

Towards dynamic digital product passport: the approach for food sector

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Abstract. Digital Product Passport is a digital tool, that collects product related information across its lifecycle and value chain and allows accessing it by relevant actors. Although food has been currently excluded from the ongoing legislation efforts at EU level, there are many potential advantages related to digital product passports implementation in food sector: enhanced traceability resulting in increased confidence in terms of food safety, facilitated auditability, improved transparency along the supply chain, facilitation of informed decision making resulting in healthier and more environmentally friendly choices. Those are even of greater importance, when it comes to organic and geographic indication food assets, which are especially vulnerable to fraud and adulterations. The paper presents ongoing work on the conceptual development of dynamic Digital Product Passport for organic/geographic indication products, which is taking place in parallel with technical development within a mobile application. The main characteristics forming the basis of the implementation (dynamic updates, consultations with stakeholders, data content) are presented and analysed in the context of EU legislation and likely environmental and health benefits resulting from implementation of the tool for organic and geographic indication food assets. Challenges faced and approaches developed to overcome them are also discussed and next steps explained.

1 Introduction

Digital Product Passport (DPP) is a digital tool, that contains information about a product and facilitates accesses to it by relevant stakeholders. The information is collected across the value chain and throughout product's lifecycle and it is encoded in a scannable data carrier, that end user can access through e.g. scanner of their mobile phone. Due to a number of benefits, that DPP implementation is expected to bring, the concept gained a lot of attention in the last years with ongoing legislation efforts at the EU level. The main document, namely Ecodesign for Sustainable Product Regulation (ESPR) introducing the DPP was adopted by the Council of the European Union in May 2024 [1] [2]. The main drive behind the introduction of the DPP to the European Union (EU) markets, is to enhance the sustainability of products and to trigger interest in products, that are sustainable. It is expected that DPPs will support informed decision-making, facilitating comparisons between products and providing information to consumers and therefore driving behavioural change towards more sustainable choices. The possibility of sharing product information between the involved actors is expected to result in improved exchange of information between supply chain actors leading to increased transparency and traceability as well as to facilitate the work of relevant national authorities. Importantly, access rights to different type of

information are defined based on stakeholder typology. [1].

Currently, the food assets are beyond the ESPR's scope. However, the potential benefits (enhanced traceability contributing to food safety and confidence, auditability and transparency along the supply chain, facilitation of informed decision making) of dynamic DPPs implementation in the future in food sector are very much in line with the requirements described in EU Regulation on food law and food safety [3]. The Regulation (EC) No 178/2002 formulates the rules of food law, establishes the European Food Safety Authority and describes procedures for rapid alert system, crisis management and emergencies within food systems. Particularly, the section on food law builds on a number of concepts (like consumer interest, fair trade, traceability) which are especially relevant to the DPP concept and could be easily embraced by this tool contributing to better implementation of the law.

Special category of food assets, that could particularly benefit from the dDPP are organic and geographical indications (GI) food assets. Those products are more vulnerable to fraud and adulterations as well as to conditions along the supply chain. Organic production is understood as sustainable agricultural system, that respects environment and animal welfare extending to other stages of the food supply chain. The principles of organic farming are stricter than those of traditional agriculture and include ban of use of chemical

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pesticides and synthetic fertilizers, significantly restricted use of antibiotics, ban of using genetically modified organisms and requirement for crops rotation [4]. As a result, those products might be more vulnerable to frauds but also to e.g. inappropriate storage conditions. EU geographical indications (GI) schemes were introduced to protect authentic products linked to specific regions. In those cases, the traceability aspect is critical to assure product authenticity [5]. Some commercial solutions are presented in CIRPASS report, which describes DPP related initiatives [6]). Despite food being mentioned several times in the report as application sector, only some commercial solution discloses more details. On the other hand, the scientific work related to DPP for food supply chains seems to be at an early stage, with projects like THEROS [7] and DPP4Food, which started recently [8] paving the way. On the other hand, TRICK project is working on replicating a traceability solution for textiles sector to the food sector [9]. In this paper an initial concept of dynamic DPP (dDPP) for organic/GI food assets is presented with the main features and aspects forming the basis for the technical implementation in a mobile application, which is progressing in parallel. The concept is distinguished by integration with THEROS toolbox, allowing for presenting within the dDPP parameters from other tools. The parameters are related to verification (of origin, non-compliance, whether the product is organic or not, etc.) providing therefore extra verification step and organic farming/sustainability aspects.

2 Methodology

The work presented here is a result of combined approach (Fig.1.). Desk study of legislation and scientific literature is being complemented by consultations with stakeholders - potential future users of the dDPP. Up to this point consultations included farmers, other supply chain actors and certification bodies and were conducted through questionnaires and online meetings. Additionally, discussions with the THEROS digital tools owners are taking place. Those tools were identified as having potential of providing as input different types of data, that could feed the dDPP with information valuable for the final user.

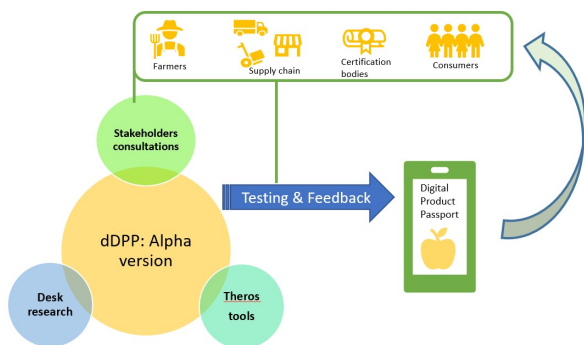


Fig. 1. Methodology workflow

The first version of the dDPP will be tested by stakeholders, including consumers who will be asked to provide their feedback. The feedback will be used to further improve the application towards its final version.

3 Dynamic DPP for organic/GI food assets

3.1. Introduction

The dynamic Digital Product Passport forms an integral part of a toolbox for verification and improved prevention of adulterations for organic and GI food assets developed within THEROS project. Through integration with other THEROS tools, dDPP presents different types of information to the user through user friendly interfaces of the mobile application and based on the role the user has in the supply chain. THEROS tools, which provide verified information about the product: Earth Observation based ecosystem services, MEMS based photonic system, DNA based authenticity kit, the verification engine, and the blockchain-based traceability component and give as output the actual data that define, if a product is organic or conventional using parameters like purity index, soil quality, map markers, origin of a product, etc. The dynamic DPP will be created for a number of products, e.g. arable crops, fruits, edible oils, flour and mussels [7].

3.2. Stakeholders

ESPR lists three main stakeholder groups in the context of the DPP: “supply chain businesses, authorities and consumers” [1] In line with that, the three main user groups of the developed dDPP are distinguished [7]: i) supply chain actors, ii) Certification bodies and iii) consumers. Supply chain actors are distinguished by two subgroups namely farmers and actors appearing further in the supply chain, e.g., transporters, transformers, packagers, distributors. Certification bodies are the organizations responsible for issuing the specific certificates for organic/GI foods, while consumers are the final users of the products. Current work focuses on definition of access rights of user groups as well as design and development of user group tailored user interfaces where diverse information is presented in different way based on the user role and allows authorized user to perform actions (e.g. related to product’s track and trace course). Additionally, there is an ongoing consultation process with future users of the dDPP. First round of consultations with farmers, other supply chain actors and certification bodies, which was performed in the form of questionnaires have revealed, that, also in the eyes of future dDPP users the sector could benefit in terms of traceability, security and increased confidence, sharing information about the product and improving the work of authorities. Further insights into the details of this study form ongoing work, which soon will be extended also to the consumers.

3.3 Data content

The data to be included in the THEROS dDPP has been a topic of ongoing debate among the involved partners. With no specific guidelines available and due to the diversity and complexity of food supply chains there was a need to develop a specific approach on how to define the data, that the dDPP will depict. Considering the regulations, the possibilities offered by other THEROS tools and initial consultations with stakeholders the preliminary data structure of the passport was decided to contain data on product information, actor information, traceability, sustainability data, verification information and compliance data.

As product information the general product data, usually available on the label of the product, related to e.g. product origin, nutritional values, storage instructions, data of production and expiration, etc is understood. Actor information are data related to the producer, e.g. contact data. Traceability data have to do with the history of the events, that product concludes along the supply chain.

The sustainability data pose a specific challenge in terms of the data content, that could potentially be included. One of the reasons foods are excluded from ESPR, is that most of the ecodesign requirements introduced by ESPR are not applicable to food assets. Ecodesign requirements are related to performance of a product in terms of environmental sustainability with some examples being durability and reliability, ease of repair and maintenance, use or content of recycled materials. Similarly, initial consultations with stakeholders have not shown a consistent path, that could be followed in the design phase of THEROS dDPP. Therefore, the current approach focuses on investigating relevance of information from other tools of the THEROS toolbox (e.g. soil properties, carbon footprint, Ecological Focus Areas and biodiversity elements) and their visualization by THEROS dDPP. At later stage the information provided by stakeholders through the consultations might be considered as well (e.g related to use of renewable sources of energy or sustainable packaging).

Compliance data are related to the specific certification, that organic/GI food assets need to comply with.

3.4. Dynamic updates

Each product is accompanied by specific set of information presented in the dDPP. Some of this information is static and is not expected to change during the lifetime of the product (e.g. the production data, producer contact information). However, there are some attributes of the products, which alter as the product reaches the consecutive stages in the supply chain (e.g. time and location). Dynamic updates are a system feature forming a core idea behind the dDPP adhering to the dynamic nature of any supply chain. As product reaches the consecutive stages in the supply chain where information flows evolve, information can be updated by

authorized actors of the value chain through system update mechanism.

3.5. Environmental and health benefits

The implementation of the dDPP is expected to result in benefits for the environment and health of the consumers. The summary of those advantages, that are expected to be apparent closely to the implementation of dDPP, as well as those related to possible next steps, also beyond the scope of the current work are summarized in Table 1 in the context of main dDPP features and characteristics. Through providing access to information and facilitating sharing of those information between the value chain actors the DPPs can contribute to more informed decision making by consumers leading to protection of human health, which is set as priority by the food law. Additionally, the food law emphasizes the importance of “protection of consumer’s interest including fair practices in food trade” [3]. The dDPP for food assets fully supports this principle by providing information and possibly also means of comparison for consumers. That can facilitate making informed choices in terms of both health and sustainability. In current work the focus is on organic and geographical indications (GI) food assets, which are especially vulnerable to fraud and adulteration, and therefore as a sector could especially benefit from a dDPP, that provides track and trace information along the lifecycle of a product minimizing the possibility of fraud. The information available in the dDPP contributes to adhering to food safety requirements and possibly to performing official controls as required by law. Potentially and with more technical development the dDPP could also contribute to other aspects described by the Regulation [3] related to rapid alert system and inclusion of functionalities allowing consumers to get updates and notifications on the products they have purchased.

By including the organic certificates in the dDPP, the consumer is assured about sustainable practices. Other aspects related to environmental benefits of the DPP could potentially include LCA results integration or aspect related to soil quality.

Table 1. Short and long term environmental and health benefits of the implementation of dDPP for organic/GI food assets in the context of the dDPP features/characteristics.

dDPP feature/characteristic	<i>Environmental</i>	<i>Health</i>
Informed decision making	1) Consumers can select more sustainable products 2) Producers are prompted to produce more sustainable products	1) Consumers can select products, which are better for their health 2) Producers are prompted to produce healthier products
	<i>Possible future expansion:</i> creation of comparison system per product groups for	

	both environmental and health aspects	
Traceability	Increased confidence in terms of authenticity of the product. This is of special importance in case of organic assets, where consumer is expecting to follow sustainable farming principles. In case of GI food assets the prove of authenticity is especially relevant.	1)Increased food safety, 2) Increased confidence that the food was properly treated along the value chain decreasing the risk of foodborne disease, 3) Increased confidence in terms of authenticity of the product (esp. important in case of organic/GI food assets)
Access to current certificates status	1)Increased confidence about sustainable practices being implemented, 2) Facilitation of the work of relevant authorities related to health and environment. <i>Possible future expansion:</i> inclusion of other relevant certificates (e.g. related to social aspects)	
Data sharing and transparency	Increased confidence in terms of sustainability and health	
Dynamic updates	<i>Possible future expansion:</i> to include real data in the context of the environmental impact assessment e.g. related to transportation	Increased confidence about food safety <i>Possible future expansion:</i> including real time data e.g. from temperature sensors during transportation step, alert system, notifications on purchased products

4 Discussion and next steps

The implementation of dDPP in organic and GI food sectors could potentially bring a number of benefits for the sectors, as well as in terms of health of consumers and environmental aspects. However, the work presented is associated with a number of challenges. Firstly, lack of legislation and therefore guidelines on which data should be included in the dDPP allow for different interpretation of what should or could be included in the dDPP. In order to address this challenge inclusive approach has been used based on involving potential users of the dDPP in the decision process. On the other hand, an attempt to comply as closely as possible with existing regulations, that seem to be especially relevant, has been made. Secondly, the decision on the sustainability data, that could be included in the dDPP at this early stage has been determined rather by the availability of data. Current approach focuses on examining the relevance of data from other THEROS

tools, which will be followed by investigating options that appeared during consultations with stakeholders. Another challenge, that has been faced, is that although a significant interest has been observed from the food sector in the dDPP, achieving the objective of obtaining satisfactory number of participants in consultations seems to be difficult.

The technical implementation of the work presented here is currently ongoing and expected to be finalized in the upcoming months. With the alpha version of the application ready, the dDPP will be tested by the stakeholders – future potential users of the dDPP and their feedback will be collected and used for enhancements towards final version of the dDPP for organic and GI food assets. Another important step is to extend the consultations to the third user group, namely consumers, with their view being of special importance, as the success of the implementation is critical and depends on their acceptance and positive reception of the dDPP.

The methodology and concept described in this paper are being currently tested in the organic/GI food sector. Several aspects of the methodology are relevant to that specific sectors, and therefore in case of transfer to other sectors, adjustments based on sector specificities, data availability and sector specific legislation or requirements would be necessary. A possible use of the methodology, could apply to other assets of food sector, which are especially vulnerable to certain parameters or where traceability aspect is particularly important. One example of needed adjustment, would be a necessity to define and include relevant tools for the verification of attributes of interest (e.g. transport temperature, light exposure), however the overarching principles of the methodology presented here, could be used to facilitate such replication.

5 Conclusions

The paper presents ongoing work on the conceptual development of dynamic DPP for the food sector, which is taking place in parallel to initiated technical development within mobile application. The work concerns a subsector of food industry, namely organic and GI food assets with particularities and special vulnerabilities in comparison to other assets of the food industry. The main features and aspects forming the basis of the implementation are presented and analyzed in the context of EU legislation and possible environmental and health benefits resulting from implementation of the dDPP. Challenges encountered and strategies developed to address them as well as next steps are also discussed.

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