Digital innovation for sustainable intensification in cereals sector. An economic valuation of contractual agreements and CAP eco-schemes adoption in bakery value chain in Italy

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This PhD thesis research project aims to implement current information and studies on the actual economic benefits of adopting sustainable agricultural practices in a raw materials supply chain. It also intends to evaluate the willingness to adopt digital tools related to support contractual relationships and to monitor raw material and values flows among bakery supply chain actors. Finally, the project aims to update the analysis of synergy between private initiatives and public policies for sustainable agricultural schemes.

Innovazione digitale per l’intensificazione sostenibile nel settore cerealicolo. Una valutazione economica degli accordi contrattuali e dell’adozione degli eco-schemi della PAC nella filiera dei prodotti da forno in Italia

Il progetto di tesi di dottorato mira a implementare le informazioni e gli studi attuali sugli effettivi benefici economici derivanti dall’adozione di pratiche agricole sostenibili nella filiera di approvvigionamento delle materie prime. Si intende inoltre valutare la disponibilità ad adottare strumenti digitali relativi al supporto dei rapporti contrattuali e al monitoraggio dei flussi di materie prime e valore tra gli attori della filiera dei prodotti da forno. Infine, il progetto mira ad aggiornare l'analisi delle sinergie che si potrebbero instaurare tra iniziative private e politiche pubbliche per i sistemi agricoli sostenibili.

# **1. State-of-the-Art**

The dominant paradigm in European agriculture is characterized by highly specialised and industrialized production. It is based on intensive use of agrochemicals, monocultures and few crops and varieties, and contributes to greenhouse gas emissions, water pollution, soil degradation and loss of biodiversity (Kleijn et al., 2019). The role of farmers in mitigating impacts on natural resources is becoming increasingly central to the decision-making process of policies such as the CAP. Among the solutions proposed by CAP, is the renewed intention to increase arable and crops diversification and to protect biodiversity by farmer and agricultural system (Bonke e Musshoff,2020).

The new CAP 2023-2027 introduces among the good agricultural and environmental conditions (GAEC) crop rotation in arable lands (GAEC7) and a minimum percentage of arable land to be allocated to area or non-productive elements (GAEC8). To this are added the new eco-schemes, the main innovation in the green architecture of the CAP. As mandatory instruments, they would oblige Member States to allocate a proportion of their Pillar 1 payments to schemes that would directly benefit the environment and climate.

The strategic plan of the CAP of Italy identifies 5 eco-schemes, in particular the eco-scheme 4 “extensive forage systems with rotation” that provides support for arable land in rotation of crops legumes and forage, and the eco-scheme 5 “Specific measures for pollinators” which aims to contribute to the preservation of biodiversity through the spread crops of bee interest and a sustainable and reduced use of pesticides (Strategic Plan for the CAP, Italy, 2021). Crop diversification, rotation patterns and flower strips are recently recognised as keys CAP measure to drive Italian agricultural sector towards sustainable path (Bonke e Musshoff 2020).

Numerous studies confirm the actual short- and long-term environmental benefits that can be derived from the adoption of sustainable farming practices, and therefore changes of this type are considered win-win strategies from the environmental point of view, however, the literature reports a smaller number of studies that investigate the potential income from the adoption of sustainable production methods and a large part of these studies refer to a small scale, often family-run business and located in developing contexts (Schleich et al., 2019).

Despite their benefits, implementing such practices often implies (initial) increased costs for farmers (Schleich et al., 2019) and a change in practices often requires the reorganization of relations with downstream partners at value chain level (Meynard et al., 2017).

Extant literature, in fact, mostly discusses forms of value chain organisation, including contract farming that have enabled farmers to adopt new practices aiming to improve product quality, or comply with food safety standards (Kumar et al., 2018). Often contractual arrangements are needed to provide premium prices to farmers to incentivise the adoption of practices and the implementation of quality standards (Banterle and Kuijpers, 2019). Nonetheless, studies suggest that there is no blueprint contract to encourage adoption (Meynard et al., 2017) and designing adequate contracts and value chain configurations to support the adoption of sustainable practices can be a complex process (Pancino et al., 2019). The transition towards sustainability commits the agri-food chains to define new business models that encourage the adoption of new agro-ecological practices by farms without undermining the volumes of the supplies. Incentives such as linking subsidies to the adoption of sustainable practices, particularly through the CAP, may be a mechanism to enhance participation, and reach additional farmers (Weituschat et al., 2023). According to this paradigm, the question arises whether the new CAP aid scheme encourages the participation of specialised agricultural enterprises in private sector schemes.

# **2. PhD Thesis Objectives and Milestones**

Within the overall objective mentioned above this PhD thesis project can be subdivided into the following activities according to the Gantt diagram given in Table 2:

1. **Analysis of the context**: literature review on sustainable cultivation practices, on the adoption of digital innovations for sustainable intensification (A1.1) and definition of case study (A1.2).
2. **Farms data collection:** structural and economic data will be collected to describe farms involved in CAP and in private scheme (A 2.1) Stable panel identification (A 2.2). Provide tools to assess farms costs and benefits in different practices adoption scenario (A2.3).
3. **Study and identification of tools and methods**: attend advance courses on socioeconomics analysis and econometrics techniques (A3.1). Development and test a useful methodology to address and validate the research questions (A 3.2).
4. **Development of analysis:** adoption scenarios characterization (A 4.1). Impact assessment of public polices and business model adoption at farm and value chain level (A 4.2). Outcome valorisation by stakeholder consultation (policy makers and business managers of the value chain)
5. **Writing and Editing:** Phd thesis, scientific papers, and oral and/or poster communications will carry on during PhD period.

***Table 2*** Gantt diagram for this PhD thesis project.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Activity Trimesters | **3** | **6** | **9** | **12** | **15** | **18** | **21** | **24** | **27** | **30** | **33** | **36** |
| A1) | ***Context analysis***  |   |   |   |  |  |  |  |   |   |  |  |  |
|  | 1) Literature review |   |  |   |  |  |  |  |   |   |  |  |  |
|  | 2) Identification of case study |   |  |   |  |  |  |  |   |   |  |  |  |
| A2) |  ***Data collection*** |   |   |   |  |  |  |  |   |   |  |  |  |
|  | 1) Farms data collection  |   |   |   |  |  |  |  |   |   |  |  |  |
|  | 2) Stable panel identification  |   |  |   |  |  |  |  |   |   |  |  |  |
|  | 3) Provide tools useful to assess farms costs and benefits |  |  |  |  |  |  |  |  |  |  |  |  |
| A3) | ***Methodology***  |   |  |   |   |   |   |  |   |   |   |   |   |
|  | 1) Advance courses on econometrics techniques |   |  |   |   |   |  |  |   |   |   |   |  |
|  | 2) Development and test of the methodology |   |  |   |  |  |   |  |   |   |  |  |   |
| A4) | ***Development of analysis*** |   |  |   |  |  |   |   |   |   |  |  |   |
|  | 1) Adoption scenarios characterization |   |  |   |  |  |   |   |   |   |  |  |   |
| 2) Impact assessment of public policies and private initiatives |   |  |   |  |  |  |  |   |   |  |  |  |
| 3) Results analysis and valorisation |  |  |  |  |  |  |  |  |  |  |  |  |
| A5) | ***Thesis and Paper Preparation*** |   |   |   |   |   |   |   |   |   |   |   |   |

# **3. Selected References**

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