The Role of Standards & AI in enabling integrated Precision Agriculture

Precision Agriculture: A Digital Transformation for policymakers.

Figure 1 Source: Humphrey Malone (Advancing Agriculture)

Introduction

Digital technologies are revolutionising agriculture. This paper explores how the Internet of Things (IoT) sensors, standardised communication protocols, and artificial intelligence (AI) are being used to create a new era of sustainable farming. By using data-driven insights, farmers can optimise resource use, reduce waste, and improve crop yields. This innovation will lead to a more secure and abundant food supply for consumers, potentially at lower prices.

However, ensuring transparency in the licensing of Standard Essential Patents (SEPs) is crucial. SEPs are key technologies driving precision agriculture, and fair licensing practices are vital to avoid hindering innovation in this critical field.

Precision Agriculture in Europe

The Europe Precision Farming Market[1] size is estimated at EUR 3.18 billion in 2024, and is expected to reach EUR 6.46 billion by 2029, growing at a CAGR of 15.30% during the forecast period (2024-2029).

[1] https://www.mordorintelligence.com/industry-reports/europe-precision-farming-market/market-size

According to the European Commission, precision agriculture can help increase crop yields and animal performance, reduce costs, and optimise the use of fertiliser inputs. The EU Commission has set up a system called the Common Agricultural Policy (CAP) Network[2] in order to share information regarding the innovations taking place within the farming and forestry sectors. In the CAP 2023-2027, Operational Group projects (OGs) continue to be a key tool for innovation and knowledge exchange. By December 2023, over 3,400 projects have been reported in the European Commission's database, and more projects are expected to be notified by the end of 2025.

An integral part of this network is EIP-AGRI, this is the European Innovation Partnership with a special focus on agriculture. Funding for these programs is made available through the EU's Horizon Program[3] .The goal of this program is to create knowledge and innovation for sustainable agriculture, forestry and rural communities. A selection of finalists in a recent EU innovation event[4] is captured below. The move to Precision Agriculture involves an increase in the application of IoT sensors to measure a variety of parameters including heat, moisture, location, Ph and nutrient levels. The data gathered by the sensors is collated then sent directly to the Cloud for processing or processed locally using Edge processing systems. The resulting information is used to automate and fine tune the agricultural processes underway. Some examples of the applications are given below. The operation of these systems increasingly relies upon sophisticated telecommunication systems to gather the data, transmit it to the processing centres and then provide information/ instructions to the farming machinery.

Precision Agriculture is an important factor in the digitisation of Europe's rural areas. It goes hand in hand with other EU initiatives E.g. Smart Villages the Smart Rural initiative in Slovenia[5] being an example of another policy intervention. In Scotland, the concept of the Digital Blacksmith[6] was developed on the Isle of Arran and is designed bring educational benefits to rural island communities. Historically the local blacksmith's premises formed as a meeting place for locals to socialise in as their horses were being attended to.

[2] https://eu-cap-network.ec.europa.eu/about/eu-cap-network_en

[3] https://eu-cap-network.ec.europa.eu/horizon-europe-creating-knowledge-and-innovation-sustainable-agriculture-forestry-and-rural_en

[4] https://capnetworkireland.eu/eip-agri-innovation-awards-2024-for-operational-groups/

[5] https://www.smartrural21.eu/countries/slovenia/

[6] https://digitalblacksmith.org/

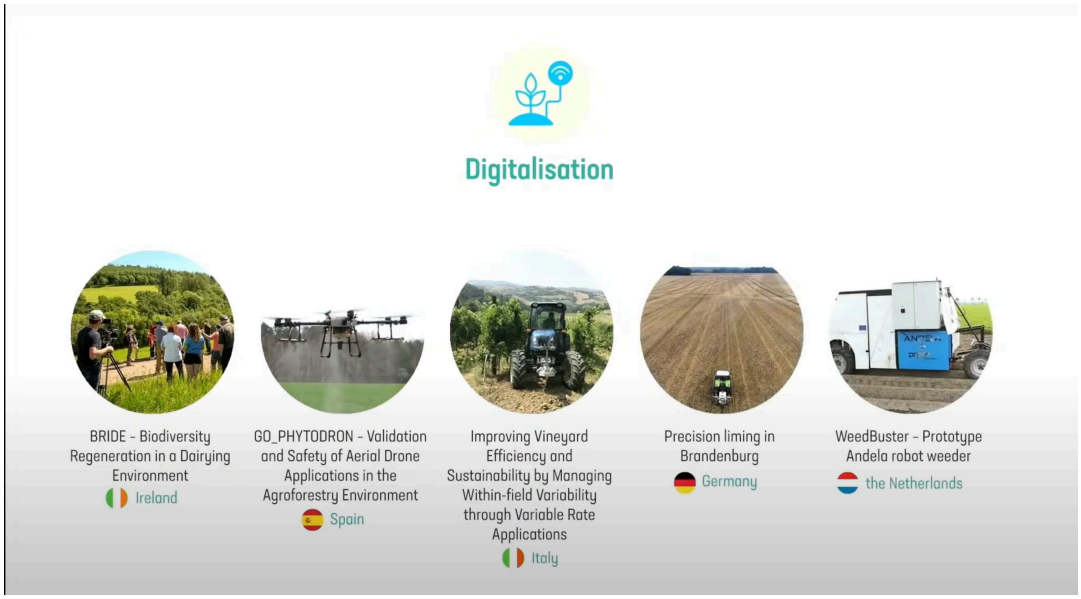

Figure 2: Source EU Commission

A recent study on the application of precision agriculture technologies in Central Europe, published in the Journal of Agriculture and Food Research [7] noted that in many of the selected countries researched, there is a growing interest in the application of Precision Agriculture as well as in the development of new AgriTech start-ups.

The role of AI in Precision Farming

A proliferation of low-cost connected IoT sensors makes it cost-effective to monitor large areas of farmland. Data from these sensor networks can be used by AI applications to transform precision farming by enabling data-driven decision on the farms. AI models can analyse historical data and current conditions to predict crop yields, potential pest infestations, and disease outbreaks. This allows farmers to take proactive measures, such as targeted irrigation or pest control, to optimise yield and minimise resource use. AI-powered image recognition can also be used to analyse data from drones or satellites to detect early signs of disease, nutrient deficiencies, or pest damage in crops. This early intervention reduces reliance on pesticides, promoting sustainable practices. In addition, AI can analyse data on soil conditions, weather patterns, and crop growth to determine the optimal application of water, fertilisers, and pesticides. This reduces waste and ensures crops receive the resources they need for optimal growth. However, these innovations do require investment in infrastructure. The most important of these is the necessity for improved broadband coverage in rural areas. The practical difficulties in obtaining rural coverage are highlighted in the recent update on the European Commission's National Broadband Plan[8]. Additionally, forward looking developments in telecommunication spectrum allocation and smart transportation will allow the creation of new processes and procedures in agriculture.

[7] https://www.sciencedirect.com/science/article/pii/S2666154324000851
[8] https://digital-strategy.ec.europa.eu/en/library/updated-study-national-broadband-plans-eu27

Grapehawk-Innovation in AgriTech

One area of rapid growth is the use of drones to monitor fields, forests and waterways.

The drone in the picture below was developed by the company Grapehawk[9] based in France and Brazil. They have developed drones for operation in vineyards of up to 350 hectares. These drones have AI smart multispectral camera (NVIDIA Jetson[10] for AI real-time image processing) to identify disease within the vineyard. Drones equipped with Jetson and GPS can create detailed 3D maps of fields, helping with tasks like measuring land area, planning irrigation systems, and identifying potential drainage issues. Smart drones offer a powerful tool for precision agriculture, enabling farmers to collect rich data, leverage AI for analysis, and make informed decisions to optimise crop yields, resource use, and overall farm operations.

The Grapehawk drone below is loaded with high performance antennas and capable of measuring biomass and moisture above and underground. Its sensors operate in three radio bands, C (4-8Ghz), L(1-2Ghz), and P (224-480M hz). Other applications include cattle counting and weed identification in sugarcane plantations.

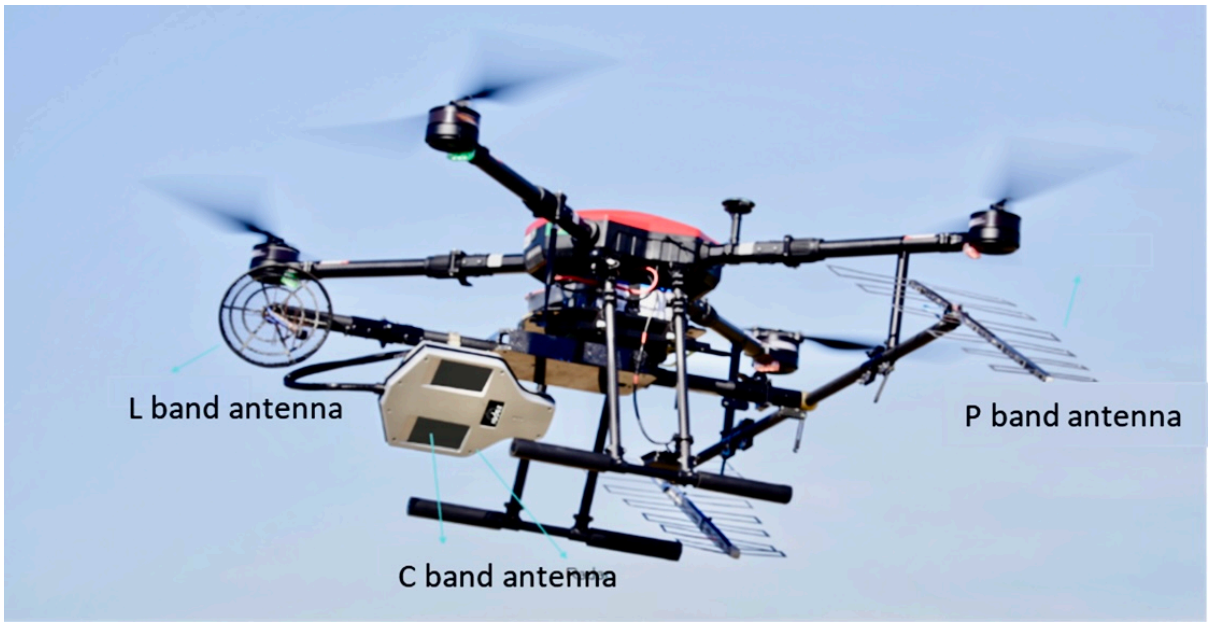

Figure 3: Source Grapehawk

These applications demonstrate how innovations in sensing, communications and farming are driving innovation in precision agriculture.

Grapehawk uses sensors to gather real-time data on soil conditions, weather, and plant health. This data is then stored and managed on cloud platforms, which allows farmers to access and analyse it from anywhere. Reliable internet connectivity is essential for transmitting and analysing this data. Once analysed, the data can be used to implement precision practices,

[9] https://www.grapehawk.com/
[10] https://www.nvidia.com/en-gb/autonomous-machines/embedded-systems/

such as targeted irrigation, fertilisation, and pesticide application. This can lead to increased efficiency, productivity, and profitability. In addition, data-driven decision-making can improve farm management and sustainability. For example, farmers can use data to optimise resource use and reduce their environmental impact.

Consumer Benefits derived from Precision Agriculture

Encouraging farmers to invest in precision agriculture technologies is not just about farm efficiency and profitability, it's a policy initiative that can deliver significant benefits to European consumers. The consumer's food becomes more organic. By using targeted application of pesticides and herbicides, precision agriculture reduces overall use. This minimises potential chemical residue.

This higher quality food then becomes more affordable, increased crop yields and reduced waste due to optimised resource use can lead to more stable and potentially lower food prices. In the same way as the introduction of the EU's Digital Product Passport[11] will improve the traceability of manufacturing processes so consumers may have access to information about the origin and growing practices used for their food, thanks to data collection in precision agriculture.

Precision techniques can help mitigate the effects of weather on crops, potentially leading to a more consistent supply of your favourite fruits and vegetables throughout the year. Improved efficiency and planning throughout the agricultural process can minimise food spoilage at the farm level, ultimately leading to less food waste.

In essence, for the consumer, precision agriculture promotes a more sustainable food system and potentially lowers food prices through efficient resource management.

[11] https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/sustainable-products/ecodesign-sustainable-products-regulation_en

Figure 4: Source Faileas

Innovation, Politics, Standards and Regulation-a cause for concern?

The concern in the field of Precision Agriculture centres around the use of a certain category of patents used to develop this market. Patents are a type of intellectual property right that protects technical inventions. In other words, it gives the inventor or owner exclusive rights to the invention for a certain amount of time. This encourages people to invest in research and development because they know they will be able to profit from their creations.

The role of Standards in Precision Agriculture

The flow of data from the drones and IoT sensors to the Cloud for processing requires wireless communication. For these solutions to be deployed in different territories and use cases interoperable wireless and video standards are required. These standards are built using special class of Patents called Standard Essential Patents (SEPs). In Europe, the European Intellectual Property Office[12] (EUIPO) provides guidance and governance in this domain.

It's not just communication protocols that uses SEPs. Agricultural machinery working remotely may require to return to an unmanned base to charge. One of the techniques to recharge devices without manual intervention is wireless charging. A recent study by the

[12] https://www.euipo.europa.eu/en

Iplytics group[13] found that even in the relatively new domain of Wireless Charging (Qi) the number of patents active has been growing steadily over time. (see Figure 1 below).

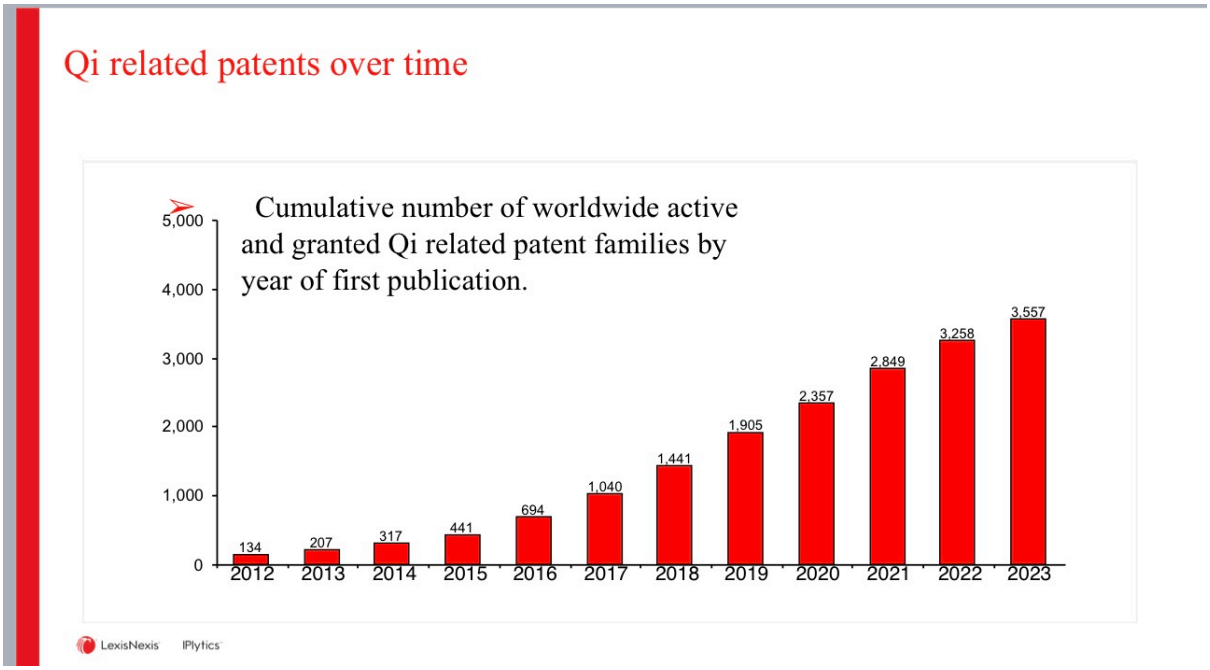

Figure 5:Source iPlytics Gmbh

As noted above SEPs are patents that are necessary for a certain technology to work in an interoperable manner. For example, many of the patents used in mobile phone networks are SEPs.

Many standards are based on patented technologies. In the mobile telecommunications sector, for instance, 2G (GSM), 3G (UMTS), 4G (LTE), 5G and WiFi networks all use SEPs.

The dominance of big companies in SEP licensing is shifting. Traditionally, SEPs were used in products made by large telecom and tech firms. Now, smaller companies in the IoT space are increasingly using these standards. This means SEP licensing is becoming more important for key European industries like agriculture, smart energy, manufacturing, transportation and health. While big companies still license SEPs to each other, there are more companies now that only make SEP-based products (without owning the patents) or only own SEPs to license (without making products).

The problem is that innovators, small and medium sized businesses (SMEs) and start-ups in the agricultural sector lack awareness of the patents behind the IoT technologies they are using. In most cases, they are unaware that they are using technologies that are patented and the patent owner has the right to charge a royalty fee on top of the cost of the component they are using.

[13] https://www.lexisnexisip.com/qi-wireless-charging/

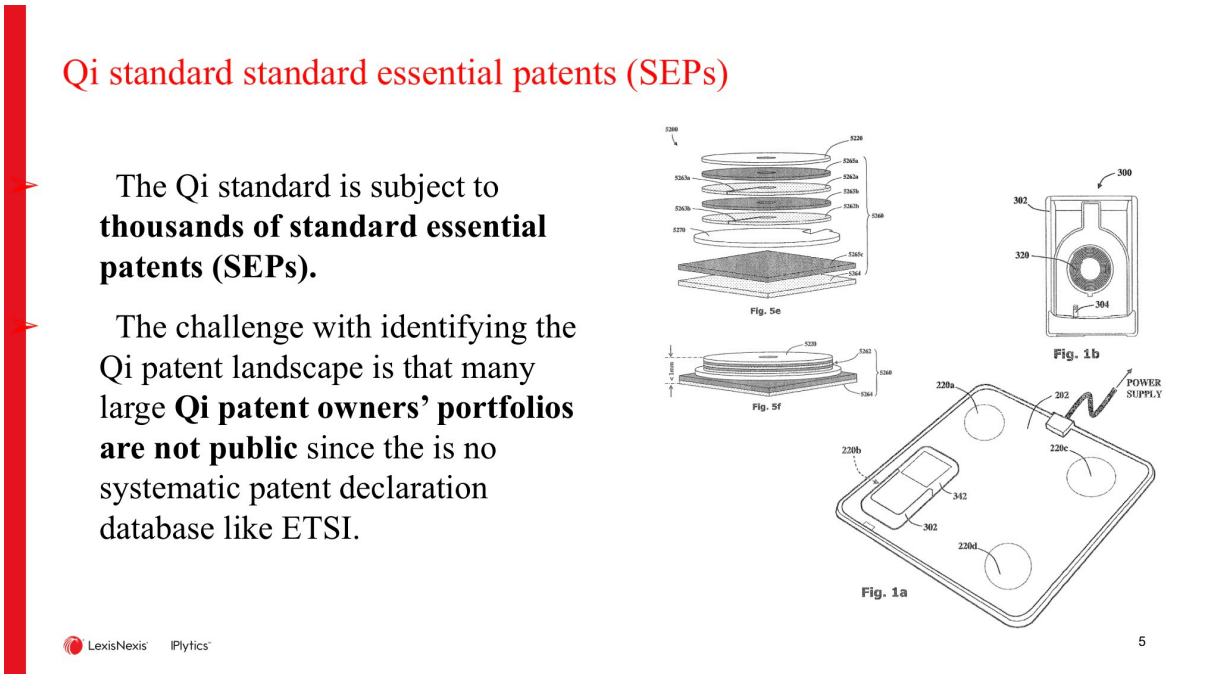

Figure 6: Source iPlytics Gmbh

The figure above from Iplytics serves to highlight the issue. The wireless standard Qi is subject to thousands of SEPs with very little information about who owns what in the public domain. This lack of transparency is one of the factors that led the European Commission to take action in the licensing of SEPs.

The balance between the interests of those who hold the patents and those who want to use them is broken. The fair, reasonable and non-discriminatory (FRAND) terms have become unfair, unreasonable and discriminatory against the companies that want to use the patents. Small and medium sized businesses and start-ups struggle to afford legal and technical advice and so suffer from the high costs and legal uncertainty caused by this situation.

A few abusive SEP holders are intent on extracting supra-FRAND terms. This posturing is being reinforced with the threat of expensive litigation and ultimately the application of injunctions.

The European Commission and the regulating of SEPs

In its 2020 intellectual property (IP) action plan[14], the Commission highlighted the existing dispute and litigation issues surrounding the licensing of SEPs, which is often a cumbersome and costly exercise for both patent holders and technology implementers.

The proposal for the EU SEP regulation was first published on April 27, 2023 by the European Commission.

The commission found that SEP licensing faces challenges that create uncertainty and hinder both implementers and holders. Companies using the standards (implementers) struggle with a lack of transparency. They're unsure who owns the essential patents (SEPs) and have difficulty judging the fairness of royalty fees due to limited information. Disputes over

[14] https://ec.europa.eu/commission/presscorner/detail/en/IP_20_2187

FRAND terms can be extremely expensive and time-consuming in national courts[15][16]. This situation also puts pressure on SEP holders. Increased competition from new players may force them to change their licensing models. The IoT market, unfamiliar with SEP negotiations, faces additional complexity and high costs. Finally, inconsistent rulings across different national courts make it difficult to get clear FRAND determinations. These challenges discourage innovation for both sides, potentially harm overall market competitiveness, and could even weaken supply chain security.

Regulation-Current Status

On February 28, 2024, the European Parliament approved regulation[17] aimed at improving SEP licensing practices. The regulation aims to bring more transparency and establish a framework to facilitate fair, reasonable, and non-discriminatory (FRAND) licensing of SEPs.

A central body at the EU Intellectual Property Office (EUIPO) would be established to manage a register of SEPs and a database. SEP holders would be required to register their SEPs with the EUIPO. Procedures for essentiality checks and FRAND determinations are included in the regulation.

It's important to note that while the European Parliament passed the regulation, it still needs to be negotiated and approved by the EU Member States before it becomes law.

Conclusion

The analysis of the market potential for precision agriculture in Europe paints a promising picture of substantial growth in the coming years. This growth is being supported by initiatives like the European Commission's Horizon program, which fosters sustainable innovation in agriculture through its EIP-AGRI partnership. The rise of AgriTech using AI plays a critical role in supporting these initiatives. It is a testament to the power of global collaboration, as exemplified by the SME Grapehawk, which brings together teams in France and Brazil to address complex agricultural challenges.

At the core of AgriTech lies the power of data collected from Internet of Things (IoT) devices in rural landscapes. This data is transmitted via a digital network to the cloud for processing and analysis, generating valuable insights that can be relayed back to farms to optimise operations. The standardised technologies underpinning these broadband and narrowband data pipelines are the result of contributions from numerous companies around the globe.

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[15] 'Case C-170/13 Huawei Technologies Co. Ltd v. ZTE Corp. and ZTE Deutschland GmbH [2015]EU:C:2015:477.

[16] UKSC 0214.Unwired Planet International Ltd and another v. Huawei Technologies (UK) Co Ltd and another [2018]

[17] https://www.europarl.europa.eu/doceo/document/A-9-2024-0016_EN.html

Policymakers have a significant role to play in ensuring a legal and regulatory framework that supports the continued growth of precision agriculture. A key aspect of this is ensuring affordable and widespread connectivity in rural areas.

Additionally, policymakers must take action to curb excessive licensing practices by a small number of bad actors when it comes to Standard Essential Patents (SEPs). Properly regulated SEPs are essential to unlocking the full potential of precision agriculture by providing SMEs with unfettered access to the essential technological building blocks at a fair price.

Figure 7:Source Faileas