CERTIFIED FUTURE

A STRATEGY FOR SUSTAINABLE & RESILIENT AGRICULTURE IN TUSCANY

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MASTER'S THESIS
PATRICK TOBIAS MAURER

DELFT UNIVERSITY OF TECHNOLOGY
FACULTY OF ARCHITECTURE
& THE BUILD ENVIRONMENT
DEPARTMENT OF URBANISM

— A CERTIFIED FUTURE

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Figure 01 -Landscape Valdera, by author.

ABBREVIATIONS AND TERMS

ORIGINAL ACRONYM		TRANSLATION
Indicazione Geografica Tipica	IGT	Typical Geographical Indication
Indicazione Geografica protetta	IGP	Geographical Protected Indication
Denominazione di Origine Protetta	DOP	Designation from Protected Origin
Denominazione di Origine Controllata	DOC	Designation from Controlled Origin
Denominazione di Origine Controllata e Garantita	DOCG	Designation from Controlled and Guranteed Origin
Specialitá Tradizionale Garantita	STG	Speciality Traditional Guaranteed
Agenzia regionale per la protezione ambientale della Toscana	ARPAT	Regional Agency for environmental protection in Tuscany
Associazione Italiana Agricoltura Biologica	AIAB	Italian Assosiation for Biologic Agriculture
Ministero delle politiche agricole alimentari e forestali	MIPAAF	Ministry Agricultural Policiy and Forestry
Istituto Regionale Programmazione Economica della Toscana	IRPET	Regional institute for economic Program in Tuscany
Piano Strategico Nazionale	PSN	National Planning Strategy
Geographical Indication	GI	
Protected Geographical Indication	PGI	
Protected Designation of Origin	PDO	
Tradicional Speciality Guaranteed	TSG	
Common Agricultural Policy	CAP	
Sustainable Development Goals	SDG'S	
Organic farming	BIO	

Figure 02 - Tuscan landscape, by Author, Camugliano.

— INTRODUCTION

CERTIFIED — FOR THE FUTURE

— A STRATEGY FOR SUSTAINABLE & RESILIENT AGRICULTURE IN TUSCANY

WHY CERTIFICATIONS?

"The development of agriculture about 12,000 years ago changed how humans lived. They switched from nomadic hunter-gatherer lifestyles to permanent settlements and farming" (National Geographic Society 2019).

Since then, agriculture has played a fundamental role, on the one hand, in defining the hierarchical structure of society and, on the other, in building an economic system that relates to complex synergies and interactions with other systems. This process did not happen equally and was contemporary on a global scale. Depending on the meteorological and morphological conditions and availability of natural resources that define a geographical area, farmers had to adapt differently. The amount of flat arable land, a good balance between medium rainfalls and sun exposure, together with soil fertility, water resources and biodiversity of available crops, are all values that have influenced the development of different agricultural practices. Practices are meant to cope with adversities, improve production capacity, and facilitate fieldwork. The various methods that farmers have developed over time have shaped the landscape and slowly became proper traditions for the agricultural community living in that place.

The so-called "Petrochemical and Genetic Engineering revolution" (Janine M. Benyus, Biomimicry, 1997) signed a decisive change in the global agri-food sector. Farmers moved more and more from using traditional farming practices that have developed over time and were created to maintain the fragile balance between human activities and their surrounding environment to new techniques. These new practices include the use of pesticides, fertilizers, and antibiotics capable of solving most of the problems farmers had to cope with and, at the same time, improving the productivity and capacity of the agricultural land.

In a capitalistic reality where bigger is better and where the short-term profit plays a key role, the new Petro-genetic practices did have such high success among farmers that they were rebaptized as "conventional farming practices". These farming practices bring two significant issues: they are both unsustainable as they deploy and pollute natural resources, deteriorating the surrounding environment, and they are not resilient. As mentioned before, capitalism focuses on short-term results. The same happens to conventional farming practices. They seem to be the solution for improving the production of a specific crop or fighting the outbreak of bacteria, but what they really do is make the crops artificially dependent on phytosanitary products and so weaker and more exposed to shocks and stresses that will occur more and more frequent.

"Now that we can synthesize what we need and re-arrange the genetic alphabet to our liking, we have gained what we think of as autonomy. Strapped to our juggernaut of technology, we fancy ourselves as gods, very far from home indeed. In reality, we haven't escaped the gravity of life at all. We are still beholden to ecological laws, the same as any other life form. The most irrevocable of these laws say that a species cannot occupy a niche that appropriates all resources, there must be some sharing. Any species that ignores this law winds up destroying its community to support its own expansion. Tragically, this has been our path" (Janine M. Benyus, Biomimicry, 1997).

For a long time, the environmental sustainability issues caused by conventional farming practices were a niche knowledge that only researchers had access to. It changed in the past three decades as awareness began spreading among farmers and consumers. The increased awareness was, in a certain way, forced by the fact that the first effects were noticeable not only in statistics and papers but also physically. Polluted water resources, soil salinization and saturation and more frequent and damaging outbreaks of pandemics are all phenomena economically damaging agri-businesses caused by conventional farming. Especially farmers that must cope with the casualties are beginning to realize that the conventional system is not sustainable anymore and has to be replaced.

The new way of thinking translated itself into a comeback of traditional and sustainable farming practices. These practices have much higher production costs and rely much more on qualitative production rather than quantitative production. Meaning that the farmer is forced to sell its product at a higher cost than not the price established for the same product cultivated conventionally to make a profit. On the free market, this means only one thing, without a consistent demand for more sustainable food products and, therefore, a specific number of consumers capable and willing to pay more for food products with particular qualities, a transition to more sustainable agri-food systems remains impossible. Once the demand for qualitative products is established, agri-food businesses that offer such food products' main task are to distinguish from other conventionally produced goods.

The agri-business has to communicate to the consumer that its product has specific qualities that similar products made by other agri-businesses have not. Communication can happen in various ways, for example, with advertisements. The most successful method, at present, is through applying specific labels to a product's packaging. The tags are linked to a certification. Certifications are, in this case, efficient because they guarantee that the agri-business follows specific rules and that a third institutional subject verifies these. Consumers are less sceptic about the quality of particular products when these are regulated by law and a non-profit-oriented entity monitors the involved agri-businesses. This established consumer trust allows certified producers to protect or improve the market value of their products. The label of a specific certification does justify a higher selling price compared to similar non-labelled food products.

AN INCOMPLETE PUZZLE

Certifications are tools used in almost all market sectors. They can present in many forms and shapes and act on different scales and in different ways. In the agri-food system, the most popular certifications are four.

(a) First are the certifications that protect a well-established and consumer-known brand, also called trademarks. *"A trademark is a sign capable of distinguishing the goods or services of one enterprise from those of other enterprises. Trademarks are protected by intellectual property rights" (World intellectual property organization, 2021).*

(b) Second, similar to the concept of property rights for trademarks but referring to a geographical area and not to a single enterprise are the certifications for geographical indication. A GI is *"used on goods that have a specific geographical origin and possess qualities or a reputation that are due to that origin. Most commonly, a GI consists of the name of the place of origin" (FAO, 2021).*

(c) Third, organic certifications expressly guarantee that the agribusinesses that apply to it use only organic farming practices during the production process.

(d) Fourth, certifications such as fair trade, where the label communicates to the consumer that reasonable prices are paid to the producers if the exchange happens between a buyer from a developed country and a producer from a developing country.

Every certification is followed by its policy or agreement that operates either on international or on a European scale. As much as these certifications might seem practical tools that are influencing the sustainable transition, their policy lacks organizational and legislative aspects.

The participation of agribusinesses in such tools is still marginal in the European agricultural context, and overall awareness is still low when it comes to certifications. The main issues behind low participation are the assessment costs, but also the policy plays its role. All four categories, trademarks, GIs, Organic and fairtrade policies, present themselves as monofunctional regarding sustainability aspects. They all represent only one of the three classes. Trademarks and GIs are tools made to protect the image of a product and are in first place policies that guarantee the economic sustainability of a single or group of enterprises. Indirectly, they can also have social and environmental beneficial effects in the longer term. Organic farming certifications indicate that no chemical products are used and other limitations that improve environmental sustainability. On the other hand, organic certifications lack social and economic sustainability. The national scale of the policy does not include the social cohesion of farming communities or a support system for financial matters. Fairtrade certificates do represent socially sustainable principles the most. They also influence economic sustainability as they improve market value and guarantee fair payments, but they have little to do with environmental aspects. Instead, they can become harmful when they are too successful, which might cause monocultural intensive agri-food systems.

What is seen rather as a weakness can at the same time become an opportunity. The possibility is to think of a combined tool between the existing certifications to cover all three aspects of sustainability. A new revolution is needed to activate the potential of the current certificates allowing them to induce the European agri-food system to become sustainable and resilient to adversities. The missing piece of the puzzle must be found.

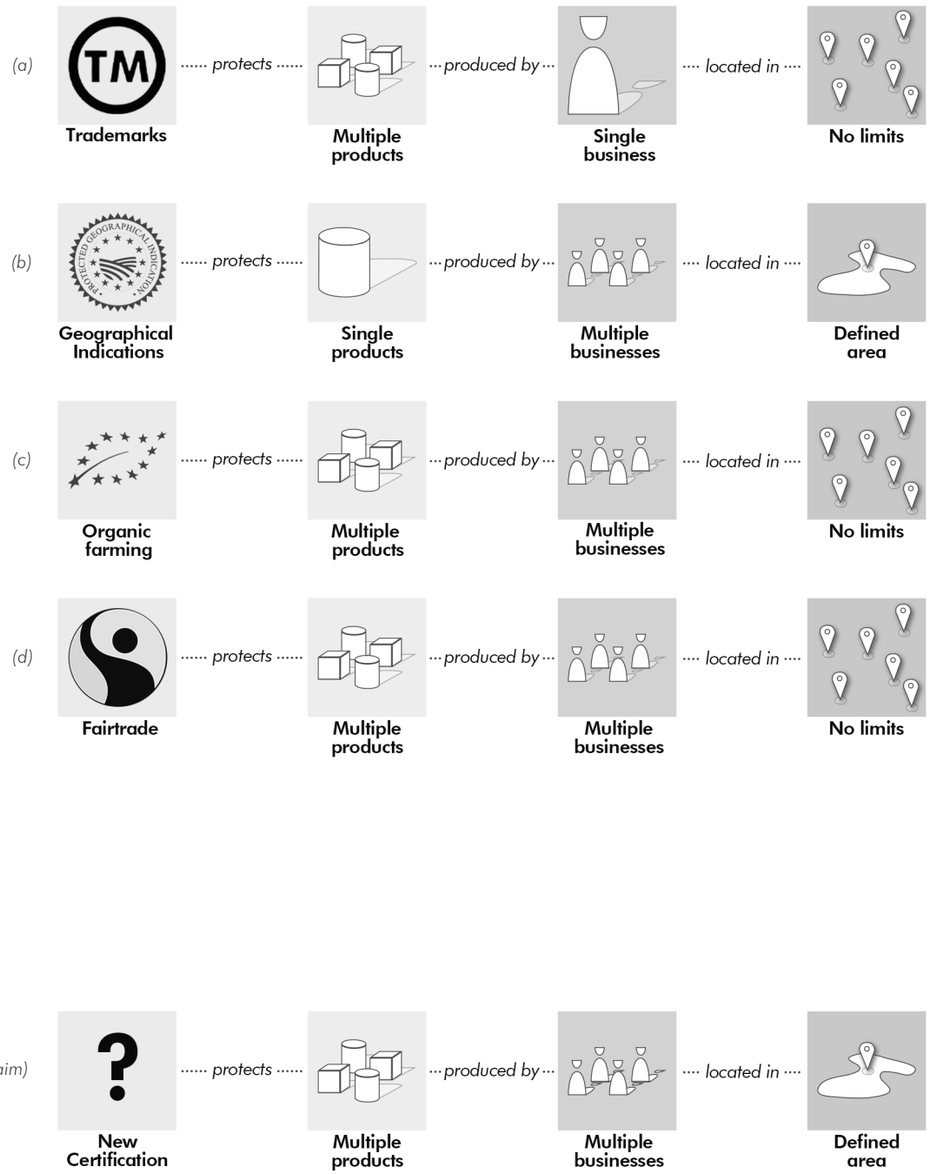


Figure 03 -Different food quality certifications and how they function.

FINDING THE MISSING PIECE

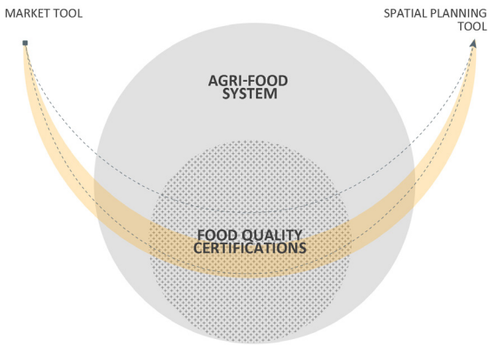
As made clear in the previous chapter, the existing agri-food certificates do indeed improve in different ways the sustainability of agri-food systems. Anyway, their full potential is far from being expressed, for several reasons, leaving their efficiency of marginal impact.

The research aim is to create a framework capable of introducing a new form of certification. This certification should work as both a market tool, protecting the economic capacities of members and a spatial planning instrument giving major instructions upon sustainable agricultural practices that have to be followed. Therefore, the policy behind the certificate must include specific indications on rules and spatial limitations it imposes to applying farmers, guidelines that define the association behind the certificate and the role institutions have in it. These three aspects of the framework do not change, even if it is applied to different agri-food sectors. What does change, are the different indications and spatial limitations. These depend on the environmental criticalities that the system has to cope with.

The resulting policy aims is to express the full capacity of food quality certifications on the sustainability of the agri-food system.

To do so, the research must conduct a parallel investigation concerning the agri-food system and the already existing policies for sustainable agricultural farming. This will provide for enough information about the main characteristics and structural composition of the selected agri-food system and the critical aspects that make it an unsustainable one, allowing the research to focus on specific issues. At the same time, understanding the nature of existing certifications and the policies that regulate them is crucial to understand where strengths and weaknesses can be found and what opportunities are there to combine different tools into a more efficient framework. Knowing what problems to address and how to possibly address them facilitates the decision-making process.

To complete such an investigation, the research has to narrow down its scope to a single agri-food system. In this case, the Tuscan region was chosen and, more precisely, for successive analysis of the sub-system of Valdera. The Tuscan agri-food system relies on a fragile environmental balance and includes a very high number of different food certifications that have little influence on the system. It is the perfect area to study when the aim is to discover why certifications are not efficient.



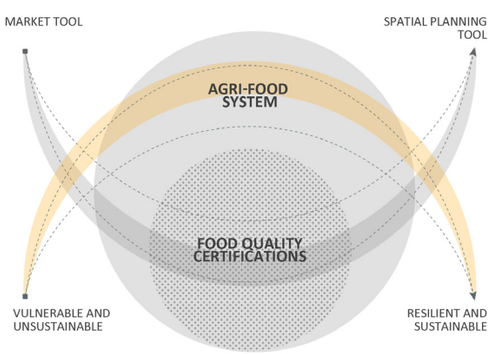
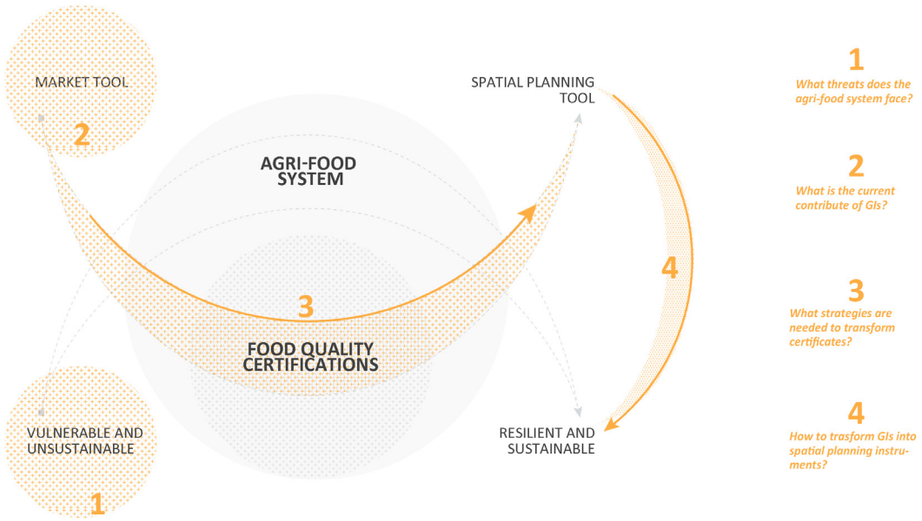


Figure 04 -Conceptual framework, First step, "learning about the context".
Figure 05 -Conceptual framework, Second step, "identifying the problem".
Figure 06 -Conceptual framework, Third step, "achieving the goal".



ASKING THE RIGHT QUESTIONS

The research follows a parallel investigation of the Tuscan agri-food system and food quality certifications, as seen in the conceptual framework. These two topics are interrelated, and making a distinction between the two may often become a difficult challenge. Therefore, it is essential to set well-defined research questions in the first place, capable of giving a defined direction to the research and structuring its parts.

The main question for the research remains, how? – How can certifications such as Geographical Indications become spatial planning instruments that positively affect the resilience and sustainability of the Tuscan agri-food system? Of course, the answer to the main research question becomes the framework itself, but it implies a set of previous sub-questions that provide the proper knowledge to answer the main question correctly.

The first sub-research question concerns the "context". How is the agri-food system in Tuscany structured, who is involved and what are the environmental criticalities? – are the questions that lead to the first analytical part of the report. The general information needed to answer the context sub-question is collected through statistical analysis, spatial investigation, and stakeholder analysis.

After the first part of the report, developed to answer the context question, the second sub-question concentrates on understanding the chosen "Tool" more in-depth. To what extent are Geographical indications and other food certificates currently contributing to sustainability and resilience in the agri-food system? – this sub-question leads to the second part of the research (see "Analysing the potential of existing policies"). The correct information is collected through in-depth policy analysis and interviews led with users and specialists.

Third and last sub-research question - What strategies are needed to transform certificates such as Geographic indication into spatial planning instruments? – refers to the final part of the research. In this part, the results of the two previous research (Context and Tool) are confronted and tested through different methods. This way, the most substantial opportunities are detected and integrated into the final framework.

Figure 07 - Research questions, "from the conceptual framework".

Figure 08 - Tuscan landscape, by Marcel Minga.

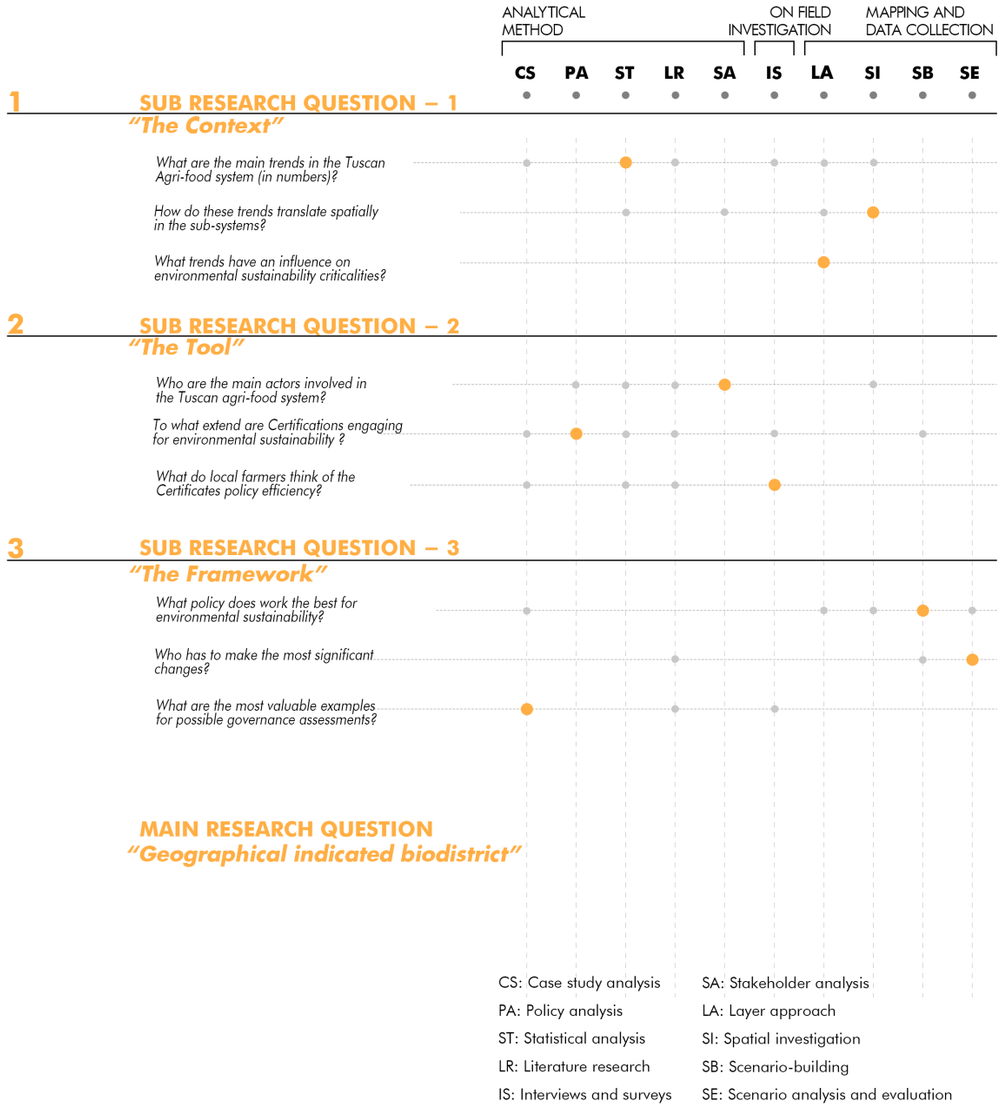


Figure 09 - Research questions and how to solve them, scheme of used methods.

USING THE RIGHT METHODS

Many methods are used to collect the information needed to build the framework. They are all strictly necessary and interconnected as the research slowly builds upon them. Apart from the more "traditional" methodologies of data analysis and interpretation as statistical analysis, spatial investigation, and policy analysis, which are used in both the "context" and the "tool", there is a set of less explored methods used in the research. While the traditional methods consist mainly of analyzing existing evidence and a final interpretation of the researcher, the less explored methods depend upon the researcher's interpretation. These methods make use of the previously collected data and produce new results that then must be evaluated. In the research, two such methods are used.

The first is the research-by-design method. This methodology is used to conclude the context chapter and define environmental criticalities and a list of spatial principles. The layer approach consists in observing how different layers behave when summing, dividing, or subtracting one from the other. In this case, it is used to overlap different conditions of soil consistency and land use properties that define a higher risk for either soil, water or biodiversity contamination and loss.
The resulting maps are helpful tools that give the environmental criticalities a defined spatial dimension. Quantifying the critical aspects of the agri-food system will also be essential in the following method as it simplifies the comparison between different scenarios.

The second method, maximization, is used to draw conclusions from the tool chapter and make decisions for the framework's structure. This method is used as a bridge between the analytical and the decisional part of the research and is so with a fundamental method for its success. The maximization method can indeed be seen as a scenario-based approach. It is used to test the different policies for sustainable farming in the agri-food system. Only through maximization can the full potential of these policies be observed, and their influence on environmental threats becomes assessable. Seeing the full potential displayed in the agri-food system makes it less challenging to identify which parts of the policies are more efficient.

The result of the maximization process, the so-called integration map, is a combination of the most efficient pieces from each maximization process and the lists of spatial and policy principles set by the research.

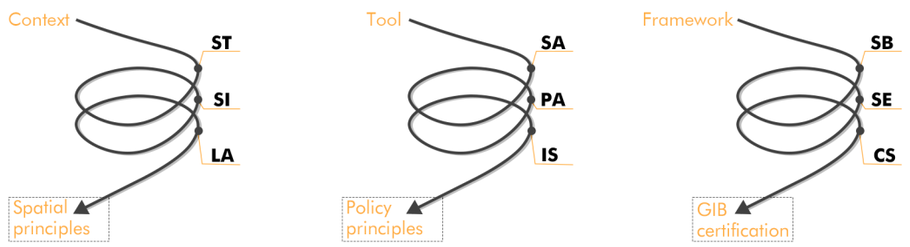


Figure 10 -Simplified methodology (see legend in figure 9).

NEXT STEPS

In the next chapters, the research will follow the diagram in figure 11. Starting from building up the knowledge that is needed to elaborate the strategy, it starts with investigating the selected agri-food system aiming to understand what the main critical aspects are and where unsustainable farming practices are more negatively influential than elsewhere. Once the problem field is set, the attention moves to food quality certificates, what they really are and how they are legally organized. The conclusions from these two steps are valuable to the research as they define the most urgent problem in the area and the possible strengths, weaknesses, threats and opportunities of the policies around the tool that the project aims to use. The main two indications are needed to initiate the scenario methodology and start the framework.

The framework results from investigations made on a specific site, the Valdera. As much as the framework is built to be adopted as a national or European model, some indications in the structure might be too site-specific and not suited to other contexts. This is why it is crucial to keep in mind that if the framework should be repeated in other agri-food systems, the structure of the process can easily be applied.

Still, its impact on the agri-food system's sustainability could differ enormously from the research results. This depends, in the first place, on the context, the agri-food systems structure, its environmental problems and on the different principles set up by the teams or the executive boards. Each bio-district has its personal priorities. Some might aim to slow down soil erosion others might be more concerned with efficient water management. Their priorities influence the lists of principles and, therefore, the result of the maximization process and the whole framework.

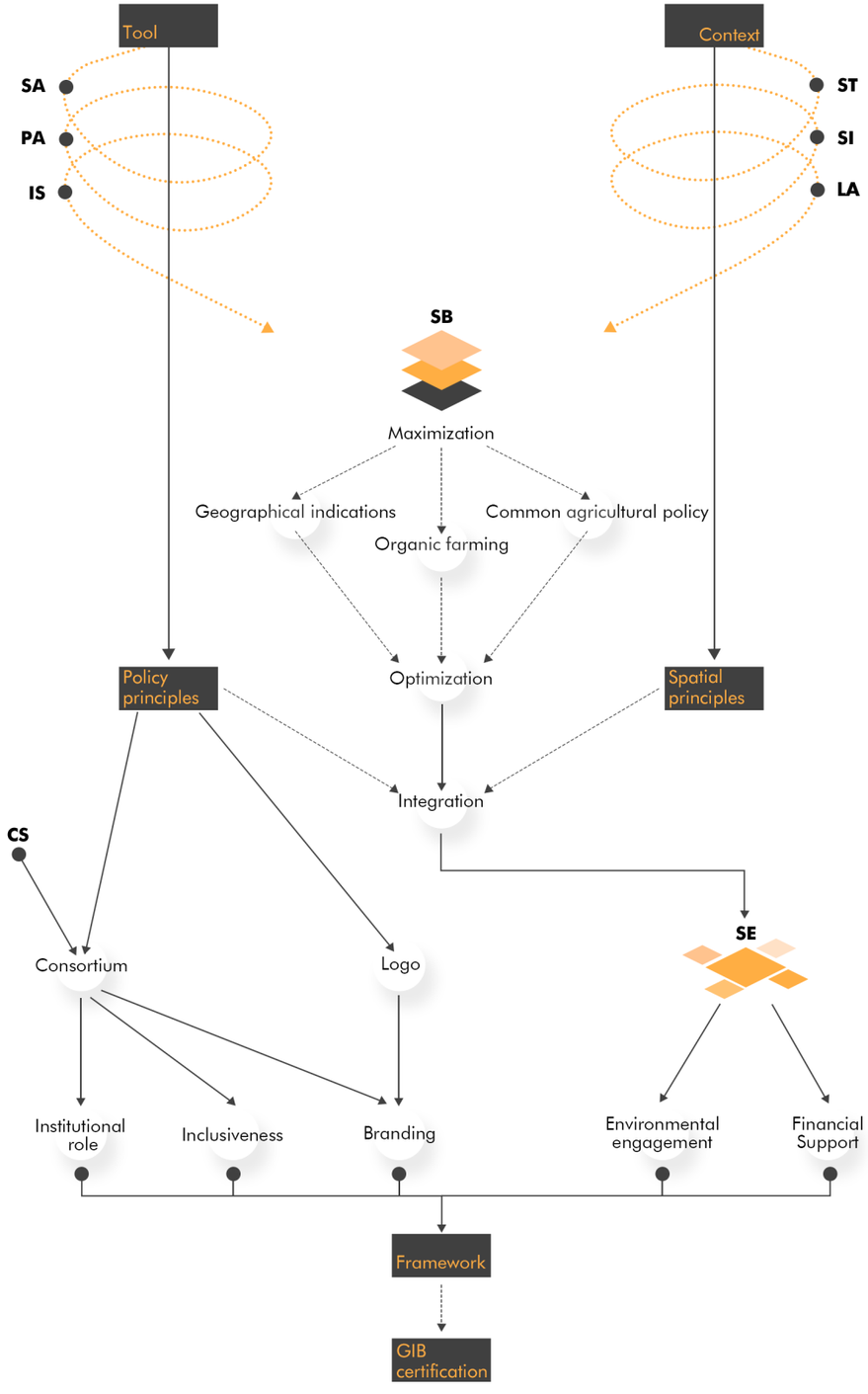


Figure 11 - Methodology scheme.

NEW WAY OF GOVERNANCE

The framework for the new food quality certifications is completed in the final pages of the research. The conclusion from the maximization and local scale test process can be considered the main body of the policy behind the certificate.

Still, other aspects of the certificate must be determined. One of these of fundamental importance is the consortium and the laws that define its role. The consortium stays behind most of the practical governance matters that must be managed once the policy is approved for a specific area. The rules in the policy define the nature of the consortium and can influence, positively or negatively, the efficiency of the policy in including stakeholders and local institutions.

A functioning consortium can also increase the market value of certified products through marketing strategies and brand protection. Another essential aspect of completing the policy framework is the definition of a logo. As with every food quality certification, the project's end result must be identified in a specific logo to be recognized on the market. Once all the framework elements are defined, they can be merged into what the research has called GIB or Geographical Indicated Biodistrict policy framework. This policy provides all the possible indications to applicate this certification to agricultural districts across Europe. Applying the policy would then mean, depending on the participation of farmers, a more substantial commitment to sustainable farming practices in the district, higher opportunities for local farmers to collaborate and create stable farming communities and economic benefits for the entire territory.

Figure 12 - Tuscan landscape, by author, "Strada Volterrana".

DEFINING KEYTOPICS OF THE RESEARCH

THEORETICAL UNDERSTANDING

Before starting to unwrap the research questions, an intermediate but fundamental step is needed. A theoretical underpinning of the keywords mentioned in the conceptual framework. These keywords are used mainly for concepts and with a long list of research papers citing them. But not always do the researchers share the same opinion on the keyword's real meaning.

This is the reason why the theoretical underpinning is so essential. It helps the reader clarify how the keyword is used in the research. After this step, it is possible to decide what methods are the most suited to answer the research questions. The keywords considered in this framework are Agri-food system, Geographical indication, Sustainable, Vulnerable, Resilient, Market tool and Spatial planning tool.

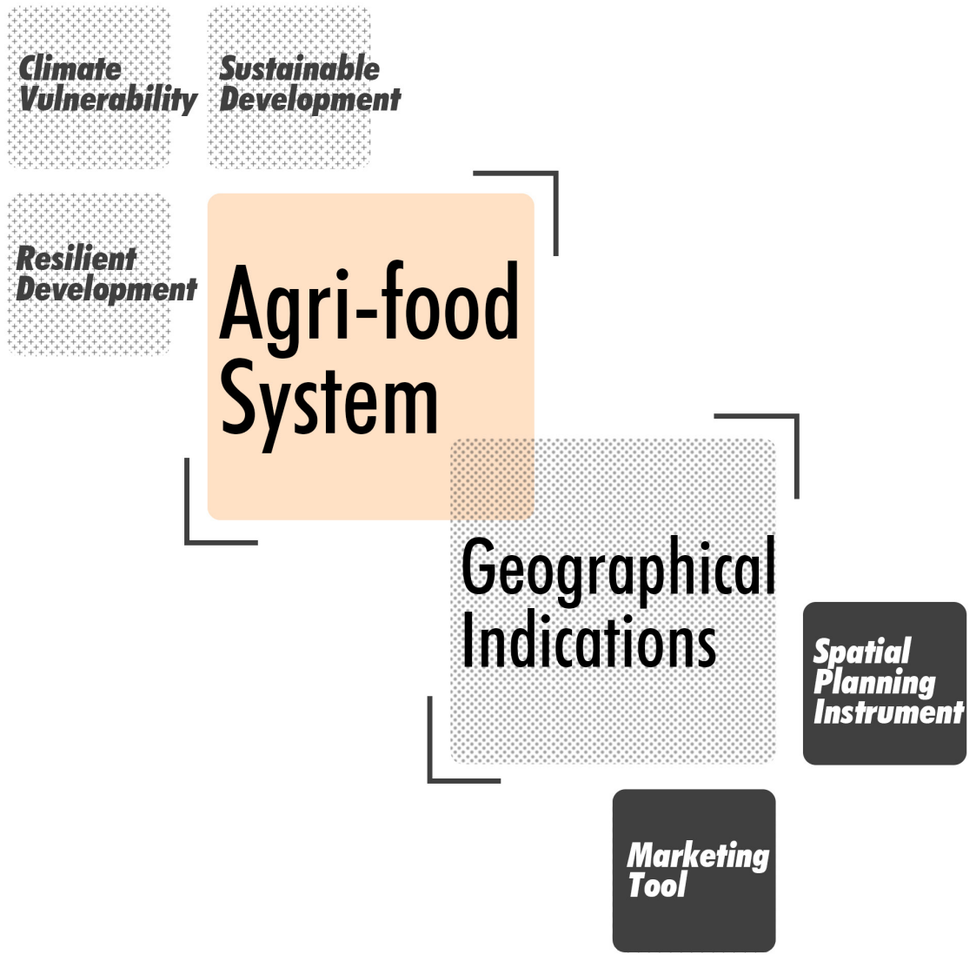
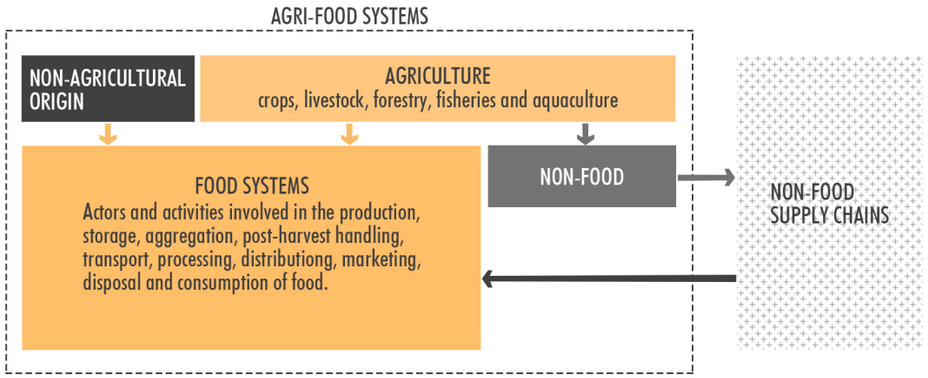


Figure 13 - Theoretical framework, Key-words and topics needed for the contextualisation of the research.



AGRI-FOOD SYSTEM

"The Agri-food sector is a complex value chain which links the procurement of agricultural raw materials produced on farms through their processing and distribution to their use by the final consumer. The sector consists of multiple players, including farmers, input suppliers, manufacturers, importers, packagers, transporters, wholesalers, retailers, restaurants, and customers...Agriculture no longer has the dominant role in economic activity which it once had, but when the contribution of the food industry is factored in, the agri-food sector remains a significant player" (O'Hogan et al. l, 2021).

The agri-food system depends upon synergies between different players that can be categorized into three main groups. Each group concerns a different process of the value chain may it be the consumption, process or production of agri-food products.
To understand the synergies between the different categorized players a substantial awareness of their position in the agri-food chain is essential. Only in this way it is possible to predict future effects on the market of a new policy as it might indirectly affect more players than expected.

"Specifically, food system-related activities include: growing, harvesting, processing, packaging, transporting, marketing, selling, cooking, consumption, and disposal of food and any food-related items. Also included are any inputs needed (land, agricultural chemicals, labour, water, machinery, knowledge, capital) and outputs generated apart from food (greenhouse gas emissions, agricultural wastes, municipal wastewater) at each step along this chain" (Gladek E., 2017).

Since the agri-food system does not only concern the mere process of raw material production, it also includes a number of socio-economical aspects. Leading the system to include players of institutional and legal nature in its synergies.

"The food system further encompasses the public officials, civic organizations, educators, researchers, and all other parties that influence it through policies, regulations, or programmes. On the highest, most abstract level, the food system includes the frameworks, belief systems, and paradigms that define its rules and invisibly control its functioning" (Gladek E., 2017).

Figure 14 -Diagram depicting the structure of the Agri-food system, source Gladek E., 2017

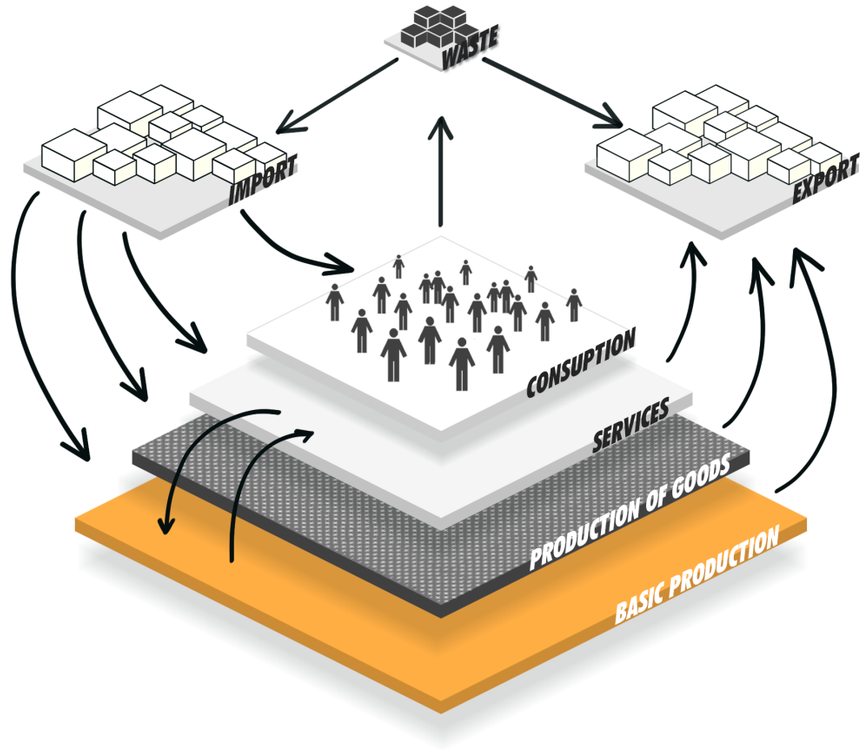


Figure 15 -The layered structure of agri-food systems.

GEOGRAPHICAL BOUNDARIES

The complexity of socio-economic aspects and the number of players involved in an agri-food system depends on the scale and the field of action of the system. The scale plays a central role. It is possible to define different agri-food systems on different scale levels; of course, a hierarchical structure implies that larger-scale agri-food systems are a combination of more sub-systems.
This also means that a higher scale system includes various internal and external actors that increase the system's complexity. Depending on the field of interest and the approached scale, it is possible to define different kinds of borders for an agri-food system. The physical borders of an agri-food system often do not follow jurisdictional borders but socio-economic conditions, ecologic and or climatic conditions. But it is also possible to work on lower scales, defining other rural districts inside the region that work partially as independent agri-food systems.

"Though different activities within the food system are highly dependent on local contextual factors and the severity of key impacts is likewise determined on different scales (for example, water scarcity), the central drivers of the system's behaviour are more centrally dependent on the dynamics of the global system" (Gladek E., 2017).

Globalisation has influenced the field of action of agri-food systems, including them in the global market. Agri-food systems have grown more and more into complex systems that depend on local and international strategies. The decisions made in developing strategies depend more and more on global necessities such as cost of production and possible profit range. Causing them to be less site-specific and often beneficial to international market scale development but harmful for low scale development affecting mainly local production chains, population and sustainability of the system involved.

The increased field of action and the progressive globalisation phenomena does not only bring adverse effects to small-scale production. It also gives the possibility to place small-scale production with specific qualities and characteristics on the global market. This increases their visibility and prestige and can lead to the raised complexity of the agri-food system through new involved actors that bring economic benefits to the area the system is connected with.

"Though the world can be said to have a multitude of smaller-scale food systems that serve local communities or regional populations, the last century has seen the progressive emergence of a global food system that has effectively linked disparate geographic regions into an interdependent structure" (Gladek E., 2017).

"It is a fact nowadays that food production, food processing and food consumption are economic activities in which local and global strategies are interconnected (Goodman 2004; Bowen 2011), and they are combined in complicated ways (Murdoch et al. 2000, Sonnino 2007). Decisions on where and how to produce, associated with what to consume, are made on a global scale. They are driven by the cost differentials of factors such as labour and transportation, but also by target market characteristics, including quality needs, beliefs and cultural heritage" (Murdoch J., Miele M., 1999).

This is the case of the Tuscan agri-food system, where the relationship between local food chains and socioeconomic values are closely related. On top of that, the quality of local Tuscan food chains has led to the creation of an additional relationship that is not mentioned in the paragraph above, the link between traditional food production and tourism.

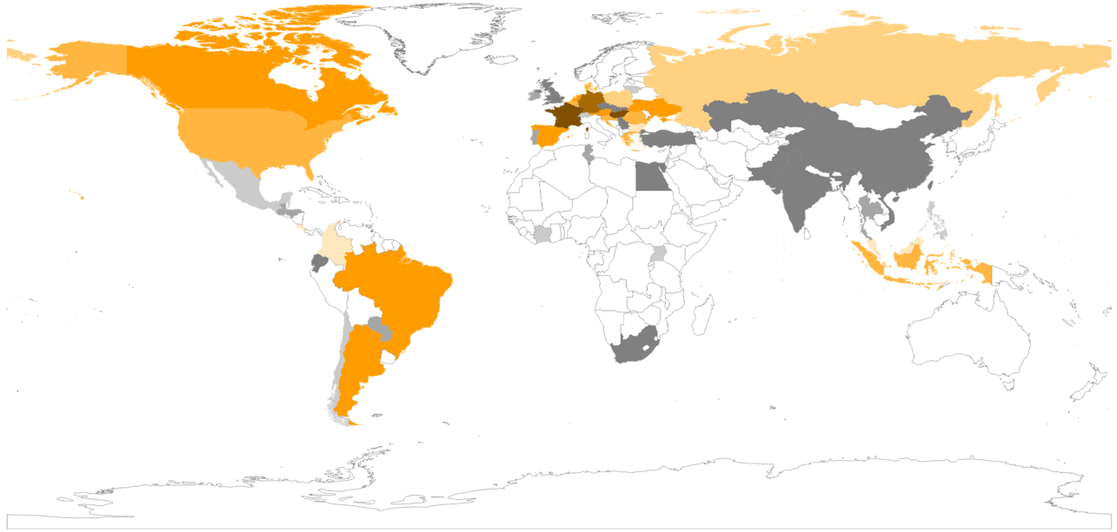


Figure 16 -Global agri-food system, import (top) and export (bottom) of food products registered for Italy in year 2020, source: Faostat.

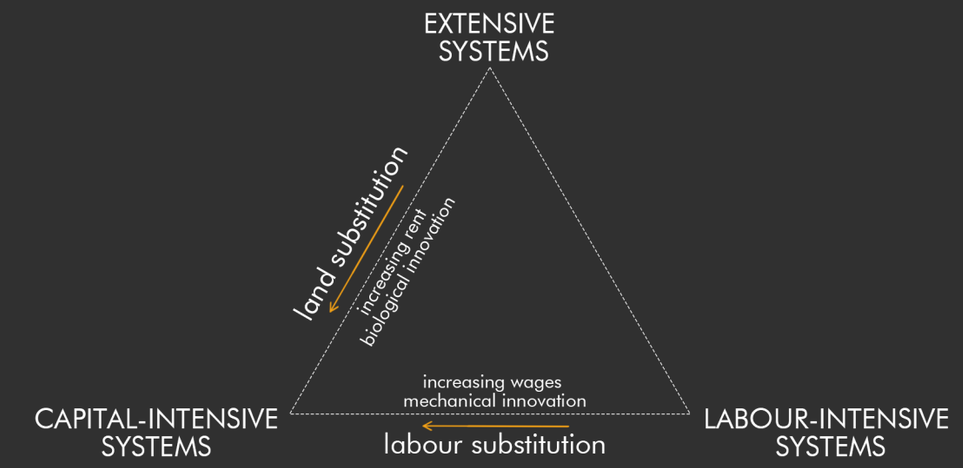
FUNCTIONAL ASPECTS

However, as much as scale and field of action influence and define the diversity of agri-food systems on the market, at the origins of the diversification between agri-food systems stands: "*..the cultural and productive characteristics of local production systems as well as the availability of resources like land and water, production costs and the localization of target markets. The implications of the relationships of different agri-food systems on local production systems are wide and varying. They fall into different areas: geography, economics, demography, sociology and agronomy which are all fields useful in assessing the impact of different behaviours and strategies on the socio-economic evolution of local production systems*" *(Arfini F. et al. l, 2012).*

The uneven availability of resources on a global scale has influenced the agri-food systems in different waysz. These resources can be categorized into three main groups Land, Labour and Capital. "*The relative abundance and cost of the three classical production factors determine the direction which has been applied to the development of agricultural systems*" *(Ruttan and Hayami, 1984, Ruttan et al., 1980, Hayami and Ruttan, 1971).*
With Land, resources are meant the availability of productive Land and any natural resource that is connected to it. "Labour refers to the agricultural workforce and involved organizations. Capital indicates any asset used in agricultural production (irrigation systems, greenhouses, ..).

The production factors of Land, labor, and capital can be represented as a triangle where the vertices represent three broad AFS: extensive (land-intensive) systems, labor-intensive systems, and capital-intensive systems. Extensive systems are relatively abundant in Land, and inputs of labor and capital are limited..Labor-intensive systems tend to occur in less wealthy areas where labor costs are low, and capital investment is relatively limited... Capital-intensive AFS predominate in high-income countries and are growing rapidly in middle-income countries...The AFS described above can be seen as "endpoints" and many systems fall between these extremes, often in transition from one to another, or outside them, where none of the production factors dominate" (Campanhola C. and Pandey S., 2019).

The map shows the distribution of different functioning agri-food systems across the globe. The Italian agri-food system places itself in between a capital-intensive system and an extensive system. the progressive increase in land value has led to a slow but constant transition to organic farming practices and mechanization processes. These two reactions aim to increase the market of produced agri-food products and to optimize production per land unit to cope with increased maintenance costs.



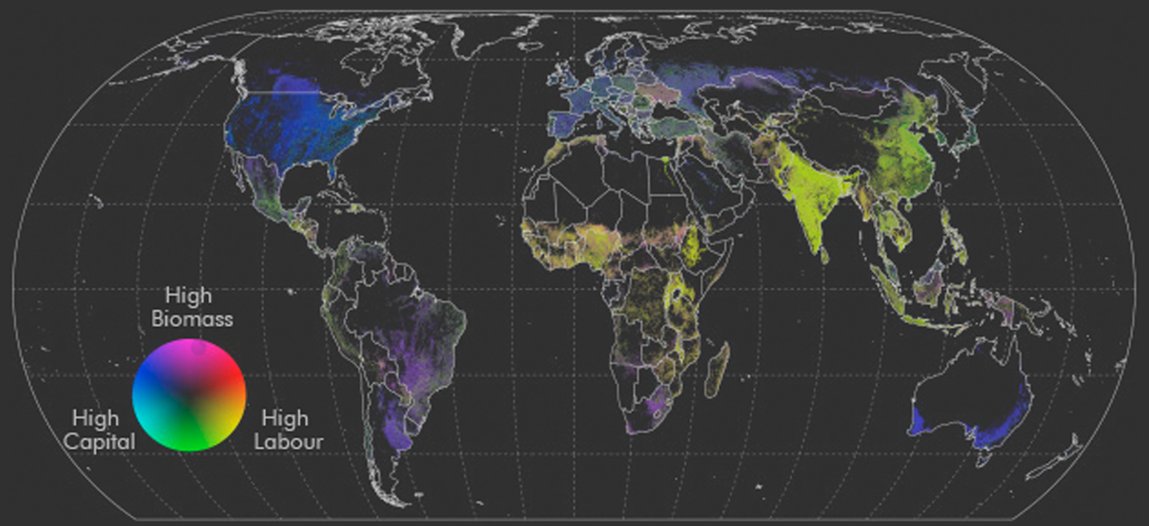


Figure 17 -Reasons behind the transition of an agri-food system from one category to the other, source (Campanhola C. and Pandey S., 2019)
Figure 18 - Global distribution of agrifood systems categorized through weights, source (Campanhola C. and Pandey S., 2019)

CLIMATE VULNERABILITY

The term "*Vulnerability refers to the degree to which a system is susceptible to or unable to cope with adverse effects of climate change (including climate mean, variability, and extremes), and it is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity*" *(McCarthy J.J. et al., 2001)*.

In order to understand to what extent a system is vulnerable different assessment methods are used. The primary method used consists of confronting the climate intensity and impact with the characteristics of the agri-food system to withstand and adapt to them. According to this definition, if the aim is to measure the vulnerability of a specific agricultural system, two leading indicators have to be taken into consideration when it comes to climate change effects.

First, the intensity and causalities of climate change's effects on that area must be researched. The current global system has shown that climate change phenomena have a negative impact on agricultural activities. Nevertheless, in some located cases, climate change effects can positively influence the productivity of an agri-food system. Intensity and causalities, together with the characteristics of the system's status quo, define if the effects can be considered positive or negative. Therefore to know more about a system's vulnerability, it is essential to be aware of the effects of climate change that threaten the integrity of the global system and the likelihood with which they will impact the selected system (see framework).

Secondly, the research must focus on the selected agri-food system itself, identifying all the aspects that might have an influence on the sensitivity, robustness or adaptive capacity of the system. To give a few examples, a system's strong relationship to specific climatic conditions, strong presence of intensive monocultures or low water capacity are all characteristics that increase the vulnerability of a system to climate change effects. At the same time, factors such as stable biodiversity and differentiation of the cultures or a strong local market and quality food chains can positively impact the resilience (see successive chapter) of the agri-food system.

Figure 19 - The first sign of climate changes longer drought seasons in Italy.

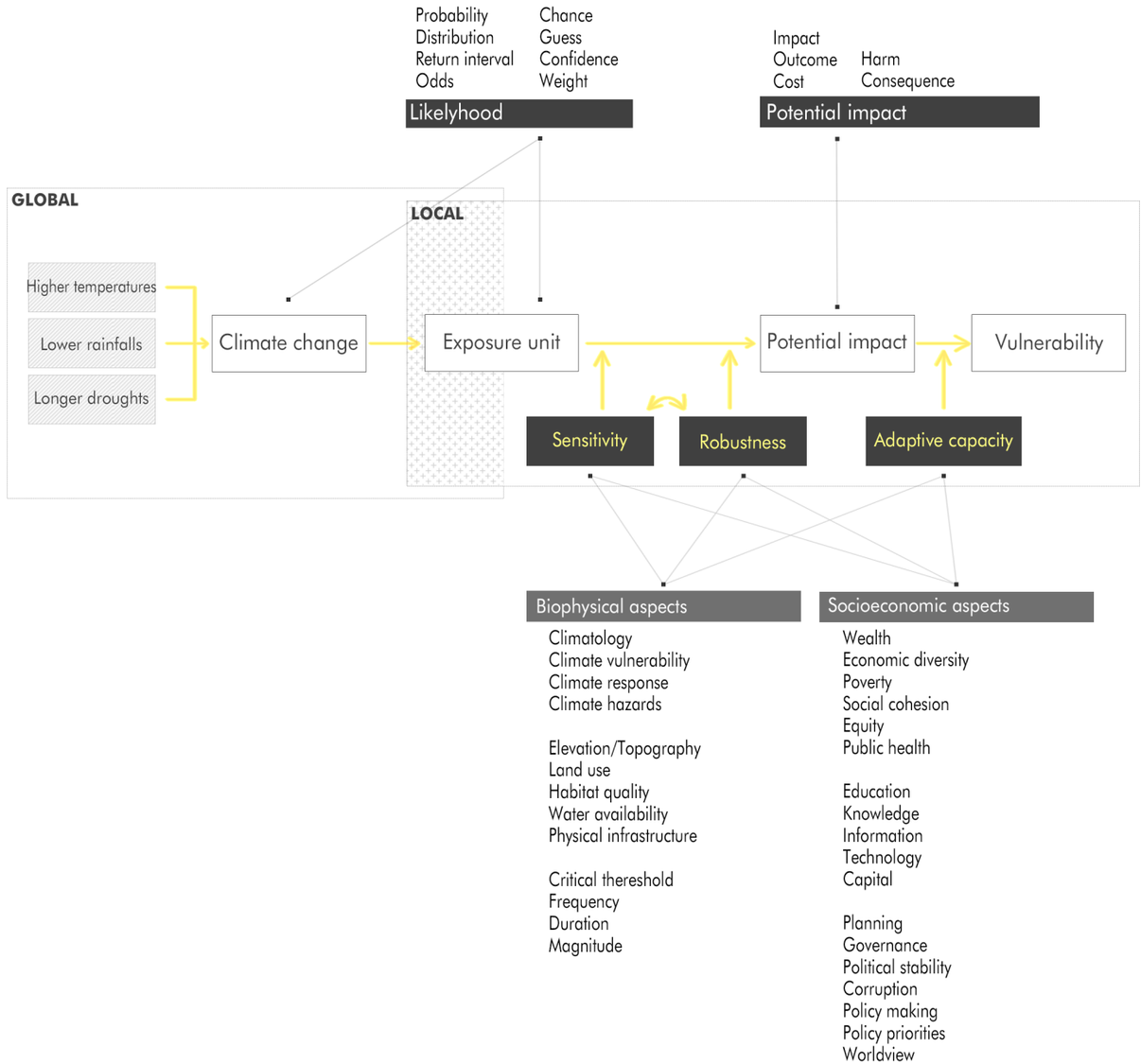


Figure 20 - Vulnerability assessment framework, reinterpretation, source: Interpretive review of conceptual frameworks and research models that inform Australia's agricultural vulnerability to climate change. L.J. Pearson et al, 2011.

"In the context of climate change and risk management, the main components that determine the vulnerability of a system are Robustness, Sensitivity and Adaptive Capacity. Robustness the measure of the amount of stress that a system can tolerate before changing its state (Loreau et al., 2002). Sensitivity, the degree to which a system is modified or affected by disturbances. Adaptive capacity, the ability of a system to adjust to disturbances, moderate potential damages and take advantage of opportunities or to cope with consequences" (Adger W. N., 2006).

It is essential to be aware that if a system appears to be very robust, this does not mean that it is not vulnerable. For example, a farming area where most of the productive land uses conventional and intensive practices is robust because it makes use of high amounts of chemical products intended to protect and improve production. Still, it is far from being resilient as it scores low in sensitivity and adaptive capacity, as monocultures are more exposed to pandemics or parasites. The more the three characteristics are balanced, the more resilient a system is to the shocks and stresses that affect it.

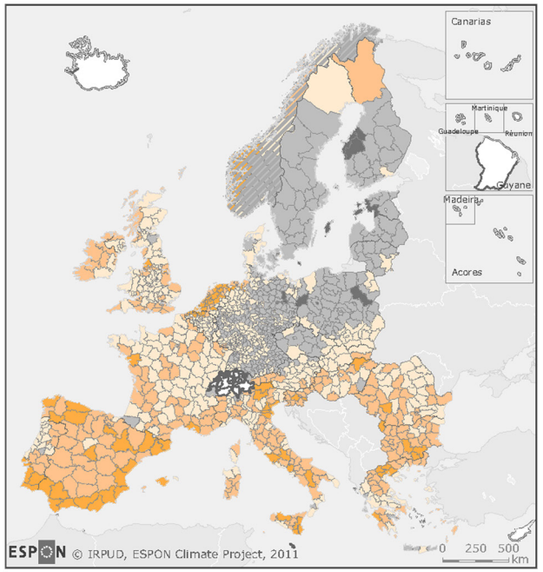
Another critical factor to take into consideration when it comes to assessing climate risk and the vulnerability of a system is time. When it comes to research aspects that affect vulnerability, two different temporal references are used. Studies concerning the biophysical vulnerability of a system are meant to indicate future vulnerability, while socio-economic aspects of vulnerability indicate present vulnerabilities. This often leads to conflicts in decision-making depending on what the stakeholders see as the most important, short or long-term solutions.

"This distinction can mostly be attributed to the different disciplines that are involved in research on vulnerability and adaptation (Preston and Stafford-Smith, 2009)...natural scientists usually focus on biophysical determinants of climate change and thus assess future vulnerability as the end-point of the analysis. On the other hand, scientists focusing on socio-economic determinants tend to focus on current vulnerability as the starting point of the analysis" (Thomas Fellmann, 2012).

"Agricultural vulnerability to climate change is the function of characteristics of **climate variability, magnitude, and rate of variation within the agricultural system**, *and the system's* **sensitivity and adaptive capacity**, *and it is the degree to which the agricultural system is susceptible to, or unable to cope with adverse effects of climate change including climate variability and extreme events" (Adger W.N., 2003).*

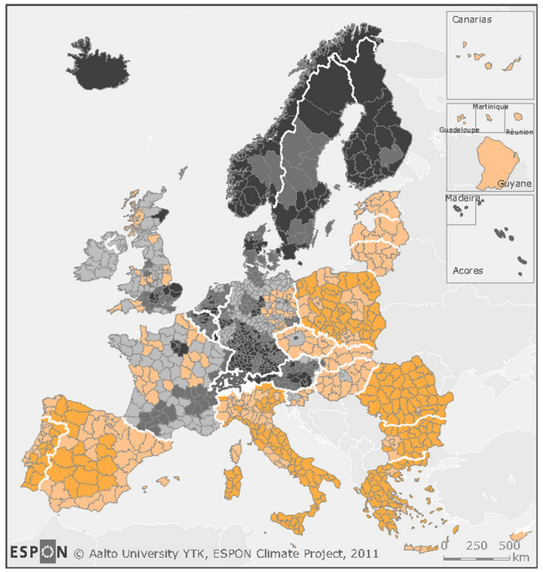
Figure 21 -Potential aggregate impact, adaptive capacity and vulnerability. Overall impacts derived from 26 impact indicators, overall adaptive capacity from 15 individual indicators, and overall vulnerability from a combination of overall impacts and adaptive capacity. (Technische Universität Dortmund, Institute of Spatial Planning (IRPUD), 2012).

Aggregate potential impact of climate change



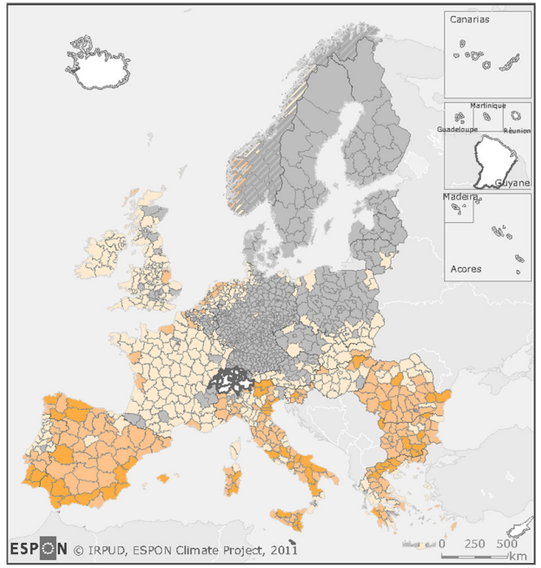
Highest negative impact
Medium negative impact
Low negative impact
No/marginal impact
Low positive impact
No data
Reduced data

Overall capacity to adapt to climate change



Highest capacity
High capacity
Medium capacity
Low capacity
Lowest capacity
No data

Potential vulnerability to climate change



Highest vulnerability
Medium nvulnerability
Low vulnerability
No/marginal vulnerability
No data
Reduced data

UNSUSTAINABLE DEVELOPMENT

"It is now generally accepted that that the industrial agrifood system is unsustainable, as stated by Buttel (2006). Agriculture in the Anthropocene Era is the leading contributor to climate change (Godfray and Garnett, 2014; Kuyper and Struik, 2014). The climate impacts of the Anthropocene make it imperative that we change the way food is produced, distributed, and consumed (Campbell et al., 2017; IPES-Food, 2016; Rockstrom et al., 2017). The problem is well understood, the solutions are much more difficult and highly contested" (Constance D. H., et al, 2018).

Besides the intensive use of natural resources, such as soil, water and biomass, needed for industrial farming, the main human activity that pollutes the environment and affects environmental sustainability is the use of chemical products. These can be classified into three main categories: fertilizers, pesticides and antibiotics. All three are artificially produced and used to improve the system's capacity and neutralize adversities that could affect production. But besides the positive effects in the short term, they have devastating consequences in the long term if used excessively.

FERTILISERS

"The global food system uses around 200 million tonnes of fertilisers annually, the vast majority of which are synthetic and derived from fossil fuels". (FAO, 2015b).

Different typologies of land use define different quantities of needed fertilizers, as can be seen from the scheme. On a global scale, cereals and other seasonal crops make up more than 85% of the total used fertilizers. This indicates that these types of crops require a higher amount of fertilizers. At the same time, cereals and seasonal crops occupy a much larger part of the total agricultural land; therefore, it is natural that big parts of fertilizers are used in that context.

Regardless, also by considering the average demand for fertilizers per hectare and not for the total agricultural surface, the distribution per crop remains similar.

"Finally it is important to note that fertiliser use varies greatly across different production systems for the same type of crop, demonstrating the high variability between differen agricultural practices" (Gladek E., 2017).

PESTICIDES

"Pesticide" is an umbrella term describing any form of chemical control of unwanted biological agents, including, but not limited to, rodents, insects, weeds, and pathogens" (Gladek E., 2017).

The most harmful ones for the environment and the preservation of natural resources are the ones that are most used. Herbicides, Fungicides and insecticides are often used not only to solve a problem but also to prevent it, for example, using them during seeding phases even before the external pathogen can develop.

"Herbicides control the growth of unwanted plants, often called weeds. Fungicides control the growth of fungal pathogens in plants. Insecticides are used to control the presence of insect pests and are generally applied either as a seed dressing or topically in prevention or response to a pest incident" (Eurostat, 2000).

In the case of pesticides, compared to fertilizers, the highest share of used pesticides is not represented by cereals but by fruits. Even tho they both are responsible for 27% of the total use, the surface of productive land used for orchards and other permanent crops is much lower than not the surface covered by seasonal crops. In conclusion, the average use of pesticides for fruit production per hectare is much higher than not the use of cereal crops.

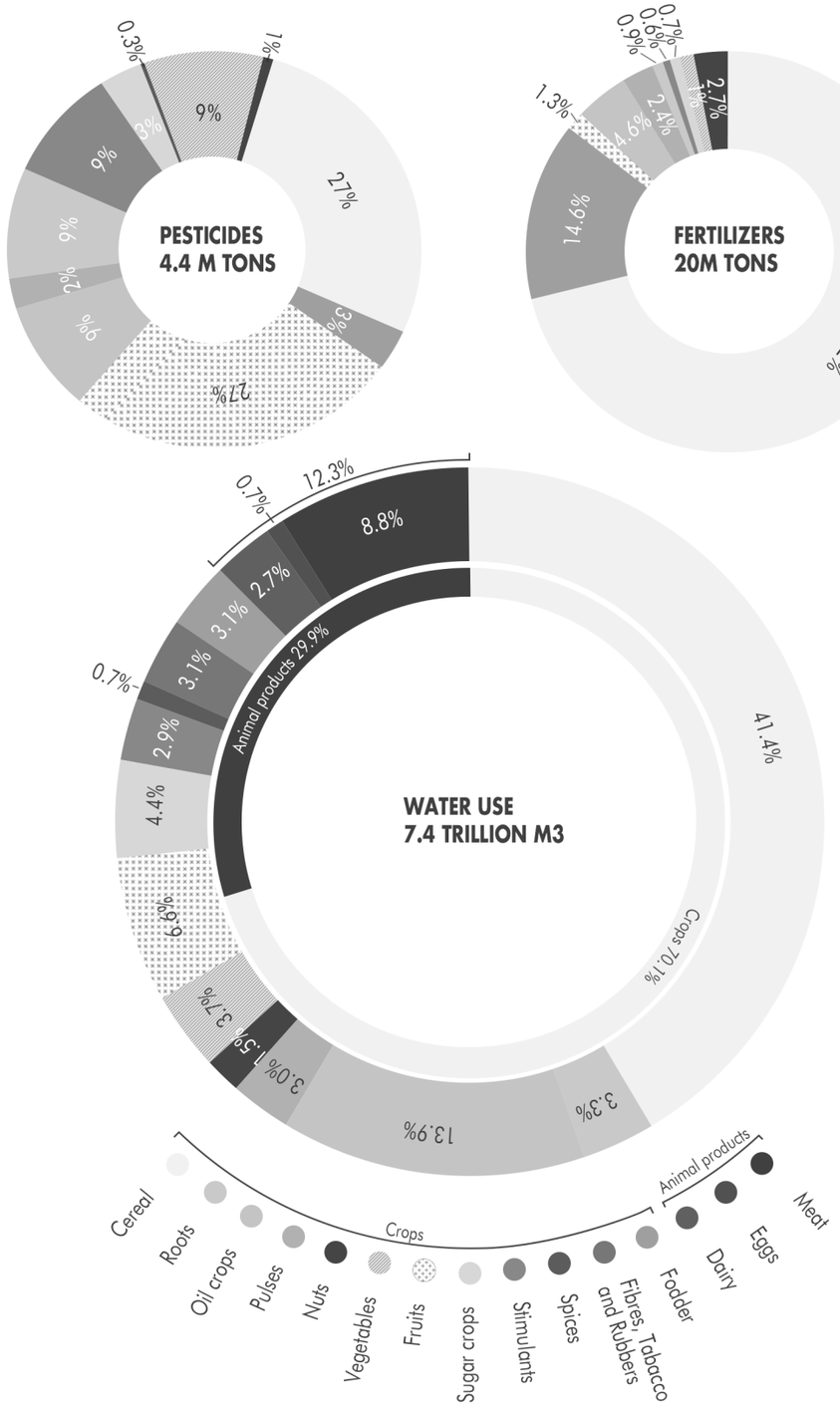


Figure 22 -Pesticide, fertilizer, and water inputs per major food type on a global scale. (FAO, 2015b; Mekonnen & Hoekstra, 2011).

SUSTAINABLE DEVELOPMENT

"We recognise that there is no, and likely will never be, a universally agreed definition of what a sustainable food system is. Definitions differ in scale, change over time and are dependent on context, reflecting different views and interests of the numerous actors in the food system" (Group of Chief Scientific Advisors, 2020). Especially in a diverse and fragmented environmental context such as the European one, where different natural conditions have created a multitude of biotopes. The concept of sustainability changes in many ways. Each food sub-system is shaped by different socio-environmental and economic aspects and develops so with different strengths and weaknesses. These aspects will also define the definition of sustainability for that specific food sub-system.

Despite the fact that they are many different forms of sustainability depending on the mentioned aspects, there is a broad agreement formulated by FAO (2014) on what effects a sustainable food system should have on the environment.

"As formulated by the FAO (2014), a sustainable food system delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised. A sustainable food system should thus ensure and contribute to all elements of environmental, social and economic sustainability" (European Commission, 2020).

With this main guideline, the European Commission aims to obtain a food system that goes along with the definition of sustainability that was previously established. Nevertheless, it can also become dangerous to simplify and generalise the tools for sustainable food systems as most of them require specific attention. This is also why the European Commission imposes specific policy-relevant recommendations that aim to improve research and innovation of the different agri-food systems. Still, effective policymaking remains a task of the national and regional authorities that are able to for more site-specific directives.

Although the European guidelines can be seen in different ways and approached with different methods, they can be grouped into five main actions and policies. Policies and actions that sustain the intensification of sustainable farming practices that aim to protect natural resources. Policies that reduce the amount of food loss in the production chain and output of waste material by improving recycling and reuse methods in all steps of the food chain. Actions that stimulate a shift in the diet of the consumers to a more quality-oriented and balanced (more plant-based) consumption nutrition. Policies to stimulate a higher diversification of land use to improve the robustness and resilience of the systems. Actions to increase social awareness on the side effects of different diet behaviours on socio-economic and environmental aspects and support stewardship of farmers who choose to become sustainable.

"..a synergistic combination of policies and actions is required (SAM 2019), which: Promote sustainable intensification... Reduce food loss and waste,... Stimulate dietary changes,... Improve the resilience and robustness of the food system, in particular by diversification,... Increase the accountability and stewardship of producers and consumers.." (European Commission, 2020).

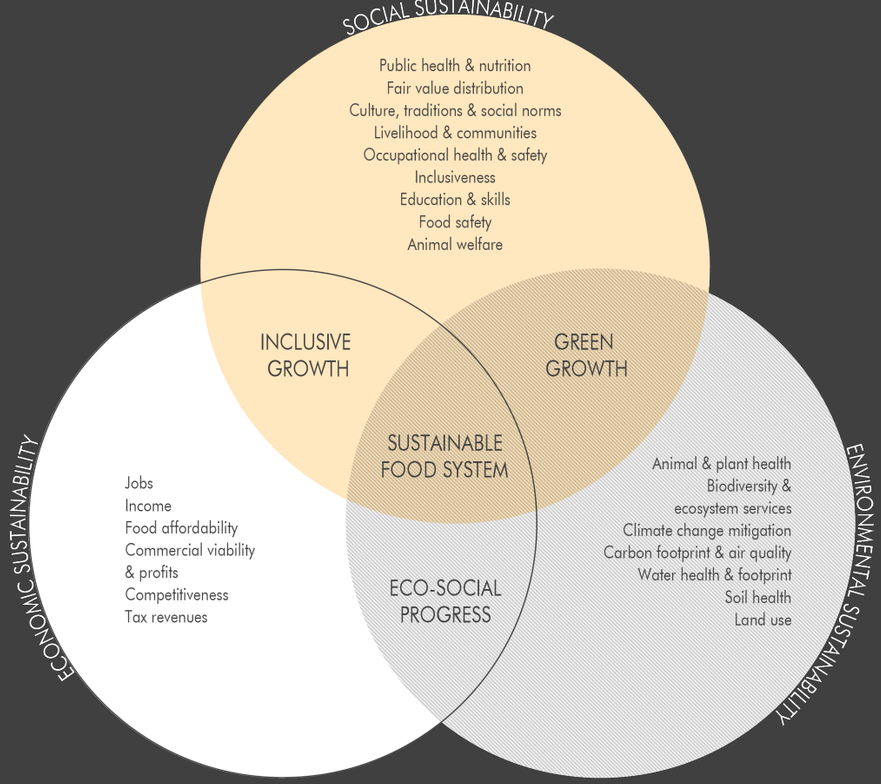


Figure 23 - Sustainability scheme, source FAO.

Figure 24 - Specialised vineyards, Peccioli, Tuscany.

HOW TO MEASURE SUSTAINABLE DEVELOPMENT

"*What is needed to achieve a sustainable food system? There is already an established, large body of high-quality scientific evidence and policy-relevant recommendations on what would contribute to a sustainable food system*". *(European Commission, 2020)*.

These recommendations can have multiple forms depending on the chosen topic or scale. One of these is the SDGs (sustainable development goals).

The SDGs are a set of seventeen goals, also known as global goals. Together they compose the universal call to action to tackle problems such as poverty or hunger and protect the planet and ensure a possible future for the coming generations in peace and prosperity. The single SDGs are interrelated. Taking action to achieve one goal could have positive or negative effects on others.

"*Despite calls to scale-back SDG ambitions and geopolitical tensions, the SDGs remain the only integrated framework for economic, social and environmental development adopted by all UN Member States*" *(Voil M., 2021)*.

Being the only international approved framework makes them crucial in every research connected to sustainable development.

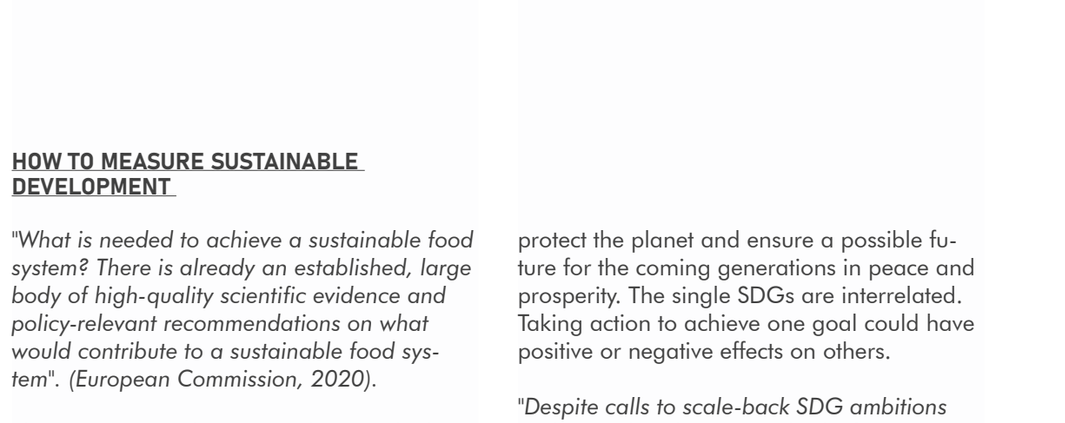


Figure 25 - Evaluation of the single SDGs for Italy in the year 2021, source Europe Sustainable Development Report 2021.

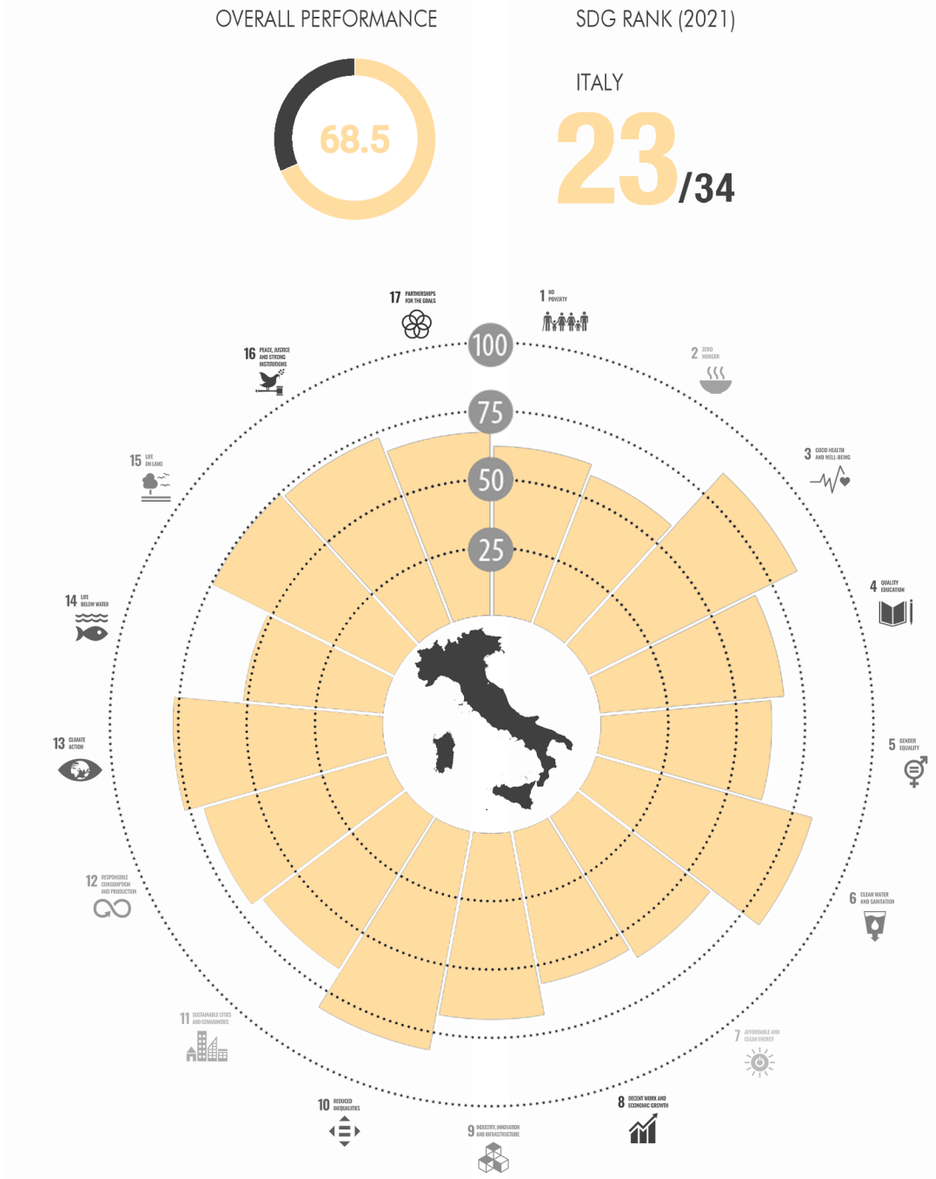
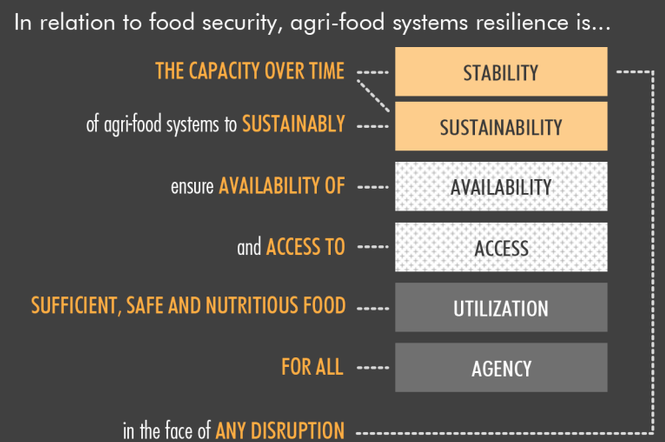


Figure 26 - Evaluation of the single SDGs for Italy in the year 2021, source Europe Sustainable Development Report 2021.

RESILIENT AGRICULTURE

"Climate-resilient agriculture can be defined as "agriculture that reduces poverty and hunger in the face of climate change, improving the resources it depends on for the future generations" (Fao, 2015).



"Agri-food systems' resilience focuses on all six dimensions of food security and nutrition, but more specifically on stability of access and sustainability, to ensure short- and long-term food security and nutrition. Agri-food systems' resilience is a dynamic process defined as: the capacity over time of agri-food systems, in the face of any disruption, to sustainably ensure availability of and access to sufficient, safe and nutritious food for all, and sustain the livelihoods of agri-food systems' actors" (FAO, 2021).

In agriculture, the term resilient agri-food system refers to the capacity of a system to withstand and adapt to the risks and externalities that have a direct negative effect on it. These events can be separated into two main categories, shocks and stresses. The main distinction between them is that stresses contain all phenomena that negatively affect the system that, endure over a longer period, and impose constant stress on the system.

Rising temperatures, economic inflation, progressive biodiversity loss, and soil erosion can be classified as stresses as they have long-term effects on the system. Shocks are less predictable events such as heavy meteorological events or diseases and have an immediate and decisive impact on the system.

An agricultural system that is considered resilient should be able to cope with both shock and stresses. A good practice to cope with stresses and shocks remains to foresee as many risks as possible that might affect the system. Therefore, a resilient agricultural system needs to create the right conditions to *"Enhance the capacity of scientists and other stakeholders in climate-resilient agricultural research and its application" (Singh R. et al., 2021).* Another important aspect of building a resilient Agri-cultural system is prevention.

Figure 27 -Main key topics of resilience of agri-food systems, source "The state of food and agriculture, making agri-food more resilient to shocks and stresses", FAO 2021.

Figure 28 -Progressive abandonment of small local activities 1, by author.

Figure 29 - Progressive abandonment of small local activities 2, by author.

Figure 30 - Progressive abandonment of small local activities 3, by author.

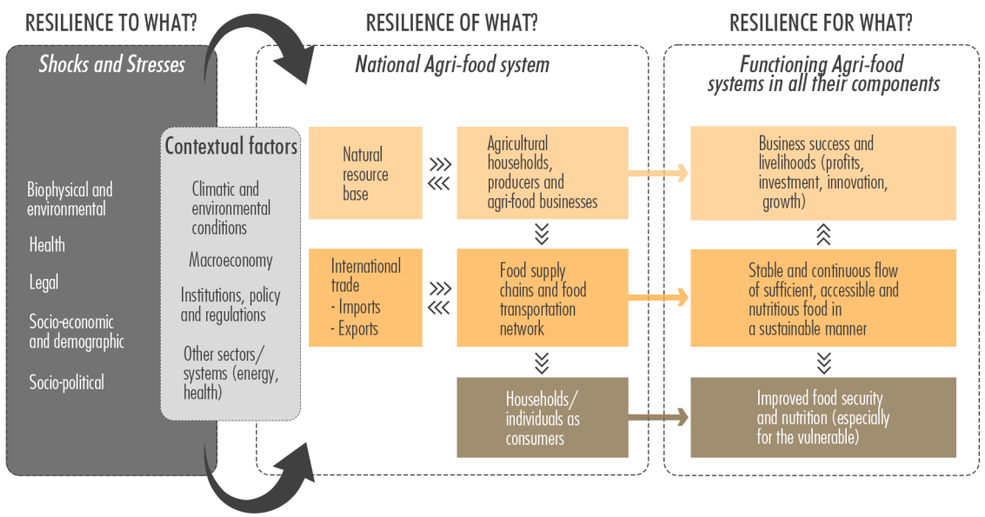


Figure 31 - Resilience to what?, source "The state of food and agriculture, making agri-food more resilient to shocks and stresses", FAO 2021.

Many different farming behaviours can improve the capacity of a system to increase its robustness and adaptivity. These farming practices can be identified as resilient agricultural practices and often include factors such as enhancement of crop resilience, improved diversification of crops, natural resource protection, downscaling to local production, improving socio-economic cohesion and fair resource distribution and accessibility.

"*Resilient Agricultural Practices (RAP) is a crucial component to food security and sustainable food systems. Resilient Agricultural Practices (RAP) identify seven principles that contribute to the resilience of the Social-Ecological Systems (SES), addressing the theory of supply chain management, and present their application in agricultural value chains.. combating pests and plant diseases; control of cross-border animal diseases (TAD); food security and information systems about natural resources, disaster risk management, and policy development; (Asian Farmers'Association for Sustainable Rural Development(AFA) 2015) generating new jobs and employment in rural and suburban areas; (Barba and Sawicka 2016) agricultural production; (Barrettet al. 2010) management of natural resources; and (Batterbury and Ndi 2018) food safety and nutrition" (Srinivasrao et al.2018).*

In the last 20 years, the importance of resilient Agricultural systems has become a more and more central issue. The main cause behind this trend is the constant increasing number of unforeseeable shocks that have shown devastating effects on the current agri-food model. These shocks brought to light the fragility of the current systems on the one hand and, on the other, the necessity to create a resilient system that is able to adjust to these changes by compensating for the caused damage. This is why understanding how much a system is resilient to specific shocks is now probably the most urgent topic. In short, the definition of a resilient agricultural system can be seen as a system that is able to cope with social, economic, and environmental changes, including not only production but also the rest of the entire agricultural production chain. How much a system is resilient is assessed by three categories: robustness, sensitivity, and adaptive capacity for vulnerability (see paragraph above).

Figure 32 -Soil saturation and heavy rainfalls cause floods and soil erosion..

Figure 33 - Resilient agricultural practices, grassing between the rows.

Figure 34 -Resilient agricultural practices, nutrients circularity.

EUROPEAN	PDO Protected Designation of Origin	PGI Protected Geographical Indication
NATIONAL		
FOOD	DOP Denominazione di Origine Protetta	IGP Indicazione Geografica Protetta
WINE	DOC Denominazione di Origine Controllata DOCG Denominazione di Origine Controllata Garantita	IGT Indicazione Geografica Tipica

GENERAL ASPECT

Product names registered as PDO are those that have the strongest links to the place in which they are made. Every part of the production, processing and preparation process must take place in the specific region. For wines, this means that the grapes have to come exclusively from the geographical area where the wine is made.

GENERAL ASPECT

PGI emphasises the relationship between the specific geographic region and the name of the product, where a particular quality, reputation or other characteristic is essentially attributable to its geographical origin. For most products, at least one of the stages of production, processing or preparation takes place in the region. In the case of wine, this means that at least 85% of the grapes used have to come exclusively from the geographical area where the wine is actually made.

Figure 35 -Example of PDO label.
Figure 36 -Example of PGI label.
Figure 37 -National distinction of PDOs and PGIs.

GEOGRAPHICAL INDICATIONS

The most exposed actors to the threats of the current system are the ones that do in some way already contribute to resilient and sustainable farming practices. Their vulnerability threatens the stability of the entire system. These vulnerable actors can be divided into certified, organic, and small farmers (one farmer may belong to 2 or 3 of these classes). With certified farmers are meant all the agricultural businesses that respect specific criteria and have the right to apply for one or multiple certifications.

As mentioned in the previous paragraph on agri-food systems, globalisation can bring several benefits to low-scale productions. In some cases, when these products have specific qualities that make them unique on the market, they can become a powerful tool for local-scale socio-economic development. These products are globally recognised for their particular qualities that can depend on traditional agricultural practices or morphological and climatic aspects that can be found only in a defined geographical area.

"There are several factors which influence the product (foodstuff) so as to be special (compared to similar products). Some of these factors are associated with the geographical area, and some of these factors concern the product as it is (e.g., traditional processing steps). Some of the characteristics of the defined geographical area which probably could affect the product are pedo-climatic features, topography, climate, soil, rainfall, exposure to the sun, altitude, temperature, etc." (Zisidis O., 2014).

The site's name is often used to distinguish the product on the global market. Once a product is known for its quality and sells well, thanks to the denomination of the area, copycats might try to use the denomination's name to sell the same product with lower quality for a better price in foreign markets. Therefore, qualitative certifications exist and are *"the main tools available to farmers, producers and firms to protect and market their agri-food" (Belletti G. et al., 2017).*

Some of these certifications are PDOs (Protected Denominated Origin) and PGIs (Protected Geographical Indication), also known as GIs (geographical indications). They are a European-approved certification that is meant to defend the intellectual property right of the name of a specific geographical area. The denomination is so owned by the producers that apply to the disciplinary of that specific geographical indication. Only they are allowed to use that denomination on the product's label. For example, the certification PGI Toscano – olio Evo certifies olive oil produced in the region of Tuscany. Only the farmers that apply to the disciplinary are allowed to label their product as "Olio Toscano".

"Products with a Geographical Indication is an intersection between typical products and products with a geographical name...they can benefit from a legally recognised protection scheme, and one or more of their intrinsic (quality) or extrinsic (reputation) characteristics derive from the territory of origin" (Qualivita, 2017).

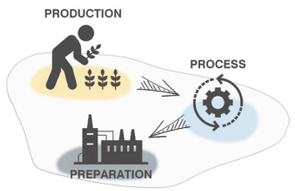
Figure 38 -PDO and PGI are the two main geographical indication certificates.
Figure 39 -PDO and PGI are the two main geographical indication certificates.
Figure 40 -STG label is the third and less known of the GIs.

"The EU geographical indications system protects the names of products that originate from particular regions and have specific attributes or enjoy a reputation linked to the production territory" (European Commission, 2021). Besides the juridical protection for these agri-food products, the legal definition of the policy helps the producers maintain a particular market placement. The authenticity of the product is guaranteed by the label of the certification printed on the product; therefore, the consumer is disposed to pay a higher price compared to similar conventional food products. According to Zisidis O. (2014), products labelled as PGI or PDO have a market value average of 2.23 times higher than the same non-labelled product.

Geographical indications divide into two different typologies, first into PGIs (protected geographical indication) and PDOs (protected designation of origin). They share the same characteristics except for one main difference. On the one hand, they both imply that each certification includes only one food product and that the applying businesses must follow the correlated disciplinary. They define a specific geographical area by incorporating it into a disciplinary. Whether raw or processed, they can certify different types of products (meats, dairy, wine, olive oil, bread, vegetables, and others). On the other hand, the main difference between PDOs and PGIs is that the first one guarantees that both the production and process of the product happen in the area defined by the disciplinary. At the same time, PGIs implies that only one step of production or process must happen inside the area of interest. This makes the PGIs less trackable than PDOs, which can also be considered good examples of a circular economy.

Despite the differences between the two quality schemes, for both PDOs and PGIs, *"it is necessary to have a link with this particular geographical area. It should be displayed in what way the product's attributes are caused by the geographical area and what are the natural, human, and other elements which configure its speciality to the product. In addition, it should be mentioned in the description in what way the methods of production are different from others and also which is the contribution of that method to the specific and unique character of the product" (Zisidis O., 2014).*

PDOs geographical restrictions:



PGIs geographical restrictions:

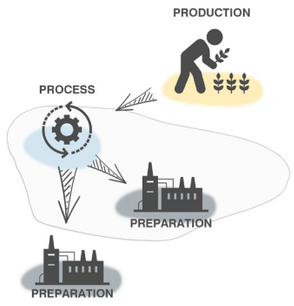
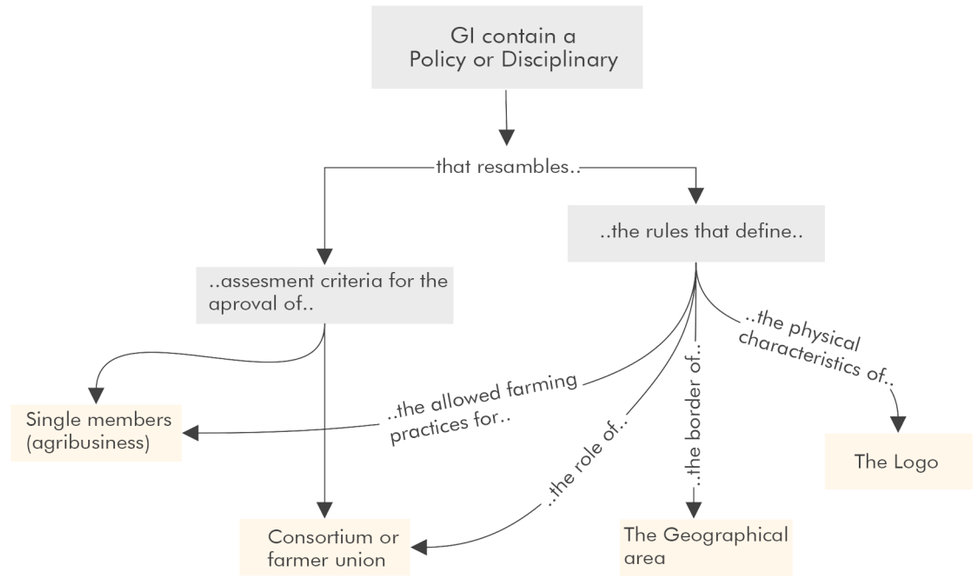


Figure 41 - Different concept behind PDO(left) and PGI (right).



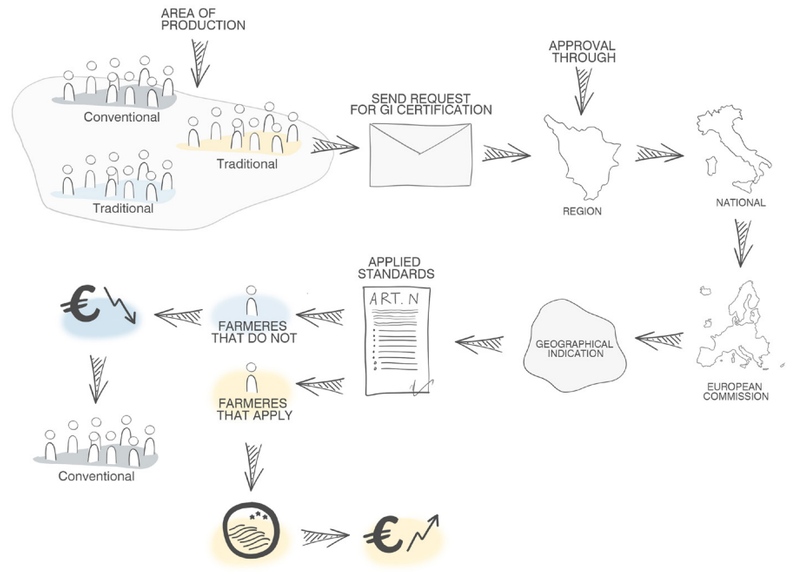


Figure 42 -Elements that are included in the policy framework of Geographical indications
Figure 43 -Creation procedure for a GI and its possible side effects.

MARKET TOOL

"*Marketing tools are the systems, techniques, strategies, resources, technology, and materials used by companies or marketing professionals to create and implement marketing campaigns that successfully promote their products and services*" *(Indeed Editorial Team, 2021)*. Marketing tools can come in many different shapes, but they all have the main aim of protecting and promoting the market image of a specific product.

When it comes to products that are produced by the food industry, they are divided into two main categories. Tools that promote the product, often in the form of individually led activities of a single business or cooperative, and tools that protect the product. These can be strategies and policies that regulate the market through institutional power. In the case of tools that promote the product, there are many different opportunities for businesses that often choose to use a combination of multiple tools to promote their goods. Market tools for the promotion of products include Printed advertising, Digital advertising, Customer loyalty programs, Event marketing, Customer feedback collection, Press releases and Search engine optimisation. Every tool has a different impact on increasing brand awareness in customers but also another cost; therefore, it becomes crucial to make the right decisions for a business to balance these two factors when it comes to choosing the marketing strategy.

Many businesses are too small to invest in proper marketing tools. This is why groups of farmers that produce the same product with the same methods and are confined into a geographical area often merge their financial capacity to build a common strategy. These businesses have the possibility to increase their market influence and have higher chances to increase their market value. By doing so, they involuntarily increase the market value of other products on the market that are produced by businesses that do not finance the strategy and do not guarantee the same qualities but profit in the same way from it. At this point, market tools that protect the product step in.

These often come in the form of certifications attached to the product's label and guarantee that the products are processed by businesses that have followed the policy restrictions concerning the certificate. Geographic indications can be considered as such tools. GIs require that legal means must be respected by the interested parties to prevent the unauthorised use of geographical indications, guaranteeing so for the fairness of market competition.

In the specific case of Geographic indications, the market tool works "*not only as a tool for protecting consumers' interests and reinforcing confidence in high-quality and local products but also as a legal and economical tool for the development of rural areas and the preservation of cultural heritage...It provides that "legal means" must be provided to interested parties to prevent the use of geographical indications which mislead the public as to the geographical origin of the goods. It also requires that legal means must be provided to prevent use which constitutes an act of unfair competition*" *(Qualivita, 2019)*.

SPATIAL PLANNING INSTRUMENT

The term spatial planning instrument indicates a tool that is able to stimulate planning initiatives or shape the outcome of a planning process by guiding it to achieve social, economic, and environmental benefits. In short, spatial planning instruments are tools that aim to improve the sustainability of a system.

Leshinsky and Legacy (2014) distinguish between "process-oriented" and "substance-oriented" planning instruments. Process-oriented tools refer to the methods and procedures that must be included in the strategy development process and are used as the main guidelines for the process. Substance-oriented tools refer to the standards and criteria that define the final output of the process and can be considered the minimum requirements a strategy has to fulfil.

Another distinction can be made based on the influence the tools have on land property markets. Two main categories are identified, tools that intend to shape markets, changing their structure or tools that regulate markets by limiting or stimulating specific market trends. Crucial for developing an efficient spatial planning instrument are three indicators: scale, clarity, and flexibility. For a national policy framework, it is essential to consider both bottom-up and top-down approaches to achieve an in-depth understanding of spatial development trends and what they implicate.

Regardless of the scale of interest, all spatial planning instruments must be detailed, precise and transparent to the public so that it has the possibility to create positive environments for investment.

The private sector welcomes clear statements for matters such as habitat protection, design standards or other restrictions as they define the range of playgrounds available for investments. Finally, spatial planning instruments need to establish how much flexibility or rigidity to include in the policy framework. This depends on the priority of a spatial planning tool and on different needs for adaptations required by local or regional contexts.

Policy frameworks should be binding on all scales (national, regional, or local) but should also allow for some flexibility when there are good reasons for it. "While some will have little flexibility, e.g., when related to the protection of critical natural resources, high-quality agricultural land or cultural heritage, others may offer more discretion to decision-makers" (Economic Commission for Europe, 2008). In the case that local governments and planning frameworks are not well established, there should be less flexibility in the use of the spatial planning instrument leaving actors less space for non-guided actions.

"Policy statements assist investors by establishing con enters for plan- and decision-making, thereby encouraging more consistent action. The private sector welcomes clear, unambiguous criteria that can apply in all places to all interests and that indicate that steps have been taken to ensure a "level playing field" for investors. Policy statements are especially potent when produced through a process of consultation and dialogue, because this has a better chance of garnering their widespread support and acceptance" (Economic Commission for Europe, 2008).

— THE CASE OF TUSCANY

PREDICTIONS ON CLIMATE CHANGE EFFECTS[58] — POTENTIAL RISKS FOR THE AGRI-FOOD SYSTEM[64] — AGRICULTURAL LAND USE IN TUSCANY[67] — GEOGRAPHICAL INDICATIONS IN TUSCANY[72] — ORGANIC IN TUSCANY[74] — DATA LEAK[76] —

PREDICTIONS ON CLIMATE CHANGE EFFECTS

The recent effects of climate change have proven to be even worse than expected. Higher temperatures, lower rainfalls and more frequent and intense meteorological events have been confirmed as significant threats to southern Mediterranean countries such as Italy. Affecting primarily agricultural activities, climate change could cause several damage to the integrity and functioning of the rural sectors within these geographical areas.

However, climate change effects do not manifest at the same degree in every agri-food system. Some systems are more vulnerable than others, depending on the magnitude of climate change effects and the system's sensitivity and adaptive capacity.

The Tuscan agri-food sector is considered as valuable, complex, interconnected with other sectors, and so highly vulnerable. In the worst-case scenario (the RCP 8.5 business-as-usual, TCFD), a medium temperature rise of 4 degrees Celsius and a decrease in rainfalls from 10 to 15% is predicted. This will cause a drastic reduction in biodiversity and the number of growable crops, especially for wine and wheat, two of the leading products of Tuscan agriculture. It is causing an increment in the abandonment of traditional activities and farmers' transition to intensive agricultural practices, progressively feeding a trend that increases the system's unsustainability and vulnerability.

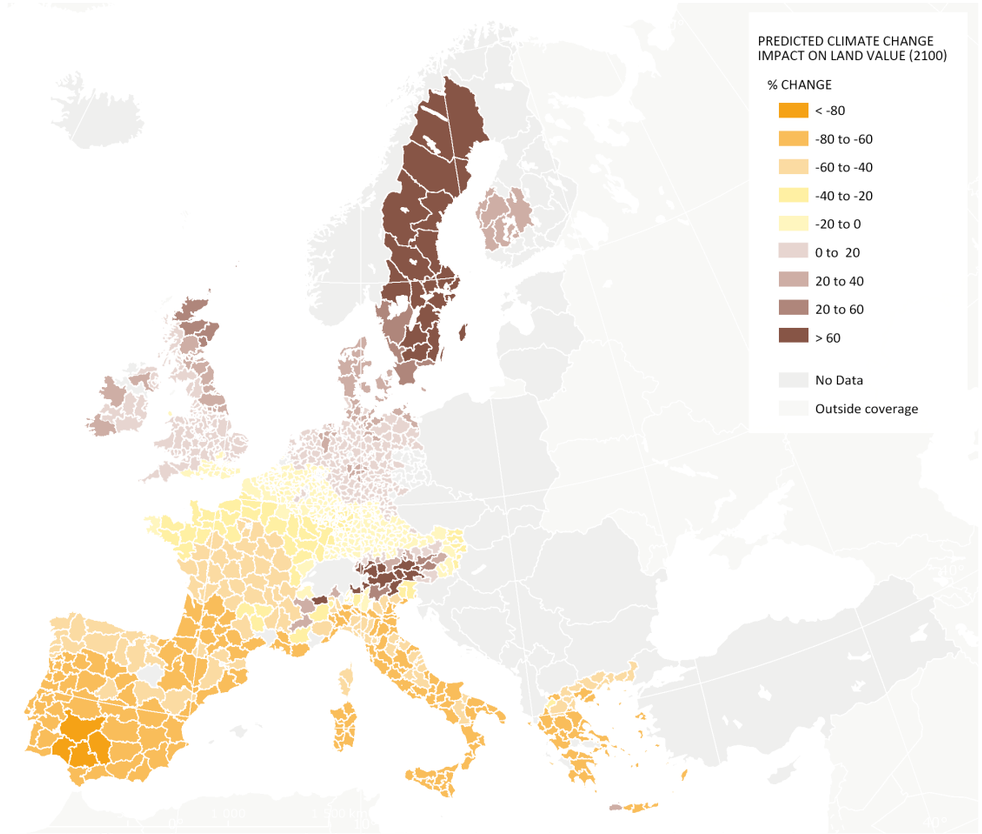


Figure 44 - Climate change impact on land value; The most threatened areas are clearly southern Mediterranean countries (Source: Eurostat).

Figure 45 - Intensive use of chemical fertilisers and pesticides harms water and soil conditions.

Figure 46 - Extensive monocultures are a threat to biodiversity and the environmental stability of an area.

At its current state, the Agri-food structure in Tuscany remains unsustainable. The use of pesticides and fertilisers and the exploitation of natural and human resources such as water, soil, and the working forces are progressively degrading the Tuscan environment increasing its vulnerability to the impacts of climate change.

The main problem with the status quo is reconnectable to the policies and investments made by the government and European administration. Too many direct subsidies and tax breaks are dedicated to industrial and intensive farming. At the same time, little attention is given to biological and organic farming activities. This means that the farmers that choose a sustainable approach must pay a double price. On one side, the costs implied in the preservation of ecosystems. On the other for the damages produced by polluting conventional farming practices. Farmers that choose to practice intensive agriculture instead are, in a certain way, funded for using a higher quantity of water resources, chemical pesticides and fertilisers.

FederBio, Isde-Medici per l'ambiente, Legambiente, Lipu e WWF state in a research paper that European funds subsidise more than 97.7% of the intensive agriculture. While only 1,8 billion euros from the total 62,5 billion go to biological farming. This trend has to be changed as soon as possible, in the Tuscan agri-food system as for the rest of the global agri-food systems.

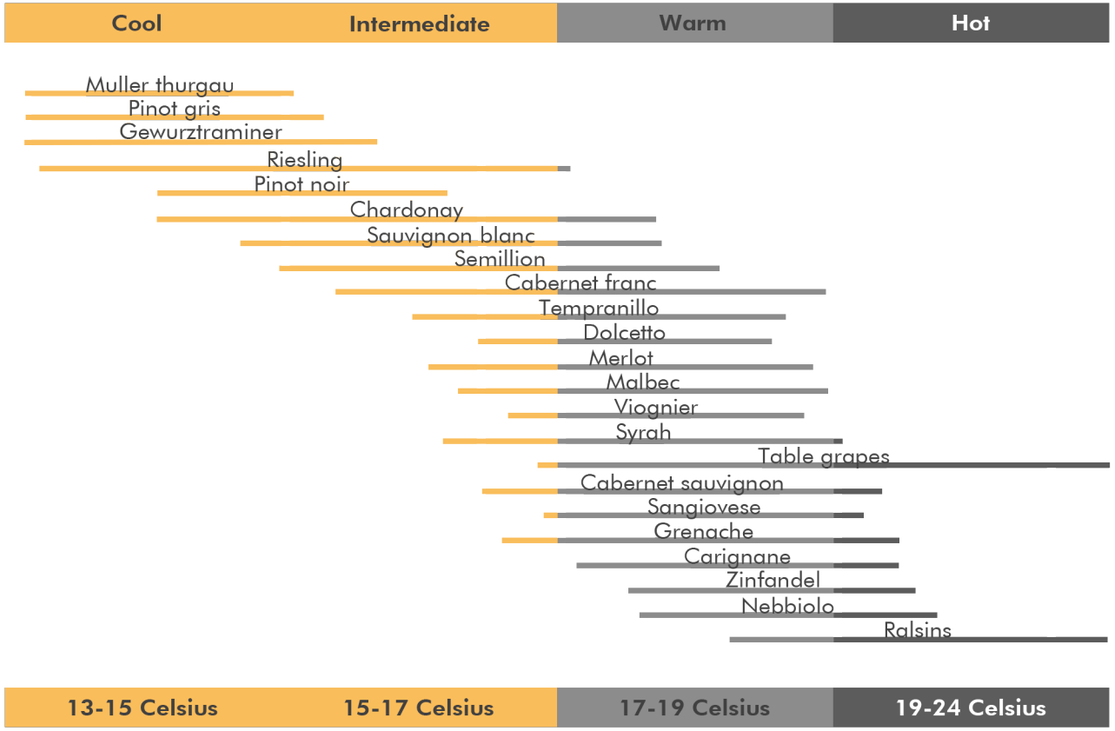
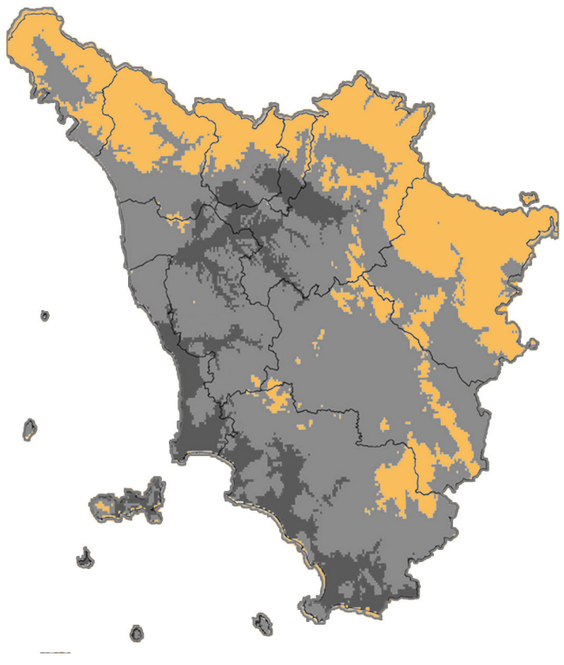


Figure 47 - Temperatures suited for different grape typologies. Different typologies of grapes prefer different climatic conditions. Currently, in Tuscany, the Sangiovese grape is the most used.



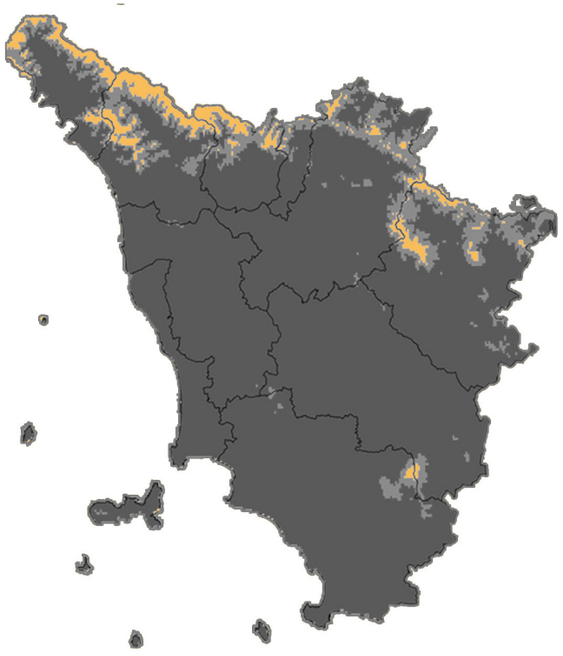
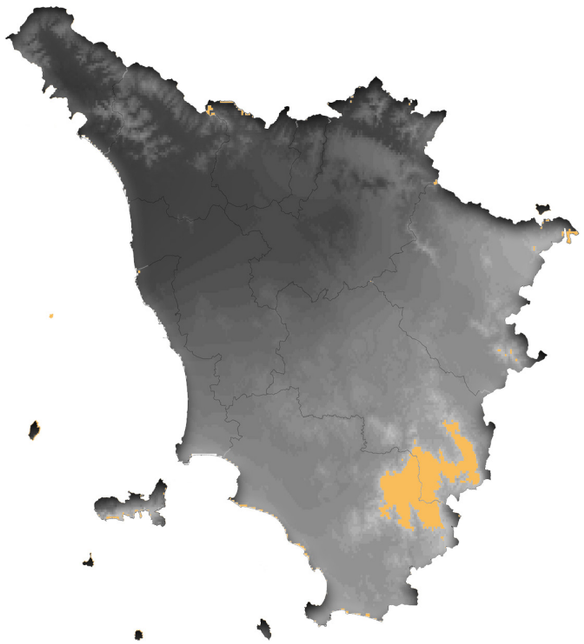


Figure 48 - Current situation.
Figure 49 -Business as usual 2050 scenario.



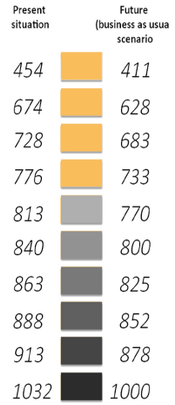


*Figure 50 - Legenda, "different rainfall capacity", present scenario rainfall on the left and future scenario on the right side of the table. Unit mm*square meter*year.*

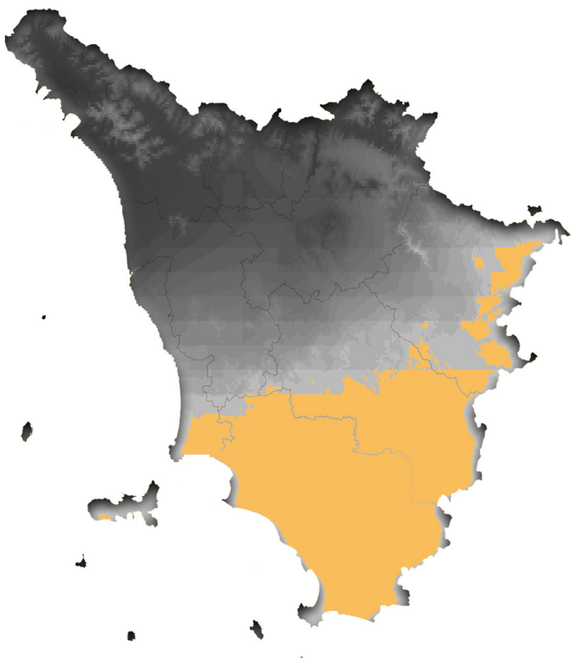


Figure 51 -Current annual rainfall, year 2015, tuscan region.

Figure 52 -Business as usual 2050 scenario, annual rainfall prediction for 2050, tuscan region.

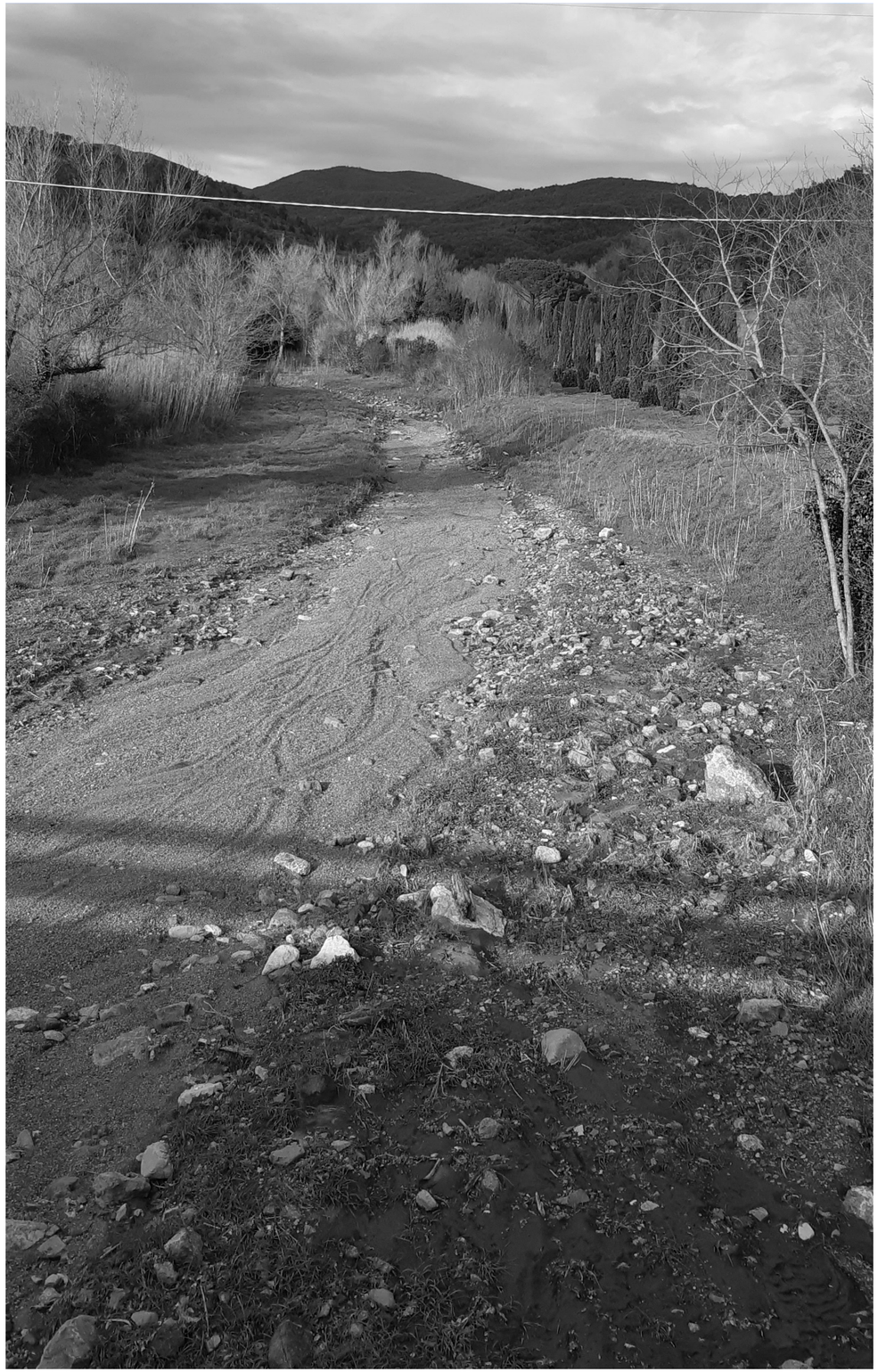


Figure 53 - Dry riverbed, Volterra, Tuscany.

POTENTIAL RISKS FOR THE AGRI-FOOD SYSTEM

From the multitude of indirect casualties caused by climate change effects and worsened by the polluting activities of unsustainable farming practices on the Tuscan territory, three of them are feasible to generate higher disparities and conflicts among the involved actors.

The first one, considered already a criticality in the status quo, is the scarcity of natural resources, such as fertile soil and water. More extended periods of summer droughts have shown the importance of natural and artificial water reserves. The growth of this criticality will lead to a progressive increase of costs for agri-food production and maintenance of the productive land. Of course, it penalises more average small businesses that are unable to afford such kinds of expenses. Therefore, scarcity of resources will deeply affect the market share, leading to a more and more restrained sector.

"Automatically, the system will become less capable of assessing shocks, sudden events that impact the vulnerability of a system and its components" (public health notes, 2021).

The second and third, loss of biodiversity and desertification, seem to be problems that concern mainly the agri-food sector, as they negatively affect the quality and quantity of the food products manufactured in Tuscany. But these phenomena also play a crucial role in influencing historical and cultural aspects of the territory, as they will shape the characteristics and traditional Tuscan landscape as we know it now. A landscape that attracts strong touristic flows to the region every year with its uniqueness and can ensure the balance between natural and human activity and guarantees a highly liveable climate condition. But this could rapidly change, and the Tuscan landscape could lose its touristic attractivity, making the problem even more urgent.

Figure 54 - Dry riverbed, Volterra, Tuscany.

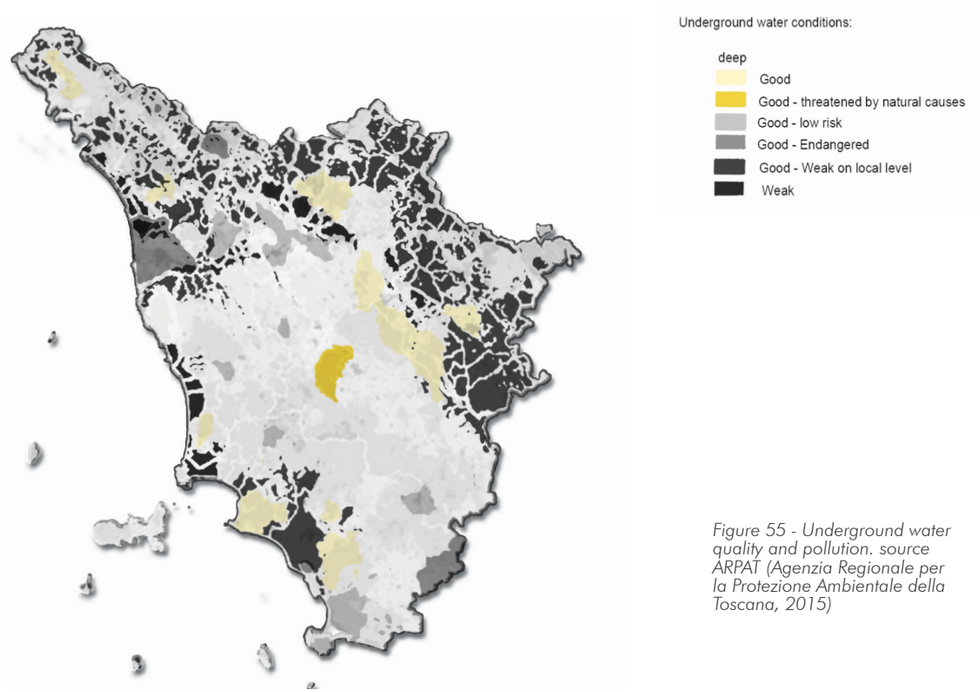


Figure 55 - Underground water quality and pollution. source ARPAT (Agenzia Regionale per la Protezione Ambientale della Toscana, 2015)

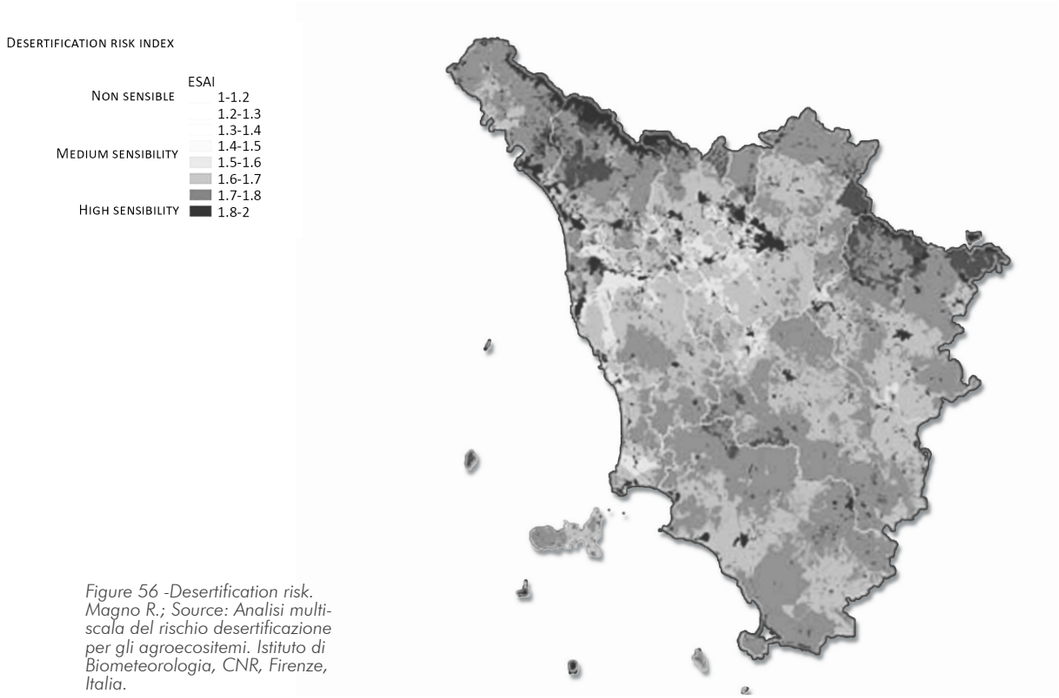


Figure 56 -Desertification risk. Magno R.; Source: Analisi multiscala del rischio desertificazione per gli agroecositemi. Istituto di Biometeorologia, CNR, Firenze, Italia.

METHOD STATISTICAL ANALYSIS

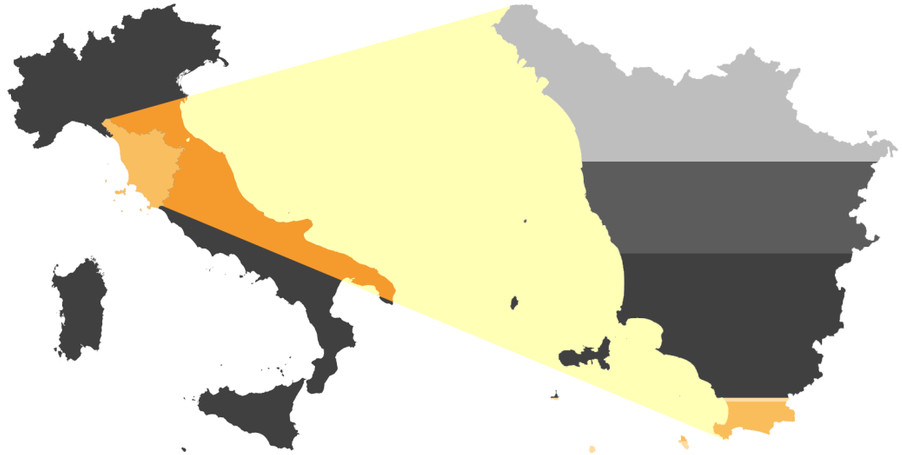
Statistical analysis means investigating trends, patterns, and relationships using quantitative data. It is a crucial research tool used by scientists, governments, businesses, and other organizations. To draw valid conclusions, statistical analysis requires careful planning from the very start of the research process. Statistical analysis does not look for an answer in words but in numbers and empirical data.

Aim - Such analysis aims to draw a personal observation and understanding of what the statistics mean for the own research. The method aims to give a quantitative definition to agricultural trends in the system.

AGRICULTURAL LAND USE IN TUSCANY

In the land-use distribution in Tuscany, the agricultural surface plays a leading role, as demonstrated in figure 58. The urbanised area covers only 8.6% of the total surface, while the agricultural land covers around 36%. Still, the agricultural surface is shrinking yearly, making space for new urban developments.

On the other hand, large areas are dedicated to natural habitats, mostly recognised by law as natural sites that limit the possibilities for new agricultural land expansions. This indirectly affects also the sustainability of the agrifood system. The less land is provided for agriculture, the higher the intensity of production to maintain production standards.



COMPLESSIVE AGRICULTURAL SURFACE 2016

Class:	area (ha)	percent (%)
Agricultural production	776,326.0	36
Wood production	462,221.0	21
Non-productive/natural	719,079.0	33
Open water bodies	22,170.0	1
Urban	198,580.0	9
Total	2,178,376.0	100

Source: Istat.

Figure 57 - The geographical location of Tuscany on a national scale.
Figure 58 -Table of productive land distribution categorized by typology.

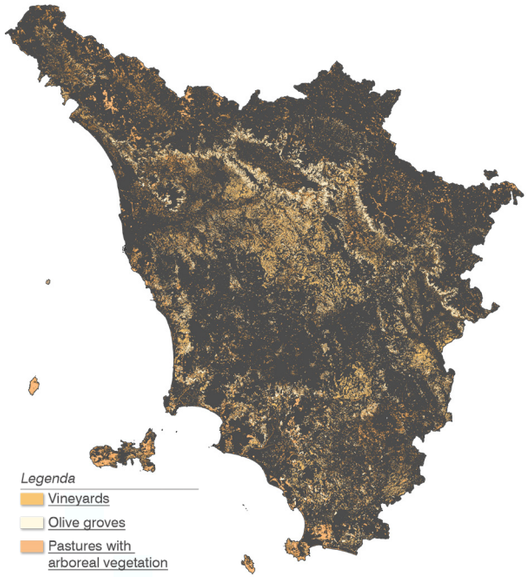
A trend that has to be stopped by fighting the abandonment of agricultural land and, at the same time, making it more challenging to use that land for urbanisation.

The Tuscan agrifood sector is globally recognised for the quality of its products. Of course, some products have earned more notoriousness than others and have influenced the agricultural landscape and its identity on the market more strongly. The most known products produced by the Tuscan agrifood sector are wines and olive oils, but also meat and dairy products. Still, as these goods production demands a low amount of agricultural surface, significant parts of the farm surface are used for other purposes.

In figure 59, it stands out that the production of wine, oil and other orchard derivates concentrates on the higher hilly areas and presents a highly fragmented texture that indicates that the size of the farmed lands is rather medium/small in most cases.

Figure 60 shows the surface used to grow wheat, oats, grasses, and other temporary meadows. In this case, the pattern changes as it contains much bigger and uniform textures the majority of which are distributed along valleys and open water bodies. This first picture of the land distribution clarifies that even if products such as oil and wine make up a good part of the gross income produced by the Tuscan agrifood sector, this has not to reflect equally on the agricultural surface and production quantity.

By examination of numbers from the national portal Istat, it is clear that production, land occupation and compressive added value are three values that relate to each other but are not proportional. In the tables of figure 61, each of the values is represented, showing the first ten products with the highest share. By confronting each table, none equals the other. The best example to explain the differences between the tables lies in the production of Olive oil. While in the first table, where the land occupation is shown, olive groves are the class with the highest share of 15% of the total agricultural land.



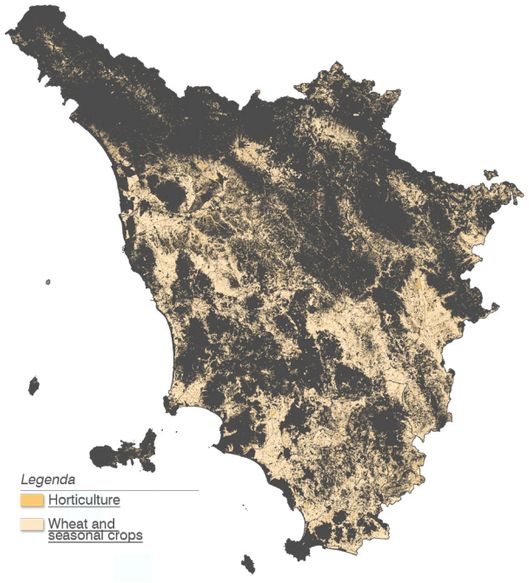


Figure 59 - Map for permanent crops distribution in Tuscany.
Figure 60 - Map for seasonal crops distribution in Tuscany.

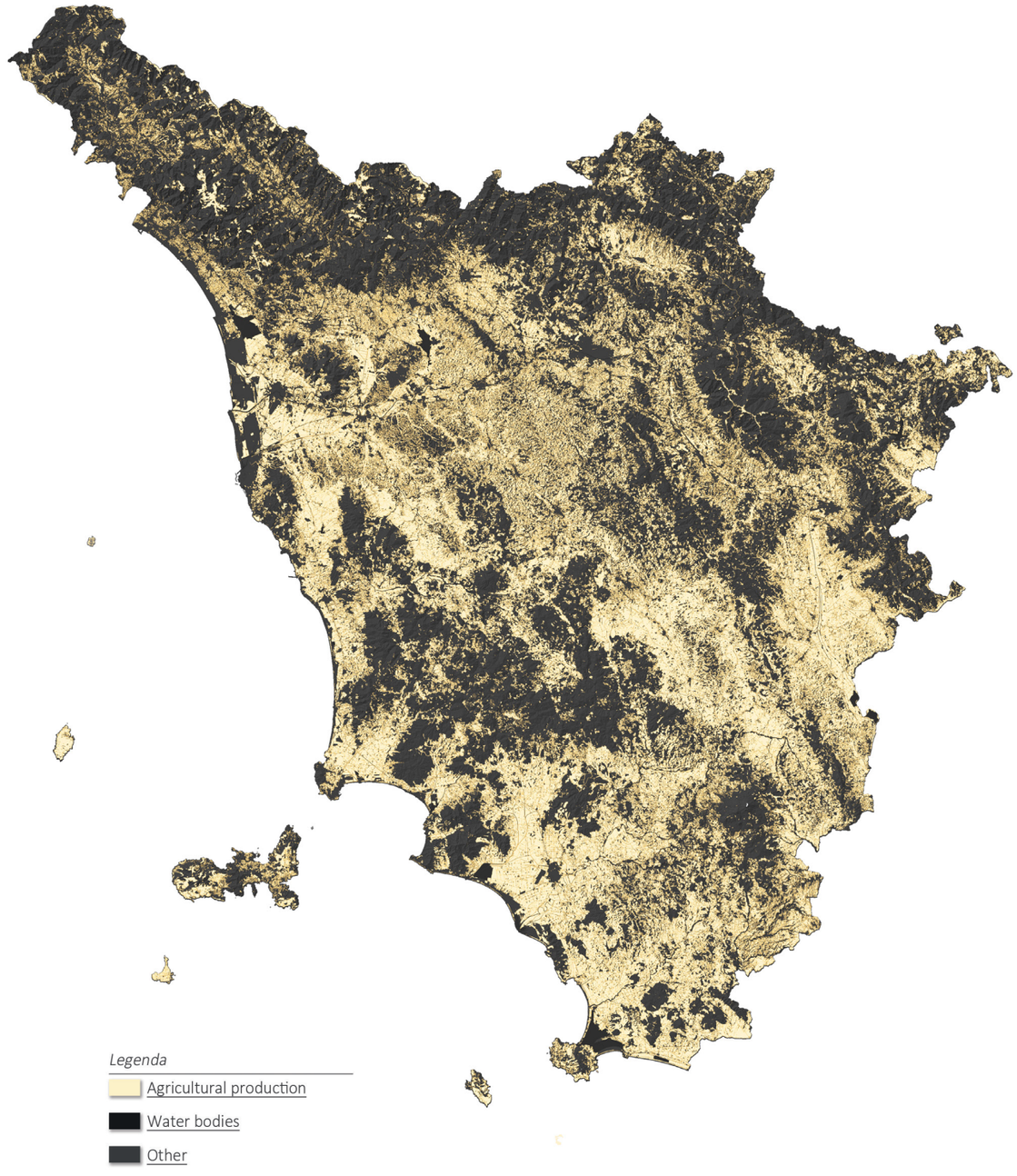


Figure 61 -Map for productive land distribution in Tuscany.

They only score a 2.2% when it comes to gross produced capacity and 3% in terms of added value. For other products, such as wine and meat, the opposite effect happens as they occupy a lower position in land use than not in added value or production capacity.

Still, in the tables emerge a pattern that could be seen as unexpected for many. The land use, production capacity, and added value of products such as wheat, meadows and other products used as food for cattle are still high. This also explains that the average size of Tuscan agri-business is higher than the average on a national scale. While Italy has a complex number of 1,104,705 agri-businesses, the average size per farm is 11 hectares; For Tuscany, with a complex number of 45,116 agri-businesses, this value reaches 14,6 hectares (Istat, 2020).

However, the land-use composition is not the only cause for the large average size of agribusinesses in Tuscany. An important role is also played by the decreasing number of agribusinesses active on the field each year. Between 2010 and 2016, the number of agribusinesses went from 72686 to 45116. A trend caused by increased costs and higher market competition forced primarily small businesses to either merge into bigger groups or abandon the activity. This affects all agricultural business typologies, whether conventional, certified or organic.

Figure 62 - Agricultural landscape, Certaldo, Tuscany, by author.
Figure 63 -Agricultural landscape, Volterra, Tuscany, by author.

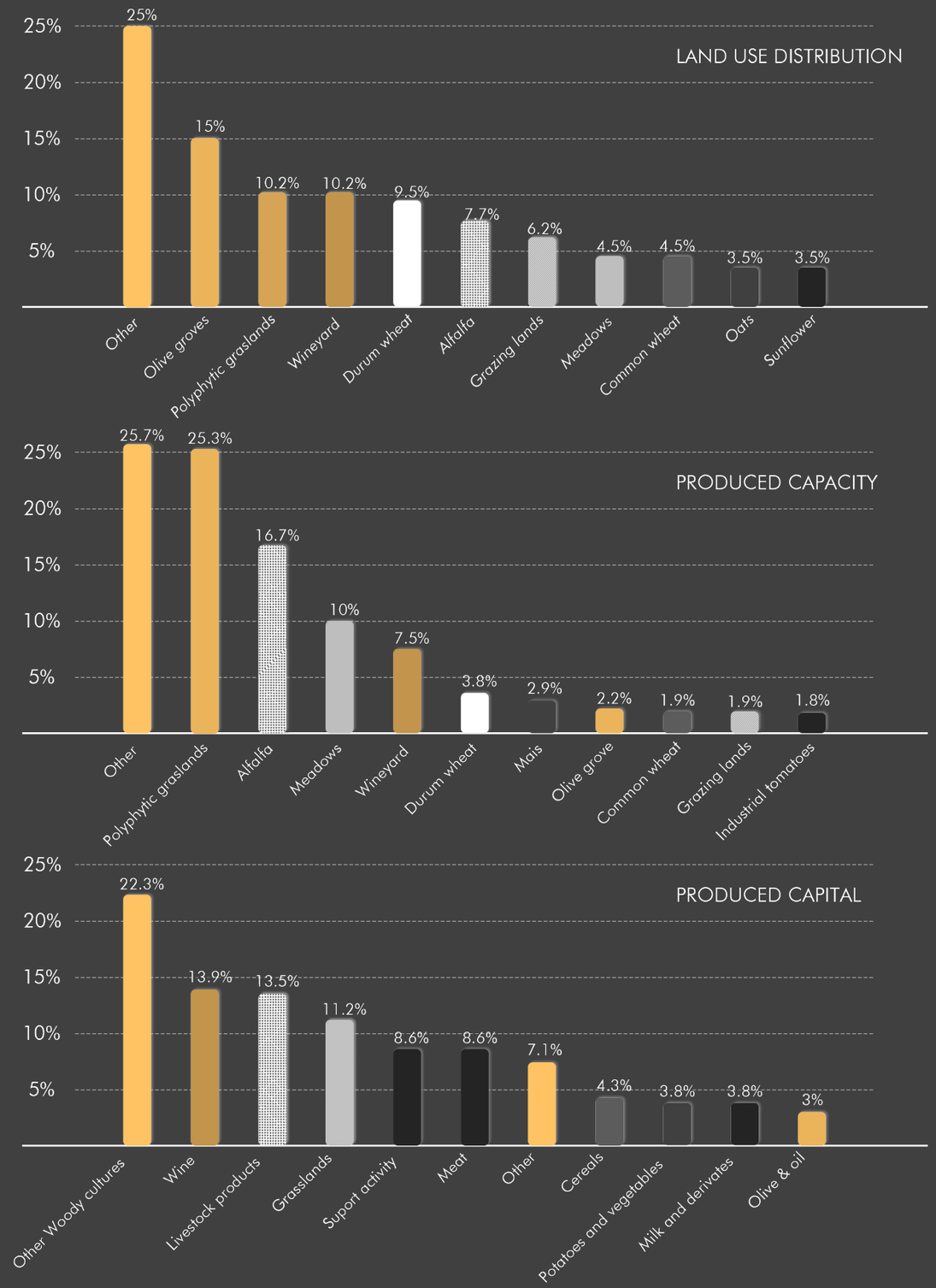


Figure 64 - Comparison between land occupation, produced quantity and produced capital per crop typology.

GEOGRAPHICAL INDICATIONS IN TUSCANY

In this context, it is crucial to understand the economic and spatial impact that certified farmers have on the totality of the agricultural system. A claim has to be made before entering this part of the method. The public information about farmers who produce certified goods as PDO or PGI is fragmented and incomplete.

The reasons behind this fragmentation are easily explained. First, it is caused by an excessive number of existing institutions and associations interested in GIs and so have and share a specific data set about the GI. Still, none of them has a collection of detailed data information concerning all GIs. Second, and most important reason, is that it is not easy to distinguish between GI-certified farmers and conventional or organic farmers in many cases. For example, as it often happens, agri-businesses produce more than one good but certify just a specific amount of them while the other products remain conventional-produced goods.

Figure 65 - Tuscan hillsided landscape, Peccioli, by author.

Third, associations created to protect and represent the farmers applying to a GI are not mandatory for all farmers that apply to the disciplinary for that GI. As consequence, they are not registered in the list of partners of the association.

Anyhow enough information can be collected from the different sources and used to evaluate the impact of GI farmers on the agri-food system. This paragraph aims to calculate the agricultural land use, the number of applying agri-business (and so with of the average farm size) and the production capacity. Once this information is obtained, it can be confronted with the average statistics of other farming classes or the whole sector.

The different numbers of occupied land and the number of participating farmers are collected separately for each geographic indication. While the land occupation is a valuable indicator of how much the GIs influence land use in Tuscany, the number of certified agri-businesses must be treated carefully. This is because an agri-business is allowed to apply for as many certifications as possible as long as it follows the disciplinary. This means that the compressive sum of the agri-businesses that apply for GIs is distorted by the fact that the same agribusiness is registered multiple times.

For example, a wine producer with three different plots might register as PDO Chianti in the first vineyard, PDO Chianti Classico in the second and PGI Toscano in the third. This would lead it to be reported in three different certifications, resulting in three separate businesses in the final count. Once clarification is made, some conclusions on the values in figure 66 can be made. First, it is noticeable that there is a sort of balance between the land cover of PGI and PDO and that they together cover up almost one-fourth of the compressive agricultural land. Second, the table shows that wine and olive oil (Tuscany's two most common certifications) make up 64% of the total surface used for PGI and PDOs. The same happens for the number of agribusinesses involved, where wine and olive oil producers represent 76,5% of the compressive number.

Main GIs certified farmers — 2019

Class:	area (ha)	businesses (n)
PDO	87,513.8	12,866
PGI	83,438.5	17,008
Total GI	170,952.3	29,874
Wine (PDO and PGI)	42,418.7	12,652
Olive oil (PDO and PGI)	67,316.8	10,232
Total GI on agri-food syst. (%)	22	66.2

Source: Istat.

Figure 66 - Spatial land occupation of GI producers in Tuscany.

ORGANIC FARMING IN TUSCANY

As for the farmers applying for a PDO/PGI, the same analysis has to be made for the agri-businesses certified as organic. Different from GIs, the number of agribusinesses that practice organic farming is stated more clearly. This is because to be considered organic, an agribusiness has to convert all its arable land to the disciplinary of organic farming practices. Another reason behind the facilitated distinction is that only one certification is used for all organic agri-food products, simplifying data collection. The statistical numbers for the past six years show the development of a general trend.

While the converted agricultural land increases, the number of agri-businesses decreases. This trend is generated by a low costs-profit rapport that pushes smaller farmers out of a competitive market and sells to more significant entrepreneurs or forces them to merge into associations with other local farmers. This trend is more noticeable in Tuscany than in different regions of Italy, as the average organic farm size is 26.2 hectares while the nation is only 17.2 hectares.

The average size of organic agri-businesses also depends on other factors, such as the planted crop, morphology and resource availability. Different types of crops require various land capacities. This is why it is essential to acknowledge what food products occupy most parts of the organic converted arable land in Tuscany. At the same time, it is crucial to confront each production with the rest of the organic farmers and the complex agricultural land used to produce that specific good.

Some conclusions can be drawn in confronting the two tables from figure 67 and figure 68. For example, Cereals and Wheat make up more than half of the organic surface, but only 20% of the complex value and vegetables make more of a niche market as they seem to be close to fully organic but make out only a tiny part of compressive land.

Organic land on complessive agricultural area — 2016

Class:	bio area (ha)	total area (ha)	bio on total (%)
Cereals and Wheats	68,881.5	325,000.0	20.6
Legumes	2,358.0	21,230.0	11.1
Vegetables	7205.0	8,328.0	86.5
Olive	14,672.5	56,506.0	26.0
Wine	13,493.0	91,080.0	14.8
Orchards	262.0	2,717.0	9.6
Meadows	16,637.5	65,133.0	25.5
Resting arable land	9,170.0	---	100
Total	131,003.0		16.9

Source: Istat.

Figure 67 - Organic production devided in categories in Tuscany, table.

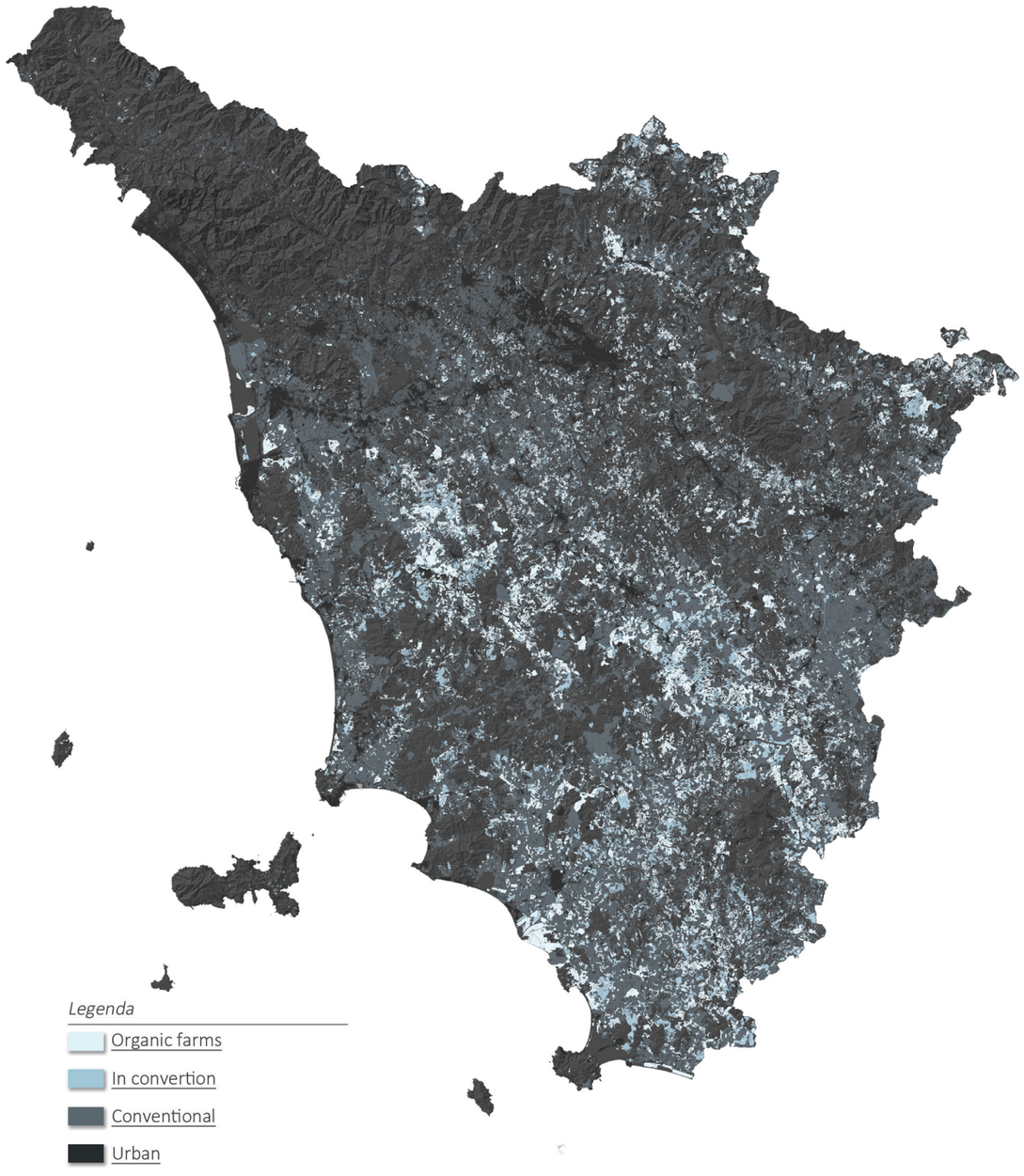


Figure 68 - Organic and traditional farming in Tuscany.

DATA LEAK

This chapter gives the possibility to strengthen the knowledge about land distribution and land use. Tuscany is a well-known region for the production of wines and olive oils. These are also the two main products produced by most of the GI-certified agri-business. Even though it is possible to conclude that, surprisingly, the region still relies strongly on the production of seasonal cultures. These are the ones that threaten the most environmental integrity as they imply upscaling production and are less cost-worthy to convert to organic.

Another issue compromising the system's sustainability is the high share of land occupied by conventionally treated wine, olive yards and other orchards. These two topics must be treated with care as they represent a threat to environmental sustainability and are also the socio-economical structure's main backbones. On the other hand, there is the need for a more restrictive policy as existing policies are not mandatory and do not attract enough business.

The statistical analysis aims to understand the impact these specific actors have on the agrifood system. It considers their share of Land use, GDP contribution and production. The difficulty in applying this method remains the fragmentation of information through the many exciting institutions. Another reason for the complexity of information is that no previous research or survey classifies the farmers into conventional, biological, and certified. It creates a knowledge gap, especially around biological and geographical certified farmers. These difficulties make the statistical analysis an even more critical step to build awareness of the present situation.

Two or more different agrifood systems may share the same characteristics, but every system is unique and needs to be understood. Agri-food systems can differ in many aspects, from general elements such as production capacity or the composition of land use to socio-economic structure or the scale of interest (local, provincial, regional, etc.). For example, in the case of scale, the Tuscan regional rural district comprises several sub-districts that mainly follow morphological borders such as mountains or coast and river lines.

In the next steps of the graduation work, the research focus will narrow down to one of the sub-districts. Concentrating on one sub-district of the Tuscan agrifood sector will help narrow down the workload and improve the quality and focus of the research and the strategy. It remains crucial to take the right decision when it comes to picking up a sub-district. The study aims to create a design with possible spillover effects and not a site-specific strategy. So it has to be a district with average characteristics compared to the Tuscan agrifood sector standards.

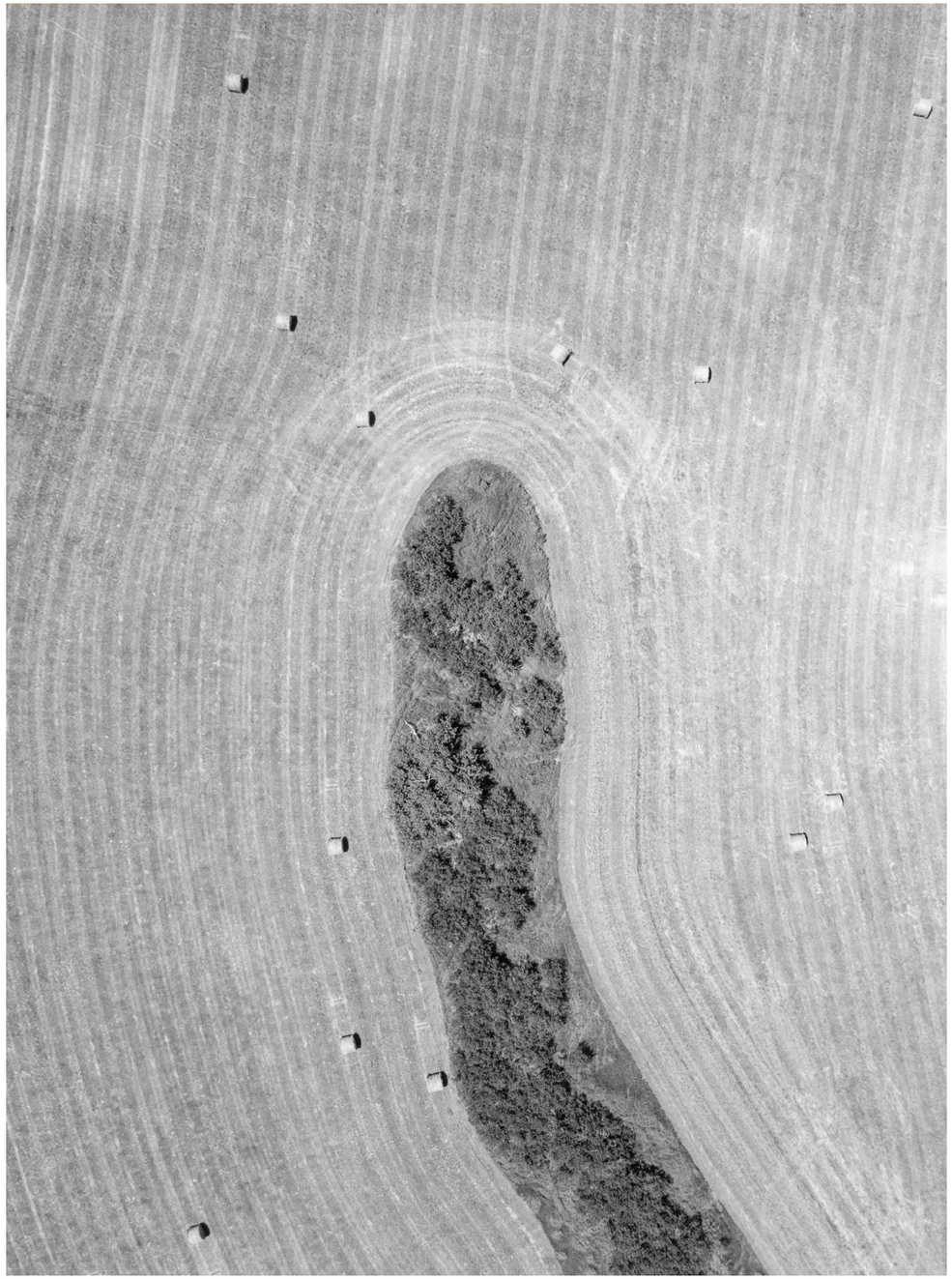


Figure 69 - Arable land, seasonal crops.

—INVESTIGATING UPON SPATIAL CHALLENGES

METHOD SPATIAL ANALYSIS

The spatial investigation method "is a process of GIS data interpretation, exploration, and modelling, from acquisition to understanding results. The retrieved information is computer-processed with spatial analysis software and varies depending on the number of tasks and their complexity"(Kogut P., 2015).

Spatial investigation lays out a number of maps depicting the agricultural, morphological, and natural characteristics of the Valdera district (area chosen for specific analysis). These maps clearly show criticalities that might occur in the area. Becoming the first milestone to create a list of principles that should respond to the detected criticalities.

Aim - The aim is to translate quantitative data obtained with previous analysis into spatial information with the help of digital mapping software such as GIS. The distribution of different farming typologies in the region, their footprint, the hydrologic risk, soil erosion areas and ecological niches can be identified and used to understand better the current situation.

THE SUB-SYSTEM VALDERA

As mentioned at the beginning of the statistical analysis, the research will narrow down its focus on a specific sub-district of the Tuscan agri-food sector. Downscaling is needed to continue the study and answer the second research question: "To what extent are Geographical indications and other food certificates currently contributing to sustainability and resilience in the agri-food system?" Before this research question can be answered, some clarity has to be made upon the most occurring threats to sustainability in the selected region.

For this purpose, the chosen sub-district is the valley of Valdera, a valley located in the centre-western part of the region. The Valdera turns out to be an excellent example as it includes most of the known agricultural patterns that can be found in Tuscany. Juridical speaking, the area can be considered as one agri-food system in which a union of municipalities collaborates in the creation of planning strategies.

Geographically and morphologically speaking, the municipal borders of the Valdera union comprehend three sub-systems. Each of these sub-systems is defined by a riverbed. Therefore, the names of the systems refer to the river they are connected to; these are the rivers Arno, Era and Cecina.

The different morphological conditions of the sub-systems have led to the development of diverse agricultural production. It is, therefore, important to generally introduce the differences between them before starting to investigate spatial patterns in the entire area. The spatial investigation aims to deepen the general knowledge concerning the area and find and study trends and behavioural patterns in the spatial distribution that could help understand the role that sustainable farming has or should have in the system. Building up a set of maps depicting the essential information about the area will also function as a critical tool for future designs in the strategy-building phase.

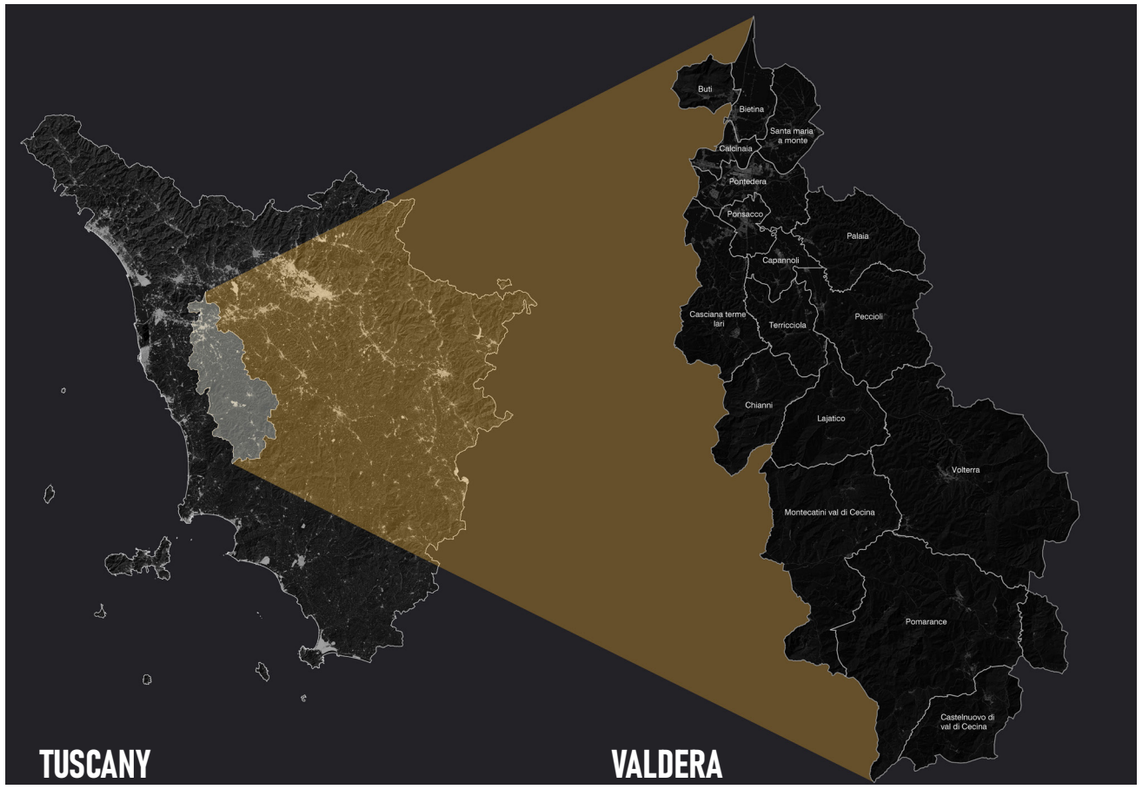


Figure 70 - Valdera sub-system, zoom in.

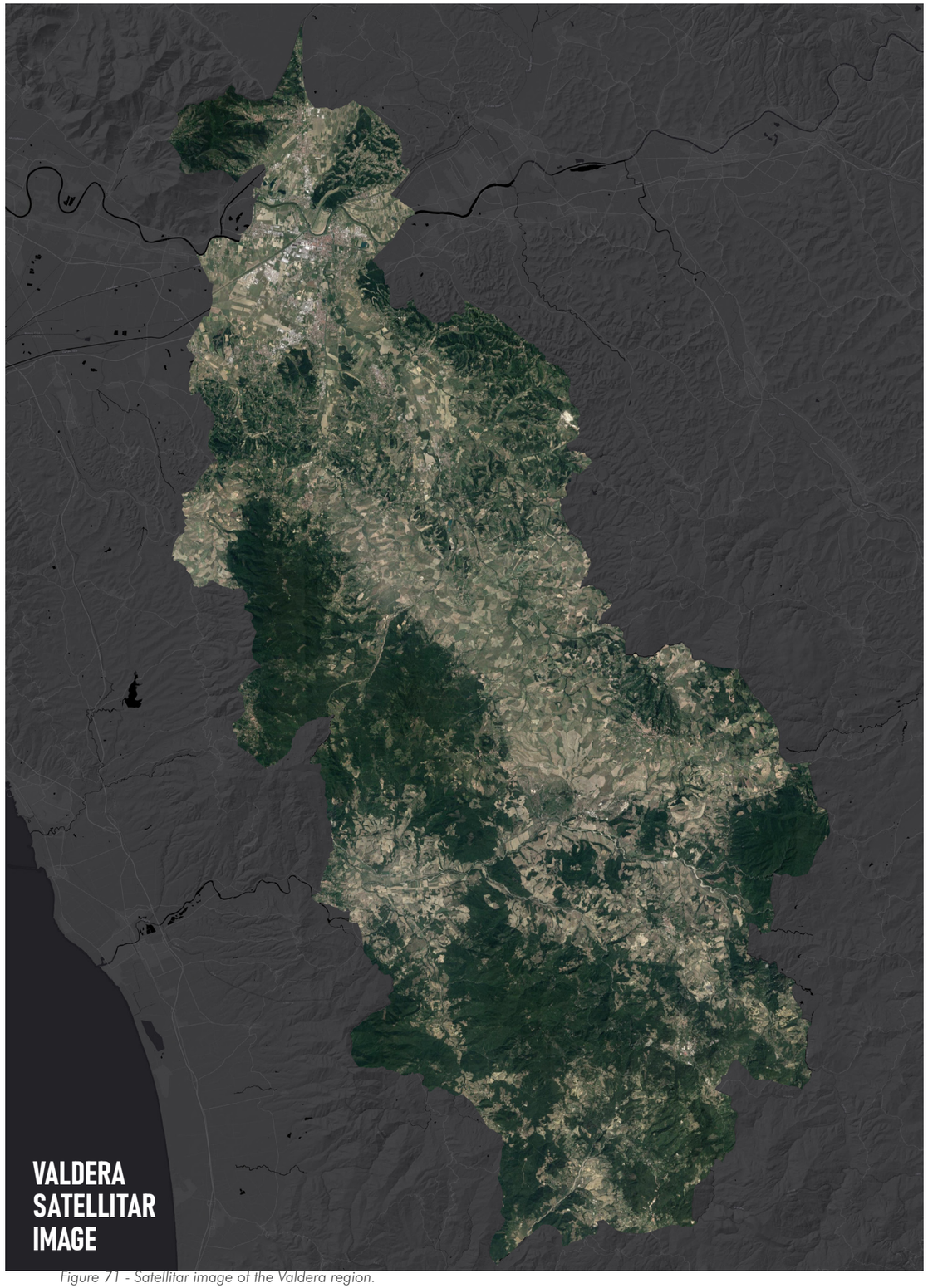


Figure 71 - Satellitar image of the Valdera region.

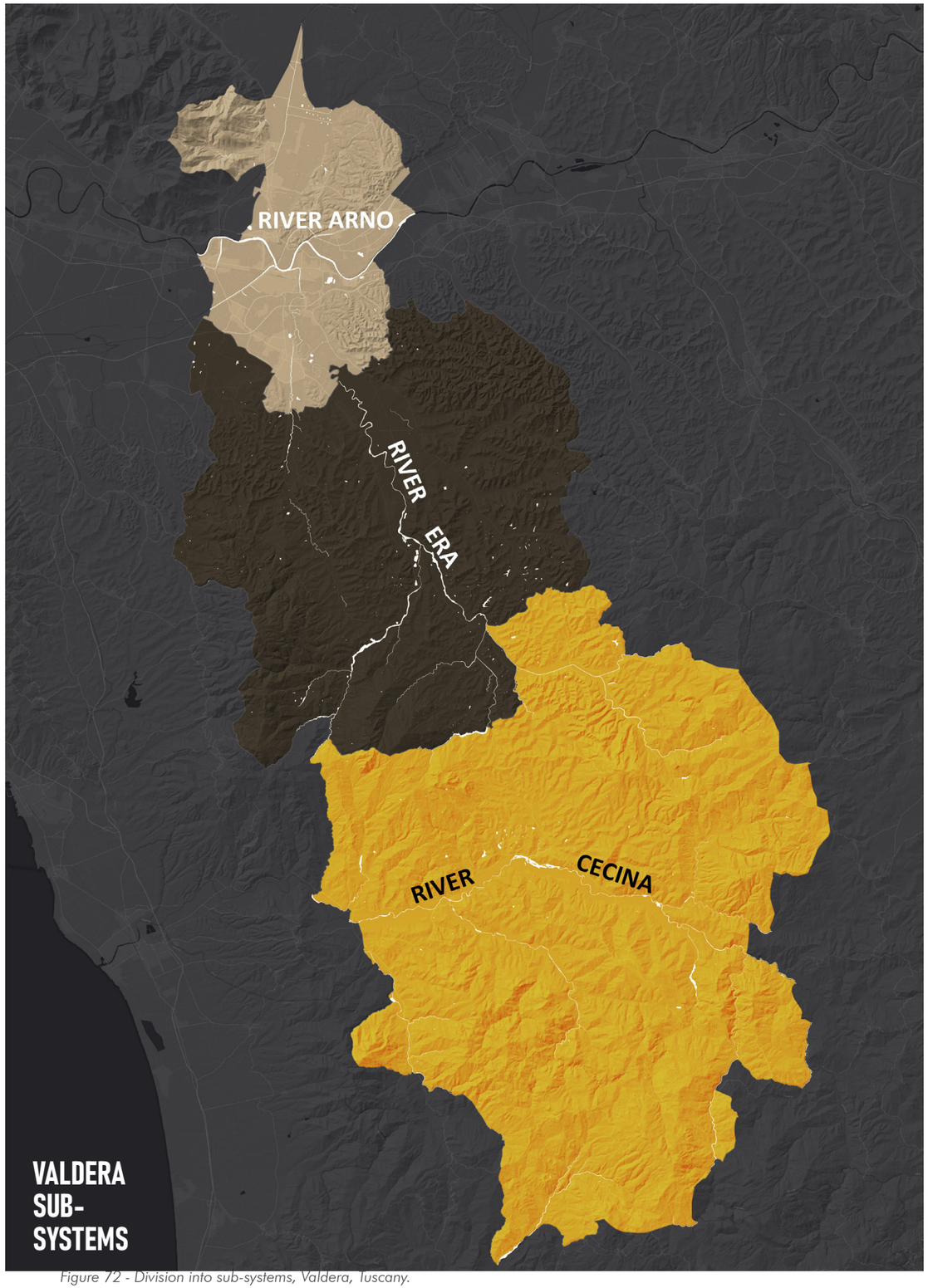


Figure 72 - Division into sub-systems, Valdera, Tuscany.

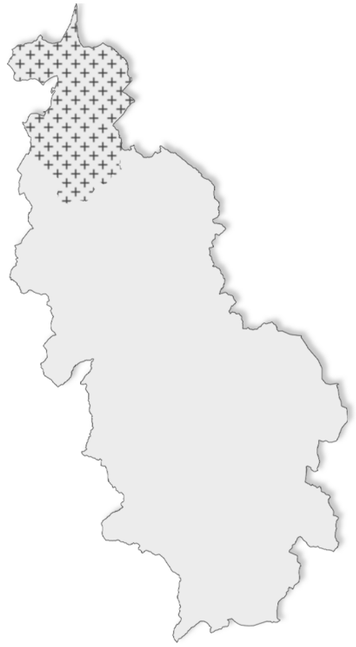


Figure 73 - Sub-system River Arno.

THE RIVER ARNO SUB-SYSTEM:

The river Arno sub-system is located in the region's northeast part. The Arno River has the highest capacity in Tuscany and almost entirely crosses the region from east to west. During its way to the sea along its riverbed, distinctive agri-food systems have been created, even though they all have main common characteristics. The river Arno area is the most extended plane in Tuscany, in fact, in this part of the region, most urban centres have developed, and the remaining productive land concentrates on the production of seasonal crops such as sunflowers, wheat, maize and others.

Figure 74 - Arable flatland, river Arno, Tuscany, by author.

Figure 75 - Arable flatland 2, river Arno, Tuscany, by author.

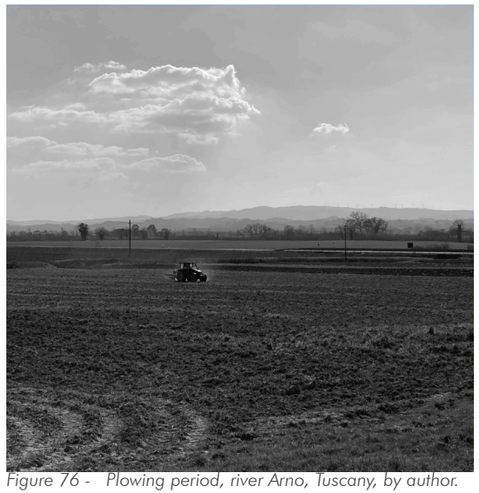


Figure 76 - Plowing period, river Arno, Tuscany, by author.

Figure 77 - Sunflower field, river Arno, Tuscany, by author.

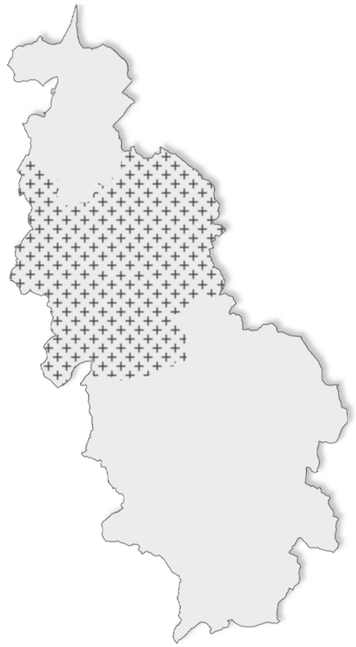


Figure 78 - Sub-system River Era.

THE RIVER ERA SUB-SYSTEM:

The central part of the Valdera region is occupied by the era riverbed, a feeder river of the Arno. This area distinguishes morphologically from the flatland of the Arno through softer hills that have favoured the development of permanent cultures such as vineyards and olive groves. This area has strong similarities with the chianti region's traditional landscape in the province of Florence.

Figure 79 - Productive landscape, River Era, Tuscany, by author.

Figure 80 - Vineyard, River Era, Tuscany, by author.

Figure 81 - Productive landscape 2, River Era, Tuscany, by author.

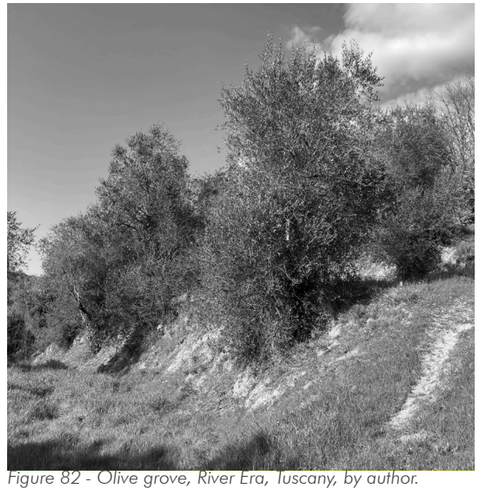


Figure 82 - Olive grove, River Era, Tuscany, by author.

Figure 83 -Sub-system River Cecina.

THE RIVER CECINA SUB-SYSTEM:

The most southern sub-system has similarities with both of the previous systems, and at the same time, it is the most independent one. The river Cecina does not flow into another river but directly into the sea. Its orientation is east to west, while the direction of the river Era remains south to north. The system is morphologically speaking closer to the era system, with soft hills dominating the landscape. Still, its land use for productive land resembles more the image of the Arno River. Seasonal crops and pasture are the two predominant activities even if the most southern part, closer to forests and significant natural spaces, vineyards and olive groves retake the lead.

Figure 84 -Seasonal crops, river Cecina, Tuscany, by author.

Figure 85 -Landmarks, river Cecina, Tuscany, by author.

Figure 86 -Abandoned buildings, river Cecina, Tuscany, by author.

Figure 87 -Hilly landscape, river Cecina, Tuscany, by author.

MORPHOLOGY AND ALTIMETRY

The morphological characteristic of the Valdera respects the average trend of the Tuscan region. A strong predominance of hilly areas leaves little space for valleys or mountains (which are more predominant in the southern parts. The narrow valleys are formed by the river basins of the Cecina River in the south (that directly flows into the Tyrrhenian sea) and the river Era that flows into the river Arno in the central-northern part of the district. In these valleys, the more significant urban centres can be found, which leaves little space for agricultural activities. Agriculture had to adapt and claim the hilly areas of the region. Forests cover the low mountain in the area as they can have slope values over 20%. The high amount of hilly areas and so of terrain with high slope values is also an indicator for an area with solid soil erosive phenomena.

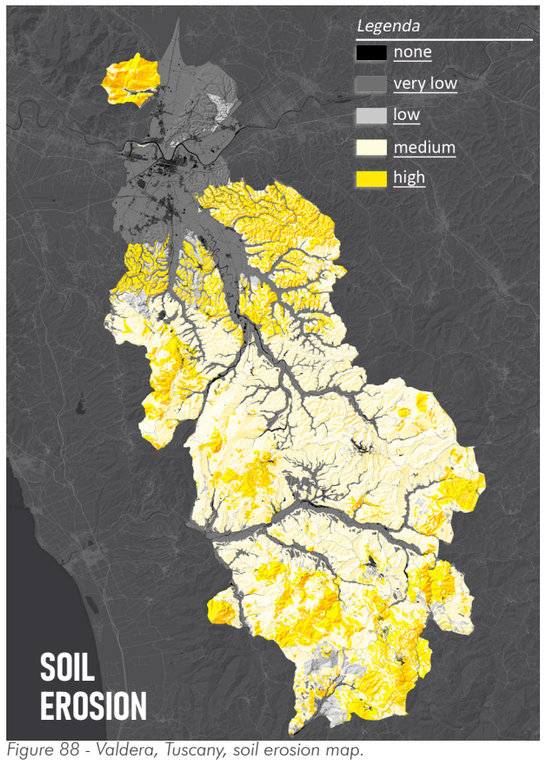


Figure 88 - Valdera, Tuscany, soil erosion map.

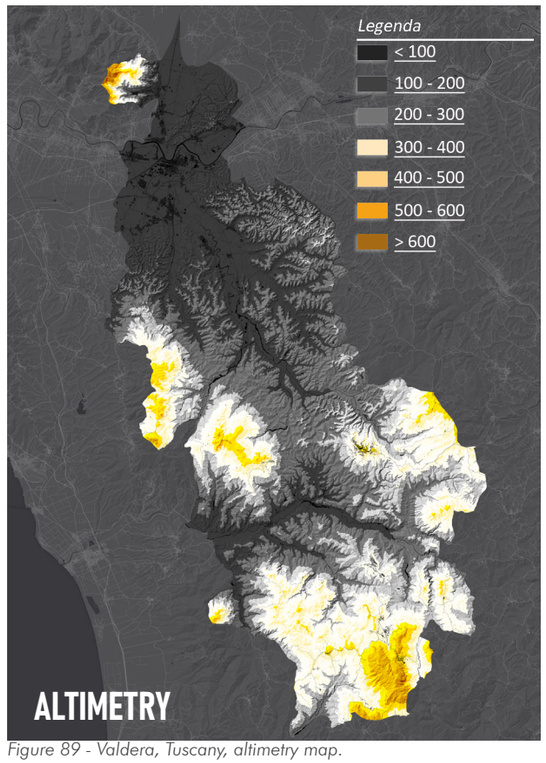


Figure 89 - Valdera, Tuscany, altimetry map.

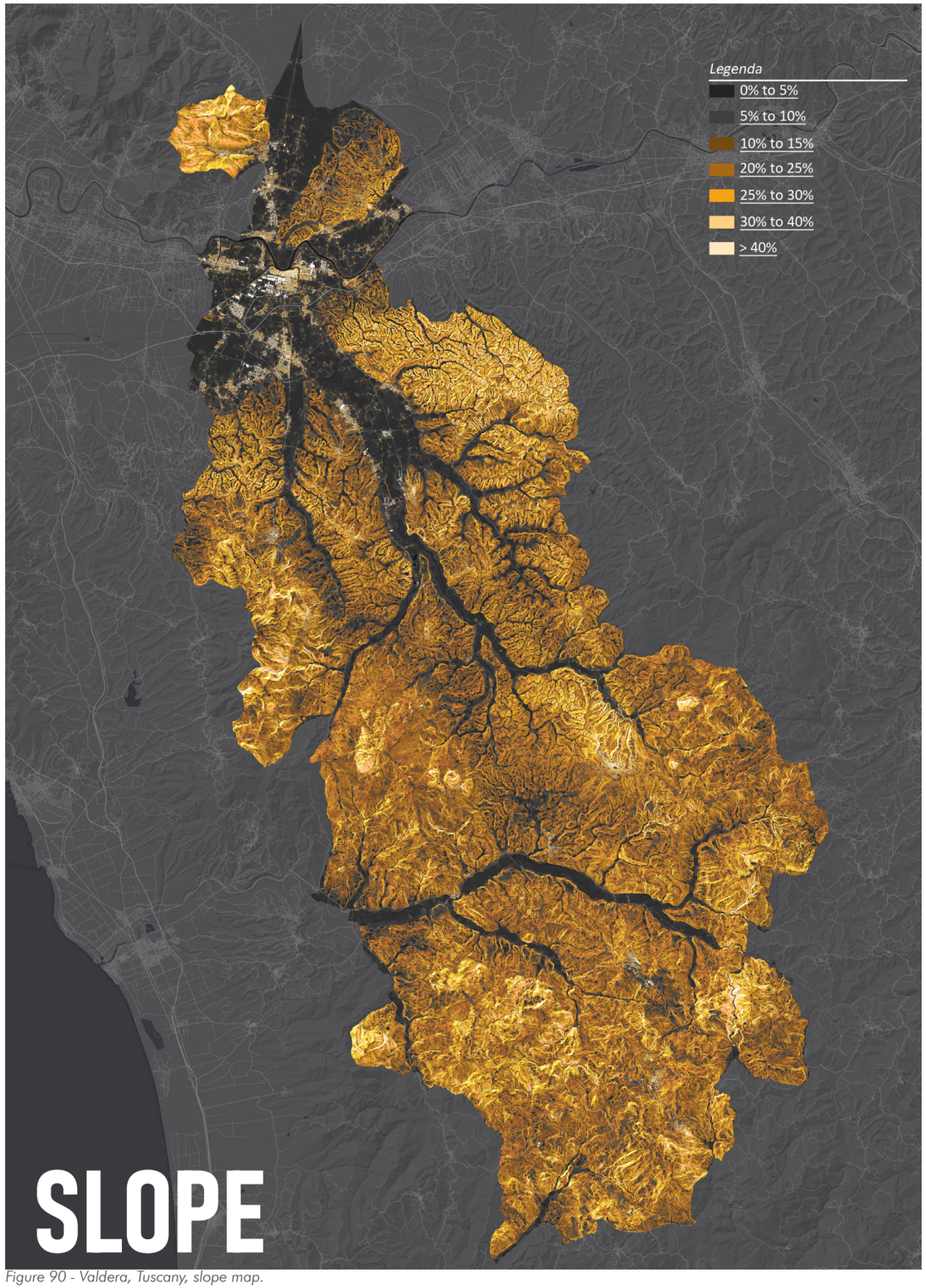


Figure 90 - Valdera, Tuscany, slope map.

HYDROGEOLOGIC RISK AND SOIL COMPOSITION

The district's high slope values also affect the area's hydrogeologic risk. A general high slope value implies higher run-off waters. This means that it is very likely that farmers who own lands far from any open water source can still contribute to water contamination. The closer the proximity to open water bodies, the higher the hydrogeologic risk, as it also appears on the map, but this does not exclude that those more distant and hilly areas are not an equal threat.

As it is the case for the southern Cecina River area. Apart from the morphological characteristics, other factors can influence the hydrogeologic risk value. The most significant indicators are soil composition, land use and farming practices. Different soil typologies have different values of permeability and fertility. Both are indicators of the capacity of the soil to retain contaminated water from direct discharge into underground resources. This retainment capacity can be decreased or increased by the typology of land use and the different farming practices.

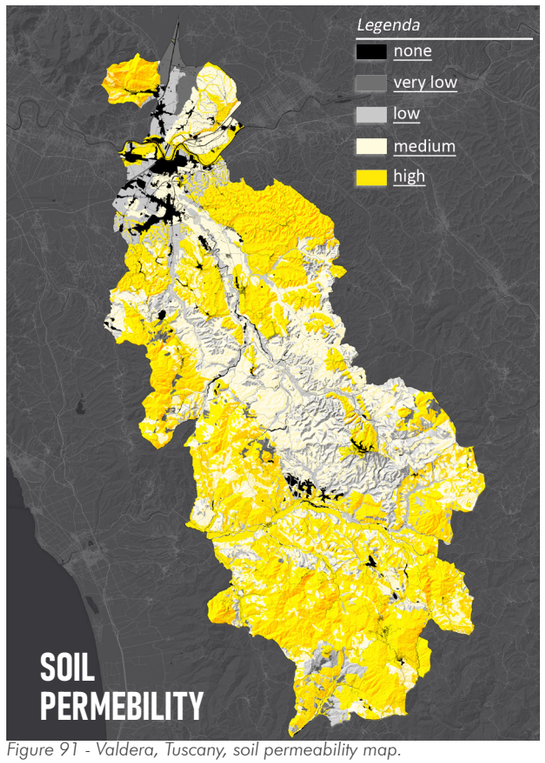


Figure 91 - Valdera, Tuscany, soil permeability map.

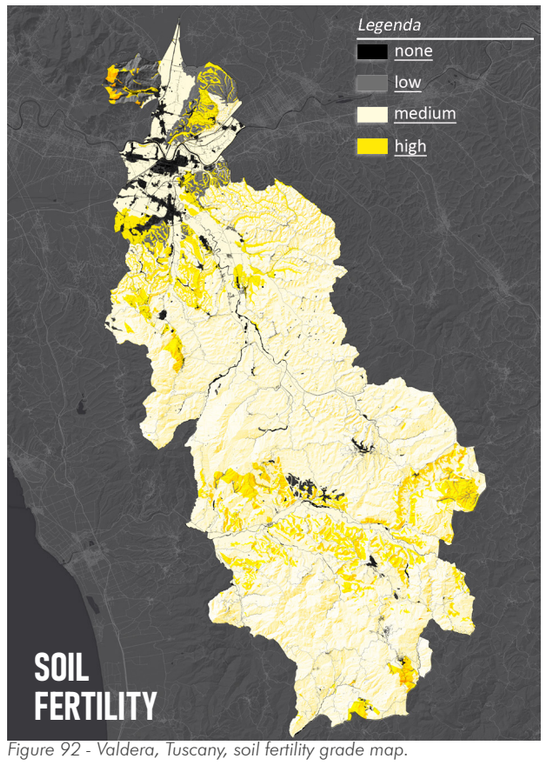


Figure 92 - Valdera, Tuscany, soil fertility grade map.

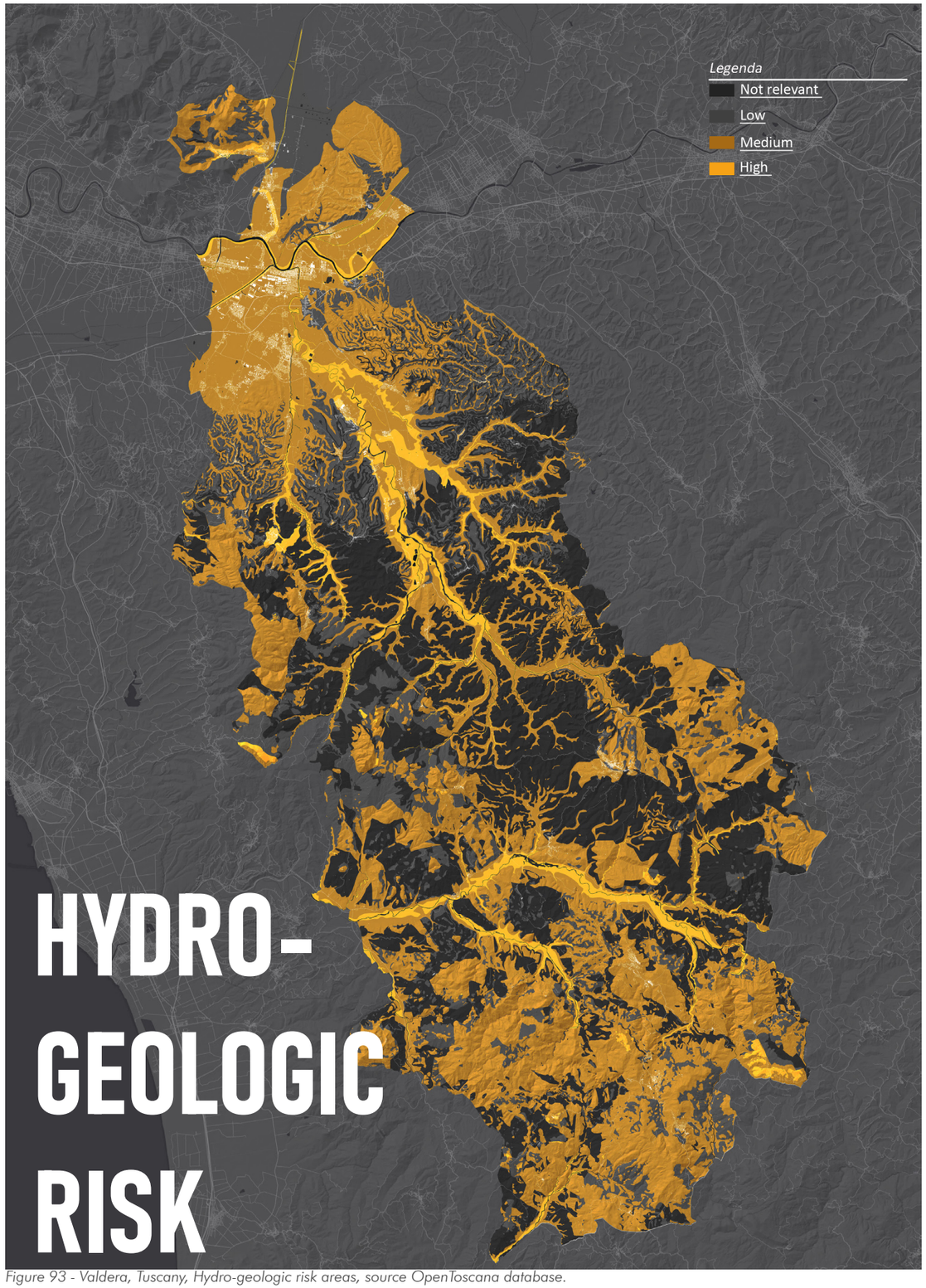


Figure 93 - Valdera, Tuscany, Hydro-geologic risk areas, source OpenToscana database.

STRUCTURAL COMPOSITION AND LAND USE

The subdistrict is characterised by the strong presence of seasonal crops that favour soil erosion through run-off phenomena, especially in areas with high slope rates. As figure 96 shows, the Valdera subdistrict presents three different agricultural land use patterns. The northern pattern in the proximity of the river Arno and the main settlement (Pontedera, PI) distinguishes for the presence of seasonal crops such as wheat, sunflowers, meadow, and others. The central pattern is defined by a more substantial presence of permanent cultures, vineyards in the first place, olive groves, and other orchards. Instead, the southern pattern distinguishes again for the high presence of seasonal crops and some pastures and orchards.

Different crops have different retainment capacities, not only for soil but also for water. This influences the run-off phenomena, water distribution, and underground water contamination. Natural spaces play a vital role in land use in Valdera. Still, even if they cover up an essential part of the land, they remain confined in areas along the borders, on sites with higher altitudes, and primarily distant from the narrow central valley. In the lower parts of the valley, little space is left for spontaneous and non-productive land is left of, this has indirect effects on the biotopes in the mountainous areas as they remain unconnected.

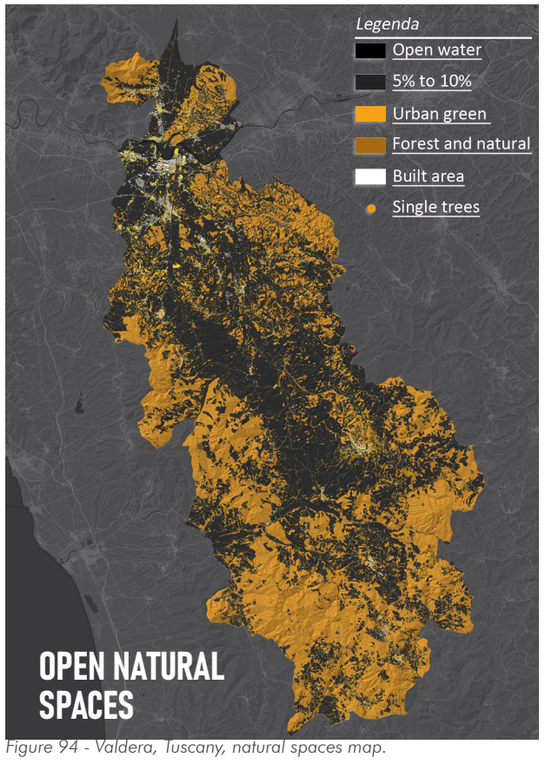


Figure 94 - Valdera, Tuscany, natural spaces map.

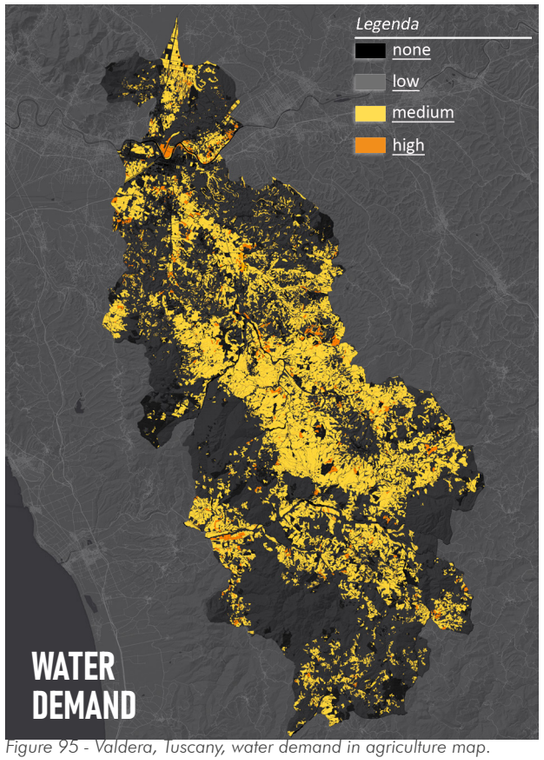


Figure 95 - Valdera, Tuscany, water demand in agriculture map.

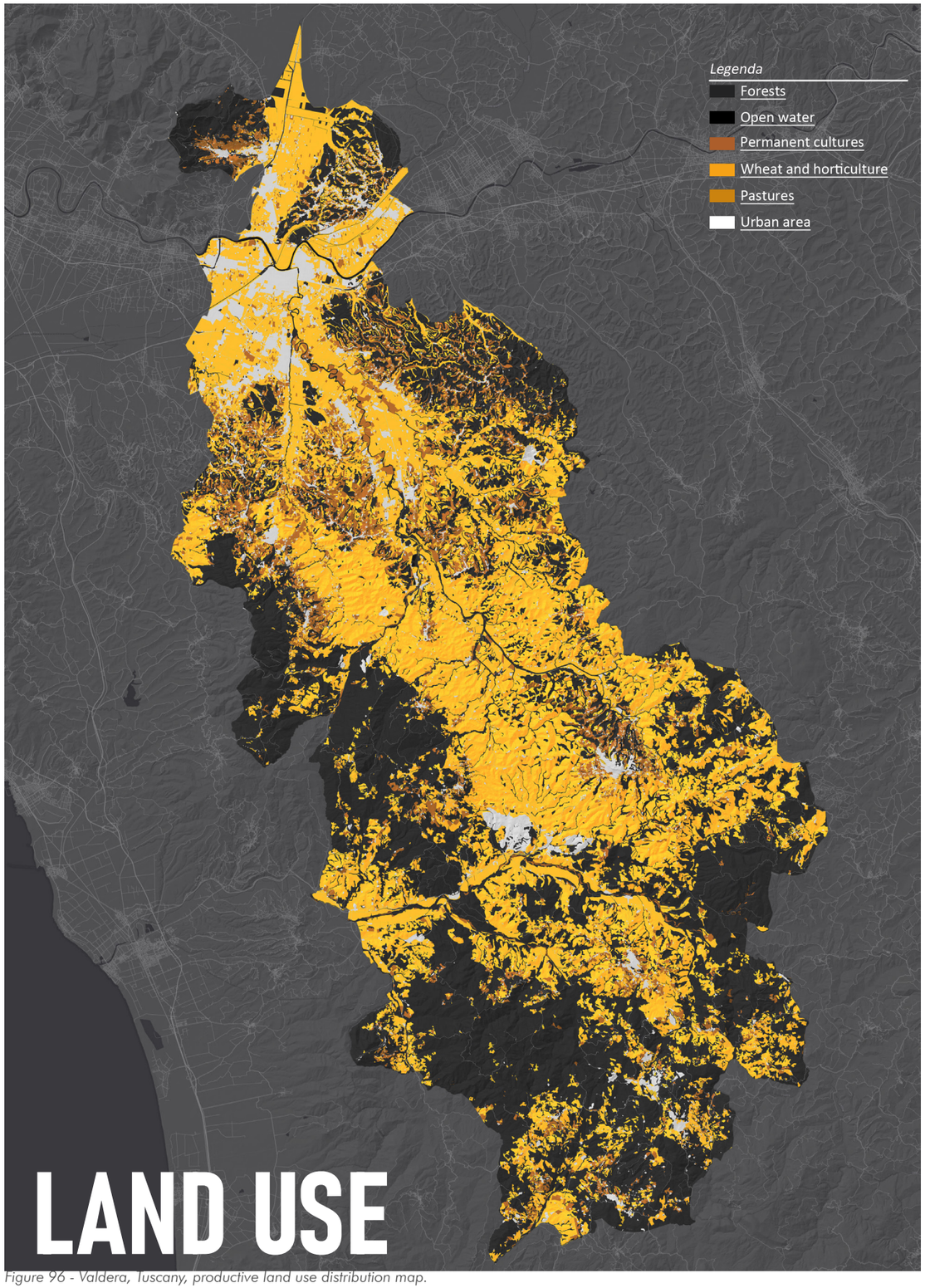


Figure 96 - Valdera, Tuscany, productive land use distribution map.

LAND PROPERTY AND FARMING PRACTICES

In figure 99, it is noticeable that the southern pattern has higher commitment to organic farming practices. While in the northern patterns, especially in the valleys, the transition delays. Significant parts of the agricultural surface along the eastern part of the valley are converting to organic practice. Meaning that within a maximum of three years, these can be considered organic farming plots in front of the law, even if they are already treated with SAP (sustainable agricultural practices) and are so with already considerable as organic.

As for the average of Tuscany, also in the case of Valdera, the size of the agricultural business is higher than the national one. Furthermore, the maps concerning single land unit sizes and agri-business size show how bigger land units and agribusiness distribute among the southern part of the valley where most seasonal crops are cultivated.

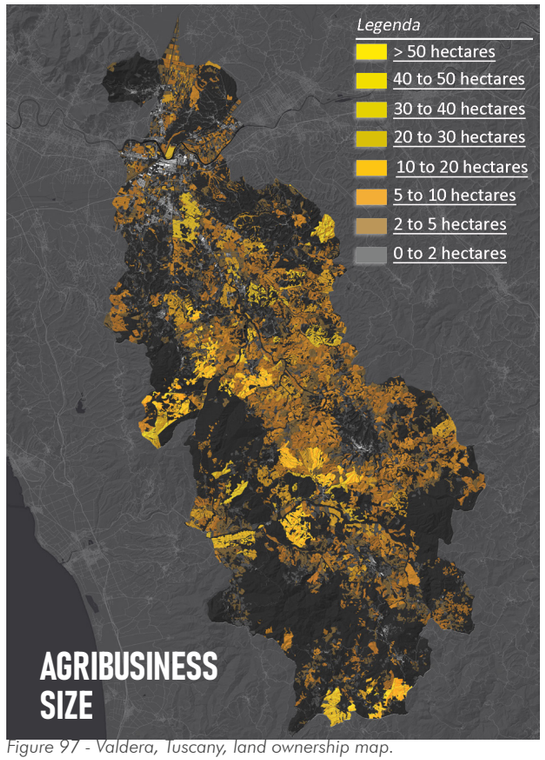


Figure 97 - Valdera, Tuscany, land ownership map.

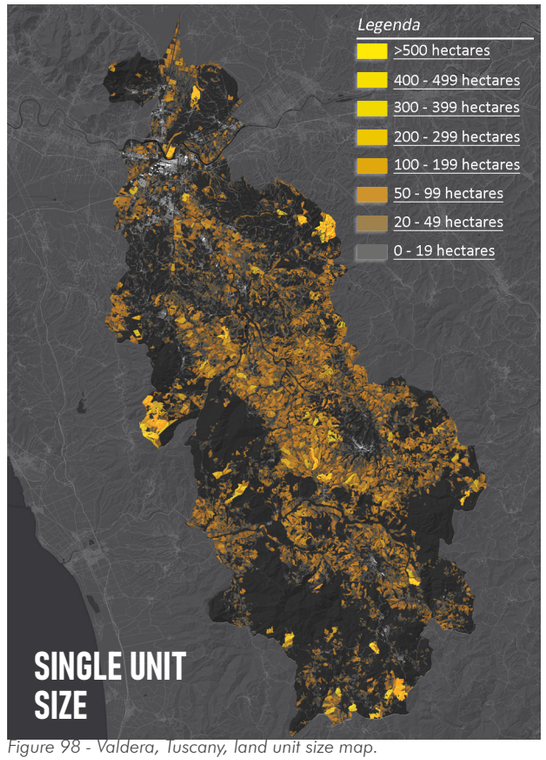


Figure 98 - Valdera, Tuscany, land unit size map.

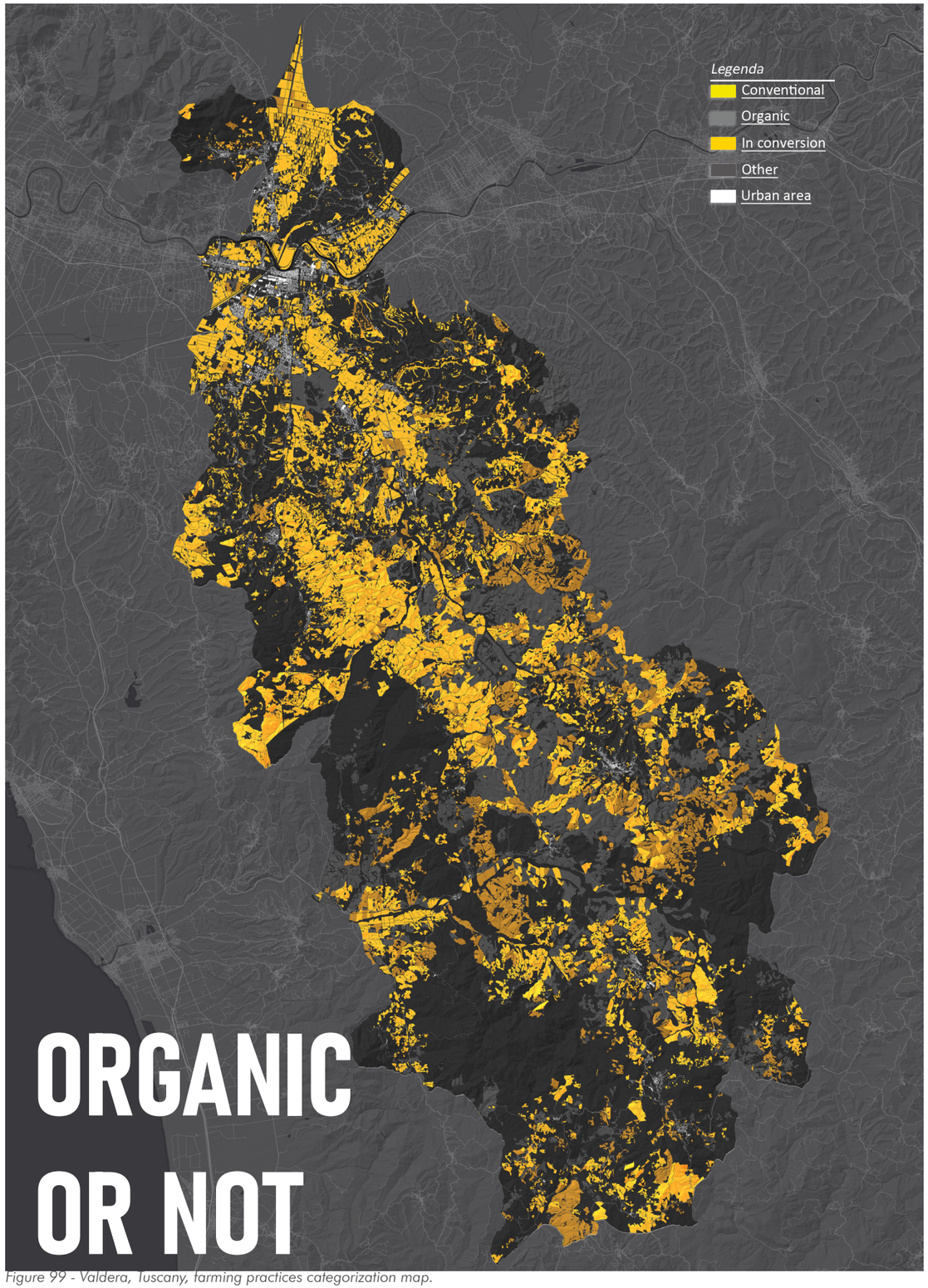


Figure 99 - Valdera, Tuscany, farming practices categorization map.

DISTRIBUTION OF PDOS AND PGIS

There seems to be no official released geographic dataset that indicates the agricultural land used for producing raw material labelled as GI or later used to produce labelled GI food products. The existing data sources present themselves as scattered and incomplete. The research must rely on statistical analysis to understand the impact of these certifications on the involved agricultural district.

As mentioned in the introduction, GIs do not respect institutional borders. Except for the GIs that extend on a regional scale where the regional borders are often taken as standard borders (see, for example, Cinta Senese DOP or Pecorino Toscano DOP). Other GIs' borders, differently, are connected to morphological and climatic reasons. It happens that the border of a GI covers only half of the interested area or covers just a part of it and other parts outside the district. Multiple variables make it challenging to define how many farmers have applied for a certification and what kind of certificate.

Therefore, the research selected all possible GI certifications to which farmers in the Valdera region can apply. Then these certificates numbers were analysed and converted in percentage to the numbers that should concern the Valdera region.

		TOTAL			VALDERA		
Name	Product	Businesses (n)	Productive land (he)	Certified area (he)	Certified area (he)	Businesses (n)	Productive land (he)
Chianti classico P.D.O.	Wine	2,970	14,266	402,823	37,600	277	1,332
Colli dell'Etruria Centrale P.D.O.	Wine	27	29	477,192	37,600	2	2
Montescudaio P.D.O.	Wine	15	94	27,685	15,537	8	53
San Torpé P.D.O.	Wine	10	2.1	70,942	44,196	6	1
Terre di Pisa P.D.O.	Wine	10	44	81,427	51,450	6	28
Vin santo del Chianti P.D.O.	Wine	213	109	402,823	37,600	20	10
Costa Toscana P.G.I.	Wine	65	257	912,324	66,987	5	19
Toscano P.G.I.	Wine	4,844	12,517	2,298,890	123,921	261	675
Cinta senese P.D.O.	Meat	122	3,103	2,298,890	123,921	7	167
Prosciutto Toscano P.D.O.	Meat	2,120	2,367	2,298,890	123,921	114	128
Salamini Italiani alla Cacciatora P.D.O.	Meat	434	491	2,298,890	123,921	23	26
Agnello del Centro Italia	Meat	85	2,809	2,298,890	123,921	5	151
Finocchiona P.G.I.	Meat	3,331	3,659	2,298,890	123,921	180	197
Mortadella di Bologna P.G.I.	Meat	6	-	2,298,890	123,921	0	0
Vitellone Bianco dell'Appennino Centrale P.G.I.	Meat	923	24,011	2,005,980	123,921	57	1,483
Toscano olio Evo P.G.I.	Olive oil	10,952	64,305	2,298,890	123,921	590	3,466
Pecorino delle Balze Volterrane P.D.O.	Cheese	12	262	82,308	82,308	12	262
Pecorino Toscano P.D.O.	Cheese	852	19,889	2,298,890	123,921	46	1,072
Pane Toscano P.D.O.	Bread	108	1,390	2,298,890	123,921	6	75
Cantuccini Toscani P.G.I.	Pastry	16	-	2,298,890	123,921	1	0

Figure 100 - List of GIs that overlap or contain the Valdera region and estimation of average land occupation in Valdera of GI farmers. The calculated estimation uses this equation (Total(certified area) : Total(businesses) = Valdera(certified area) : Valdera(businesses)) and (Total(certified area) : Total(productive land) = Valdera(certified area) : Valdera(productive land))

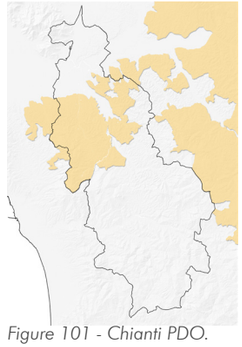


Figure 101 - Chianti PDO.

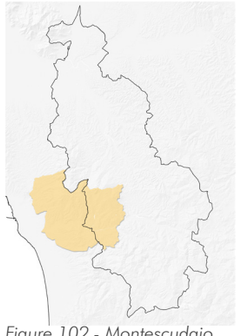


Figure 102 - Montescudaio PDO.

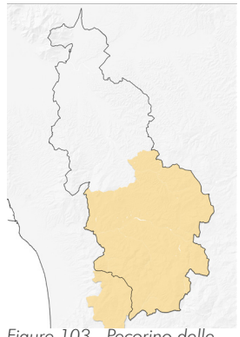


Figure 103 - Pecorino delle balze Volterrane PDO.

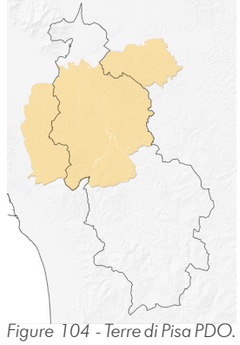


Figure 104 - Terre di Pisa PDO.

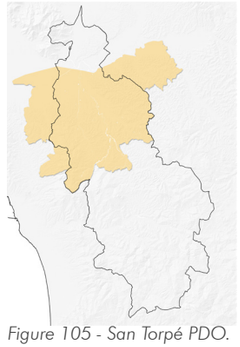


Figure 105 - San Torpé PDO.

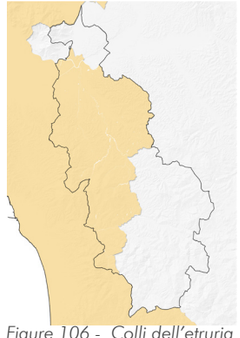


Figure 106 - Colli dell'etruria centrale PDO.

METHOD _ LAYER APPROACH

Spatial planning nowadays must handle complex issues that conventional thinking is not able to cope with anymore. Problems such as climate change, migration, economics, and social dynamics "are the so-called wicked problems. There is no single accepted formulation of these problems…" (Roggema R., 2008).

Aim: By combining different layers of the maps from the spatial investigation chapter, more complex issues, such as environmental ones, can be understood. The method provides insight into the most critical areas regarding soil erosion, soil contamination, water contamination, water use, and biodiversity loss.

IDENTIFYING CRITICALITIES

A sustainable agri-food system relies on the availability of essential natural resources and climatic conditions. Resources such as fertile soil, water and biodiversity are crucial for the existence of any system. The quantity and quality of these available resources define the possible productivity capacity of an agri-food system.

Preserving them from excessive use, pollution and dispersion might have the highest priority on the list of things to do to guarantee a sustainable system for future generations. Predictions on climate change effects (page 58) mention that this is not the general trend for agri-food systems in Europe. Current agricultural practices are oriented more towards a strategy for optimizing production and short-term solutions against shock and stresses. These practices imply using chemical products to fertilize, protect from parasites or change composition. Causing the progressive pollution and overuse of the available natural resources and accelerating their dispersion. The same happens in the Tuscan agri-food system, where the intensive use of fertile soil and the excessive dependency on underground water resources have made the system vulnerable and fragile.

Therefore, before drawing any conclusions on what measures must take place to transform the system into a sustainable one, it is essential to identify all the elements that make it unsuitable. The inefficient use and pollution of natural resources must be seen as wicked problems. Both cannot be described by considering only a single index, as the interaction of multiple factors defines them. These factors can create, with their interaction, either positive or negative effects that influence the quality and quantity of the available natural resources.

This is the reason behind the subdivision of the topic "natural resources" into five subgroups, soil erosion, soil contamination, water contamination, water use and biodiversity loss. By exploring them one by one and, in the end, recomposing them, the understanding of the critical areas will be much more productive. Still, each of the sub-groups must be considered as a wicked problem as well. Therefore, for each topic, the several factors that influence it are identified and, through the layer approach, overlayed and analyzed. This way, it will be possible to identify the most critical areas.

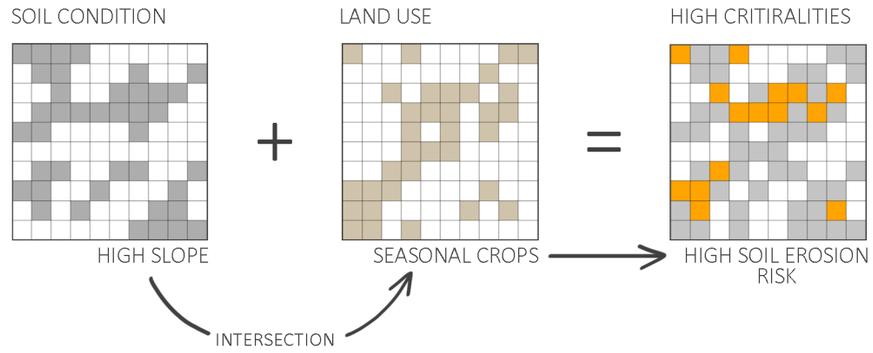


Figure 107 - The overlay between different threats defines the criticalities.

SOIL EROSION AND CONTAMINATION

The Tuscan agri-food system faces the threat of desertification (see "Predictions on climate change effects," page 64). Less regularity in rainfalls, eutrophication of soil and loss of fertile land are the leading causes behind the phenomena. Especially the loss of fertile soil is a threat to Tuscany as its hilly morphology leads it to be one of the first regions in Italy by the amount of lost fertile soil to erosion. It is clear that to mitigate the process of desertification, it is crucial to maintain good soil quality and decrease the amount of runoff and soil erosion.

Soil erosion is mainly measured through soil composition, such as the grain size or porosity and the degree of slope of the soil. The higher the grade, the higher the amount of soil loss through erosion. However, soil composition and slope are not the only factors influencing soil erosion. What happens on the surface indeed plays a crucial role too.

Different farming practices and diverse land uses increase or decrease the capacity of soil retainment and so of soil erosion. For example, permanent crops like orchards or olive groves with more profound and robust roots also have higher retainment capacity in dry seasons and decrease the erosion rate.

Two layers were overlayed to identify where in Valdera the productive land is most exposed to soil erosion risk.

These two layers include all soils in Valdera with a higher slope degree than 15% and all productive land used to grow seasonal crops. The resulting layer will show the land used to grow seasonal crops on high slopes. The resulting map shows how the problem of soil erosion focuses on the central-southern part of the valley and covers significant parts of the overall productive land in Valdera.

The second phase consists in selecting the factors that mainly cause soil contamination, another indirect cause of desertification. Excessive contamination and eutrophication of productive land will lead to progressive salinization of the soil, making it less and less fertile. So, it becomes clear that practices such as conventional farming and, in general, the ones that allow the use of chemical products for animal and plant treatments are the leading cause of soil contamination. Still, the soil composition, in this case, soil permeability, can play an important role. The higher the capacity of a soil to retain water and so with-it chemical products, the higher the risk that the soil becomes contaminated as it contains too many chemical nutrients. To understand where the most critical areas for soil contamination are displaced in the Valdera valley, the layers of highly permeable soils and traditional productive land must be overlayed. The outcoming layer indicates the most threatened areas to soil contamination.

Figure 108 - Soil erosion on seasonal crop field.

Figure 109 -Volterra, Tuscany, soil contamination, bing satellite.

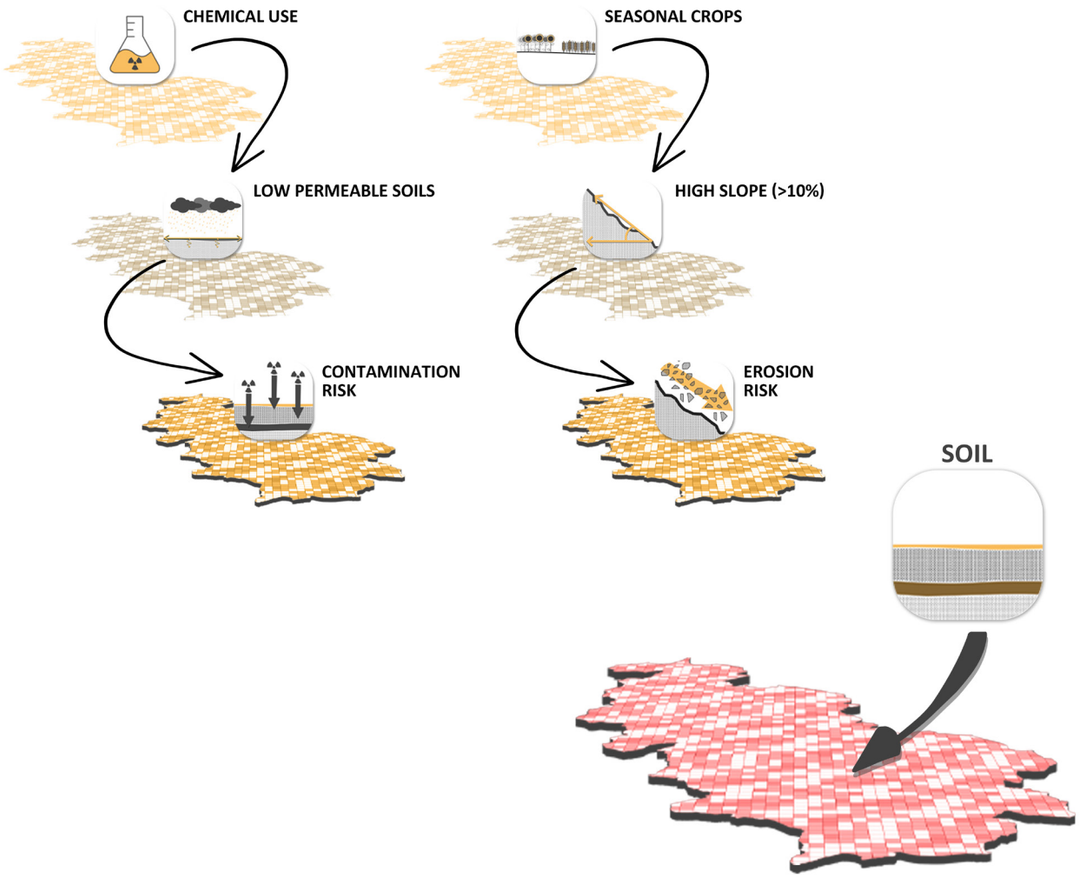
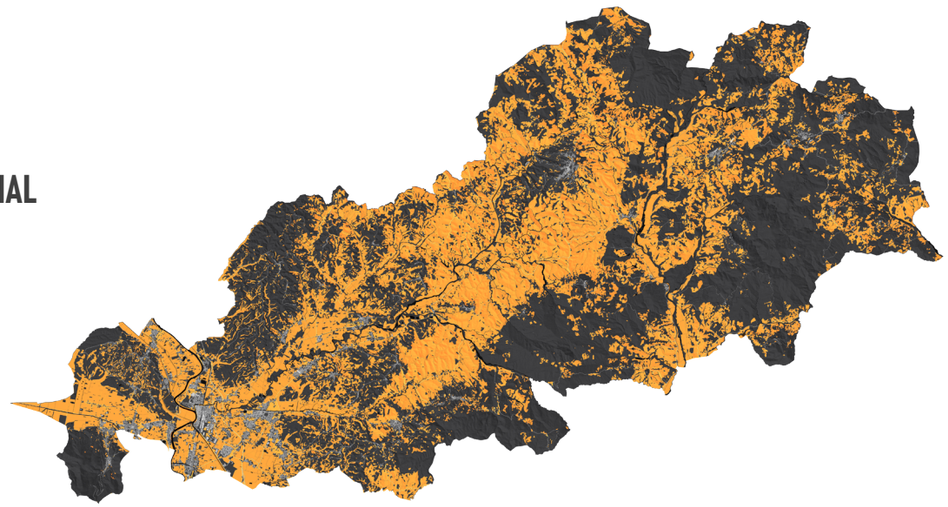


Figure 110 - Definition of soil criticalities.

SEASONAL CROPS



HIGH SLOPE (>10%)

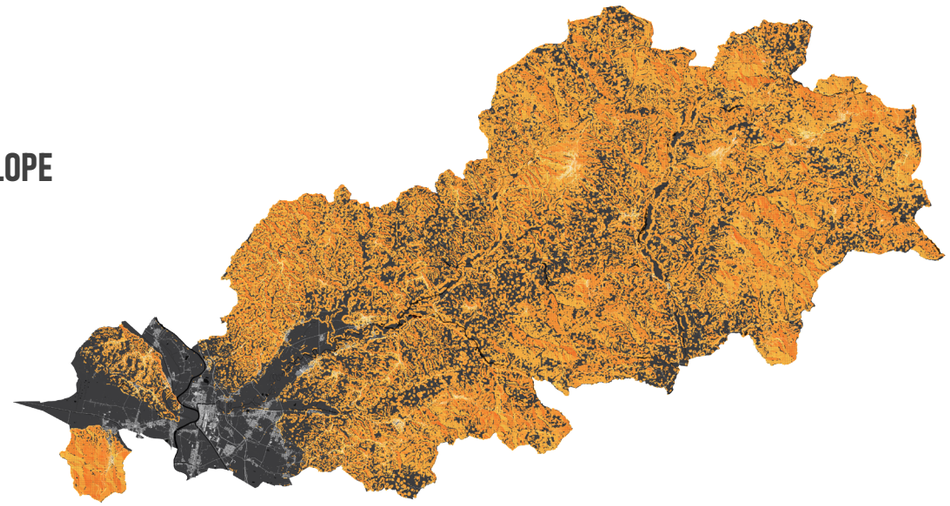


Figure 111 - Valdera, productive land for seasonal crops map.
Figure 112 - Valdera, high slope soils map.

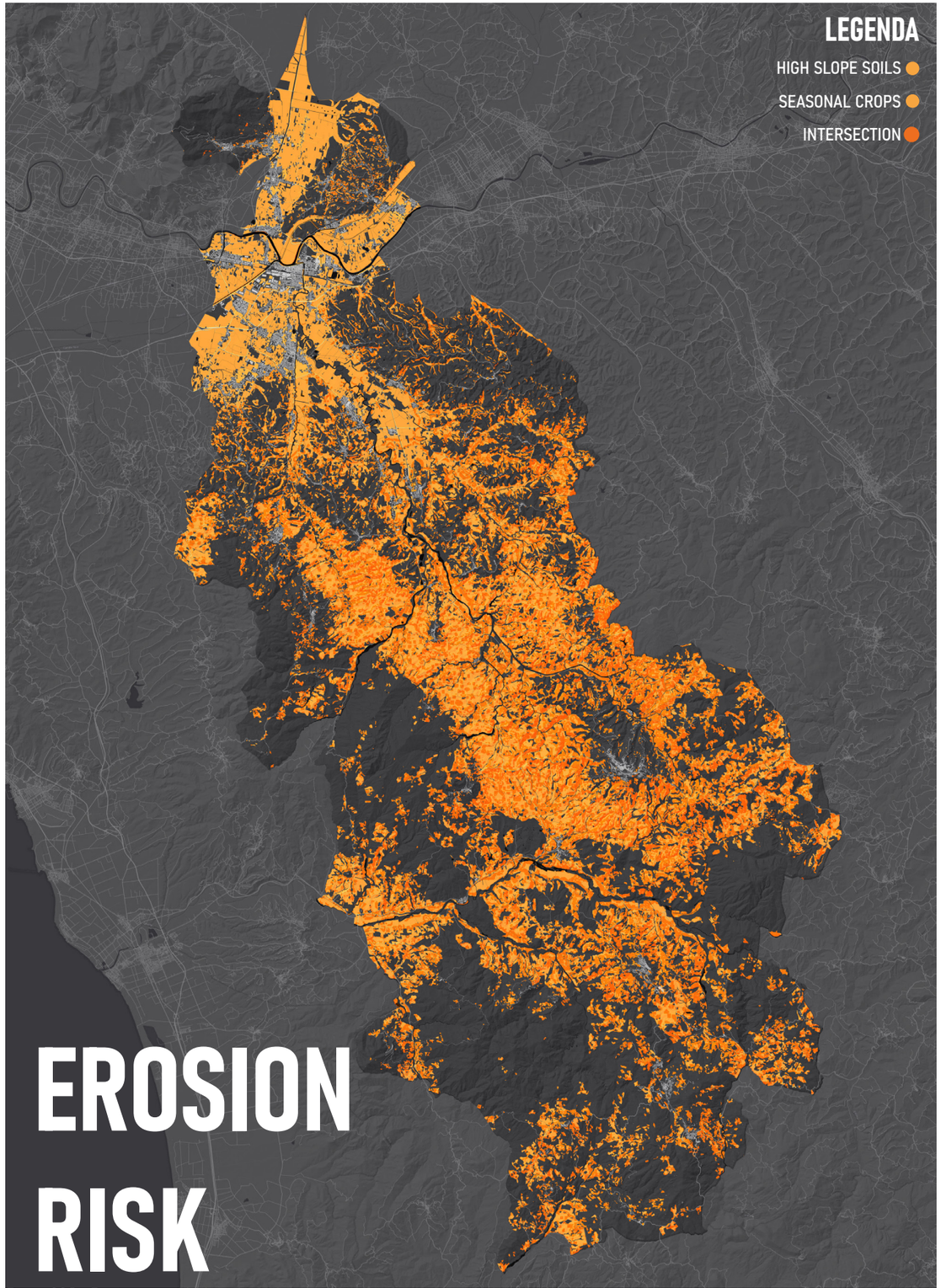
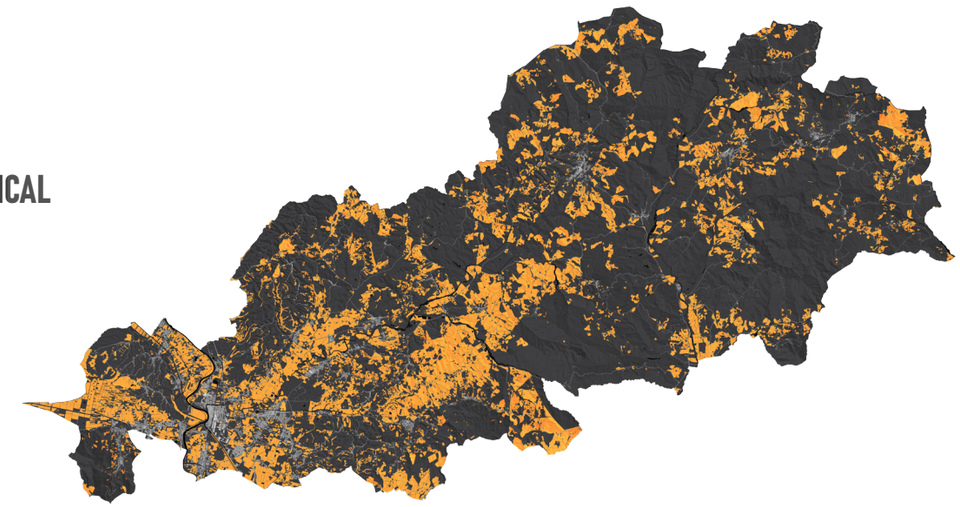


Figure 113 - Erosion map, Valdera, high slope and seasonal crops are overlayed to identify the areas with the highest erosion risk.

CHEMICAL USE



LOW PERMEABILITY

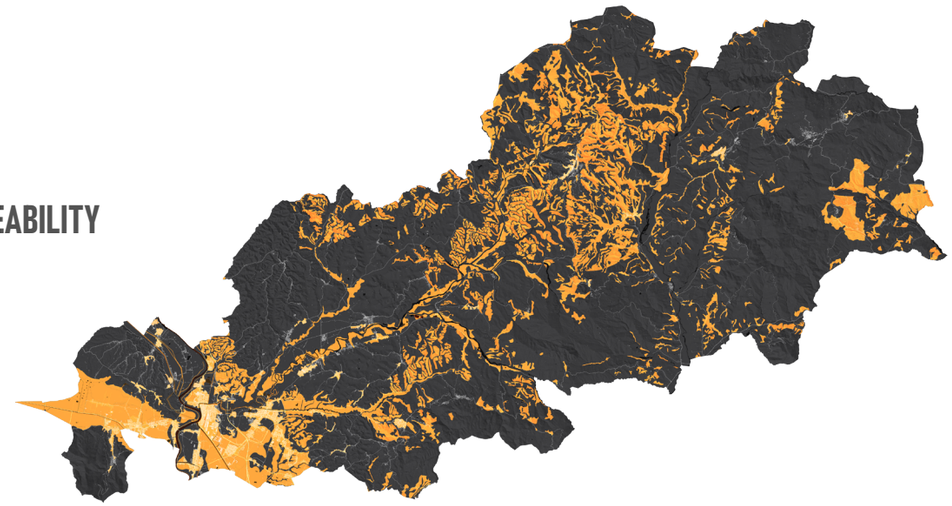


Figure 114 - Valdera, productive land under confentional farming practices map.
Figure 115 - Valdera, low permeable soils map.

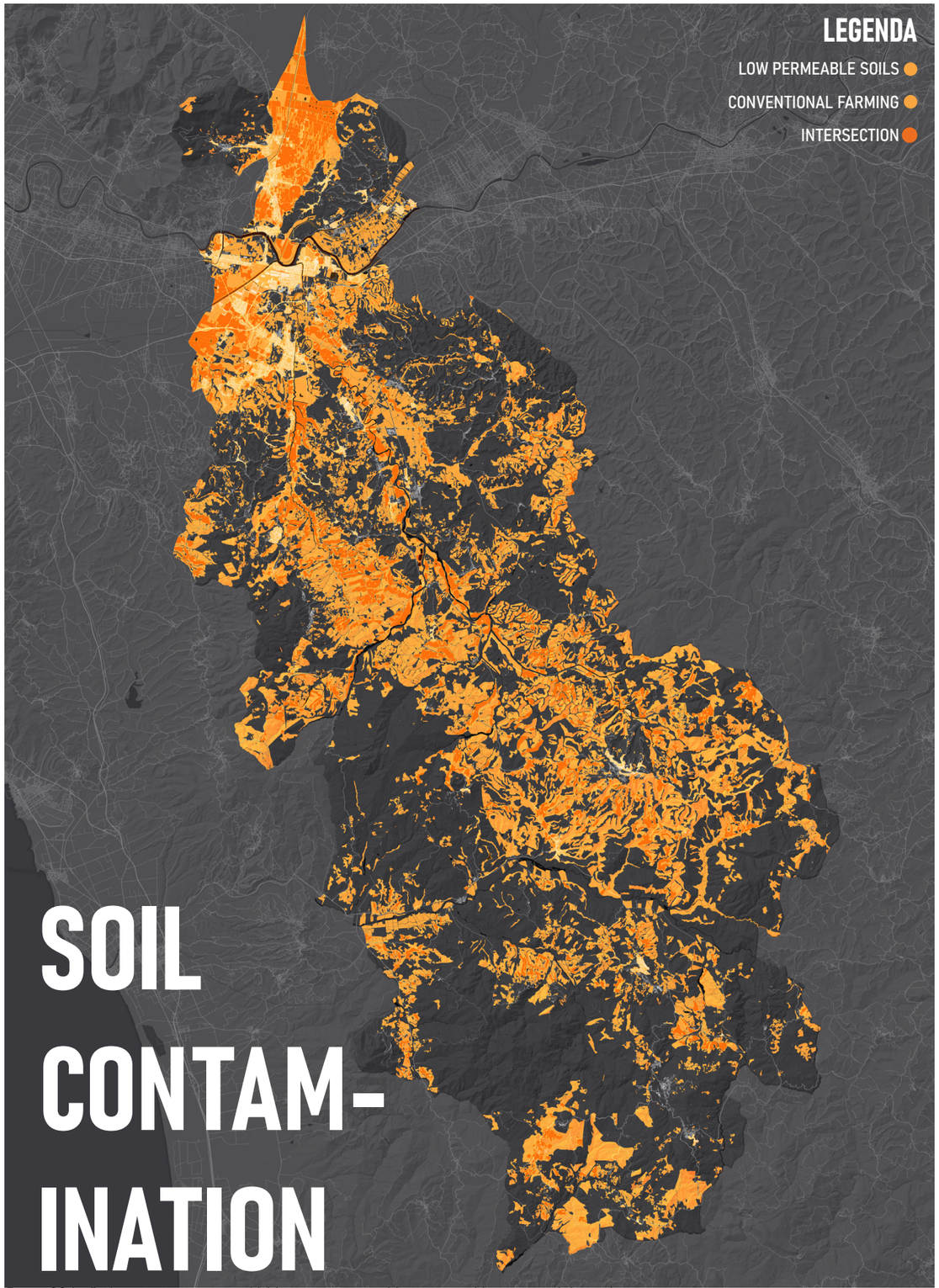


Figure 116 - Soil contamination map, Valdera, conventional farming, and low permeability soils are overlayed to identify the areas with the highest contamination risk.

WATER CONTAMINATION AND USE

As mentioned in the chapter "Potential risks for the agri-food sector" (page 64), the water resources available in Tuscany are affected by two different threats. First, the current condition of underground water bodies is below average. Most of them present themselves as already contaminated. Only a few, more profound water resources that are more difficult to access, have preserved good water quality. This is a very urgent problem as more than 65% of agriculture and private users rely upon water supply from underground resources. The predictions on future climate change bring this problem even more to the foreground. These predict drastic changes in the rainfall frequency and amount of rainfall each year (see map pages 62-63). Meaning that it will rain less and more concentrated over short periods, making it difficult for the soil to store water and refill the underground resources. Fewer rainfalls will also increase the need for available groundwater resources, especially in the dry seasons. It is clear that to guarantee sufficient water capacity and quality for the future, problems such as excessive underground water contamination and inefficient use of water resources must be solved.

In terms of water contamination, three elements play a crucial role in defining the most critical areas. The risk of contaminating open water bodies and underground water resources is at its highest degree if these three layer overlap. The first indicator to consider for this layered approach is the elevated risk of hydrogeologic threat. This layer presents itself as a severe threat for open water bodies and surface water. The second indicator to include

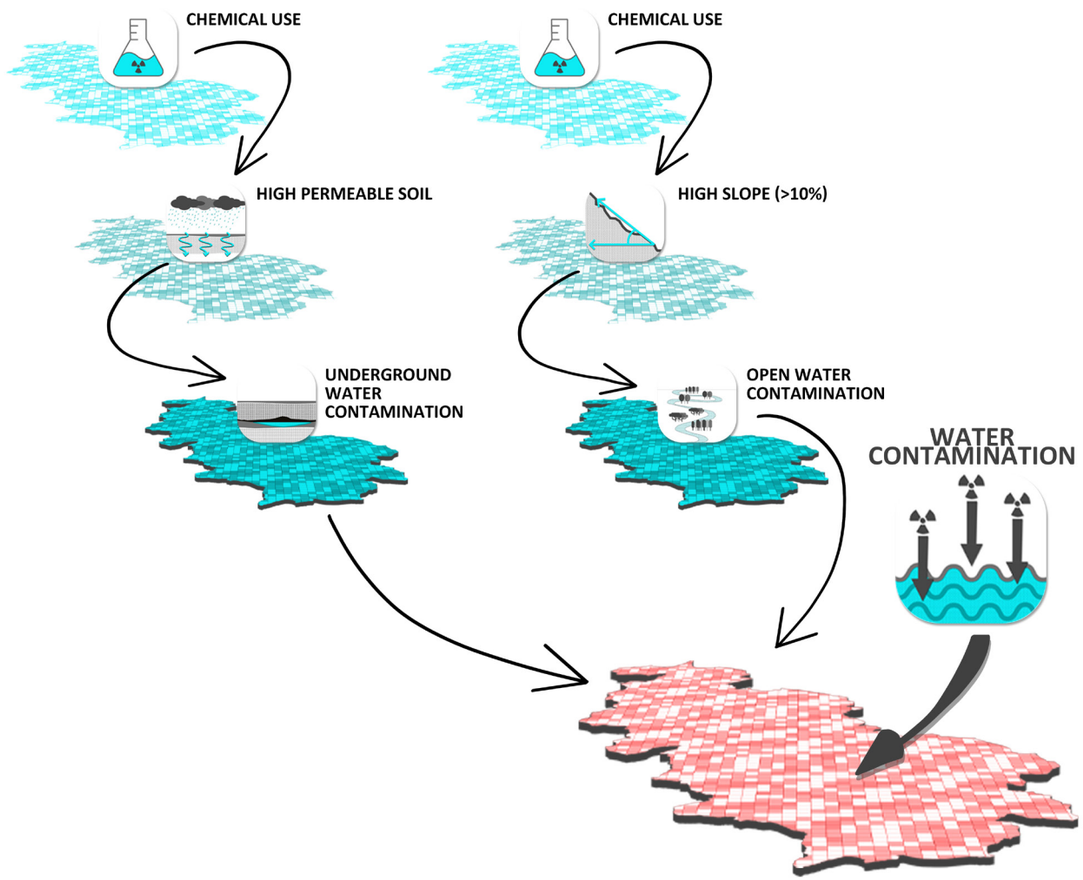


Figure 117 - Definition of water criticalities for contamination threats.

are soils with moderate-high or high permeability. They represent a more severe threat to underground waters. The last parameter to include is the productive land, as for soil contamination, where the use of chemical products is not regulated by law. The resulting map shows an expected outcome where the most endangered areas are the ones next to open water bodies, such as rivers or ponds. Nevertheless, also, the zones in the valley and around it where the soil is mainly sandy or clayish present as solid components of the critical area for water contamination.

To identify critical areas in terms of inefficient water use, the overlay of two different factors is required. As for water contamination, the area covered by highly permeable soil plays a crucial role as it is the soil that, if used for agricultural practices, requires more frequent watering and is less capable of retaining the water. In addition to soil permeability, what makes the use of water resources even more inefficient is the typology of crops grown on highly permeable soils.

Different crops have different water demands. If a high demandant crop is cultivated upon highly permeable soil, this will increase the amount of used water for irrigation of that productive field even more. The combination of these indicators identifies the layer for the most critical areas exposed to inefficient water use. In the resulting map, the distribution of these areas concentrates on the northern-central part of the valley.

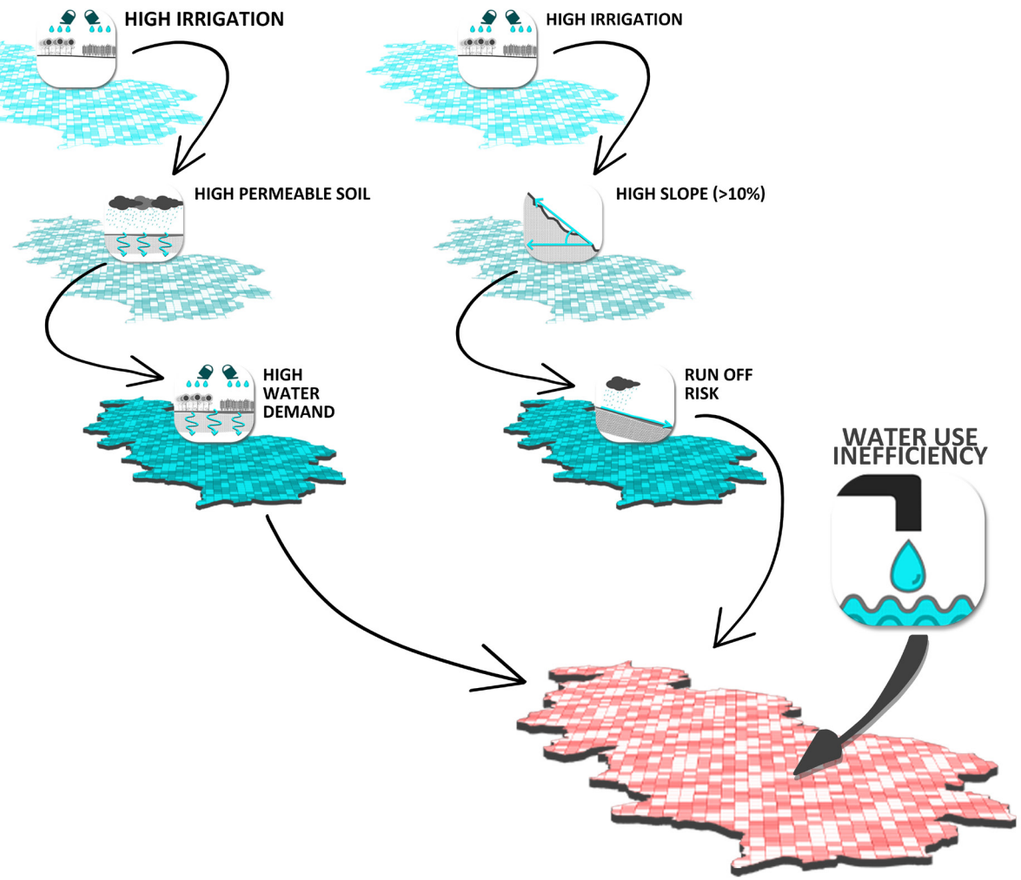
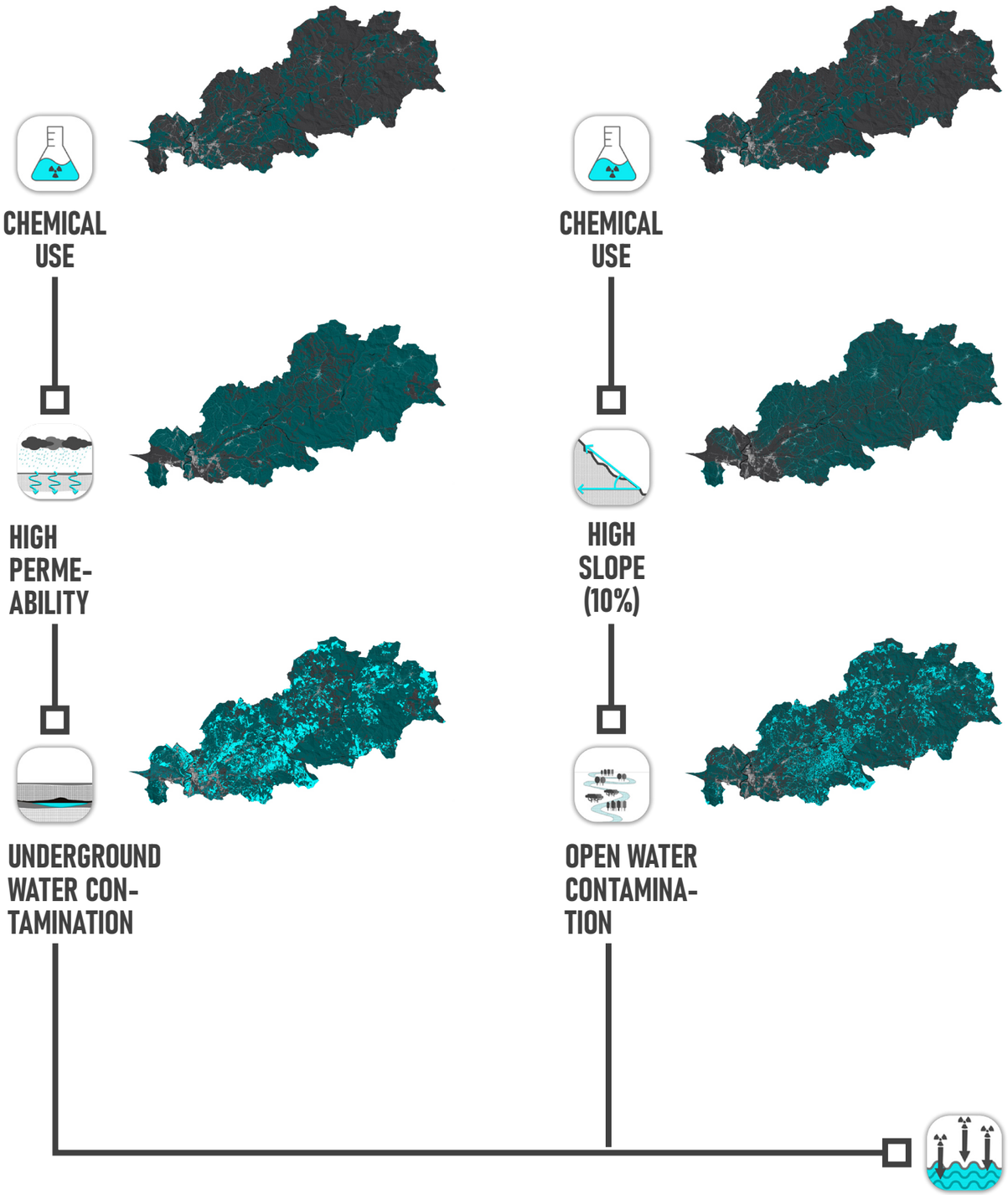


Figure 118 - Definition of water criticalities in use inefficiency.



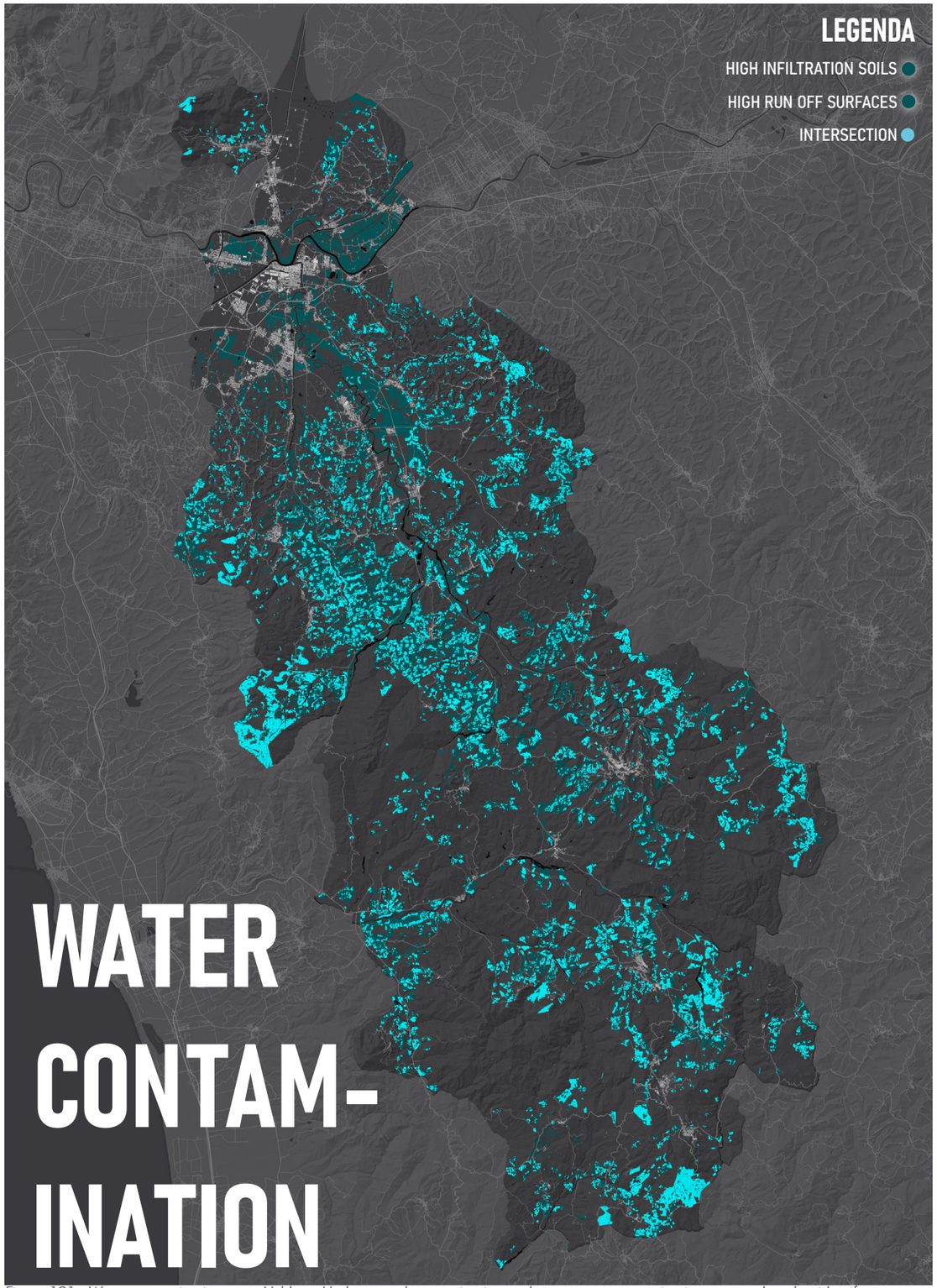
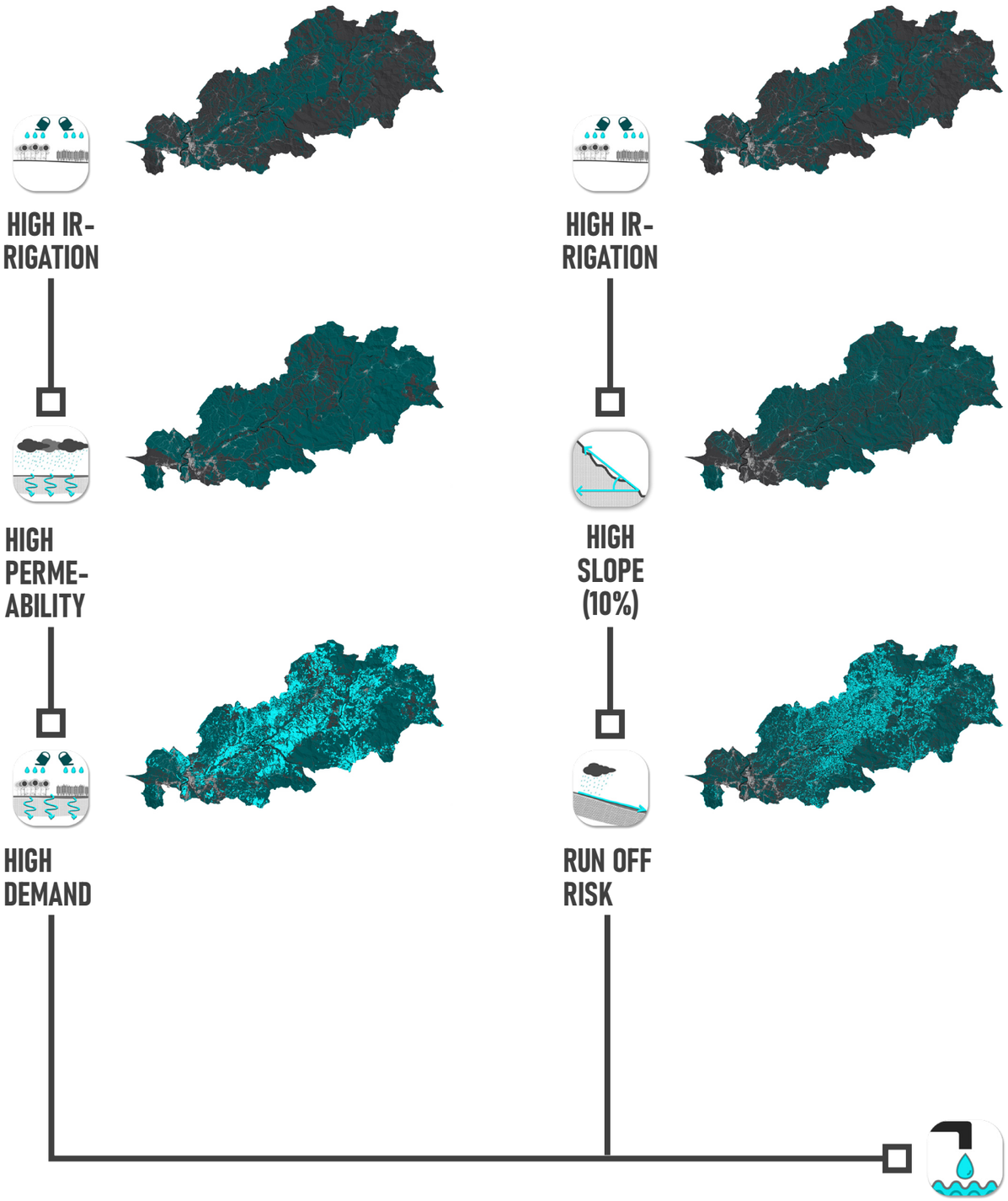


Figure 119 - Conventional farming is overlayed with highly permeable soils. The resulting map indicates high infiltration risk.
Figure 120 -Conventional farming is overlayed with soils with a high slope. The resulting map indicates a high run-off risk.

Figure 121 - Water contamination map, Valdera, Underground contamination and open water contamiantion are overlayed to identify the areas with the highest contamination risk.



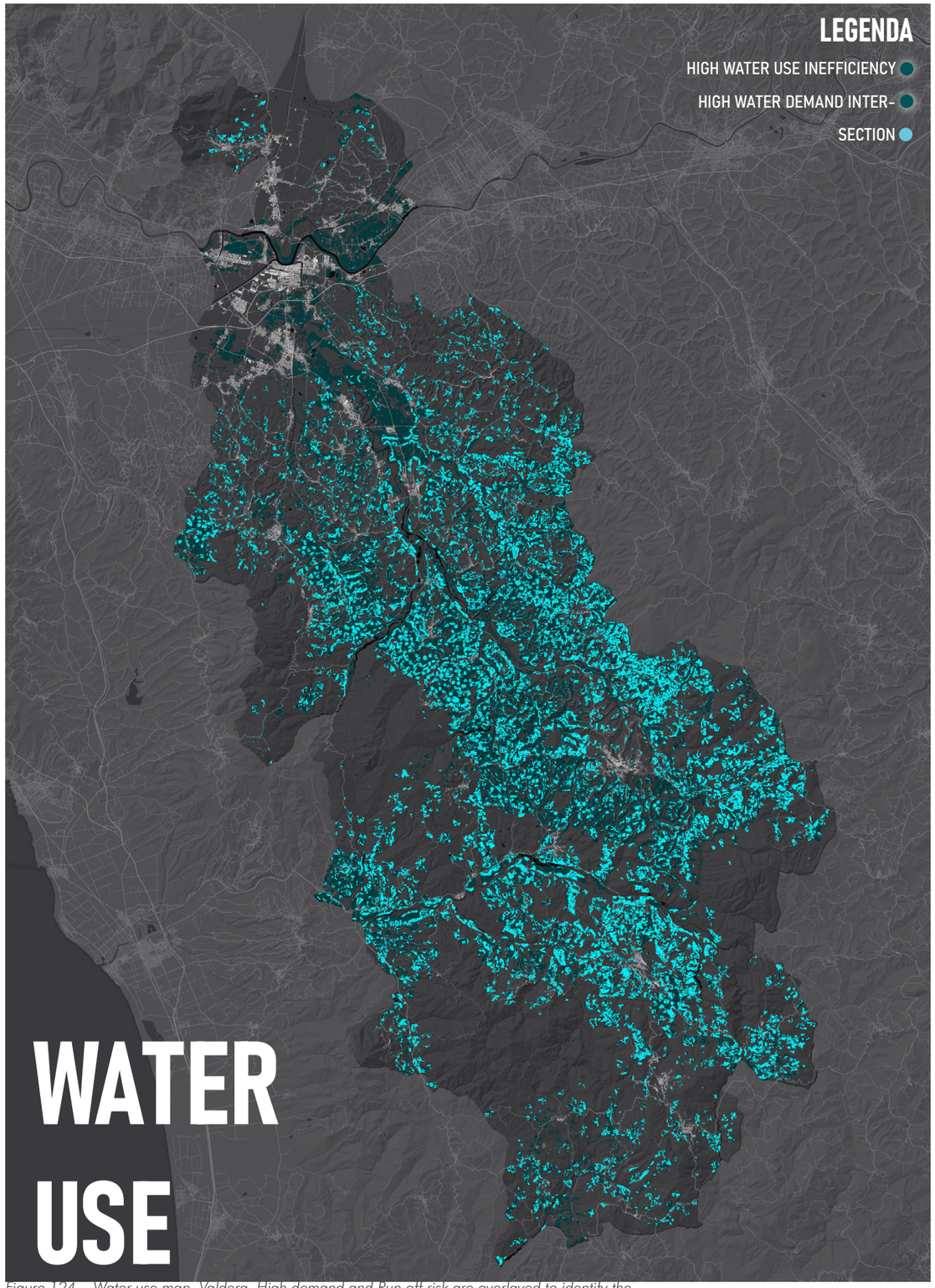


Figure 122 - High irrigation crops are overlayed with highly permeable soils. The resulting map indicates soils with high water demand.
Figure 123 - High irrigation crops are overlayed with soils with a high slope. The resulting map indicates a high run-off risk.

Figure 124 - Water use map, Valdera, High demand and Run off risk are overlayed to identify the areas with the highest inefficiency rate for water use.

RISK OF BIODIVERSITY LOSS

"The FAO (2019) states that of the approximately 6,000 plant species that can be grown for food, only a handful (~9) of crops determine 66% of our diet. These homogeneous crops occupy more than 90% of the global agricultural area. That is a vulnerable base of the food system, especially considering the growing threat of pests and climate change. It is therefore essential to broaden that basis with more species, genetically more diverse and resilient species, and more variety between species in fields and grasslands. Strip cultivation and gene banks are examples of ways to safeguard and increase biodiversity" (FAO, 2022, Framework for Action on Biodiversity for Food and Agriculture. FAO Commission on Genetic Resources for Food and Agriculture, Rome).

Biodiversity plays a crucial role in preserving and supporting the productivity and capacity of an agri-food system. In the case of biodiversity loss, it is essential to look at two sides of the issue. First, the diversification of cultivated crops and second, the quantity of land use dedicated to the development of natural spaces and reservoirs and their quality defined by the number of interconnectors or green corridors.

To spatially evaluate the situation in Valdera and to localise the most critical areas for potential biodiversity loss, four layers must be considered. The first two indicate the actual surface occupied by natural reservoirs, including open fields, forests and green corridors that connect them. The third and fourth layers indicate the criticalities. By overlaying land units bigger than twenty hectares with agri-businesses that exceed two hundred hectares, it is possible to identify clusters of monocultures. These harm biodiversity as they work as an interruption in the communication between biotopes. The resulting map shows that the most threatened area in terms of biodiversity loss remains the southwestern part. It matches with the area dedicated to the growth of seasonal crops that require more land than permanent cultures and are more likely to create monocultural situations.

Figure 125 - Bolgheri, Tuscany, example of monocultures, bing satellite.

Another conclusion that can be drawn from observing the biodiversity loss map is that, even if natural spaces cover 43% of the total area of Valdera, these maintain a marginal position covering the higher hilly regions.

In the valley, little room is left for natural, spontaneous development weakening the communication between the different green areas in the absence of a well-developed network of green corridors.

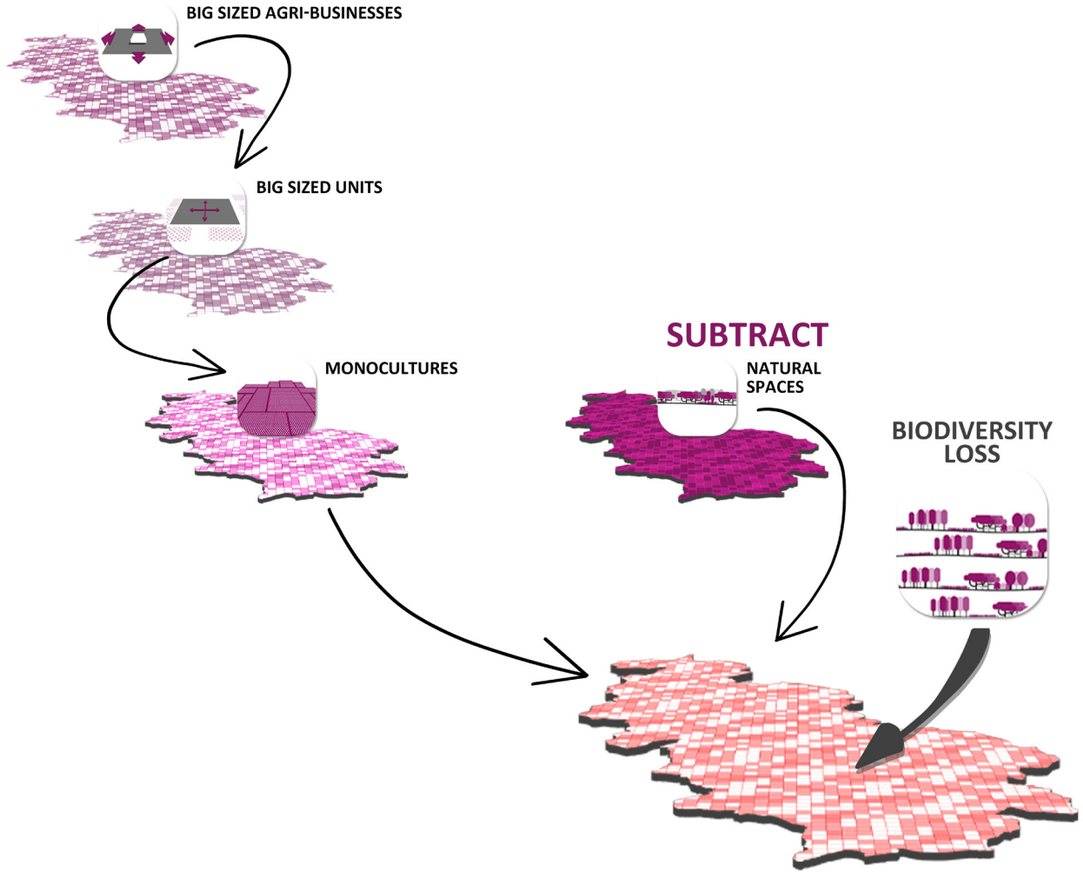


Figure 126 - Definition of criticalities for biodiversity loss.

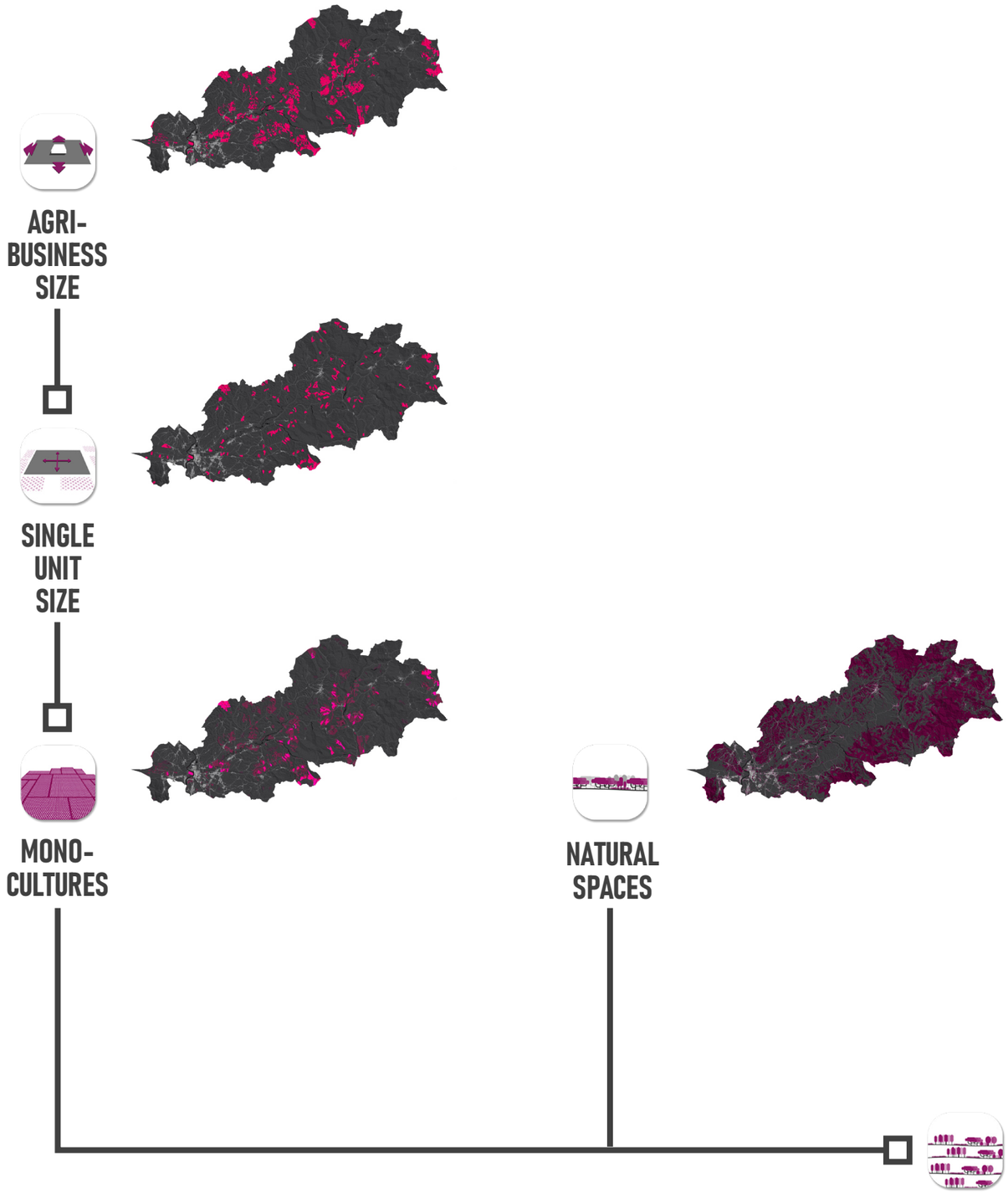


Figure 127 - Big sized agribusiness are overlayed with big sized land units to define monocultural and intensive farming clusters.
Figure 128 - Natural spaces map, Valdera..

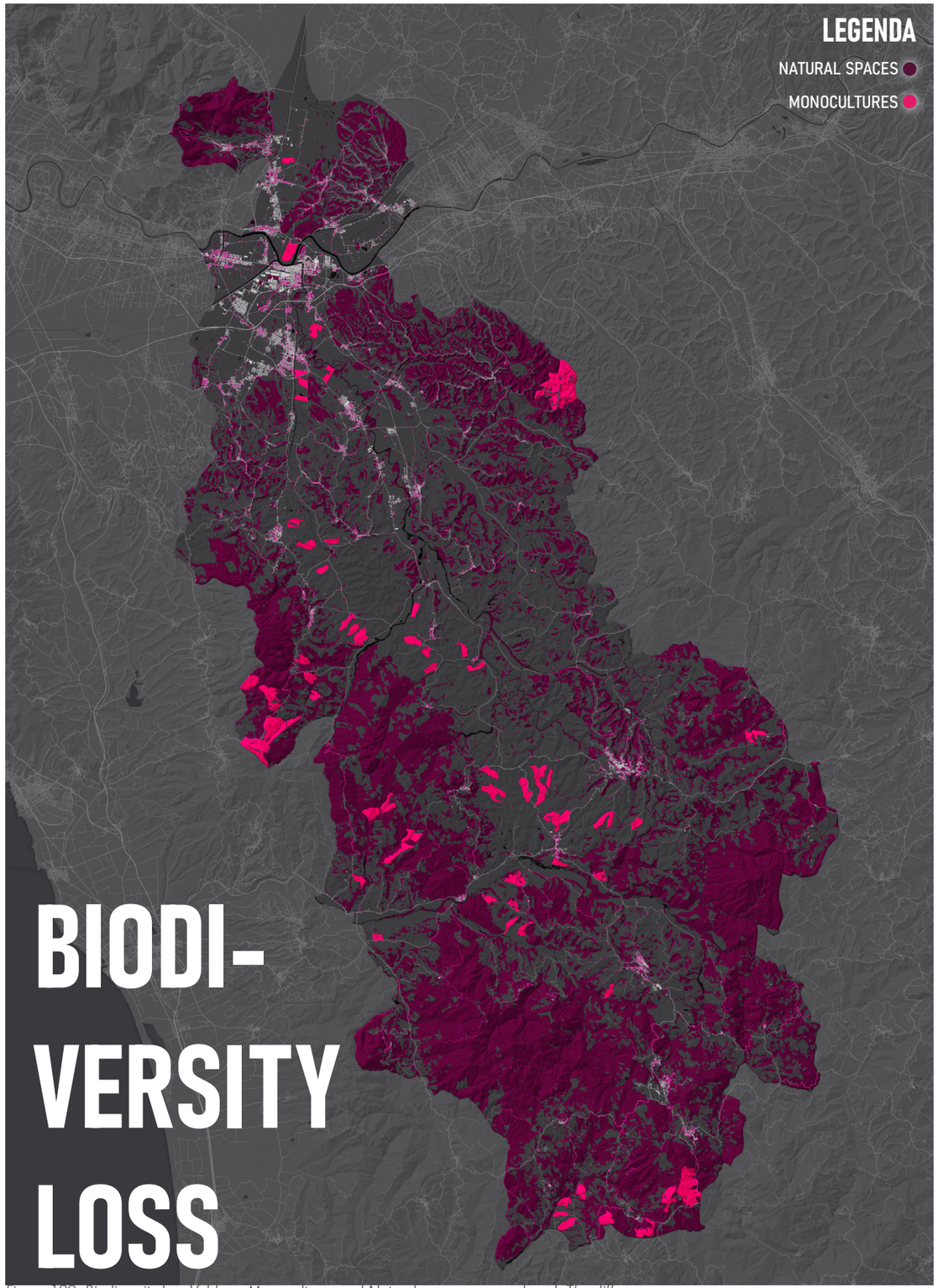


Figure 129 -Biodiversity loss Valdera, Monocultures and Natural spaces are overlayed. The difference does define the areas with the highest risk for biodiversity loss.

— A CERTIFIED FUTURE

PROBLEM MAP

— INVESTIGATING UPON SPATIAL CHALLENGES

LEGENDA

SOIL EROSION

WATER USE INEFFICIENCY

SOIL CONTAMINATION

WATER CONTAMINATION

BIODIVERSITY LOSS

Figure 130 -Problem map, Valdera, all five criticalities merged in one map.

LIST OF SPATIAL PRINCIPLES

The investigation made upon the data collected through the methods of statistical analysis and spatial investigation allowed the layer approach method to produce essential material for the project's success.

By combining different factors that influence the same issue, the study can now distinguish spatially where the most critical areas in the Valdera region are. In the problem map, this becomes even clearer as the different criticalities are once more overlayed. In addition to the spatial output that helps the study to define specific patterns of the critical aspects that threaten the environmental sustainability of the agri-food system, the layer approach method also allows the translation into numbers of these threats. The use of QGIS to calculate the intersection areas between the different conditions that define a risk area allows the simple conversion of these into numbers.

Having in place the numbers of each spatial criticality simplifies their comparison furthermore. The numbers show that, as for the general Tuscan trend, water and soil preservation remain the most urgent topics.

Especially soil contamination and water contamination prevention should be at the top of the list of goals if the aim is to achieve a sustainable agri-food system.

Once these observations were made, the research focused on developing the list of spatial principles. These principles define the goals the future framework needs to achieve to achieve the system's sustainability. Each of the criticalities is formed by the intersection of at least two layers, one of which is a morphological condition (high or low slope, high or low permeability) and the other relates to the actual use of the land (conventional or bio, seasonal crops or high irrigation crops). This means that if the research aims to decrease the amount of risk area in Valdera, it must interfere with the second layer, which defines land use.

For example, suppose the research aims to decrease soil erosion in the area and the high-risk areas for soil erosion are characterised by seasonal crop production on high slope areas. In that case, the needed intervention is a decreased number of seasonal crops on high-slope surfaces.

Topic		Area (he)	Percentage (%)
	Tot. area	134,476.00	100
	Natural spaces	56,892.50	-
	Natural spaces on tot. area	56,892.50	42.31
	Slope above 10%	131,103.00	100
	Seasonal crops	52,837.90	-
	Seasonal crops on high slope	25,779.10	19.66
	Low permeability soil	28,245.30	100
	Conventional farming	34,005.00	-
	Conventional farming on low permeability	14,951.30	52.93
	High permerability soils	106,222.00	100
	Conventional farming	34,005.00	-
	Conventional farming on high permeability	37,866.60	35.67
	Slope above 10%	131,103.00	100
	Conventional farming	34,005.00	-
	Conventional farming on high slope	15,939.80	12.16
	High permerability soils	106,222.00	100
	High irrigation crops	52,471.00	-
	High irrigation on high permeability	58,166.60	54.75
	Slope above 10%	131,103.00	100
	High irrigation crops	52,471.00	-
	High irrigation crops on high slope	15,939.80	19.79
	Big size businesses	43,173.20	100
	Big size units (>20 he)	12,432.10	-
	Big size units oned by big businesses	3,311.98	7.67

Figure 131 - Translating the spatial criticalities into numbers.

Spatial Principles

1 - - Decrease the amount of seasonal crops on high slope areas by minimum 50%

2 - - Decrease the amount of chemical use on low permeable areas by minimum 50%

3 - - Decrease the amount of chemical use on high permeable areas by minimum 50%

- Decrease the amount of chemical use on high slope areas by minimum 25%

4 - - Decrease the amount of high irrigation crops on high permeable soils by 50%

- Decrease the amount of high irrigation crops on high slope areas by minimum 25%

5 - - Increase the covered surface for natural spaces to 50% or higher

- Decrease the area for monocultural treaths to 5% or less

Figure 132 - Spatial principles, goals for the research and minimum requirements for the framework.

— ANALYSING THE POTENTIAL OF EXISTING POLICIES

CERTIFICATIONS

Tuscany is Europe's region with the highest concentration of certified geographical indications. It counts up to eighty-nine certifications. The high number of GIs in the Tuscan territory indicates a vast number of agricultural products that either have typical characteristics or/and use a geographic name. A well-known example could be the Chianti wine, where Chianti refers to the agricultural area between Florence, Arezzo, and Siena. The fact that Tuscany presents a high number of GIs in its territory does not relate to the influence the geographical indications play on the effective GDP of the agri-food sector.

Today Tuscany is the fifth region of Italy by economic impact in the agri-food sector and the first region in Italy by the number of Protected Denominations. This result is a strong indicator that the Tuscan agri-food sector relies more on quality than not on the quantity of products.

The acronym does not say that, in some cases, the certificates can become genuine examples of controlled and sustainable practices. "There is evidence that engaging GI producers in a sustainability strategy can maximise their contribution to different components of sustainable development" (Belletti G. et al., 2017). When it comes to products labelled as DOP, DOC and DOCG, the logo applied on the product certifies that every step in the process it was involved in has happened inside the borders of the, by law, specified area following precise rules.

This is the case, for example, of the Chianti Classico area, where the GI successfully protected the label and encouraged collaboration between agri-businesses. It resulted, over the years, in a strong and cohesive agri-food system where both farmers and consumers are aware of and concerned with sustainability issues. In these cases, where a strong GI influences the local agri-food system, farmers start to adopt multiple certifications to increase the market value further. Producers certified as GI often also commit to the organic certification or apply for the CAP (Common agricultural policy). These three certificates commit in some way to more sustainable practices compared to conventional ones. The more farmers apply to them, the more the system gains environmental stability.

The main reason behind it is that every certification has its policy. These policies define the parameters that farmers must respect if they wish to be eligible for the use of the certification. This happens for all certifications, but with some differences. In geographical indications, every food product has its policy defining the parameters. This is not the case for organic food products and the CAP, as they follow the same discipline. Another difference might occur in scale action that can change from European to regional and local.

Since an agri-business can apply for multiple certifications, giving credit to one policy for direct or indirect beneficial outcomes on the system becomes challenging. It may occur that more than just one policy has positively influenced environmental sustainability. To establish how much the single policies behind the certificates influence sustainable agricultural practices, an extensive analysis of the existing policies has to be led. Included in the analysis are the policies that concern the three mentioned certificates (GI, Organic, CAP) and all the general laws that regulate agriculture and target all agri-business. Only in this way it is possible to understand the real value given by the certification to environmental sustainability.

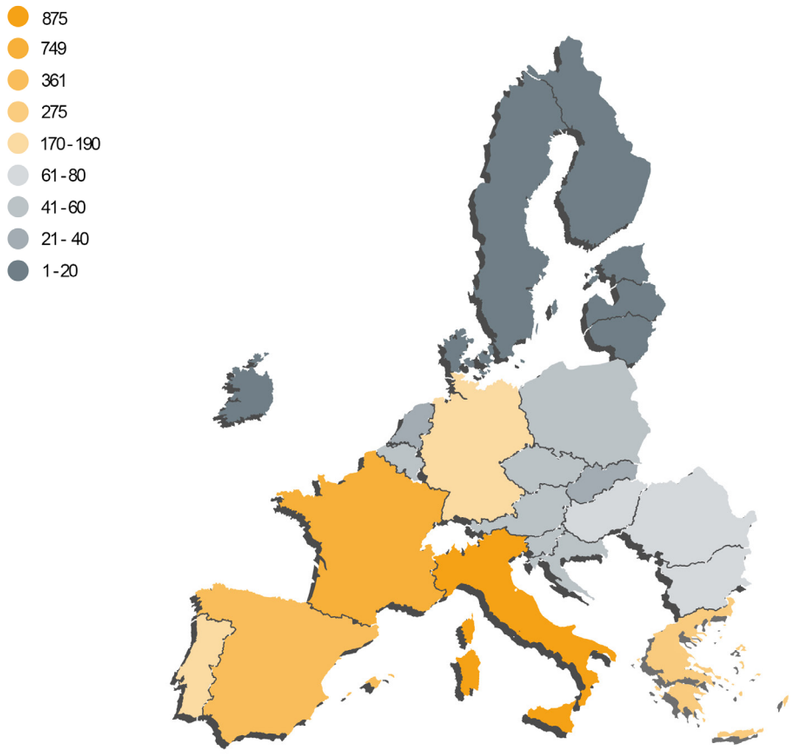


Figure 133 - European concentration of PDO and PGIs.

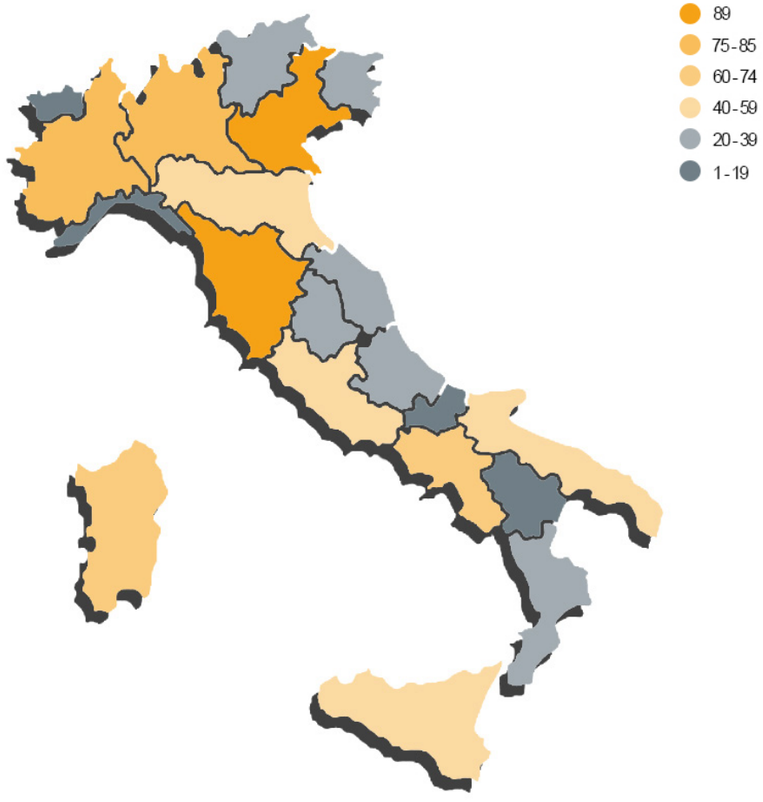


Figure 134 -National distribution of PDOs and PGIs.

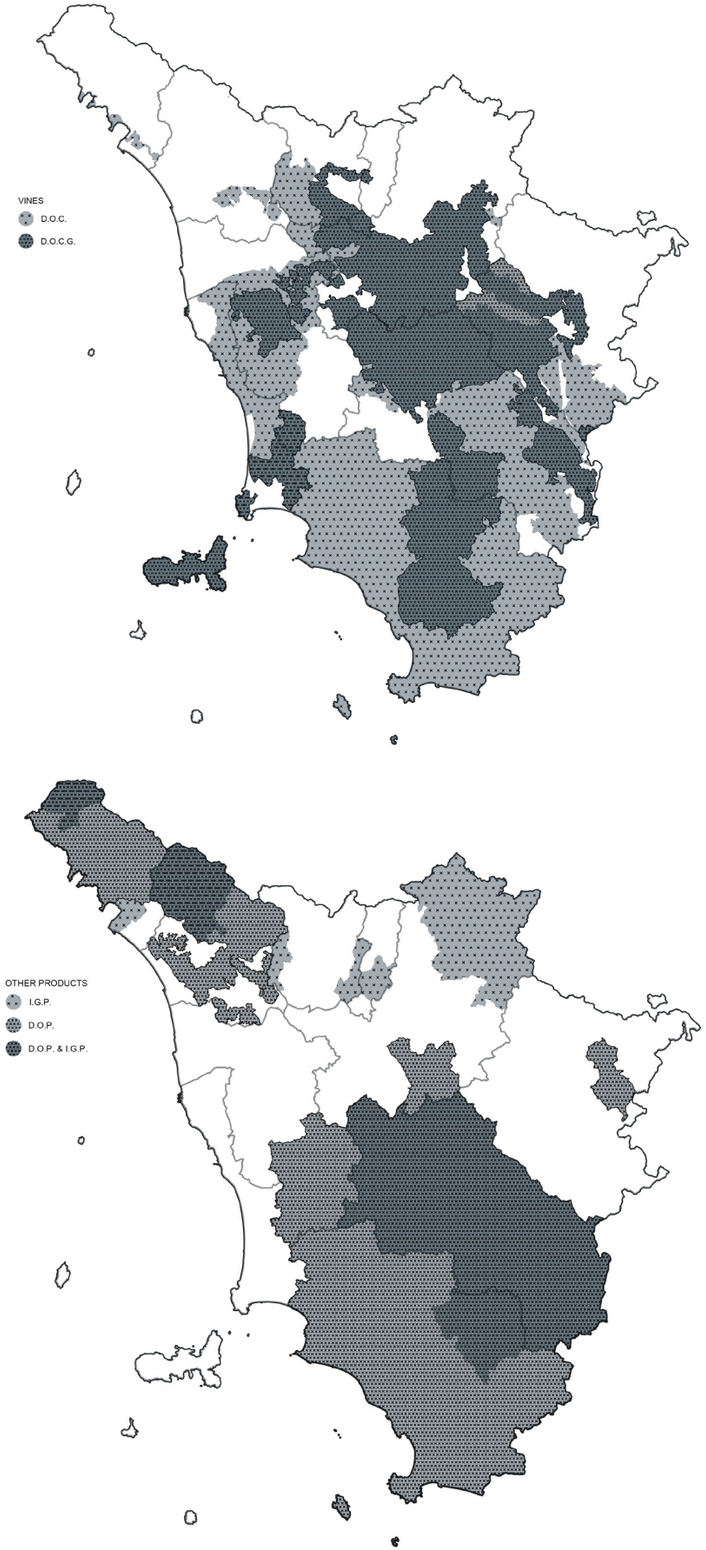


Figure 135 -Regional distribution of vine PDOs and PGIs.
Figure 136 -Regional distribution of other PDOs and PGIs.

METHOD POLICY ANALYSIS

The method of policy analysis consists of a deeper understanding of how regulation around the topic is structured. In order to depict the complete picture, the analysed policies should cover both different scales (European, national, and regional) and other topics. The analysis is conducted on all existing policies that regulate in some way agricultural practices and have an influence on the sustainability of the system.

Aim: The aim of the method is to define if the policies affect negatively or positively one or more of the sustainability targets and why. The bullet points of each policy that influence the spatial criticalities are then selected for further investigation

POLICIES FOR SUSTAINABLE AGRICULTURAL PRACTICES

With "policies for sustainable agricultural practice" are meant all policies that engage in the protection and diffusion of traditional or organic farming practices.

Under this category fall both mandatory and non-mandatory policies. The first one must be followed by all actors involved in the agri-food system. In contrast, the second group is followed exclusively by farmers that apply willingly. The non-mandatory ones divide into certifications and financial programs.

For the following analysis, the research considered all policies for sustainable agricultural practices that agri-business in Tuscany have or can assess. These policies can be mainly categorized by the scale of interaction, starting from the European one and concluding with the regional or local one. The scale often also defines the detail of the policy. It happens that national policies are just subordinated policies that follow the primary guidelines of the policy established by the European commission. The smaller-scale policy, in this case, limits itself to adding some specifications regarding the provided measures.

The same happens with regional policies that approve the national implications. For this reason, the policy analysis must follow a top-down approach starting from the European policies, continuing with the national ones, and concluding with regional or site-specific legislation to select all possible variables.

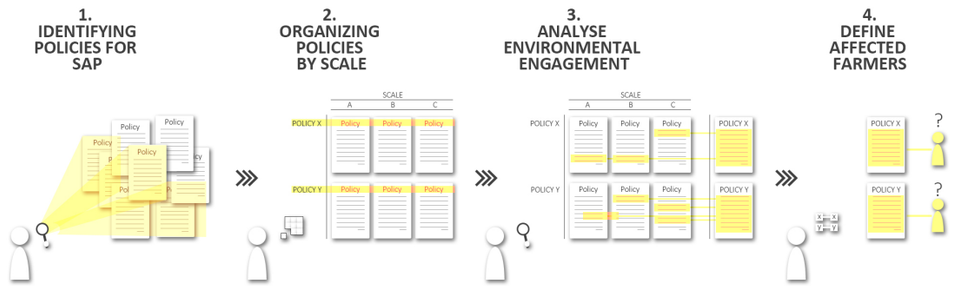


Figure 137 - Example of advertisement strategies for product branding.
*Figure 138 - Different steps in policy analysis. (*SAP - Sustainable Agricultural Practices).*

A policy for sustainable agricultural practices must contain specific characteristics. Five main aspects are considered the most important in this case.

Financial support: the policy must provide sufficient financial support to applying agri-businesses. The accessibility of financial aid in the form of loans or direct support is crucial to outbalance the investments needed to assess the policies' standards.
Branding strategies: Together with financial support, protection and planning of marketing actions for the brand or product must be sufficiently represented by the policy to guarantee economic sustainability for involved actors.
Inclusiveness and accessibility: The policy should be as transparent and accessible as possible to favour major inclusiveness. Inclusiveness does not limit to equal possibilities when it comes to the registration of a certificate but also a fair-minded and well-structured distribution of power in decision making. More importantly, it should stand for equal possibilities for all agri-businesses of different sizes or natures to participate in the whole process described by the policy. Participation has proven to be very important for the efficiency of non-mandatory tools, such as certifications.

Environmental engagement: To support the environmental stability of the agri-food systems, the policies must engage the transition of farmers to sustainable practices. The engagement for sustainability is often declared upfront in the policy's aim and objectives, but it can also be caused by indirect effects, as is the case for GIs. The policy analysis concentrates on selecting the rules stated in the formal text of the different policies that indicate an engagement of the policy towards sustainable agricultural practices.
Institutional role: The last point remains the most important one. The involved institutions and the precise definition of their role in governance can positively or negatively influence the efficiency of the other parts of the policy (financial support, branding, inclusiveness, and engagement for sustainability). The scale of interaction of the involved institution plays a massive role in affecting the procedure's efficiency. For example, the common agricultural policy (CAP) is managed on the European scale and struggles to produce positive effects on the local scale. Controversially, GIs are regulated by specific consortiums that often do not exceed provincial or regional borders. This has been shown to produce little influence on a larger scale, with a few exceptions for GIs with a high participation rate.

Together with the scale, the number of involved institutions and their tasks in governance can play a fundamental role in improving the performance of a policy. However, both participation and function in the management of members must be treated carefully. Not always a high number of diverse participants brings benefits as it might be the cause of more increased conflicts of interest that slow down and decrease the field of action for the policies.

All five aspects of the analysed policies are considered in this research chapter.
In the first part, through policy analysis, the aim is to understand to what extent the different policies engage in environmental sustainability. Understanding which of these rules might influence spatial trends is crucial. The information is successively used to test the policies in the maximisation process.

INDICATORS FOR POLICY EFFICIENCY

ENGAGEMENT FOR SUSTAINABILITY -
The policy provides clear indication on sustainable farming practices

INCLUSIVENESS AND ACCESSIBILITY -
Affordable application costs, trasparent governance and strategies for partecipation.

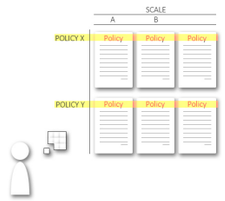
FINANCIAL SUPPORT -
The policy provides finanical aids to farmers in form of loans and direct payments.

PRODUCT BRANDING -
The policy should inglude a strategy for marketing actions to promote the brand.

INSTITUTIONAL ROLE -
The policy should clearly define the involved institutions and their role in governance.

Figure 139 - Indicators for an efficienty policy.

STEP 2. ORGANISING POLICIES BY SCALE.



POLICIES FOR SUSTAINABLE AGRICULTURAL PRACTICES

MANDATORY POLICIES

USE OF FERTILISERS
Policies concerning the specific indications of what chemical fertilisers are allowed and where. These guidelines are mandatory for all agricultural businesses of the defined scale.

USE OF PESTICIDES
Policies concerning the specific indications of what chemical fertilisers are allowed and where. These guidelines are mandatory for all agricultural businesses of the defined scale.

NON-MANDATORY POLICIES

CERTIFICATIONS

ORGANIC (BIO)
Policie concerning the specific indications of what organic farming practices are. These practices have to be followed only registered members.

GEOGRAPHICAL INDICATIONS (GI)
Policies concerning the specific indications of what Geographical indications are and how they function. The included practices have to be followed only registered members.

FINANCIAL AIDS

COMMON AGRICULTURAL POLICY
Policies concerning the specific indications of Sustainable agricultural practices involved in the CAP. The included practices have to be followed only registered members.

EUROPEAN SCALE

FERTILISERS - FERT.RE UE 2019/2009
The European Commission introduces general guidelines for the policy principle. These guidelines must be less site specific so they can be adopted in different contexts.

PESTICIDES - RE. CE N.1107/2009
The European Commission introduces general guidelines for the policy principle. These guidelines must be less site specific so they can be adopted in different contexts.

BIOLOGIC RE. UE 2018/848.
The European Commission introduces general guidelines for the policy principle.In this case also the farming practices are described in the european policy.

PDO & PGI RE.EU N.510/2006
The European policy defines the acronym's meaning and introduces its general criteria.

CAP RE.UE N.1306/2013
The European Commission introduces general guidelines for the policy principle. These guidelines must be less site specific so they can be adopted in different contexts.

NATIONAL SCALE

FERTILISERS - FERT.DM. N.5046/2016
Adapts the general guidelines from the European policy and extends their detail to national planning knowledge.

PESTICIDES - PEST.DL N.150/2012
Adapts the general guidelines from the European policy and extends their detail to national planning knowledge.

PSRN 2014-2022
Adapts the general guidelines from the European policy and extends their detail to national planning knowledge.

REGIONAL SCALE

FERTILISERS - FERT.RE. N.802/2010
Gives precise indications on limits and rules for the farming practices of the involved area.

PESTICIDES - PEST.RE. N.42/2018
Gives precise indications on limits and rules for the farming practices of the involved area.

DOC/DOP DM. 1151/2012
Gives precise indications on limits and rules for the farming practices of the involved area.

EUROPEAN POLICIES

The selected policies for analysis on a European scale are CAP RE.UE N.1306/2013, FERT. RE UE 2019/2009 PEST.RE.CE N.1107/2009, for general farming activities and PDO & PGI RE.EU N.510/2006 and BIOLOGIC RE. UE 2018/848 for certified organic. Once the policies are detected and analysed, the main conclusion can be sorted into the different fields of action they respond to when it comes to direct and indirect casualties on the three sustainability topics.

MANDATORY POLICIES

PESTICIDES - RE. CE N.1107/2009

Is the european policy concerning the use of pesticides. The policy allows the use of pesticides products in general only if the following conditions are respected.

(a) They have no harmful effect either on human health, including that of vulnerable groups or on animal health.

(b)They have no unacceptable effect on the environment, in particular concerning surface water contamination, including estuarine and coastal waters, groundwater, air, and soil.

(c) They have no unacceptable effect on the environment and non-target species, its impact on biodiversity and the ecosystem.

(d) Is sufficiently effective.

(e) Has no unacceptable effect on plants or plants products.

(f) Does not cause the vertebrates to fight unnecessary suffering and pain.

(g) To control a severe phytosanitary emergency that cannot be contained by other available means, including non-chemical methods, this active substance may be approved for a limited period.

(h) This derogation does not apply to active substances which are or must be classified as carcinogenic or toxic.

(i) The residues of plant protection products have no harmful effect on human health, including that of vulnerable groups, or on animal health.

(l) The residues of plant protection products have no unacceptable effect on the environment.

FERT.RE UE 2019/2009

Is the european policy concerning the use of fertilizers. The policy allows the use of pesticides products in general only if the following conditions are respected.

(a) They have no harmful effect either on human health, including that of vulnerable groups or on animal health.

(b) They have no unacceptable effect on the environment, in particular concerning surface water contamination, including estuarine and coastal waters, groundwater, air, and soil.

(c) They have no unacceptable effect on the environment and non-target species, its impact on biodiversity and the ecosystem.

(d) Is sufficiently effective.

(e) Has no unacceptable effect on plants or plants products.

(f) Does not cause the vertebrates to fight unnecessary suffering and pain.

(g) To control a severe phytosanitary emergency that cannot be contained by other available means, including non-chemical methods, this active substance may be approved for a limited period.

(h) This derogation does not apply to active substances which are or must be classified as carcinogenic or toxic.

Figure 140 - Logo of the European Commission.

NON-MANDATORY POLICIES

CAP RE.UE N.1306/2013

The policy contains several indications that must be followed only by farmers that apply for the CAP and in reward get specific financial supports.

(a) Protection of water from pollution caused by nitrates from agricultural sources.

(b) Introduction of buffer strips along the waterways, prohibition of the use of fertilizers in the therefore mentioned areas.

(c) Compliance with the rules and procedures that step in when the use of water for irrigation purposes is subject to authorization.

(d) Protection of groundwater from pollution: prohibition of direct discharge into groundwater and measures to prevent indirect pollution.

(e) Minimum soil cover for highly erosive soils.

(f) Minimum land management that respects specific local conditions to limit erosion.

(g) Maintain soil organic matter levels through appropriate practices, including a ban on stubble burning, except for plant health reasons.

(h) Concerning the conservation of wild bird habitats.

(i) Relating to the conservation of natural and semi-natural habitats and wild flora and fauna.

(l) Maintenance of landscape features, including, where appropriate, hedges, ponds, ditches, trees in rows, in groups or isolated, field edges and terraces.

(m) Ban on the use of certain substances with a hormonal, thermostatic action, and beta-agonist substances in animal production.

(n) Relating to the identification and registration of pigs.

(o) Identification and registration of cattle.

(p) Identification and registration of ovine and caprine animals.

(q) Minimum standards for the protection of livestock.

BIOLOGIC RE. UE 2018/848.

The european policy for Organic food producers. During this period of conversion and later on, the agri-businesses must respect the following criteria:

(a) The whole agribusiness is convicted to the rules for organic production.

(b) The use of fertilisers pesticides is restricted to natural products only.

(c) The use of ionising radiations processes is prohibited.

(d) The use of cloned animals for cattle farming is prohibited.

(e) The use of OGMs in the production process of biological products is forbidden.

(f) Agribusinesses must apply for a conversion period that endures three years.

PDO & PGI RE.EU N.510/2006

Interests only the agribusinesses that apply for a PDO or PGI. For the purposes of this Regulation, 'designation of origin' is a name that identifies a product that:

(a) Originally come from a place, region.

(b) Whose quality or characteristics are essentially or exclusively due to a particular geographical environment.

(c) Whose production stages take place in the defined geographical area (PDO).

(d) The production of which takes place for at least one of its stages in the defined geographical area (PGI).

(e) The description of the product, including the raw materials where appropriate, as well as the primary physical, chemical, microbiological, or organoleptic characteristics of the product.

(f) Evidence that the product originates in the defined geographical area.

(g) A description of the method of obtaining the product and, where applicable, of the local, fair, and consistent methods as well as information on the packaging.

(h) The name and address of the authorities or, if available, the name and address of the bodies that verify compliance with the provisions of the specification.

NATIONAL POLICIES

The following policies were selected for the national scale: PSRN 2014-2022, FERT.DM. N.5046/2016 and PEST.DL N.150/2012 for general farming activities (these reflect the national assessment of European laws with the integration of some additional parts that the EU commission must approve) and DOP/DOC DM. 1151/2012 for certified farming policies.

MANDATORY POLICIES

PEST.DL N.150/2012

Differently to the fertilisers policy that on national level becomes very clear in field of action the policy around pesticides (PEST.DL N.150/2012) is still rather weak in specificness. The policy mentions five different actions that should guarantee a more conscious use of chemical products. The policy enforces largely:

(a) Promotion and protection of users and consumers.

(b) The protection of water bodies and their environment.

(c) The conservation of biodiversity and ecosystems.

(d) It restricts the use in protected and particular areas.

(e) It imposes monitoring and evaluation of the imposed standards.

FERT.DM. N.5046/2016

Concerning the mandatory tools around fertilisers used in agriculture, the national scale policy (FERT.DM. N.5046/2016) gives much more defined guidelines and leaves less space for misinterpretation. The policy underlines clearly that, the use of solid fertilizers is not allowed:

(a) On non-agricultural surfaces.

(b) In forests and natural sites.

(c) In areas within five meters from an open waterbody.

(d) On frozen or with snow covered surfaces as well as fully soaked soils.

(e) While the use of semi-liquid fertilizers is not allowed: On surfaces with ten or more % pendency and in areas within ten meters from an open waterbody.

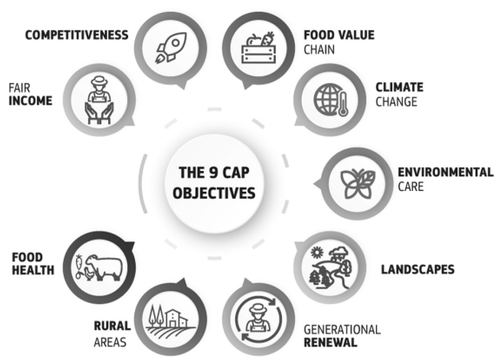


Figure 141 - Main goals of the CAP, common agricultural policy.

Ministero delle politiche agricole alimentari e forestali

NON-MANDATORY POLICIES

PSRN 2014-2022

Focuses on the issue of agricultural sustainability, in line with the objectives of environmental protection and combating climate change that the EU is pursuing with ever greater determination. Only farmers that apply to the following rules can

(a) Promote knowledge transfer and innovation in agriculture and forestry and rural areas.

(b) Stimulating innovation, cooperation, and the development of the knowledge base in rural areas.

(c) Strengthen the links between agriculture, food production and forestry, on the one hand, and research and innovation, on the other, also to improve environmental management and performance.

(d) Encourage lifelong learning and vocational training in agriculture and forestry.

(e) Enhance the profitability of farms and the competitiveness of agriculture in all regions.

(f)Improve the economic performance of all farms and encourage the restructuring and modernization of farms.

(g) Promote the entry of qualified farmers into the agricultural sector and, in particular, generational turnover.

(h) Promote the organization of the agri-food chain, including transformation.

(i) To improve the competitiveness of primary producers by better integrating them into the agri-food chain through quality schemes...local markets, short supply chains, producer associations and organizations and interbranch organizations.

(l) Support the prevention and management of corporate risk.

(m) Preserve, restore, and enhance ecosystems related to agriculture and forestry.

(n) Protection, restoration, and improvement of biodiversity, including in Natura 2000 areas and in areas subject to natural or other specific constraints.

(o) Better management of water resources, including the management of fertilizers and pesticides.

(p) Prevention of soil erosion and better management of the same.

(q) Encouraging the efficient use of resources and the transition to a low-carbon and climate-resilient economy in the agri-food and forestry sectors.

(r) Making the use of water in agriculture more efficient.

(s) Making the use of energy in agriculture and the food industry more efficient.

(t) Promote the supply and use of renewable energy sources, by-products, waste and residual materials and other non-food raw materials for the purpose of the bioeconomy.

(u) Reduce greenhouse gas and ammonia emissions from agriculture.

(v) Promote the conservation and sequestration of carbon in the agricultural and forestry sector.

(z) Strive for social inclusion, poverty reduction and economic development in rural areas.

Figure 142 - Logo of the Italian institution for agricultural policies.

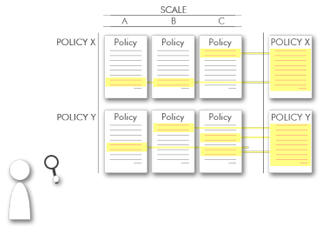
REGIONAL POLICIES

For the regional scale, the laws considered for the analysis are FERT.RE. N.802/2010 and PEST.RE. N.42/2018, as they present higher indications than the national ones. For certifications such as GI, the regulation splits up into multiple laws, one for each product, but they all present similar general guidelines. The example will wear the name of GI disciplinary, indicating the general aspect of all GI disciplinaries.

MANDATORY POLICIES		NON-MANDATORY POLICIES
FERT.RE. N.802/2010	PEST.RE. N.42/2018	DOC/DOP DM. 1151/2012
Is a regional policy concerning the specific indications of what chemical fertilisers are allowed and where. These guidelines are mandatory for all agricultural businesses in the region.	The policy includes specific indications of what chemical pesticides are allowed and where;	GIs have a singular disciplinary for each food-products. Every disciplinary differs from the other, but the main guidelines can be categorized and generalised for the purpose of the research. Even if with different limitations in numbers, all disciplinaries regulate:
(a) Soil monitoring, each 5 years for every 10ha of cultivated surface.	(a) Only areas located no less than 10 meters from the banks of rivers, ponds and lagoons may be affected by the treatments.	(a) It defines the geographical area. area of production in which the production of the good takes place.
(b) Fertilisation plan approved by an expert in the agrarian sector.	(b) Only the use of products not belonging to the very toxic, toxic, and harmful classes is allowed.	(b) It establishes the breed or plant typology.
(c) The use of fertilizers is allowed if they do not surpass certain parameters: N maximum dose allowed is 170 kg/ha; P2O5 maximum dose allowed 100 kg/ha; K2O maximum dose allowed 55 kg/ha;	(c) The areas affected by the treatments must be located no less than 10 meters from the homes and shelters of the animals.	(c) It defines the pedo-climatic conditions.
(d) The use of wastewater originating from water treatment plans is not allowed.	(d) The areas affected by the treatments must also be located no less than 10 meters from public roads.	(d) It defines the soil conditions.
		(e) It limits the produced quantity.
		(f) It defines the time of harvest.
		(g) It indicates the process for transformation.
		(h) It indicates the chemical values of a food-product.

Figure 143 - Landscape Lajatico, Valdera, by author.

STEP 3. ANALYSE ENVIRONMENTAL ENGAGEMENT



POLICIES ENGAGEMENT FOR ENVIRONMENTAL SUSTAINABILITY

MANDATORY POLICIES

NON-MANDATORY POLICIES

(1) EUROPEAN SCALE

FERTILISERS - FERT.RE UE 2019/2009	PESTICIDES - RE. CE N.1107/2009	BIOLOGIC RE. UE 2018/848.	PDO & PGI RE.EU N.510/2006	CAP RE.UE N.1306/2013
A - B - C	A - B - C - E - F - H	A - B - C - D - E	B - D - E	A - B - D - E - F - G - H - I - L - M - Q

(2) NATIONAL SCALE

FERTILISERS - FERT.DM. N.5046/2016	PESTICIDES - PEST.DL N.150/2012	PSRN 2014-2022
A - B - C - D - E	B - C - E	M - N - O - P - Q - R - S - T - U - V

(3) REGIONAL SCALE

FERTILISERS - FERT.RE. N.802/2010	PESTICIDES - PEST.RE. N.42/2018	DOC/DOP DM. 1151/2012
A - B - C - D	A - B - C - D	B - C - D - E - F

RULES WITH EFFECTS ON SPATIAL CRITICALITIES

MANDATORY FERTILISERS POLICIY	MANDATORY PESTICIDES POLICIY	ORGANIC FARMING POLICY	GEOGRAPHICAL INDICATIONS	COMMON AGRICULTURAL POLICY
1B - 1C - 2E - 3D	1B - 1C - 3A	1A - 1B	1E - 3C - 3D - 3E	1A - 1C - 1D - 1E - 1G - 1L

ENGAGEMENT OF POLICIES FOR SUSTAINABILITY

The chapter gives us insights into the general aspects of the different policies that the agri-businesses in Valdera must follow. Not all these policies have to be followed by all farmers. Some of them are mandatory for all. Others apply only to specific categories.

To simplify the categorization of these policies and to have easy access to the information needed for the research, the policies were divided not anymore by scale but by category of certification (GI, organic or CAP). The new classification makes it possible to identify what policies are mandatory for each category of agri-business. Once the new categorization is done, it is possible to list all the rules that farmers must or can follow. Still, the categorization is too broad and cannot be used for further research. Another distinction has to be made.

By assuming that all the previously selected aspects have a direct or indirect impact on agricultural practices, but not all have the same impact on environmental sustainability. It becomes possible to simplify further the list of general aspects for each farming category maintaining only the rules from each policy that in some way influence at least one of the five topics that have been analyzed in through the layer approach chapter (see "investigating upon spatial criticalities"). This classification procedure is helpful as it gives insights into the bullet points that might affect critical areas positively or negatively. Maximizing these general aspects' effects would mean maximizing a policy's spatial potentialities.

RULES WITH EFFECTS ON SPATIAL CRITICALITIES

ORGANIC FARMING POLICY

1A - *Grassing in the high-risk months on grasslands and other seasonal crops. Grassing between the rows of permacultures. Resting period every two years for each agricultural land unit. The whole agribusiness is convicted to the rules for organic production and must fulfil a 3-year resting cycle before the approval.*
1B - *Only the use of non-chemical products is allowed (they can be chemically processed have to be made of natural ingredients)*
The forced resting period for land units influences Indirectly the size of land units and the diversification of production.

GEOGRAPHICAL INDICATIONS

1E - *The typology: only a set of specific animals or crops has to be used. Most of them are indigenous species.*
3C - *Land use limitations on altitude. Land use limitations on slope.*
3D - *Land use: limitations on soil composition.*
3E - *Nourishment: how much can be fed to the animals, how much can fields be irrigated. The Costs: High costs assessment force smaller business to merge into assosiations or abandon productive land.*

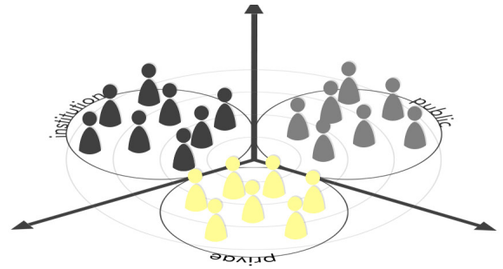
COMMON AGRICULTURAL POLICY

1A - *Protection of water from pollution caused by nitrates from agricultural sources.*
1C - *Making the use of water in agriculture more efficient.*
1D - *Protection of groundwater from pollution: prohibition of direct discharge into groundwater and measures to prevent indirect pollution.*
1E - *Minimum soil cover for highly erosive soils.*
1G - *Maintain soil organic matter levels through appropriate practices, including a ban on stubble burning, except for plant health reasons*
1L - *Maintenance of landscape features, including, where appropriate, hedges, ponds, ditches, trees in rows, in groups or isolated, field edges and terraces.*

METHOD STAKEHOLDER ANALYSIS

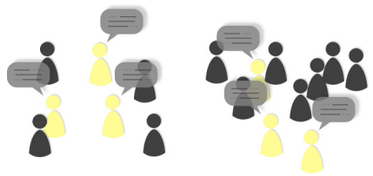
The stakeholder analysis method is widely used to analyse who are the actors that are possibly involved in the act of developing a plan. This does not include only the actively involved institutions but also every social group that the outcomes of a strategy might influence.

Aim - The stakeholder method remains one of the most crucial methods in spatial planning. Recognising the different actors, their positions in the power/interest matrix, their attitude toward the project, and the possible conflicts that could arise will enable the possibility to create an engagement strategy to stimulate higher participation in spatial planning processes.



Identification

Power and interest



Target identification

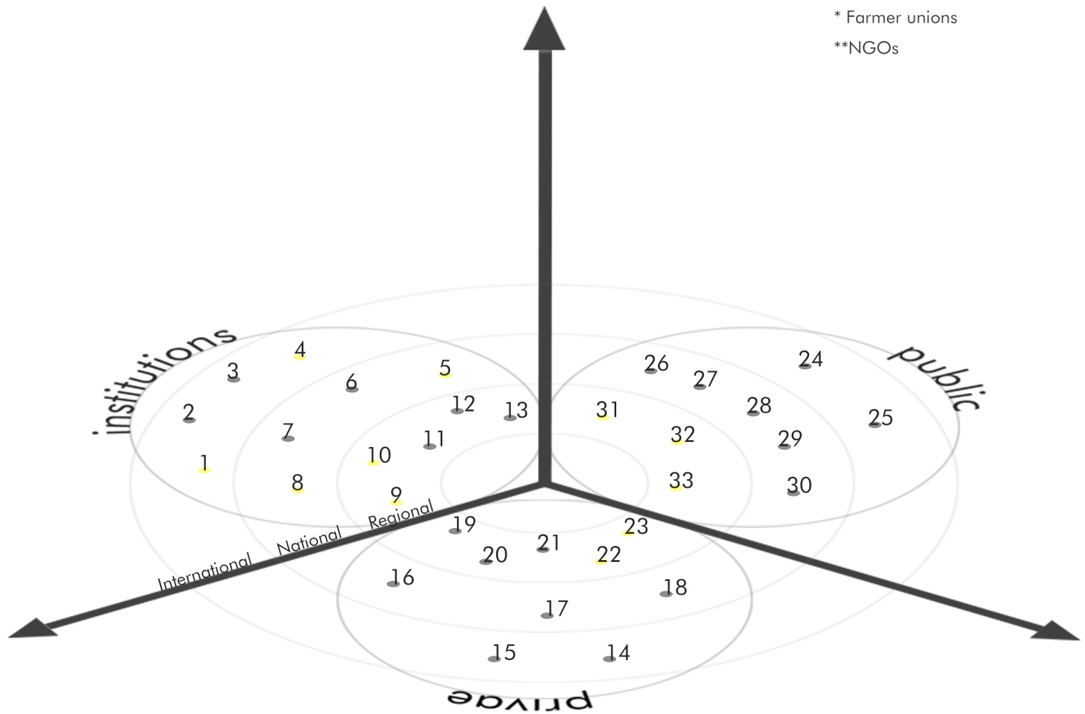
STAKEHOLDER ANALYSIS

An on-field investigation is needed to understand how the policies for environmental engagement work in the agri-food system. Knowing the opinions of farmers, consortiums, specialists, and other players makes it possible to give an answer to some causes of the inefficiency of these policies.

This means that the research has to include both direct and indirect actors. Considering as direct all actors that are actively involved in the policies framework and as indirect all other actors that are involved in the agri-food system. The final aim of this research step is to investigate not only the costs and benefits of farmers applying for a policy for sustainable environmental engagement but also the influence these policies have on the socio-economic structure of an agri-food system.

Therefore, in order to select the correct targets for an interview-led investigation, the research must first categorize and identify the most critical actors involved in the field. For this purpose, stakeholder analysis is applied.

Figure 144 - Stakeholder analysis, explained in steps.



INSTITUTIONS

1. EU Agricultural directory
2. EU Health directory
3. EU Tourism directory
4. EU Natura2000
5. MIPAAF (ministry for agricultural policies)
6. Ministry of health
7. Ministry of tourism
8. Ministry for environmental protection
9. Regione Toscana
10. ARPAT (Regional office for environmental protection)
11. Provinces
12. Municipal unions
13. Municipalities

PRIVATE

14. Transport companies
15. Food wholesalers
16. Pesticides manufacturers
17. Seed suppliers
18. Fertilizers manufacturers
19. Landowners
20. Local retailers
21. Conventional farmers
22. Organic farmers
23. GIs certified farmers

PUBLIC

24. Consumers
25. HELP**
26. Confagricoltura*
27. Coldiretti*
28. CIA*
29. Verde Chiaro**
30. Lipu Onlus**
31. GIs Consortiums
32. Biodistretto
33. Rural residents

Direct stakeholders
(involved policies for sustinable agricultural practices)

Indirect stakeholders
(involved in the agri-food system)

Figure 145 - Stakeholder in the regional agri-food system.

ACTORS OF THE AGRI-FOOD SYSTEMS

Regarding regional planning, many different actors and stakeholders are involved. Especially in projects concerning agricultural circularity, it often influences a set of different disciples other than the agricultural and environmental ones. This is why to recognise the different groups targeted by such a topic, it is a good practice to consider three main categories, these are Institutional, Public and Private.

Starting from the institutions, developing a plan for the Tuscan region involves multiple governmental bodies that differ mainly in scale and political orientation. The largest scale concerns the European Union and its departments, such as the directorates for Agriculture, Health, and Environment, that define policies that influence the Tuscan region. The protection of specific ecological sites such as Natura2000 or the policy "farm to fork" are examples of these policies. On a national scale, a similar pattern of stakeholders is repeated. Ministries of Environment, Agricultural policies, Health and Tourism, are directly involved in decision-making. On the regional scale, the spatial planning authorities can be classified into the region, the provinces, unions of municipalities and municipalities.

Figure 146 -Logo for AIAB biodistretti italiani.
Figure 147 -Logo of the consortium for Chianti classico DOC

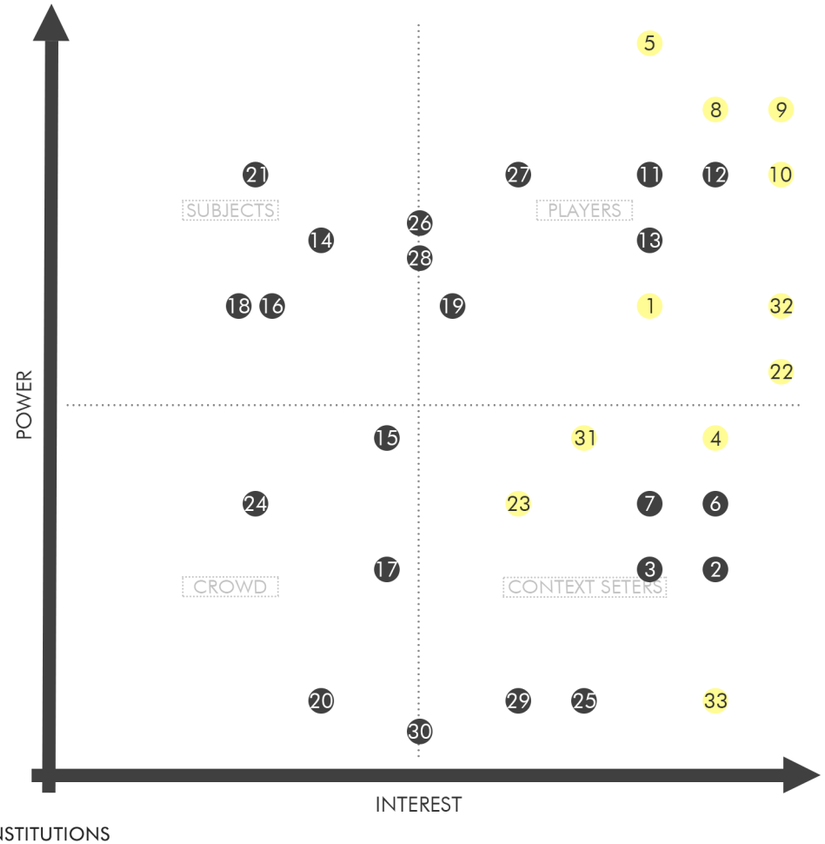
Different from the institutional categorisation in the public sphere, a classification through scale is not applicable to simplify the categorisation, as it differs per each stakeholder in each different context. Unlike the governance system, there is no strict relation between scale and power hierarchy.

Local public stakeholders can have a much stronger influence on planning than not international and national operating ones. They often have to rely much more on interest in participatory planning than not on power influence. NGOs can act on a multitude of scales that can vary from global to local. In this case, the leading NGOs involved operate nationally (HELP) or on a regional to local scale (LIPU Onlus and Verde Chiaro). The same happens for the consumers that are not connected to a specific scale as it depends on how far a region exports agri-food products (in the Tuscan case, this can be globally for particular products).

In the end, there are the local and rural residents that can refer to a regional or local scale. They represent the public group involved and are most affected by planning decisions. Only farming unions act on a well-defined scale. The general farming unions (Coldiretti, Confagricoltura and CIA) are related to the provincial scale. In contrast, GIs and Biodistricts have other borders that do not follow institutional ones but geographical ones that often refer to a single agri-food system.

The private category is again classifiable through scales as it has a more rigid interaction structure, but as for the public sector, it does not respect the scale/power hierarchy. On the largest scale, the international/national one, food wholesalers, transport and logistic companies have a particular influence. Immediately underneath the sellers of the end products or export agencies, the suppliers of seeds, fertilisers and pesticides find their spot. The local scale is occupied by small retailers, land owners and the different categories of farmers, conventional, organic and GI-certified.

Figure 148 - Logo of the consortium for Olio toscano IGP.



INSTITUTIONS

1 EU Agricultural directory
2 EU Health directory
3 EU Tourism directory
4 EU Natura2000
5 MIPAAF (ministry for agricultural policies)
6 Ministry of health
7 Ministry of tourism
8 Ministry for environmental protection
9 Regione Toscana
10 ARPAT (Regional office for environmental protection)
11 Provinces
12 Municipal unions
13 Municipalities

PRIVATE

14 Transport companies
15 Food wholesalers
16 Pesticides manufacturers
17 Seed suppliers
18 Fertilizers manufacturers
19 Landowners
20 Local retailers
21 Conventional farmers
22 Organic farmers
23 GIs certified farmers

PUBLIC

24 Consumers
25 HELP**
26 Confagricoltura*
27 Coldiretti*
28 CIA*
29 Verde Chiaro**
30 Lipu Onlus**
31 GIs Consortiums
32 Biodistretto
33 Rural residents

Direct stakeholders
(involved policies for sustinable agricultural practices)

Indirect stakeholders
(involved in the agri-food system)

Figure 149 - Power interest matrix.

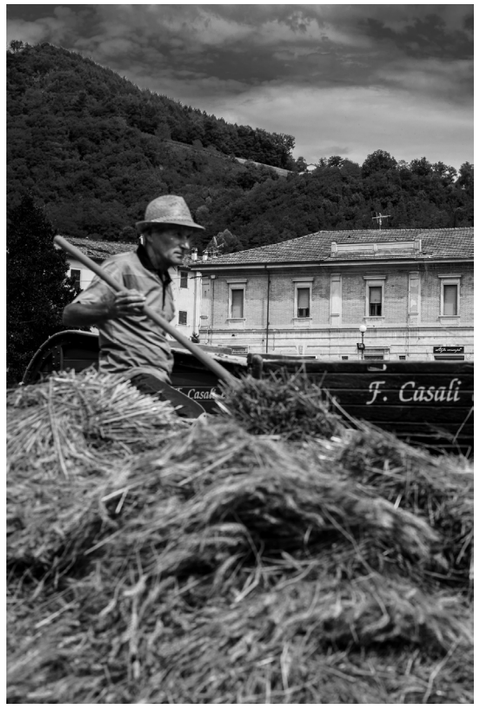


Figure 150 -A farmer at work, author Giorgio Minguzzi.

mipaaf
ministero delle politiche agricole alimentari e forestali

Figure 151 -Logo for the National institution for agri-cultural policies.

REGIONE TOSCANA

Figure 152 -Logo for the Tuscan Region.

VALDERA
UNIONE DEI COMUNI

Figure 153 -Logo for the Municipal union of Valdera.

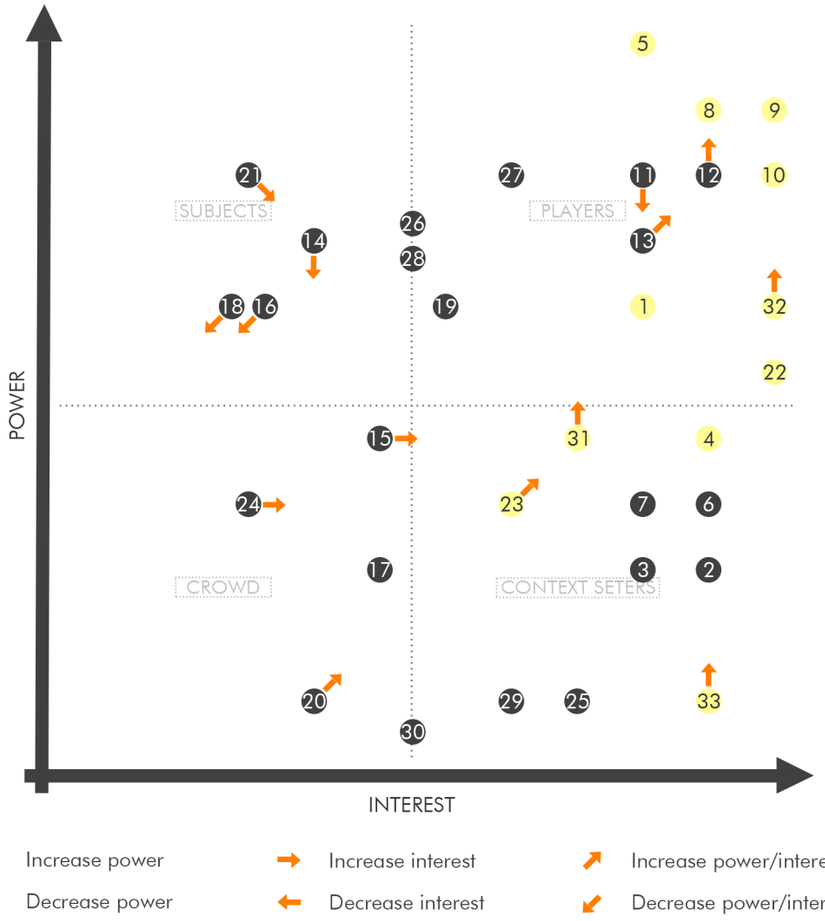
POWER AND INTEREST RELATIONS

In the power interest matrix, the stakeholders are positioned on the cartesian plane following two criteria, power and interest. The indicated power refers to the influence a stakeholder has on decision-making processes. While the interest value indicates how much an actor is engaged with policies for environmentally sustainable agriculture.

This gives a clear insight into the relationship between these two variabilities for each stakeholder involved in the project. Once the stakeholders are displaced on the matrix, the matrix is divided into four quadrants to make the general overview easier to read. Each quadrant represents stakeholders with similar attributes. Four subgroups are established, the players, the context setters, the subjects and the crowd.

In this case, the “players” and “context setters” with the highest power influence in decision-making are the ones of the Institutional category.

Public and Private stakeholders instead are unequally distributed on the table. Still, a pattern emerges showing the Public stakeholders more involved and interested and the Private ones less interested but with higher power capacities.



For the sake of building up enough consent that supports the building of a new policy that transforms the nature of GIs, the current situation gives the following opportunities: Empower - Public stakeholders with a direct concern for protecting and conserving the environment and landscape (Biodistretto and consortiums) and stakeholders concerned with the problem of resource scarcity and distribution (Municipal Unions, Municipalities and ARPAT). Disempower - stakeholders that benefit economically from unsustainable agri-food practices. Increase - interest and participation in the food circle's final part (Local retailers and Consumers).

Figure 154 - Engagement strategies matrix.

Figure 155 - Waterboard, water management in Grosseto, Tuscany.

CRITICAL STAKEHOLDERS

Once all direct and indirect stakeholders in the agri-food system are identified, their power-interest position in it is defined. Next, a further step into classifying the stakeholders is needed. This phase is essential for selecting the critical actors for a specific topic. Two new criteria have to be included, dependency and position. With dependency is meant how much a stakeholder depends on the efficiency of the existing policies for sustainable agricultural practices. With position is meant if a stakeholder approves, disapproves or is neutral to the proposal of a mandatory sustainable agricultural practices policy.

The power-interest matrix does define the position of each stakeholder in the field. What it does not show is the attitude of a stakeholder (for example, stakeholders that benefit from unsustainable farming practices can be high in interest on the matrix but exclusively because they disapprove of further restrictions on farming practices).

Therefore, the critical stakeholder analysis table gives this precise information concerning stakeholders' dependency and role. Added to that, it summarises the problem perception and the personal goal of each of the stakeholders. Confronting different goals and problem perceptions can help to find common problems and objectives and possible conflicts between the parts.

— A CERTIFIED FUTURE

ACTOR	POSITION	DEPENDENCY	CRITICAL ACT.	PROBLEM PERCEMPTION	GOAL
EU Agricultural directory	✓		Yes	The current agricultural structure is unsustainable.	Improve the "FarmtoFork" strategy, moving towards circularity
EU Health directory	○		No	Food and water pollution.	Banning chemicals in the food chain production.
EU Tourism directory	○		No	Loss of attractiveness due to intensive farming.	Preserving landscape and historical heritage.
EU Natura2000	✓		Yes	Ecological niches threatened by pollution.	Preserving and improving the ecological system.
Ministry of agri-policies	✓		Yes	The current agricultural structure is unsustainable.	Improve the "FarmtoFork" strategy, moving towards circularity.
Ministry of health	○		Yes	Food and water pollution.	Banning chemicals in the food chain production.
Ministry of tourism	○		No	Loss of attractiveness due to intensive farming.	Preserving landscape and historical heritage.
Ministry of environment	✓		Yes	Ecological niches threatened by pollution.	Preserving and improving the ecological system.
Regione Toscana	✓		Yes	Lack of an effective rural development strategy.	Develop a strategy for a resilient and sustainable agri-food sector.
ARPAT	✓		Yes	The current agricultural structure is unsustainable.	Preserving and improving the ecological system.
Provinces	○		No	Difficulties in collaboration with Municipal Unions.	Higher decision making power.
Municipial unions	○		Yes	Play a rather small role in decision making.	Higher decision making power, increased funds for participatory planning initiatives.
Municipalities	○		No	Play a rather small role in decision making.	Higher decision making power, increased funds for participatory planning initiatives.
Consumers	○		No	Increased services costs.	Decreased costs and increased quality of the food products.
HELP**	✓		No	Has small potential budget.	Increase number of partecipants and partecipation at decision making.
Confagricoltura*	○		No	Does represent stakeholders with different positions.	Efficient business plan for the transition to sustainable agriculture.
Coldiretti*	○		No	Does represent stakeholders with different positions.	Efficient business plan for the transition to sustainable agriculture.
CIA*	○		No	Does represent stakeholders with different positions.	Efficient business plan for the transition to sustainable agriculture.

* Farmer unions ** NGOs

Figure 156 - Critical stakeholder analysis table, part 1.

— ACTIVATING THE POTENTIAL OF EXISTING POLICIES

ACTOR	POSITION	DEPENDENCY	CRITICAL ACT.	PROBLEM PERCEMPTION	GOAL
Lipu Onlus**	✓		No	Has small potential budget.	Increase number of partecipants and partecipation at decision making.
Verde chiaro**	✓		No	Has small potential budget.	Increase number of partecipants and partecipation at decision making.
GI Consortiums*	○		Yes	Does represent only a reduced number of partecipants. Has little influence on decision making.	Efficient business plan for the transition to sustainable agriculture.
Biodistretto*	✓		Yes	Low partecipation rate of farmers.	Efficient business plan for the transition to sustainable agriculture.
Rural residents	○		Yes	Farming dependent communities suffer job losses in the sector.	Preserving landscape and jobs in the rural areas.
Transport companies	✕		No	A more sustainable agriculture would mean a decrease of transported goods.	Business as usual. Infrastructural development.
Food wholesalers	✕		No	A more sustainable agriculture would mean a decrease of transported goods.	Business as usual. Infrastructural development.
Pesticide Manufacturers	✕		No	Governmental restrictions on used and produced chemicals	Increased governmental funds. A stronger voice in decision making.
Seed suppliers	○		No	Climate change potentially leads to desertification.	Increased differentiation in crops. Increased fertility.
Fertilizers Manufacturers	✕		No	Governmental restrictions on used and produced chemicals	Increased governmental funds. A stronger voice in decision making.
Landowners	✕		Yes	Heavy meteorological events increase costs and decrease property value.	Increased security in investments and property value.
Local Retailers	○		No	Market competition with low-cost distribution chains.	Increased governmental funds. A stronger voice in decision making.
Conventional Farmers	✕		Yes	Higher costs for resources, use of chemicals and emissions.	Decreased costs of primary resources,abolition of chemicals bans.
Traditional Farmers	✓		Yes	Low statal financings, high maintenance costs.	Increased governmental funds. A stronger voice in decision making.
Organic Farmers	✓		Yes	Low statal financings, high maintenance costs.	Increased governmental funds. A stronger voice in decision making.

* Farmer unions ** NGOs CLASS. Institutions Public Private

Figure 157 - Critical stakeholder analysis table, part 2.

The first and most important conflict that arises in this scenario is internal to a specific stakeholder, the farmer unions and associations. At the status quo, in Tuscany, their voice is enormously influential, but the problem is that they represent farmers of a specific area. In this case, they are divided into provinces. All province farmers are sustained by their association or union without making any distinction between the farming practices. This naturally leads to conflicts between farmers who maintain biological practices and those who practice intensive farming. The first group feels neglected and non-supported by governmental funds and has to pay a high price caused by the polluting activities of the second group. On the other hand, the second group contrasts decisions such as restrictions on the use of chemical products and water resources that the government tries to impose and that would benefit the first group. This is the case for farmers that have applied to the EU CAP policy. They follow sustainable agricultural practices but are not represented by a consortium, as it is the case for certified and organic farmers. GIs and BIO farmers have higher autonomy thanks to the representation of the consortium or biodistrict, even if these have less influence on decision-making.

Another conflict that seems to be more intuitive is the one between fertilizers and pesticide manufacturers and the NGOs that are trying to limit the use of especially these kinds of chemical products to protect the environment, biodiversity, and consumer health. This conflict also includes the institutions that are directly involved, in this case, the Ministry of Agriculture on one side and the ministry of the environment on the other.

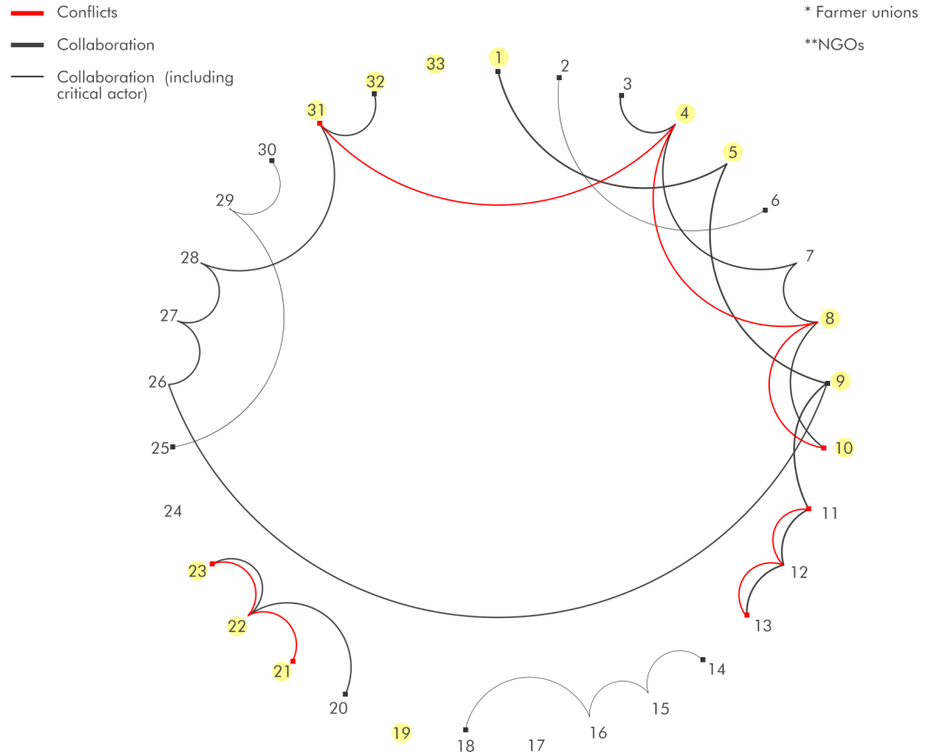
Last but not least is the conflict between different local administrations. Changing the agricultural structure to achieve higher sustainability will also demand significant changes in land use, affecting some areas more than others. The provinces or municipalities that rely economically on the outcome of unsustainable agricultural activities will claim higher amounts of funds for redevelopment. This will progressively stimulate conflicts in decision-making regarding how funds, resources and incentives will be distributed across the region.

CONCLUSION & ENGAGEMENT STRATEGIES

In the stakeholder analysis, all possible players that are either directly or indirectly involved in the synergies of the Valdera agri-food system are included. This encloses, of course, actors that act on a different scale but that contain the Valdera region.
Further on, the analysis defined the 'position' of these actors in the field of governance, making evident how much power and interests they share in it.
In the final steps, their position and dependency upon the policy proposal to increase sustainable and resilient practices in the agri-food system. In this way, the most critical stakeholders are selected. It becomes clear that the group of critically involved actors resembles, with a few exceptions, the group of directly involved actors (identified during the first phase).

The critical actors are considered the ones that most depend on the outcome of a policy for sustainable agricultural practices and, therefore, also share a high interest in the governance of the policies. They remain the most exciting actors to interview if the aim is to understand where the policies lack efficiency and why.

In the following chapter, members of the different critical stakeholder groups are interviewed regarding the efficiency of the different policies for SAP.



INSTITUTIONS

1. EU Agricultural directory
2. EU Health directory
3. EU Tourism directory
4. EU Natura2000
5. MIPAAF (ministry for agricultural policies)
6. Ministry of health
7. Ministry of tourism
8. Ministry for environmental protection
9. Regione Toscana
10. ARPAT (Regional office for environmental protection)
11. Provinces
12. Municipal unions
13. Municipalities

PRIVATE

14. Transport companies
15. Food wholesalers
16. Pesticides manufacturers
17. Seed suppliers
18. Fertilizers manufacturers
19. Landowners
20. Local retailers
21. Conventional farmers
22. Organic farmers
23. GIs certified farmers

PUBLIC

24. Consumers
25. HELP**
26. Confagricoltura*
27. Coldiretti*
28. CIA*
29. Verde Chiaro**
30. Lipu Onlus**
31. GIs Consortiums
32. Biodistretto
33. Rural residents

Critical stakeholders

Non critical stakeholders

Figure 158 - Possible conflicts and collaborations between stakeholders.

Figure 159 -Productive landscape in Peccioli, Valdera, Tuscany, by author.

METHOD INTERVIEWS AND SURVEYS

This method can be seen as a hybrid between field investigation and analytical methods. "Research interviews are a method of data collection that uses people's answers to researchers' questions as to their source of data. In this respect, they have something in common with questionnaires – the data comes from what people tell the researcher" (Denscombe M., 2018).

Aim: The technique focuses on interviewing as many subjects as possible that are involved in the agri-food system, from farmers to experts and municipalities. This method aims to produce data that deals with the topic in-depth and in detail. Interviews can help to build a dataset capable of showing different trends and patterns that are not described by literature or by policies.

TESTING POLICIES EFFICIENCY

The previous chapter, "Engagement for sustainability of policies", gives an overall image of the different policies, target groups and general aspects that define the environmental sustainability engagement of each policy. Further, the policies were sub-categorized according to the farmer categories that must follow them. However, to determine if a policy is efficient or not, the mere understanding of the rules that induce forms of sustainable agricultural practices is not enough.

As mentioned, the efficiency of these rules, in the case of non-mandatory policies (such as CAP, GI policies and Organic farming policies), depends on the grade of participation of farmers in the policy itself. It might seem obvious, but it remains essential to state that such policies would be redundant and have no practical impact on the sustainability of the agri-food systems if no farmer decides to apply for the policy.

The rules identified as engagement for sustainability guidelines must be seen as restrictions that limit production capacity or increase production costs for farmers.

This means that farmers who apply for a non-mandatory certification will do it only if there are other forms of beneficial aspects to it that help the agri-business to improve economically. These policies primarily work with a kind of give-and-take system, where the agri-business promises to follow specific farming practices. In exchange, the policy provides proper support for the economic growth of the agri-business.

Many different elements can influence beneficially or negatively a policy. In this case, the factors considered as most important are the nature and typology of involved institutions, the grade of inclusiveness of the policy, financial support for applying farmers and branding strategies to protect the market value of the product.

To understand dynamics such as these, the best option remains to ask the local producers themselves and to talk with the involved institutions. Only in this way is it possible to conclude on strengths and weaknesses of a policy that are not evident in the mere analysis of the policies disciplinaries.

Figure 160 -Podere la chiesa, Peccioli, Tuscany, one of the interviewed agribusinesses, by author.

SETTING UP THE INTERVIEWS

A critical tool to lead productive interviews is a previous investigation of the argument at the core of a discussion. Extensive interviewer knowledge and a well-defined line of interview questions will benefit the result significantly. On top of that, the proper awareness of the interviewer will also simplify the decision-making process when it comes to deciding on different target groups.

To get the right results, the research aims to approach at least one person for each target group defined in the previous stakeholder analysis chapter: Conventional farmers, Certified farmers, Organic farmers, Specialists, and farmer unions. The chapter will develop stepwise, starting from establishing the topic and sub-arguments that will lead the conversation of the interviews and concluding with the digitalization and evaluation of the collected data from the interviewed agri-business.

The first steps are selecting interviewed individuals and creating a framework of questions and topics that can eventually adapt to different situations. For example, even though the questions asked to a specialist or a farming union representative are different from those asked to the agri-businesses, the topic that the interview aims to target remains the same. Keeping the same topics for all discussions enables the possibility of creating and using the framework in various ways. At the same time, it simplifies the task of collecting and interpreting conclusions.

SUSTAINABLE POLICY ESSENTIALS

Engagement for sustainability
- Promoting sustainable practices..
- Promoting environmental protection..
- Restrictions on conventional practices..

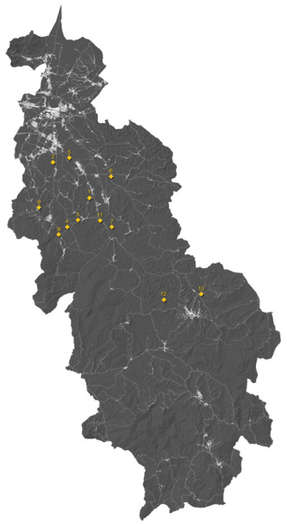
Inclusiveness
- Accessible application costs..
- Promoting actor's participation..
- Fair decision-making power distribution..

Institutional role
- Actively involved institutions..
- Local-scale public participation..

Financial support
- Promoting sustainable practices..
- Promoting environmental protection..
- Restrictions on conventional practices..

Product branding
- Advertisement strategies..
- Communication strategies..
- Legal market protection..

Figure 161 - Main topics used as guidelines to form the questions in the interview framework.



Interviewed agri-businesses

1. Podere la chiesa - Organic, DOC, IGT	WINE
2. Podere spazzavento - Organic, DOC, IGT	WINE
3. Azienda agricola castelvecchio - Organic, DOC, IGT	WINE
11. Fattoria fibbiano - Organic, DOC, IGT	WINE
8. Azienda agricola verdoliva - Organic, IGT	OIL
9. Azienda agricola di Nenna Guido - Organic	OIL
10. Oleificio cooperativo volterra -	OIL
4. La collina del pane -	WHEAT
5. Marchese di camugnano - Organic	WHEAT
7. Il Poggione s.s. - Organic	DAIRY
12. Fattoria Lischeto - Organic, DOP	DAIRY
6. Casa ilaria badia di carigi - Organic	DAIRY

Besides general questions, such as production capacity, size, or land use of an agri-business, used to open up the interview and to make the interviewer more familiar with the interviewed person. The main topics remain the ones mentioned in the previous chapter, “Policies for sustainable agricultural practices”. These topics are inclusiveness, institutional role, financial support, and product branding. Inclusiveness means how much a policy provides an equal right to the applying farmers. Regarding participation, decision-making inside the related association, accessible conversation costs or funding programmes for application for all agri-business, no matter the size. The institutional role is needed to understand the task of farming associations related to the certifications, if there is active participation from authorities such as municipalities or others, depending on the scale of interest. The financial support topic aims to clarify the possible benefits farmers can access when actively participating in a certification and at what stage of the application process these funds are provided. The product branding topic is meant to answer the question of if and how much using certifications is profitable for farmers.

As mentioned in the conclusions of the stakeholder analysis chapter, the interviews should target at least one subject for each of the following classes: conventional farmer, certified farmer, and organic farmer.

Nevertheless, a second selection criterion must be added to have an even more extensive overview of the current situation. As the GIs specifically address a single product and might differ depending on the discipline concerning the products, it is essential to also consider a classification of the agri-businesses depending on their produced output. Therefore, before starting the selection of the interviewed subject, the decision was taken to include at least one of the following farming classes: Wine, Oil, Wheat, Vegetable, and meat or dairy producers in the case of GI production.

Once the framework for the interviews is ready, the successive step is to select the possible interviewed subjects. Of course, not all agri-businesses contacted for the study were available for an interview. The most reluctant were those still practising conventional farming, those in the meat, dairy, and wheat sectors. These activities do not interact much with the public and strongly mistrust institutions and everything they might relate to it. On the other hand, organic and certified farmers are more interested in sharing information and increasing their market visibility and are more open to interviews.

In the end, the interviewed agri-businesses were twelve, differing in size, production, and farming practices (see figure 162). Eleven of the interviewed farmers are certified or organic, or both, and only one is conventional.

Figure 162 - Geographical location of the interviewed agri-businesses.

LEADING QUESTIONS FOR INTERVIEWS OF..

	AGRI-BUSINESSES	CONSORTIUMS
General questions	- Hectares of the agri-business... - Hectares of productive land... - Number of employees... - Produced crops... - Produced capacity... - Use of fertilizers and pesticides... - Provenience of used materials... - Water use for irrigation...	- Why is the consortium founded ? - When is the consortium founded ?
Inclusiveness	- What are the main reasons you have chosen to apply for a certification? - Have you participated in decision-making in the disciplinary? - How high were the assessment costs for application to the certificate? - What were the structural changes you had to execute?	- How does the registration procedure for a consortium work? - How long does it take to register for members? - How does it differ from registering for the certification itself? - Is there a quote the agri-businesses must pay to participate? - How high is the fee, and how is it established?
Institutional role	- Is the consortium responsible for solving the conflicts of interest between members and non-members? - Does the consortium establish market prices for the certified product?	- What is the role of the consortium? - Who are the members? - Who does administrate the consortium? - What is the juridical nature of consortiums?
Financial support	- Did you perceive financial support for the conversion to a certification? - At what stage of the process did you receive them? - Are these financial aids adequate? Is there a financial support program to cope with climatic change adversities?	- Do registered farmers benefit economically from the registration? In what form do financial benefits express?
Product branding	- Did the certification increase the market value of your product? - Did the market demand for your product increase? - Was it enough to cover the expenses for conversion?	- What are the possible promotion strategies? - What are the possible measures that the consortium can take against fraud? - How often are quality checks needed? - Who is in charge of quality checks?

Figure 163 -Framework for structured interviews.

In addition to the producers (agri-businesses), two field specialists and two farming associations were interviewed. These were Benedetto Rocchi, professor at the University of Florence, Economy and rural appraisal department. Monica Coletta, Vice-president of the Italian association for organic agriculture. The bio district of Chianti classico and Marco Alessandro Bani, president of the Consorzio chianti classico.

The following paragraph summarizes the inputs obtained from the interviews by showing the main findings concerning GIs, Organic certifications, the consortium, and Agri-policies. Knowledge of strengths and weaknesses in the current structure of existing policies is crucial when it comes to writing down policy principles that will serve the creation of a new policy framework, as it is the aim of the research.

EFFICIENCY OF EXISTING POLICIES

The information collected from the interviews is crucial to understand trends and patterns that cannot be captured on paper. The summary consists in a list of main conclusions the interviewer was able to draw from the answers given by the interviewed subjects. These conclusions focus on weaknesses and strengths of certifications (Gis, Organic and Cap) and their relative association or consortium in the field of sustainability.

Figure 164 - Tenuta storica di Camugliano, Ponsacco, Italy, one of the interviewed agri-businesses.
Figure 165 - Productive land of La collina del pane, Ponsacco, Italy, one of the interviewed agri-businesses.

CONCLUSIONS ON GIS POLICIES

Multiple conclusions can be drawn from the input received by members of a GI certification. They can mainly be divided into practical, financial, bureaucratic, and other aspects. Beginning with the practical aspects, according to the interviewed subjects, the law behind GIs restricts the use of water, fodder, and intensity of production depending on the protected crop or cattle category. Meanwhile, Gis disciplinaries do not restrict the use of chemical pesticides or fertilizers. Yet, most of the certified activities are also certified as biologic, especially permanent crops such as wine and oil. This is not the case for wheat or seasonal crops, as the resting time imposed by organic law decreases production and profit for organic farming.

Financially the primary effect of GIs is not the increased market value of the product as, for many, it did not change. The only support given by GIs themselves is the guaranteed market value (the price remains stable). Only when a GI becomes notorious it also improves the selling rates.

The main costs are determined by the yearly chemical examination made by certified examination centres. No governmental funding is provided for the conversion to a GI certification. The costs for maintaining a GI are higher than the profits for most small/medium activities. Many agri-businesses had to conform to the GI because otherwise, they could not maintain the region's name on the product's label. Many other small realities practice according to GI rules but do not have the time to work through the bureaucracy. If the GI is too successful, this could lead to an excessive specialization of the region. In exchange, GIs gives an identity to the specific region, which increases the interest and demand for the product.

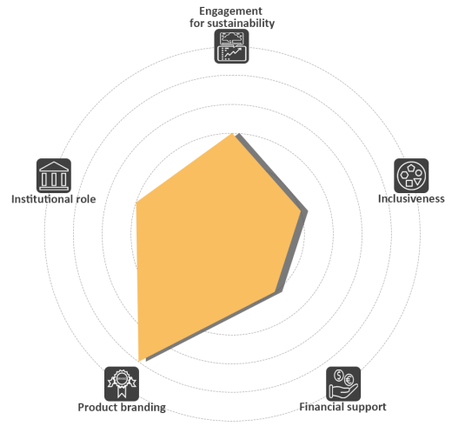


Figure 166 - Efficiency test of the GI policy.

A GI must go through several authorizations from regional to European committees to be approved. The main political issues remain the long application times for a GI (not for single members but for the creation of the GI itself). The tool is not mandatory for all farmers within the borders of a GI.

A strong GI attracts big investors and favours monopolization of the market niche, as there is no limit to the size of certified businesses. Consumers mistrust the institutions in charge of quality control in the blockchain. Most farmers do not believe in GIs and the consortium.

Instead, the consortium's strengths and weaknesses are more of organizational nature. For example, Agri-businesses that pay a higher quote have more influence on consortiums' decision-making and can so easily propose changes. This makes it easy for big businesses to propose changes in the disciplinary in their favour.

The "Consorzio" or farmer association behind a GI is not necessarily created with the creation of the GI. Most GIs that represent smaller realities does not have an active Consorzio. When a Consorzio is created, it does not automatically include all certified farmers. A Farmer can be Certified under a specific GI but is not forced to participate in the Consorzio, but all members of the Consorzio must be certified. Members must pay an additional yearly quote to the consortium based on the number of grapes, wine or final products produced by the agribusiness.

In exchange, the consortium promotes and protects the certificate's name but also proposes changes in the laws concerning it. Further on, the consortium facilitates bank loans for members of the consortium.

CONCLUSIONS ON THE ORGANIC FARMING POLICY

For Organic Certifications, the image changes. They still present weaknesses but of different nature, if compared to GIs. This is because Organic farming certificates do not cover a specific product as for the Gis. Indirectly this is also the reason why more and more farmers are switching from GIs to Organic. The interviews of Organic agri-businesses made clear that:

The law concerning Organic farming does restrict the use of chemical pesticides or fertilizers. This does not include organic alternatives that can be used but according to the measures established by the general fertilizers and pesticides law.

Once a farmer decides to make the transition, the whole productive land of the agri-business must be involved. Before a farmer is legally entitled to sell its products with an organic certification, a forced time for conversion of three years is needed. During this period, the farmer is entitled to use the productive land at the condition that the sustainable agricultural practices of the organic policy are followed.

The main costs are determined by the conversion time and forced resting periods in the case of seasonal crops. These costs are outbalanced by the financial aid provided by the policy. The market price of Bioproducts and conventionally produced ones is quite close, keeping the profit range low.
Farmers can access financial funding for the conversion only once they have converted to organic farming. The financial reward for the transition equals eighty euros per hectare.

Like the consortium for Gis, the organic farmers have started to split up from general farming unions. They have created, in some cases in Italy, their farming unions called Bio-districts. The bio district is a new concept that mixes the idea of the Gis consortium with the participation of institutions but does not guarantee market engagement like the GI consortiums.

The bio-district includes the active participation of institutions, local municipalities, and technical offices. Nonetheless, it does not guarantee market engagement like the GI consortiums. Participation is open to all farmers, but only active members have the right to decide following initiatives. Differently, from the GI association, the bio district includes the active participation of local institutions. Farmers pay a quote for registration, but this does not determine their influence on decision-making. Only agri-businesses that have converted all their land use to organic can register.

The Bio district focuses on promoting organic products and involving local communities.
It aims to create a network of organic farmers within the borders and to simplify policy and bureaucratic procedures. The bio-district relies on territorial borders that do not match institutional ones.

CONCLUSIONS ON THE COMMON AGRICULTURAL POLICY (CAP)

Even if there was no direct interview with agri-food businesses that have applied for the Common agricultural practices, it was possible to deduce why the interviewed farmers did not choose to apply for it. The general opinion indicates that CAP, PSR, and national funds are difficult to access for small farming realities and often restrict the field of action of the farmers too much. They do assess slowly to the rising cost of production and unexpected causalities. They do not have a local farming association or consortium.

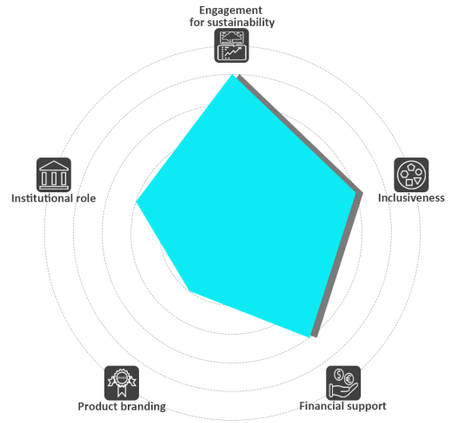


Figure 167 - Efficiency test of the BIO policy.

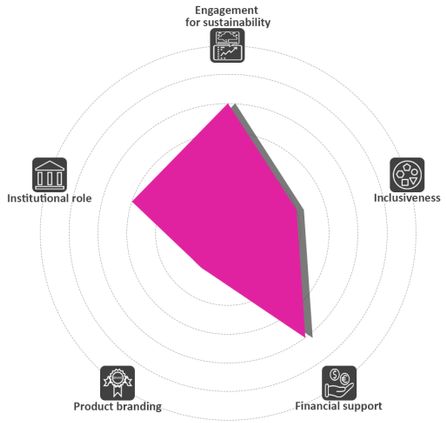


Figure 168 - Efficiency test of the CAP policy.

Figure 169 - Azienda agricola Castevecchio, Peccioli, Tuscany, one of the interviewed agribusinesses, by author.

SWOT ANALYSIS

The second section of the analytical framework, "Investigating the potential of existing policies," aimed to answer the research question about how much Certificates are sustainable. While evidence from the literature emphasises the socio-economic benefits of Certifications, not much is researched about their environmental sustainability. These two hypotheses have proven to be less realistic during the field investigation. GIs, for example, can indeed become strong enough to positively influence an agri-food system's environment.

However, the policy surrounding it makes it an inefficient tool, in cases of lower participation. The certificates also present more problems in the socio-economic structure than expected, particularly in the consortium that has the tasks to promote, protect and modify the disciplinary.

The information collected from the interviews is crucial to understanding trends and patterns that cannot be captured on paper.

In fact, all three policies surrounding certifications seem somehow incomplete in one or the other aspect. GIs remain inaccessible for many smaller farmers due to the high application costs and inadequate funding provisions. Instead, the policy for organic farming and the Cap present themselves as generalised and unsuitable for local-scale strategies.

The same happens to farming unions or consortiums. If, on the one hand, the GI consortiums neglect the inclusiveness and participation of institutions in the consortium's activity. The organic farmers' unions (in this case, the bio-district) are not involved in creating market and branding strategies for their members.

It is possible to conclude that, the fact that all three policy types that describe the certificates lack efficiency in some way or the other. The lack of efficiency is the leading cause of the low participation of agri-businesses. Consequently, their influence on the sustainability and vulnerability of the system remains weak.

Figure 170 -Fattoria il Poggione s.s., Terricciola, Tuscany, one of the interviewed agribusinesses, by author.

	Strenghts	Weaknesses
GIs	EN- Restricts the use of water, fodder, and intensity of production. EN- Most of the crops, especially permanent crops such as wine and oil, are also certified as biologic. BR- GIs guarantee for stable market value. BR- GIs give an identity to their region, this increases the interest and demand for the product.	EN- Gis do not restrict the use of chemical pesticides or fertilisers. BR- Smaller GIs do not improve market value of the products. IN- GIs must go through several authorisations to be approved. IN- Gis have long application times for farmers. EN- The tool is not mandatory for all farmers within the borders of a GI. FS- High costs for yearly chemical examination made by certified exami nation centres. FS- No governmental funding is provided for the conversion to GIs. IN- The costs for maintaining a GI are higher than the profits for most farmers. IN- Many agri-businesses had to conform to the GI only to maintain the geographical name on the label. IN- Small realities practice according to GI rules but do not want to work through the bureaucracy. EN- Successful GIs can lead to an excessive specialization of the region. IN- GI attracts big investors and favours monopolization of the market niche. EN- There is no limit to the size of certified businesses. IS- Consumers' mistrust the institutions in charge of the quality control. IS- Most farmers do not believe in GIs and the consortium.
Consortium	BR- The consortium promotes and protects the certificate's name. IS- It proposes changes in the laws concerning it. FS- The consortium facilitates bank loans for members of the consorti um.	IN- Agri-businesses that pay a higher quote have more influence on con sortiums' decision-making. IN- This makes it easy for big businesses to propose changes in the disci plinary. IS- The "Consorzio" is not necessarily created with the creation of the GI. IS- Most GIs that represent smaller realities do not have an active Con sorzio. IN- Farmers can be certified but are forced to participate in the Consor- zio IN- Only certified farmers can become members of the consorzio. IN- An additional quote member must pay to the consortium based on size and production of the agri-business. IS- The borders of the GI do rarely match with the provincial or munici pal border.
Organic	EN- The law concerning Organic farming does restrict the use of chemical pesticides or fertilizers. EN- The time for conversion to biologic is three Years. IN- It does not cover a specific product as for the Gis. FS- More and more farmers are switching from GIs to Organic. FS- It provides financial supports for conversion.	FS- For seasonal crops, the resting time imposed by law decreases pro duction drastically. FS- Main costs are determined by the conversion time. BR- The market price of Bioproducts and conventionally produced ones is quite close. IN- Farmers can access funding once they have converted to organic farming.
Bio district	IS- Includes the participation of local municipalities and technical offic es. IN- Participation is open to all farmers, but only active members have the right to decide following initiatives. IN- Farmers pay a quote for registration, but this does not determine their influence on decision-making. EN- Only agri-businesses that have converted all their land use to organ ic can register. IN- It focuses on promoting organic products and involving local com munities. EN- It aims to create a network of organic farmers within the borders. IS- It aims to simplify policy and bureaucratic procedures.	BR- Does not guarantee market engagement and product branding. IN- Includes a participation fee. BR- Does not have a distinctive certification label. IS- The bio-district relies on territorial borders that do not match institu tional ones.
CAP		IN- Difficult to access for small farming realities. IN- Restrict the field of action of the farmers to much. FS- They do assess slowly to the rising cost for production unexpected causalities. IS- CAP farmers are not represented by a specific farmer union. IS- They fall under the representation of general provincial associations.

EN = Engagement for sustainability IN = Inclusiveness FS = Financial support BR = Financial support IS = Institutions

Figure 171 - Swot analysis, organizing the findings of the interviews.

LIST OF POLICY PRINCIPLES

The last two sections of the research have given a good insight into the physical and formal criticalities. Before stepping into the strategy section, it is crucial to define, as for the spatial impact of the policy, a list of principles that should be respected in the framework of the new policy.

By looking at the bigger picture, it becomes clear that these policies' weaknesses and strengths are in some way complementary. For example, the specificness of GI policies, each referring to a single region and to a unique certificate, is what the organic farming policy is missing and what organic farmers are trying to put into practice through the bio district. Therefore, the idea of merging the existing tools into one becomes plausible. The combined policy cannot replace the old ones in the short term but needs to explore a slow transition towards a gradual replacement.

Of course, adjustments are necessary. Some of the general aspects and principles behind the existing certifications contrast with each other. Therefore, only a specific number of general aspects of each policy can become helpful instruments to be used in the framework for the merged policy. Identifying the best combination between the three policies becomes possible if two factors are considered.First, the hypothesis is that the policy's efficiency depends upon five key topics (engagement for sustainability, inclusiveness, institutional role, financial support, and branding). Second, the discovered strengths and weaknesses of the policies.

Since every single strength or weakness is connectable to at least one of the five key topics, it is possible to evaluate the performance of each policy for each key topic. Using a scoring system can help measure the policies' efficiency. For each topic, one policy will score higher than the other two. To build the principles behind the new framework, the five best scores are selected and reconducted to the principles of the existing policy that defines them. Suppose two or all three policies have the same score for one of the aspects. In that case, it is up to the research to define if just one of the policies is considered or if combining the policies' characteristics is a more efficient solution.

In the graphic (figure 172), the three scores are overlayed. This makes it easy to observe which of them is most suited to obtain efficiency for that specific topic. Regarding engagement for sustainability and inclusiveness, the organic farming policy represents the highest score. For product branding, the most efficient policy remains the Geographic indication.

Both these scores are valid for situations where consortiums and bio-districts are active on the field, as is the case for the Valdera region. Financial support and Institutional role have more than one score with the same value. It is so with best to consider the policy that is more suited for local-scale interventions, excluding so with the CAP from the very beginning. It is now proven that GIs lack an efficient funding system for financial support, while some funds are provided to organic farmers. In the case of institutional roles, both have their strengths and weaknesses, so combining them is the most suited solution.

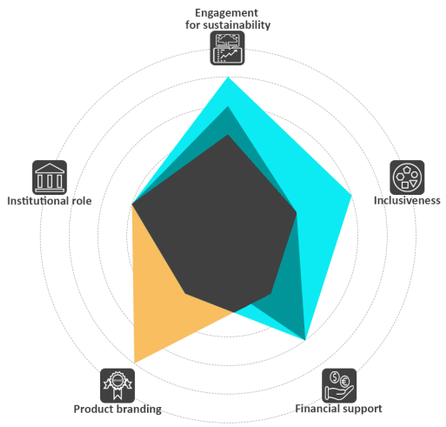


Figure 172 - Compared efficiency tests, GI (yellow), BIO(turquise), CAP (blue).

SPATIAL PRINCIPLES

1 - Engagement for sustainability

(a) The policy engages in banning chemical pesticides and fertilizers.
(b) The policy and consortium engage in the protection and regulation of the use of local water resources.
(c) The policy and consortium engage in protecting fertile soil from erosion and eutrophication.
(d) The policy and consortium engage in the protection of biodiversity and preservation of natural spaces.
(e) The policy engages in preserving crop diversity and landscape quality.

2 - Inclusiveness

(a) The application costs for single members should be affordable and proportional to the size of the agri-business.
(b) The bureaucracy for the application procedure of single members should be simplified.
(c) The activities of the consortiums should allow the participation of non-members.
(d) The membership for consortiums should be extended to not only agri-businesses but also local residents, retailers, and field specialists.
(e) Power in decision-making should be equal for all associated producers.

3 - Institutional role

(a) The policy defines the active participation and the role of local municipalities in the governance of the certification.
(b) The policy contains a framework for assessing and creating new certifications.
(c) The policy guarantees the creation of a consortium for each certification and previous to the creation of the certification itself.
(d) The policy defines the role and composition of the consortium.
(e) Involved institutions and the consortium are responsible for strategy development to increase participation.

4 - Financial support

(a) The policy provides financial support to farmers in different stages of the transition.
(b) The policy financial support is proportional to the different assessments the agri-business has to fulfil.
(c) The available funding system of the policy favours small agri-businesses.
(d) The consortium simplifies the accessibility to loans for the farmers that apply for the certification.
(e) The consortium has the role of an intermediary between associates and wholesalers for input materials to obtain better prices.

5 - Product branding

(a) The logo communicates the specific quality of the product and guarantees that specific sustainable agricultural practices were used during the production steps.
(b) The logo indicates the geographical area of provenience of the certified products.
(c) The logo includes the denomination of the designated geographical area.
(d) The consortium provides a marketing strategy for the certification.
(e) The consortium is in charge of the governance of the monitoring system to guarantee quality and law compliance.

Figure 173 - Policy principles, goals set for the new policy.

ACTIVATING THE POTENTIAL OF EXISTING POLICIES

GEOGRAPHICAL INDICATED BIO-DISTRICT

The analysis of Certifications, the strategy's tool needed to achieve a sustainable agri-food system, highlighted many issues in the juridical structure. Problems that negatively affect the impact that Certifications have on the agri-food system and that make them less efficient for sustainable agriculture than not what they could be. Still, there is potential in merging the GIs and the bio-district concept to develop a new certification that certifies organic products with specific qualities related to the geographical area of provenience.

This means that the aim is to take out the concept of GIs to certify products linked to a specific Geographical indication that closely connects with particular qualities of the product. Merging the previously mentioned concept with the one of the bio districts to promote environmental sustainability through organic farming, stakeholder engagement, biodiversity, and local traditional cultures. In addition to the two concepts, a set of rules, such as a minimum percentage of organic surface, must be established. These rules are defined by a combination of principles set in the first place to cope with environmental criticalities and elements contained in the policies of existing tools.

Using as many existing policies for the needed intervention as possible will simplify the approval process for the new policy as it relies on existing measures. Since the policies considered for building a new strategy are not mandatory, selecting the rules to be included in the new policy might not create the wanted effect. Knowing what effects each rule might have if displaced on the full scale of action is essential. This means it is helpful to know what would happen if the policy switched from participatory to mandatory, as it gives more precise insight into the outcome it would create. The research puts a strong emphasis on achieving this specific knowledge before stepping into decision-making for the new policy framework.

Creating a new tool could influence farming practices and current market trends. Currently, most consumers choose organic products because they believe in their positive impact on health. Rarely is the choice made primarily for a more conscious and sustainable or ethical reason. The consumer does not know that it is impossible to produce fully organic products at the status quo as our natural resources (water, soil, air) are strongly polluted and influence organic crops. For example, when an organic farm has neighbours that practice conventional farming activities that make use of chemical products, it will indirectly receive part of the chemicals through winds, infiltration, evapotranspiration, and rainfalls. The current certification for organic farming does not make any distinctions between organic farmers and their surrounding environment. All producers are labelled as the same organic food product making it difficult for small niches to distinguish on the market.

Creating a GIB (Geographical Indicated Bio district) makes it possible for consumers to distinguish organic products. Recognizing the ones that come from an area where a good part of farmers produces organic can guarantee together with the integrity of natural resources for future generations and the quality and healthiness of the products.

The strategy develops in 6 main steps. It starts with the maximization method. The technique maximizes the spatial influence of each of the three non-mandatory policies surrounding sustainability (GIs, Organic and CAP) to observe their maximum impact on critical aspects. The best score for each of the five criticalities is selected and combined (soil erosion, soil contamination, water contamination, water use and biodiversity). The output of this method phase is also called an optimization phase. The optimization map is then, in an ultimate step, combined with external factors, in this case, the principles listed at the end of the research by design and policy chapters. The outcome, the integration map, can be considered the backbone of the main rules behind the framework for the new certification policy. The policy is interpreted and evaluated on a local scale in different contexts. Finally, the rules for the governance of the certification are included.

METHOD MAXIMIZATION

"A scenario can be regarded as a story about the way the world might turn out tomorrow. ("Scenario Building | SSWM - Find tools for sustainable sanitation and ...") Because there are numerous possibilities of how the situation can be in the future, a scenario cannot be considered as a specific forecast of the future" (Widler S., 2005).
The maximization method is just a way to approach scenario development. It focuses on maximizing different previously selected topics to see what consequences they might have on the structure of the selected site.

Aim: In the first steps of the maximization method, the research has the opportunity to identify the potentialities and threats that each maximization map causes. In the successive optimization, the representation of the optimal outcome is shown. At the same time, the Integration map induces the possibility of developing a draft policy scheme that merges the optimization map with the list of principles.

MAXIMIZING EXISTING POLICIES

Scenarios always include an essential part of speculation and intuitions. Still, they can become valuable instruments for decision-making in the strategy. Two different methodologies were chosen and applied in the study.

First, the method of maximization (learned and used in AR3U110 Q5 Integrative intensive, designing with flows: Applying the maximization method). Second is the efficiency scenario test methodology, where the draft plan is tested on a local scale. This helps to define if the results of the large-scale decisions have the same effects on all sub-systems or not. The second one plays a marginal role compared to the first one as it is used to evaluate results during the reflection. In contrast, maximization is used during the process as the primary tool to build the framework itself.

The structure behind the maximization process remains quite the same as the standard model (see figure 174). It maintains all the different steps, beginning with the maximization, continuing with optimizing and finalizing with the integration part. What does change is the main aim of the method. In the case of the research, this means understanding the consequences that environmental sustainability must face when one of the different policies (Certifications, organic farming, and general European CAP) is extended to all farming activities in the region (or maximized). The maximization helps us to understand the full potentiality of a policy. It does not express the goal of a stakeholder as it does in the standard procedure.

While in the traditional process, each maximization map represents the best possible outcome for each of the involved parts and answers the question, “what would it look like if that stakeholder would decide?”. In the maximization process used in the research, each maximization map will answer the question:” what if all farmers apply for a GI/ organic or CAP certification?”.

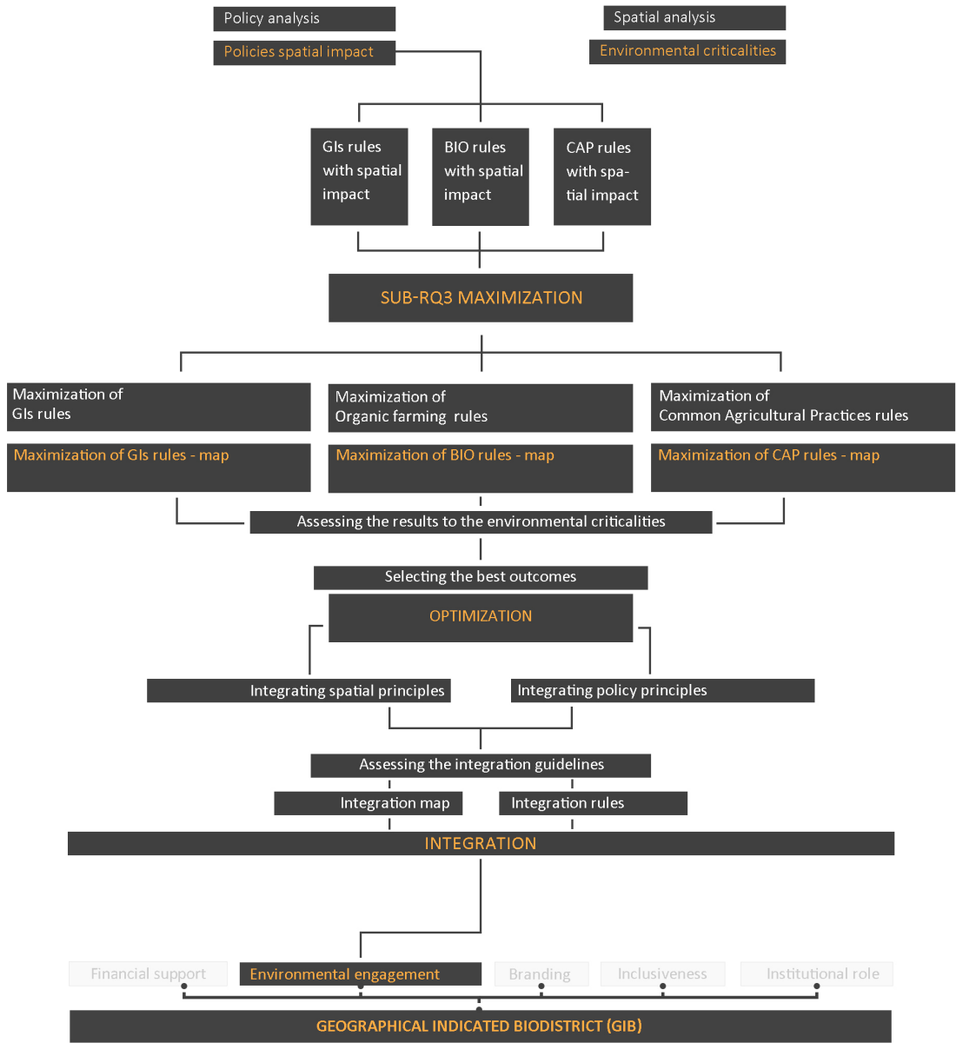


Figure 174 - Maximization process.

To answer this question, the table from the chapter "Engagement of policies for sustainability" is used as base information (see page 139). Not all the elements in the table are mappable, but they all influence spatial trends that can be mapped in some way. The resulting scenarios represent a possibility to deeper comprehend the strengths and weaknesses of each agricultural practice, and their impact on sustainability topics becomes quantifiable.

Once the maximization maps are drawn, each layer is compared with the "Layer approach" maps, and its influence on the criticalities is defined. The layers that share an effect on the same criticality are merged, and through QGIS tools, their intersection with the critical area is subtracted. This results in a clear indication, in numbers, of the new risk area and the amount of decreased risk surface. The smaller the new risk area, the better the outcome of the maximization for environmental sustainability. Once all three policies are maximized, all necessary tools are ready, and the optimization phase can begin.

The report only illustrates the results of each of these processes, but one example was included to clarify the technique behind the maximization. In figure 175, it is possible to read about each policy's identified spatial influences. In figures 176 and 177, the focus shift to one of the aspects in specific, the first one of Gis.

This aspect of the Gis implies that no land above 700m of altitude is suited for production. If the policy is maximized, this indicates that all productive land that exists at the status quo is withdrawn from production. Meaning that this land is now open for the expansion of new natural spaces, leading it to influence several critical issues.

For example, if natural spaces replace productive land, this will lead to decreases land occupation of seasonal crops on high slope areas or chemical use on high permeable soils. The criticalities that each aspect influences are so with identified and categorized as they represent a piece of valuable information needed for the next phase.

RULES WITH EFFECTS ON SPATIAL CRITICALITIES

ORGANIC FARMING POLICY

1A - *Grassing in the high-risk months on grasslands and other seasonal crops. Grassing between the rows of permacultures. Resting period every two years for each agricultural land unit. The whole agribusiness is convicted to the rules for organic production and must fulfil a 3-year resting cycle before the approval.*
1B - *Only the use of non-chemical products is allowed (they can be chemically processed have to be made of natural ingredients)*
The forced resting period for land units influences Indirectly the size of land units and the diversification of production.

GEOGRAPHICAL INDICATIONS

1E - *The typology: only a set of specific animals or crops has to be used. Most of them are indigenous species.*
3C - Land use limitations on altitude. Land use limitations on slope.
3D - Land use: limitations on soil composition.
3E - *Nourishment: how much can be fed to the animals, how much can fields be irrigated. The Costs: High costs assessment force smaller business to merge into associations or abandon productive land.*

COMMON AGRICULTURAL POLICY

1A - *Protection of water from pollution caused by nitrates from agricultural sources.*
1C - *Making the use of water in agriculture more efficient.*
1D - *Protection of groundwater from pollution: prohibition of direct discharge into groundwater and measures to prevent indirect pollution.*
1E - *Minimum soil cover for highly erosive soils.*
1G - *Maintain soil organic matter levels through appropriate practices, including a ban on stubble burning, except for plant health reasons*
1L - *Maintenance of landscape features, including, where appropriate, hedges, ponds, ditches, trees in rows, in groups or isolated, field edges and terraces.*

In red - the chosen policy rules to explain the maximisation process.

Figure 175 - List of rules that have some spatial influence.

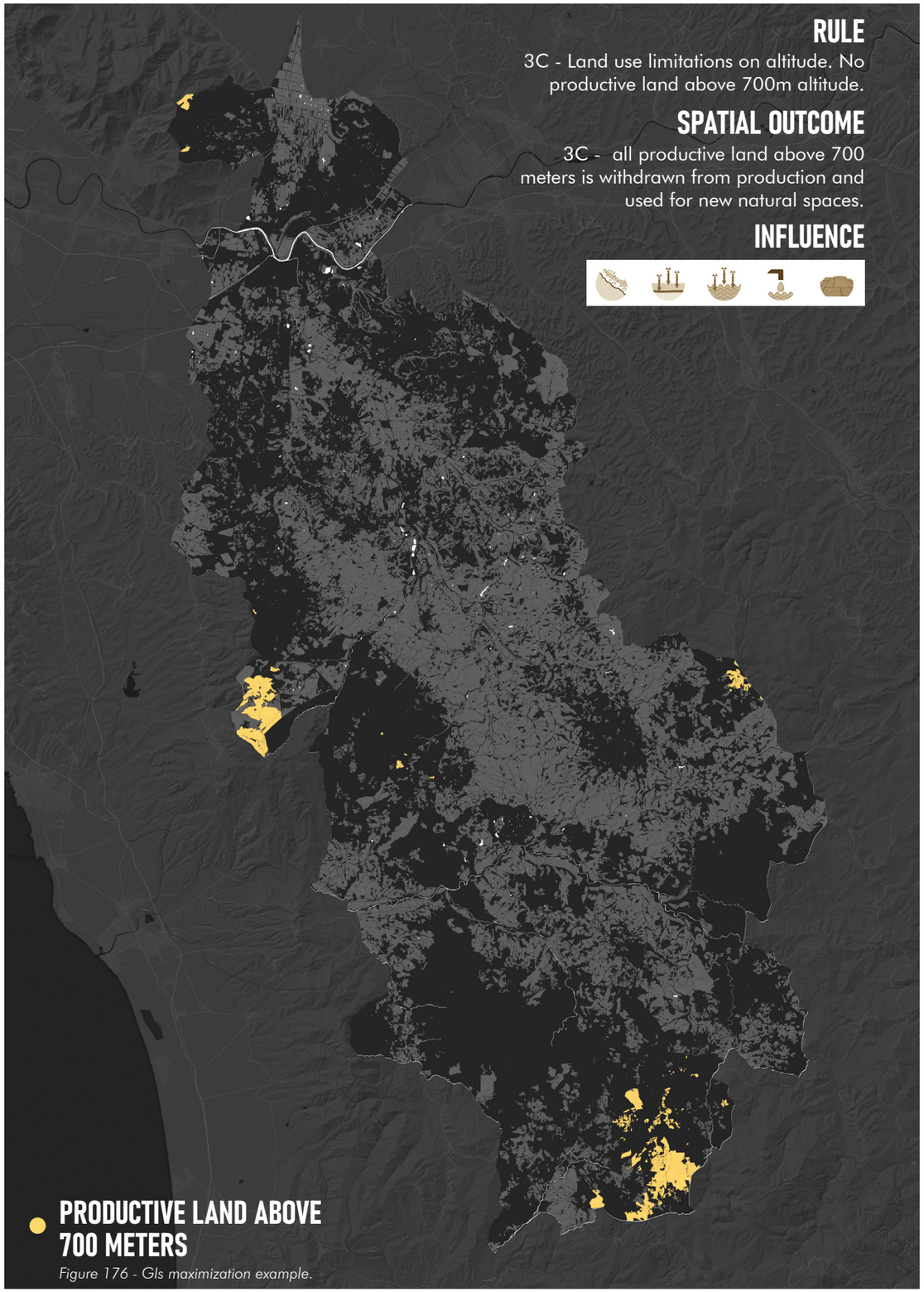


Figure 176 - Gis maximization example.

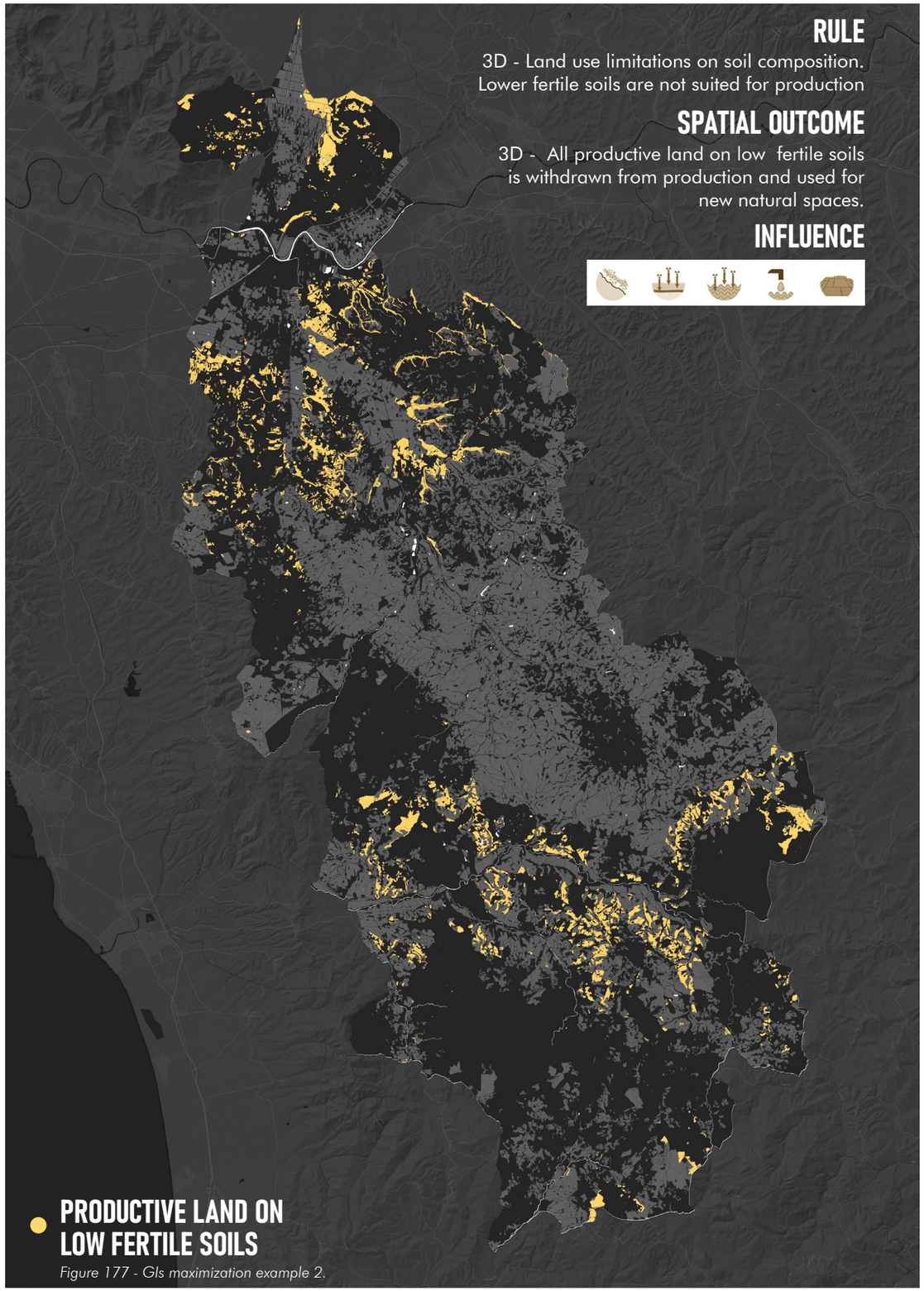


Figure 177 - GIs maximization example 2.

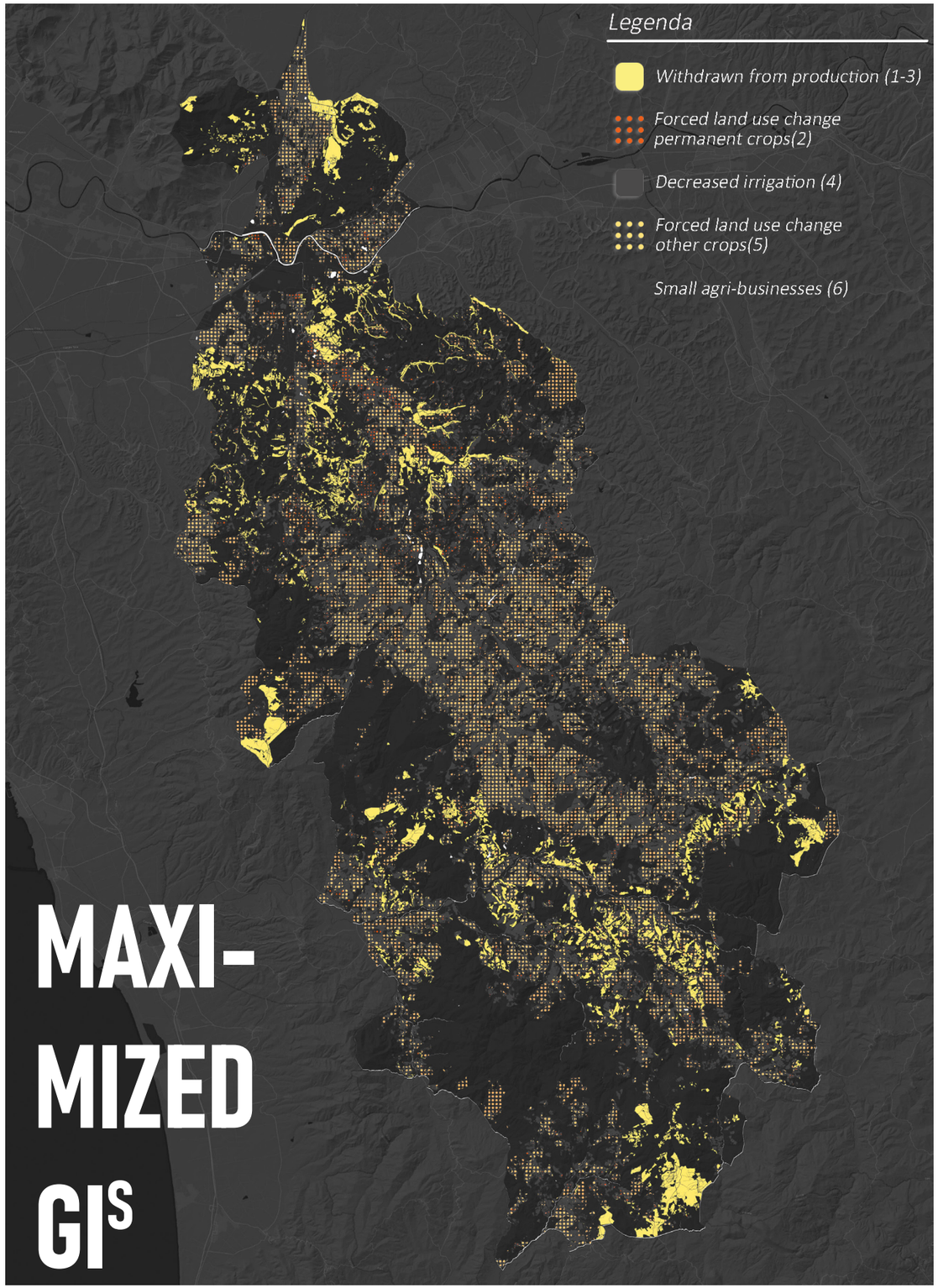
Figure 178 - Excessive soil contamination increases the risk of fertility loss.

In the chapter "engagement for sustainability," only the general aspects contained in the policies that directly affect farming practices and so with the spatial structure of the productive land were selected.

Other known factors might have indirect influences, but these are not quantifiable and so not suited for maximization.

Regardless, each of the chosen rules contained in the policy has a direct spatial effect, and subsequently, the spatial impact will influence spatial criticalities. The maximization method aims to observe to what extent the policies can influence spatial criticalities in a scenario where the full potential of the policy is expressed.

In the maximization phase, the first necessity is translating the general restrictions into spatial outcomes.



MAXI-MIZED GIS

MAXIMIZING GEOGRAPHICAL INDICATIONS

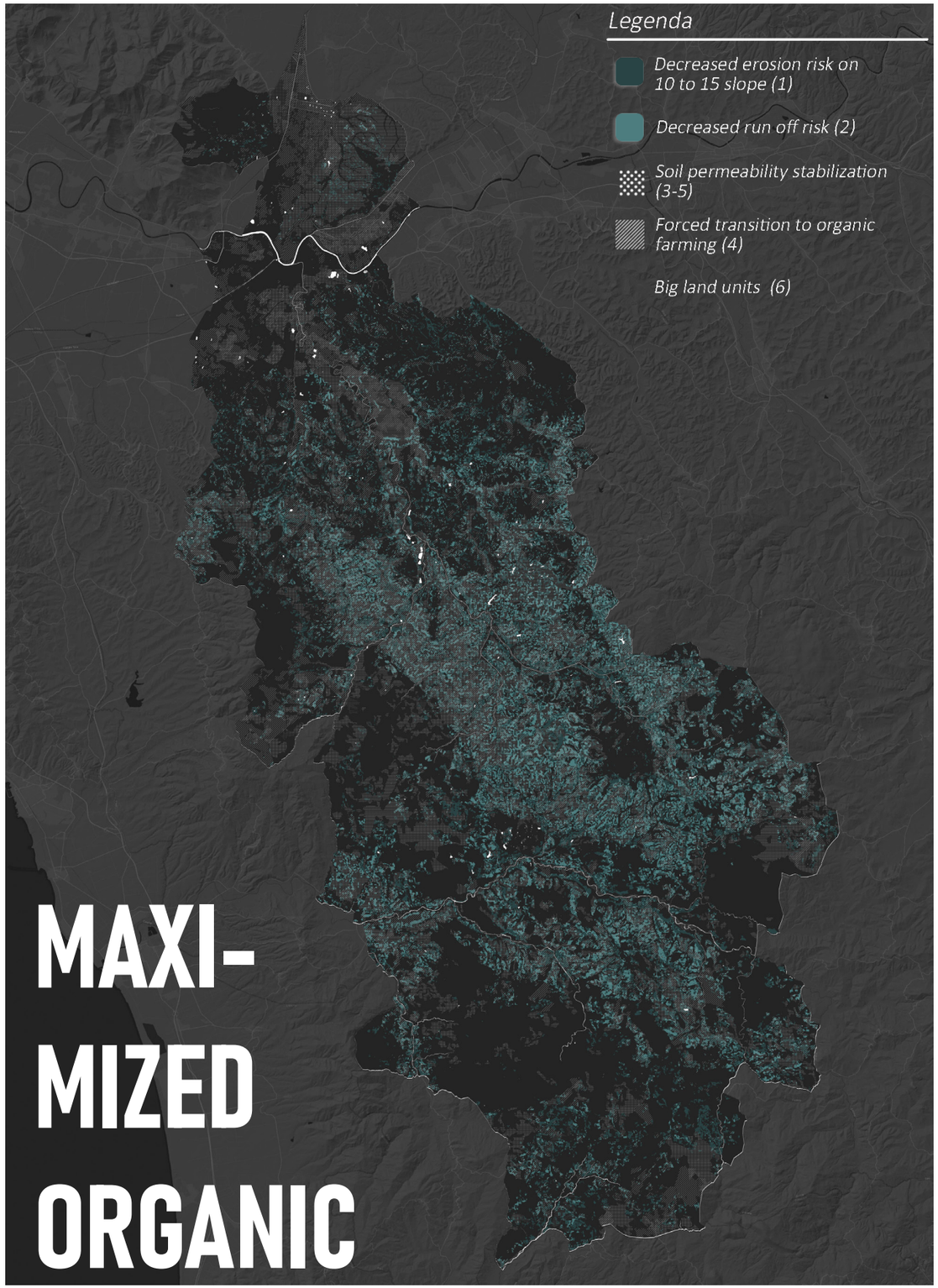
In the case of Geographical indications, six rules were selected from the policy. Of the selected rules, some of the effects are very straightforward and do not need much explaining, but some of them are less intuitive and require more attention.

The straightforward ones consist of points number one, three and four. The first and third general aspects indicate restrictions on productive land qualities, while the fourth clearly states the limitations on resource consumption. Rule number one has been used as an example to explain the method. It imposes that no productive land can be above seven hundred meters of altitude, influencing all five critical aspects. The third point defines that low fertile lands are not suited for agricultural activities and has so with the same effect as the first one but applied to different areas. The fourth aspect imposes a strict limitation on the use of resources. This includes water used for irrigation, and the direct effect is a decreased surface of high irrigation use.

The other general aspects are way less intuitive. Points number two and five impose restrictions on land use. While the second point does not allow permanent crops in low-slope areas and so with indirectly pushes permanent crops into high-slope areas and decreases soil erosion risk. The fourth imposes restrictions on the typologies of crops grown able in the area, forcing land use change for all productive land that is not directly involved in the production of a GI-certified product. It plays a significant role in influencing soil erosion risk and water use inefficiency. This is because the food products certified as GIs depend mainly on permanent crops and crops with medium to low water demands. The sixth and last general aspect differs from the others, as it is not a rule included in the policy but a conclusion drawn from the interviews. During the interviews, a discovered trend was that farmers merged into corporations. This allows them to assess the costs of a GI that they otherwise would not be able to afford. It directly impacts the size of small agri-businesses and can influence the risk of monoculturalization.

GEOGRAPHICAL INDICATION		Affected spatial criticalities				
		Soil erosion	Soil cont.	Water cont.	Water use	Biodiv-ersity
GENERAL RESTRICTIONS	**SPATIAL OUTCOME (MAXIMIZATION)**					
1• Land use limitations on altitude: No productive land allowed above 700m altitude.	• All productive lands above 700m are withdrawn from production.	✓	✓	✓	✓	✓
2• Land use limitations on slope: No permanent crops (orchards olive groves or wineyards) on low slope areas.	• All permanent crops on low slope are forced to land use to seasonal crops.	✓				
3• Land use limitations on soil composition: Lower fertile soils are not suited for productions	• All productive lands on low and low-medium fertility soils are withdrawn from production	✓	✓	✓	✓	✓
4• Nourishment, how much can be fed to the animals, how much can fields be irrigated: Irrigation is kept to the minimum possible.	• Decreases the irrigation demand of all productive land by 1 point.				✓	
5• The typology: only a set of specific animals or crops has to be used. Most of them are indigenous species.	• All productive land not included in a GI production chain is forced to land use change.	✓			✓	
6• The Costs: High costs assessment force smaller business to merge into assosiations or abandon productive land	• All business smaller than 2 hectares merge into business with 15 hectares avarege					✓

Figure 179 - GI maximization map, Valdera.
Figure 180 -Table of policy rules, their spatial outcome and the impact it has on the environmental criticalities.



MAXIMIZING ORGANIC FARMING

Of the six aspects, this time, only one is straightforward, while the other needs further clarification. The straightforward point is number four. Rule four states that organic farmers cannot use any chemically produced phytosanitary. This makes it clear that if the organic policy is maximized, the ban on chemical products will be extended to all farmers in the region.

As said, the other points are less intuitive. Following a chronological order, number one imposes grassing practices in high-risk months and on seasonal crops in sowing seasons. This practice guarantees an almost permanent soil cover leading it to be less exposed to soil erosion, especially in medium slope areas (between 10 and 15%). The second rule, like the first, imposes grassing practices between the rows of permacultures. As a result, it increases the quality of soils and their water retention capacity, decreasing the amount of runoff water in high-slope areas and the inefficiency of water used for irrigation. Rule numbers three, five and six can seem very similar but differ in general aspect and spatial influence.

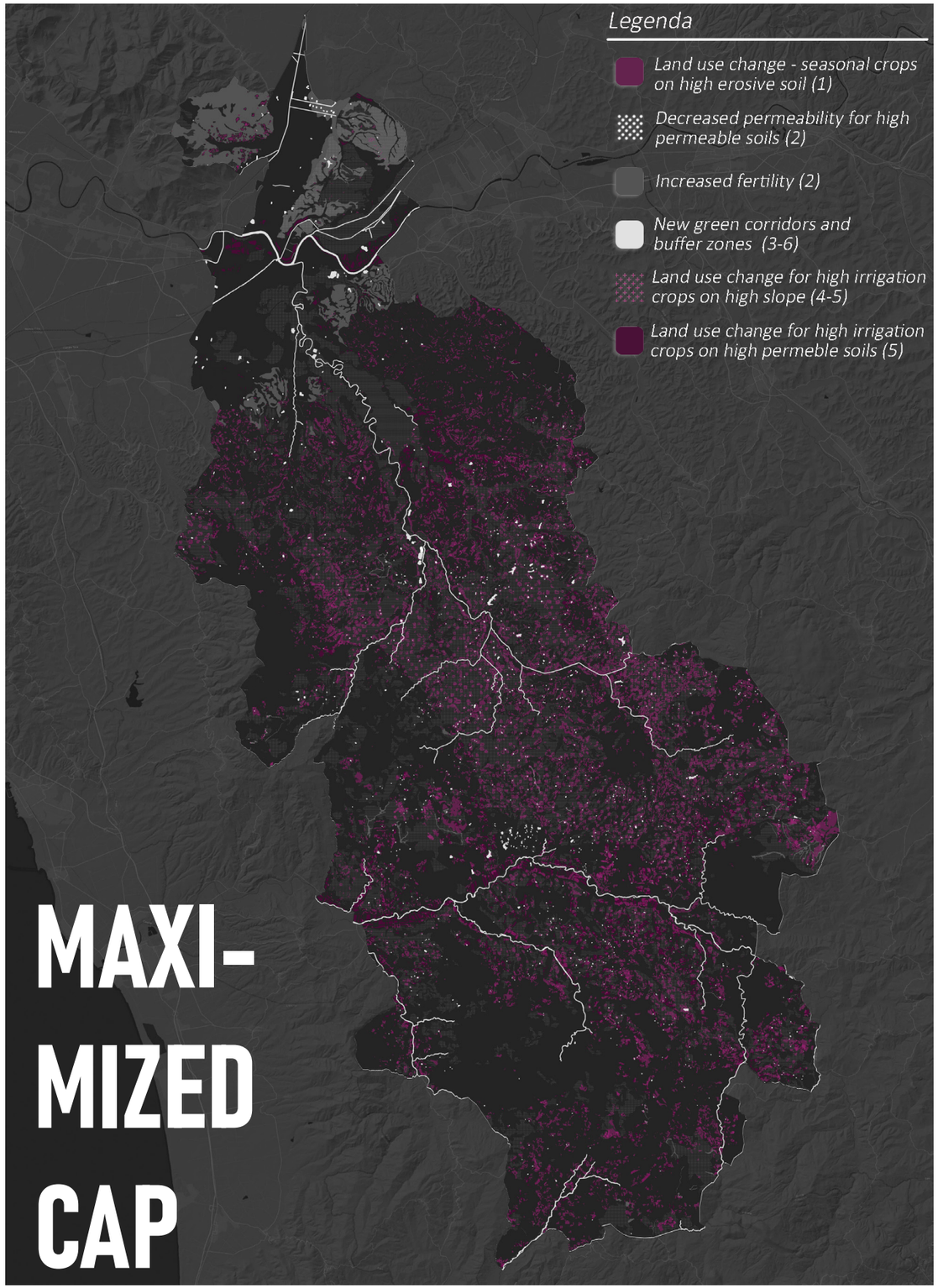
While number five indicates the mandatory resting period of three years that an agri-food system is forced to do before it becomes certified as organic, three and six refer to the rotation system an agribusiness is forced to do once it practices organic farming.

The three years of resting period refers to the use of chemical products. Fields can still be used for production but without the use of chemical products, and the agribusiness is not entitled to use the organic certificate for the first three years. The initial resting period improves soil quality and influences so with soil contamination and water retention of the less contaminated soils. The resting period referred to in points three and six is a resting period that must be applied to all organic land also after having applied for the certification. This resting period decreases the intensive use of soils and so of its eutrophication. The policy has two effects; the soil has higher water retention capacities and leads the agricultural businesses to assess land units organizing them into smaller plots that improve the rotation system.

ORGANIC FARMING

	GENERAL RESTRICTIONS	SPATIAL OUTCOME (MAXIMIZATION)	Affected spatial criticalities: Soil erosion	Soil cont.	Water cont.	Water use	Biodiversity
1	• Grassing in the high-risk months on grasslands and other seasonal crops.	• Protects seasonal crops on 10/15% slope from soil erosion	●				
2	• Grassing between the rows of permacultures.	• Decreases run off water on high slope land (above 10% and beneath 15%)				●	
3	• Resting period every two years for each agricultural land unit.	• Decreases soil eutrophication (decreases permeability by by 1 point for high permeble soils)				●	
4	• Resting period every two years for each agricultural land unit.	• Ban for chemical products extended on all productive land		●	●	●	
5	• Only the use of non-chemical products is allowed (they can be chemically processed have to be made of natural ingredients)	• Increases soil fertility by 1 point • Increases the value of low permeability soils by 1 point		●		●	
6	• The forced resting period for land units influences indirectly the size of land units and the diversification of production.	• Land units over 50 hectares are splitten up into 20 hectares units or smaller					●

Figure 181 -Bio maximization map, Valdera.
Figure 182 -Table of policy rules, their spatial outcome and the impact it has on the environmental criticalities.



MAXI-MIZED CAP

MAXIMIZING THE COMMON AGRICULTURAL POLICY (CAP)

The third maximization interests the Common agricultural policy. In the Common agricultural policy, the general aspects are often just guidelines that must be interpreted in some way to understand the spatial impact they might have.

As a matter of fact, the CAP is a European policy and includes mainly general indications as they must fit into very different contexts across the union. With the PSRN, the national version, the aim is to make the policy more site-specific. Still, again the policy seems to put upfront a list of suggestions and ambitions but does not indicate the rules farmers have to stick to.

As for the other two maximizations, six general aspects were selected for the maximization (this coincidence was not forced).

Again, explaining the thought between the steps is essential to understand why they could unfold in the chosen way. Also, for these rules, the subdivision into straightforward and complex ones is possible.

On one side, general aspects number one, three and six are direct, while on the other, number two, four and five are way less intuitive. In the first group, number one makes evident suggestions on a minimum soil cover for erosive soils, influencing the soil erosion risk positively. Roles three and six instead make clear statements concerning green corridors for the maintenance of landscape futures or water protection. This reduces the productive land surface and influences all five of the critical aspect (as seen in the first and third points in “Maximizing geographical indications”).

COMMON AGRICULTURAL POLICY

	GENERAL RESTRICTIONS	SPATIAL OUTCOME (MAXIMIZATION)	Affected spatial criticalities: Soil erosion	Soil cont.	Water cont.	Water use	Biodiversity
1	Minimum soil cover for highly erosive soils.	• Land use change for seasonal crop on high erosion soils	●				
2	Maintain soil organic matter levels through' appropriate practices, including a ban on stubble burning.	• Increased fertility for low fertile soils by 1 point • Increased water retention for high permeble soil by 1 point			●	●	
3	Protection of water from pollution caused by nitrates from agricultural sources.	• Introduction of buffer strips along the waterways (20m), prohibition of the use of fertilizers.	●	●	●	●	●
4	Protection of groundwater from pollution: prohibition of direct discharge into groundwater and measures to prevent indirect pollution.	• Land use change for high irrigation crops on high permeable areas				●	
5	Making the use of water in agriculture more efficient	• No high-irrgation crops on slope over 15% • No high irrigation crops on high permeable soils				●	
6	Maintenance of landscape features, including, hedges, ponds, ditches, trees in rows, field edges and terraces	• Increased number of green corridors (10m) crossing the productive clusters (land units over 50 hectares)	●	●	●	●	●

Figure 183 -CAP maximization map, Valdera.
Figure 184 -Table of policy rules, their spatial outcome and the impact it has on the environmental criticalities.

Topic		Topic	Area (he)	Percentage (%)	Geographical indication		Organic farming		Common agricultural policy	
					New area(he)	Difference(%)	New area(he)	Difference(%)	New area(he)	Difference(%)
Valdera		Natural spaces on tot. area	56,892.50	42.31	83,851.79	47.39%	56,892.50	0%	57,223.95	0.58%
Soil erosion		Seasonal crops on high slope	25,779.10	19.66	9,104.80	-64.70%	14,068.60	-45.43	23,246.20	-9.83%
Soil contamiantion		Conventional farming on low permeability	14,951.30	52.93	15,645.80	+4.65%	0	-100%	13,801.30	-7.69
Water contamiantion		Conventional farming on high permeability	37,866.60	35.67	39,897.10	+5.31%	0	-100%	15,272.60	-59.69%
		Conventional farming on high slope	15,939.80	12.16	28,445.60	+10.34	0	-100%	25,596.20	-0.71%
Water use		High irrigation on high permeability	58,166.60	54.75	1,399.99	-97.59%	13,349.60	-77.05%	44,817.00	-22.95%
		High irrigation crops on high slope	25,944.00	19.79	723.163	-97.21%	13,808.80	-46.78%	12,135.40	-53.22%
Biodiversity		Big size units oned by big businesses	3,311.98	7.67	3,311.98	0%	1,618.00	-51.15%	3,311.98	0

Figure 185 - Convertion of influence on criticalities into numbers and comparison with status quo, scheme 1.

Figure 186 - Convertion of influence on criticalities into numbers and comparison with status quo, scheme 2.

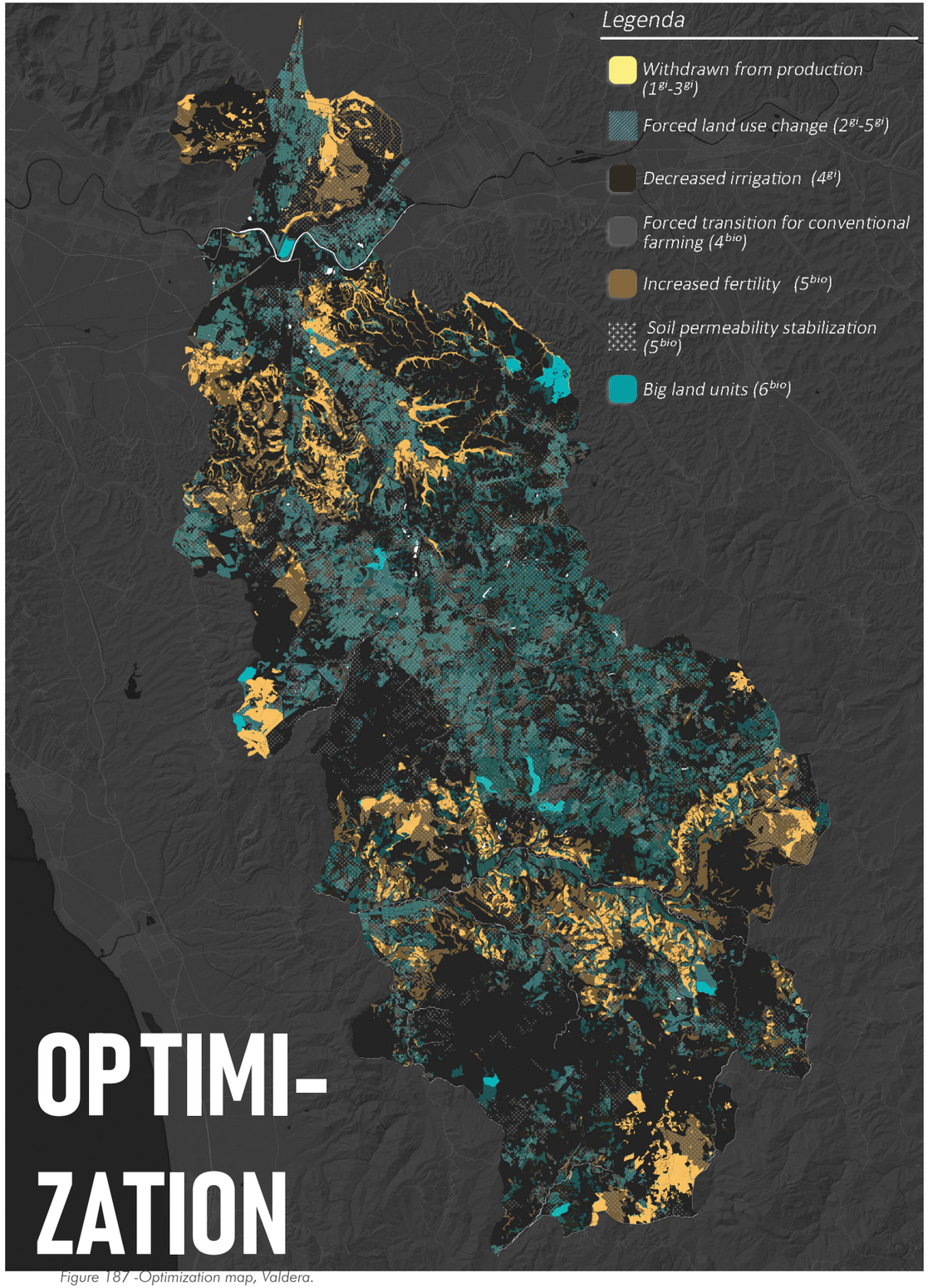
OPTIMIZING THE RESULTS

The optimization process also differs from the standard procedure. In the classic approach, optimization is obtained by confronting the previously created maximizations to identify possible conflicts and shared goals. Then negotiation between the parties starts to find a good compromise for all of them. In this case, the optimization phase does not involve a negotiation process, as no parts are involved. The maximizations consist in evaluating existing policies and not of stakeholders' expressions. It is the planner's task to evaluate the results of the maximization maps and define which of them has scored the best in terms of environmental sustainability, divided into the five crucial topics.

To determine the score each maximization has in terms of influence on spatial criticalities, a method like the intersection technique of the "research by design" chapter is used. This time the overlayed elements are the conditions that define a highly critical area (for example, seasonal crops, conventional farming, or high irrigation) and the spatial outcomes caused by the maximized general aspects of the policies. Six different general aspects are maximized in each of the three policy maximizations.
These general aspects influence one or more criticalities by increasing or decreasing their risk area. For each of the five criticalities, the risk area is recalculated after the addition or subtraction of the maximized general aspects. This way, it is possible to obtain all scores for the maximized outputs and pick the one that increases or decreases the defined area the most for each of the five sustainability issues. Only in the case of biodiversity loss the increased value of natural space occupation is considered positive.

In the case of this research, the best scores obtained are, the maximized Gi values for Soil erosion and water use. In contrast, the organic policy is the best score for biodiversity, soil, and water contamination. Once the best outcomes are selected, it can be possible to collect the different parts of policies that are responsible for the positive result.
In this phase, it becomes clear how important it is to define in the first place, in this case in the maximizations, what general aspects influence what spatial criticalities. The categorization makes it way easier to get back to the single maximizations and trace what the general aspects are responsible for the generated outcome. Putting these parts of the policies together could work as an improved mechanism. The process will then lead to the development of an optimization map.

This map expresses all positive attributes of the merged maximization methods. The optimization map is considered the spatial expression of the perfect policy regarding environmental sustainability. Still, it cannot be viewed as the final product of the maximization method to improve the results, and it must go through the last phase, integration.



OPTIMI-ZATION

Figure 187 -Optimization map, Valdera.

OPTIMIZATION SELECTION

(Spatial criticalities)	(Maximization)	(Rules)
	GI^{s}	1^{GI}, 2^{GI}, 3^{GI}, 5^{GI}
	Organic	4^{BIO}, 5^{BIO}
	Organic	4^{BIO}
	GI^{s}	1^{GI}, 3^{GI}, 4^{GI} ,5^{GI}
	Organic	6^{BIO}

OPTIMIZATION

	GENERAL RESTRICTIONS	SPATIAL OUTCOME (MAXIMIZATION)	Affected spatial criticalities: Soil erosion	Soil cont.	Water cont.	Water use	Biodiv-ersity
1^{GI}	Land use limitations on altitude: No productive land allowed above 700m altitude.	• All productive lands above 700m are withdrawn from production.	✓			✓	
2^{GI}	Land use limitations on slope: No permanent crops (orchards olive groves or wineyards) on low slope areas.	• All permanent crops on low slope are forced to land use to seasonal crops.	✓				
3^{GI}	Land use limitations on soil composition: Lower fertile soils are not suited for productions	• All productive lands on low and low-medium fertility soils are withdrawn from production	✓			✓	
4^{GI}	Nourishment, how much can be fed to the animals, how much can fields be irrigated: Irrigation is kept to the minimum possible.	• Decreases the irrigation demand of all productive land by 1 point.				✓	
4^{GI}	The typology: only a set of specific animals or crops has to be used. Most of them are indigenous species.	• All productive land not included in a GI production chain is forced to land use change.	✓			✓	
4^{BIO}	Only the use of non-chemical products is allowed (they can be chemically processed have to be made of natural ingredients).	• Ban for chemical products extended on all productive land		✓	✓		
5^{BIO}	The whole agribusiness is convicted to the rules for organic production and must fulfil a 3-year resting cycle before the approval.	• Increases soil fertility by 1 point • Increases the value of low permeability soils by 1 point		✓			
6^{BIO}	The forced resting period for land units influences indirectly the size of land units and the diversification of production.	• Land units over 50 hectares are splitten up into 20 hectares units or smaller					✓

Figure 188 - Selection of the best scoring policy for the optimization process.
Figure 189 -Table of policy rules, their spatial outcome and the impact it has on the environmental criticalities.

INTEGRATING SPATIAL PRINCIPLES

The maximization method's final stage consists of the integrative phase. This phase remains relatively unchanged compared with the traditional way. In the standard procedure, the optimized map or outcome is confronted with external indicators to understand if it is compatible or might have to be further assessed to the needs. The same happens in the maximization lead in the research paper.

In this case, the optimization list, containing the general aspects that define the best possible outcome, is confronted with the two established lists of spatial and policy principles (considered as the 'external indicators'). This is a necessary step for integrating specific goals defined during the research analysis. In a way, the integration phase guarantees that the planner's aim is compatible with the guidelines of the policy obtained through optimizing the existing ones.

The integration phase aims to confront the three previously mentioned elements and observe if they present contrasting aspects or if the optimization respects the parameters set by the principles list. In the case of conflicts, the optimization shapes according to the needs of the two lists of principles and not vice versa. Once the planning principles are confronted and combined with the optimization scenario, the result can be considered the backbone of the policy framework, representing the engagement for the sustainability of the last one.

The first comparison is made between the list of spatial principles and the optimization table. Both present indications in numbers and percentages, so it becomes less of a challenge to draw conclusions. In Figure 169, it is possible to observe how these two elements are compared. The parameters set by the spatial principles are confronted with the actual results from the optimization. If the value of the optimization is higher than the aimed minimum value of the list of principles, then the two are compatible. In comparison, if the value of the spatial principles list is higher than the value of the optimization, then the two are incompatible. Something has to be changed in the parameters of optimization that define that specific characteristic.

Picture 190 also shows that the optimization, in this case, is above the required minimum from the spatial principle list in all different categories. This implies that no further changes must be made to the optimization table to become an integrated table. But this is only the first step. Before the optimization can be called an integration table, it must be confronted with the policy principles from the chapter "policy principles".

SPATIAL PRINCIPLES			OPTIMIZATION	
SPATIAL CRITICALITIES	GOAL	EXISTING AREA	NEW AREA (OPTIMIZED)	PREDICTION
High soil erosion risk area	*by 50%*	*25,779.10*	*9,104.80*	*by 64.7%*
High soil contamination risk area	*by 50%*	*14,951.30*	*0.00*	*by 100%*
Underground contamination risk area	*by 50%*	*37,886.60*	*0.00*	*by 100%*
Open waters contamination risk area	*by 50%*	*15,939.80*	*0.00*	*by 100%*
Irrigation high inefficiency area	*by 50%*	*58,166.60*	*1,399.99*	*by 97.6%*
High Run off risk area	*by 50%*	*25,944.20*	*723.16*	*by 97.2%*
High monocultures risk area	*by 50%*	*3,311.98*	*1,618.00*	*by 51.2%*
Natural spaces area	*18%*	*56,892.50*	*85,851.79*	*by 47.4%*

Figure 190 - Integrating the spatial principles with the optimization list.

INTEGRATING POLICY PRINCIPLES

Policy principles are the result of extensive analysis of policies and the collection of farmers' opinions through interviews. This list is likely to contain principles that might interfere negatively with some of the points of the optimization list. In the integration of the list of policy principles, only the first group of the list is considered "engagement for sustainability". The other four points do not relate to environmental issues but to more organizational topics that influence the efficiency of a policy in terms of participation. These points of the list are not considered in the maximization method but will be included in future steps of policy building.

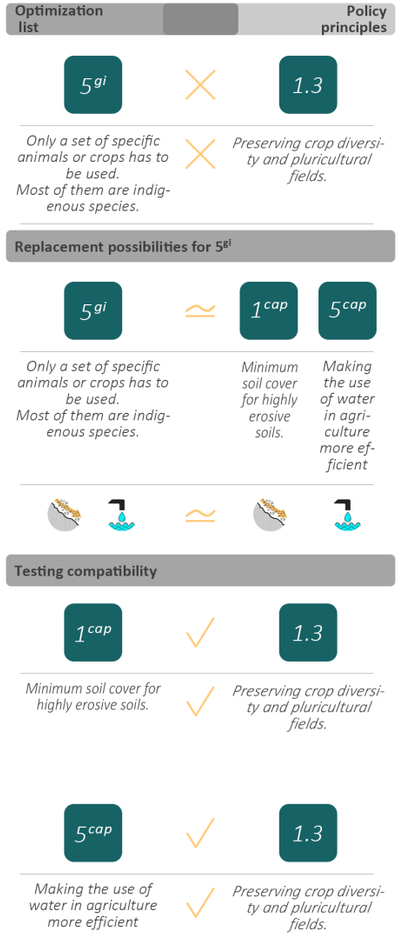


Figure 191 - Integrating the policy principles with the optimization list.

Even though only the first three points of the list are considered, a conflict arises. There is a clear contrast between the third planning principle and rule number 4 of the GI general aspects included in the optimization. In this case, the principle aims for biodiversity protection also of different crops used for production and not only of the natural spaces.

While point 4 of the Gis policy does impose precisely the opposite. As a small number of food products only represents Gi compared to the rest of produced goods, maximizing the policy behind it would mean forcing land use change to significant parts of the agricultural system. This effect could have devastating casualties on crop biodiversity since the production land pushed to change land use is replaced by new productive land that produces raw material and final products linked to Gis and so to a restricted number of crops. As the two elements have opposite effects, as said before, the one which must assess is the optimization table. In this case, the general aspect must be modified in such a way that it can solve two issues. First, it does not interfere with the spatial policy principle, and second, it must maintain general characteristics that do not change its effects. Effects that could lead the optimization to lower scores on the previous table that are no longer compatible with the spatial principles.

The general aspect number 4gi from the optimization table influences soil erosion and water use but decreases crop diversity. It must be replaced by two general aspects that cover these two topics but do not interfere with biodiversity. In this case, the chosen general aspects come from the CAP maximization. First, to compensate for the inefficiency of water use, point five is selected as it restricts the use of high-irrigation crops but does not limit the diversity of other crops. Second, number one of the general aspects in the CAP maximization compensates for erosion risk as it imposes grassing on high erosive areas but does not contrast the use of different crops. Once the two new points are assessed, the integration map and scheme are ready and can be used to continue the process of building a policy framework.

REFLECTION ON THE MAXIMIZATION RESULTS

In the previous chapter, the optimization is confronted with a list of spatial principles and a list of policy principles. Conflicts between the three are identified and solved by modifying the general aspects included in the optimization table that are incompatible with the goals stated in the two lists of principles.

The resulting scheme is called the integration scheme. The integration scheme is precious for the development of the policy framework itself. The research selected the concluding general aspects of the integration scheme through the combination of optimization and the list of pre-established principles.

In this way, the outcome of the whole maximization method is described in the integration scheme. This scheme contains only the rules and guidelines that have, at the same time, a spatial impact, the highest impact on environmental criticalities and are compatible with the principles of the research aim. So, through integration, it is possible to define an essential aspect behind the creation of a certificate.

The general aspects contained in the integration scheme can be seen as the first milestone in building a set of rules and restrictions concerning agricultural practices. These rules are essential to write the disciplinary for the policy framework, which defines the engagement for the sustainability of the policy. Still, to create an efficient tool, this is not enough. The claim made in the "policy analysis" chapter is that to achieve efficiency of a not mandatory policy, the rules that define engagement for the sustainability of applying farmers cannot stand alone. They must be reinforced by a well-established framework that includes clear indications of financial support, branding strategies, institutional role and inclusiveness, all aspects that define the benefits provided to farmers in case they apply for the certification. For this purpose, the research will refer to an existing framework to define the secondary aspects of a policy besides the disciplinary.

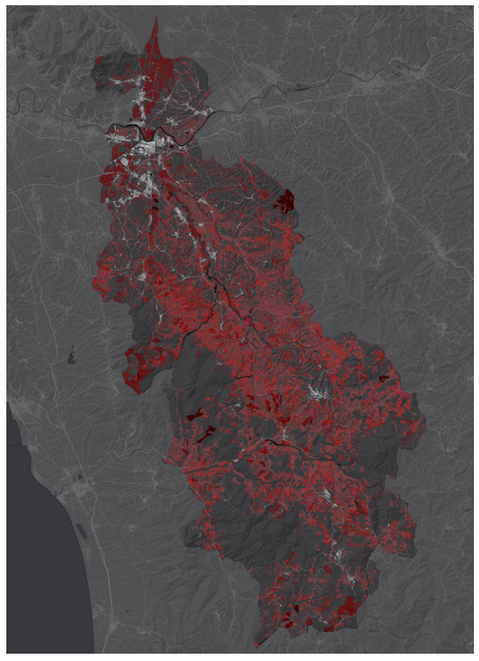


Figure 192 - Status quo criticalieties map. Legenda on page 118.

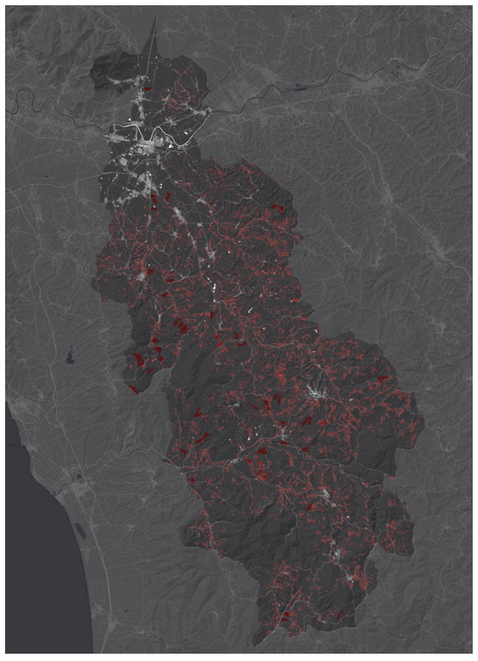


Figure 193 - Post Integration criticalities map. Legenda on page 193.

INTEGRATION

Affected spatial criticalities

	GENERAL RESTRICTIONS	SPATIAL OUTCOME (MAXIMIZATION)	Soil erosion	Soil cont.	Water cont.	Water use	Biodiversity
1 GI	Land use limitations on altitude: No productive land allowed above 700m altitude.	• All productive lands above 700m are withdrawn from production.	●			●	
1 CAP	Minimum soil cover for highly erosive soils.	• Land use change for seasonal crop on high erosion soils	●				
2 GI	Land use limitations on slope: No permanent crops (orchards olive groves or wineyards) on low slope areas.	• All permanent crops on low slope are forced to land use to seasonal crops.	●				
3 GI	Land use limitations on soil composition: Lower fertile soils are not suited for productions	• All productive lands on low and low-medium fertility soils are withdrawn from production	●	●	●	●	●
4 GI	Nourishment, how much can be fed to the animals, how much can fields be irrigated: Irrigation is kept to the minimum possible.	• Decreases the irrigation demand of all productive land by 1 point.				●	
4 BIO	Only the use of non-chemical products is allowed (they can be chemically processed have to be made of natural ingredients).	• Ban for chemical products extended on all productive land		●	●		
5 BIO	The whole agribusiness is convicted to the rules for organic production and must fulfil a 3-year resting cycle before the approval.	• Increases soil fertility by 1 point • Increases the value of low permeability soils by 1 point		●		●	
6 CAP	Making the use of water in agriculture more efficient	• No high-irrgation crops on slope over 15% • No high irrigation crops on high perm				●	
6 BIO	The forced resting period for land units influences indirectly the size of land units and the diversification of production.	• Land units over 50 hectares are splitten up into 20 hectares units or smaller					●

Figure 194 - Concluding table of rules selected for the Integration map.

INTEGRATION MAP

Legenda

- Withdrawn from production (1^{gi}-3^{gi})
- Forced land use change (1^{cap})
- Land use change (2^{gi})
- Decreased irrigation (4^{gi})
- Forced transition to organic (4^{bio})
- Forced land use change (5^{cap})
- Increased fertility (5^{bio})
- Soil permeability stabilization (5^{bio})
- Big land units (6^{bio})

Figure 195 - Integration, conclusive map.

NEW PROBLEM MAP

Legenda

- High soil erosin risk
- Water use inefficiency
- Monocultures
- Decreased soil erosion risk
- Decreased biodiversity loss risk
- Decreased water use inefficiency
- Decreased contamination risk

Figure 196 - Problem map after integration application.

TESTING THE POLICY

TESTING THE POLICY ON LOCAL SCALE

For the local scale test of the integration scenario, three locations were selected, each one belonging to a different sub-system of the Valdera. The choice to use three distinct sub-systems has multiple reasons and benefits. It makes sure that the zoom-ins on a local scale present different characteristics. The three areas differ in morphological aspects and soil conditions, but they also diverge in land use, farming practices, water use and average agri-business size. Such diversity increases the value of the outcome of this method.

The method is divided into three main steps. In the first phase of scenario testing, the areas are individually exposed to a scenario where the integration map was approved, and all farmers have decided to apply. The needed modifications forced by the integration law are adapted to the chosen areas. This allows the research to draw a conclusion map which indicates the future structure of the area if it follows the transition steps needed to apply to the policy. The resulting map is then used in the second phase of the method. The map is required to calculate and identify the new area occupied by the critical risks that have been modified together with the productive land. The two crucial aspects maps, status quo and post maximization are then compared. In conclusion, the third phase consists of a reflection on the findings of the local scale test and how these can influence the decision to make in the concluding chapter concerning the policy framework.

Figure 197 - River arno, Valdera.

Figure 198 - River Era, Valdera.

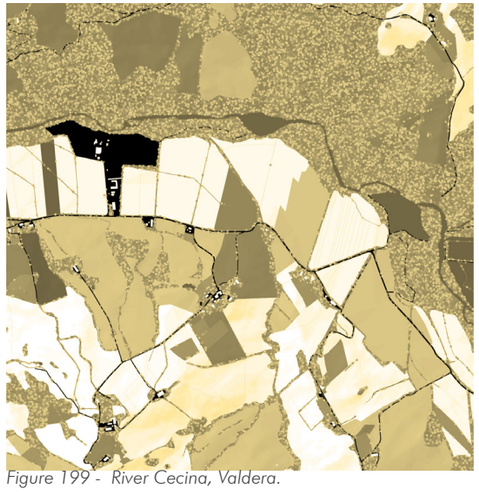


Figure 199 - River Cecina, Valdera.

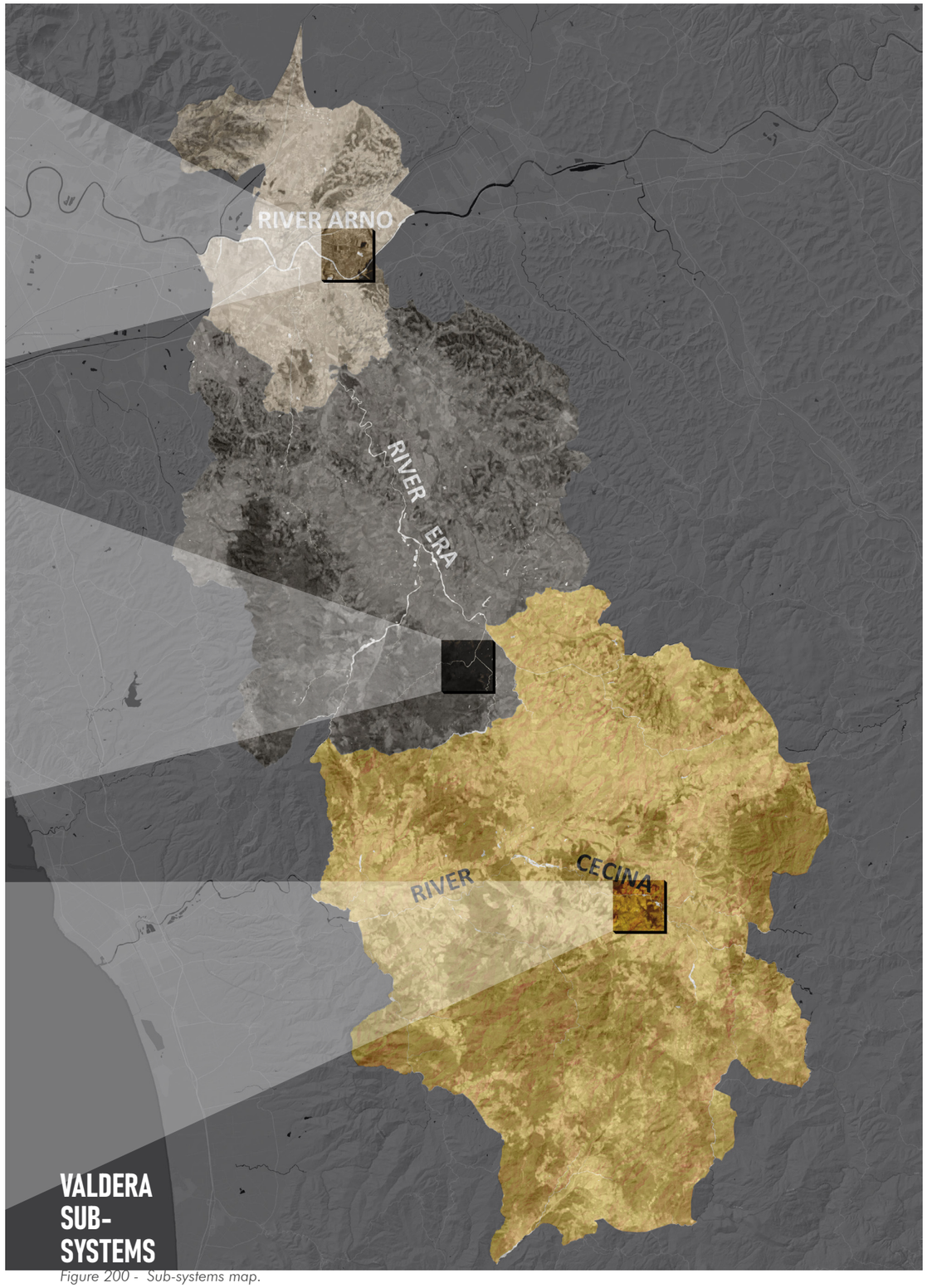


Figure 200 - Sub-systems map.

ZOOM 1 - SUB-SYSTEM RIVER ARNO

The first test location is in the river Arno sub-region (also noticeable in picture number 200). In this area, the general use of agricultural land use is dedicated to the production of seasonal crops. The typology of crops may vary between different crop typologies, such as maize, sunflower, other kinds of wheat and so on. A sandy, highly permeable soil characterizes the area, so the predictions were that this area has a high risk of water contamination. If this comes in combined with the high water demands of the sowed crops, the situation becomes even more critical.

By maximizing the policy obtained from the integration phase and by analysing the different steps separately, it becomes clear that only small parts of the productive land are withdrawn from production as the soil has high fertility in this area, and no relevant changes concern the land use or the size of land units in this first test. While the most significant changes in this area concern the reduction of water use for irrigation (see art. n.4) and the forced transition of conventional farms to organic practices (see art. n.5).

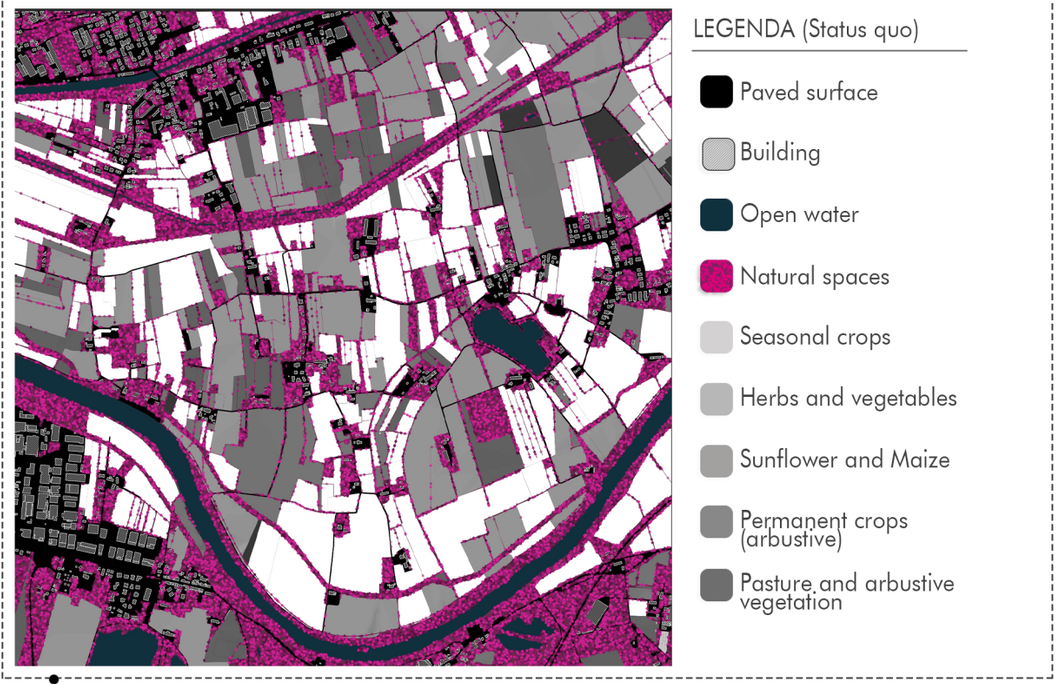
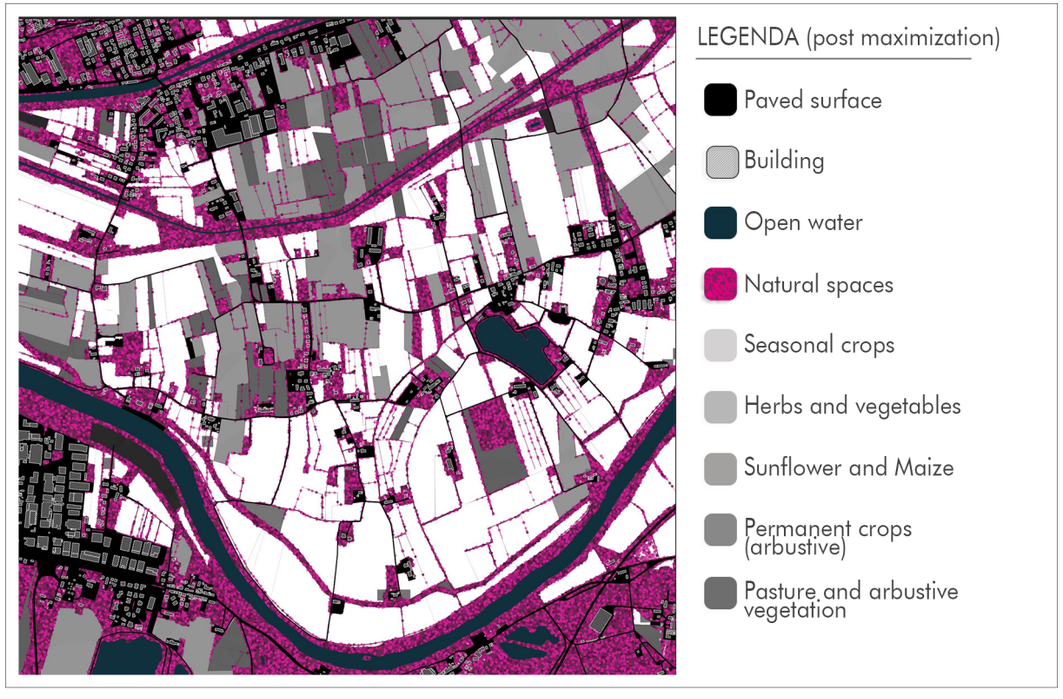


Figure 201 - Time laps of the policy implementation.



For the second phase, the steps on the integration policy list are applied to the status quo land use. As mentioned in the reflection chapter, the resulting land use map is relatively indicative as the typologies used to draw the maps indicate only a few macro groups. For example, when the map shows seasonal crops, this includes a large number of crops the agri-business can decide to grow on it. Or a land unit indicated as a permanent crop indicates all agricultural activities that include tree cultures such as vineyards, olive groves or fruit trees. This also helps to justify that the prevailing seasonal crop pattern in the resulting map for the river Arno area does not indicate monoculturalization but simply a higher concentration of seasonal cultures on flat land as wanted by the policy. The resulting land use map is then used to recalculate critical areas and confront them with the existing problem map.

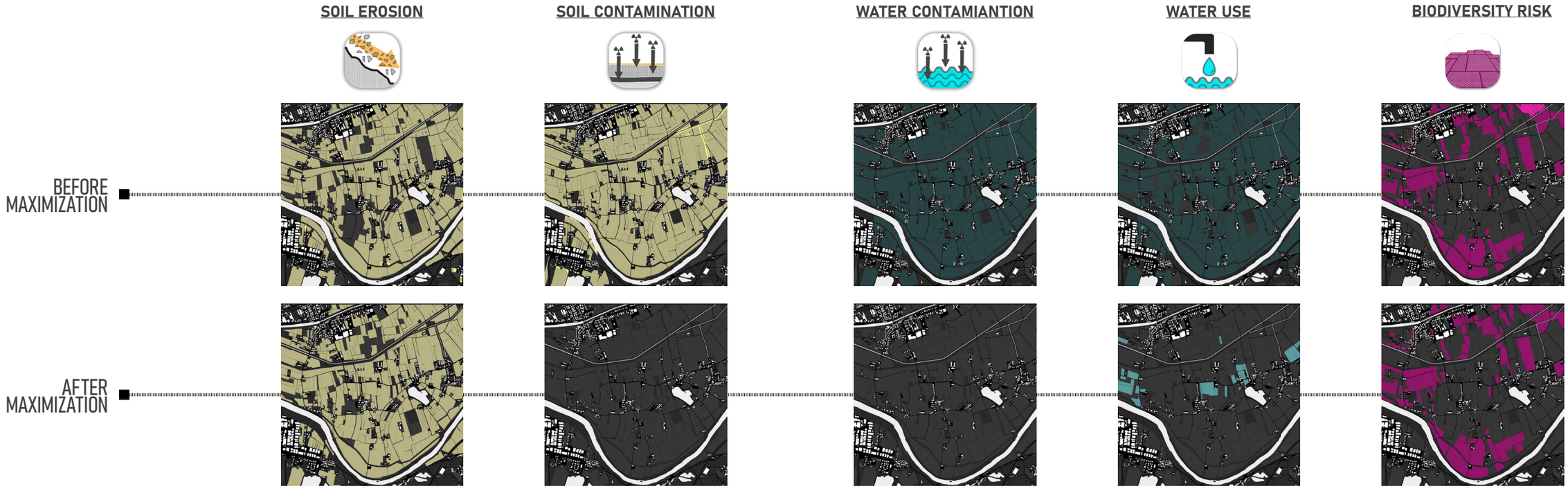
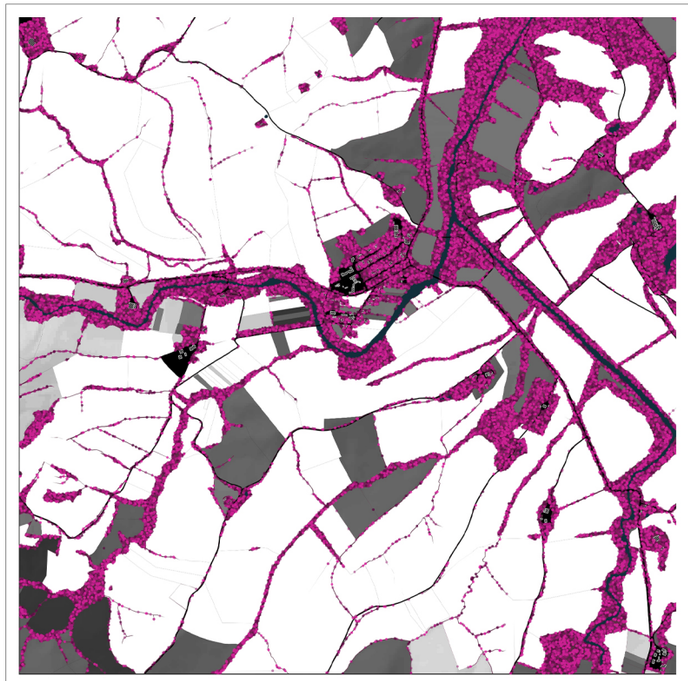


Figure 202 - Comparison of the status quo and the new criticalities.

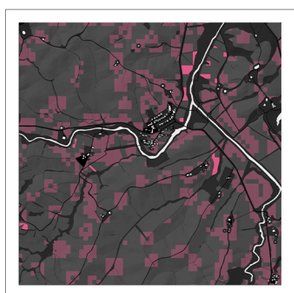


LEGENDA (Status quo)

- Paved surface
- Building
- Open water
- Natural spaces
- Seasonal crops
- Herbs and vegetables
- Sunflower and Maize
- Permanent crops (arbustive)
- Pasture and arbustive vegetation

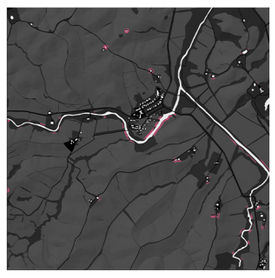
(Left map) Art. 4 - Decreased water use for irrigation.

(Right map) Art. 7 - Decreased size of land units.



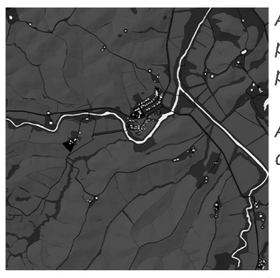
(Left map) Art.2 & 8 - Forced land use change.

(Right map) Art.9 - Forced land use restriction.



(Left map) Art. 1 and Art. 3 - Agricultural land withdrawn from production.

(Right map) Art. 5 - Transition from traditional to organic farming practices.



Art.6 - Increased permeability for low permeable soils

Art. 6 - Increased overall soil fertility.

STRATEGY DEVELOPMENT FOR THE APPROVAL OF A GIB POLICY

NEW FARMING PRACTICES

LAND USE TRANSITION

RESTORATION OF NATURAL RESOURCHES

2022 2025 2028 2028 2040 2045

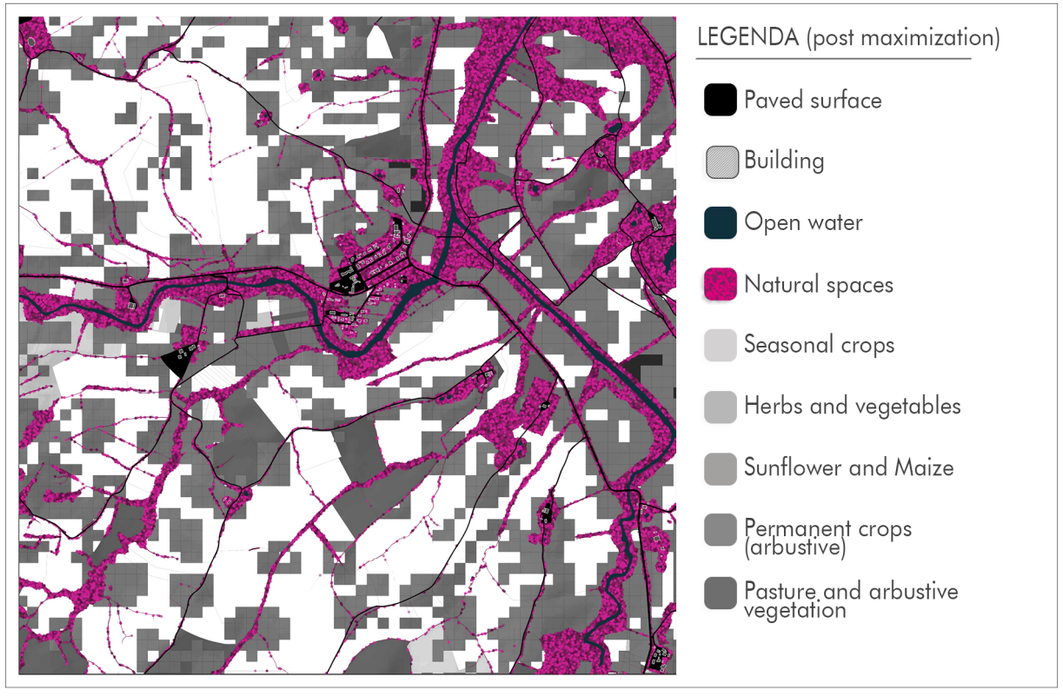
Figure 203 - Time laps of the policy implementation.

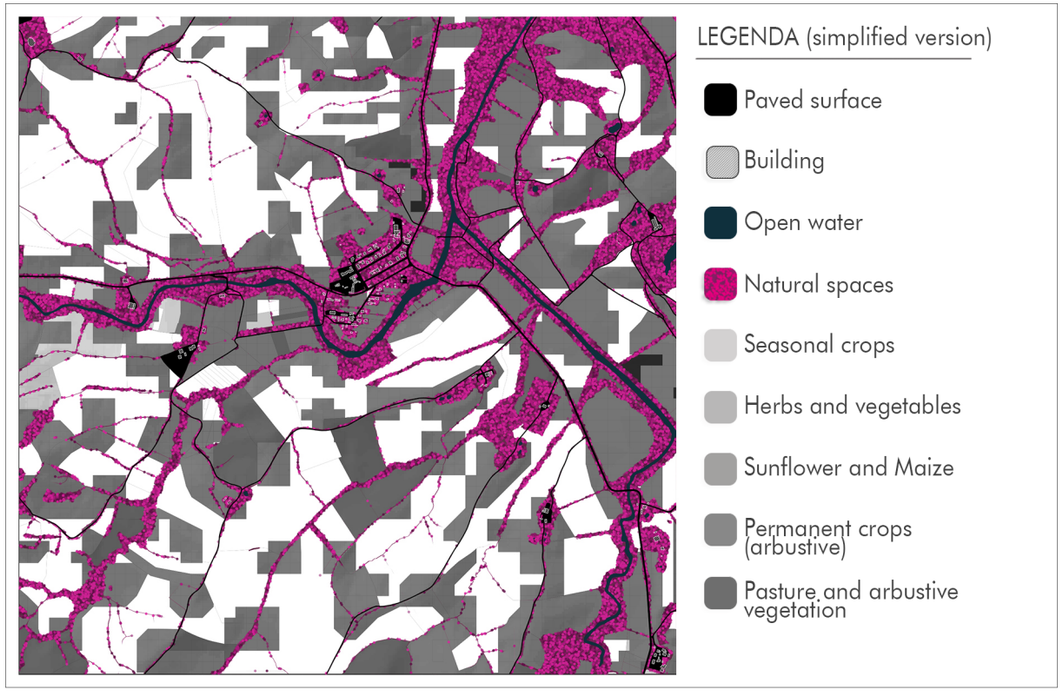
ZOOM 2 - SUB-SYSTEM RIVER ERA

The second local scale locates in the southern area of the central subsystem, the river Era system. The location of Lajatico, the most southern municipality in the Era system, has similar land use characteristics to the first zoom-in. The primary production concerns seasonal crops and open grassland for pasture. The application of the integration principles, though, has a different influence on this site than not on the first, mainly caused by the diverse morphological attributes. The river Era area presents a hilly landscape so with a high average slope of the productive lands. Seasonal crops on high-slope soils are considered a threat that increases the risk of soil erosion; therefore, the policy engages in changing parts of it, especially on the grounds that are above 15% of pendency.

As a result, in the second local scale, it is possible to observe how the forced land use change from seasonal crops to permanent ones on high-slope soils influences also the following steps (see art. n. 4). Another interesting observation to be made is that, as this is the most rural area of the three locations, it is also the only one affected by changes in the size of the land units that are more than 50 hectares large. In this context, the agricultural pattern has a much vaster texture compared to the river Arno system.

In the second phase, as in the first case, the new critical areas are calculated and confronted with the existing problem map. Unlike the first location, the river area agri-businesses were already committed more to organic farming activities. The most significant changes do appear in the prevention of soil erosion risks and inefficiency in the use of water resources for irrigation. This, of course, does not happen without a strong readaptation of the current land use structure.





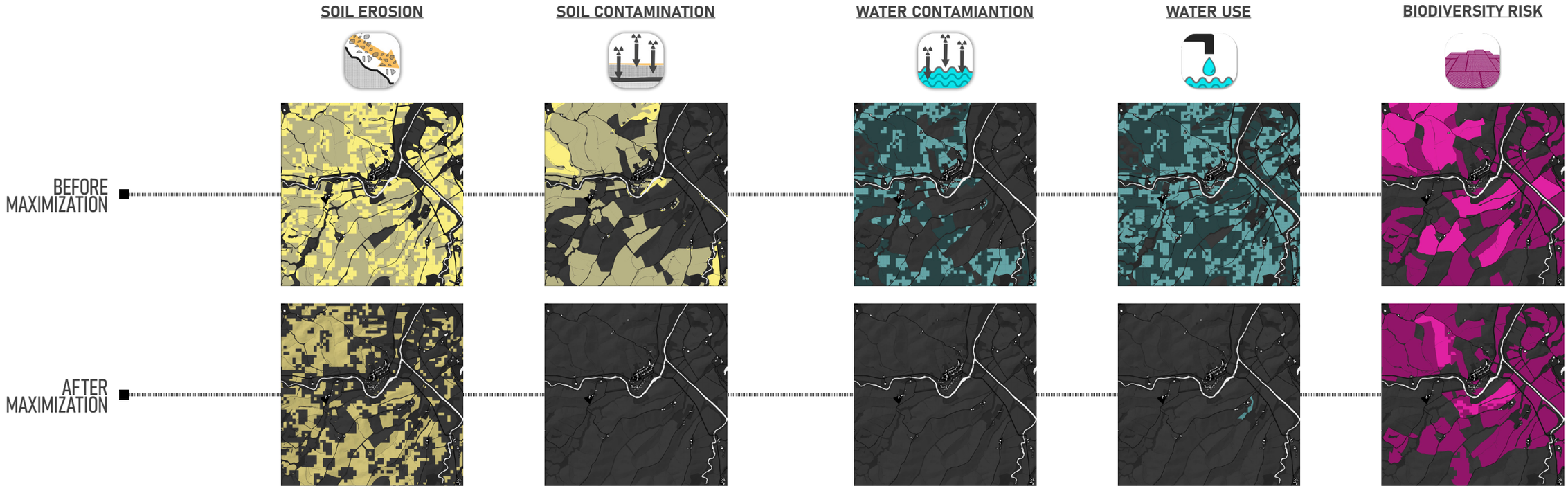
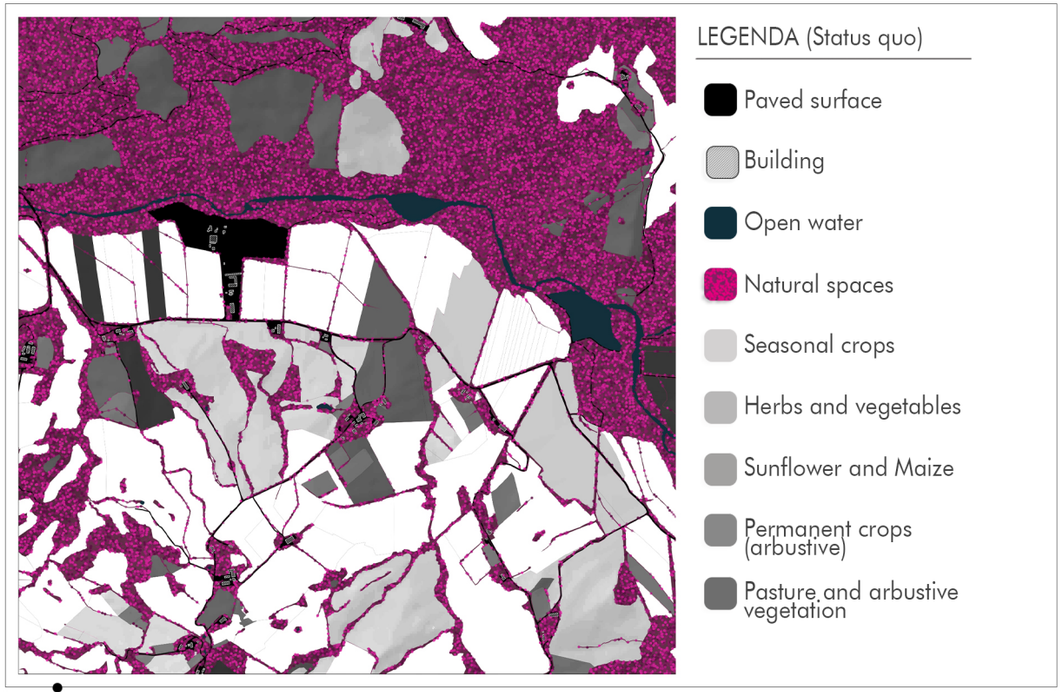


Figure 204 - Comparison of the status quo and the new criticalities.

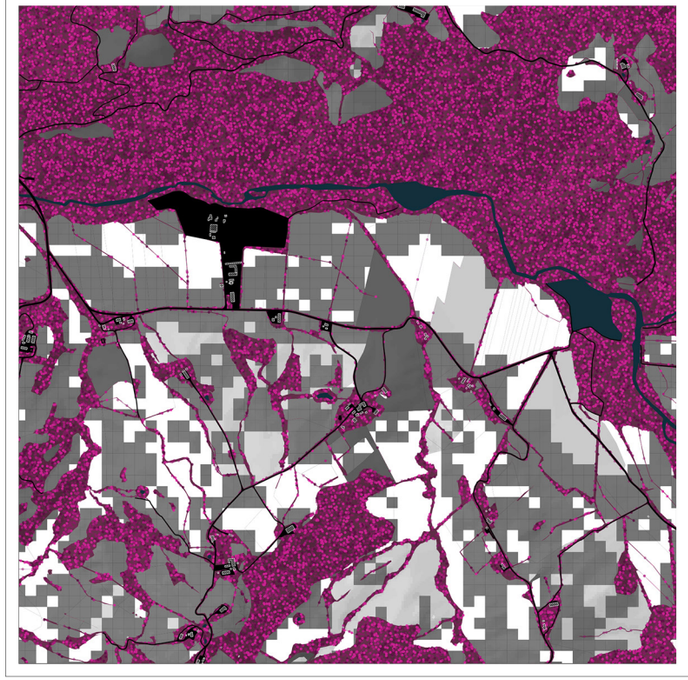


ZOOM 3 - SUB-SYSTEM RIVER CECINA

The third and last local scale is located in the river Cecina area. Of the three local sites, this one is the one with the highest vocation for natural spaces and protected ecosystems. Its productive land reassembles morphologically in a similar pattern to the second zoom-in, with extensive land units mainly used for seasonal crops or pastures. Nevertheless, at the same time, it differs from the second location as it presents areas of low fertility, as demonstrated by the art. n.1. Areas of low fertility are withdrawn from production, which means that they are dedicated to the development of new natural spaces.

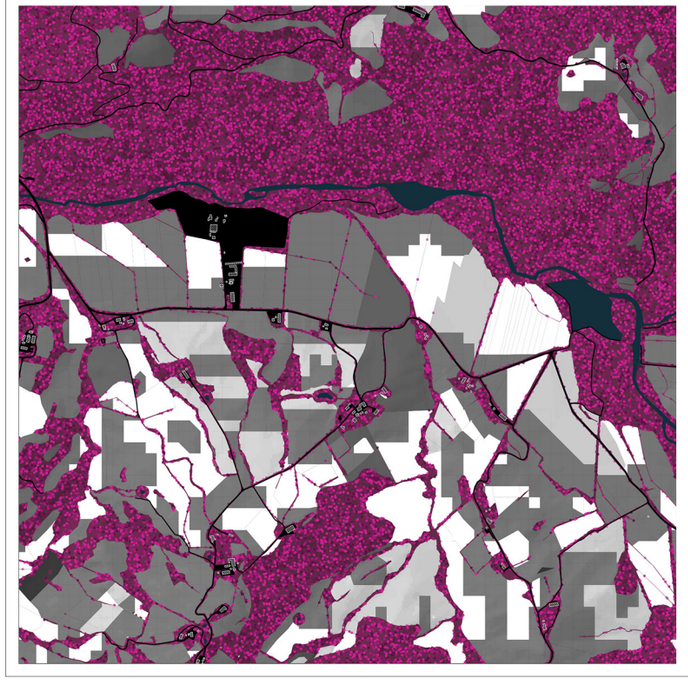
This might take a more extended period of time, but the process begins immediately after the policy is put into place. In the confrontation between the area of the new criticalities and the existing problem map, it is clear that the most significant changes for the area concern soil and water contamination risks and inefficiency of water use. These three factors are, in this case, entirely influenced by the integration articles n.5 (commitment to organic farming practices), n.4 (decreased water for irrigation) and n.8 (land use change for seasonal crops on high erosive soils).

Figure 205 - Time lapse of the policy implementation.



LEGENDA (post maximization)

- Paved surface
- Building
- Open water
- Natural spaces
- Seasonal crops
- Herbs and vegetables
- Sunflower and Maize
- Permanent crops (arbustive)
- Pasture and arbustive vegetation

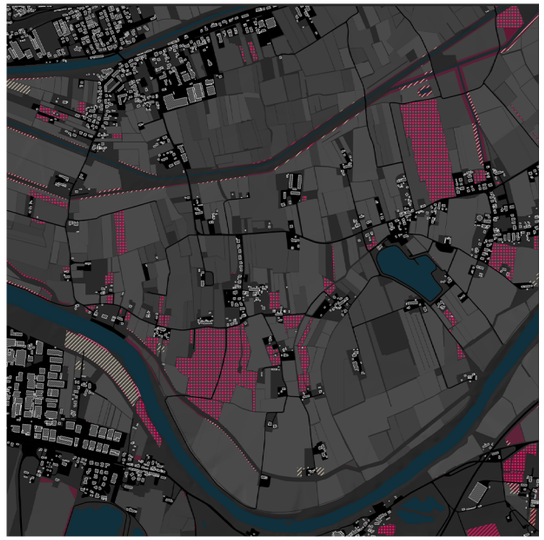


LEGENDA (simplified version)

- Paved surface
- Building
- Open water
- Natural spaces
- Seasonal crops
- Herbs and vegetables
- Sunflower and Maize
- Permanent crops (arbustive)
- Pasture and arbustive vegetation

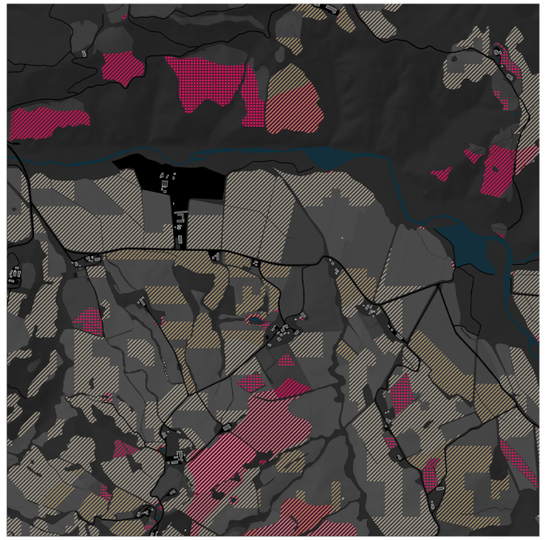
Figure 206 - Comparison of the status quo and the new criticalities.

RIVER ARNO



RIVER ERA

RIVER CECINA



LEGENDA (Structural changes)

- Permanent crops
- Pasture and open fields
- Seasonal crops
- Vegetables and aromatic herbs
- Withdrawn from production
- Paved surface
- Buildings
- Open water
- Productive land

TOTAL AREA (m^2)	LAND USE CHANGE (m^2)	(%)	TOTAL AREA (m^2)	LAND USE CHANGE (m^2)	(%)	TOTAL AREA (m^2)	LAND USE CHANGE (m^2)	(%)	
4,228,750.0	110,607.0	2.5	5,908,110.0	2,655,030.0	45.0	2,947,660.0	1,741,070.0	59.0	SEASONAL CROPS
3,526.5	2,946.5	83.5	235,615.0	139,039.0	59.0	1,353,050.0	622,395.0	46.0	VEGETAGLES AND HERBS
426,539.0	425,932.0	99.9	253,794.0	52,559.40	20.5	183,745.0	20,600.8	11.0	PERMANENT CROPS
440,995.0	17,209.5	4.0	705,954.0	12,452.0	2.0	697,491.0	236,340.0	34.0	PASTURES

DISCUSSING THE OUTCOMES

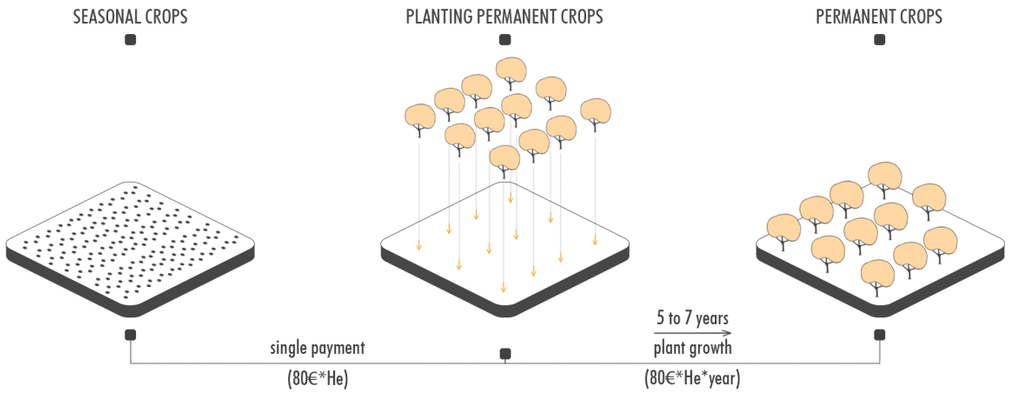
As a result of the maximization method on a large scale, it was possible to obtain the list of policy recommendations the project aims to apply to the new certification. These rules represent the environmental engagement of the certificate. However, from the policy analysis, the research has learned that engagement in sustainability alone cannot be the foundation of a successful certification. Some economic and social support must be guaranteed to the farmers that choose to apply. These guarantees express in the form of the five key elements that define a good framework. A policy framework for food quality certificates should therefore include financial support, inclusiveness and fairness, branding strategies for the product and communication and involvement of local institutions.

In this chapter, it is possible to define the outlines of the financial support programme and to whom it should be provided and for what reason. It is now clear that the rules that the policy proposes need to be assessed by farmers and that this assessment brings high costs with it. To better cover the costs and allow the farmers to make the transition, it is important to evaluate who must make the most significant land-use changes. Therefore, the study calculated the amount of area that must change the destination of use due to the policy for each of the zoom-ins. It becomes clear that the most affected typology of crops by the forced land use change remains the seasonal ones, especially for zoom numbers two and three.

Figure 207 - Evaluation of the needed changes for the GIB policy.

Of course, it must be kept in mind that a land use change can have different costs depending on the transformation. The conversion of a vineyard into seasonal crops has higher expenses than the other way around. This means that it requires higher compensation in the first phase. While seasonal crops that change to permanent ones do need more time to start production, which means they will require financial support during the transition phase. In conclusion, the productive land that is forced to withdraw production must be compensated financially for each lost hectare of arable land.

The principles of financial support included in the policy of GIBs should therefore be: The financial aid included in the organic policy for each hectare of converted land. Financial support in the form of loans and compensations to farmers that must change the destination of land units ([X]/[He] for seasonal crops and [X*3]/[He] for permanent crops). Financial support should favour small agribusinesses introducing additional support for agri-businesses that have less than 20 hectares of productive land ([2X]/[He] instead of [X]/[He]) for the transition to organic practices.



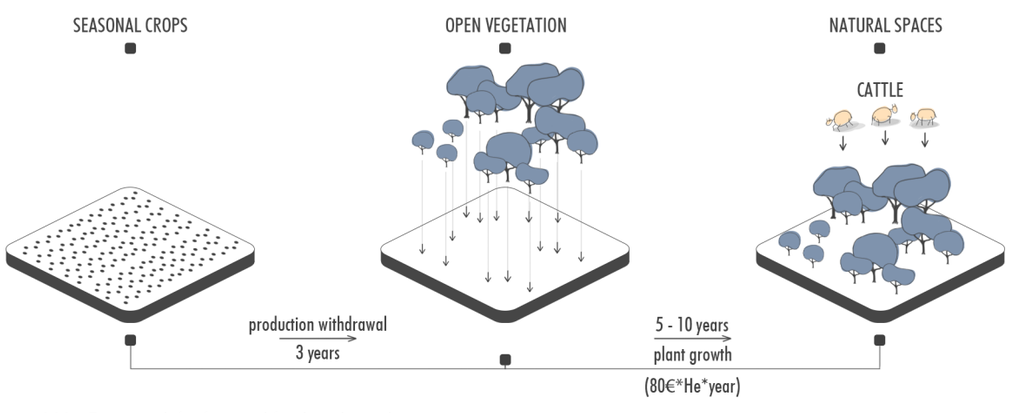
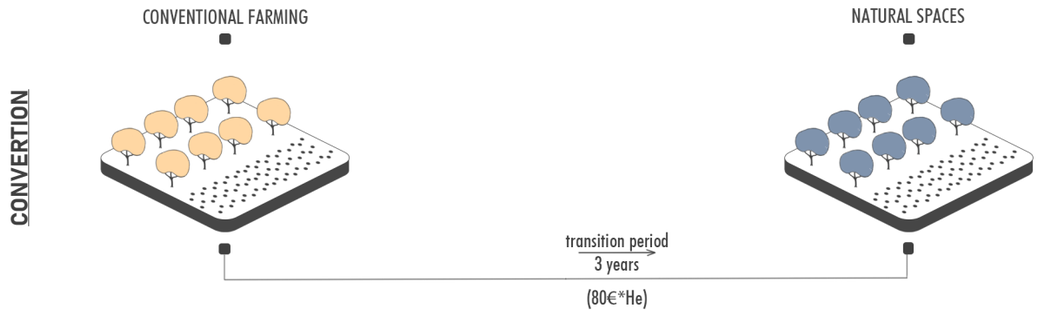
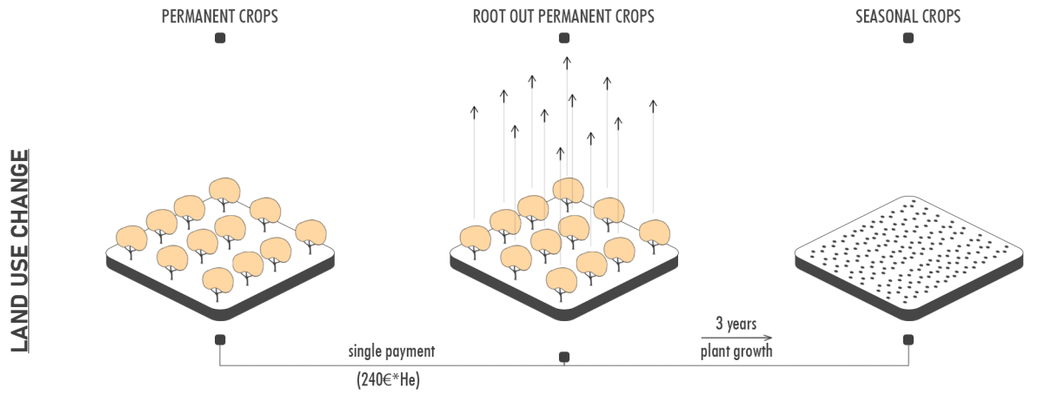
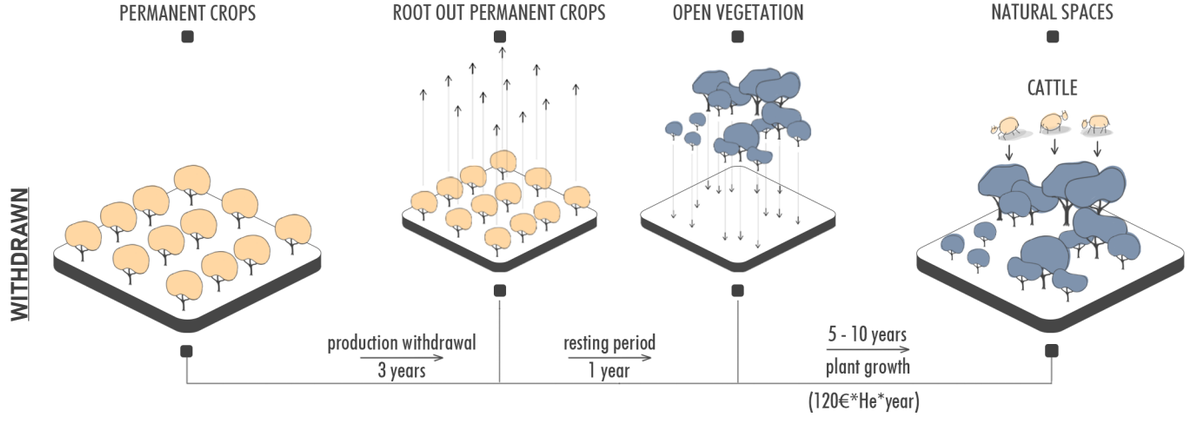


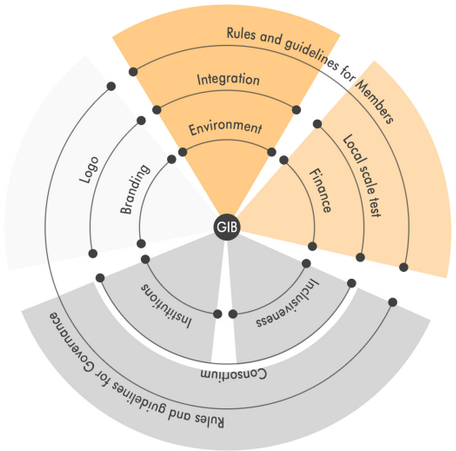
Figure 208 - Framework for financial funding, by author







—FRAMEWORK FOR A NEW POLICY



RULES AND GUIDELINES FOR MEMBERS

In the paragraph “List of policy principles”, five key topics were defined as the leading indicators for the efficiency of a non-mandatory policy for sustainable agricultural farming certificates.

As the project’s main aim is to produce a sustainable agricultural system through food quality certifications, the research emphasizes most on the first of the five topics, engagement for sustainability. An efficient policy should contain a set of rules and limitations that improve the sustainability of farming practices. In the research, this is represented by the results of the “integration phase”.

Subsequently, the aspects of financial support are defined through conclusions from the test on the local scale. To determine how to distribute financial aid to agri-businesses, knowing where the potential policy causes the most significant structural changes is essential. The test made on the local scale gave insights into what changes the new policy would bring to the structure of land use of the agrifood systems and who is most affected by it.

The conclusions from the two chapters, “activating the potentiality of the policies” and “testing the policy”, define the engagement of sustainability and the rules for financial support of the new certificate, the GIBs. Together they compose the policy paper behind the legal protection of the certification.

Besides the policy, there are two other essential elements that a certificate must have to exist on the legal level. First, the logo or symbol that identifies products from registered members. Second is the consortium or farming union that stays behind the governance of the certification once it is put into practice. These two elements of the certificate will provide the correct input to define the three missing essential topics of the policy efficiency table, inclusiveness, institutional role, and product branding.

Figure 209 - Elements that complete the policy framework

1 Engagement for Environmental sustainability
Rules for sustainable farming practices

Art. (1.1) - Land use limitations on land use - land units above 700m of altitude are not suited for agricultural production, except for mountain areas and forestry.

Art. (1.2) – High erosive soil minimum cover – Soils with values of erosion risk higher than 'medium' may be used in agricultural production only for permanent cultures or mixed fields seasonal/permanent with a maximum distance of 20 m per arbustive row.

Art. (1.3) – Land use limitations on low slope surfaces – Land units with a slope of 10% or lower are not suited for agricultural production of permanent crops, such as orchards, vineyards, or olive groves.

Art. (1.4) - Land use limitations of low fertile soils – Land units with low-medium or low fertility values are not suited for any agricultural activity.

Art. (1.5) – Nourishment and irrigation limitations – The use of external waters for the irrigation of crops has to be kept within the minimum amounts defined for each crop. Exceptions are made in more extended drought periods when authorised by the consortium.

Art. (1.6) – Limitations for using pesticides and fertilisers – Agribusinesses that apply for the Geographical indicated biodistrict are not entitled to use any kind of chemical product (fertilisers, pesticides, antibiotics, insecticides). Agri-businesses may use organically produced inputs according to the limits set in European law (FERT.RE.UE 2019/2009 and RE.CE.N.1107/2009).

Art. (1.7) – Soil resting period – Conventional agribusinesses that use chemical inputs have to fulfil a three-year rest period when they apply for the Geographical indicated biodistrict. During the resting period, the agribusiness is entitled to use the resting land for production following the 'GIB policy' laws.
The product cannot be sold with the label of the certification till the conclusion of the resting period.

Art. (1.8.a) – Limitations for run-off waters – The use of crops with medium/high to high water demands is limited to land units with a slope value lower than 15%.

Art. (1.8.b) – Limitations for run-off waters – The use of crops with medium/high to high water demands is limited to land units with medium to low permeability.

Art. (1.9) – Rotation resting period – Land units used for seasonal crop growth are forced to use a rotational system that includes a resting period every two yields.

2 Finanacial support program
Local scale test

Art. (2.1) – Farmers that apply for a GIB certification and have a productive land surface beneath 20 hectares are entitled to X*2 times the compensation for the transition.

Art. (2.2) – Farmers that switch from conventional farming to Gib sustainable practices are entitled to a compensation of 80 euros per hectare of converted land. The conversion time lasts three years, and financial support is derogated after 18 months from the beginning.

Art. (2.3.a) – For farmers that have to convert seasonal crops into permanent crops. A single payment of 80euros per converted hectare is allocated at the beginning of the transition. Successively the agri-business receives 80 euros per hectare during the period of unproductivity of land (depending on the chosen permanent crop).

Art. (2.3.b) - For farmers that have to withdraw seasonal crops from production. These lands can be used for production in the first three years from application. After three years, the productive land is withdrawn from production. The business obtains financial aid of 80 euros per hectare for the successive five years for arbustive vegetation or ten years for high arbustive vegetation.

Art. (2.4.a) – For farmers that have to convert permanent crops into seasonal crops. A single payment of 240 euros per converted hectare is allocated at the beginning of the transition. The business is given three years to convert the productive land.

Art. (2.4.b) - For farmers that have to withdraw permanent crops from production. These lands can be used for production in the first three years from application. After three years, the productive land is withdrawn from production. After a year of soil resting, the business obtains financial aid of 120 euros per hectare for the successive five years for arbustive vegetation or ten years for high arbustive vegetation.

Figure 210 - Results of the spatial analysis, Environmental engagement and financial support. Policy framework - rules and guidelines for members

METHOD CASE STUDY

The Case study method makes it possible to learn from similar situations and contexts. The primary issue is to find situations where certifications were used as a planning instrument or at least involved institutional subjects in the administration of the tool. The method then consists of analysing the selected example that might be a planning tool or a policy that has demonstrated itself as "good practice" by contributing intensely to the development of local, sustainable farming practices.

"The instrumental case study uses a particular case (some of which may be better than others) to gain a broader appreciation of an issue or phenomenon" (Crowe S. et al., 2011).

Aim: "Case studies can be used to explain, describe, or explore events or phenomena in the everyday contexts in which they occur. These can, for example, help to understand and explain causal links and pathways resulting from a new policy initiative or service development" (Yin RK., 2009).

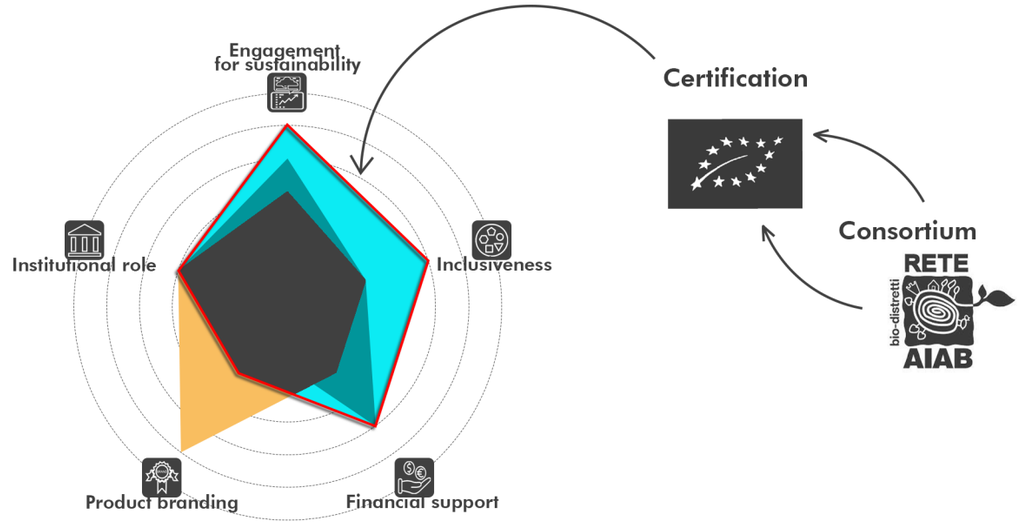


Figure 211 - The Biodistrict has the best scores except for product branding.

THE CONSORTIUM

In the interview analysis, the strengths, weaknesses, opportunities, and threats of the existing consortiums for organic and GI certificates, together with their respective policies, were examined.

These pointed out how vital the consortiums are for the success of the certificate. The consortium stays behind the governance of the certification. It engages in marketing strategies, proposes assessments in the policy according to the member's request and protects its members legally. The consortium, though, can also express negatively. In some cases of GIs, the progressive readaptation of parts of the policy has pushed out institutions from participating in consortium activities and enforced the exclusiveness of the consortium involving only registered members.

Beneficial or not, the influence of the consortium depends entirely on the legal definition it is attributed. To decide what the best options are for the project's consortium, the research selected a case study. The policy analysis method demonstrates that the organic farming certificate has the highest value in terms of the inclusiveness of stakeholders and participation of institutional entities. The high scores are also policy related, but in most cases, it is thanks to the efforts made by the consortium. Therefore, the bio district was chosen as the "good practice" to learn a lesson from.

THE BIODISTRICT AND ITS ROLE

A biodistrict is an association defined by law that aims to collaborate with institutions, farmers, and consumers to promote organic farming practices in the area and in the market. The biodistrict has some similarities with the GI consortium, when it comes to the fact that both require a registration fee but do not guarantee direct payment to their associates.

At the same time, it differs from the consortium in many other aspects. It begins from the fact that the consortium is interested in a particular product, while Biodistricts comprehend all types of biologically produced goods. The associates and their roles in the organisation represent another big difference. While for the consortium, only farmers that apply to the disciplinary are allowed and can actively participate in decision-making, bio-districts also involve the administrative bodies of the municipalities interested in the project and others, such as organic wholesalers. In the biodistrict, the quote of the members does not reflect on each individual's decision-making power, making it fairer and more equal than the consortium.

Unlike the consortium, the biodistrict does not have a distinctive label for products produced by associated farms. This remains the main weakness of the biodistrict in terms of branding. Members cannot distinguish from other organic labelled producers and cannot increase their market value. Meaning that the bio district, even if connected to a territorial concept as the GIs, does work more as a farmer union that aims to increase the transition of farmers to organic practices of a specific area. Then not as a consortium that uses the territorial link as a market symbol for quality and sustainability.

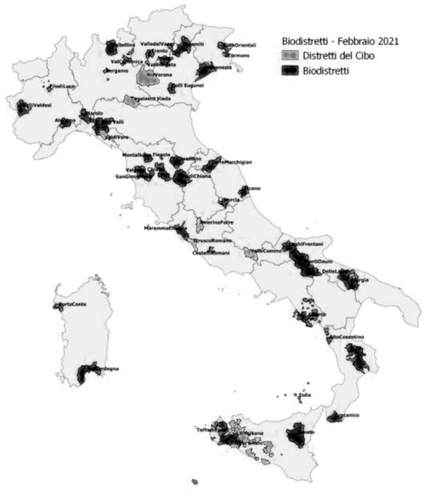


Figure 212 - National distribution of Bio-districts.

APPLICATION PROCEDURE FOR BIODISTRICTS

What is most interesting about the bio districts is their procedure for approval. The procedure for bio-districts differs from the one for GIs. Even if the process is similar, the criteria change drastically. This and many more indicators separate the biodistrict from a GI consortium.

First of all, the role of each biodistrict differs in line with the context. The administrative body of the biodistrict has the task of proposing a strategic plan that includes a list of planned activities and other indications. Once the strategic plan is ready, it must be revised by a national entity (in Italian cases, the ministry of agricultural policies MIPAAF). The revision uses a precise scoring system to evaluate the completeness of the proposed plan. The score defines if a biodistrict is approved or not.

A biodistrict needs to score at least 70 points to be approved. With less than 70 points but more than 35, the plan needs re-evaluation, and the process repeats itself. With less than 35 points, the plan is rejected.

	TOPIC	ASSESSMENT	SCORE
1	Involved territory	- High (3/3 municipalities have agreed) - Moderate (between 1/2 and 3/3) - Low (between 1/3) and 1/2)	5 3-4 1-2
2	Organic agricultural land occupation	- High (organic land use over 50%) - Moderate (organic land use between 35% and 50%) - Low (organic land use between 30% and 35%)	15 4-14 1-4
3	Number of agricultural businesses participating	- 10 or more businesses - From 6 to 9 businesses - From 3 to 5 businesses	10 3-9 1-2
4	Animation activity of the district	- Adequate direct participation of the members - Missing animation activity. Presents only digital information - Poorly sponsored and low visibility - No activity is planned	7-10 5-6 1-4 0
5	Conformity to the art.4, comma 4, letter b	- Detailed description, supported by planning acts - Detailed description, not supported by planning acts - General description, not supported	6-10 3-5 0-2
6	Evaluation of the territorial economic integrated plan	- Extensive description - Sufficient description - Not presented	10-15 5-9 0-4
7	Synergies created by the agreement meant to increase the number of associated farmers	- Extensive description - Sufficient description - An adequate description is missing - Not presented	7-10 5-6 2-4 0-1
8	Environmental, social and economical impact	- Extensive description - Sufficient description - Not presented	15-20 7-14 0-6
9	Territorial measures for the restriction of phytosanitary products close to urban areas	- Specific and detailed - Sufficient detail - Not presented	8-15 2-7 0-1
10	Monitoring system	- Extensive description of planned actions - Generic description - No planned monitoring system	8-10 5-7 0-4
11	Total	Proposal approved Proposal approval postponed Proposal denied	> 70 35 / 70 < 35

Figure 213 - Application procedure for Bio-districts, scoring system.

The assessment table for approval of biodistricts gives the opportunity also to territories with low organic farming participation or low local interest to apply for a biodistrict. In this case, by using a well-structured planning strategy, institutions can create a biodistrict. This seems of little relevance but has to be considered a powerful tool. It allows to use of the biodistrict tool in two different ways. First, as typical for other certifications, to protect existing sustainable agricultural practices were present. Second, it can be used as a planning tool to stimulate the transition to sustainable agricultural practices where this is not the case yet.

A good example is the case of the existing biodistrict of the Chianti Classico region, where a robust organic farming community has developed thanks to a strong GI. The approved plan for Chianti Classico Biodistrict includes measures such as:

Sustaining local organic agriculture, including diversification of production by technical assistance and bureaucratic simplification. To engage for the activation of measures for the joint development of organic agriculture; to organise meetings, workshops, exhibitions and markets. To promote schooling programs for information and technical assistance for associated farmers; to promote initiatives that favour short production chains; to inform consumers through educational programs for healthy diets and organic production. To introduce areal brands of quality to protect local biological productions; to promote study programmes and workshops based on the organic method; to coordinate social, legal, legislative, and associative initiatives for the confirmation of organic agriculture. To participate in decision-making processes of local, regional and national organisms that focus on organic agricultural development and environmental protection.

ASSESSING THE APPLICATION PROCEDURE TO GIBs

The application procedure for a GIB certification resembles the framework used to assess biodistricts. Expect a few exceptions. The criteria to evaluate the proposal remain the same. At the same time, significant changes are applied to the pointing system itself. The weight distribution of points is more outbalanced and gives additional importance to topics such as involved territory or the number of participating farmers. In this way, all eight topics used to assess the score are equally important, and an approved GIB must have at least a minimum score for each.

	TOPIC	ASSESSMENT	SCORE
1	Involved territory	- High (3/3 municipalities have agreed) - Moderate (between 1/2 and 3/3) - Low (between 1/3) and 1/2)	15 7-14 1-6
2	Organic agricultural land occupation	- High (organic land use over 50%) - Moderate (organic land use between 35% and 50%) - Low (organic land use between 30% and 35%)	15 9-14 1-8
3	Number of agricultural businesses participating	- 10 or more businesses - From 6 to 9 businesses - From 3 to 5 businesses	10-15 3-9 1-2
4	Marketing strategy and animation program evaluation	- Adequate direct participation of the members - Missing animation activity. Presents only digital information - Poorly sponsored and low visibility - No activity is planned	7-15 5-6 1-4 0
5	Evaluation of the territorial economic integrated plan	- Extensive description - Sufficient description - Not presented	10-15 5-9 0-4
6	Strategies for increased participation	- Extensive description - Sufficient description - An adequate description is missing - Not presented	10-15 5-9 2-4 0-1
7	Environmental, social and economical impact	- Extensive description - Sufficient description - Not presented	10-15 5-9 0-4
8	Monitoring system	- Extensive description of planned actions - Generic description - No planned monitoring system	10-15 5-9 0-4
9	Total	- Proposal approved - Proposal approval postponed - Proposal denied	> 70 35 / 70 < 35

Figure 214 - Application procedure for Geographical indicated bio-districts, scoring system.

THE GIB LOGO

Every food quality certificate needs to include a detailed description of the logo it decided to use to identify the products under its guarantee. This helps the consortium in case of legal disputes against possible fraud. In addition, a solid and communicative label can also become a powerful branding tool as it might positively affect the product's market value.

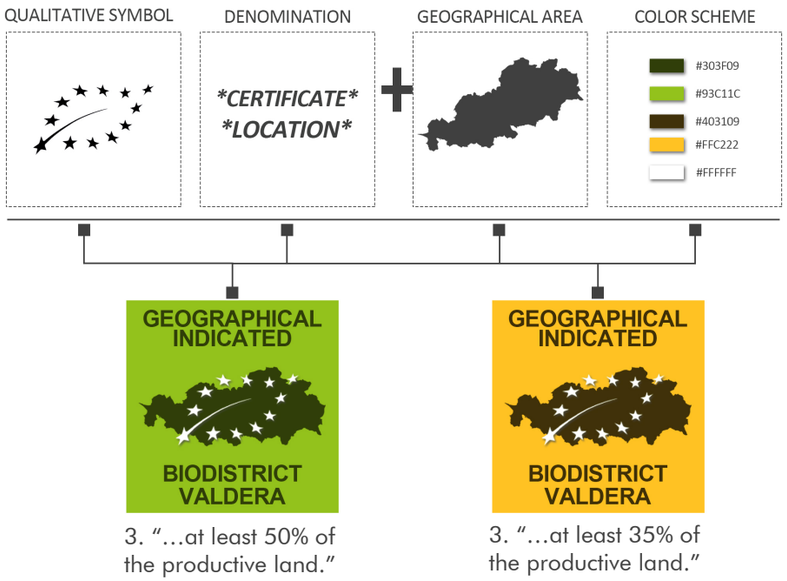
Existing food quality certificates tend to use logos that are often too elaborate and use a set of colours with low efficiency. This usually brings unwanted consequences, such as misleading consumer choices. To be efficient, the logo has to become a sort of eyecatcher, where intense colours attract attention, and simple and straightforward designs should increase the capacity of consumers to memorize and remember the certification.

Regardless, the marketing strategies alone cannot define a logo, as symbology also has a meaning and often tells a story. Therefore, both methods were considered in creating the GIB logo, and symbology and design were combined in the best possible way.

The creation of the logo divides into three steps. First, "The concept behind the GIB is to certify organic farming products…" so the organic label is included. Second, "…that come from a specific location that has convicted to sustainable practices to…" means that the geographical area and its name are included. The third step defines the background colour of the logo, yellow (hex code: #D6D215) for "…at least 35% of the productive land." and green (hex code: #93C01C) for "…at least 50% of the productive land."The policy framework must include precise indications of how the logo is designed to impede replications.

1. "The concept behind the GIB is to certify organic farming products…"

2. "…that come from a specific location that has convicted to sustainable practices to…"

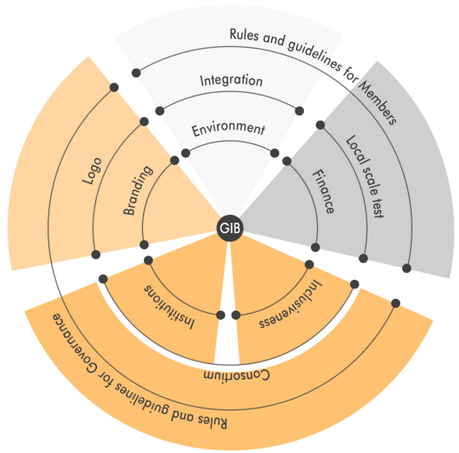


3. "…at least 50% of the productive land."

3. "…at least 35% of the productive land."

Figure 215 - How to create a logo for a food quality certificate.

Figure 216 -Tuscan landscape, Valdera, Italy.



RULES AND GUIDELINES FOR GOVERNANCE

Now that all the information needed to build an efficient policy for the new food quality certificate is collected, the separately analysed elements can be converted into one framework. The connected aspects are (1) The list of rules and limitations resulting from the integration phase (these indicate the environmental engagement of the policy). (2) The list of conclusions from testing the policy on a local scale (these show the financial support the policy provides to the applying agri-businesses). (3) A list of rules that denotes the consortium's role; is contained in the policy principles. (5) A set of requirements and a scoring system for the consortium's approval. (4) a description of the components and colours of the logo.

The first part of the chapter shows the main body of the policy, which includes two main aspects of the policy. The rules for sustainable agricultural practices that the applying agri-businesses must follow and the indications for the financial support provided to farmers that decide to join the certification. This first part can be defined as the "rules and guidelines for members". These rules depend on the necessities of an agri-food system, and to be truthfully efficient, they must transform according to the system's needs for increasing sustainable and resilient development.

The second part includes the "rules and guidelines for governance". This means that it contains instructions for how a new GIB district is created, how the consortium is regulated and what tasks it has and how the logo is represented. These guidelines should work as the previous assessment for the creation of a new GIB district. Therefore, they represent the framework's backbone as they support the first part. In this case, the rules do not depend on the needs of a specific agri-food system, as for the first part.

Figure 217 - Elements that complete the policy framework, second part.

3 Inclusiveness
Consortiums role

Art. (3.1) – The Consortium declares its engagement in environmental sustainability. A list of main principles is written once the consortium is founded.

Art. (3.2) – The Consortium organises meetings, workshops and participative processes that increase participation and collaboration between members.

Art. (3.3) – The Consortium is in charge of developing market strategies for the certification.

Art. (3.4) – The consortium regulates the monitoring system and chooses the external examination boards.

Art. (3.5) – The consortium simplifies application procedures for farmers who want to apply for a consortium membership and the certification policy. At least one field expert is provided to help farmers in the bureaucracy of transition.

Art. (3.6) – The consortium organises members into buyer groups with similar needs for input materials.

Art. (3.7) – Application costs for farmers that aim to become members of a GIB consortium are proportioned to the productive land of the agri-business.

Art. (3.8) – All agri-businesses' members of the consortium have the same influence on decision-making processes.

Art. (3.9) – Local residents, retailers, field experts and members of local institutions can become members of a GIB consortium by paying a non-productive member quote. They do not have an influence on decision-making that influence the policy.

Art. (3.10) – The consortium has the role of increasing the local participation of non-members.

Art. (3.11) – Non-members are entitled to participate in the consortium's events actively.

4 Branding
Certifications label

Art. (3.1) – The logo indicates the concept behind the GIB certificate. It certifies products produced with the use of sustainable agricultural practices and produced in a specific geographical area with a strong vocation for organic farming.

Art. (3.2) – The logo contains the European label for organic farming.

Art. (3.3) – The logo contains a symbol that refers to the specific geographical area. This can be represented by the physical form of the border of the selected area.

Art. (3.4) – The logo must contain the denomination of the geographical area.

Art. (3.5) – The logo must contain a defined colour scheme for the label, where a yellow (hex code: #D6D215) is used for GIBs where the share of organic productive land is equal or over 35% and green (hex code: #93C01C) for GIBs where the share of organic productive land is equal or over 50%.

5 Governance
Application procedure

Art. (5.1) – A scoring system assesses the approval of the GIB and its consortium.

Art. (5.2) - The European Commission evaluates the scoring system. If the GIB proposal scores seventy points or above, it is approved. If the proposal scores between thirty-five and seventy points, it is approved but needs to achieve at least seventy points after a maximum of three years after the approval. If the score is under thirty-five, the proposal is rejected.

Art. (5.3) – The scoring system considers the following criteria: (1) Number of involved municipalities, (2) Percentage of organic farming on total productive land, (3) Number of involved agri-businesses, (4) Marketing strategy and evaluation, (5) Strategies for increased participation, (6) Environmental, social, and economic impact report, (7) Territorial economic integrated plan, (8) Monitoring system.

Figure 218 - Policy framework - rules and guidelines for governance.

Figure 219 -Badia Camaldolese, Volterra, Italy. by author.

CONCLUSIONS AND REFLECTIONS

CONCLUSIONS ON THE RESEARCH

In the first steps of the paper, the research highlighted issues concerning the vulnerability and sustainability of the Global agri-food system. Further in-depth analysis of the status quo issues in the Tuscan agri-food system clarified that new strategies and tools are needed to make the system resilient to future threats caused by climate change.
Crucial for an agri-food system to become resilient is the preservation and controlled use of natural resources such as fertile soil, clean water and biodiversity. Therefore the research aims to create a strategy that mainly aims to mitigate pollution and excessive use of natural resources. At the same time, the strategy works as an adaptation strategy as it accommodates the system to some issues that cannot be solved otherwise.

Since the aim is to create new tools for sustainable farming systems, the research dedicated an essential part of the process to analyze existing tools and policies that farmers that use SAPs can use to protect their interests and have a proper market position. Through the research, it became clear that by now, the tools available to protect sustainable farming are inefficient. They do not only fail in stimulating the transition of farmers to sustainability. They are also part of the problem, as they can unintentionally lead to specific negative trends that affect the current system.

The inefficiency of the policies is strictly connected to participation in the policy. Besides the general limitations for pesticides and fertilizers that all farming activities must follow, all other existing policies and certifications for sustainable agricultural practices are non-mandatory. Of course, the reasons behind the decision of a farmer to apply voluntarily for a policy or not can be multiple and unpredictable. However, most of the reasons are, of course, financial reasons and depend on costs for assessment, financial aids and profit range and production change.

The fact that these policies are not mandatory and influence only participants makes it even more challenging to study them. Knowing that most of the policies' positive influences on environmental sustainability are displayed indirectly as a collateral cause makes it difficult to conclude the actual effect of the policy. Therefore, it remains impossible to conclude what would happen if the certification manages to increase participation.

The research decided to use a particular method for this purpose, the maximization method. The maximization method is probably one of the few ways researchers have, in this case, to evaluate how these policies express in full potential. Even if the classic structure of the maximization method is used to evaluate stakeholder goals on a local scale and produce a final draft plan through negotiation between the part, the method can be re-adapted to many contexts if only the process is considered. In this way, the threats and opportunities of the policy are revealed and how they fully express spatially if they become mandatory. It turned out to be the perfect method to explore possibilities and decide on the elements that would then define the new framework, together with the prepositions established by the researchers' ambitions.

Figure 220 -Abandoned farm in Volterra, Tuscany.

THE MAXIMIZATION PROCESS

The process of maximization defines the framework itself. The output of the method is a list of rules. These rules combine the most efficient rules from the existing policies discovered through maximization and research principles. The final rules define the sustainable agricultural practices that farmers have to follow.

These rules depend on the necessities of an agri-food system. To be genuinely efficient, they must transform according to the system's needs to stimulate sustainable and resilient development. Therefore the first part of the policy needs to be assessed for each agri-food system, as the research did through maximization for the Valdera area. This is why it is possible to define the maximization method as an integral part of the framework. The maximization method has to be applied to every agri-food system that aims to create its own geographically indicated biodistrict. It needs to identify the spatially the most unsustainable practices and, therefore, the "spatial criticalities" and then later try to maximize different existing policies to see how they react to the issues is crucial and will profoundly shape the outcome of the policy.

The conclusions from the maximization method include the rules for potential members of the new certification. The Geographical indicated biodistrict or GIB. A second part of the framework defines the governance of the certification. It is crucial for a non-mandatory tool to include, besides financial aid, a set of guidelines that define the nature of the logo and the consortium that stays behind the certification. as much as the logo does not seem relevant to the proper efficiency of the certificate it is the critical tool. A strong label increases market potential. In contrast, the consortium remains the main stakeholder in the governance of the certificates. It is the task of the consortium to manage socio-economic and environmental strategies, propose changes to the policy, support members, and organize activities and actions to increase participation. Therefore the research included in the framework clear indications of the tasks of the consortium and the process the consortium must fulfil to formalize the GIB.

Figure 221 -Tuscan landscape, Peccioli, Valdera.

THE GIB CERTIFICATION

The final product brings to light a new certification for food products, the GIB. The principle behind the label of GIBs is to tell consumers that the product is produced through sustainable agricultural practices and comes from a geographical area where at least a specific percentage of farmers convict to the same rules. Since the GIB aims to elevate organic food products and distinguish some of them from others, it could find some contrast in farmers that produce organic food goods in areas without GIBs. Nevertheless, the framework for the certificate allows the creation of a new GIB in areas where the numbers of organic farmers are low. Bringing into place a GIB stimulates the transition of agri-businesses to sustainable practices, and organic farmers can benefit from it.

The conclusions of the research gave many answers, and many more doors were opened by it for future studies and investigation. Not only does it detect multiple gaps in the scientific knowledge of geographical indications, which are extensively explored in the economic and social field, but with no doubt they lack in literature for spatial and environmental large-scale impact analysis. The topic also requires further investigation for further development of the framework, as the research focuses on environmental and spatial aspects of the certificates. Some of these could be the extension of the study over consumer behavioural trends or a more detailed analysis of strategies to increase the participation of the farming communities in the certificate.

REFLECTION ——

DIFFICULTIES AND HOW TO OVERCOME THEM

During my first master's year at TU Delft, I cultivated a strong interest in agricultural processes, including rural development, market trends, social aspects, and many more. In Q3, I managed to collect and enrichen my knowledge about the agri-food sector as I worked with the team on a strategy for agricultural circularity for Zuid-holland. In the literature research made for this quarter, I came across the definition of Geographical Indications. As a student with an Italian background, I was already quite familiar with the term, and the possible socioeconomic benefits GIs can bring to local farming communities. Regardless, they never seemed to be a relevant spatial planning tool till then. At that moment, I thought that transforming the GIs from simple economic-politic tools to planning policies could be an efficient solution adaptable to the Tuscan situation, as to others, to find a way to push the agri-food sector towards sustainable development. There were already some cases that could help me demonstrate that food certificates can affect an agri-food system's environmental stability. Nevertheless, finding the correct information to demonstrate the thesis was one of the more significant issues the research had to solve.

The number of available research papers about food quality certifications is impressive. Still, the number shrinks to a mere few when the search keywords are environmental sustainability or spatial planning. Most of the time, the existing knowledge about GIs and other certificates is produced by researchers specializing in agricultural or economic sciences. These papers tend to use a rather technical language and are less accessible to non-experts in the field. On top of that, the first group, which specializes in agricultural sciences, focuses on analyzing the effects of the certification on the single agribusiness and not on the whole agri-food system. The second group, which specializes in economic and political sciences, is looking at larger-scale effects that match the scope of this research. Still, the topic differs, as the researchers insist on elaborating upon the "direct effects" GIs have on the economic and social aspects of an agri-food system and not on the indirect environmental effects it could cause.

Finding evidence to sustain the research hypothesis that GIs are in some way influencing environmental sustainability in literature research was not the only difficulty encountered. Another hurdle comes from drawing clear conclusions from the policy analysis. While the policy that organic farmers must follow in order to be entitled legally to use the bio certificate is one for all product typologies, the GIs have a more fragmented policy scheme where every food product has a different disciplinary. To understand what is meant by excessive fragmentation and to get behind all the regulations and policies farmers that belong to a defined geographical indication must follow, it is necessary to investigate three to four different scales of legal jurisdiction, depending on the scale of the certification.

Different but at the same time complementary, policies can be found on European, national, regional, and local scales (with the local scale meaning the defined area of the GI certificate). The European scale gives general indications of the principles followed by GIs and the procedural iter to approve a new certification. The national scale adapts the European policy to the national context. Since some certificates were used already before the approval of the common European policy, every nation has its pre-existing acronyms. This is indeed the case for countries where food quality schemes, such as France, Greece, or Italy, already play an integral role. The general European distinction of GIs into PDOs and PGIs is insufficient in the Italian case. Italian PDOs divide into DOCs and DOCGs exclusively for wine and DOPs for all other food products. The same happens to PGIs that become IGTs exclusive for wines or IGPs for all other food products. It is understandable that this new distinction also brings the necessity of additional policies that specify the characteristics of the new classification. The regional or local scale, depending on the GI scale, contains the most specific policy regulating GIs. In this case, the policy gives precise indications of all the rules the applying farmers must follow. It describes the particular characteristics that the product must have and defines the geographical borders of the GI.

The main problem behind the last scale is that, even though a general scheme is followed, these policies differ one from one another, and each GI has its own very explicit policy. It is necessary to distinguish the specific agricultural practices needed to achieve the qualities for which a traditional food product is known. On the other hand, having to handle eighty-nine different policy papers only for the Tuscan scale in addition to the national and European scale becomes challenging.

The challenge of finding useful information is not limited to the literature and policy analysis. Maybe the most important hurdle, also because the reaction to it changed the whole structure of the research, is a spatial data-related one. GI does not have to respect traditional institutional borders. The confined area described in the disciplinary does follow its own, often geomorphological-related, rules. This means that often the border of a GI does not match any municipal, provincial, regional, or national border. What does not seem like a big problem becomes crucial in data evaluation. To make an example, the chianti Classico DOC area comprehends parts of central Tuscany, including many provinces, such as Florence, Pisa, Siena, and Arezzo. Even by knowing the total number of registered agri-businesses for the certification, it is impossible to know how they are distributed across the different provinces. Another issue connected to data evaluation is the absence of geodata sources that include agri-businesses that are GI certificated. Even creating such information becomes challenging as the most important information is missing, a complete list of the names of the agri-businesses that applied for the certificate.

Each of these challenges that the research has encountered brought a solution that profoundly shaped the research outcome. The scarcity of topic-specific information in literature research forced the study to conduct a combined use of different methods to achieve satisfying results. The parts of available data helpful to the investigation have not all the same format and exist in the form of text, tables, or mappable information. After a first analysis of the different parts, through statistical analysis and spatial investigation, the primary strategy used to surpass the obstacle is to translate most information into the same format and produce the missing information through the elaboration of the results. Through research by design and, later, through maximization, the data was spatialized and became quantifiable.

To overcome the complexity of the political system, after a general analysis, only the points in each policy that could possibly directly affect the environmental sustainability of the farming practices were selected. The policies that act on different scales were then confronted and merged into a single list containing the rules of each analyzed certificate (Gi, organic and Cap in this specific case). This narrowed down the scope but limited the findings to direct effects. Still, to know which of the rules really has spatial influences and so with, also include the parts of policies that have indirect effects, the research needed to make use of interviews with both users and specialists.

The interviews turned out to be a significant addition to the study as they revealed many indirect influences, strengths and weaknesses of the policies and the institutions behind the certificates that do not appear on paper.

Finally, the maximization method is used to solve the issue of missing geodata information. The research can't precisely determine how many Gi-certified farmers are registered in Valdera. At the same time, this information, important as it might be for the study, cannot be made up through speculations or approximations. An alternative method that does not necessarily need the missing data information must be used. What the research does know and needs to make use of is what rules GI and other certificated sustainable agricultural farmers must follow. In this case, the maximization method comes in quite handy. As the word maximization says, the policy is maximized (or extended) to the entire agricultural land in the area, which is available information. In this way, the research has the possibility to produce and observe the results of the policies' full potential displayed in the selected agri-food system.

MERITS AND DEFECTS OF THE MAXIMIZATION METHOD

The most decisive advantage of using the maximization method is that it perfectly bridges the analytical part of the research with the strategical part. The first part of maximization helps to conclude the analytical part by drawing conclusions from the maximized policies. In this way, it is possible to answer the question, what if all farmers apply for a certificate and, additionally, observe what specific rules have the highest impact on spatial outcomes. Successively the maximized results of the policies are confronted with the environmental criticalities in the area, and the ones that score best are selected and merged into the optimization phase.

The optimization phase can be considered as the best possible outcome from joining different policies from different food quality certificates. This allows a comparison between the effect caused by the optimization and the pre-established principles that are used as guidelines for the strategy. The result, and final phase of the maximization process, called integration, becomes the main structure of the policy behind the new certificate and represents the environmental engagement of the policy. Everything else included in the framework for the new policy is meant to increase the financial support and participation rate of farmers that apply for the certificate.

Besides the advantages, the method brings some limitations with it. First of them all, and common to all scenario-based approaches, is the infinity of possible outcomes. As much as the scenarios are built upon specific rules, they remain speculative tools and often risk misinterpretation.

Some indicators are necessarily dependent on the researcher's interpretation, especially when it comes to the indirect consequences of a policy. For example, when maximizing GI rules, rules can be very straightforward and leave no place for interpretation, as the law that indicates productive land over 700meters of altitude and on low fertile soil is not suited for production. The outcome of this law in the maximization will clearly show that productive land on low fertility soils and over 700 meters altitude is withdrawn from production. Less direct rules leave more space for doubts, such as the GI rule that indicates that no permanent crops should be placed on low-slope land. Maximizing this rule would mean forcing land use change for all vineyards, olive groves and other arbustive cultures placed on lower slope soils, but what happens to the productive land after the forced land use change is challenging to say. It limits the possible answer of the researcher to a generic one.

To say that the land use changes to a specific crop would be complete speculation. The only possibility is to limit the options of available crops following the policy's limitations.

GIB OR GEOGRAPHICAL INDICATED BIODISTRICT

Besides the advantages and limitations, the maximization method presents, its final output, the integration map, must be considered as the vision for an environmentally sustainable agri-food system. Furthermore, as it is the combination of the most efficient parts of different policies and the spatial principles defined by the researcher, it also indicates how to achieve such a vision.

This process lays the foundations for the creation of a new certification, the GIB or geographically indicated bio district. Unlike the existing certifications, the GIB is considered as both a market tool and a spatial planning instrument. It preserves the classic characteristics of a food quality certification, as it presents a controlled label, a non-mandatory policy that applies only to the farmers that chose to register and the consortium that develops marketing strategies and represents farmers in legal matters. What differs from the existing certifications is how a GIB is created. The procedure can be initiated not only by a group of farmers that share the same principles but also by institutional forms such as municipal unions. In this way, there is the chance to use the certification to defend the rights of already pre-established sustainable farming groups but also to stimulate the creation of farming unions in regions where this is not the case.

Still, as the tool remains a non-mandatory one, how much the new certification positively influences the sustainability and resilience of the agri-food system it is applied to, depends entirely on the participation of the local agri-businesses. What the report proposes is the full expression of this certificate. That all farmers of an area decide to apply to a non-mandatory tool remains a difficult but not impossible scenario. The critical element to achieve high participation numbers stays in finding the right balance between the costs and benefits of a certificate.

To conclude, the grade of success for the certificate depends on participation, while participation relies on the possibility of providing sufficient financial support. This means that the number of possible outcomes for the certification is unlimited. The policy will always positively influence environmental sustainability; the two criteria it depends on will define how much this influence will be.

Scientific contribution: The project's position at the intersection between the two topics, qualitative food chains and spatial planning, made clear that there is a knowledge gap between certifications and their spatial impact. Little has been explored when it comes to the question of what possible spatial outcomes food quality schemes can create when they are legally linked to a specific area. Food quality schemes were always seen as the result of a particular characteristic of a productive area. Distinct traditions and conditions of territory led to the creation of quality schemes that must be protected via a certification. It is never the other way around where the certification is used to intentionally modify a system and influence spatial outcomes in order to stimulate higher qualitative engagement.

Through researching the spatial influence and especially the environmental engagement of existing certifications, the research contributes to answer some of the questions raised by the knowledge gap. The intersection between certifications and spatial planning must be further researched to be entirely covered, but the first milestone is set.

In addition to the scientific relevance of the chosen topic and its position, the use of less "traditional" methods could be seen as innovative strategies to adapt not only for this specific context but also for other research papers interested in exploring the spatial influence of policies or evaluating environmental risks. The first, less "traditional method" used is the research by design one. It is indeed a widely used method, but the study used it to obtain something very specific.

While usually, the layer approach method is used by researchers to introduce maps that investigate multiple topics at the same time as a support for analytical research. In this case, the method is used to produce precise results to conclude the analytical paragraph. It is used with the goal not of supporting evidence but of elaborating it and producing results that make data quantifiable.

The second method is the maximization method. Again, the research uses the principles and follows the structure of the technique but changes its application. The use of the maximization method in the development of the study points out the utility of the method when it comes to evaluating and confronting the effects of different policies. This approach to the procedure can be a helpful tool for any future research needs to compare diverse options and build a vision out of the combined opportunities.

Social relevance: The project proposes to create a new certification that is attributed to agri-food systems that commit to a specific grade to organic farming, the GIB. This will positively influence the system's environmental sustainability and regeneration of polluted natural resources such as water, soil, or biodiversity.

As much as the improvement and preservation of natural resources is the primary goal of the research, the GIB also has other positive effects that are not environmentally correlated. These effects depend entirely on aspects of the policy and the consortium that stay behind the certifications governance. The policy that legally regulates the GIB certificate does sustain smaller familiar agri-businesses by decreasing the monopolization of productive landfills and increasing the financial support for local owners.

Additionally, the policy distributes financial resources in relation to the structural changes an agri-business must fulfil to apply. It provides financial aid and loans to transitioning agri-businesses at the beginning and not at the end of the process as for existing Certifications. The consortium guarantees strategies for product branding and certificate fraud protection. In this way, the economic sustainability of small, local agri-businesses is improved. At the same time, the consortium becomes the leading representative for the GIB agri-businesses in legal causes and promotes the certification through the inclusiveness of non-members and consumers. To guarantee a fair distribution of power in the consortium, the active members have an equal voice in decision-making. This further balances out the possibility of excessive market monopolization, improves collaboration and creates stronger interdependent farming communities.

CONCLUSIONS AND ETHICAL REFLECTION

The research focused in its early steps on understanding the true nature of food quality certifications. A needed step to demonstrate the initial hypothesis is that certificates positively affect the sustainability of the agricultural system. Once the investigation proceeded, some examples of the positive effects of GIs on the agri-food system were found. But at the same time, the same amount of evidence was found demonstrating that the certificates can also produce negative inputs that harm the agri-food system.

A too-high success of a GI certificate, for example, often causes a few greater enterprises to monopolize the market. This forces smaller agribusinesses either to merge into larger corporations or to sell their land concessions. In addition to the market monopolization comes the complementary monoculturalization of the productive area legally under the GI influence. At the same time, the legislation behind PGIs allows the producers to practice only one of the production steps in the defined area, increasing the possibility of importation and so that more prominent producers occupy the market niche. This also puts PDOs in a bad light as their labels are too similar and can barely be distinguished by the average consumer. To avoid monopolization and monoculturalization, the GIBs policy proposes the following: "The GIB certification engages in protecting food products that come from a specific geographical area defined as Biodistrict. All steps of production must happen inside the specified area. The GIB label certifies that products were processed according to the practices of sustainable agriculture and inside the Biodistrict's border". The fact that the policy limits production to the indicated area becomes essential because it limits the size of agri-food businesses to the confined space. At the same time, point 6a in the framework shows the following: "The forced resting period for land units indirectly influences the size of land units and the diversification of production.

As a result, land units over 50 hectares are split into 25 or smaller units". The limitation stimulates an increased diversity in productive land use. Finally, another element that could make the problem of market monopolization less relevant for the study is that this often happens for certificates that protect only a particular product, as for the GIs. In these cases, the niche market they occupy is quickly filled up by only one enterprise that monopolizes the system. The market niche occupation by relatively few entities seems more challenging in certifications such as the biological one, where one label represents all products and creates a global market niche that is too big and diverse to be entirely monopolized.
In conclusion, there are two ethical issues that GIB cannot control, which are greenwashing phenomena and corruption in the system. Unfortunately, episodes of greenwashing, the improper use of the certificates and corrupt institutions in charge of the controls are not rare. For example, I likewise discovered a case of greenwashing during my research. As I don't want to be sued for defamation, I won't use the name of the two involved businesses. During my field investigation, I had the chance to talk with the owners of different agri-businesses, including certified and non-certified ones. One of the interviewed farmers was a conventional producer of wheat. When the question "to whom do you sell your products?" came up, he answered that he sells mainly to two mills in the Tuscan region. It sounded immediately strange to me as I occasionally encountered one of the mills during previous online research and was pretty sure of the fact that they were selling only organic products. As soon as I had the chance, I double-checked. At that point, I knew I had found a case of greenwashing. This made me assume that the more steps in the production chain of a food product, for example, pastry, bakery or meat goods, the more frequent greenwashing phenomena will be.

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APPENDIX

KEYTOPICS

THE AGRI FOOD SYSTEM

"The Agri-food sector is a complex value chain which links the procurement of agricultural raw materials produced on farms through their processing and distribution to their use by the final consumer. The sector consists of multiple players, including farmers, input suppliers, manufacturers, importers, packagers, transporters, wholesalers, retailers, restaurants, and customers...Agriculture no longer has the dominant role in economic activity which it once had, but when the contribution of the food industry is factored in, the agri-food sector remains a significant player" (O'Hogan et al. I, 2021).

The complexity of the relationship between the agri-food system and socio-economic environment increases when the local agri-food systems are connected with global markets. With globalisation, this trend has spread over the systems of the entire globe. "It is a fact nowadays that food production, food processing and food consumption are economic activities in which local and global strategies are interconnected (Goodman 2004; Bowen 2011), and they are combined in complicated ways (Murdoch et al. 2000, Sonnino 2007).

Decisions on where and how to produce, associated with what to consume, are made on a global scale. They are driven by the cost differentials of factors such as labour and transportation, but also by target market characteristics, including quality needs, beliefs and cultural heritage. This process generates positive and negative externalities which can affect the welfare of the local population and, more generally, the sustainability of local production systems. Local production systems are competing on the global market by producing specific quality goods, where innovation, services, culture and local heritage are part of the concept of quality. They also affect the welfare of consumers and citizens; if products fail on the market, perhaps because of exogenous conditions, feedback mechanisms will affect local production systems. In a globalised world, it is possible to locate production activities in a limited geographical area and reach markets that are global (Murdoch and Miele 1999).
These may be commodity markets, but in other cases, they are niche and spatially concentrated markets. As a result, there is a wide range of agri-food systems showing a striking coexistence of diverse organisational patterns, ranging from simple food chains to more complex food networks.

Agri-food systems always, however, develop according to the cultural and productive characteristics of local production systems as well as the availability of resources like land and water, production costs and the localisation of target markets. The implications of the relationships of different agri-food systems on local production systems are wide and varying. They fall into different areas: geography, economics, demography, sociology and agronomy which are all fields useful in assessing the impact of different behaviours and strategies on the socio-economic evolution of local production systems (Arfini F. et al. I, 2012).

This is especially the case of the Tuscan agri-food system, where the relationship between local food chains and socio-economic value are very closely related. On top of that, the quality of local Tuscan food chains has led to the creation of an additional relationship that is not mentioned in the paragraph above, the link between traditional food production and tourism. The agri-food system can be seen as a complex value chain that includes a large set of actors. It is important to acknowledge that changes concerning one actor included in this value chain could affect directly or indirectly other elements of the system. Every agri-food system differs in a way from the other depending also on the scale of approach. The Tuscan agri-food system can be classified as rather complex compared to the average as its structure includes a large number of elements and other sectors that remain strongly interconnected.

GEOGRAPHICAL INDICATIONS

"There are several factors which influence the product (foodstuff) so as to be special (compared to similar products). Some of these factors are associated with the geographical area, and some of these factors concern the product as it is (e.g. traditional processing steps). Some of the characteristics of the defined geographical area which probably could affect the product are pedo-climatic features, topography, climate, soil, rainfall, exposure to the sun, altitude, temperature, etc. For Products with Geographical Indications, it is necessary to have a link with this particular geographical area. It should be displayed in what way the product's attributes are caused by the geographical area and what are the natural, human and other elements which configure its speciality to the product. In addition, it should be mentioned in the description in what way the methods of production are different from others and also which is the contribution of that method to the specific and unique character of the product" (Zisidis O., 2014).

"Products with a Geographical Indication is an intersection between typical products and products with a geographical name...they can benefit from a legally recognised protection scheme, and one or more of their intrinsic (quality) or extrinsic (reputation) characteristics derive from the territory of origin" (Qualivita, 2017).

"A Geographical Indication indicates a specific place, or region of production, that determines the characteristic qualities of the product which originates from that place. It is crucial that the product derives its qualities and reputation from that place. Since those qualities depend on the place of production, a specific "link" exists between the products and their original place of production". These intellectual properties are "the main tools available to farmers, producers and firms to protect and market their agrifood" (Belletti G. et al. I, 2017).

SUSTAINABLE DEVELOPMENT

"We recognise that there is no, and likely will never be, a universally agreed definition of what a sustainable food system is. Definitions differ in scale, change over time and are dependent on context, reflecting different views and interests of the numerous actors in the food system (SAPEA 2020a: 4.2). The 'EU food system' consists of many highly diverse food sub-systems and is intertwined with other food systems beyond the EU, as well as with energy, water and health systems. However, broad agreement exists on what the outcomes of a sustainable food system should be.

As formulated by the FAO (2014), a sustainable food system delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised. A sustainable food system should thus ensure and contribute to all elements of environmental, social and economic sustainability" (European Commission, 2020). But "What is needed to achieve a sustainable food system? There is already an established, large body of high-quality scientific evidence and policy-relevant recommendations on what would contribute to a sustainable food system (SAM 2019). There are also ongoing relevant initiatives in the European Commission, as mentioned above. In addition, FOOD2030 that includes a series of policy-relevant recommendations and associated Research & Innovation requirements all with associated ongoing actions involving multiple stakeholders.

Although there are different views on the exact type of actions and approaches to be taken, there is a broad consensus that a synergistic combination of policies and actions is required (SAM 2019), which: Promote sustainable intensification and/or scale up agro-ecological approaches: increasing or maintaining yields and efficiency, while decreasing environmental burden (on biodiversity, soils, water and air); Reduce food loss and waste, while encouraging the reuse and recycling of unavoidable

food waste; Stimulate dietary changes towards healthier, less resource-intensive (i.e. more plant-based) diets; Improve the resilience and robustness of the food system in particular by diversification, to cope with shocks from geopolitical developments and to adapt to the effects of climate change; Increase the accountability and stewardship of producers and consumers on the environmental, economic, social and public health effects of the food system through, among others, participatory policy development and monitoring, increasing transparency, training/education and improving labelling to better inform consumer choices"(European Commission, 2020).

CLIMATE VULNERABILITY

"Vulnerability refers to the degree to which a system is susceptible to or unable to cope with adverse effects of climate change (including climate mean, variability, and extremes), and it is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity" [McCarthy et al., 2001].

"According to the definition of vulnerability to climate change given by the IPCC assessment report, agriculture vulnerability to climate change is the manifestation of the agricultural sensitivity and adaptive capacity to climate changes [Wang, 2003], and it changes with the location, time, and socio-economic and environmental situations. Agricultural vulnerability to climate change is the function of characteristics of climate variability, magnitude, and rate of variation within the agricultural system, and the system's sensitivity and adaptive capacity, and it is the degree to which the agricultural system is susceptible to, or unable to cope with adverse effects of climate change including climate variability and extreme events" [Hou and Liu, 2003].

In order to understand to what extent a system is vulnerable different assessment methods are used. In the context of climate change and risk management, the main components that determine the vulnerability of a system are Robustness, Sensitivity and Adaptive Capacity. Robustness, the measure of the amount of stress that a system can tolerate before changing its state (Loreau et al., 2002). Sensitivity, the degree to which a system is modified or affected by disturbances (Adger, 2006; IPCC, 2018). Adaptive capacity, the ability of a system to adjust to disturbances, moderate potential damages and take advantage of opportunities or to cope with consequences (Adger, 2006; IPCC, 2018). Robustness and sensitivity are summarized as the potential impact of disturbances on a system to enable the comparison of different systems. As the last component of this vulnerability assessment, we account for the adaptive capacity of a system. Hence, low robustness and/or a high level of sensitivity does not necessarily translate to a high vulnerability since the potential impact can be compensated by the adaptive capacity of a system. Hence, vulnerability is the net impact that remains after adaptation is taken into account" (Adger, 2006; FAO/OECD, 2012; IPCC, 2018).

"The discussion on alternative interpretations of vulnerability highlights that there are two different temporal references (time horizons) for assessing vulnerability. While the conceptualization of outcome vulnerability focuses on future vulnerability, contextual vulnerability focuses on current vulnerability. This distinction can mostly be attributed to the different disciplines that are involved in research on vulnerability and adaptation (Preston and Stafford-Smith, 2009)...natural scientists usually focus on biophysical determinants of climate change and thus assess future vulnerability as the end-point of the analysis. On the other hand, scientists focusing on socio-economic determinants tend to focus on current vulnerability as the starting point of the analysis" (Thomas Fellmann, 2012).

RESILIENT DEVELOPMENT

Climate-resilient agriculture can be defined as "agriculture that reduces poverty and hunger in the face of climate change, improving the resources it depends on for the future generations" [Christian Aid 2015]. "Communities or systems which are prone to hazards should be able to foresee the risks so that they can respond when disaster strikes and adapt to changing risks and situations".

A resilient agricultural system should be able to: "Enhance the resilience of crops, livestock and fisheries to climate change variability and climate change through development and application of improved production and risk management technologies. Demonstrate site-specific technology packages on farmers fields for adapting to current climate risks. Enhance the capacity of scientists and other stakeholders in climate-resilient agricultural research and its application"(Singh R., 2021).

Resilient Agricultural Practices (RAP) is a crucial component to food security and sustainable food systems. Resilient Agricultural Practices (RAP) identify seven principles that contribute to the resilience of the Social-Ecological Systems (SES), addressing the theory of supply chain management, and present their application in agricultural value chains. The key element is that the accuracy of these principles is important for the assessment of each case individually and depends partly on the trade-offs between resistance and other dimensions of the value chain. New challenges related to population growth, political conflicts, climate change, and degradation of natural resources may increase the frequency and magnitude of disturbances such as droughts, fires, floods, hurricanes, whirlwinds, rapid price increases, food availability, and food distribution (Hodbod and Eakin2015; Simmons and Storms2017; Srinivasrao et al.2018).

These shocks are often unpredictable, which limits the possibilities of standard risk management, which is aimed at estimating the probability and the effects of distortions (Vroegindewey and Hodbod2018). Understanding the resilience of the nutritional system to these shocks is now probably the most urgent. As part of sustainable development, resilience has therefore become a very important concept that allows the analysis of various compromises to move the system toward more sustainable economies. Therefore, there is a growing need for both design and management that can give triple benefits, social, economic, and environmental, which in turn means sustainable development (Srinivasrao et al.2018).

The ability of food systems to cope with social, economic, and environmental change is crucial, not only at the level of agricultural production but in the entire value chain for agriculture. These are a set of measures to create value, transforming raw materials into final products and institutions that combine these different production links. As the main intermediary between agroecological systems, households and markets are value chains as an important part of the structure of the food systems of a society" (Srinivasrao C., 2018).

MARKET TOOL

"Businesses and professionals working in the marketing industry have a wide range of marketing tools available to them. Marketing tools can help a business or marketing professional accomplish several things, including increasing brand awareness, driving lead generation and sales, and gathering valuable customer and market information and data. Marketing tools are the systems, techniques, strategies, resources, technology and materials used by companies or marketing professionals to create and implement marketing campaigns that successfully promote their products and services.

There are several types of marketing tools available, and each type of marketing tool serves a unique purpose. It is common for businesses and marketing professionals to

use a combination of marketing tools in their overall marketing strategy. A few of the most common marketing tools include Print advertising, Digital marketing, Search engine optimization (SEO), Social media marketing (SMM), Press releases (PR), Commercial advertising, Customer loyalty programs, Brand reputation management, Event marketing, Information gathering"(Indeed Editorial Team, 2021).

In the specific case of Geographic indications, the market tool works "not only as a tool for protecting consumers' interests and reinforcing confidence in high-quality and local products but also as a legal and economical tool for the development of rural areas and the preservation of cultural heritage". "It provides that "legal means" must be provided to interested parties to prevent the use of geographical indications which mislead the public as to the geographical origin of the goods. It also requires that legal means must be provided to prevent use which constitutes an "act of unfair competition"(Qualivita, 2019).

SPATIAL PLANNING INSTRUMENT

Referring to spatial planning tools as instruments that guide "urban change to achieve social, economic, and environmental benefits" and "fundamentally shape planning outcomes, both in what can be achieved and what is ultimately achieved, Leshinsky and Legacy (2014) distinguish between "substance-oriented" and "process-oriented... Substantive policy tools refer to those that directly affect the delivery of policy goals while procedural policy tools refer to those that affect the process and procedures of developing policy".

They can also be distinguished based on how they influence land property markets: " (i) tools intended to shape markets, (ii) tools intended to regulate markets, (iii) tools intended to stimulate markets, and (iv) tools intended to develop the capacity of market actors"(Stead D., 2021).

"However, national policy frameworks require a high degree of capacity in government, an in-depth understanding of spatial development trends and their implications, and a high degree of political consensus. Such frameworks should not take priority over the development of regional strategies. A national perspective may then be built from the regional level upwards. All countries should also have a national sustainable development framework; most countries have one in place. Detailed policies on spatial development matters can be helpful for creating a positive climate for investment. These may cover varied subjects such as habitat protection, accessibility criteria for types of development and design standards.

Policy statements assist investors by establishing con enters for plan- and decision-making, thereby encouraging more consistent action. The private sector welcomes clear, unambiguous criteria that can apply in all places to all interests and that indicate that steps have been taken to ensure a "level playing field" for investors. Policy statements are especially potent when produced through a process of consultation and dialogue, because this has a better chance of garnering their widespread support and acceptance. Though consensus may be very difficult to achieve, there is great benefit in employing a "bottom-up" as well as a "top-down" approach to policy development. Policy statements should generally be binding on all levels, but allow for some discretion where there is a good reason. When decisions contradictory to agreed policy statements are made, these should be accompanied by rational explanations.

There will be a need for a variety of forms of policy statements at national, regional and local levels. While some will have little flexibility, e.g. when related to the protection of critical natural resources, high-quality agricultural land or cultural heritage, others may offer more discretion to decision-makers. Where local governments and planning systems are not well established, it is better to have clear and unambiguous statements that allow for less discretion. With the stabilization of local government, it will become possible to take a move interactive approach to spatial planning policy development"(Economic Commission for Europe, 2008).

KEYWORDS AND DEFINITIONS

AGRI-FOOD SYSTEM

"The Agri-food sector is a complex value chain which links the procurement of agricultural raw materials produced on farms through their processing and distribution to their use by the final consumer. The sector consists of multiple players including farmers, input suppliers, manufacturers, importers, packagers, transporters, wholesalers, retailers, restaurants, and customers...Agriculture no longer has the dominant role in economic activity which it once had, but when the contribution of the food industry is factored in, the agri-food sector remains a significant player".

O'Hagan J., O'Toole F., Whelan C., 2021; "The Economy of Ireland: Policy Making in a Global Context", Bloomsbury Publishing.

GEOGRAPHICAL INDICATIONS

"Products with a Geographical Indication is an intersection between typical products and products with a geographical name...they can benefit from a legally recognised protection scheme and one or more of their intrinsic (quality) or extrinsic (reputation) characteristics derive from the territory of origin". These intellectual properties are "the main tools available to farmers, producers and firms to protect and market their agri-food".

Fondazione Qualivita, 2017; "The european GI system, the italian model and the case of Aceto Balsamico di Modena PGI Food & Wine products with Geographical Indication". Drivas K., Iliopoulos C., 2017; "An Empirical Investigation in the Relationship Between PDOs/PGIs and Trademarks", Journal of the Knowledge-Economy.

SPATIAL PLANNING

Spatial planning is a key instrument for establishing long-term, sustainable frameworks for social, territorial and economical development...Spatial planning has a...regulatory mechanism, the government has to give approval for given activity...and a development mechanism, the government has to elaborate upon development tools for providing...directions for urban development, preserving national resources and for establishing incentives for investment, etc."

Economic Commission for Europe, 2008; "Spatial Planning, Key Instrument for Development and Effective Governance with Special Reference to Countries in Transition", Geneva.

Figure 223 -Main keywords definitions from scientific literature.

SECONDARY KEYWORDS AND DEFINITIONS

VULNERABLE

"Vulnerability refers to the degree to which a system is susceptible to or unable to cope with adverse effects of climate change (including climate mean, variability, and extremes), and it is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity" [McCarthy et al., 2001]. "Agricultural vulnerability to climate change is the function of characteristics of climate variability, magnitude, and rate of variation within the agricultural system, and the system's sensitivity and adaptive capacity, and it is the degree to which the agricultural system is susceptible to, or unable to cope with adverse effects of climate change including climate variability and extreme events" [Hou and Liu,

McCarthy, J. J. et al., 2001; "Climate Change 2001: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergov- ernment Panel on Climate Change", Cambridge University Press, 1032pp.
Hou Y., Liu W., 2003: "Forecast of changes in climate vulnerability of agricultural production in the Loess Plateau in China", Journal of Catastrophology (in Chinese), 34/38.

RESILIENT

Climate-resilient agriculture can be defined as "agriculture that reduces poverty and hunger in the face of climate change, improving the resources it depends on for the future generations" [Christian Aid 2015].
"Communities or systems which are prone to hazards should be able to foresee the risks so that they can respond when disaster strikes and adapt to changing risks and situations". A resilient agricultural system should be able to: *"Enhance the resilience of crops, livestock and fisheries to climate change variability and climate change through development and application of improved production and risk management technologies.*
Demonstrate site-specific technology packages on farmers fields for adapting to current climate risks. Enhance the capacity of scientists and other stakeholders in climate-resilient agricultural research and its application".

Singh R., Machanuru R., Singh B., Shrivastava M., 2021; "Climate-resilient agriculture: enhance resilience toward climate change", Global Climate Change.

MARKET TOOL

"*Acting* not only *as a tool for protecting consumers' interests and reinforcing confidence in high-quality and local products* but also as a legal and economic tool for the development of rural areas and the preservation of cultural heritage".
"It provides that "legal means" must be provided to interested parties *to prevent* the use of geographical indications which mislead the public as to the geographical origin of the goods. It also requires that legal means must be provided to prevent use which constitutes *an "act of unfair competition"* ".

Zografos D., 2010; "Geographical Indications and Socio-Economic Development", IQsensato Working Paper No. 3.

POLICY TOOL

Referring to policy tools as *instruments that guide* "urban change to achieve social, economic, and environmental benefits" and "fundamentally shape *planning outcomes*, both in what can be achieved and what is ultimately achieved, Leshinsky and Legacy (2014) *distinguish between "substance-oriented" and "process-oriented"*.
"Substantive policy tools refer to those that directly affect the delivery of policy goals while procedural policy tools refer to those that affect the process and procedures of developing policy". They can *also be distinguished based on how they influence land property markets*: " (i) tools intended to shape markets, (ii) tools intended to regulate markets, (iii) tools intended to stimulate markets, and (iv) tools intended to develop the capacity of market actors".

Stead D.,2021; "Conceptualizing the Policy Tools of SpatialPlanning", Journal of Planning Literature.
Leshinsky R., Legacy C., 2014; "Instruments of Planning. Tensions and Challenges for More Equitable and SustainableCities", Routledge.

Figure 224 -Secondary keywords definitions from scientific literature.

METHODS

STAKEHOLDER ANALYSIS

Description - The stakeholder analysis method is widely used to analyse who are the actors that are possibly involved in the act of developing a plan. This does not include only the actively involved institutions but also every social group that the outcomes of a strategy might influence. Through literature research and geographical analysis, the different actors are identified. These actors are categorized into main subgroups, defining if they are private, public or institutional. Later on, the position they might have towards a possible policy proposal is evaluated, together with their primary interest and the power they have in decision-making. This analysis requires the use of two graphs, the critical stakeholder table and the power/interest matrix. The table gives insight into the stakeholders' different problem and goal perceptions and defines their dependency on the Tuscan agri-food sector. This tool allows the research to determine which stakeholders might play a crucial role in developing a new policy and what position they will take (positive, negative, or neutral). The matrix positions the actors on a two axis scheme where X is power and Y is interest. The standard structure of the matrix suggests how to interact with it by applying minimum effort in engaging with stakeholders that have low power and low interest. To keep stakeholders with high power and low interests satisfied. To keep the ones that have low power and high interests informed and engage with key stakeholders with high power and high interests. The matrix is a necessary tool for the stakeholder engagement analysis.

Aim - The stakeholder method remains one of the most crucial methods in spatial planning. Recognising the different actors, their positions in the power/interest matrix, their attitude toward the project, and the possible conflicts that could arise will enable the possibility to create an engagement strategy to stimulate higher participation in spatial planning processes.

Resources - The needed resources for this method comprehend Academic and scientific literature on stakeholders, the GIS Tuscan database, surveys, interviews with experts, and interviews with farmers and consumers.

STATISTICAL ANALYSIS

Description - Statistical analysis means investigating trends, patterns, and relationships using quantitative data. It is a crucial research tool used by scientists, governments, businesses, and other organizations. To draw valid conclusions, statistical analysis requires careful planning from the very start of the research process. Statistical analysis does not look for an answer in words but in numbers and empirical data. Therefore, the research focuses on comparing the numbers that define land occupation, amount of production and generated income for the different farming typologies (conventional, certificated, and organic). The statistical analysis becomes a crucial method when the spatial information is missing, as in the case of GIs (see chapter reflection).

Aim - Such analysis aims to draw a personal observation and understanding of what the statistics mean for the own research. The method aims to give a quantitative definition to agricultural trends in the system. For example, what organic farmers produce the most, what product has the highest production/surface ratio, or how much surface GI certificated farmers occupy. The knowledge collected from the method becomes valuable information for the upcoming list of principles.

Resources - To build the statistical analysis, a number of online datasets had to be consulted. For the research following institutional portals were used: Censimento istat, Qualivita, Mipaaf, Regione Toscana and Arpat.

SPATIAL INVESTIGATION

Description - The spatial investigation method "is a process of GIS data interpretation, exploration, and modelling, from acquisition to understanding results. The retrieved information is computer-processed with spatial analysis software and varies depending on the number of tasks and their complexity". The focus of spatial investigation in this research is to give a spatial dimension to the statistical information gathered in the analytical phase through the statistical analysis method. By illustrating the results collected with GIS data sources, the spatial investigation method is a critical step in preparing for the strategy. Spatial investigation lays out a number of maps depicting the agricultural, morphological, and natural characteristics of the Valdera district (area chosen for specific analysis). These maps show a clear picture of criticalities that might occur in the area. Becoming the first milestone to create a list of principles that should respond to the detected criticalities.

Aim - The aim is to translate quantitative data obtained with previous analysis into spatial information with the help of digital mapping software such as GIS. The distribution of different farming typologies in the region, their footprint, the hydrologic risk, soil erosion areas and ecological niches can be identified and used to understand better the current situation.

Resources - Necessary resources for the application of this method are primarily the results from the statistical analysis; secondary geodata portals such as Geoscopio, Corine landcover, academic literature and QGIS.

LAYER APPROACH

Description - Spatial planning nowadays must handle complex issues that conventional thinking is not able to cope with anymore. Problems such as climate change, migration, economics, and social dynamics "are the so-called wicked problems. There is no single accepted formulation of these problems… Design is a very suitable approach for these types of problems because it makes creative jumps in thinking and solving possible. This way, unprecedented solutions and inventions through design innovations come into reach" (Roggema R., 2008).

Aim -This method aims to experiment with distinctive design solutions and compare them in separate phases of the research. By combining different layers of the maps from the spatial investigation chapter, more complex issues, such as the environmental ones, can be understood. The method provides insight into the most critical areas regarding soil erosion, soil contamination, water contamination, water use, and biodiversity loss.

Resources - Resources needed for this method are the maps from the Spatial investigation.

POLICY ANALYSIS

Description - The method of policy analysis consists of a deeper understanding of how regulation around the topic is structured. In order to depict the complete picture, the analysed policies should cover both different scales (European, national, and regional) and other topics. In the case of the research lead, the most urgent issues remain environmental criticalities defined in the previous method of "spatial analysis". So, the focus remains to identify all policies that include limitations and concessions that might directly or indirectly affect the interesting area's water, soil, and biodiversity conditions. This means that a cross analysis is needed on one side, considering the policies that concern different typologies of farmers and, on the other hand, different scales of institutional influence (European, na-

tional, or regional). Therefore, both options of the method are explored, the policy analysis and the policy options analysis. These "analyses are related methodologies designed to evaluate either existing or potential policies in terms of their ability (or potential ability) to achieve the stated policy goals" (Wehmeier D. et al., 2005). Policy analysis is used to find strengths and weaknesses, while the options analysis helps to find viable solutions to the policy issues or improvements for a future framework.

Aim - The aim of the method is to define if the policies affect negatively or positively one or more of the sustainability targets and why. The analysis is conducted on all existing policies that regulate in some way agricultural practices and have an influence on the sustainability of the system. Weaknesses and blind spots that can be used and shaped to own needs are defined. The problems persisting in the political nature of GIs and their high costs for assessment are identified. The bullet points of each policy that influence the spatial criticalities are selected.

Resources - The resources needed to use the policy analysis as a method are easily accessible as they consist mainly of Policy documents. These must be publicly accessible in democratic nations. The use of Academic literature and Research papers could facilitate an understanding of specific laws. The European, National, and regional sites are consulted for the documentation.

INTERVIEWS AND SURVEYS

Description - This method can be seen as a hybrid between field investigation and analytical methods. "Research interviews are a method of data collection that uses people's answers to researchers' questions as to their source of data. In this respect, they have something in common with questionnaires – the data comes from what people tell the researcher" (Denscombe M., 2018). Using interviews and surveys as a method is very often underestimated. Especially nowadays, thanks to digital communication accessible to almost everyone, this method has become fundamental. Only through interviews and surveys targeting specific interest groups it is possible to achieve social inclusion in spatial planning processes. Before going into field investigation, two main tools are required. First, a list of topics that must lead the discourse in the interviews. Second, a list of more specific questions that lead the interviewed subject to short, clear statements must be established from the topics. With these tools, the interviews can be made and recorded. After the field investigation, the questionaries are exanimated and summarized into main conclusions.

Aim - The technique focuses on interviewing as many subjects as possible that are involved into the agri-food system, from farmers to experts and municipalities. This method aims to produce data that deals with the topic in-depth and in detail. Interviews can help to build a dataset capable of showing different trends and patterns that are not described by literature or by policies. The information is needed to establish appropriate criteria for the upcoming scenario methods. The resulting conclusion table must be compared with the table of spatial influence of policies. Together they will work as the primary assessment tool for the maximization method.

Resources - One advantage of this method is the fact that it requires only simple equipment and easily accessible data such as a Digital recorder, Target groups, On-field interviews, GIS data, Research on scientific interviews, Journals, Mixed media access, and Google workspace.

MAXIMIZATION

Description - "A scenario can be regarded as a story about the way the world might turn out tomorrow. ("Scenario Building | SSWM - Find tools for sustainable sanitation and ...") Because there are numerous possibilities of how the situation can be in the future, a scenario cannot be considered as a specific forecast of the future" (Widler S., 2005). Scenario-making can be extremely helpful if used to test possible outcomes of a specific decision or unwanted change. It is very universally used to foresee climate change effects; it can also be used to observe the impact of planning decisions. Even if, in the second case, the scenario is unable to include unpredictable changes, it can offer a pretty insight into what could be the cause-effect process. There is a vast number of different scenarios building methods. The research makes use of the maximization method. The maximization method is just a way to approach scenario development. It focuses on maximizing different previously selected topics to see what consequences they might have on the structure of the selected site. The standard process of maximization is often used in local-scale urban interventions. In the case of standard procedure, the whole process would divide up into five distinctive steps. The maximization process is used to create an environment of communication and negotiation between the parts (stakeholders) that actively take part in a project. So, the first step is a careful analysis of the goals of each of the parts. Once these goals are collected, they are maximized for each target group. This means that a map or other form of infographic is realized, showing what would happen to the site if the planner listened exclusively to one of the stakeholders. When all stakeholder goals are maximized, the planner disposes of a very handy tool. By overlaying the results, it will be possible to identify both conflicts and shared interests of the stakeholders. In the second step, these findings must be discussed and negotiated between the parts to obtain a common solution, also called an optimization map. Finally, the optimized goals are confronted with external factors that must be considered as they strongly influence the system, such as climate change or other environmental aspects. Even if assessing them might not be in the interests of any stakeholder, they remain crucial for the planner itself and must be included.

Aim - In the first steps of the maximization method, the research has the opportunity to identify the potentialities and threats that each maximization map causes. In the successive optimization, the representation of the optimal outcome is shown. At the same time, the Integration map induces the possibility of developing a draft vision that merges the optimization map with the list of principles. This vision is then translated into written bullet points that define the policy framework.

Resources - Using the maximization method requires a number of previously researched spatial and statistical data. Primary needed information remains spatial investigation and layer approach maps, field investigation, and a list of principles.

CASE STUDY

Description - The Case study method makes it possible to learn from similar situations and contexts. The primary issue is to find situations where certifications were used as a planning instrument or do at least involve institutional subjects in the administration of the tool. The method then consists of analysing the selected example that might be a planning tool or a policy that has demonstrated itself as "good practice" by contributing intensely to the development of local, sustainable farming practices. Once the most valuable knowledge has been collected from the selected case study, it becomes necessary to reflect on what principles and good practices can be readapted and applied to the case study chosen for

the research. The case study selected for this research is the "Bio district". The disciplinary of biodistricts has some similarities in structure to the geographical indications but has two major additional characteristics. The disciplinary for approval for a Bio district includes a list of requirements that give a final score. Under these requirements are also included minimum participation of municipalities and of applying farmers. This makes the assessment table used to approve a Bio district a valuable instrument for the strategy that must be deeply understood. More specifically, the method is classified as an instrumental case study.
"The instrumental case study uses a particular case (some of which may be better than others) to gain a broader appreciation of an issue or phenomenon" (Crowe S. et al., 2011).

Aim - "Case studies can be used to explain, describe, or explore events or phenomena in the everyday contexts in which they occur. These can, for example, help to understand and explain causal links and pathways resulting from a new policy initiative or service development" (Yin RK., 2009). In this research, the purpose of the case study analysis is to find previous examples of provincial scales that have tackled sustainability and vulnerability issues and have efficiently promoted sustainable agricultural practices. Understanding their policy framework and their key to efficiency.

Resources - Some initial resources are required to complete a successful case study analysis. First, a set of keywords must be established to simplify the case research process. Several documentary papers must be selected concerning the chosen case studies. In the end, existing data and research papers concerning the results of a case study can become a valuable resource.

SCENARIO TESTING

Description - "Scenario analysis is conducted to analyse the impacts of possible future events on the system performance by taking into account several alternative outcomes, i.e., scenarios, and to present different options for future development paths resulting in varying outcomes and corresponding implications. Scenario analysis is the process of forecasting the expected value of a performance indicator, given a time period, the occurrence of different situations, and related changes in the values of system parameters under an uncertain environment" (Balaman S., 2019). Complementary to the Scenario-building method, the Scenario analysis and maximisation method focuses on assessing the built scenarios to pre-established evaluation scales. These are taken from literature to analyse how the outcome of a scenario will have impacts on the chosen site and what are the possible outcomes that remain unseen on a map.

Aim - The method focuses on deepening the analysis of the scenarios built with the previous help method. Confronting the scenarios with different assessment tools can help to find the right balance in actions to create a strategy that induces the most positive outcomes possible.

Resources - For this method, a combination of resources is needed. On the one hand, the resources used for the scenario-building method. On the other, the resources from the literature review and stakeholder analysis. The last two will help to establish the assessment criteria for the first.

POLICIES

EUROPEAN POLICIES

1) The CAP RE.UE N.1306/2013

(not mandatory) the policy contains several indications on sustainable agricultural practices (SAP) that can have positive influence on environmental sustainability and resilient development of the agri-food system.

These indications must be followed only by farmers that apply for the CAP and in reward get specific financial supports. (a) Protection of water from pollution caused by nitrates from agricultural sources. (b) Introduction of buffer strips along the waterways, prohibition of the use of fertilizers in the therefore mentioned areas. (c) Compliance with the rules and procedures that step in when the use of water for irrigation purposes is subject to authorization. (d) Protection of groundwater from pollution: prohibition of direct discharge into groundwater and measures to prevent indirect pollution. (e) Minimum soil cover for highly erosive soils. (f) Minimum land management that respects specific local conditions to limit erosion. (g) Maintain soil organic matter levels through appropriate practices, including a ban on stubble burning, except for plant health reasons. (h) Concerning the conservation of wild bird habitats. (i) Relating to the conservation of natural and semi-natural habitats and wild flora and fauna. (l) Maintenance of landscape features, including, where appropriate, hedges, ponds, ditches, trees in rows, in groups or isolated, field edges and terraces. (m) Ban on the use of certain substances with a hormonal, thermostatic action, and beta-agonist substances in animal production. (n) Relating to the identification and registration of pigs. (o) Identification and registration of cattle. (p) Identification and registration of ovine and caprine animals. (q) Minimum standards for the protection of livestock.

2) The FERT.RE UE 2019/2009

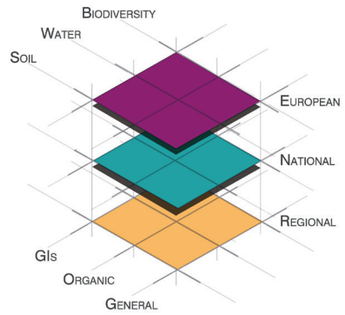
policy concerning the use of fertilisers must be respected by all farming activities. This makes it a mandatory policy for the agri-food sectors. The policy allows the use of phytosanitary products in general only if the following conditions are respected.

The use is allowed if the residue of phytosanitary products, used in conditions of good farming practices, does not: (a) They have no harmful effect either on human health, including that of vulnerable groups or on animal health. (b) They have no unacceptable effect on the environment, in particular concerning surface water contamination, including estuarine and coastal waters, groundwater, air, and soil. (c) They have no unacceptable effect on the environment and non-target species, its impact on biodiversity and the ecosystem. (d) Is sufficiently effective. (e) Has no unacceptable effect on plants or plants products. (f) Does not cause the vertebrates to fight unnecessary suffering and pain. (g) To control a severe phytosanitary emergency that cannot be contained by other available means, including non-chemical methods, this active substance may be approved for a limited period. (h) This derogation does not apply to active substances which are or must be classified as carcinogenic or toxic.

3) PESTICIDES - RE. CE N.1107/2009

is the european policy concerning the use of pesticides. the policy is mandatory and has to be respected by all farming activities. This makes it a mandatory policy for the agri-food sectors. The policy allows the use of pesticides products in general only if the following conditions are respected.

The use is allowed if the residue of phytosanitary products, used in conditions of good farming practices, does not: (a) They have no harmful effect either on human health, including that of vulnerable groups or on animal health. (b)They have no unacceptable effect on the environment, in particular concerning



	GENERAL FARMERS	GIS FARMERS	ORGANIC FARMERS	CAP FARMERS
1 CAP RE.UE N.1306/2013	P	P	P	M
2 FERT.RE UE 2019/2009	M	M	M	M
3 PEST.RE. CE N.1107/2009	M	M	M	M
4 PDO & PGI RE.EU N.510/2006	P	M	P	P
5 BIOLOGIC RE. UE 2018/848	P	P	M	P
6 PSRN 2014-2022	P	P	P	M
7 FERT.DM. N.5046/2016	M	M	M	M
8 PEST.DL N.150/2012	M	M	M	M
9 DOP/DOC DM. 1151/2012	P	M	P	P
10 FERT.RE. N.802/2010	M	M	M	M
11 PEST.RE. N.42/2018	M	M	M	M

M MANDATORY P PARTECIPATORY

surface water contamination, including estuarine and coastal waters, groundwater, air, and soil. (c) They have no unacceptable effect on the environment and non-target species, its impact on biodiversity and the ecosystem. (d) Is sufficiently effective. (e) Has no unacceptable effect on plants or plants products. (f) Does not cause the vertebrates to fight unnecessary suffering and pain. (g) To control a severe phytosanitary emergency that cannot be contained by other available means, including non-chemical methods, this active substance may be approved for a limited period. (h) This derogation does not apply to active substances which are or must be classified as carcinogenic or toxic. (i) The residues of plant protection products, in conditions of use in accordance with good phytosanitary practices, have no harmful effect on human health, including that of vulnerable groups, or on animal health.. (l) The residues of plant protection products, in conditions of use in accordance with good phytosanitary practices, have no unacceptable effect on the environment. (m) They are sufficiently effective. (n) It has no immediate or delayed harmful effect on human health, including that of vulnerable groups or animals. (o) It has no unacceptable effect on plants or plant products.(p) Does not cause the vertebrates to fight unnecessary

Figure 225 -policies on different levels
Figure 226 -mandatory and participatory policies

suffering and pain. (q) It has no unacceptable effect on the environment, particularly on surface water contamination, including estuarine and coastal waters, groundwater, air, and soil. its impact on non-target species and its effects on biodiversity and the ecosystem. (r) To control a serious phytosanitary emergency that cannot be contained by other available means, including non-chemical methods, this active substance can be approved for a limited period. (s) This derogation does not apply to active substances which are or are to be classified as carcinogenic or toxic.

4) The PDO & PGI RE.EU N.510/2006

is a non mandatory policy that acts on an european level but interests only the agribusinesses that apply for a PDO or PGI.

For the purposes of this Regulation, 'designation of origin' is a name that identifies a product that: (a) Originally come from a place, region. (b) Whose quality or characteristics are essentially or exclusively due to a particular geographical environment. (c) Whose production stages take place in the defined geographical area (PDO). (d) The production of which takes place for at least one of its stages in the defined geographical area (PGI). (e) The description of the product, including the raw materials where appropriate, as well as the primary physical, chemical, microbiological, or organoleptic characteristics of the product. (f) Evidence that the product originates in the defined geographical area. (g) A description of the method of obtaining the product and, where applicable, of the local, fair, and consistent methods as well as information on the packaging.
(h) The name and address of the authorities or, if available, the name and address of the bodies that verify compliance with the provisions of the specification.

5) BIOLOGIC RE. UE 2018/848.

Last but not least, the european policy for Organic food producers. To be entitled to label their products as organic, agribusinesses must apply for a conversion period that endures three years.

During this period of conversion and following the agri-businesses must respect the following criteria: (a) The whole agribusiness is convicted to the rules for organic production. (b) The use of fertilisers pesticides is restricted to natural products only. (c) The use of ionising radiations processes is prohibited. (d) The use of cloned animals for cattle farming is prohibited. (e) The use of OGMs in the production process of biological products is forbidden.

NATIONAL POLICIES

6) The National Plan (PSRN 2014-2022)

focuses on purely sectoral aspects, paying significant attention to the issue of agricultural sustainability, in line with the objectives of environmental protection and combating climate change that the EU is pursuing with ever greater determination. In a nutshell, the Plan aims to promote, with the co-financing of the European Union and, in particular, of the European Agricultural Fund for Rural Development (EAFRD), the competitiveness of the agricultural sector through the financing of measures that invest prevention and management of business risks, the promotion of the efficient use of irrigation resources and the protection and protection of the environment, through the safeguarding, restoration of animal biodiversity and genetic improvement of livestock.

Only farmers that apply to the following rules can require the national funding provisioned by the PSRN. (a) Promote knowledge transfer and innovation in agriculture and forestry and rural areas. (b) Stimulating innovation, cooperation, and the development of the knowledge base in rural areas. (c) Strengthen the links between agriculture, food production and forestry, on the one hand, and research and innovation, on the other, also to improve environmental management and performance. (d) Encourage lifelong learning and vocational training in agriculture and forestry. (e) Enhance the profitability of farms and the competitiveness of agriculture in all regions. (f)Improve the economic performance of all farms and encourage the restructuring and modernization of farms.(g) Promote the entry of qualified farmers into the agricultural sector and, in particular, generational turnover. (h) Promote the organization of the agri-food chain, including transformation. (i) To improve the competitiveness of primary producers by better integrating them into the agri-food chain through quality schemes... local markets, short supply chains, producer associations and organizations and interbranch organizations. (l) Support the prevention and management of corporate risk. (m) Preserve, restore, and enhance ecosystems related to agriculture and forestry. (n) Protection, restoration, and improvement of biodiversity, including in Natura 2000 areas and in areas subject to natural or other specific constraints. (o) Better management of water resources, including the management of fertilizers and pesticides. (p) Prevention of soil erosion and better management of the same. (q) Encouraging the efficient use of resources and the transition to a low-carbon and climate-resilient economy in the agri-food and forestry sectors. (r) Making the use of water in agriculture more efficient. (s) Making the use of energy in agriculture and the food industry more efficient. (t) Promote the supply and use of renewable energy sources, by-products, waste and residual materials and other non-food raw materials for the purpose of the bioeconomy. (u) Reduce greenhouse gas and ammonia emissions from agriculture. (v) Promote the conservation and sequestration of carbon in the agricultural and forestry sector. (z) Strive for social inclusion, poverty reduction and economic development in rural areas.

7) FERT.DM. N.5046/2016

Concerning the mandatory tools around fertilisers used in agriculture, the national scale policy gives much more defined guidelines and leaves less space for misinterpretation. The policy underlines clearly that, the use of solid fertilizers is not allowed: (a) On non-agricultural surfaces. (b) In forests and natural sites. (c) In areas within five meters from an open waterbody. (d) On frozen or with snow covered surfaces as well as fully soaked soils. (e) While the use of semi-liquid fertilizers is not allowed: On surfaces with ten or more % pendency and in areas within ten meters from an open waterbody.

8) PEST.DL N.150/2012

Differently to the fertilisers policy that on national level becomes very clear in field of action the policy around pesticides (PEST.DL N.150/2012) is still rather weak in specificness.
The policy mentions five different actions that should guarantee a more conscious use of chemical products. The policy enforces largely: (a) Promotion and protection of users and consumers. (b) The protection of water bodies and their environment. (c) The conservation of biodiversity and ecosystems. (d) It restricts the use in protected and particular areas. (e) It imposes monitoring and evaluation of the imposed standards.

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Figure 227 -National policy for agricultural development

REGIONAL POLICIES

For the regional scale, the laws considered for the analysis are FERT.RE. N.802/2010 and PEST.RE. N.42/2018 as they present higher indications that the national ones. For certifications such as GI the regulation splits up in multiple laws, one for each product, but they all present similar general guidelines, the example will wear the name of GI disciplinary indicating the general aspect of all GIs disciplinaries.

9) The FERT.RE. N.802/2010

is a regional policy concerning the specific indications of what chemical fertilisers are allowed and where.

These guidelines are mandatory for all agricultural businesses in the region. (a) Soil monitoring, each 5 years for every 10ha of cultivated surface. (b) Fertilisation plan approved by an expert in the agrarian sector. (c) The use of fertilizers is allowed if they do not surpass certain parameters: N maximum dose allowed is 170 kg/ha; P2O5 maximum dose allowed 100 kg/ha; K2O maximum dose allowed 55 kg/ha; (d) The use of wastewater originating from water treatment plans is not allowed.

10) The PEST.RE. N.42/2018

is another mandatory regional policy concerning the specific indications of what chemical pesticides are allowed and where;

(a) Only areas located no less than 10 meters from the banks of rivers, ponds and lagoons may be affected by the treatments. (b) Only the use of products not belonging to the very toxic, toxic, and harmful classes is allowed. (c) The areas affected by the treatments must be located no less than 10 meters from the homes and shelters of the animals. (d) The areas affected by the treatments must also be located no less than 10 meters from public roads.

11) GI single policies

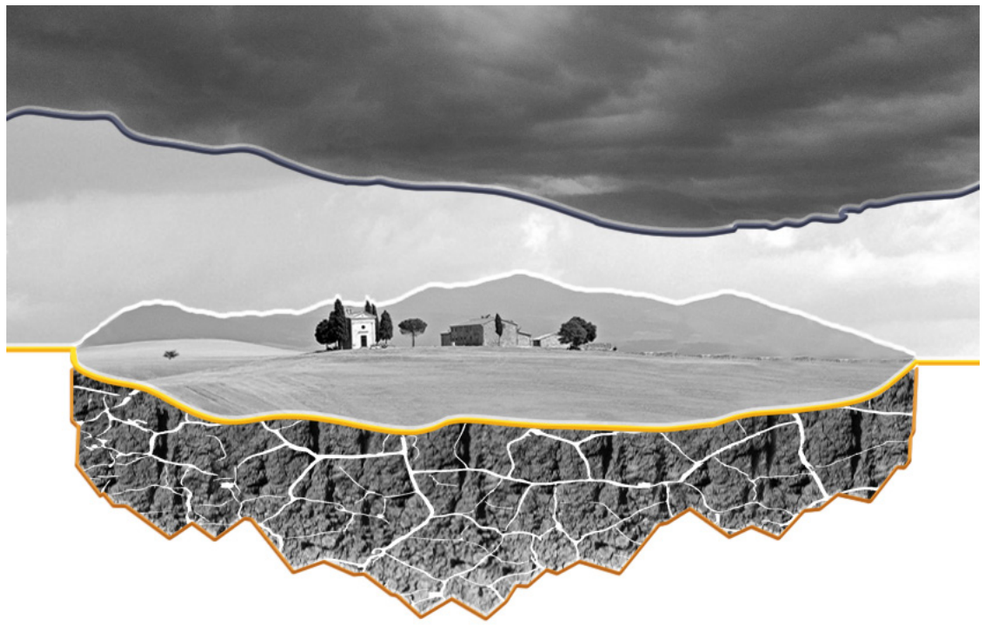
As mentioned in the first chapter, GIs have a singular disciplinary for each food-products. The area of influence of the disciplinary depends entirely on the area of production in which the production of the good takes place. Every disciplinary differs from the other, but the main guidelines can be categorized and generalised for the purpose of the research. Even if with different limitations in numbers, all disciplinaries regulate:

(a) It defines the geographical area. (b) It establishes the breed or plant typology. (c) It defines the pedo-climatic conditions. (d) It defines the soil conditions. (e) It limits the produced quantity. (f) It defines the time of harvest. (g) It indicates the process for transformation. (h) It indicates the chemical values of a food-product.

Figure 228 -Engagement for environmental sustainability.

GOVERNANCE

STUDIO, GOVERNANCE, POLICIES & STAKEHOLDERS 2020-2021



Patrick Tobias Maurer (5384915)
Delft University of Technology, MSc track Urbanism, AR3U115 Graduation Lab Urbanism

Figure 229 -Cover page of the report

CURRENT STATUS

The present Agri-food structure in Tuscany remains unsustainable. The use of pesticides, fertilizers, and the exploitation of natural and human resources such as water, soil, and the working force are progressively degrading the Tuscan environment. Making it remarkably vulnerable to the impacts of climate change. The main problem with the status quo is reconnectable to the policies and investments made by the government and European administration. Too many direct subsidies and tax breaks are dedicated to industrial and intensive farming. At the same time, little attention is given to biological and organic farming activities. This means that the farmers that choose a sustainable approach have to pay a double price. On one side, the costs implied in the preservation of ecosystems. On the other for damages produced by polluting activities. Farmers that choose to practice intensive agriculture instead are, in a certain way, funded for using a higher quantity of water resources, chemical pesticides and fertilizers. FederBio, Isde- Medici per l'ambiente, Legambiente, Lipu e WWF, state in a research paper that more than 97.7% of the intensive agriculture is subsidized by European funds. While only 1,8 billion euros from the total 62,5 billion go to biological farming. A trend that has to be changed as soon as possible, especially for the Tuscan region. Intensive agriculture is causing it to be the first region in Italy by the number of lost tons of fertile soil, responsible for the loss of 1.5 billion tons of it to erosion and degradation each year.

FUTURE THREATS

Recent effects of climate change have proven to be even worse than expected. Also in the case of Tuscany, phenomena like rising temperatures, extreme meteorological events and lower annual rainfalls will lead to a chain reaction with catastrophic effects. These meteorological events will have negative impacts not only on the natural environment and agricultural activities. Many other social and economic systems that relate to them (the retail and touristic sector, historical heritage and local identity, and many more) will suffer under its effects.
The worst-case scenario, (the RCP 8.5 business-as-usual, TCFD), would imply a medium temperature rise of 4 degrees celsius and a decrease of rainfalls from 10 to 15%. This will cause a drastic decrease in biodiversity and the number of growable crops, especially for wine and wheat, two of the main products of Tuscan agriculture. From the multitude of indirect casualties of climate change and pollution on the Tuscan territory, three of them are likely to cause higher disparities and conflicts among the involved actors. The first one, considered already as a criticality in the present, is the scarcity of resources. The growth of this criticality will lead to a progressive increase in costs for production and maintenance. Penalizing more small businesses that are unable to afford these kinds of expenses. Scarcity of resources will therefore strongly affect the market share leading to a more and more restrained sector. Automatically the sector will become less capable of assessing to shocks, sudden events that impact the vulnerability of a system and its components (Public Health notes, 2021). The second and third, loss of biodiversity and desertification, seem to be problems that concern mainly the agri-food sector, as they negatively affect the quality and quantity of the food products manufactured in Tuscany. These phenomena also play an important role in historical and cultural aspects, as they will shape the characteristics and traditional Tuscan landscape as we know it now. A landscape that attracts strong touristic flows to the region every year with its uniqueness. But also ensures the balance between natural and human activity and guarantees a highly livable climate condition.

CATEGORISATION

When it comes to regional planning, many different kinds of actors and stakeholders are involved. Especially in projects concerning agricultural circularity, it often influences a set of different disciples other than the agricultural and environmental ones. This is why to recognize the different groups targeted by such a topic, it is a good practice to consider three main categories. These are Institutional, Public and Private.

Starting from the institutions, developing a plan for the Tuscan region involves multiple governmental bodies that differ mainly in scale and political orientation. The largest scale concerns the European Union and its departments, such as the directorates for Agriculture, Health, and Environment, that define policies that influence the Tuscan region. The protection of specific ecological sites such as Natura2000 or the policy “farm to fork” are examples of these policies. On a national scale, a similar pattern of stakeholders is repeated. Ministries of Environment, Agricultural policies, Health and Tourism, are directly involved in decision-making. On the regional scale, the spatial planning authorities can be classified into the region, the provinces, unions of municipalities and municipalities. In the public sphere, differently from the institutional categorization, a classification through scale is not applicable in order to simplify the categorization, as it differs per each stakeholder in each different context. Different from the governance system, there is no strict relation between scale and power hierarchy.

Local public stakeholders can have a much greater influence on planning than not international and national operating ones. This is because they often have to rely much more on interest in participatory planning than not on power influence. NGOs can act on a multitude of scales that can vary from global to local. In this case, the main NGOs involved operate on a national level (HELP) or on a regional to local scale(LIPU Onlus and Verde Chiaro). The same happens for the consumers that are not connected to a specific scale as it depends on how far a region exports agri-food products (in the Tuscan case, this can be globally for specific products). In the end, there are the local and rural residents that can refer to a regional or local scale. They represent the public group involved and are affected the most by planning decisions.

The private category is again classifiable through scales as it has a more rigid structure of interaction, but as for the public sector, it does not respect the scale/power hierarchy. On the largest scale, the international/national one, food wholesalers, transport and logistic companies have a certain influence. Immediately underneath the sellers of the end products or export agencies, the suppliers of seeds, fertilizers and pesticides find their spot. On a local or provincial scale, farmer unions, associations, retailers and landowners play a bigger role in influencing decisions.

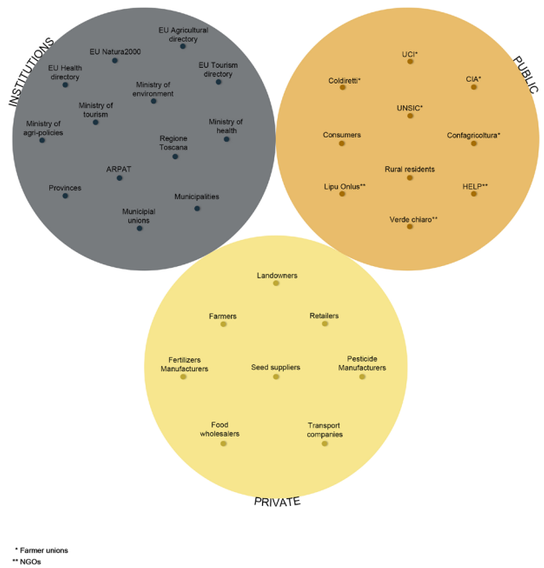


Figure 230 - categorisation of stakeholders in macro-groups

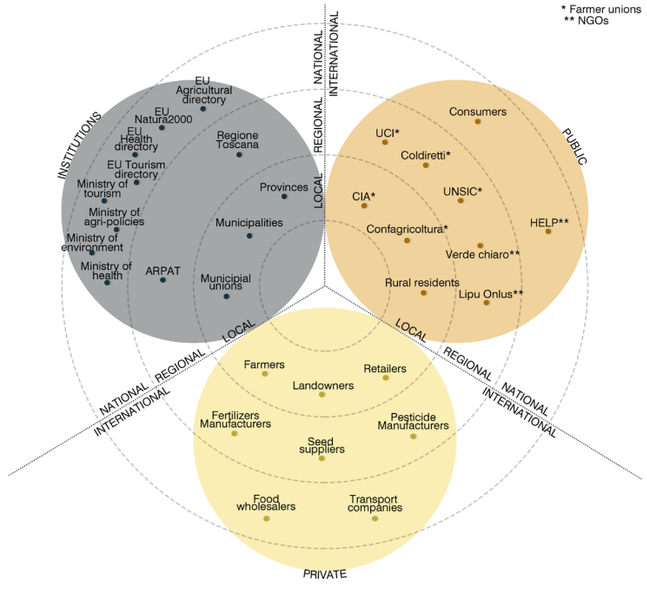


Figure 231 - further distribution on the different scales of interaction

GEOLOCALISATION

For some stakeholders, mapping their spatial claims on a bigger scale than the local one remains challenging. Other stakeholders do not have specific spatial claims as they are more economically or socially engaged. However, the spatial claim of a good part of the involved actors is mappable also on a bigger scale.

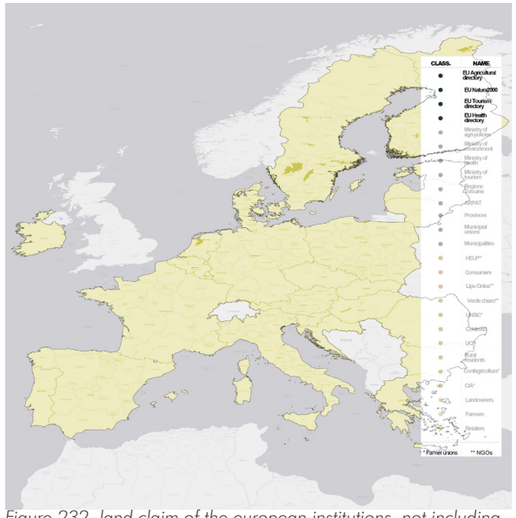


Figure 232 -land claim of the european institutions, not including the Schengen countries

Figure 233 -National stakeholders include some NGOs but mainly it contains the governmental ministries

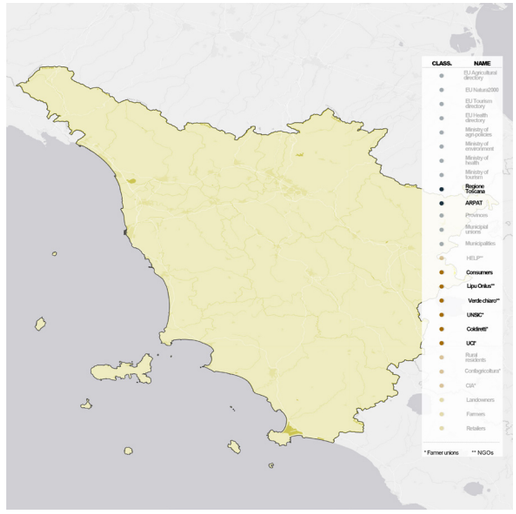


Figure 234 - On the regional scale not only the authorities operate but also farmer associations and NGOs

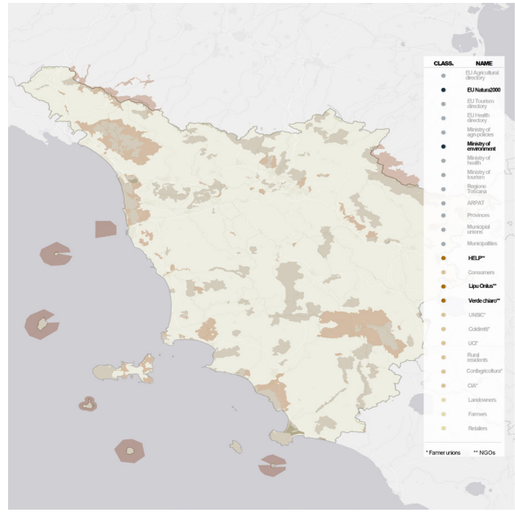


Figure 235 -The regional claim of Natura2000 protected sites (light grey) and areas defined by the Ministry of environment (light brown)

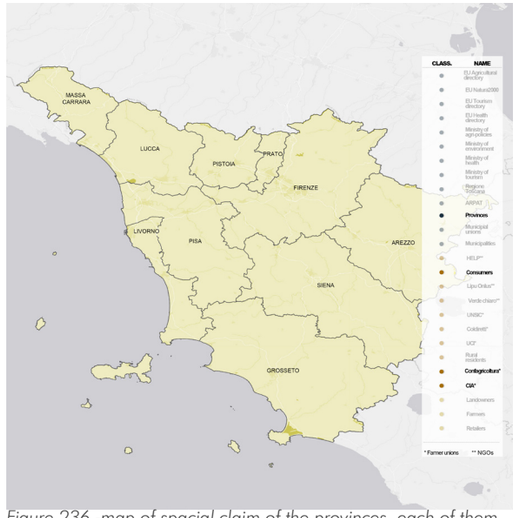


Figure 236 -map of spacial claim of the provinces, each of them presents a provincial association of farmers (CIA, confagricoltura)

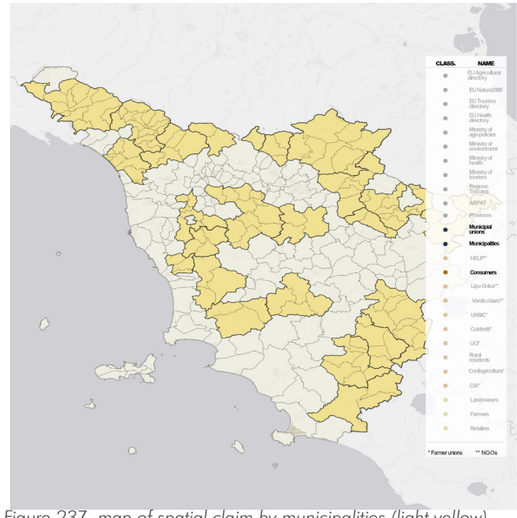


Figure 237 -map of spatial claim by municipalities (light yellow) and municipal unions (yellow)

POWER/INTEREST MATRIX

In the power/interest matrix, it is possible to observe the relation between these variabilities for each stakeholder involved in the project. In this case, the “players” and “context setters” with the highest power influence in decision-making are the ones of the Institutional category.

Public and Private stakeholders instead are unequally distributed on the table. Still, a pattern emerges showing the Public stakeholders more involved and interested and the Private ones less interested but with higher power capacities.

CLASS.	NAME	POSITION	CRITICAL ACTOR	DEPENDENCY	PROBLEM PERCEPTION	GOAL
●	EU Agricultural directory	✓	Yes / No		The current agricultural structure is unsustainable.	Improve the “FarmtoFork” strategy, moving towards circularity
●	EU Natura2000	✓	Yes / No		Ecological niches threatened by pollution.	Preserving and improving the ecological system.
●	EU Tourism directory	○	Yes / No		Loss of attractiveness due to intensive farming.	Preserving landscape and historical heritage.
●	EU Health directory	○	Yes / No		Food and water pollution.	Banning chemicals in the food chain production.
●	Ministry of agri-policies	✓	Yes / No		The current agricultural structure is unsustainable.	Improve the “FarmtoFork” strategy, moving towards circularity.
●	Ministry of environment	✓	Yes / No		Ecological niches threatened by pollution.	Preserving and improving the ecological system.
●	Ministry of health	○	Yes / No		Fod and water pollution.	Banning chemicals in the food chain production.
●	Ministry of tourism	○	Yes / No		Loss of attractiveness due to intensive farming.	Preserving landscape and historical heritage.
●	Regione Toscana	✓	Yes / No		Lack of an effective rural development strategy.	Develop a strategy for a resilient and sustainable agri-food sector.
●	ARPAT	✓	Yes / No		The current agricultural structure is unsustainable.	Preserving and improving the ecological system.
●	Provinces	○	Yes / No		Difficulties in collaboration with Municipal Unions.	Higher decision making power.
●	Municipial unions	○	Yes / No		Play a rather small role in decision making.	Higher decision making power, increased funds for participatory planning initiatives.
●	Municipalities	○	Yes / No		“....”	“....”
●	HELP**	✓	Yes / No		Has small potential budget.	Increase number of partecipants and partecipation at decision making.
●	Consumers	○	Yes / No		Increased services costs.	Decreased costs and increased quality of the food products.
●	Lipu Onlus**	✓	Yes / No		Has small potential budget.	Increase number of partecipants and partecipation at decision making.
●	Verde chiaro**	✓	Yes / No		“....”	“....”
●	UNSIC*	○	Yes / No		Does represent stakeholders with different positions.	Efficient business plan for the transition to sustainable agriculture.
●	Coldiretti*	○	Yes / No		“....”	“....”
●	UCI*	○	Yes / No		“....”	“....”
●	Rural residents	○	Yes / No		Farming dependent communities suffer job losses in the sector.	Preserving landscape and jobs in the rural areas.
●	Confagricoltura*	○	Yes / No		Does represent stakeholders with different positions.	Efficient business plan for the transition to sustainable agriculture.
●	CIA*	○	Yes / No		“....”	“....”
●	Landowners	✗	Yes / No		Heavy meteorological events increase costs and decrease property value.	Increased security in investments and property value.
●	Traditional Farmers	✗	Yes / No		Higher costs for resources, use of chemicals and emissions.	Decreased costs of primary resources,abolition of chemicals bans.
●	Sustainable Farmers	✓	Yes / No		Low statal financings, high maintenance costs.	Increased governmental funds. A stronger voice in decision making.
●	Retailers	○	Yes / No		Market competition with low-cost distribution chains.	“....”
●	Fertilizers Manufacturers	✗	Yes / No		Governmental restrictions on used and produced chemicals	“....”
●	Pesticide Manufacturers	✗	Yes / No		“....”	“....”
●	Seed suppliers	○	Yes / No		Climate change potentially leads to desertification.	Increased differentiation in crops. Increased fertility.
●	Transport companies	✗	Yes / No		A more sustainable agriculture would mean a decrease of transported goods.	Business as usual. Infrastructural development.
●	Food wholesalers	✗	Yes / No		“....”	“....”

* Farmer unions ** NGOs

Figure 238 - stakeholders position, problem and goal table

Figure 239 - power/interest matrix, status quo

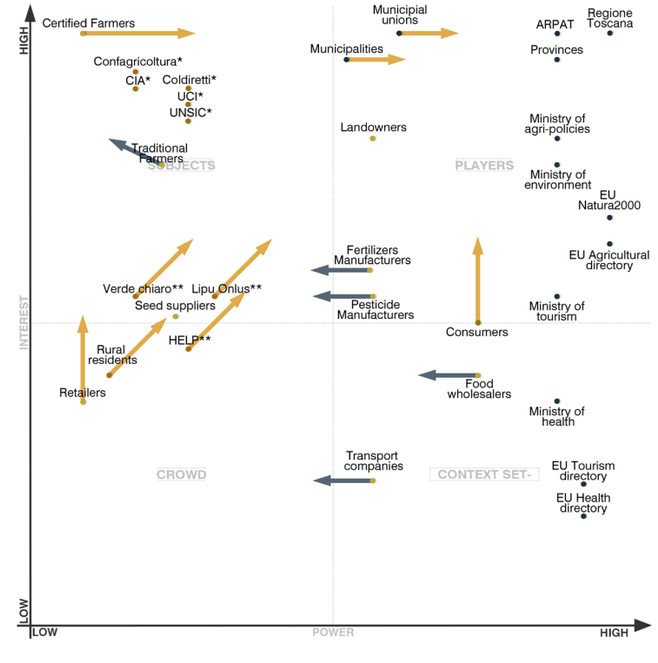


Figure 240 -power/interest matrix, opportunities

CONFLICTS

The first and most important conflict that arises in this scenario is internal to a specific stakeholder, the farmer unions and associations. Currently, in Tuscany, their voice is strongly influential, but the problem is that they represent farmers of a specific area. In this case, they are divided into provinces. All farmers of a province are sustained equally by their association or union without making any distinction between the farming practices. This naturally leads to conflicts between farmers that sustain biological practices and farmers that practice intensive farming. The first group feels neglected and non-supported by governmental funds and has to pay a high price caused by the polluting activities of the second group. The second group, on the other hand, contrasts decisions such as restrictions on the use of chemical products and water resources that the government tries to impose and that would benefit the first group.
Another conflict that seems to be more intuitive is the one between fertilizers and pesticide manufacturers and the NGOs that are trying to limit the use of especially this kind of chemical product to protect the environment, biodiversity, but also the health of the consumer.
This conflict also includes the institutions that are directly involved, in this case, the Ministry of Agriculture on one side and the Ministry of the environment on the other. At least but not least is the conflict between different local administrations. Changing the agricultural structure to achieve higher sustainability will also demand important changes in land use, affecting some areas more than others. Especially the provinces or municipalities that rely economically on the outcome of unsustainable agricultural activities will claim higher amounts of funds for redevelopment. This will progressively stimulate conflicts, especially in the moment of decision-making of how funds, resources and incentives will be distributed across the region.

Figure 242 -conflict between traditional and certified farmers

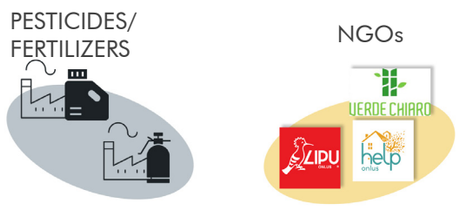


Figure 241 -conflict between chemical manufaturers and NGOs

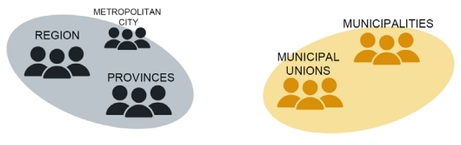


Figure 243 -conflict between big scale and low scale institutions

ENGAGEMENT STRATEGY

INTEREST AND PARTECIPATION -
Many different opportunities exist, also thanks to digitalisation, to involve larger parts of the population.
Techniques such as informative apps, virtual realities and advertisements can be easily used to engage citizens and create a stronger awareness in the consumer.
The main goal is to convince them that consuming certificated products is not only healthy but also sustainable in all aspects(economic, social, environmental).
Virtual realities and exhibitions might be the most effective tools to show possible future scenarios and criticalities. It is important to combine these new technologies with traditional practices as they might not involve certain societal groups, such as the elderlies, for example.
In this case, traditional and biological markets, open farm days or cooking workshops can help to create a stronger connection between urban residents and their surrounding environment.
A good practice example for this strategy can be seen in the example of "Civic participation for energy transition" operated by the Metropolitan Authority of Nantes. The main success of this practice was the high amount of involved citizens in the project.

POWER AND DISEMPOWER
- Groups of Certified Farmers:
To strengthen the voice of farmers who practice sustainable activities and are certified for it, the general structure of existing farming groups and associations has to be updated. Instead of general associations that represent all farmers on different scales, the new structure divides them into Traditional and Certified, preserving the scale module. This will facilitate the conversation between sustainable and certified associations of farmers and stakeholders concerned with environmental matters, forming a stronger coalition.
- Unions of Municipalities:
The creation of municipal unions is already an existing practice, they normally have the goal of empowering small municipals that otherwise would have little to say in provincial scale matters.
The municipal unions exist just within a specific provincial boundary. The strategy proposed uses the concept and extends it on cross-boundary unions, including all municipalities concerned with the protection of an important resource, such as open water bodies.
- Non-sustainable economies:
To disempower manufacturers of chemical products and transport companies, two methods can be used. On one side, the limitation and taxation of the use of these nocive products. On the other the rise of incentives to engage the local producers to a transition towards biological and sustainable practices.

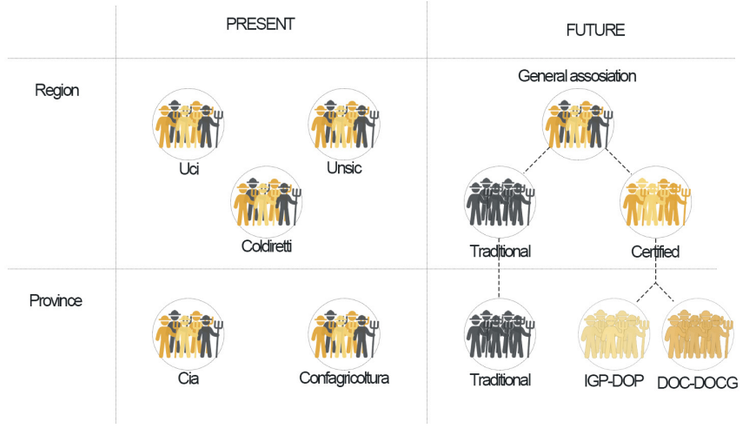


Figure 244 -update of the current structure in farmer assosiations

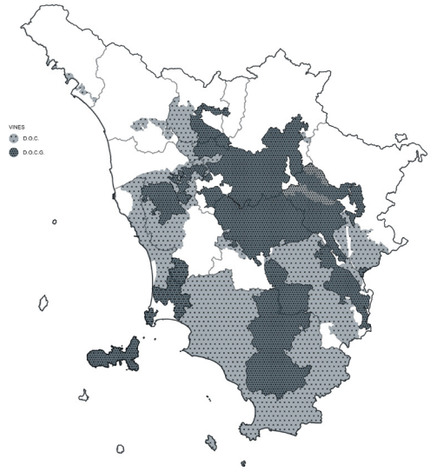


Figure 246 - spatial claim of certified farming associations

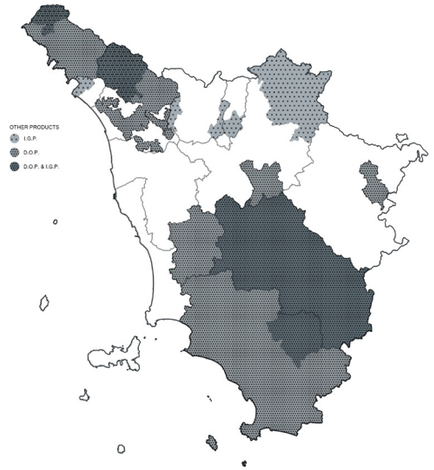


Figure 245 -spatial claim of certified farming associations

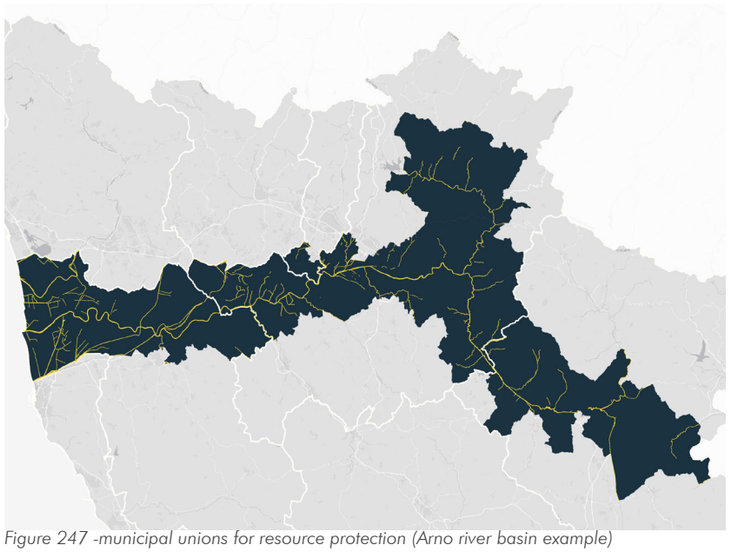


Figure 247 -municipal unions for resource protection (Arno river basin example)

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Figure 248 -Tuscan landscapes, Volterra, Italy

COLOPHON

CERTIFIED FUTURE
A strategy for sustainable and resilient agriculture in Tuscany

MASTER'S THESIS REPORT
for the Degree of Master of Science (MSc) in Architecture, Urbanism and Building Sciences (specialization: Urbanism)

PATRICK TOBIAS MAURER
Student

VERENA ELISABETH BALZ
Mentor

ALEXANDER WANDL
Mentor

STAVROS KOUSOULAS
Delegate of the Board of Examiners

DELFT UNIVERSITY OF TECHNOLOGY
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MSc Graduation Studio - Planning Complex Cities

TU Delft BK Bouwkunde — Department of Urbanism

Complex Cities