SUMMARY AND REMARKS - SESSION 2: The role of agriculture mechanization in crop production traceability

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1. Introduction

Nowadays, social welfare, sustainability, decarbonization and digitalization are no buzzwords anymore but become more and more the basis for future social, political and economic decisions. Of course, these trends will have an impact on the agricultural crop and food production. One impact could be an increased demand for traceability.

Therefore, the Club of Bologna puts the focus on this topic, by presenting and discussing different aspects of the role of agriculture mechanization in crop production traceability. High-level experts hold presentations that were discussed by different representatives of research and scientific communities as well as from the industrial sector and international associations. Three different presentations were held by Raffaello Prugger, the general director of Tecnoalimenti S.C.p.A., by Friedrich Lüdeke, who is consultant for standard management (crops) and trainer within GLOBALG.A.P, and by Matteo Masin, who is global manager for precision technology at New Holland Agriculture of CNH Industrial.

2. Traceability status and trends

Raffaello Prugger reported about the origin of traceability framework, the status and challenges as well as about future trends of traceability in agricultural crop production. He is the general director of Tecnoalimenti S.C.p.A., which is a non-profit research consortium specializing in agrifood research management that is composed of 28 agrifood industries.

The origin of traceability is conducted to a series of food scandals, e.g. mad cow crisis (1996), dioxin contamination (1999) and the horsemeat scandal (2013). All these scandals demonstrate the deficits in the European (EU) food and feed regulation. Consequently, the food business reinforced their tools to track and trace the food supply chain upstream and downstream to ensure better food chain integrity and food defense as well as more transparency and authenticity. On the other hand, the customers start to require more and detailed information about the purchased food and products.

The purpose of traceability is to keep track of and to record the history of an item to comply with regulations. Currently, the most important traceability related regulations are: ISO 22000:2005; ISO 22005:2007; Reg. (EU) 178/2002; Reg. (EU) 1935/2004 and Reg. (EU) 1829,1830/2003. Further, traceability is the ability to identify the provenance, the motivation and the relation between components of a product, resulting in the basic principle of linking an information flow to the physical flow of a product. Within the EU two labels and trademarks, called "Protected Designation of Origin (PDO)" and "Protected Geographical Indication (PGI)", are existing to prove the products origin, its ingredients and its processing approach. Finally, by applying an information flow onto the physical flow of a product, the food product can be seen as a "meta-product" consisting of three layers (**Figure 1**). The inner layer is the edible itself, which is probably the less costly component. The next layer represents the packaging of the product and the third layer is representing the information and labeling belonging to the product. This layer is getting to be the most valuable part of the product.

The benefits of traceability should be a better brand image and inventory tracking as well as higher customer service and trust which should lead to higher feasible market prices of the product. However, it remains open to which extend the customer is willing to pay the extra price. Further, traceability should offer a better food safety and public health due to less food recalls and counterfeits. At least in

the EU market, 1400 food recalls exist in the year 2022 (2020 RASFF) with an average cost of about 1 to 8 million euro. The range of counterfeited products is about 5 to 7 percent compared to the overall food production within the EU.

Currently, traceability is a compulsory component of the food law. It is frequently fulfilled as administrative analog and digital paperwork and thus potentially subjected to failures and frauds. Therefore, reliable data, digitalization and interoperability of data along the entire food production chain are of high importance for a practicable and reliable traceability (**Figure 2**).

For the future, five main outlooks are identified with regard to food traceability. First, it should be very important to start with traceability from the very onset of the food chain, meaning that precision and digital agriculture is mandatory to generate the basic origin data. Second, the market size for agriculture analytics will extend strongly within the next years, starting with a volume of 0.8 billion USD in year 2020 and forecasted to be around 1.4 billion USD in year 2025. Third, traceability follows the trend of data driven consumer preferences of the generation Y (1980-1994) and the younger generation Z (1995-2010). The forth outlook is that traceable data will be valuable for the food market because it can increase the value of a product from a customer point of view due to the fact that it satisfies the consumer preferences of the younger generations. The fifth and final outlook is that the importance of data traceability will raise because it is required to evaluate sustainability metrics of agricultural production such as defined by the EU green deal (**Figure 3**).

In the discussion following the presentation, the CoB members pointed out, that traceability will have an impact on the cost of a product but it is not clear who will pay the extra costs. There could be a risk, that retailers sell traceable products for a higher price to the customer because they have a value-added. On the other hand, retailers could force the farmers and producers to deliver the information and spend the cost. Therefore, it was recommended that some strategies should be implemented so that traceability will become an instrument for market transparency and not a luxury feature, which potentially increase the gap between rich and poor or even exclude poor customers and producers/farmers from full traceability.

3. Demands of retailers

Friedrich Lüdeke, who is consultant for standard management of crop production and trainer within GLOBALG.A.P, reported about the demands of retailers and the specific initiative of GLOBALG.A.P standard. The roots began in 1997 by an initiative of retailers that belong to the euro-retailer produce working group. British retailers who worked together with supermarkets in central Europe get aware of consumers growing concerns regarding product safety, environmental impact, social responsibility, as well as safety and welfare of workers and animals. As an outcome, they harmonize their own standards and procedures to develop an independent certification system for Good Agricultural Practice (G.A.P.). The defined and Europe-wide accepted standards (EUREPGAP) helped producers to comply with criteria to fulfill food safety, sustainable production methods, worker and animal welfare, responsible use of water as well as compound feed and plant propagation materials. In addition, the production costs could be reduced, because producers just need to comply with one uniform standard compared to several individual standards before.

The EUREPGAP was a success story within the European market. Due to the increasing globalization, more and more producers and retailers from all over the world participate to that system. To satisfy its global reach and the goal of becoming the leading international G.A.P. standard, EUREPGAP changed its name into GLOBALG.A.P. in 2007. Today, it is the world's leading agricultural business management program, which transfers consumer requirements into good agricultural practice in a rapidly growing list of countries. Currently, it certifies more than 208,000 producers in more than 130

countries (**Figure 4**). To assure that all standards are fulfilled, more than 2,000 inspectors and auditors work for 172 accredited certification bodies around the world.

In the beginning, the use of market labels for GLOBALG.A.P. certified products was not possible because the certification took only place on producer level and not along the entire supply chain. The first labeling was possible with the introduction of the "Chain of Custody (CoC)" certification in aquaculture and in flowers and ornamentals. Both product groups had their own logo (**Figure 5**). In 2021 the GLOBALG.A.P. logo (GGN label) for all certified loose and packed products was introduced (**Figure 5**). This label confirms that the products are produced in line with certified, responsible farming practices that cover food safety, environmental protection, animal welfare, social responsibility and supply chain transparency.

Responding to the growing demand for stronger quality assurance, the GLOBALG.A.P. developed add-ons that enhance the certification in specific aspects of the agricultural production and supply chain, e.g. "risk assessment on social practice (GRASP)" or "sustainable program for irrigation and groundwater use (SPRING)".

Further, a focus group was established to improve the environmental sustainability module of the newest Integrated Farm Assurance standard (IFA) V6, provided by GLOBALG.A.P. It incorporates the latest scientific research as well as the data-driven and outcome-based approach for implementation on farm level. For the first time this standard contains continuous improvement to be relevant on an individual producer level, meaning that producers are required to analyze current practices, identify "hot spots" and set clear and measurable goals for improvement which will be checked year by year. This version covers the latest demands of retailers and is available as two parallel editions "IFA V6 SMART" and "IFA V6 GFS". The "IFA V6 SMART" edition fully covers the GLOBALG.A.P. philosophy and is appropriate for most producers, whereas the "IFA V6 GFS" is relevant for producers that require an additional certification by the "Global Food Safety Initiative" (GFSI).

4. Technological solutions to generate traceability: The case of harvesters

Matteo Masin, who is the global manager for precision technology at New Holland Agriculture of CNH Industrial, reported about technological solutions and requirements to generate traceability within the food production chain with special focus on harvesting technologies. He points out that the traceability of raw materials for the food industry depends on the ability of farmers to document and trace their harvesting and crop production activities over the years. In case of agricultural production, talking about traceability means to talk about what, where, how and when something is produced. To answer these questions, companies like New Holland should provide CAN-bus machine data and agronomy data combined with a GNSS position information.

Starting with first geo-referenced yield mapping systems at the end of the nineties, the technology has evolved from hardware and software point of view. Now, New Holland is able to provide 500 to 1000 data point information per hectare containing information regarding fuel consumption, engine load, moisture, etc. for various types of machines like combine harvesters, forage harvesters, tractors as well as balers. Each type of information, e.g. fuel consumption, is transmitted in real time to telematics portals like e.g. the MyPLMConnect portal offered by New Holland (**Figure 6**). Within these portals, the data is stored in different data layers per field to keep the origin of each data point and to allow the farmers to monitor agronomic performance and to track production. It is also possible to integrate information of third-party companies into these portals.

Today, harvesting machines are equipped with more and more sensors to document also the quality of the crop production, by measuring the ingredients of crops like e.g. protein content, starch content, fiber digestibility, ashes, etc. In addition, it is possible to document pre-harvest information as e.g.

applied fertilizer, fungicide, herbicide or tillage processes, etc. and post-harvest information as route tracking between field and storage facilities. By knowing this information, the farmer can demonstrate the origin and quality of the raw materials for the food production directly to the food or agro-energy industry via a digital portal or cloud services. This possibility offers benefit for the farmer as well as for the industry and improves the traceability within the food production chain.

Following the presentation, the CoB members underlined that new sensor technology need to be developed to measure more operative and quality parameters during the harvest and some of the pre-harvest processes. However, a potential problem of harmonizing the data sets need to be addressed, so that they are comparable between different machines and manufacturers. In addition, it was mentioned that there are a lot of harvesting processes existing where manual labor is still required, instead of machines. To develop sensors or methods to trace quality in manual processes will be a big challenge and quite costly.

5. Summary

The session provided an overview of current demands and trends with regard to traceability within the entire food production chain. Three speakers give an overview and point out different aspects of traceability. First, Raffaello Prugger gives a general overview and pointed out that traceability has its origin in a series of food scandals end of the 90s and beginning of 2000. Since then the food business and the customers require more traceability and the EU enshrined several new regulations. However, full traceability of the whole production chain will be very labor and cost intensive. Therefore, the labeling of a product could be much more expensive than the edible core of the product. It remains open to which extend the customer is willing to pay the extra price. Nevertheless, the digitalization and modern data exchange platforms are one of the key factors that allow precise and cost-effective traceability and can fulfill data-driven demands of young consumer preferences.

Second, Friedrich Lüdeke presented the demands of retailers and their initiative to establish the GLOBALG.A.P standard. It started as a pure European standard but due to its success it become the world's leading agricultural business management program, which transfers consumer requirements into good agricultural practice in a rapidly growing list of countries. One of its key advantages is that producers just need to comply with one uniform standard compared to several individual standards. Since its certifications expire over the entire supply chain, a product market label exist, e.g. "GGN certified farming".

As the last speaker, Matteo Masin presented technological solutions to generate traceability with special focus on harvesting technologies. For companies like New Holland, traceability means to provide CAN-bus machine data and agronomy data combined with a GNSS position information. New sensor technology and documentation facilities offer not only pure machine data but also crop ingredients as well as pre- and post-harvest information. Digital portals or cloud services like the New Holland MyPLMConnect portal allow the farmers to document, analyze and to demonstrate the origin and quality of the raw materials for the food production directly to the food or agro-energy industry.

FIGURES

Figure 1 - Three layers of the "meta food product" [Prugger, CoB 2022].

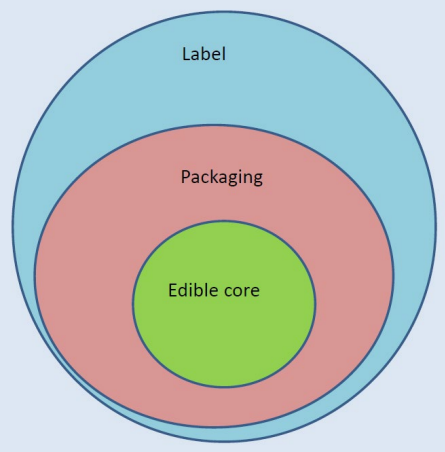


Figure 2 – Overview of tracking and tracing along the food production chain [Prugger, CoB 2022].

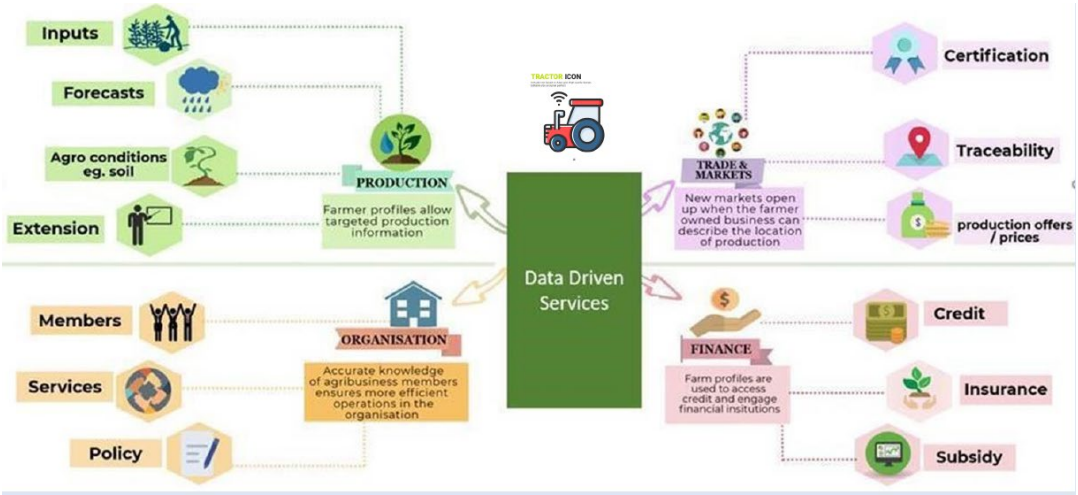


Figure 3 – European targets for sustainable food production in year 2030 [Prugger, CoB 2022].

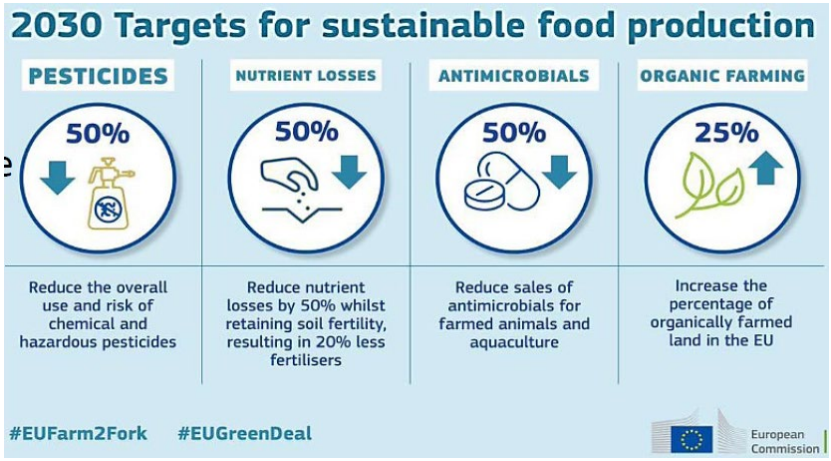
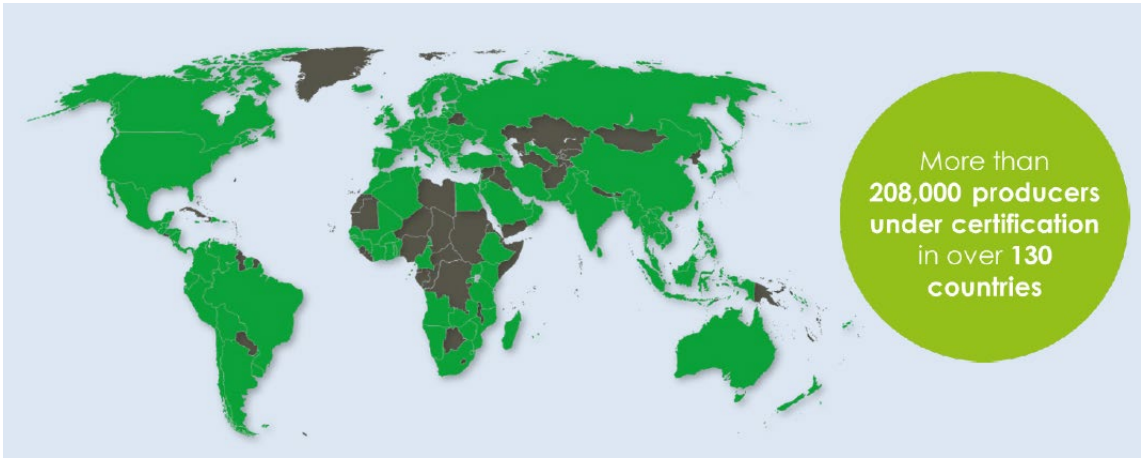


Figure 4 – Global distribution of GLOABAL.G.A.P certifications and share of producers under certification per region [Lüdeke, CoB 2022].



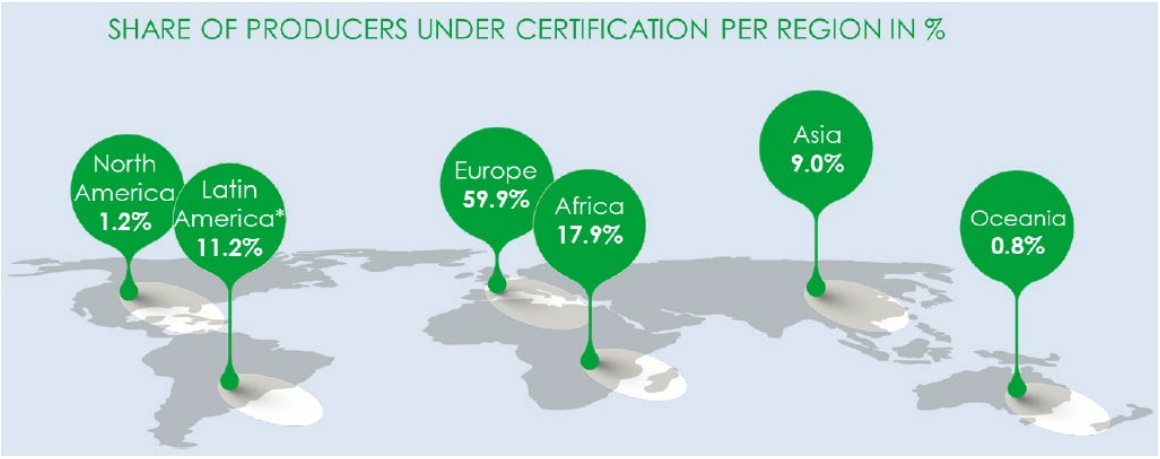


Figure 5 – GGN labels for Aquaculture, Floriculture and Certified Products in general [Lüdeke, CoB 2022].

Figure 6 – Telemetry and Telematics – The MyPLMConnect Portal by New Holland [Masin, CoB 2022].