

# Pilot interactive visualization tool of a Participatory Guarantee System: The case of “Terra Thessalia’s PGS”

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**Abstract— Object:** *The present proposal explores the digital representation of the Participatory Guarantee System (PGS) of the Protected Designation of Origin (PDO) cheese feta with the territorial mark 'Terra Thessalia' created under LACTIMED European program.*

**Aim:** *The aim is the relief revelation and guarantee of the products quality through the use of ICT technology and the creation of a pilot visualization tool of "the link of the product to the place of production" in an understandable way for the "average" consumer.*

**Methods:** *The research is based on: (a) processes recording of identification and revelation of a geographical indication (GI) food and its distinctive characteristics associated with the place of production through interconnection of various PGS features of a territorial resource and their role on the PGS, b) previous research utilizes a conducted preliminary consumer survey on local food preferences, and c) use and connectivity of modern ICT interactive representation technologies.*

**Results:** *Creating an interactive web-based digital pilot representation tool of "product and its link to place of production". The proposed tool combines the PGS guarantees representation and the simulation of, inter alia, the site's real image including both geographic material elements and immaterial element (principles, values, heritage, etc) by using ICT, in order to enhance the interactivity and accessibility of the GPS itself and to integrate consumers into the guarantee process.*

**Index Terms—** Interactive spatial representation, Multimedia Visualization, Participatory Guarantee System, Terra Thessalia, Territorial marketing, Territorial resource.

## I. INTRODUCTION

### A. Review Stage

The overproduction crisis of agricultural products, the tendency to lower their prices and the demand of consumers for products of quality and identity push to transfer the question of the survival of the farms outside the 'productionist' model [1]. The dematerialization of agri-food products of any element of quality and identity that traditionally linked them to the place of production was only the result of the intensive agricultural model and competitiveness based on the reduction of the production cost, which allows the transition of products to the generic state and the continuous decline of their value. In the last few decades, researchers and representatives of the territorial

sectors have been trying to move towards the research for higher added value of their agri-food products [2]. This effort is based on the reintegration of dematerialized products into the territorial resources defined here as a set of material and immaterial ingredients, patrimonial elements and recognized values [3]. Operationally, it is a question of inviting the territories to identify, reveal and activate their resources in order to be able to ensure the specificity of the final products and thus to increase their added value [4], [5].

To achieve this goal, these areas had to mobilize every material and immaterial component of their activated and / or potential resources through specific forms of co-operation and coordination of their stakeholders (territorial governance) [6]. This integration of the product into the resource has required the widening of the role of all those involved, namely farmers, processors, social and public actors involved in the management and reproduction of the material and immaterial components of the resource. They should be actively involved in guaranteeing the relationship between product and place of production, quality with inherited practical knowledge and know-how. A tool to support the promotion of this objective was the strengthening of an effective territorial engineering [7].

In this context, the development of product quality and identity certification systems in Europe appeared on the one hand, in response to overproduction, to the lack of knowledge of the origin of the raw material and its production and processing procedures and, on the other hand, as a tool of certification and legalization of the effort by local producers and territories to reveal the specificity of their products based on the way and place of production ('terroir') and the inherited knowledge, practices and know-how [8], [9].

At the same time, there was a need to reveal this product-resource-place of production relationship to the consumers concerned. The message of such a revelation is complex because it combines principles, practices to space, landscapes and guarantees, in other words elements that can directly or indirectly reveal in guaranteed way the connection of the internal quality characteristics of the product with its external bonds with the place of production [10]. It should also be interactive to facilitate contact and communication between producers and consumers by making informal and

formal knowledge compatible. In addition, the spatial dimension of the projected elements necessitates the use of the image provided that the space is accurately depicted along with place and time correlation where this is necessary. The identification of consumer expectations, the active involvement of actors and the opportunities offered by new technologies (ICT) allow us to experiment with the creation of a visual navigation tool in the world of components' resource with intensive territorial dimension and complex messages.

In the context of the orientation of consumption towards quality [11], food territorial labeling [12] (relationship between product, place of origin and society) is of particular importance since it guarantees authenticity and quality by creating GI products and empowering rural communities to reproduce their territorial resources. Alternative direct distribution networks are also created between producers and consumers with better communication, mutual understanding and trust between them creating environmental, social and economic benefits to local communities [13], [14], [15], [16], [17].

#### **B. The various certification systems**

The first interventions in the relationship of generic agri-food products and markets were the certification systems known as Controlled Designation of Origin (CDO), Protected Designation of Origin (PDO), Protected Geographical Indication (PGI), etc. Their credibility is rather linked to the fact that they are issued by the States and by Brussels which requires, so far, procedures and heavy steps to reach the recognition of PDO or PGI product. The effectiveness of these certification systems depends on the size of their application scale [7] since their major dysfunction is observed in cases where the scale of application is regional or national (such as Greek Feta cheese). At these large scales, the definition of the specificities of the product in question remains generalized while there are difficulties to ensure the effective functioning of governances able to respect the accepted jointly specifications. In the same way, the control tools imposed by the top also become heavy. Gradually, these protected products are no longer able to increase their value, they often return to their previous generic state. As time goes by, the added value keeps decreasing in these systems whose driving force is not so much the specificity of the product but the recognition obtained initially and the label that accompanies it.

Since the early 1990s, the products market is accompanied by a certification system based on peer review to a system of third-party certification (TPC) [18], [19]. TPC is the most common biological certification system and is often viewed as the most reliable form of conformity assessment [20], [21]. TPC implies a high degree of standardization in inspection, certification and related processes. In recent years, however, TPC has faced increasing criticism, due to:

- (a) The high costs of certification and documentation requirements,
- (b) Small-scale farmers who often find hard to achieve TPC

and access organic markets [18], [22], [23].

(c) Its high degree of standardization. TPC is deemed by some as incapable of allowing the adaptation of organic production systems to local contexts [24], [25], or accounting for the diverse economic, ecological and sociocultural environments of organic farming [18], [26], and

(d) External inspections through annual visits. This type of certification is considered as a "conventionalization" [27] contradictory to farmers' self-determination and empowerment, an obstacle to their involvement, encouraging the concentration of power in the hands of TPC bodies [28], [29], [30].

#### **C. Towards more participatory and guaranteed systems**

Motivated by these criticisms, alternatives have been developed since the 1990s that aim to provide farmers with a more locally adapted certification scheme for domestic markets. Most of these alternatives can be classed as Participatory Guarantee Systems (PGS), [24], [31], [32].

The International Federation of Organic Agriculture Movements (IFOAM) defines PGS as "locally focused quality assurance systems". They certify producers based on active participation of stakeholders and are built on a foundation of trust, social networks and knowledge exchange" [33].

In the context of the internationalization of markets, consumers are increasingly seeking to know where food comes from, how it is produced and processed. Countryside producers and small and medium-sized enterprises (SME), weak against to global competition, are looking for ways to diversify their production by revealing the identity of the production place and the specific quality of their products [34], [35]. Creating a guarantee system of the quality with the participation and cooperation of the 'producer community' of the region of origin and the 'consumer community' is a goal of strategic importance. This participative process stabilizes / enhances small-scale productions, ensures compliance with the quality standards of local traditional products, reinforces the local economy and reveals, inter alia, the identity and the unique quality associated with the unique characteristics of the place of production (natural and cultural environment) [2], [36], [37], [38].

PGS are also promoted as less costly and less bureaucratic than TPC [31], [39], more flexible and better adapted to the realities of smallholder farmers [22].

The innovation of PGS is based on the fact that local bodies and producers guarantee in their own ways and means the internal and external quality of their products (along with official certifications). This means that PGS simultaneously plays an important role as a tool of territorial labeling promotion [7]. However, the orientation / focus of PGS to consumers create additional needs in terms of recognition and accessibility of the tool itself. The achievement of such a complex goal can be based on a combination of the emergence of material and immaterial components of the

territorial resource, using ICT [40] and the active involvement of consumers in a 'learning' process [2].

#### D. Visualization and PGS

The attempt to facilitate access to PGS through internet and new interactive technologies necessarily leads to the use of the image as a means of mediating between the territorial area and consumers [41]. It is important that each virtual message faithfully reflects (photographic objects) and without arbitrariness (abstract reality) the connection of geographical objects and other immaterial elements (e.g. heritage, tradition, history, etc.) to the production place ("anchorage"). In other words, these characteristics / components of the territorial resource allow the anchorage of the territorial resource at the production place [42]. Corresponding image elements (signifying and signified) with the material and immaterial components of the territorial resource can enhance the realism of the image content [43].

At the same time, it is found that the ever-increasing use and interpolation of the image to promote or even understand the complex relationship of territory, resource and end product needs to link the virtual message with additional information, knowledge and guarantees. However, if we consider that the virtual message is both a carrier of information but also an abstract representation of reality [43], then this connection / link should, at the same time, ensure that the virtual message restricts the abstraction and the arbitrary message for the promotion of a territorial resource. The images must be able to reflect the real space in which a common cultural and productive history of territorial area are inscribed [44].

Consequently, using visualization methods [45], there is a need to identify [46], and visualize [47] elements and forms recordings projected to space, which reveal the anchorage between elements and space as well as quality and identity features of the resource and the relationship with the finished product. These recordings can help create virtual representations, in other words, create images that:

(a) Certify to the consumer that the object belonging to the particular territorial resource has been imprinted in that location in the requested space and time (relevance of space and time or the cause / effect relationship [48].

(b) Imprint the components of the territorial resource as elements integrated into spatial productive units (e.g. pasture, pastoral activity, link to heritage, claims of authenticity, quality, identity, etc.) whose functionality is guaranteed by the PGS.

These images may be arranged in such a way as to:

(a) Successively cover all activities upstream and downstream of the agri-food chain, respectively following the structure of the PGS;

(b) Guide consumer in discovering the relationship between finished product, territorial resource and territorial area, through the guarantees provided by PGS.

The attempt to arrange the images should act as a photographic narrative (e.g. of the territorial resource links

with the region). In this case, the ability of consumers to interact with the photographic narrative using a multimedia simulation tool can dramatically contribute to their spatial perception [49] and its relationship to time.

The ultimate goal of this study is to make the visualization process:

(a) An information and territorial resource components visualization tool

(b) A "compass" that enables consumer/user to interactively enrich his needs (information retrieval, online deliberation (forum) and his correlation with the corresponding geo-productive units and components of the territorial resource

(c) A means that enables continuous awareness, education and three-dimensional formatting, poetry in the "mind's eye" of guarantee procedures and their territorial correlations [50].

#### E. The aim of this research

The present research addresses the creation of a visualization pilot tool of 'product and link to production place', which combines 'Terra Thessalia' PGS and the visualization of the production place with the use of ICT in order to enhance accessibility of PGS itself and ensure its interactivity. In this way, the proposed visualization pilot tool will:

(a) Contribute to enhancing the image of the place production through the territorial marking of the food,

(b) represent and visualize, using ICT, the 'jointly' perceived and accepted elements of the specificity and uniqueness of the GI food (material and immaterial) in order to construct, for an ordinary consumer, a reliable and easy-to-use tool that guarantees this specificity GI food,

(c) Represent the PGS components of the territorial resource with full accessibility to the guarantee procedures in an ergonomic and understandable manner for consumers,

(d) Embed within images non-material elements, such as immaterial elements (values, knowledge, heritage, etc.)

(e) Contribute, through the image, to the more efficient functionality of the PGS guarantee mechanism for the consumers,

(f) Contribute to interactivity of PGS itself,

(g) Enable interactive participation and enrichment of consumer needs through online deliberation / forum (retrieval, exchange, sharing of information, needs, thoughts, suggestions, etc.). At the same time, both the ergonomic navigation of consumers in the visualized PGS and the future creation of a supplementary pedagogical tool, will enable them to be continuously sensitized and educated on the functional and reciprocal benefits of the PGS.

The research is organized on the basis of:

(a) The projection of the productive 'links' (production and small-industry unit elements described in the following chapter) of the agri-food chain into corresponding geo-productive units with their simultaneous recording and visualized correlation. In other words, the projection of each productive 'link' related either to space (geo-productive

units) or to its immaterial elements (patrimony, etc.)

(b) The results integration of a previous questionnaire survey examining consumers' expectations, knowledge and participation based on their purchasing choices, eating experiences and expectations, and

(c) The development of individual multimedia applications and the linking of internet technology in order to design a tool that visualizes and ascends between 'links' of agri-food chain and their elements that characterize the territorial resource having either a spatial dimension (proximity, grazing land, land properties, etc.) or immaterial / patrimonial dimension (heritage, know-how, tradition, etc.) [51].

## II. RESEARCH ORGANIZATION

### A. The field's choice: the case of Terra Thessalia and its PGS

Submit In this context of change in offer-demand relationships, several initiatives aiming at the adoption of the PGS have even emerged in Europe, where certification systems are already a tradition. For our research, we have chosen the case of the "Terra Thessalia" cluster, which brings together a number of small dairy territories (sheep and goat breeding) and proposes a participatory guarantee system managed by a territorial administration. 'Terra Thessalia' was created in 2016 as a result of Lactimed European program [2012-2015] [52] having as purpose the strengthening of production and distribution of innovative dairy products in the Mediterranean by the organization of local industries [53].

What makes this case interesting is the willingness of a group of actors to propose a PGS although their feta cheese is already registered as a PDO product. The PGS is used here as a tool managed by a territorial administration whose objective would be to better contribute to the respect of a more territorialized specifications, to the revelation of the quality and the identity. This same initiative having succeeded in better integrating the final product of Feta cheese to the pastoral resource, brings to the surface the question of the transmission of the qualitative and identity characteristics of their product territorially 'baptized' again to consumers through the territorial brand named "Terra Thessalia".

This study focuses on 'Terra Thessalia, the first dairy cluster in Greece and its adapted developed Participatory Guarantee System. Terra Thessalia is cooperation of small dairy territories of the region of Thessaly in Greece (Velesino, Ellassona, Kalampaka, Mouzaki, Palamas, Temp) illustrated in Fig 1.

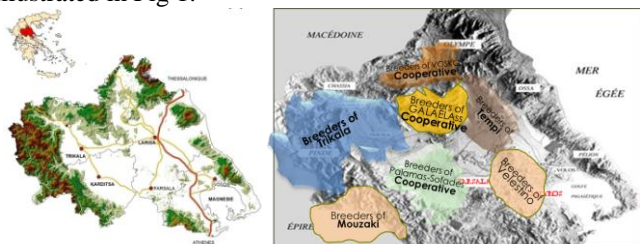


Fig. 1. Distribution of seven dairy territories of Terra Thessalia, Thessaly, Greece

These territories have a strong pastoral and Thessalian gastronomic tradition giving prominence to dairy products with a significant competitiveness in livestock (quantity of holdings, extensive and small-industry production approach, local animal breeds, dairy production) and several distribution networks established at different market levels, including short distribution circuits [52].

The management organization of Terra Thessalia dairy cluster consists of three bodies and many stakeholders, illustrated in Fig 2.:

(a) Territorial Assembly which is governed by a territorial charter and outlines general policy

(b) Terra Thessalia non-profit corporation which networks and pilots actions to support pastoral holdings (pastures improvement, ration, information on local breeds etc.) and develops a complex of activities specifically aimed at realizing plans and strategies for the development of a territory in the long term ("territorial" marketing)

(c) Trade Thessalia Lactis which promotes and sales Terra Thessalia's products.

The main objectives of Terra Thessalia dairy cluster consist of:

(a) contributing to the functionality and effectiveness of an alternative system of guarantee - certification - traceability (linking of sheep-goat milk produced by extensive livestock with the territory) vis-à-vis TPC - that ensures and guarantees the authentic quality standards of local traditional GI products by involving producers, consumers and other actors in the production chain,

(b) Stabilizing / enhancing small-scale productions by strengthening the local economy and creating local and territorial dynamics (resource reproduction), etc.

(c) Establishing a nutrition / ration enhancement system

(d) Creating a continuous support system research center to Terra Thessalia's producers

supporting a common vision for both small producers and consumers by encouraging the participation of consumers and sharing knowledge, experiences with producer groups in a more complete way [54], [55], based on the principles of participation, reciprocity, transparency and trust, [7].

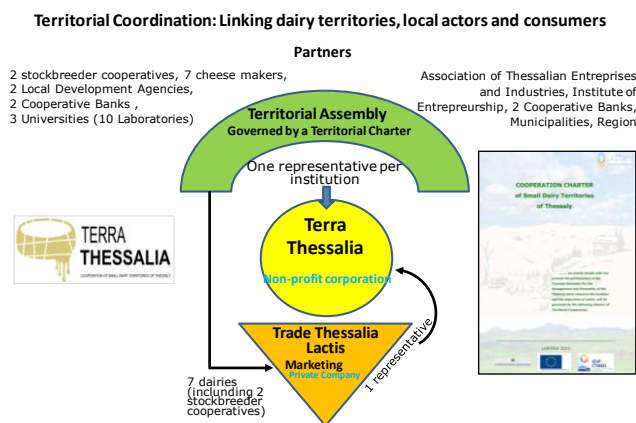


Fig. 2. Terra Thessalia dairy cluster governance organization chart

The fields in which Terra Thessalia's PGS intervenes to establish its guarantees are, inter alia:

- (a) Traditional manufacturing process cheeses and maturing period (Batch codes/ISO)
- (b) Animal welfare and quality of milk due to grazing on natural pastures and grasslands (by monitoring of herds' movement with GPS, analysis of the pastures flora and cheese characteristics)
- (c) Low environmental footprint (proximity of livestock holding, feeds and cheese production)
- (d) Indigenous breeds (official public service documents, identification, followed by Terra Thessalia experts)
- (e) Small, family and modern dairy businesses
- (f) Milk collection at an optimal period in terms of flora quality (by transportation control)
- (g) Form of governance
- (h) Solidarity market
- (i) Integration consumers to Terra Thessalia's PGS (pilot digital tool).

**B. Research introduction**

The difficulty of such a study is related to the fact that the initial conception and key role of PGS is primarily to guarantee the claims of a producer group and their region [7]. PGS is organized on the basis of the projection of the productive links of the agri-food chain in respective geo-productive units. Within geo-productive units, PGS guarantees the links of agricultural structures and various productive factors (land, pasture) with the material and immaterial components of the territorial resource from which is the final product of the chain. This guarantee procedure is based on the evaluation through criteria, such as links to the productive systems of the territory (livestock, agricultural), revealing the relationship between territorial resource, heritage and area, as well as principles and values shared by consumer society. However, while this guarantee process is easily understood by experts, traders, etc., it is not equally visible to the average consumer [56].

The research organization consists of methodological steps related both to the recording of the food-chain links and their components and to the relationship between them. At the same time, the methodology also concerns the projection of these components to space, their visualization, as well as the creation of a digital platform. This platform allows the coexistence of guarantee procedures visualization of territorial resource components and the interactive consumer participation in enriching PGS's guarantee procedures. In particular the methodological steps, illustrated in Fig 3, can be summarized as follows:

- (a) Visualization (spatial projection) of "links" of the territorial resource's agri-food chain
- (b) Visualization (spatial projection) of main components of the territorial resource's links
- (c) Visualization (spatial projection) of material and immaterial elements of the principal components
- (d) Correlation of all elements and components of the

territorial resource

- (e) Selection of components and their elements for visualization and guarantee
- (f) Consumer integration in participatory guarantee procedures
- (g) Creation of a digital tool for visualization of components and elements of the territorial resource that are transformed into PGS guarantee procedures
- (h) Creation of a digital space of interactive consumer deliberation to enhance the guarantee procedures
- (i) Creation of a digital online combinatorial platform for visualizing the PGS's guarantees procedures with interactive consumer participation.

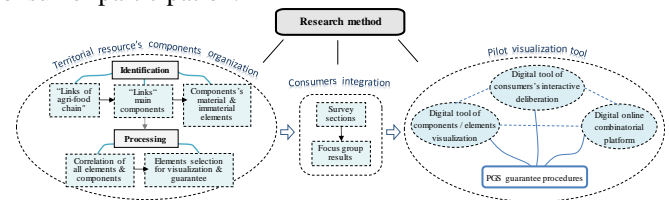


Fig. 3. Scheme of research method

**C. Research methodological steps**

*The Visualization (spatial projection) of "links" of the territorial resource's agri-food chain*

The 'links' of the agro-food chain of the territorial resource "Terra Thessalia's dairy products" (with focus on Feta cheese) refer to the agro-food chain, production structure and process units and in particular to the: (a) "Production Unit" and (b) "Small-industry unit". The production unit deals with 'livestock holding', 'grazing' and 'feedstuffs', while the small-industry unit is dealing with 'Small-industry space', 'milk collection' and 'product'. These 'links' are essentially groupings of territorial resource components which in turn constitute elements of 'links' of the agri-food, productive and procedural chain of a pastoral territorial resource, illustrated in Fig 4.

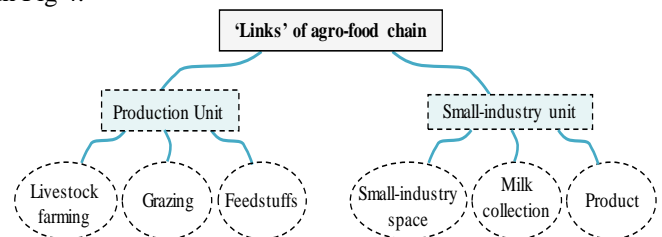


Fig. 4. The main 'Links' of the territorial resource's agro-food chain

*Visualization (spatial projection) of the main components of the territorial resource's links*

The components' units of a territorial resource are in essence the elements that make up the central 'links' of the agri-food chain. Each 'link' consists of its own corresponding units of territorial resource components. In particular, "livestock holding" resource component unit consists of the following: "herd", "corral", "animal breed" and "place of installation". The "grazing" unit consists of the following:

"flora", "path", and "grazing area". The unit "feedstuffs" consists of the following: "Feeds", "proximity" and "agricultural production area", illustrated in Fig 5. According to the above, the 'link' of agro-chain "Small-industry unit" consists of the following: "small-industry area", "milk collection" and "product". Each link and territorial resource component is 'enclosed' and corresponds to a series of appropriate representative images that generate the appropriate virtual messages (interactive images, maps, multimedia elements), which refer directly or indirectly to the PGS guarantee procedure. These images contribute both to the visualization-simulation of the PGS's territorial resource components as well as to the interpretation of the geo-productive units which correspond to each link of the agri-food chain and thus to the components of the territorial resource. So, consumers, in their turn contribute to the ongoing feedback and adjustment of the PGS itself.

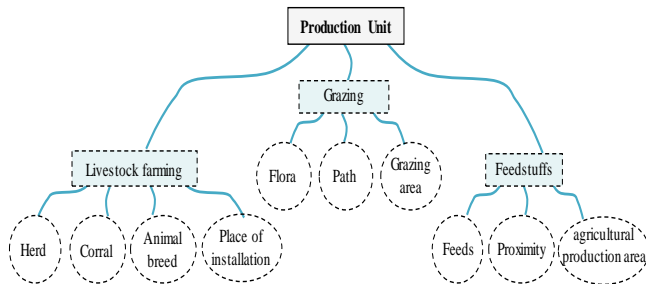


Fig. 5. The production unit components of the territorial resource

*Visualization (spatial projection) of the material and immaterial elements of the principal components*

Every territorial resource's component is associated with material and immaterial elements that characterize and enhance it. The material elements (landscape, water, buildings, paths, etc.) as well as the immaterial elements of a territorial resource (heritage, sustainability, prosperity, historical event, etc.) are correlated ("anchored") in the space while at the same time being related both to each other and to corresponding material and immaterial elements of other resources' components belonging to other agri-food links. Any material or immaterial element can be a key feature of searching for a territorial resource guarantee element of the PGS visualization tool to be grasped by consumers-users. The material elements often correspond to the main components of the territorial resource links identified in the previous section because these are the components that can be visualized. The immaterial elements can mainly fall into the central category of "Principles and Values" where they fit the units "Heritage", "Pastoralism", "Proximity", "Quality", "Solidarity" and "Small-industry tradition". Each unit of principles and values breaks down into specific 'sub-values'. Particularly:

(a) 'Heritage' is divided into a) 'livestock holding tradition' which includes 'grazing knowledge', 'milking knowledge' and 'animal relationship' and b) 'small-industry tradition' which includes 'know-how / experience' and

"handwork".

(b) 'Pastoralism' includes 'movement', 'grazing' and 'family unit'.

(c) 'Proximity' includes 'livestock holding's proximity to an agricultural holding (animal feeds production)' and 'to a small-industry' and their result which is 'environmental footprint'.

(d) 'Quality' includes 'feedstuffs', 'flora', 'milk' and 'cheese'.

(e) 'Solidarity' includes 'livestock community / social space', 'dairy producers and breeders' connections' and 'breeders and farmers' connections', illustrated in Fig 6.

Each resource component is surrounded and governed by the above principles and values, which can also be a key feature of seeking a territorial resource guarantee element for revealing by sensitized consumer.

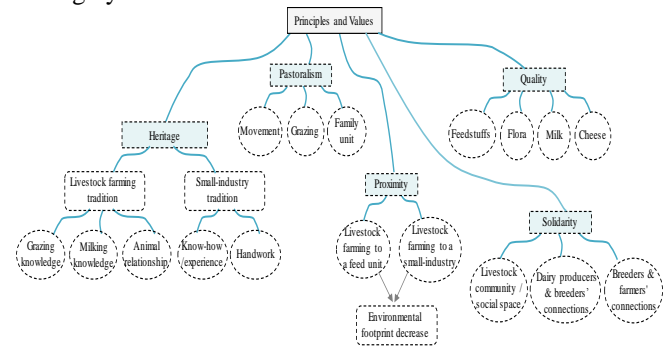


Fig. 6. The principles and Values components of the territorial resource

The analysis so far concerns the structure and identification of the components of the territorial resource, while the following chapters deal with the correlation of these components and the consumer integration procedures.

**Correlation of all elements and components of the territorial resource**

The analog and consequently digital correlation of the material and immaterial components of the territorial resources is based on:

- (a) Their practical relationship in the field
- (b) The ability for visualization and spatial projection
- (c) The transversal involvement mainly of immaterial elements of "principles and values" in many units of territorial resources
- (d) The ergonomic design of the proposed guarantee's visualization tool by seeking a guarantee through specific projected to space components correlations,
- (e) the ability to attribute new properties and uses to material elements of territorial resource (e.g. a historical old building with new use of cheese making, etc.) based on its form and incorporation of principles and values (reputation, historical event, etc.).

**Selection of components and their elements for visualization and guarantee**

It should be emphasized that the specific research organization concerns the selected components and the corresponding guarantee procedures that can be visualized. The choice of components to be visualized will act as

recognition guides of the territorial dimension of the resource for consumers. Based on these elements, images and visual material will be created and they will form:

- (a) an object of examining the knowledge and ability of consumers to recognize the value of these connections, and
- (b) a participatory tool for their subsequent interactive participation in the PGS guarantees procedures.

At the same time, the completion of the linking of images and geo-production units with all the links in the agri-food chain will highlight a series of images whose content and layout will introduce consumer to respective thematic guarantees of PGS.

**Consumer integration in participatory guarantee procedures**

The Integration of consumers into an existing PGS with bidirectional feedback (consumer opinions and features to be guaranteed) concerns a previous research which utilizes a conducted preliminary consumer survey on local food preferences and was used to improve the quality of products and services [57]. The ultimate purpose of this integration was:

- (a) The integration and qualitative improvement of the PGS designed to support a common vision between small producers and consumers,
- (b) Enhancing the transfer of knowledge based on the principles of participation, reciprocity, transparency and trustworthiness by developing guarantee instruments that were inserted between official certifications.
- (c) Supporting and feedback the pilot PGS visualization tool.

A preliminary consumer survey on local food preferences was conducted between March and May 2019. The survey consisted of online and face-to-face questionnaires mainly addressed to “conscious” consumers connected to extended networks of alternative food initiatives that are looking for locally-sourced products and are interested in regional foods and tradition, as well as, “common” consumers representing. A sample of 199 adult consumers was randomly responded. The overall sample consisted of:

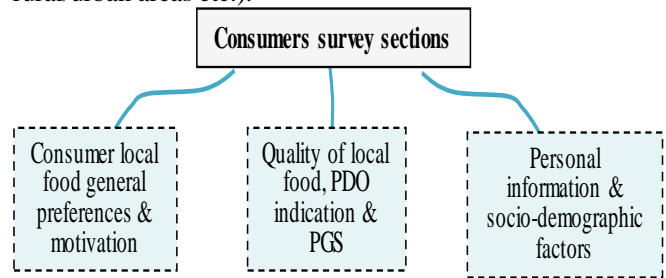
- (a) consumer cooperatives (15%)
- (b) Local grocery, fair trade or small specialized shops and (16%)
- (c) movements without middlemen (6%)
- (d) Students and other academic members through university mailing lists (29%)
- (e) and other “simple” or “common” consumers (snowball method through social media) (38,5%)

The questionnaire was divided into three thematic areas of questions (using mainly closed-ended and few open-ended questions), illustrated in Fig 7.:

- (a) The first section referred to the general context which analyses consumers’ local food preferences and distribution channels, as well as their motivation to buy local food and ways in which local foods are conceptualized as authentic or traditional etc.
- (b) The second section referred to the quality of local food while focusing on PDO FETA and on issues of indication and guarantee systems. The aim was to check the level of

awareness and satisfaction concerning the guarantees of the PDO-feta labeling system, the meaning of PGS and consumer willingness to participate in a PGS for feta.

- (c) The third section included personal information. The socio-demographic factors and their impact on purchasing habits and local food narratives (e.g. gender, age, education, residential area, family status, professional status, income, rural/urban areas etc.).



**Fig. 7. Survey sections of questionnaire addressed to consumers**

The summary of the basic analysis revolves around the following few central thematic discussions [57] which are presented in relation to the required contribution and impact on the functionality of the proposed visualization tool:

- (1) Local food (LF): There is an ambiguity in the definition and attributes of local products and their scaling. When consumers think of “local”, they associate this phenomenon with a shift towards Mediterranean dietetic products. Taste and organoleptic characteristics seem to be the most important criteria to purchase a LF. For the majority of people, "local" indicates the ability to obtain seasonal nutritious food from small farms. While the vast majority think that eating locally is linked to a short transport distance, only a quarter of consumers spontaneously associate LF with the place of production and physical proximity to the consumer. So, the consumers do not understand the importance of these elements in the quality and guarantee of locality. Thus, it is concluded that the tool through visualization should reveal the space in relation to values. The tool should incorporate a time-lapse tracking mechanism (e.g. GPS tracking, etc.) or indirectly contribute to reveal this relationship (e.g. showing a pasture in spring and winter etc.).
- (2) Attributes associated with LF: Knowledge and acceptance of the attributes associated with LF from almost 70 to 80% of respondents can be divided into two categories:
  - (a) Intrinsic "ingredients" of the internal quality of the product (fresh and seasonal, healthy with nutritional value, perfume, organic). The tool can display corresponding certifications from laboratories.
  - (b) The relationship with the place and the heritage which affects both the production of the final product and the surrounding physical and social space (production using traditional local methods), respectful of the environment, better appearance, manually cultivated very closely and small-industrial production. The tool can display grazing

organization, grazing with near animal feed, origin-proximity of animal feed and small-industry production methods.

(3) Location of production: includes proximity to their place of residence (up to 300 km), concerns a certain place of production, and considers that all stages of the production process must take place in the defined geographical area, while location is associated with a village or with the countryside. The tool should reveal both livestock activity (corral, herd, and livestock) and its organization around and through a village.

(4) Quality: concerns freshness, taste, nutritional content, health, good taste, locally produced raw materials, knowledge, less production and less processed products. The tool should reveal the products quality via formal certifications, animal feeds, grazing, local production procedure, etc.

(5) Tradition: Concerns traditional production methods and authenticity, PDO and local identity, local gastronomy. This is about small-scale farms and cooperatives: relationships of trust. There is a support for local economies: elimination of intermediaries, market integration while thanks to less intensive production systems and fertilizers there is a reduction of carbon environment footprint. The tool should reveal at least a pasture with proximity to the production animal feeds area, etc.

(6) Labeling: There is a lack of consumer knowledge and ineffective labeling on production methods: information, convenience and guarantees. Consumers don't trust labels. The logo or labels cover only part of the production links. This has an impact on the lack of confidence in small producers as well as on existing certifications or on a lack of labeling on production methods. This indicates a strong need to communicate information to the consumer in an organized and integrated manner on certification requirements via a reliable procedure. The tool should visualize the image of a small herd in relation to grazing.

(7) Price / quality relationship: The price / quality relationship is questioned: consumers seem to need more specific information on the local food chain in terms of health, taste and indirect contribution to society, to economy and to local environment in order to be convinced of the higher price. There is a need to increase transparency and consumer confidence so that the consumer can be empowered as an active receiver of the communication message (education, understanding, etc.). The tool should visualize the relationship between high value and immediate benefits (health, taste, etc.) and indirect benefits (population attention in the countryside, improved biodiversity, environment, etc.).

(8) Market access for local foods: There is a gap between producers and end users. FL is not easily accessible. Consumers rarely buy directly from small dairy units and are

very often directed to large industrial labels because they cannot easily find local food products.

(9) Guarantee issues: Consumers need additional information and guarantees explicitly mentioned on the packaging. Quality expectations are closely linked to clear indications for antibiotic-free milk, local products from small family holdings using traditional production methods, locally produced animal feed, use of fresh milk (a few days) and production stages made into the region. The tool should visualize every guarantee that can be visualized (traditional production methods, proximity of animal feed, grazing, etc.).

(10) Certification: There is confusion regarding symbols and certifications. Very few people answered the question correctly to explain the criteria that differentiate feta from other types of cottage cheese. In terms of certification process, the study revealed that more transparency was needed, which could be recognized through a PGS system since the vast majority of respondents would trust a PGS including consumers, organizations local, citizens, etc., rather than a producer guarantee. The tool should visualize every formal certification (research certifications, quality analysis, etc.) and every informal certification (procedures, immaterial elements, etc.).

Focus groups with consumers, producers and consumer cooperatives were conducted in the second phase of the fieldwork in June 2019. This work included group discussions that provide qualitative information on participants' perceptions and ideas on specialized issues concerning:

- (a) Quality of the PDO cheese of Thessaly under the Terra Thessalia label,
- (b) Guarantees of Terra Thessalia's PGS, and finally
- (c) Participation and visualization of PGS features of the territorial resource by the use of 3D spatial representations as a way to consult consumers, share information and receive their feedback on the links between territorial resource components and their elements, illustrated in Fig 8.

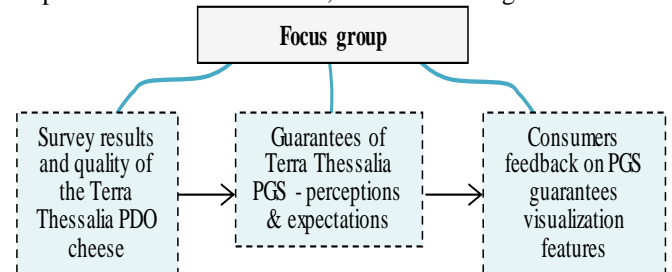


Fig. 8. Group discussions on specialized issues with consumers, producers and consumer cooperatives

### III. PILOT VISUALIZATION TOOL OF TERRA THESSALIA PGS

#### A. Introduction

Local community, local authorities/actors and consumers need a participatory planning support tool in order to communicate the guarantee process to different stakeholders



in a collaborative way while allowing active participation and interaction of the average consumer. This formalized organization of the tool will be based on the PGS of Terra Thessalia and will project territorial resource's components and elements of the dairy chain into a given space so that participants can:

- (a) See and understand the spatial dimension of all these elements,
- (b) have a more complete picture of these components
- (a) Agree on a common perception of the development of specific local products and services

Consequently, the need of visualization of the PGS by user-friendly digital tools and visualization methods [45] is obvious and it is essential to visualize [47] elements and forms' entries in the space. These elements facilitate their anchor to space and the quality / identity of the territorial resource's characteristics, as well as the relationship with the final product while enhancing the understanding of the PGS through an inclusive approach.

The creation of pilot multimedia tool concerns guarantees procedures visualization of Terra Thessalia's PGS. The aim is to seek such a structure and visualization of all information (territorial resource components and their elements) through multimedia interactive access to corresponding layers (links of geo-spatial units, territorial resource components, principles and values, material and immaterial elements, cognitive elements, etc.) in order to allow:

- (a) Each user both ergonomic and comprehensible information retrieval on Terra Thessalia's PGS guarantees,
- (b) Consumer's gradual "inward penetration" and "decryption" of actual information through a process of interactive images and maps,
- (c) Most quality dialogue between sensitized and ignorant consumers

The entire simulation process will be complemented by specific guarantee procedures and correlations of territorial resource components provided by PGS.

### ***B. Influence of research method steps on pilot tool design***

The results from previous research method steps of Territorial resource components identification as well as consumer integration are used to complete the PGS visualization. To achieve this, the following steps are sought:

- (a) a re-integrating process of geographical objects (to which the images relate), into the demarcated geo-spatial units,
- (b) Geographical objects' functional connection to the respective agri-food chain links and the PGS thematic guarantees.

Each component of territorial resource as well as any material and immaterial element is identified and organized in such a way that:

- (b) Its projection to space is clear,
- (c) be a key-feature contribution to the visualization of each guarantee.

At the same time, the results of both previous research method steps contribute and influence conception and ergonomic design of guarantee visualization pilot tool. This is for the following reasons:

- (a) The structure and organization of territorial resources' components significantly affect the ergonomic layout and navigation of the pilot tool,
- (b) Each component or material / immaterial element constitutes a visualized guarantee,
- (c) The projection of each component to the space highlights the spatial dimension of the guarantee, always for the purpose of the specification of the resource and the final product and thus facilitates its visualization and makes its meaning and role more understandable,
- (d) Recorded consumer thoughts and needs contribute to both confirmation and identification of guarantees to be revealed and visualized,
- (e) Survey results organization in thematic, reveals consumer thoughts and needs and contributes to better organization of thematic discussion of adapted interactive consumer deliberation tool,
- (f) Participatory deliberation of consumers allows continuous upgrading of new guarantees and customized visualization mode.

### ***C. Comparisons with relevant systems***

Today, one of the technological challenges are digital 3D representations of either graphical and descriptive data or small and large data volumes [58]. Many systems allow the dynamic management and representation of environmental and social features such as Scientific stakeholders, Public opinion, Transportation / Air Quality / Land Use, etc. [59]. Other representation systems employ dynamic spatial simulation (DSS) models [60] using, inter alia, object-oriented programming solutions for the development of integrated computer models [61]. Also, Participatory System Dynamics modeling (PSD) triangulates stakeholder expertise, data and simulation of implementation plans prior to attempting change [62].

The modeling and simulation of participatory guarantee systems allow the integration of stakeholder deliberation and incorporate diverse stakeholder knowledge that can accommodate changing information and changing social and environmental conditions [59].

However, despite many active PGSs around the world [63], [64], [65], as well as multiple visualization models such as DSS, PSD, etc., no corresponding PGS guarantee visualization system has been observed. Obviously, the proposed visualization system is not directly related to a DSS system since it does not simulate dynamically spatial data and its visualization is based on images with spatial reference. Also, the proposed system does not allow dynamic modeling of space or data updating as PSD systems do, because of its static but very powerful virtual reality approach.

**D. Technical approach**

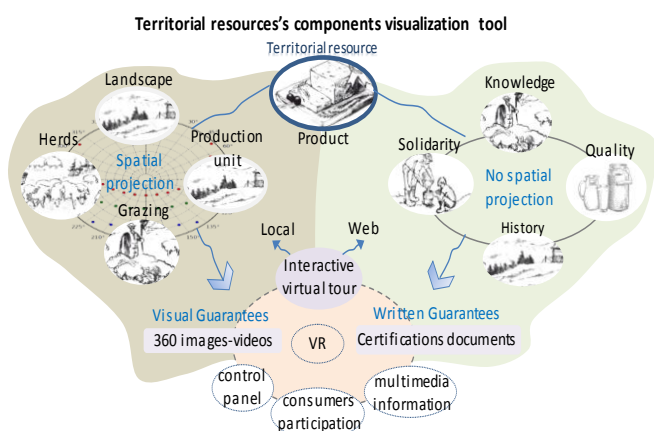
The proposed visualization tool includes three related development and design stages:

- (a) Creation of a digital tool for visualization of components and elements of the territorial resource that are transformed into PGS guarantee procedures,
- (b) Creation of a digital space of interactive consumer deliberation to enhance the guarantee procedures,
- (c) Creation of a digital online combinatorial platform for visualizing the PGS's guarantee procedures with interactive consumer participation.

The first design stage of territorial resources' components visualization tool is based on:

- (a) The linking and correlating of material and immaterial components of the territorial resource,
- (b) The spatial projection and simulation of all these elements and correlations. The correlation and projection of the resource links to space reveals "anchorages" with spatial references creating new uses and innovative, specific local products and services.

This pilot tool implements the proposed research method by simulating all structure and relationships between components and elements of territorial resource. Each feature with a spatial reference is projected through an interactive 360° image in an interactive multimedia virtual tour environment. Particularly, each material and immaterial element with a spatial projection (e.g. landscape, herds, grazing, production unit, etc.), is visualized in an interactive 360° real image with the help of adapted description and multimedia feature and transformed into a visualized guarantee. On the other hand, each element without a spatial projection (e.g. knowledge, experience, solidarity, quality, etc.) is visualized in corresponding written guarantees / certificates, illustrated in Fig 9. Each of these elements is associated with one or more values / practices such as animal rest with well-being, proximity with environmental footprint, local breed with animal resilience, etc.)



**Fig. 9. Scheme's partial structure of territorial resource's components visualization tool**

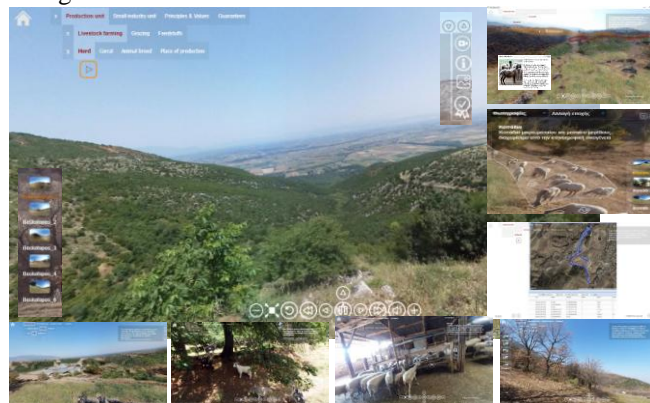
An apache 2.4 web server with mode rewrite and php 7.1 with extensions enabled hosts an html application of virtual tour environment with 360° images simulating the material

and immaterial characteristics of the territorial resource.

The entire structure of territorial resources' components up to final guarantees are visualized in menus / submenus, illustrated in Fig 10. Each visualized guarantee (image 360° or certification document) corresponding to a territorial resource's component, element or principal / value is accompanied by a control panel containing multimedia information:

- (a) Description text,
- (b) Series of corresponding images,
- (c) Video
- (d) Certifications and guarantees

Each 360° image contains interactive areas that allow either browsing and connecting with other guarantees / virtual tour elements (panorama 360°, block of images, video, popup info, video 360°, etc.), or individual focus information that correspond to the guarantee features (multimedia information on specific guarantee, e.g. animal breed: categories, place of origin, exterior features, production capacity, etc.), illustrated in Fig 10.



**Fig. 10. Views aspects of territorial resources' components visualization tool**

The proposed visualization enhances the correlation between the 'spatial' and the 'temporal duration' (annual production circle) by using further techniques which connect the static spatial projection to the guarantees procedures) (e.g. GPS tracking or mapping of agricultural holdings from which animals' feedstuffs are derived). Terra Thessalia's PGS uses GPS technology to guarantee grazing. The embedded GPS in animals detects the quality of the pasture through the speed of the animals and whether or not they stay in specific pasture areas. At the same time the use of drone contributes to the accurate mapping of pastures [41], [46]. This technology is integrated into the implemented visualization tool, illustrated in Fig 11.

The tool's technical operating framework around the central core of spatial simulation, is implemented in an interactive virtual tour environment that can 'run' either locally (browser environment without web connection or autonomous executable file) or online (web environment connection in html). Both environments enable fully digital spatial simulation, with representation of interactive multimedia applications, internet links of all multimedia

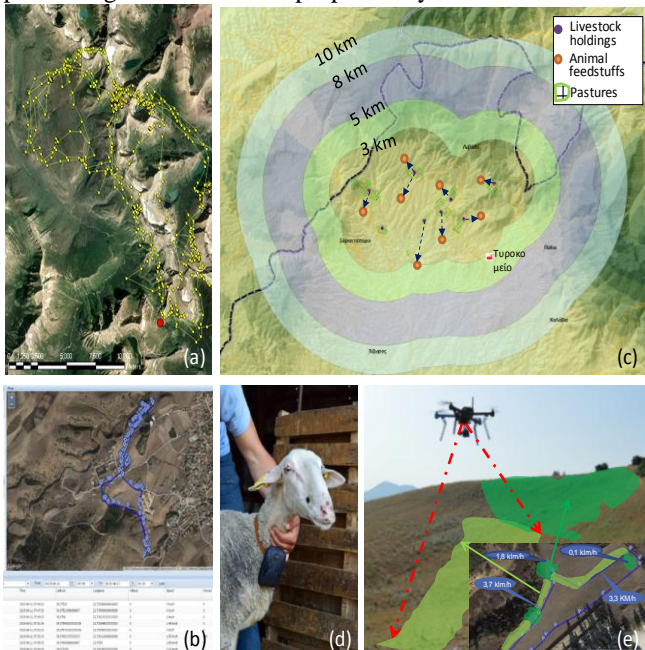
elements [47] and their organization on web environment, facilitating the active navigation and participation of local actors and consumers. At the same time, the tool's technical operating framework allows the implication of virtual reality environment by using VR headset glasses and sensors in order to provide a live immersion experience.

This will allow users to:

- (a) have a more complete spatial perception of the product's location,
- (b) To better understand the implications of a guarantee with spatial reference to space its shelf,
- (c) To give their participation an entertaining approach,
- (d) Facilitate their navigation in PGS,
- (e) Facilitate their adaptation to PGS learning processes.

The second design stage of digital interactive consumer deliberation tool is based on:

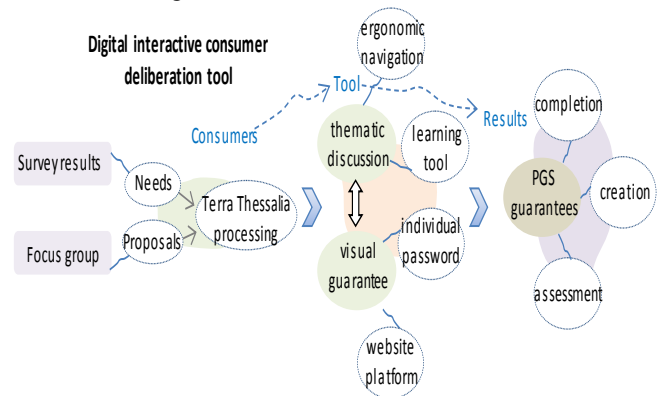
- (a) Thematic of survey results
- (b) Recorded consumer thoughts and needs that confirm existing guarantees or contribute to the creation of new ones
- (c) The need of free participation and deliberation of each consumer with ideas and needs submission,
- (d) The institutional concentration, categorization and processing of all consumer proposals by Terra Thessalia.



**Fig 11: Terra Thessalia's technology integrated into visualization tool: (a) Views of GPS tracking (animals movement), (b) Animal movement recording software, (c) Mapping of agricultural holdings from which animals' feedstuffs are derived, (d) Use of GPS in the animal, (e) Use of drone for mapping of pastures**

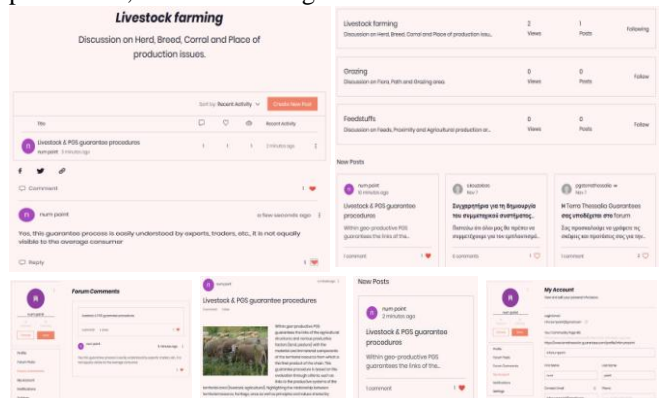
The proposed pilot tool implements all the experience and organization of survey results and focus group creating a digital deliberation tool adapted to a website platform environment on a specific server. Each user has his/her own password with permission from platform administrator. The deliberation tool acts as a social networking forum tool. That

means that every consumer proposal is recorded in a discussion history that anyone who has access to this topic can view, complete, confirm or disapprove. Subsequently, all proposals, opinions, and ideas of the respective theme are processed by Terra Thessalia in order to enrich both the visualization of the guarantees, the ergonomic navigation of the tool, and the adaptation, evolution of the tool as a learning tool of Terra Thessalia's PGS guarantee procedures, illustrated in Fig 12.



**Fig 12: Scheme's structure of digital interactive consumer deliberation tool**

At the same time, access to thematic discussions of the deliberation tool is provided through the corresponding visualized guarantees of the territorial resources' components visualization tool (1st design stage). This allows immediate connection of the respective visualized guarantee to a deliberation forum and thus the online and real-time feedback; completion and evaluation of PGS guarantee procedures, illustrated in Fig 13.



**Fig 13: Aspects of the digital online interactive consumer deliberation tool**

The third design stage of the digital online combinatorial platform is based on:

- (a) PGS's guarantee procedures via the corresponding tool referred to the first design stage of territorial resources' components visualization tool,
- (b) Interactive consumer participation via the corresponding tool.

In fact, this pilot tool adapts and combines these two digital tools of the previous design stages into a single website combinatorial platform ([www.terraithessalia-guarantees.com](http://www.terraithessalia-guarantees.com) – under construction), illustrated in Fig 14.

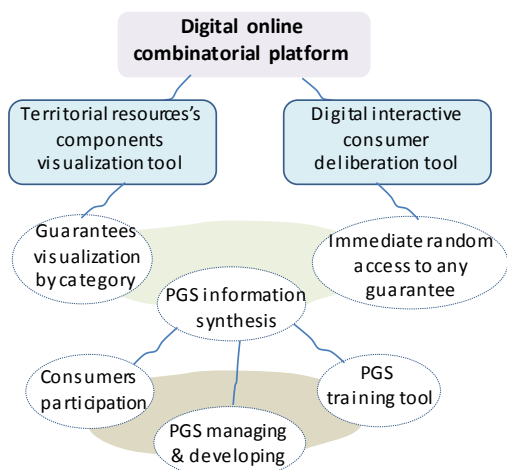


Fig 14: Scheme's structure of digital online combinatorial platform

This platform enables, inter alia:

- (a) Access to the guarantee visualization tool and the consumer deliberation tool,
- (b) Overall schematic visualization of all guarantees by category according to the research method,
- (c) Immediate random access to any guarantee,
- (d) Institutional synthesis of all PGS information into an online tool,
- (e) Facilitating involved actors to participatory planning processes,
- (f) Facilitating the development of the visualization tool into a training tool of PGS processes,
- (g) Raising awareness and potential activation of all stakeholders and local actors on the issue of managing and developing a PGS, illustrated in Fig 15.

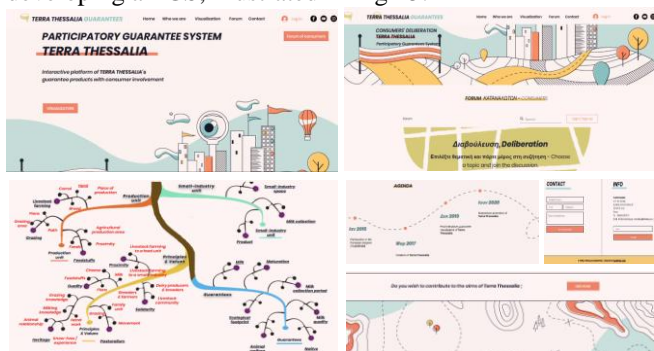


Fig. 15. Aspects of the digital online combinatorial platform (www.terra-thessalia-guarantees.com – under construction)

#### IV. CONCLUSION

##### A. Introduction

The proposed interdisciplinary approach links: i) spatial analysis focusing on territorial resource anchoring through territorial resource identification and relationships, ii) social research through consumer integration processes in a PGS, and iii) the use of innovative digital tools to visualize PGS's guarantee processes and facilitate consumer participation on a unique online platform. This link contributes, inter alia, to:

- (a) The interpretation and understanding of the

image-referenced element (material or immaterial) as a territorial resource component but also as a functional element of a territorial link (with space, heritage, society, etc.) and a production process,

(b) A link to the principles and values (sustainability, environmental footprint, heritage, etc.) surrounding the territorial resource and the end product,

(c) An innovative combination of visualization methods / techniques and interactive consumer participation in order to facilitate the recognition of guaranteed by PGS links between end product, territorial resource components and territory.

The present study records the processes of identifying and revealing the quality specific characteristics of a food associated with the place of production. It, also, improves the territorial participatory quality certification system by involving consumers and it guarantees the authenticity of food and its specificity by informing and representing in an understandable way the 'bond with the place of production' to the 'average' consumer. Finally, the implemented tool that visualize the 'product's bonds, to the place of production combines the Participatory Guarantee System and the site's visualization by using ICT and interconnection of multimedia elements [66], enhancing the interactivity and accessibility of the guarantee system itself.

##### B. Innovation of the research proposal

The conducted research is innovative as it uses a methodology that combines spatial analysis with social research by integrating digital consumer support, deliberation tool and PGS's guarantee visualization tool. Its innovation focuses on the following:

(a) Activation and interaction between consumers and producers, in a participatory and innovative process of territorial recourse revealing (bottom-up approach). These actors co-guarantee product quality through territorial clusters, forming preferential conditions for food revealing as a "local territorial resource" by integrating properties of the area of origin and enhancing / establishing territorial marking.

(b) Methodology of organizing the integration of consumers into a collective process of revealing and guaranteeing a territorial product. The innovation lies on the fact that research approaches consumers not only as knowledge and opinion bodies but also as potential actors in the final coordination of a territorial area's guarantee system.

(c) Use of state-of-the-art technological means to enhance territorial resources. Visualization of territorial resource PGS's components is implemented through a multimedia interactive online platform, based on active consumer participation through digital support, deliberation, and awareness raising. It integrates innovatively the territorial dimension, social capital (territorial governance, consumer organizations) as well as the values shared by consumer society. It uses spatial digital simulation techniques and tools for decision making and managing complex relationships that allow easier understanding of issues and provide the basis for learning conversations [41].

(d) The creation of a new platform and a new field of collaboration and mutual learning focusing on the operation of a PGS creates the conditions for building a dynamic network of producers and consumers [67]. This innovation is socio-institutional and fits, as a cooperation form, in the evolving urban-rural relationship, highlighting the social dimension of the agri-food chain as an important sustainability parameter.

(e) The tool contributes to the communication of ever-increasing consumer associations.

**C. Contribution to theoretical and applied scientific knowledge**

The conducted research contributes to the reflection on the process of development ‘territorializing’ which tends to evolve into a theory of rural development. It contributes to the territory approach as a natural background to economic activity and as a productive factor that seeks competitiveness based on resource distinction. The research approaches the role of resources by focusing, via spatial analysis, on their links with the territory. In the field of applied scientific knowledge, it develops and combines methods and technological tools that help to enhance the capacity of rural territories to ensure the specificity of their products and their competitiveness.

Exploring ways to improve the functionality and the effectiveness of guarantee systems, it combines geographic spatial analysis (focusing on resource anchoring), social research and participatory methods (to integrate consumers into the guarantee system), and digital tools (online interactive platform, multimedia interactive virtual representation). In addition, the interdisciplinary approach of resource through the science of geography (spatial dimension of the resource and productive system) and semantics (reduction of the arbitrary image of a spatial reality through PGS) contributes to the development of a methodology useful for actions of revealing and activating rural territorial resources. At the same time, the research aims to improve the ‘bottom-up approach’, the use of a PGS with consumer’s participation by creating an interesting interdisciplinary scope for ICT and online social networks.

**V. PERSPECTIVES**

This study suggests a form of collaborative participatory interactive representation that will improve learning. In particular, the interactive visualization tool of territorial resource components of PGS can be transformed and developed both to a learning tool of PGS procedures and to a tool to raise awareness of PGS guarantees with an educational approach.

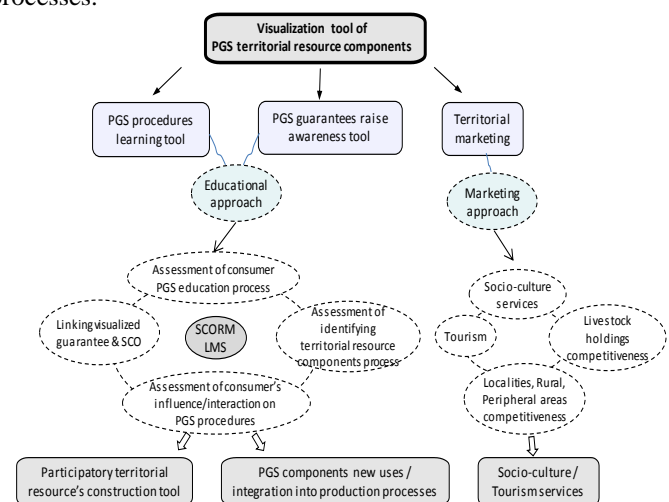
At the same time, the proposed visualization tool will actively contribute to the assessment of both consumer education process regarding PGS procedures and the process of identifying territorial resource components. This will be achieved by adapting a digital e-learning assessment system with “Sharable Content Object Reference Model” (SCORM)

- mechanism [68] to the existing PGS components visualization tool.

The “Sharable Content Object” (SCO) indicates that SCORM is all about creating training units that can be shared across systems. SCORM will define how to create SCOs that can be reused in different systems and contexts. In other words, SCORM will define a specific way of constructing Learning Management Systems (LMSs) and training content so that they work well with other SCORM compliant systems. So, every visualized guarantee procedure will be linked to a SCO on the existing multimedia combinatorial platform in order to assess both consumer learning process and the influence and interaction of the consumer with the PGS procedures.

The integrated components of representation can contribute to a common spatial perception and create a "common language" of communication [66] between stakeholders. Thus, the PGS components visualization tool, with the help of (a) the PGS procedures awareness and learning tool and (b) the PGS procedures assessment tool, can create sensitized and specialized actors on PGS issues. This will allow the tool to evolve along the way with the development of a new digital participatory territorial resource construction tool and its corresponding components with the active action and involvement of all relevant stakeholders (‘conscious’ consumers and producers cooperatives, local actors and authorities, etc.), illustrated in Fig 16.

The proper organization of all PGS components can create 'linked group data' that will allow the creation of new uses for the components and their integration into production processes.



**Fig. 16. Perspectives of the PGS components visualization tool**

The tool will feed, contribute and enrich the procedures of a territorial marketing. This will allow to:

- (a) Intensify the localities' competitiveness and the territory will have to pay a special attention to the development of its product in accordance with the needs of society, making use of all its resources and potentials [69],
- (b) Help small livestock holdings in disadvantaged areas

to be competitive in the market,

(c) Formulate, implement territorial development strategies and improve the competitiveness of rural and peripheral areas [70],

(d) Apply this territorial marketing to cultural tourism by analyzing touristic attitude of destinations [71] as well as to socio-culture service, tourism and hospitality by promoting products and services, solving current regional problems and creating territorial brands [72].

Finally, the implemented tool is a digital medium allowing to:

(a) Enhance and support the territorial marketing of the revealed and guaranteed territorial resource, and

(b) Help consumers to understand the relationship between the final product and the territorial resource from which is provided.

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