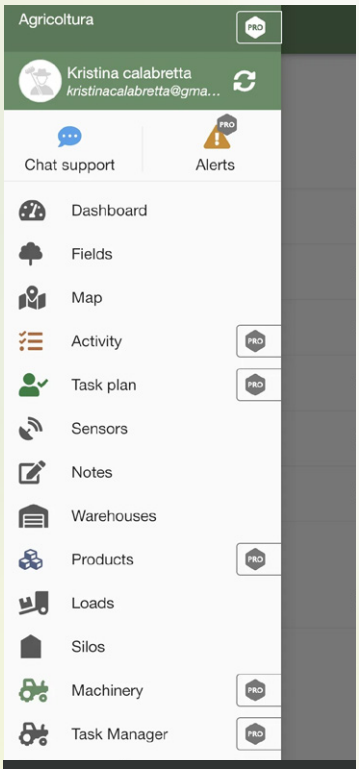
Smart farming with agriculture IoT - Image by rawpixel.com on Freepik

– food sovereignty: sustainable agriculture contributes to development of rural communities, and fights against hunger and poverty, guaranteeing the availability of healthy, safe and economically sustainable food;
– produce and consume better, especially avoiding food waste;
– increase the use of the agro-photovoltaic sector which is not yet widespread and has a hybrid nature, it is half agriculture and half renewable.

It is a sector that promotes the production of renewable energy through solar panels without burying productive land for agriculture and livestock but rather by integrating both activities.

This system represents a solution to reduce the conflicts between agricultural and electricity production. Agrophotovoltaics had a first historical phase with photovoltaic greenhouses, created to give support for photovoltaic modules to be placed on land on which it would not have been possible to install systems; [8]

– increase the use of smart control units which is an excellent way to limit the waste of energy and resources. These devices allow you to automatically distribute the correct amount of water. When the control unit is connected to the internet via Wi-Fi, it will be possible to adjust the frequency of watering based on the weather forecast. For example: Irrigation will stop in case of heavy rain. Conversely, the amount of water will increase if there is no precipitation. You can also decide to connect the system to a smart weather station for better results.
By analysing air pressure, humidity and other factors, these products allow you to obtain reliable forecasts and keep weather conditions under control. There are many online services available for farmers to manage their fields, they use sensors, software, and cloud platforms. [3]



Screenshot of the App xFarm used to monitor and manage cultivated fields (picture by K. Calabretta)

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CONCLUSIONS

It is now clear that traditional intensive agriculture is not a solution to provide food to an everyday growing population. It could work for some time, but, in the long run, the side effects are harmful to the environment. It is time to move towards sustainable agriculture. New tools are now available to maintain healthy soil and clean water, and manage these resources wisely. Sustainable agriculture repudiates the use of chemicals and protects the soil from erosion, pollution and acidification.

This is because it maintains or develops the organic component of the soil (for example compost or manure), feeding the variety of organisms present within it.

Sowing the ground (picture by Calabretta K.)

At the same time, this ecological production model protects water from pollution and aims to use it as efficiently as possible, and also to produce in a smart way that reduces the food we waste every day.

Apart from the practices that can be carried out in the fields, what can make the difference are the policies that the policy makers will put in place.

Gift of nature (picture by K. Calabretta)

Of course there are already policies at local, regional national levels. The first step should be to adjust them to promote the scaling up of smart agriculture.

And before doing that, current policies need to be analysed and corrected if needed.

The second step could be the formulation of new policies to cover the areas of intervention that are not covered by the existing ones. Examples could be fiscal benefits. [12]

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Smart agriculture seems to be convenient for everyone in the long run, but to quickly encourage the shift from traditional to climate-smart agriculture, policy makers should take into account environmental needs of different areas, accompanying with incentives for producers and other stakeholders, so that they can find convenient now to adopt these new practices.

Smart farming can make agriculture more profitable for farmers. Decreasing resource inputs will save the farmer money and work, and increased reliability of data will reduce risks. Only cooperation between private sector (farmers, producers of needs for agriculture), civil society (consumers) and institutions could create a good environment for implementing of climate-smart agriculture.

These groups need to work together with governments and development agencies in order to find the right solutions.

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