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Editorial

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The Volume 24, Issue 3 of *Economia agro-alimentare / Food Economy*, features four regular Articles and two Notes, all written in English. The articles mainly cover issues related to forest products, seafood, cereals, pork, considering their use, value chain, consumer perception and willingness to purchase.

The range of the analysis goes from local to global and covers geographical areas in Europe, South America and Africa.

The authors are affiliated with Institutions based in Italy, Colombia, France, and Nigeria.

The article by Balanta Martínez, Celis Parra, Gonzáles Muñoz & Ortiz Meneses, titled "Factors influencing the use of non-timber forest products in cattle production under humid tropical conditions" aims to determine the socioeconomic factors that affect the use of non-timber forest resources in the Colombian Amazon region. The study found that knowledge about Non-Timber Forest Products (NTFP) and strategies for knowledge transfer are key factors affecting their use for cattle nutrition. The study emphasizes the importance of investing in knowledge transfer strategies and programs that aim to increase producers' awareness and understanding of NTFP. Additionally, the availability of resources, such as land and financial

resources, also play a significant role in using NTFP for cattle nutrition. Factors such as the level of education and the producer's age also impacted the use of NTFP.

In the article "Adapting a participatory modelling method to prospect scenarios of food systems: case study on the pork value-chain", written by Chaib, Macombe & Thamopoulos, the authors compare a "classic" prospective method to co-construct scenarios of the evolution of the food system with its stakeholders with an "adapted method" that was implemented because of the pandemic situation. The participatory foresight methods were used to create scenarios for the evolution of French pork value-chain and select the most desirable ones. This value-chain is a good example of challenges such as environmental impact, human resources, and social acceptability that many food value-chains in developed countries face. Adaptations were made to the participatory scenario method for remote working during the pandemic, including organizational and methodological changes. The approach allowed introducing new ideas, familiarising influential players with potential changes to be adopted quickly.

The article "Social farming in high mountain regions: the case of the Aosta Valley in Italy" by Fazari & Musolino, examines social farming (SF) in a mountain area in Italy, highlighting its social mission and economic sustainability. It uses literature and 3 case studies from semi-structured interviews to show that SF fulfils a crucial social role in remote areas and is economically sustainable based on environmental and agricultural resources in high mountain regions. SF can restore meaning to agricultural work, enable the work placement and social inclusion of disadvantaged people and reverse the depopulation of rural areas. The paper suggests that policymakers should prioritize developing SF in mountain areas, including recruiting and training qualified staff, supporting new investments and improving distribution and sales stages.

Oteh, Agwu, Mbanasor, Ibem, Okpokiri, Oloveze & Onwusiribe, in the article "Wheat or cassava flour? Marketing and willingness to pay for cassava flour confectioneries in Nigeria", examine consumer perception and willingness to purchase confectionery made from cassava flour, in light of the global supply disruption emanating from the Russia-Ukraine war. Based on a cross-sectional survey in Abia State, Nigeria, the study found that taste, awareness, odour, and availability shape consumer perception but low awareness of its existence and nutritional and economic values persist. Improving packaging, labelling, availability, and price can improve consumer perception. According to the authors, the government should also encourage

the cassava value chain diversification and the production of High Quality Cassava Flour.

The current issue continues with two Notes.

In the note "An overview of state subsidies in Italian agriculture in the period 2000-2019" written by Briamonte, Vaccari, Gaudio, Amato, Piatto & Ievoli, a descriptive analysis of public support for agriculture in Italy over the two decades just before Covid-19 pandemic is provided. Overall public support for the agriculture sector decreased by over EUR 4 billion, and the share of support in agricultural added value also decreased. The decrease is due to the halving of tax and social security reliefs and the significant reduction in the support provided by the budgets of the regions and autonomous provinces. EU support was stable in the first decade and increased in the last ten years. The paper highlights different support models characterizing the different regions.

Romanelli & Giovanardi wrote the note "Commentary on Italy's international seafood trade and some of its impacts" to examine the state of Italy's seafood trade within the European Union. The paper highlights that Italy has significantly higher commercial deficits than other EU-27 member states with similar populations. Domestic production from fishing and aquaculture only covers 20% of consumption, and even less in the case of crustaceans and cephalopods. Inflows from abroad in 2016-2019 were considerably concentrated on some species (or their groups). Despite this dependence, per capita consumption in Italy is high. Additionally, a significant proportion of imported seafood is obtained through fishing rather than aquaculture. The study suggests that, to improve the overall sustainability of Italy's seafood trade, Italy should focus on more sustainable exploitation of its own fishing resources, the development of domestic aquaculture, and a shift in consumption patterns towards less reliance on wild fish and shellfish.

Like every year since 2011, we will change some of the Scientific Advisory Board members to expand the opportunities to contribute to the scientific development of our journal's community of practice. We heartily thank the SAB members leaving the Board at the end of 2022. The scholarly contribution of all the SAB members has been terrific, and we are grateful for their help in reviewing, suggesting reviewers, and evaluating the papers published in the previous year as candidates for the "Best Paper Award".

It is a good opportunity to remind the results of the "Best Paper Award" for Articles & Notes written in English. In 2021, 29 papers published in

our journal were eligible. Each member of the Scientific Advisory Board used 5 evaluation parameters to score 4 articles randomly assigned to them. Overall, 172 evaluations were received, and each article received a minimum of 4 evaluations. The award was assigned to De Devitiis, Viscecchia, Carfora, Cavallo, Cicia, Del Giudice, Menna, Nardone & Seccia for their article "Parents' trust in food safety and healthiness of children's diets: A TPB model explaining the role of retailers and government", published in *Economia Agro-alimentare/Food Economy*, *23*(2).

We also welcome the new SAB members for the year 2023, who will help us confirm the journal's strong international character. The updated list of SAB members will be available in the journal front matter in the next issue and on the website http://www.economiaagroalimentare.it. The Editor-in-Chief and the Editorial Board look forward to working with our new Scientific Advisory Board during the next year. The journal's Editorial Board remains unchanged, the members are grateful to the SIEA Presidential Board for the renewed trust.

We also wish to thank once again the staff of FrancoAngeli Edizioni for the usual high-quality work in editing and publishing the journal. We look forward to continuing to work with them also next year.

As usual, we appreciate the support of our community of authors and readers. The editorial team especially thanks the reviewers who contributed to this journal's manuscript selection process. Their expertise and dedication have been instrumental in ensuring the high quality of the manuscripts that we publish. We recognize that reviewing is a significant and often underappreciated task, and we are grateful for the time and effort that they have invested in evaluating the submissions to *Economia agro-alimentare / Food Economy* during the year 2022, providing insightful feedback to the authors. The complete list of reviewers is available at the end of the issue.

We hope this volume has provided valuable insights and sparked further interest in the covered topics. We extend our gratitude to the readers for taking the time to engage with our work, and we look forward to continuing the conversation in the academic community.

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Factors influencing the use of non-timber forest products in cattle production under humid tropical conditions

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Abstract

As more attention is paid to the integral management and the problems of cattle production systems in the achievement of sustainable productivity and competitiveness in the territories of the Colombian Amazon region, it is necessary to determine the socioeconomic factors that affect the use of the potential and comparative advantages of productive units located in the region for nutritional supplementation from local inputs, such as Non Timber Forest Products (NTFP). For this purpose, a descriptive-cross-sectional scope with non-experimental design and quantitative approach study was carried out, applying the collection instrument to the sample size defined in a non-probabilistic way in the municipalities of Albania San Vicente del Caguán, El Doncello, Puerto Rico, and Cartagena del Chaira of the department of Caquetá Colombia. Information was systematized using the R software, where the principal component analysis of the socioeconomic factors with the use of cattle nutrition in the NTFP was carried out. It was found that the factors that have the greatest impact on the use of NTFP are related to the degree of knowledge about NTFP and the strategies for the transfer of scientific knowledge as a complement to the knowledge of the producers.

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Introduction

The challenge for the agricultural sector is to develop sustainable production strategies that improve the profitability of production units by taking advantage of environmental resources that have a positive impact on their competitiveness. Therefore, biodiverse territories such as the Amazon have comparative advantages due to the presence of various non-timber forest products (NTFP) that have potential for animal feed as a sustainable alternative to the unsatisfied nutritional demand of production systems (Stepakova *et al*., 2019).

It should be clarified that competitiveness is related to the generation of profitability in organizations based on efficiency and effectiveness (Avedaño and Schwentesius, 2005), creating comparative advantages in the markets; evidencing its impact on price and profit. Therefore, bovine productive systems present as a challenge to develop alternative animal feeding strategies based on NTFP that reduce the high costs of feed concentrates (Osorio, 2014) contributing to sustainability from the social responsibility of these actors in the face of environmental challenges that seek to promote responsible productions and consumption (Fonseca *et al*., 2011). It should be noted that research fosters competitiveness by contributing to technological development based on the innovation of models, processes and use of resources; positively impacting the productivity of agricultural systems by improving their practices, strategic efficiency and financial management (Stellian and Danna, 2017).

It is worth highlighting the role of NTFP in the development of biotrade, generating an attractive and relevant market that can generate substantial income for rural areas through the generation of employment and the creation of companies or business models that take advantage of the potential of these forest resources, generating value in the products and services offered and having a positive impact on the economy and regional development (Weiss *et al*., 2020). The income that can be obtained from NTFP extraction varies depending on the ecological conditions, social, economic and political structures of the communities (Kar and Jacobson, 2012; Hogarth *et al*., 2013) from the economic point of view NTFP extraction is perceived as an option to improve the livelihoods of rural communities by diversifying household incomes (Kamaljit *et al*., 2007), in some cases the income from it can represent up to 39% of net household income (Heubach *et al*., 2011) and can be constrained by factors such as livestock numbers, size of agricultural and non-agricultural land (Khosravi *et al*., 2017); however, the effects of economic factors are not necessarily the same in different socioeconomic conditions and geographic locations, as they can vary depending on the scale at which they are measured (Kar and Jacobson, 2012).

Regarding the social implications that determine the use of NTFP, it is common to evidence in rural communities a high incidence of gender socio-cultural barriers (Lakerveld *et al.*, 2015), particularly women are engaged in activities ranging from NTFP collection to NTFP commercialization, this being a secondary economic activity of the household, since the main economic activity of families is livestock and is traditionally carried out by men (Madhusmita *et al.*, 2016); on the other hand, the level of education and age of the head of household determine the economic activities carried out within the household (Khosravi *et al.*, 2017). Other factors such as political structures can incentivize NTFP use within communities with government programs that offer technical accompaniment to make raw material collection and transformation processes more efficient, however, the coverage of these programs is often limited (Gupta *et al.*, 2020; Nassl and Löffler, 2019).

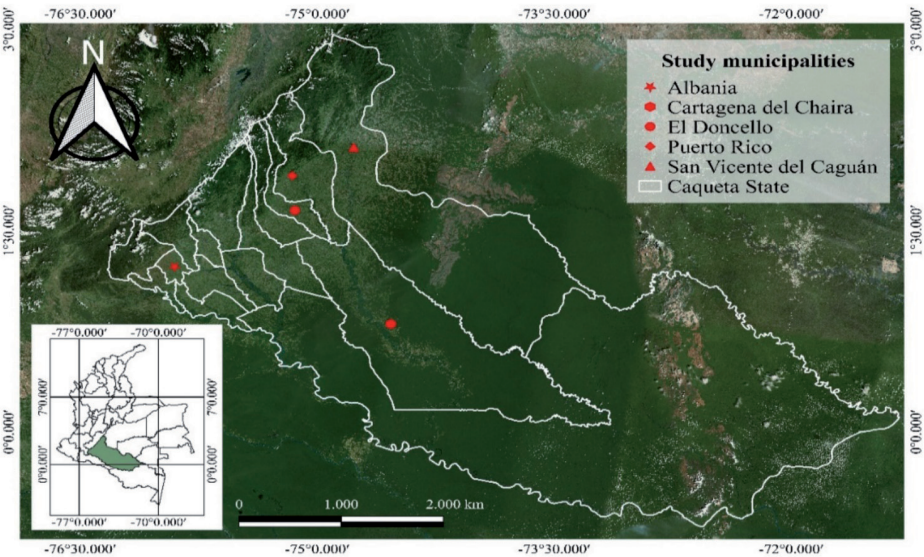
The recognition of the socioeconomic factors that limit the degree of NTFP use is of vital importance to identify the potential resources of the region, promote economic models that promote rural development, generate useful information for the creation of public policies that establish land use patterns, strengthen governance models within the framework of an integral and contextual approach that starts from the recognition of the complexity of the socioecological reality of the regions (Lakerveld *et al.*, 2015). Therefore, the objective of this study is to determine the socioeconomic factors that affect the use of non-timber forest resources in the Colombian Amazon region.

1. Materials and methods

To achieve the objective of the study, a methodological design was implemented according to the guidelines of Hernandez (2018), which was descriptive transectional in scope, where information was collected through a structured survey of 108 units with cattle production distributed in the municipalities of San Vicente del Caguán (25 units), El Doncello (03 units), Albania (5 units), Cartagena del Chaira (03 units), and Puerto Rico (08 units) belonging to the department of Caquetá. These units were selected using a non-probabilistic method based on selection criteria established by the dimensions of the research and the respective characteristics of the small cattle producers.

The units selected as observation units were those that had the following characteristics: a) To have cattle production systems, b) That the land has at least one (01) ha^{-1} of forest area, c) That 70% of the income comes from agricultural activities, d) That 80% of the assets are destined to the development of agricultural activities, and e) To have minimum 5 years of experience in the development of agricultural activities.

Figure 1 - Observation unit of the study



Source: Own data from ArcGIS.

The data collection was based on the measurement of 10 social and 68 economic factors, in reason to 4 fixed factors of the NTFP through a principal component analysis (PCA) using the statistical package "FactoMineR" (Husson *et al.*, 2016) and the package "factoextra" (Alboukadel Kassambara & Fabian Mundt, 2017). Factors with a percentage of variance explained greater than 10% were selected, which centers the analysis in 10 social and 36 economic factors (Table 1).

Subsequently, the correlation matrix is constructed to jointly analyze the incidence of the social and the economic factors selected in the PCA on the fixed factors that influence the use of NTFP in the cattle production systems. For this purpose, the Pearson correlation test was used (p-value > 0.05) using the statistical package "corrplot" (Wei & Simko, 2021), data that were analyzed using the statistical software R version 4.0.5 (R Core Team, 2021), using the programming language Rstudio version 1.3.1 (RStudio Team, 2021).

It should be clarified that the fixed factors on which the analysis of the information is carried out address the technical or popular knowledge that the producers have about the NTFP, as well as the periods of production of NTFP under humid tropical conditions. On the other hand, the visual identification of the NTFP present in the productive units, in addition to the degree of utilization of NTFP in animal feed, was also included.

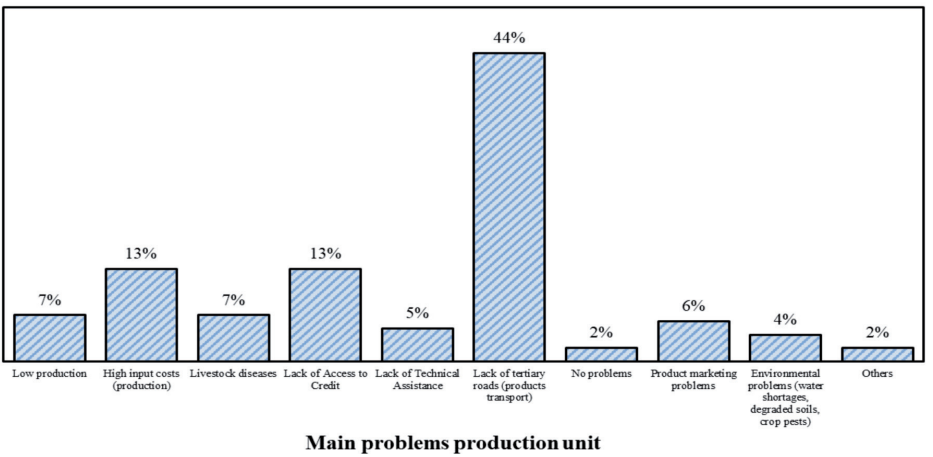
Table 1 - Fixed and socioeconomic factors of the cattle production system

Cod	Economic factors	Cod	Economic factors	Fixed factors
EF1	Total Hectares	EF39	Grouped Cananguchal Area	Know About NTFP
EF2	Access Road	EF43	Grouped Area Stubble	Know About Production Periods
EF4	Type Of Transportation Access	EF45	Permanent Crop Area	Identified NTFP
EF5	Type Of Organization	EF46	Grouped Wetlands Area	Knowledge Of NTFP for animal
EF6	Benefit Received from Org.	EF47	Grouped Silvopastoral Area	
EF7	Type Of Assistance Last Year	EF48	Grouped Non-Arable Land	
EF8	Technical Assistance Practice	EF49	Environmental Impacts	
EF9	Source Of Monetary Resources	EF50	Severity Environmental Events	
EF10	Reason For the Loan	EF51	Actions Taken Against Environmental Events	
EF11	Loan Amount	EF53	Power Generator	
EF14	Principal Problems	EF54	Tractor Productive Unit	
EF15	Irrigation System Unit	EF55	Cattle Corral	
EF16	Number Of Cattle Grouped Together			
EF18	Milk Production		Social factors	
EF19	Daily Milk Production	SF1	Health System Affiliation	
EF21	Identified Breeds of Cattle	SF2	Land Tenure	
EF24	Load Capacity of The Cattle Unit	SF3	Time Of Agricultural Activity	
EF25	Load Capacity Cattle Grouped	SF4	Family Composition	
EF28	Patch Burn Grazing	SF5	No. Minors	
EF29	Rotational Grazing	SF6	Schooling Level of Producers	
EF32	Crop-Pasture Rotation	SF7	Principal Problems Productive Unit	
EF33	Mixed Pastures NTFP	SF8	Forest Importance in Productive Unit	
EF34	Environmental Study Unit	SF9	Attitude Towards Quality of Life	
EF36	Cattle Income Contribution	SF10	Forest Conservation for Water	

2. Results and discussion

From the information collected in the prioritized municipalities, it was determined that the main problems of the cattle units of the municipalities in the department of Caquetá are the difficulty of transporting and marketing products due to the poor condition of the tertiary roads, the lack of access to credit, the high cost of production inputs, environmental problems, and livestock diseases, in addition to low productivity. This shows that there is little transfer of innovative knowledge about alternatives for sustainable use of the potential of the Amazon territory, causing dependence on commercial inputs and low levels of competitiveness in the sector (Figure 2).

Figure 2 - Main problems cattle production unit



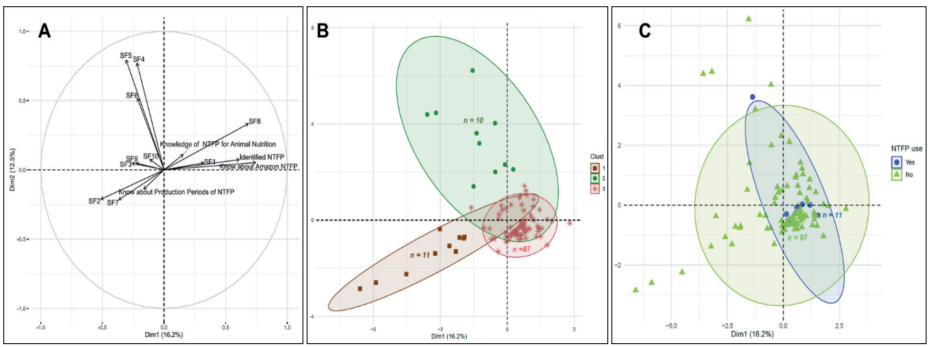
Source: Own data

The principal components analysis (PCA) that explains 28.7% of the cumulative variance of the social factors of the cattle production units of the prioritized municipalities of the department of Caquetá (Figure 3) shows that 80.6% of the observation units (Figure 3B) have a directly proportional relationship between the degree of knowledge of the NTFP with the perception of importance of the forest in the production units (SF8), just as the periods of knowledge about NTFP production have a significant relationship with the type of land tenure (SF2) and the main problems (SF7) present in the cattle production systems. On the other hand, it is evident that despite a negative correlation with the fixed factors, there are positive

correlations in these productive units between the time of agricultural activity (SF3), the perception of quality of life (SF9), water resource conservation (SF10), level of schooling (SF6), and the presence of children in the households (SF5).

From the above, it is possible to intuit that most of the units with cattle production systems have diversity in terms of social factors, which should be taken into account from a systemic approach to define strategies for the transfer of scientific knowledge to promote the use of the potential related to the RNMB in the feeding of livestock, the conservation of biodiversity and the strengthening of public policies that allow for the expansion of local markets to increase community income and generate competitiveness in cattle production systems (Alves *et al*., 2017).

Figure 3 - Principal component analysis (PCA) A. biplot with selected social factors (SF) in cattle production system. B. Observations grouping by similarity (clustering analysis). C. Observations grouping according to NTFP use



* n: number of observations according to each group.

Source: Own data.

The above scenario based on social factors, which are the result of cultural representations built from community processes has generated that only 10.2% of the cattle production units analyzed make use of NTFP with sustainable alternatives in the nutritional supplementation of livestock.

Economic factors influencing the use of NTFPs

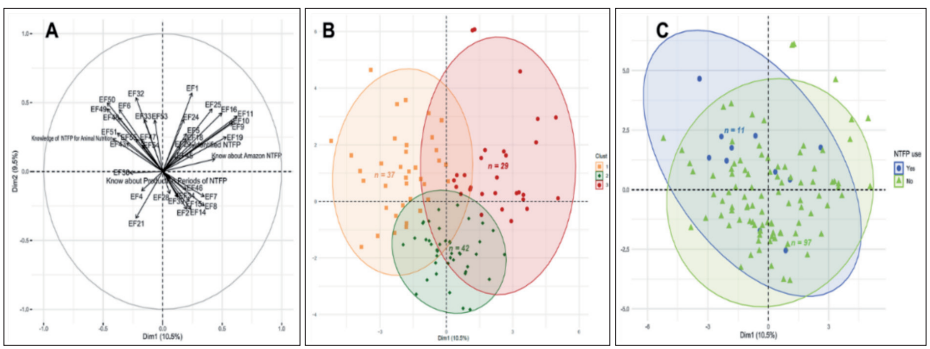
As for the economic factors, the PCA, which explains 20% of the cumulative variance shows three groupings according to the fixed variables

of analysis. In the first place, there is a grouping that concentrates 38.9% of the observation units (Figure 4B) that show a high correlation around the knowledge of the production periods of the NTFP. These factors are related to wetland areas (EF46), the realization of environmental studies in the productive unit (EF34), and technical assistance (EF7, EF8), as well as a moderate correlation with the perception of problems (EF14) and access roads (EF2), in addition to a negative correlation with the management of pasture land (EF28) and the type of cattle breed (EF21).

Secondly, 34.25% of the production units (Figure 4B) are grouped according to the knowledge of the nutritional properties of the NTFP, where a high correlation is established with the actions taken to mitigate environmental impacts (EF49, EF51) and the severity of the events as an effect of the productions (EF50). Likewise, there is a moderate correlation with the benefits received by the organizations (EF6) and the equipment of the producers to develop the economic activity (EF53, EF54, EF55).

Lastly, 26.9% of cattle production units (Figure 4B) against the fixed variables of identification and knowledge of Amazonian NTFP have a positive correlation with permanent crop areas (EF45), production levels (EF16, EF18, EF19), availability of financing sources (EF9, EF10, EF11), in addition to a moderate correlation with load capacity (EF24, EF25) and total hectares of production units (EF1).

Figure 4 - Principal component analysis (PCA) A. biplot with selected economic factors (EF) in cattle production system. B. Observations grouping by similarity (clustering analysis). C. Observations grouping according to NTFP use



* n: number of observations according to each group.

Source: Own data.

Consequently, 10.2% of the production units (Figure 4C) make use of NTMB in cattle feed, of which 54.5% are concentrated in the second grouping (Figure 4B) that revolve around the fixed factor of knowledge of the nutritional properties of NTFP, which shows a directly proportional relationship with the management and environmental responsibility of the production units with the territory of which it is part.

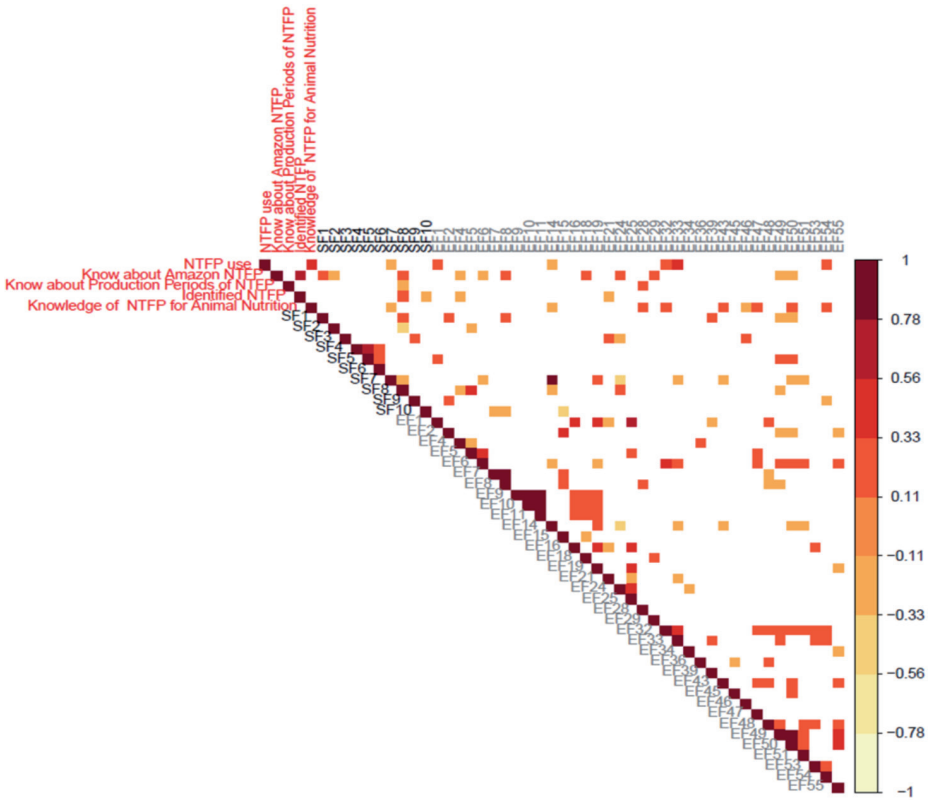
Relationship of socioeconomic factors with NTFP in cattle units

Regarding the fixed factors, it was generally determined that the use of NTFP has a high correlation with the degree of knowledge that cattle producers have about the nutritional properties of the resources, and the strategies related to mixed pastures (EF33). Likewise, there is a moderate correlation with the total hectares of the productive units (EF1), pasture rotation (EF32), and the availability of machinery (EF54). This shows the importance of transferring scientific knowledge to producers about sustainable production systems, bromatological properties and the competitive advantages that can be generated by taking advantage of the potential of the territory.

From another point of view, it was found that the knowledge about the NTFP of the Amazon region has a significant correlation with the ability to identify the NTFP by the producers, and a moderate correlation with the perception of importance of the forest in the productive units (SF8), the practice of technical assistance (EF8), milk production (EF18) and the load capacity of the land (EF25). In summary, the degree of knowledge for the identification of the NTFP can be attributed to the degree of technical guidance offered to the producers in relation to the productivity of the cattle systems and the integration of alternatives based on the comparative advantages of the productive units.

As a result, the degree of knowledge about the nutritional components of the NTFP is correlated to the type of generally conventional productive practices, where the most significant practices are patch- burn grazing (EF28), crop-pasture rotation (EF32), as well as areas with silvopastoral management (EF47), which are generally introduced with species that are not very efficient or with high implementation and maintenance costs. In addition, the use of stubble areas (EF43), together with the perception of the severity of environmental impacts (EF50) and availability of machinery (EF54).

Figure 5 - Pearson correlation matrix among fixed, social and economic factors in cattle production system, interactions without color are not significant (p-value < 0.05)



Source: Own data.

Conclusions

Throughout the study, significant results were achieved regarding the analysis of the factors that affect the use of NTFP in cattle production systems under conditions of the Colombian Amazon region. These elements that can guide strategies for the promotion and strengthening of the potential based on the biodiversity of the territory that contribute to sustainable production of agricultural organizations, especially cattle, which are slightly blamed for the negative impacts on forests, as well as for problems related to high production costs, availability of economic resources, environmental problems, low production levels, and lack of infrastructure for competitiveness.

According to the social factors, it can be affirmed that the degree of knowledge about the NTFP is defined by the degree of importance that the forest has in the productive units, which is the social representation constructed from the technical orientations and conventional practices on the economic activity that perpetuate problems that affect the sustainability and competitiveness of these agricultural organizations, in addition to the generation of negative externalities on the various ecosystem services. However, regarding economic factors, the knowledge for the use of the NTFP is determined by the alternatives and strategies of responsible management for the sustainability of the organizations with the territory, in addition to the productive equipment and the degree of organization of the producers.

The research allows us to determine that the socioeconomic factors that influence the use of NTFPs in livestock production units in the Colombian Amazon region are defined by the degree of knowledge of these ecological and regional resources, which requires not only the transfer of scientific knowledge to articulate it with the knowledge of producers and the breaking of production paradigms, but also to facilitate sources of funding for productive innovation relevant to the territory and its potential.

Although the analysis is limited to defining the social and economic factors that influence the use of NTFPs in livestock feed, it presents a great opportunity and orientation for the generation of articulating strategies with producers, government agencies and private organizations that allow the productive strengthening of the region in a sustainable manner, through the implementation of promising resources of the region such as NTFPs as a potential solution to reconcile the different land uses, while promoting biodiversity conservation and the provision of ecosystem services. However, these measures must be implemented with defined strategies that integrate complementary public policies, as sustainable intensification can have negative environmental, economic and social effects.

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References

Alves-Pinto, H.N., Latawiec, A.E., Strassburg, B.B., Barros, F.S., Sansevero, J.B., Iribarrem, A., & Silva, A.C. (2017). Reconciling rural development and ecological restoration: Strategies and policy recommendations for the Brazilian Atlantic Forest. *Land Use Policy*, *60*, 419-426. doi: 10.1016/j.landusepol.2016.08.004.

Avendaño, R.B., & Schwentesius, R.R. (2005). Factores de competitividad en la producción y exportación de hortalizas: el caso del valle de Mexicali, B.C., México. *Problemas del Desarrollo*, *36*(140), 165-192.

Bawa, K.S., Joseph, G., & Setty, S. (2007). Poverty, biodiversity and institutions in forest-agriculture ecotones in the Western Ghats and Eastern Himalaya ranges of India, *Agriculture, Ecosystems & Environment*, *121*(3), 287-295. doi: 10.1016/j.agee.2006.12.023.

Comité Departamental de Ganaderos del Caquetá (2020). Cifras de Contexto Ganadero Caquetá 2020. -- https://issuu.com/rafaeltorrijos/docs/contexto_ganadero_caqueta_2020.

Dash, M., Behera, B., & Rahut, D.B. (2016). Determinants of household collection of non-timber forest products (NTFPs) and alternative livelihood activities in Similipal Tiger Reserve, India. *Forest Policy and Economics*, *73*, 215-228. doi: 10.1016/j.forpol.2016.09.012.

FAO (2014). El estado de los bosques del mundo. Potenciar los beneficios socioeconómicos de los bosques. 1 ed. Roma (Italia), pp. 20-49.

Fonseca, C.J.A., Muñóz, P.N.A., & Cleves, L.J.A. (2011). El sistema de gestión de calidad: elemento para la competitividad y la sostenibilidad de la producción agropecuaria colombiana. *Revista de Investigación Agraria y Ambiental*, *2*(1), 9-22. doi: 10.22490/21456453.909.

Gupta, D., Lele, S., & Sahu, G. (2020). Promoting a responsive state: The role of NGOs in decentralized forest governance in India. *Forest Policy and Economics*, *111*, 102066. doi: 10.1016/j.forpol.2019.102066.

Hernández-Sampieri, R., & Torres, C.P.M. (2018). *Metodología de la investigación* (Vol. 4). México^ eD. F DF: McGraw-Hill Interamericana.

Heubach, K., Wittig, R., Nuppenau, E.-A., & Hahn, K. (2011). The economic importance of non-timber forest products (NTFPs) for livelihood maintenance of rural west African communities: A case study from northern Benin. *Ecological Economics*, *70*(11), 1991-2001. doi: 10.1016/j.ecolecon.2011.05.015.

Hogarth, N.J., Belcher, B., Campbell, B., & Stacey, N. (2013). The Role of Forest-Related Income in Household Economies and Rural Livelihoods in the Border-Region of Southern China. *World Development*, *43*, 111-123. doi: 10.1016/j.worlddev.2012.10.010.

Husson, F., Josse, J., Le, S., & Maintainer, J.M. (2016). Package "FactoMineR." Multivariate Exploratory Data Analysis and Data Mining, 96, 698. -- https://cran.rediris.es/web/packages/FactoMineR/FactoMineR.pdf.

Kar, S.P., & Jacobson, M.G. (2012). NTFP income contribution to household economy and related socio-economic factors: Lessons from Bangladesh. *Forest Policy and Economics*, *14*(1), 136-142. doi: 10.1016/j.forpol.2011.08.003.

Kassambara, A., & Mundt, F. (2017). Package 'factoextra'. Extract and Visualize the Results of Multivariate Data Analyses, 76. -- https://cran.microsoft.com/snapshot/2016-11-30/web/packages/factoextra/factoextra.pdf.

Khosravi, S., Maleknia, R., & Khedrizadeh, M. (2017). Understanding the Contribution of Non-timber Forest Products to the Livelihoods of Forest Dwellers in the Northern Zagros in Iran. *Small-scale Forestry*, *16*, 235-248. doi: 10.1007/s11842-016-9353-y.

Lakerveld, R.P., Lele, S., Crane, T.A., Fortuin, K.P.J., & Springate-Baginski, O. (2015). The social distribution of provisioning forest ecosystem services: Evidence and insights from Odisha, India. *Ecosystem Services*, *14*, 56-66. doi: 10.1016/j.ecoser.2015.04.001.

Nassl, M., & Löffler, J. (2019). How Societal Values Determine the Local Use of Forest Resources – Findings from the Rural Community Kegong (Northwest Yunnan, China). *Sustainability*, *11*(12), 3447. doi: 10.3390/su11123447.

Osorio, L.F. (2014). *Silvopastoreo. Colombia forestal*, *17*, 73-75.

Pardo, O., Fornaguera, J.E.C., & Hess, H.D. (2008). Efecto de la relación proteína y energía sobre los niveles de amonio ruminal y nitrógeno ureico en sangre y leche de vacas doble propósito del piedemonte llanero, Colombia. *Revista Colombiana de Ciencias Pecuarias*, *21*(3), 6.

R Core Team (2021). R: A Language and Environment for Statistical Computing. -- www.r-project.org.

RStudio Team (2021). RStudio: Integrated Development Environment for R. -- www.rstudio.com.

SMBYC, IDEAM (2018). Sistema de Monitoreo de bosques y carbono -- Recuperado: http://smbyc.ideam.gov.co/MonitoreoBC-WEB/pub/reporteGeoproceso.jsp?id_reporte=7123.

Stellian, R., & Danna-Buitrago, J.P. (2017). Competitividad de los productos agropecuarios colombianos en el marco del tratado de libre comercio con los Estados Unidos: análisis de las ventajas comparativas. *Revista Cepal.*

Stepakova, N.N., Kiseleva, T.F., Koryakina, N.A., Frolova, N.A., & Reznichenko, Y.Y. (2019). Food forest resources as a component of environmental management. IOP Conference Series: Earth and Environmental Science: Earth and Environmental Science, 315, 052046–. doi: 10.1088/1755-1315/315/5/052046.

Wei, T., & Simko, V. (2021). R package "corrplot": Visualization of a Correlation Matrix (Version 0.90). -- https://github.com/taiyun/corrplot.

Weiss, E., Corradini, & Živojinović (2020). New Values of Non-Wood Forest *Products*, *11*(2), 165. doi: 10.3390/f11020165.

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Adapting a participatory modelling method to forecast food system scenarios: a case study on the pork value-chain

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Abstract

For a value-chain to be sustainable, the main challenge is sometimes its durability. When stakeholders are lost in the shifting maze of economic, social and environmental issues, participatory foresight methods help them consider the options and choose a strategy to follow. The aim is to create several scenarios of evolution of the value-chain and select desirable scenarios. Because of the global context in 2020 and 2021, implementing methodological and organizational adaptations in the classic "scenario method" from Michel Godet was necessary. These adaptations are exemplified by the case study of the prospective for the French pork value-chain in the next 5 years. Indeed, this value-chain touches particularly on certain contemporary concerns, with much discussion about its environmental footprint, its human resource challenge and its social acceptability, as is the case for most food value-chains in developed countries.

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Introduction

Complex systems are characterized by a large number of components which may interact with each other and with their environment. The behavior of complex systems is intrinsically difficult to model and to predict due to the dependencies and the various types of interactions between their components, or between the system and its environment (Bar-Yam, 2002). Agri-food chains can be considered as such (Croitoru *et al.*, 2016): they rely on various interdependent actors whose objectives and priorities may be divergent, from producers to consumers, including processors, distributors, managers, professional associations, public authorities (Handayati *et al.*, 2015). The concerns of these actors relate to different criteria (economic, environmental, health, sensory, technical, etc. …). They are also constrained by the pressure of production upstream and consumption downstream, be it climatic, regulatory, economic or social. In addition, their actions are not centralized but distributed, poorly coordinated and in constant evolution (Balmann *et al.*, 2006). Taking decisions in agri-food value-chains can thus seem very challenging.

The problem considered in this paper stems from the necessity of changes in complex agri-food systems. The higher aim is to raise awareness among stakeholders, especially the dominant ones, expecting the value-chain to be managed in a more sustainable way.

To do that, we need to co-construct scenarios of evolution of the food system with its stakeholders: each stakeholder group holds part of the knowledge to understand the situation and to better comprehend how changes may influence not only the operations of its members, but also of the other groups of interest. Gaining such an overall understanding of the situation on all the involved parties certainly helps reach solutions that are more thoughtful and acceptable. In the end, it is up to the stakeholders to choose the best path they wish to follow.

Different approaches have been proposed to help increase stakeholders' awareness of critical situations in agri-food chains and to better understand the different positions of concerned stakeholders (Bourguet *et al.*, 2013; Kopainsky & Stave, 2014; Perrot *et al.*, 2011; Taillandier *et al.*, 2021; Thomopoulos *et al.*, 2018; van Bruggen *et al.*, 2003). We are concerned in our case with prospective-oriented approaches (Cordobes *et al.*, 2004; De Jouvenel, 1964; Godet & Lesourne, 1977; Lesourne, 1989; Meadows *et al.*, 1972) including consensus building between the stakeholders of the supply chain (Susskind *et al.*, 1999). Therefore, we focused on the so-called "method of scenarios" or "Godet method" (Godet, 2007, 2008; Godet & Durance, 2001). This method belongs to the "French school of prospective" and has been implemented with success at different scales for years, e.g. demand

side management of energy at World scale, future of management school in Europe, etc. It fits when dealing with changes at a value-chain level, in the agri-food sector, as was the case for the foresight exercise about the innovative issue of industrial insects supply chains in France (Macombe *et al*., 2019). Another advantage is that this method is a very formal prospective method.

In the situation of Covid-19 pandemic, the traditional face-to-face collaborative way has been proven inoperable. Consequently, we had to consider adaptations in the classic scenario method and jointly, possible biases induced by these adaptations in the results obtained.

The paper focuses on the comparison of the two methods: the classic and the adapted.

We will consider, as an illustrative application, a case study provided by the French SENTINEL project, the French pork meat sector.

In the remainder of this paper, the "classic method" is the prospective method by Godet that we should have implemented (if there's no pandemic), and the "adapted method" is the approach implemented in reality, because of the pandemic situation. The general questions dealt with are:

1. What are the adaptations of the classic method needed when a face-to-face collaborative way is inoperable?
2. What are the biases of implementing the adapted method instead of the classic one?
3. How do we deal with those biases to ensure proper modelling of the food system to later guarantee adequate value-chain management strategies?
4. What are the scenarios obtained using the adapted method?

To answer these questions is it first of all fundamental that we introduce in Section 1 the classic scenario method and its steps. We will then discuss in Section 2 the problems encountered due to the sanitary context as well as the organizational and methodological adaptations we have made; we provide a detailed description of the calculations performed, so that the method developed can be formally reproducible and verifiable. Examples of the results obtained are presented in Section 3 of this article, before discussing the scientific interest (including possible biases of the method as well as ways of surpassing them) and the business interest in Section 4. Section 5 is a brief conclusion.

1. Background: the "Scenario Method", a Participatory Method for Scenario Building

The theory and the tools underlying the so-called "scenario method" are extensively presented in Godet (2008) and Godet & Durance (2001). The data

are gathered thanks to interviews of prospects, who are stakeholders (in the broadest sense) of the supply chain under study.

An important stage of the scenario method, the so-called "Constructing the base" stage, aims to link the food system variables, to identify the key actors and the key variables, and to build numerous base scenarios, obtained by combining the modalities (values) of the key variables.

In the present paper we focus on **this "Constructing the base" stage**. Several reasons explain why we are focusing on this stage: on one hand, the steps followed in this stage are time consuming and are spread out over several months (12 months in our case study). On another hand, usually, the complete Godet method is not necessarily used in its entirety as it is a very consequential process. Finally, it is essentially this first stage that is centered on interactions with the prospects. Plus, the difficulties faced during further stages are the same as the ones faced in this initial stage. The problems encountered will be detailed in Section 2.

The "Constructing the base" stage consists of building a model, which represents the current state of the system under study, and detects the potential for change. It is composed of the following steps, familiar in system modelling approaches.

Step 1: Delimiting the system under study

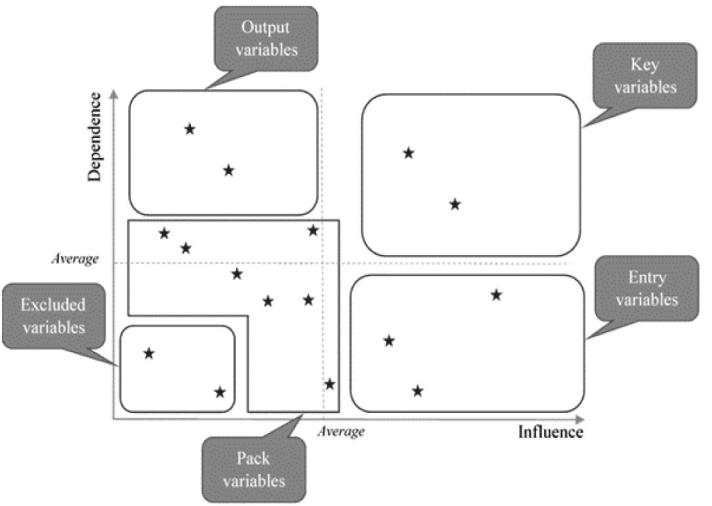
It implies identifying the actors that should be gathered, in order to collectively discuss the variables that will influence the evolutions of the system. In the remainder of the text, these actors are called "prospects".

Step 2: Determining the key variables

It consists of:

- making a list of the variables that the prospects deem to be relevant in influencing the future of the system;
- reducing the number of variables, by merging all the equivalent ones, i.e. those standing for the same concept;
- asking the prospects to consensually design influence relationships between all the remaining variables (pair by pair), whether they are direct or indirect. Determining the key variables. Indeed, identified variables influencing the system evolution can be classified into 5 categories (Figure 1).

Figure 1 - Denomination of the different kinds of variables at the end of step 2



If the variables are very influent and little dependent, they are the input or "entry variables", so the built scenarios use them at the beginning of the prevision. At the contrary, the very dependent and little influential variables are "output variables": their value is given at the end of the scenario elaboration, as a consequence. "Pack variables" are moderately dependent and influent, so they are seldom included in the scenarios. As for the "excluded variables" they are neither dependent nor influential, so they are not taken into account when constructing the scenarios. Finally, the "key variables" have the particularity of being both more influential and more dependent than the averages calculated. Consequently, it is impossible to anticipate in which direction they will evolve. This means that they represent important issues, since despite fairly small changes, they can make the situation evolve in very different directions.

Step 3: Elaborating the general base scenarios

The role of the key variables is crucial when it comes to building the foresight. Indeed, the general base scenarios are built by the systematic combination of the modalities taken by the key variables. It is therefore of the utmost importance to make a rigorous and meaningful selection of the key variables as well as their modalities, which is a central topic of this paper.

Each step is based on appropriate tools which we summarize in Table 1.

Table 1 - Different steps of the 'Constructing the base' stage of the scenario method

Step	Who does what?	Tools used in the classic method
1. Delimiting the system under study	*Researchers:* identifying the prospects. *Researchers:* make individual and collective interviews with specialists. *Prospects:* provide variables influencing the system evolution.	No specific method. **Brainstorming**, **workshops**, etc. to determine the main variables influencing the system evolution.
2. Determining the key variables	*Researchers:* make a list of the variables quoted by the prospects; merge the variables standing for the same concept; organize groups (e.g. 3 groups of 10 prospects). *Prospects:* each group of prospects builds a consensus about the relationships between the variables. *Researchers:* build the matrix of relationships between variables for each group, and provide a synthesis matrix to be discussed by the group of prospects as a whole; select the key variables as those which are at the same time more influential than the average, and more influenced than the average (see Fig. 1); implement new surveys of experts if reduction of the number of key variables is needed.	The relationships between variables (influences and dependences) are built by consensus during **collective workshops, by small groups, then all together**. '**Survey of experts**' methods such as Delphi, Régnier's Abacus, or Smic-Prob-Expert allow the team to reduce the number of key variables.
3. Elaborating thebase scenarios	*Prospects:* build a consensus about the main modalities that can be taken by each key variable. *Researchers:* envision the different possible combinations of modalities.	Collective **workshops**. The general base scenarios are built as combinations of the possible modalities for all key variables.

2. The Remote Context

2.1. *The problems encountered*

The global pandemic that started early 2020 in France rapidly changed the way people worked as it forced remote-work on a great number of them. However, this way of working dates back to decades especially in scientific fields (Krämer-Flecken *et al.*, 2010; Stepanov *et al.*, 2011; Sun *et al.*, 2017). Nevertheless, other sectors are absent from the scene. Users' experience in the fusion sector was addressed in 2002 by Suttrop *et al.* (2002). In medical education, remote participation was very recently addressed by Kopp *et al.* (2021) in the context of the Covid-19 pandemic. Although the sectors

and considerations of these two latter studies strongly differ, both converge on several points and in particular: (i) personal communication remained of good quality and (ii) large meetings were to be excluded in the remote context.

In our case, remote work was not only an option, it was a necessity considering the sanitary context. However, since the scenario method is primarily based on face-to-face interactions, adjustments had to be made throughout the 3 steps of stage (1) of the classic method. In fact, as shown in Table 1, the first step can be easily adapted. Nevertheless, our specific problem concerns steps 2 and 3 of the classic method: those two steps are particularly problematic because they require mutual interactions between prospects in addition to the interactions with researchers.

Different choices had to be made to adapt the classic scenario method. They are presented in the following paragraphs.

2.2. *Organizational Adaptations of the Scenario Method*

The classic scenario method is based on collective sessions (usually face-to-face interactions with chosen prospects), particularly during the first two steps, as shown in Table 1. Several choices were available to us:

2.2.1. Replacing collective face-to-face sessions by **collective remote sessions**, such as video calls

Although more straightforward, this solution was not retained for the different reasons:

- Availability reasons: although it might seem easier to find common slots suitable for everyone during remote work, in practice the constraints related to the Covid context have reduced availability for reasons ranging from the management of the domestic daily life (children, meals, shopping with constrained schedules…) to the lack of motivation and a decrease in the implication in long distance projects while time spent on communicating with colleagues is increased. Last but not least, the last-minute cancellation facility is not to be overlooked: it is much more pervasive than for a long-standing trip which requires heavier logistics and leaves the participant with the feeling of taking part in group events and direct interactions.
- Technical reasons: possible connection problems can prevent the reunion, or prolong its duration and thus affect people's concentration (Roos *et al.*, 2020).

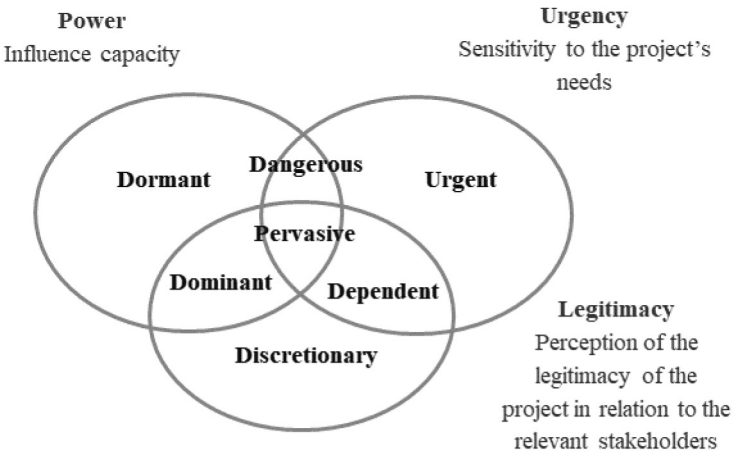
- Concentration reasons: remote discussions can hamper productivity. The longer the reunion, the less effective it can be. Long distance discussions can also affect people's ability to understand others' opinions (Simons *et al.*, 2000).
- Involvement reasons: when the number of participants in remote meetings is quite high, prospects may feel less involved (Simons *et al.*, 2000).
- Confidence-related reasons: confidence can be degraded since the risk of losing information is higher in long distance reunions (Roos *et al.*, 2020).

2.2.2. Multiplying the diversity of sources

Even in the classic method, the researchers seek gathering prospects from various domains, in order to generate original scenarios and breakdown scenarios. This issue is even more important in the adapted method. If the researchers interview only people with the same background, they will probably always receive always the same key variables, which is an impoverishment.

To mitigate this effect, we seek interviewing stakeholders with backgrounds and opinions as diverse as possible. There are several ways to classify the actors of a value-chain to improve the diversity of the interviewees (Clarkson, 1995; Sobczak & Girard, 2006). Mitchell, Agle and Wood (1997) classify the stakeholders according to 3 categories which are power, legitimacy and urgency. They then identify 7 types of stakeholders based on whether they possess one, two or all 3 characteristics (Figure 2 below).

Figure 2 - Classification of the stakeholders of a value-chain according to Mitchell, Agle and Wood's classification



We also added documents from literary reviews which provide factual and substantial information about the agri-food chain studied. Each document read is considered as an interview done.

2.2.3. Replacing collective face-to-face sessions by multiple **individual remote sessions** (video calls) whilst using other tools to complete the analysis of the interviews

Although increasing the time spent on the project for the team, this solution was retained. The semi-structured interview method is indeed often used in sociology studies (Chevalier & Meyer, 2018). It has the advantages of individual interactions referred to in Suttrop *et al.* (2002), Kopp *et al.* (2021) and Chevalier et Meyer (2018):

- The interviewee has higher confidence in the interviewer.
- He interacts with the interviewer more easily.
- He gives more information and structures his views according to his own vision of the matter.
- He can elicit opinions (out of the mainstream) that he would not have dared to say as such in a collective session, especially if the topic is sensitive.

When treated separately individual long distance interviews do not suffice to determine the key variables. Indeed, it is possible that a variable cited just a few times can be deemed crucial if thoroughly discussed within the group of experts.

From a methodological viewpoint, this required some adaptations of the method. Those adaptations are presented in Table 2.

The tools used and the process followed are described more thoroughly in *Section 2.3. in Annex 1.* In the Annex 1, we detail the calculations followed so that the adapted method can be verified and reproduced.

After determining the key variables and their modalities, a questionnaire is sent to the prospects in order to confirm, complete or change the list of key variables selected from the first range of interviews. This idea is inspired by the Delphi method. Illustrations of the results are provided in the next section.

Table 2 - Tools used in each step of the "Constructing the base" stage of the adapted method. The main tools are highlighted in bold

Step	Tools implemented by researchers in the adapted method
1. Delimiting the system under study	Identification of the stakeholders by the **tool of Mitchell *et al.* (1997)**. Remote individual interviews. **Analysis of existing documents** (treated as interviews) on the matter.
2. Determining the key variables	List of the sub-concepts quoted by the sources (prospects and documents). Merging of the sub-concepts standing for the same concept. Conversion of each interview into a **cognitive map** to visualize influence relationships between the concepts identified. Grouping concepts into variables. Construction of **partial squared matrices** of variables. We can thus identify the partial influence and dependence of each variable. But we do not account for the indirect links, that is different from the classic method. Construction of the global set of variables by merging all partial sets of variables together. Merging of all partial **squared matrices** into a global one by summing partial influences and dependences of all variables. Identification of the key variables by two ways: whose influence and dependence are higher than the average, – and analysis of the **answers from the interviewees** following the submission of the list ofvariables and their modalities.
3. Elaborating the base scenarios	The preliminary scenarios are built by scientists as combinations of the possible modalities of all key variables. The scenarios presenting incompatible modalities are discarded.

3. Results: application to the French pork value-chain

The example taken is in the meat sector, which currently faces various challenging social demands, from reduced environmental impact to animal well-being, and tensions between vegetarian food trends and meat-based culinary traditions (Reijnders & Soret, 2003). The French pork sector is particularly illustrative of these concerns, with debates around health-nocive additives (Sindelar & Milkowski, 2012), salt (Campbell *et al.*, 2011), fat in traditional food products, and its environmental footprint (Basset-Mens, 2005), especially since the French value- chain is very strongly concentrated in the West of the country (more than 55% of French pigs come from the West (AGRESTE, 2021)).

The challenge is to build prospective scenarios about the likely evolution of the French pork value-chain in the next 5 years. The French pork value-chain actors are used to the cyclicality of selling prices (favorable and then unfavorable) that have punctuated its existence for 70 years. It has developed without the intervention of the State or the subsidies which other agricultural sectors have access to. It is a sector that seizes export opportunities (i.e. to

Russia and China in 2020)[1] and whose efficiency has grown steadily (Roguet, 2017; Roguet *et al.*, 2014; Teffène *et al.*, 1998), through a standard model of very intensive breeding, while the average number of animals raised per farm multiplied (Dourmad *et al.*, 2010; Roguet *et al.*, 2014). The shared values of the main players in the value-chain (slaughterers, farmers with large pig farms, specialized cooperatives, salters, IFIP[2]…) are efficiency, cost control, technicality. As a result, it is very difficult for them to think about alternative models (especially for the upstream part of the sector) because they would put in danger what they have built. On the other hand, because of the usual cyclicality, the surge in feed and energy prices is not perceived as a signal that a more sober model must be adopted. From the point of view of these stakeholders, the most important challenge is the attractiveness of the sector, which struggles to recruit young breeders or workers for the farm, slaughterhouse, cutting or processing. This was already their main concern 40 years ago (Chaib *et al.*, 2022). Another problem to which they are sensitive is the refusal by the local population of new pig farms, in connection with the societal rejection mentioned above.

In this section, we present the results obtained by applying the adapted method to the case study regarding the French pork value-chain. Our goal is to consider the plurality of the possible futures of the French pork industry. What are the factors that will determine its evolution?

3.1. *Results of the methodological adaptations of the scenario method*

3.1.1. Lists of concepts and concept-merging results

We realized a total of 21 interviews (including 12 prospects representing different professions in the pork value chain and 9 opinion papers). From them, 651 sub-concepts were defined. After merging similar sub-concepts as described in 2.3.1 and 2.3.2 in annex 1, we obtain a list of 169 concepts. In this list of concepts, we identify 12 variables (A to L). They are presented in Table 3 below:

1. Because of a surge in African Swine Fever in 2020, China's imports of meat of swine (fresh, frozen or chilled) from France almost doubled in volume according to the trade statistics for international business development. France also exported more than 780 tons of live pork to China whereas normally, such transactions do not take place. Exports of live pork to Russia until 2012 were around 500 tons. Those volumes drastically plummeted in 2014: Moscow had in fact decreed an embargo on European pork, officially motivated by the discovery of some cases of African swine fever in dead wild boars in Lithuania and Poland. In 2020 however, because of structural deficiencies, a few tons of live pork and pork grease and offals were exported to Russia (information from trademap.org).

2. IFIP is the French pork technical institute.

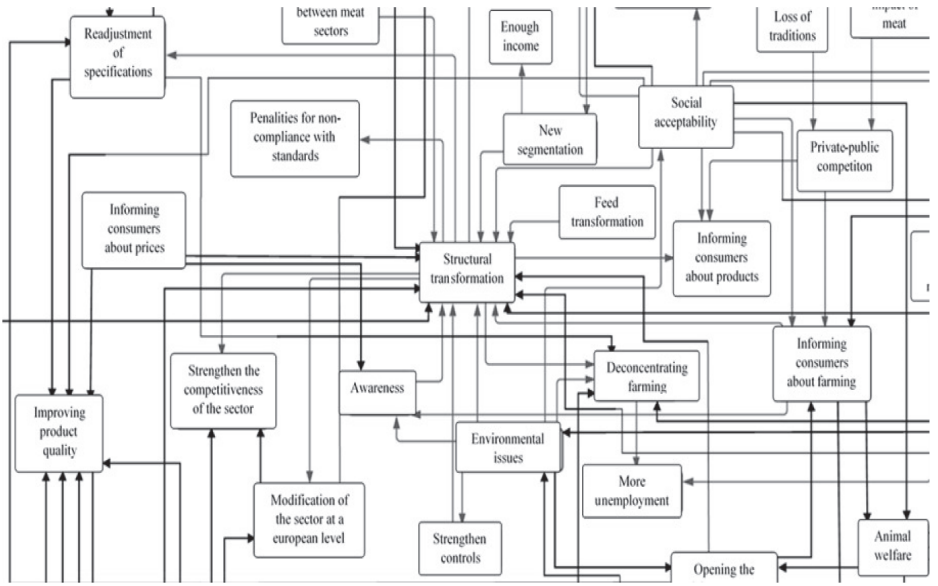
Table 3 - List of variables obtained after analysing interviews and documents

A	Social acceptability	**G**	Evolution of job attractiveness
B	Process of production and transformation	**H**	Institutional context
C	Consumption modes	**I**	Energy consumption
D	Production costs	**J**	Communication
E	Technical and technological progress	**K**	Value-chain structure
F	Market access	**L**	Product prices

3.1.2. Elaborating cognitive maps of the concepts identified per interview

Cognitive maps are drawn, based on the information gathered per prospect and per document. Figure 3 represents an extract of one of the 21 cognitive maps. They represent the influence and dependence links between two concepts identified in an interview.

Figure 3 - Extract of a cognitive map representing links between concepts identified in an interview



For example, the concept 'Structural transformation' in the center represents variable K (Value-chain structure). It influences the concept 'Informing consumers about products' (an arrow to the right) which represents variable J (Communication). This indicates that a readjustment of the value- chain structure can have an impact on the improvement of communication, according to the interviewee.

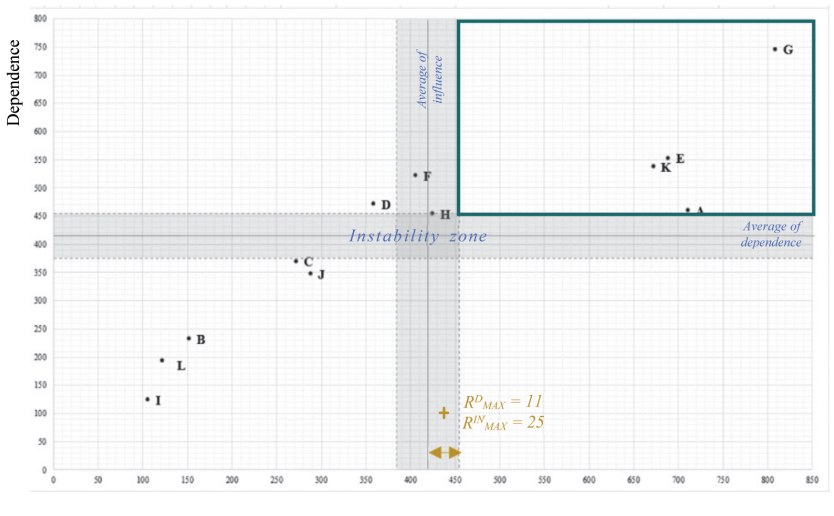
3.1.3. Creation of partial and global matrices to graphically determine the final key variables

The cognitive maps are translated into tables of concepts as described in definition 2 (2.3.3 in the annex 1).

Then the partial matrices are created (according to the processes described in definition 2, in annex 1). Figures 5, 6, and 7 in annex 1 are examples of the matrices obtained.

The final global squared matrix obtained (Figure 8 in annex 1) allows us to calculate influence and dependence values for each variable. The dot cloud corresponding to this matrix is below in Figure 4.

Figure 4 - Final graph allowing the identification of the key variables for all 21 interviews



Variables on the top right of the graph are the ones with the highest influences and dependences. They are key. Variables on the bottom right are entry variables, which means that they are also important when creating the reference scenarios. It is the same for the output variables on the top left. As for the variables at the bottom left of the graph, they are excluded: they are not considered when creating the scenarios.

The final stabilized key variables deduced from the adapted method are G (evolution of job attractiveness), A (social acceptability), E (technical and technological progress) and K (value-chain structure). Variable D (production costs) is a stabilized output variable. The variables located in the instability

zone are reallocated in the new category where they might fall in. Variables F (Market access) and H (Institutional context) for instance are more likely to be output variables.

Those results can be explained by the fact that considerable importance is granted to whether the pork sector is unattractive or if its professions are becoming attractive (variable G); it has always been the case (Chaib *et al.*, 2022). They also show that the number, the size and the location of farmsteads (variable K) heavily weighs on the evolution of the system. As for technical and technological progress in the value-chain (variable E), it is viewed by the prospects as a gateway to avoid negative consequences in the future – this of course can't always be the case. The social acceptability (variable A) of the pork value-chain is also an essential factor taken into account nowadays. It covers animal welfare, health and the socio-economic environment as well as the concerns around ecosystems, water and air pollution (Chaib *et al.*, 2022). We expected some of the variables to be key according to the interviews (notably variable I for energy supplies and use), especially considering the current world context. This however can be explained by the times at which the interviews were conducted (before the eruption of a war in Ukraine) and by the fact that it is indeed an underlying cause and not the first one that comes to mind when discussing issues of the French pork value-chain. However, this does not mean that we do not take those excluded variables into consideration: we do not use them when creating the different scenarios, however we cannot neglect them when describing the alternatives in detail.

3.1.4. Determining the modalities of the key variables

As mentioned in section 2.3.4 in annex 1, the modalities of the key variables are identified in the lists of concepts which make up said variable. In the following paragraphs and in Table 4, we illustrate through the example of variable A how we identify modalities.

- The modality gathering all the characteristics described in the first column of the table 4 is:

> Society demands a major change in the production model in the name of animal welfare, respect for the environment and public health. It is no longer possible to establish a new pig farm somewhere, and short circuits are developing at the expense of long circuits.

We give it the name "**rejection of the current model of pig production**"

Table 4 - Determination of the modalities of the variable A "social acceptability", through concepts and opposite concepts

Some of those concepts (the ones in bold and italic in Table 4) are rather explicated by us, according to what was said during the interviews.

A: Social Acceptability	
Concepts identified in the interviews	**Opposite concepts found in the interviews or elicited**
Refusing all types of productions near houses	***Accepting nearby pig farming***
Desire to develop local circuits	Accepting current long circuits
Consumer awareness (criticism) Criticism of the environmental impact of livestock farming Strengthening environmental requirements Increasingly recurring environmental problems	Improving the image of the (current) pig sector
Animal welfare requirements Improving animal health Reducing the use of inputs for human health Meeting consumer demands	***Status-quo***
Criticism of the nutritional impact of processed meat Concerns about traceability	***Recognition of the current quality of meat***

- The modality gathering the characteristics described in the second column is:

> At the price of some adjustments (increase in the surface area devoted to spreading, methanisation of surpluses, etc.) a consensus is reached with society.

We give it the name "**consensus about an improved model**"

At the end of the process for all the variables, we handle a list of stabilized key variables with their modalities presented in Table 5 below.

Table 5 - List of stabilized key variables and their modalities

Variable	Modality 1	Modality 2
A: social acceptability	Rejection of the current model of pig production	Consensus about an improved model
G: evolution of the job attractiveness	Unattractive sector, professions less and less practiced	Making the sector attractive
E: technical and technological progress	Improvement of techniques and technologies used	Stagnation in the use of techniques and technologies
K: value-chain structure	Restructuring and improving the sector	No structural changes

Even though we 'stabilized' the variables we obtained, we still wanted to make sure that those variables are indeed key to the prospects, plus, it is possible that some likely "real" key variables (that would have been selected thanks to long discussions and consensus building in the classic method) are let aside in the adapted method. That is why we submitted the list of variables with their modalities as discussed below.

3.2. *Submitting the list of variables and modalities to interviewees*

We assume that the "real" key variables are all included in the list of variables elicited thanks to the individual interviews. Indeed, it is highly unlikely that variables representing key issues in the food chain are not cited by anyone. This could happen if we only chose respondents from the same group of stakeholders, but this is not the case (see 2.2.2).

We decided to merge the list of the selected key variables graphically identified with the rest of the variables identified by all former interviewees: prospects are thus in a way 'forced' to see and think of **all** the variables together. Indeed, each reader can think that "if this variable is in the list, it means that someone quoted it as being key, is it true?". Our idea is to replace the impossible face-to-face consensus building by a second step of a Delphi consultation.

We thus contacted the interviewees and sent them an email with the questionnaire. For those who preferred filling it directly, we did it with them, by phone, since most prospects are geographically far from our locals.

Table 6 is an extract of the questionnaire we sent. The experts were asked to choose 5 variables at most to which they accord a high or very high importance. The variables are classified according to the French alphabetical order.

Table 6 - Extract of the Delphi questionnaire sent to the prospects

Below are the results of the analysis of 21 interviews with experts like you. Filling this questionnaire allows you to confirm and explicit your choices.
The objective of our working group is to gather different and contrasting points of view on the sector and its trends. The purpose of this questionnaire is therefore to identify the key variables in order to be able to develop reference scenarios for the future of the pig sector over the next 3-5 years. Below you will find all the variables and their modalities (values that can be taken by the variable) noted during the interviews about the evolution of the pig sector.
Please choose no more than 5 variables with a "High" or "Very high" importance.

Variables cited by the experts interviewed (and the 2 or 3 modalities that this variable can take)	**Importance of the variable**				
	Very low	**Low**	**Average**	**High**	**Very high**
Acceptability of the current production model (Requirement for change concerning the sector OR acceptance of the current porkvalue-chain)					
Market access (Facilitation of international trade OR difficulty of international trade)					
Inter- and intra-link communication (Improved communication OR same level of communication)					

By displaying the contrasted modalities of each variable, we expect to raise reflection about the role of the variable itself, especially to prospects who did not quote this variable spontaneously. In addition, to push the prospects to sort out the more important variables, we limit the number of variables to which a "very high" or "high" importance is attributed to 5.

We do not ask the prospects to classify the variables as either, key, output, input or excluded for several reasons: first of all, most of them are not familiar with those terms which could lead them into confusion. Secondly, our aim is only to confirm the results we already have: ideally we would like the results of all questionnaires to be that the five variables A, E, G, K and D are highly important.

After gathering all the responses, the results were the following (Table 7):

Table 7 - Results obtained after receiving 10 responses from prospects

Variables	Very high	High	Total
A: Acceptability of the current production model	6	3	9
G: Evolution of the attractiveness of professions	2	5	7
L: Final product price	3	4	7
D: Production costs	2	4	6
J: Inter- and intra-link communication	1	4	5
C: Pork meat consumption	4	1	5
F: Market access	2	1	3
H: Institutional context	0	3	3
B: Production and transformation processes	2	1	3
I: Costs and sources of energies	2	0	2
K: Value-chain structure	1	1	2
E: Technical and technological progress	0	0	0

The variables obtained are not quite the same as those that were identified as key according to the interviews. This however does not discredit our work. In fact, the questionnaires were sent almost a year after the interviews were conducted, and a lot has happened since then (numerous other waves of Covid, war between Ukraine and Russia, increase in feed prices, etc. …); this shows how much prospects opinions is highly influenced by current events (Cossette, 2004). In addition, some variables such as K (value-chain structure) are undoubtedly key, but prospects do not consider that the value-chain's structure can change, at least not in the next 3 to 5 years. That is why most of them did not mark it as high or very high importance for the following years. As for the variables that were excluded according to the adapted Godet method but are of high importance according to the Delphi results (L, J and C), particular attention is paid to them when describing in detail the scenarios chosen.

3.3. *Scenarios obtained using the adapted Godet method*

The scenarios are created by combining the modalities of the key variables obtained using the adapted Godet method (A, E, G and K). Each of those variables has 2 modalities. We thus have 2^4=16 scenarios possible. However, certain incompatibilities between the modalities were detected, and so the scenarios including them were eliminated. We were left with 8 possible framework scenarios, two pairs of which were compatible; we ended up merging them together. We obtain 6 final framework scenarios, called "framework-scenarios" as they are quite roughly described. They are presented in the following order: from the one that requires the least inflections in the current trends to the one that would require the largest inflections. On the other hand, they describe a trend that could emerge in 5 years, rather than a stabilized situation in 5 years.

Business as usual

The pork value-chain does not change its model, it remains unattractive because of the continuous expansion of farms (which are becoming too expensive to be taken over), the low selling prices of carcasses and finished products (because of competition with imports) and its poor image in society. Some efforts are made by the stakeholders of the value-chain when it comes to animal welfare, health and the environment. Advances in the technologies actually adopted do not change the situation. The sector remains concentrated in the Great West. Production costs remain volatile and continue to rise in trend, while selling prices remain affordable for consumers. The quantities produced in France are gradually eroding.

Technologies to the rescue

The jobs offered by the value-chain remain unattractive, and the image of the sector in society remains mediocre. Major efforts are being made to reduce pollution (methanization, etc.) and reduce additives in cold cuts, in order to ease social demands. Techniques and technologies (robotics, digital) are more and more efficient, and lead to the automation of many tasks (in breeding, slaughter, cutting…) to increase hourly productivity. Their introduction requires expensive investments. Many workstations are robotic. Intensification and concentration of production continues. Costs are rising, but the increase is modulated by productivity gains linked to the use of technology. Prices for the consumer remain reasonable, and the quantities produced are stable or slightly increasing as export markets open.

A more attractive value-chain

The sector has managed to make its professions more attractive, among other things through inter- and intra-link communication. Some aspects

of animal welfare and other environmental and health aspects are being improved, making it easier for consumers to accept pig farming as it is. The techniques and technologies used greatly improve the working conditions of all the actors in the value-chain, at the cost of rather heavy investments. The sector remains intensive and concentrated in the West region. Costs are increasing while prices for the consumer remain reasonable. This puts the most fragile stakeholders in difficulty, but the succession is nevertheless assured. Quantities produced remain stable.

Regional magnet/Compromise

Communication with consumers and potential future breeders and actors in the sector has succeeded in making the sector attractive, which improves the transmission and survival of very large pig farms. It is easier to find workers trained in the meat sector. Following a strengthening of standards and regulations (environment, animal welfare and health) at national and European level, the pork value-chain has managed to forge a new compromise with society. Consumers are willing to pay more for pork, which allows for higher selling prices and better remuneration for all players. Without significant technological progress, the value-chain remains concentrated in the major areas of current pig production, with a stabilization of the quantities produced. Production costs continue to rise in trend, but selling prices follow.

A two-faced value-chain

The strong demands of society towards the pork value-chain (organic, animal welfare, less pollution…) lead to a new distribution on the territory: large structures towards the West develop little, while small to medium farms are deployed throughout the territory, using multi-species slaughterhouses and local processing workshops. The professions in this short livestock sector are becoming more attractive, which encourages future breeders and processors to set up. The West invests in digital and robotization technologies and continues to export when opportunities arise. Direct sales in short supply chains are developing, with high prices, while prices remain moderate for products from intensive structures in the West. Overall, the quantities produced are stable. Production costs remain reasonable. On average, the consumer consumes less pork, and pays more for it. Consumer markets continue internationally.

Stop in the West

The current sector is becoming less and less attractive: large pig farms do not find buyers, especially since institutional support is unsuited to the problem. It becomes impossible to install a new building in the great West.

Society totally rejects pig farming as it is today, demanding different farming techniques in the name of animal welfare, and the end of "green algae". As a result, the sector is undergoing drastic regulations, and a profound transformation (new distribution of livestock throughout the French territory, growth in the number of small/medium farms, short circuits etc. …) without significantly modifying the techniques and technologies used. The quantities produced fall very sharply and rapidly. Pork and deli meats are becoming scarce and expensive commodities, and consumers are reducing their purchases. There is no longer any "basic" commodity for major international markets. Some niche markets for renowned artisanal processing (Bayonne ham, rillettes, etc.) continue to develop for export.

Those are the six framework-scenarios developed thanks to the adapted Godet method. Normally, in the Godet method, the scenarios would have been presented to the stakeholders of the French pork value-chain so that they could choose two of them as desirable. However, in the adapted Godet method, considering the situation, they are rather presented to project Sentinel partners (including IFIP representatives). During a general assembly of the partners of the SENTINEL project, two scenarios were unanimously chosen, on the grounds that they were the only bearers of hope. In particular, in these two scenarios, the sector's professions have become attractive again. The scenarios chosen are ***"Regional magnet/ Compromise"*** and ***"A two-faced value-chain"***. In the rest of the project (not covered in this paper), these two framework scenarios will be studied in detail, in order to explain the conditions and actions to be taken for their realization.

4. Discussion

4.1. *About scientific issues*

From the adapted method proposed, results are obtained in the case study regarding the future of the French pork supply chain, showing that the remote constraints do not prevent from delivering some "key variables" of the system.

4.1.1. Limits

The time granted to the process is considerably expanded. The approach allows highlighting possible biases induced by these adaptations in the results obtained.

Even though it is possible to conduct the adapted method by using virtual individual reunions and including new tools, it is possible that some key variables that would have been selected thanks to consensus in the classic method are left aside in the adapted method for two reasons: 1) because the number of prospects quoting them spontaneously in individual interviews is not large enough, and 2) because Delphi consultation is less efficient to raise awareness than peer-to-peer discussions. The fact that prospects cannot meet with each other influences the final choice of the key variables.

In addition, there is a risk of misusing subjectivity, which nonetheless is essential in the participatory approach. In the adapted method, a subjectivist perspective is adopted (Cossette, 2008; Lundberg *et al.*, 2020; Nissen, 2012). Citing Cossette (2008), "the individual cannot disregard his own cognitive structure when he approaches reality". Therefore, the cognitive maps, which serve as foundations to our analysis, are biased by the perception and interpretation of events specific to each individual (Cossette, 2004; Nissen, 2012). It is however what interests us and what allows us to collect as many variables as possible in order to create different scenarios.

Before the pandemic, we had chosen to implement the scenario method because of two particularly interesting features of it.

The first is that it generates by consensus building a shared vision of the future, stemming from actors bearing in mind different visions before this process. It would be an asset for the supply chain, especially when the time comes to develop a new collective vision (French EGALIM law n. 2018_938 30th of October 2018[3]). The second feature is that this scenario method builds scenarios that nobody, among the prospects, predicted before nor thinked of. Indeed, by combining systematically different characteristics – the modalities of the key variables –, Godet's method generates totally unexpected scenarios. In a nutshell, the classic method presents "emerging" properties, including ruptures.

Unfortunately, meeting with prospects individually and virtually sweeps away a strength of participatory methods which is to collectively involve a wide range of actors. They allow us to get a global view of the supply chain in its current and future state, but do not provide the expected consensus building process. So, by using the adapted Godet method, we do not benefit from the first feature, but we do benefit from the second one, especially since we tried to make the process of identifying the key variables sufficiently robust.

3. EGALIM (2018), *Loi pour l'équilibre des relations commerciales dans le secteur agricole et une alimentation saine et durable*, Ministère de l'Agriculture et de l'Alimentation. Available via www.legifrance.gouv.fr/loda/id/JORFTEXT000037547946.

4.1.2. Scientific interest

Overall, probably less scenarios are depicted by the adapted method than by the classic one. However, it is clear that notwithstanding the sanitary crisis we faced, reuniting prospects (as was usually done in the classic Godet method) is becoming more complicated and will be less and less frequent, because of both work intensification and the difficulties to travel. Consequently, the adapted method can offer a contribution to scientists to replace the classic method, when it is not practicable.

4.2. *About business issues*

It is important we note that none of the interviewees described any of the scenarios. It is the combination of factors considered major for the evolution of the sector that birthed them.

From the stakeholders' points of view, the six framework scenarios obtained may seem frightening at first. Indeed, they depict either a sector that is moving more or less quickly towards its defeat, or a complete reversal of the trends at work for 50 years.

4.2.1. Scenarios of defeat

- In the ***"business as usual"*** scenario, French production is eroding because "Production costs remain volatile and continue to rise in trend, while selling prices remain affordable for consumers". Farmers give up, eventually defeated by the "price scissor" that ruthlessly shrinks their margins as charges rise (input prices rise) while products decline (through lower pork and consumer prices).
- ***"Stop to the West"*** is even scarier because of its realism[4]. For some stakeholders, it describes the situation that is taking hold: drastic regulations and a rapid fall in the takeover of farms and installations. The industry is shrinking, defeated by societal attacks to which it has not been able to respond.
- The scenario ***"a more attractive value-chain"*** has solved the question of the attractiveness of the sector, but it is slowly fading, eliminating the most fragile breeders, and without great prospects for the future.
- ***"Technologies to the rescue"*** forms the bet that robotization and digitalisation will be the "deus ex-machina" of the sector. They should

4. See in this regard the recent demands of the Dutch government towards breeders (June 2022).

compensate for its weaknesses: lack of manpower and attractiveness in general, pollution of all types, lack of acceptability by society, performance cap… but nothing is less certain in reality.

4.2.2. Trend reversing scenarios

Both the ***"Regional magnet/Compromise"*** scenario and ***"a two-faced value-chain"*** describe a stagnation or even a decline in production, slaughter and processing in the West of France. Similarly, both scenarios foresee an increase in pork prices, which would cope with rising input costs and the trend erosion of consumption. Finally, they plan to comply with societal expectations, which would help make the sector's professions more attractive.

These three characteristics describe developments diametrically opposed to the trends of the last 50 years. It is therefore psychologically difficult for the actors of the sector to confront it.

Moreover, favoring these scenarios would profoundly affect the French agricultural policy in at least three areas.

- From a macroeconomic point of view, pork meat would become much more expensive at the retailer's stall. It is nevertheless currently a "cheap" meat, a factor of social peace because it makes it possible to preserve the purchasing power of households when the price of other meats soars.
- From a regional planning point of view, a new distribution of slaughtering and processing of meat on the territory would lead – among other things – to a geographical rebalancing of structures (methanizers, slaughterhouses, cutting plants, roads, etc.), often subsidised by local authorities. The same applies to intangible structures. For example, training in pig farming and the pork sector should be redeployed throughout the country, and no longer reserved for the West and the surroundings of Rodez. Instead of advocating the generalization of digital technology and robotics, we should train breeders and workers in their basic profession.
- From a micro-economic point of view, at the level of farms, these 2 scenarios call for practices (straw farming, freedom of movement of animals, access to the open air, daylight etc.) that are impossible to achieve in large intensive pig barns. The fact is, this is the scheduled end of intensive pig farming in the West.

4.2.3. Novelties

From a business perspective, the advantage of this approach is to generate scenarios that no one had considered before. It is a way of avoiding hyper-

sensitive themes (pollution of waterways, hyper-intensification, animal welfare…) without provoking a sterile confrontation of stakeholders. It is also a positive way of dealing with sensitive themes (for example, the excess pollution, linked to the concentration of livestock in the Great West is automatically "managed" in the hypothesis of a more balanced distribution of farms throughout the national territory). Finally, the problems are considered actively (what scenario will we put in place?) and no longer defensive.

The main limitation for business is that it is necessary to force oneself to gather (virtually) actors of the sector whose opinions differ profoundly on "what to do". It is tempting to consult only those with whom the profession is used to working, and whose "business" values are common. In the latter case, the approach would probably be very disappointing, and the scenarios not very innovative.

5. Conclusion

In this paper, we proposed adaptations in the classic participatory "scenario method" to the constraints of remote working generalized during the pandemic. These adaptations concern, on the one hand, organizational aspects such as the replacement of collective face-to-face sessions by recorded individual remote interviews complemented by literature reviews. On another hand, we dealt with methodological aspects characterized by numerous additional steps required in comparison with the classic method, and with the biases induced by implementing the adapted method instead of the classic one.

The application to the case of foresight of the French pork sector, within a scope of 5 years, has given 6 possible scenarios, of which we discussed the main characteristics and implications in terms of public policies. In the upcoming phases of project Sentinel, we anticipate and evaluate the impacts of changes in two of the presented scenarios using multicriteria argumentation.

The prospective approach followed in the SENTINEL project has a main merit. It familiarizes influential players in the French pork industry with new ideas, which are very difficult to make them hear in any other way, but which may need to be adopted quickly in the years to come.

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Annex 1

2.3. *Methodological Adaptations of the Scenario Method*

In this section, we will be detailing the calculations followed so that the adapted method can be verified and reproduced.

In the classic scenario method, collective sessions serve to identify the variables and to build consensus about relationships between variables, first of all by small groups then by joining all prospects together. From these group discussions about the relationships between each pair of variables, matrices of relationships are built for each group. From the consensus built between the different groups, all the relationships (direct and indirect) are summarized in a single matrix which is then discussed by all prospects, who have the final decision concerning the determination of the meaningful relationships. This whole process is called "structural analysis". Since this part of the classic method is based essentially on social interactions, skipping from collective to individual sessions had methodological repercussions.

In the adapted method, structural analysis is based on individual semi-directive discussions as we said previously in 2.2. As explained before, the interviews are carried on with experts who presumably have different views on the sector (political, social, economic, technological, environmental, etc.). It is therefore expected that the variables quoted as the main determinants of the system evolution differ from one actor to another.

In the following section, we discuss the different approaches used to determine the variables after extracting concepts from the interviews done with experts of the studied value chain.

2.3.1. Linguistic and mathematical approaches

In the classic as well as in the adapted method, we access and identify variables through interviews, discussions or document readings, that is to say, through natural language.

As we have said before, in the classic method, the variables – with their final denominations – are given directly by the prospects after establishing consensus. However, in the adapted method, variables are delivered by the sources – the prospects and the documents – with a given terminology, which differs from a source to another. That is why we distinguish concepts (linguistic approach) from variables (mathematical approach) and we combine the use of both.

- The notion of concepts belongs to the lexical domain. A concept $\mathbf{c} \in \mathbf{C}$ (a set of concepts) can be extensively described by the set of sub-

concepts denoted by $\mathbf{C_c}$ composed of the various denominations (synonymous or more specific) of said concept: in other words, a sub-concept (or a denomination) is a word or a phrase extracted as is from the verbatim of the interviews or the documents. Thus, a concept is made up of one or more sub-concepts. So, for a concept **c**, $\mathbf{C_c} = \{\mathbf{c'} \in \mathbf{C} \mid \mathbf{c'} \preccurlyeq \mathbf{c}\}$ (Thomopoulos *et al.*, 2013). All concepts together make up what Thomopoulos *et al.* (2013) call an ontology Ω defined as a tuple $\Omega = \{\mathbf{C},\mathbf{R}\}$ where **C** is the set of concepts and **R** is a set of relations between concepts. **R** is here composed of the synonymy and specialization relations.

- Variables on another hand are used in mathematical approaches and are handled in the "scenario method". Given a set of variables **V**, each variable $\mathbf{v} \in \mathbf{V}$ is associated with a concept $\mathbf{c} \in \mathbf{C}$ in the ontology Ω. Each variable can take several values which are called modalities.

The process followed below (Definitions 1, 2 and 3) is not automated, it is therefore a delicate and time consuming task. It is of course a subjective analysis of the interviews and the documents. Nevertheless, by involving several researchers and experts in the merging process and validating it at each step, the vocabulary defined becomes more relevant, and the process more efficient (Thomopoulos *et al.*, 2013).

2.3.2. Definition 1: Concept-merging process to obtain the variables

After doing the interviews and perusing the documents found on the matter studied, the set of concepts **C** is extracted, and considered as distinct, for each interview or document. The experts – which have different opinions and different domains of expertise – can adopt different ontologies to describe similar things, however the underlying concepts can be common to two or more sources. That is why an ontology matching procedure is followed in order to limit the heterogeneity of the concepts used (Todorov *et al.*, 2010). The ontology is built manually by merging concepts which have synonym denominations (Thomopoulos *et al.*, 2007, 2013). Given two equivalent concept denominations name(c1) and name(c2), we deduce c1 = c2 which allows us to merge both concepts and thus reduce the cardinality of the set of concepts **C**.

Then, concepts which refer to the same global notion are grouped into a variable. We will denote by var(c) the variable which concept c is associated with. So a variable **v** is a global notion made up of similar concepts which are explanations and descriptions of what it could be.

Example: In our case study, the concepts expressed as "Informing consumers about products" and "Informing consumers about farming" could be merged

and associated with the variable labelled "Communication". Similarly, the concepts "Refusing all types of breedings near houses" and "Criticism of the negative environmental impact of livestock farming" were both identified as concepts belonging to the variable "Social acceptability".

Let us now define the elements handled respectively in the classic and in the adapted method in order to identify the key variables of the system studied.

2.3.3. Definition 2: Partial versus global sets of variables, matrices, influences, dependences and key variables

- **In the classic method**, the global set of variables of the system, which we denote by **V**, is built by collective consensus between the prospects. The influence and the dependence of each variable of **V** is determined as follows. For each couple of variables (x, y) belonging to **V**, we will denote by $n_{xy} \in \{0; 1\}$ the existence of an influence relationship from x to y, built by collective consensus between the prospects. There are two cases:
  – $n_{xy} = 1$ if the prospects agree on the existence of an influence relationship from x to y;
  – $n_{xy} = 0$ otherwise.
  These influence relationships are represented as a squared matrix which resumes the influence relationships between each couple of variables.
  The influence of a variable $v \in \mathbf{V}$ is then computed as $I(v) = \sum_y n_{vy}$.
  Similarly, the dependence of $v \in \mathbf{V}$ is computed as $D(v) = \sum_x n_{xv}$.
- **In the adapted method**, a partial source-by-source phase is followed by a global merging phase.
  Partial source-by-source phase. For each source i, the following process is performed:
  – A *partial* set of concepts is defined, which we will denote by $\mathbf{C_i}$ valid for source i.
  – Individual cognitive maps are created to formalize relationships between concepts cited spontaneously by each source.
  – Cognitive maps are then converted into tables of concepts for each source i. For each couple of concepts (c, c') belonging to $\mathbf{C_i}$, we will denote by $n_{cc'i} \in \{0; 1\}$ the existence of an influence relationship from c to c' according to source i.
  $n_{cc'i} = 1$ if c influences c' (and equivalently c' depends on c) according to source i;
  $n_{cc'i} = 0$ otherwise.

From these pairwise relationships, the *partial* influence of concept c according to source i can be defined by $I_i(c) = \sum_{c'} n_{cc'i}$, while the *partial* dependence of concept c according to source i can be defined by $Di(c) = \sum_{c'} n_{c'ci}$.

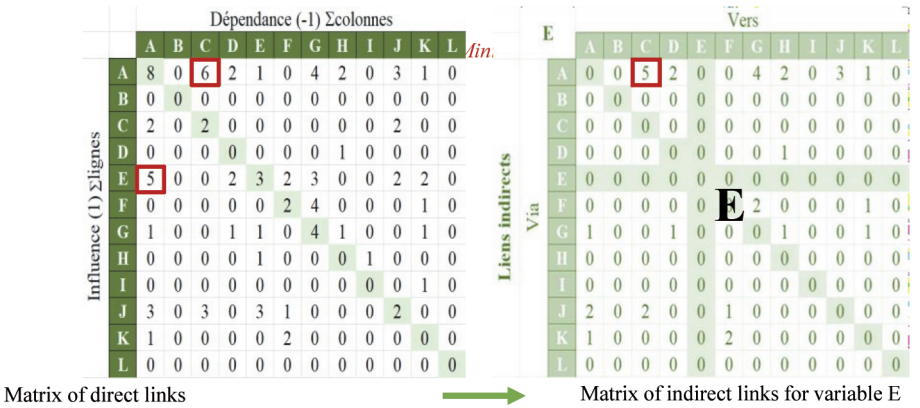
- After merging the concepts into variables (Definition 1), a *partial* set of variables $\mathbf{V_i}$ is defined for source i. The number of direct influence links $n_{vv'i}$ between two variables v and v' according to source I can be computed by summing the direct influence links between the concepts composing them: $n_{vv'i} = \sum_{c,c'|var(c)=v,\ var(c')=v'} n_{cc'i}$.
- A *partial* squared matrix representing the **direct links** between variables is created for each source i.
  A *partial direct* influence $I_i^d(v)$ and a *partial direct* dependence $D_i^d(v)$ of each variable $v \in \mathbf{V_i}$ are calculated for each source i independently.
  $I_i^d(v) = \sum_{c|var(c)=v} I_i(c)$
  $D_i^d(v) = \sum_{c|var(c)=v} D_i(c)$
  This squared matrix thus represents direct pairwise influences and dependences in the set of variables $\mathbf{V_i}$. Figure 5 is an example of the result obtained.

Figure 5 - Squared matrix of direct links identified in an interview between 12 variables

Influence (1) Σlignes \ Dépendance (-1) Σcolonnes	A	B	C	D	E	F	G	H	I	J	K	L
A	8	0	6	2	1	0	4	2	0	3	1	0
B	0	0	0	0	0	0	0	0	0	0	0	0
C	2	0	2	0	0	0	0	0	0	2	0	0
D	0	0	0	0	0	0	0	1	0	0	0	0
E	5	0	0	2	3	2	3	0	0	2	2	0
F	0	0	0	0	0	2	4	0	0	0	1	0
G	1	0	0	1	1	0	4	1	0	0	1	0
H	0	0	0	0	1	0	0	0	1	0	0	0
I	0	0	0	0	0	0	0	0	0	0	1	0
J	3	0	3	0	3	1	0	0	0	2	0	0
K	1	0	0	0	0	2	0	0	0	0	0	0
L	0	0	0	0	0	0	0	0	0	0	0	0

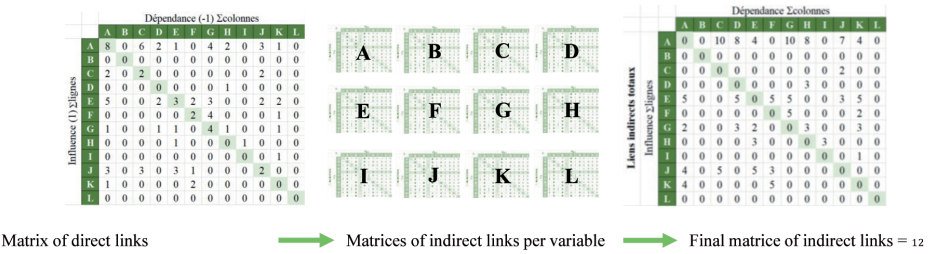
- We also need to calculate indirect **links of first order** between the variables. In fact, the number of indirect links between two variables is higher than the number of direct links between them. This could change the final results of which variables are key.
  Those indirect links of first order are calculated based on the partial matrix of direct links. The results are also squared matrices. For each variable, we obtain a specific squared matrix of first-order indirect links. Those squared matrices are then summed to obtain the final squared matrix of first-order indirect links for all variables on an interview. Figure 6 and 7 illustrate how we obtain the matrices of indirect links from the matrix of Figure 5.

Figure 6 - How indirect links of first order are calculated for each variable



Variable E is taken as an example here. To compute the number of indirect links from E to C through A, we retain the minimum between the number of direct links from E to A (5 direct links) and the number of direct links from A to C (6 direct links). The minimum is 5, there are thus 5 first-order indirect links from E to C through A. The same computation has to be performed taking all other ways from E to C (through B, D, etc.), then from E to all other variables than C.

Figure 7 - How we obtain the final squared matrix of indirect links of first order based of the squared matrix of direct links identified in an interview



More generally, to obtain the number of indirect links between two variables v and v' according to source i, denoted by $I_i^{in}(vv')$, we proceed as follows: $I_i^{in}(vv') = \sum_z \min(n_{vzi}; n_{zv'i})$ where $z \in \mathbf{V_i}$ is the intermediate variable between v and v'.

After identifying the number of indirect links between each pair of variables, we obtain as many matrices as we have variables (as shown in Figure 7). All those matrices are summed to obtain the final squared

matrix of all indirect links. We denote by $I_i^{in}(v) = \sum_{v' \in \mathbf{V_i}} I_i^{in}(vv')$ and $D_i^{in}(v) = \sum_{v' \in \mathbf{V_i}} I_i^{in}(v'v)$ the number of *partial* indirect influence and dependence links for each variable $v \in V_i$.

- Total influence and dependence values for each variable can be then calculated for each source i independently:

$$I_i(v) = I^d(v) + I_i^{in}(v)$$
$$D_i(v) = D_i^{in}(v) + D_i^{in}(v) \text{ with } v \in V_i$$

Partial key variables can be determined as in the classic method. They are the ones with $I_i(v)$ and $D_i(v)$ higher than the averages.

Global merging phase. From the partial sets of variables of all the sources i, we define the *global* set of variables **V** by merging all the partial sets together:

$$\mathbf{V} = \bigcup_i \mathbf{V_i}$$

If one variable appears several times in one partial set, it is counted once in the global set.

From the partial influences stemming from all sources, we compute the *global* influence of variable v as the sum of its partial influences, for all sources which considered the variable v:

$$I(v) = \sum_i I_i(v) \text{ with } v \in V_i$$

Similarly, we compute the *global* dependence of variable v as the sum of its partial dependencies, for all sources which considered the variable v:

$$Dv = \sum_i D_i(v) \text{ with } v \in V_i$$

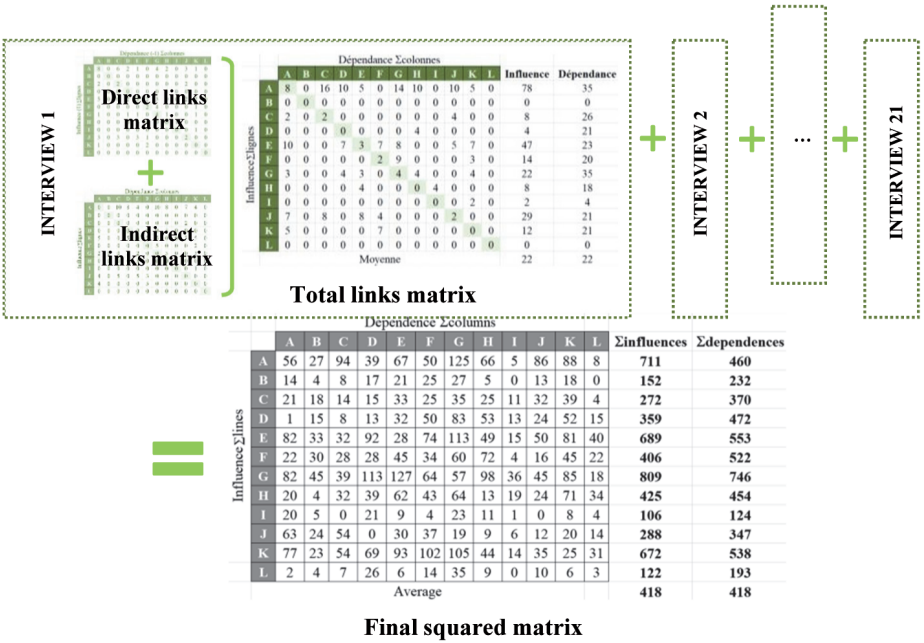
The results are represented in a final *global* square matrix. Figure 8 resumes all the process followed.

Finally, the *global* key variables are determined using the final squared matrix. The results obtained resemble those that would have been obtained using the classic Godet method (Figure 1). The key variables are those that are more dependent and more influential than the average.

However, the robustness of the identification of the key variables is a specific issue, especially in the adapted method because the prospects do not spontaneously agree about the determinants of the future. If we can perform hundreds of interviews, we could reasonably expect that the addition of one new interview to the former pool of results would not change the identification of the key variables. They would be "stabilized". We are however committed to stabilizing the key variables without necessarily doing a huge number of interviews.

The rule we chose is therefore the following: in this foresight exercise, the key variables are those which are graphically determined and which are not

Figure 8 - Summary of how we obtain a final squared matrix using the adapted Godet method



threatened to become output, input or excluded variables by the addition of one new interview. For that reason, we calculate instability zones of influence and dependence:

$Z_{influence}$ = average of influence ± (R^{D}_{MAX} + R^{IN}_{MAX})

$Z_{dependence}$ = average of dependence ± (R^{D}_{MAX}+ R^{IN}_{MAX})

With R^{D}_{MAX} the maximum number of direct relations;

R^{D}_{MAX} = Max(I^{d}_{i}(v);

D^{d}_{i}(v)) and R^{IN}_{MAX} the maximum number of indirect relations;

R^{IN}_{MAX} = Max(I^{in}_{i}(v);

D^{in}_{i}(v)) with v ∈ V_i

The process for determining the values of R^{D}_{MAX} and R^{IN}_{MAX} is iterative: it's done after each interview as the values may change. We then decide to exclude from their status of key variables, those which could change their status (by becoming either output, input or excluded variables) by the addition of (R^{D}_{MAX} + R^{IN}_{MAX}) links or less. Graphically speaking, it means that the key variables positioned too close to one or the other of the average lines are not "stabilized" key variables. The rule is valid whatever the status of the variable is.

After determining the stabilized key variables, their modalities must be considered as defined in the next section of the main text.

2.3.4. Definition 3: Defining the **modalities** of the variables

The modalities of one given variable are the values that can be taken by this variable, according to the analysis of the interviews and documents included.

- **In the classic method**, the modalities of each key variable are chosen by consensus whilst choosing the key variables. It should be noted that it is necessary to limit the number of modalities (while 2 are the minimum), or it will generate an extremely high number of scenarios!
- **In the adapted method**, the modalities of variable v are extracted from the set of concepts **C**, **c** being the concept associated with variable **v** (see Section 2.3.1 in this Annex). The modalities of v are the concepts strictly more specific than **c** – synonyms are thus excluded. More precisely, we look at the list of concepts and keep the ones which describe some characteristics of the variable v. Some of those concepts can either be explicit modalities of the variable, or they can be "rebuilt" in a simpler brief manner – implied by the interviewee or the document – so that they are modalities of the variable. The number of modalities for each variable is also at best limited to two.

References

AGRESTE (2021). Essentiel filière porc Bretagne. *Statistiques publiques*, 7. -- https://draaf.bretagne.agriculture.gouv.fr/IMG/pdf/07_Essentiel_Bgne_por cs_2021_cle8e7943.pdf.

Balmann, A., Dautzenberg, K., Happe, K., & Kellermann, K. (2006). On the Dynamics of Structural Change in Agriculture: Internal Frictions, Policy Threats and Vertical Integration. *Outlook on Agriculture*, *35*(2), 115-121. doi: 10.5367/000000006777641543.

Bar-Yam, Y. (2002). General Features of Complex Systems. *UNESCO Encyclopedia of Life Support Systems*.

Basset-Mens, C. (2005). *Proposition pour une adaptation de l'Analyse de Cycle de Vie aux systèmes de production agricole. Mise en oeuvre pour l'évaluation environnementale de la production porcine*, thèse de doctorat, Agrocampus Ouest.

Bourguet, J.-R., Thomopoulos, R., Mugnier, M.-L., & Abécassis, J. (2013). An artificial intelligence-based approach to deal with argumentation applied to food quality in a public health policy. *Expert Systems with Applications*, *40*(11), 4539-4546. doi: 10.1016/j.eswa.2013.01.059

Campbell, N., Correa-Rotter, R., Neal, B., & Cappuccio, F.P. (2011). New evidence relating to the health impact of reducing salt intake. *Nutrition, Metabolism and Cardiovascular Diseases*, *21*(9), 617-619. doi: 10.1016/j.numecd.2011.08.001.

Chaib, R.L., Macombe, C., & Thomopoulos, R. (2022). *Designing the Future of Agri-Food Chains: Comparison of Prospective Analysis Built 40 Years Ago and Today*, 6.

Chevalier, F., & Meyer, V. (2018). Chapitre 6. Les entretiens. In: *Les méthodes de recherche du DBA* (pp. 108-125). EMS Editions; Cairn.info. doi: 10.3917/ems.cheva.2018.01.0108.

Clarkson, M.E. (1995). A Stakeholder Framework for Analyzing and Evaluating Corporate Social Performance. *Academy of Management Review*, *20*(1), 92-117. doi: 10.5465/amr.1995.9503271994.

Cordobes, S., Durance, P., & Lesourne, J. (2004). *Les entretiens de la mémoire de la prospective*.

Cossette, P. (2004). *L'organisation: Une perspective cognitiviste*. Presse Université Laval.

Cossette, P. (2008). La cartographie cognitive vue d'une perspective subjectiviste: Mise à l'épreuve d'une nouvelle approche. *M@n@gement*, *11*(3), 259. doi: 10.3917/mana.113.0259.

Croitoru, M., Buche, P., Charnomordic, B., Fortin, J., Jones, H., Neveu, P., Symeonidou, D., & Thomopoulos, R. (2016). A Proposal for Modelling Agrifood Chains as Multi Agent Systems. In: J.P. Carvalho, M.-J. Lesot, U. Kaymak, S. Vieira, B. Bouchon-Meunier, & R.R. Yager (Éds.), *Information Processing and Management of Uncertainty in Knowledge-Based Systems* (Vol. 610, pp. 498-509). Springer International Publishing. doi: 10.1007/978-3-319-40596-4_42.

De Jouvenel, B. (1964). *L'art de la conjuncture*. Edition Du Rocher.

Dourmad, J.Y., Canario, L., Gilbert, H., Merlot, E., Quesnel, H., & Prunier, A. (2010). Évolution des performances et de la robustesse des animaux en élevage porcin. *INRAE Productions Animales*, *23*(1), 53-64. doi: 10.20870/productions-animales.2010.23.1.3287.

Godet, M. (2007). *Manuel de prospective stratégique-Tome 1-3ème édition-Une indiscipline intellectuelle*. Dunod.

Godet, M. (2008). *Strategic foresight: Use and misuse of scenario building.*

Godet, M., & Durance, P. (2001). *La prospective stratégique pour les entreprises et les territoires.* Dunod.

Godet, M., & Lesourne, J. (1977). *Crise de la prévision, essor de la prospective: Exemples et méthodes*. Presses universitaires de France.

Handayati, Y., Simatupang, T. M., & Perdana, T. (2015). Agri-food supply chain coordination: The state-of-the-art and recent developments. *Logistics Research*, *8*(1), 5. doi: 10.1007/s12159-015-0125-4.

Kopainsky, B., & Stave, K. (2014). *Dynamic thinking about food system vulnerabilities in highly developed countries: Issues and initial analytic structure for building resilience*. -- www.researchgate.net/publication/281280683_Dynamic_thinking_about_food_system_vulnerabilities_in_highly_developed_countries_Issues_and_initial_analytic_structure_for_building_resilience.

Kopp, A.R., Rikin, S., Cassese, T., Berger, M.A., Raff, A.C., & Gendlina, I. (2021). Medical student remote eConsult participation during the Covid-19 pandemic. *BMC Medical Education*, *21*(1), 120. doi: 10.1186/s12909-021-02562-6.

Krämer-Flecken, A., Krom, J., Landgraf, B., & Lambertz, H.T. (2010). Remote Participation tools at TEXTOR. *Fusion Engineering and Design*, *85*(3-4), 625-627. doi: 10.1016/j.fusengdes.2010.02.008.

Lesourne, J. (1989). *Plaidoyer pour une recherche en prospective*, *137.*

Lundberg, A., de Leeuw, R., & Aliani, R. (2020). Using Q methodology: Sorting out subjectivity in educational research. *Educational Research Review*, *31*, 100361. doi: 10.1016/j.edurev.2020.100361.

Macombe, C., Le Feon, S., Aubin, J., & Maillard, F. (2019). Marketing and social effects of industrial scale insect value chains in Europe: Case of mealworm for feed in France. *Journal of Insects as Food and Feed*, *5*(3), 215-224. doi: 10.3920/JIFF2018.0047.

Meadows, D.H., Meadows, D.L., Randers, J., & Behrens III, W.W. (1972). *The limits to growth-club of Rome*.

Mitchell, R.K., Agle, B.R., & Wood, D.J. (1997). Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts. *Academy of Management Review*, *22*(4), 853-886.

Nissen, M. (2012). Constructing Subjectivity in Participation. In: M. Nissen, *The Subjectivity of Participation* (pp. 193-230). Palgrave Macmillan UK. https://doi.org/10.1057/9780230367890_8

Perrot, N., Trelea, I.C., Baudrit, C., Trystram, G., & Bourgine, P. (2011). Modelling and analysis of complex food systems: State of the art and new trends. *Trends in Food Science & Technology*, *22*(6), 304-314. https://doi.org/10.1016/j.tifs.2011.03.008.

Reijnders, L., & Soret, S. (2003). Quantification of the environmental impact of different dietary protein choices. *The American Journal of Clinical Nutrition*, *78*(3), 664S-668S. https://doi.org/10.1093/ajcn/78.3.664S.

Roguet, C. (2017). Evolution des modèles d'exploitations porcines en France sous l'effet des contraintes économiques et réglementaires depuis 2008. *Journées Recherche Porcine*, *49*, 277-282.

Roguet, C., Perrot, C., Gallot, S., & Rieu, M. (2014). Les types d'exploitations agricoles ayant des porcs en France en 2010: Identification, caractéristiques et évolution. *Journées Recherche Porcine*, *46*, 229-234.

Roos, G., Oláh, J., Ingle, R., Kobayashi, R., & Feldt, M. (2020). Online conferences – Towards a new (virtual) reality. *Computational and Theoretical Chemistry*, *1189*, 112975. doi. 10.1016/j.comptc.2020.112975.

Simons, P.R.-J., Admiraal, W., Akkerman, S., van de Groep, J., & de, M. (2000). *How people in virtual groups and communities (fail to) interact*, 12.

Sindelar, J.J., & Milkowski, A.L. (2012). Human safety controversies surrounding nitrate and nitrite in the diet. *Nitric Oxide*, *26*(4), 259-266. doi: 10.1016/j.niox.2012.03.011.

Sobczak, A., & Girard, C. (2006). Des parties prenantes aux parties engagées: Pour une nouvelle lecture de la théorie des stakeholders. In: *1er Congrès du Réseau International de recherche sur les Organisations et le Développement Durable (RIODD)*. -- https://hal.archives-ouvertes.fr/hal-00757948.

Stepanov, D., Abla, G., Ciarlette, D., Fredian, T., Greenwald, M., Schissel, D.P., & Stillerman, J. (2011). Remote participation in ITER exploitation – Conceptual design. *Fusion Engineering and Design*, *86*(6-8), 1302-1305. doi: 10.1016/j.fusengdes.2011.01.120.

Sun, X., Wang, F., Wang, Y., & Li, S. (2017). Data Handling in EAST Remote Participation. *IEEE Transactions on Nuclear Science*, *64*(11), 2891-2894. doi: 10.1109/TNS.2017.2756631.

Susskind, L.E., McKearnen, S., & Thomas-Lamar, J. (1999). *The consensus building handbook: A comprehensive guide to reaching agreement*. Sage publications.

Suttrop, W., Kinna, D., Farthing, J., Hemming, O., How, J., & Schmidt, V. (2002). Remote participation at JET Task Force work: Users' experience. *Fusion Engineering and Design*, *60*(3), 459-465. doi: 10.1016/S0920-3796(02)00047-9.

Taillandier, P., Salliou, N., & Thomopoulos, R. (2021). Introducing the Argumentation Framework Within Agent-Based Models to Better Simulate Agents' Cognition in Opinion Dynamics: Application to Vegetarian Diet Diffusion. *Journal of Artificial Societies and Social Simulation*, *24*(2), 6. doi: 10.18564/jasss.4531.

Teffène, O., Rieu, M., Dagorn, J., Mainsant, P., Marouby, H., & Porin, F. (1998). *Trente ans d'évolution du secteur porcin en France*, 20.

Thomopoulos, R., Baget, J.-F., & Haemmerlé, O. (2007). Conceptual Graphs as Cooperative Formalism to Build and Validate a Domain Expertise. In: U. Priss, S. Polovina, & R. Hill (Éds.), *Conceptual Structures: Knowledge Architectures for Smart Applications* (Vol. 4604, pp. 112-125). Springer Berlin Heidelberg. Doi: 10.1007/978-3-540-73681-3_9.

Thomopoulos, R., Destercke, S., Charnomordic, B., Johnson, I., & Abécassis, J. (2013). An iterative approach to build relevant ontology-aware data-driven models. *Information Sciences*, *221*, 452-472. doi: 10.1016/j.ins.2012.09.015.

Thomopoulos, R., Moulin, B., & Bedoussac, L. (2018). Supporting Decision for Environment-Friendly Practices in the Agri-Food Sector: When Argumentation and System Dynamics Simulation Complete Each Other. *International Journal of Agricultural and Environmental Information Systems*, *9*(3), 1-21. doi: 10.4018/IJAEIS.2018070101.

Todorov, K., Geibel, P., & Kühnberger, K.-U. (2010). Mining concept similarities for heterogeneous ontologies. *Industrial Conference on Data Mining*, 86-100.

van Bruggen, J.M., Boshuizen, H.P.A., & Kirschner, P.A. (2003). A Cognitive Framework for Cooperative Problem Solving with Argument Visualization. In: P.A. Kirschner, S.J. Buckingham Shum, & C.S. Carr (Éds.), *Visualizing Argumentation* (pp. 25-47). Springer London. doi: 10.1007/978-1-4471-0037-9_2.

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Social Farming in high mountain regions: The case of the Aosta Valley in Italy

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Abstract

This paper investigates and analyses social farming in the Aosta Valley, a tiny Italian mountain region in the Alps. It aims to highlight the features of social farming in this region, focusing on the social mission and economic sustainability. The paper first presents the literature on social farming, focusing on marginal and remote areas, and illustrating the main characteristics of Italian social farms. Secondly, it focuses on the findings coming from a qualitative investigation of three case studies of Valdostan social farms based on data collected from semi-structured direct interviews. The analyses reveal that social farming in the Aosta Valley fulfils a crucial social mission in areas with poor accessibility to social services. It is economically sustainable, basing its business model on the environmental and agricultural resources typical of high mountain regions.

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1. Introduction

Social farming (SF) is an innovative practice that links multifunctional agriculture and the supply of health, social, education, and employment services in rural and peri-urban areas (Di Iacovo & O'Connor, 2009; Di Nazzaro *et al.*, 2021; Henke, 2004; Wilson, 2007).

Literature provides several definitions of SF and different ways of discussing the phenomenon (care farming, green care, social farming). These concepts are often used interchangeably, but they all have different backgrounds and meanings according to the country (Bassi *et al.*, 2016; Di Iacovo & O'Connor, 2009; Guirado *et al.*, 2017, Hassink *et al.*, 2020). Care farming focuses on mental and physical health through routine farming activities on a farm or with a rural landscape (Dessein, 2008; Leck *et al.*, 2014; Hine *et al.*, 2008; Sempik *et al.*, 2010). Social farming refers to all the activities mobilising agricultural resources, both from plants and animals, aimed at promoting the care, rehabilitation, life-long education, and sheltered employment of the most vulnerable and marginal segment of the population, i.e., people with social, physical, or mental disabilities, children with a learning disability, detainees or ex-prisoners, drug, or alcohol addicts (Bassi *et al.*, 2016; Di Iacovo, O'Connor, 2009). Finally, green care is a broad concept that encompasses all the benefits of contact with nature (Galardi *et al.*, 2022). It's an umbrella term that includes therapeutic, social and educational practices involving farming, farm animals, gardening, social farming, care farming, therapeutic horticulture, and animal-assisted intervention (García-Llorente *et al.*, 2018; Hine *et al.*, 2018).

International empirical research has highlighted heterogeneous approaches in Europe to SF (Tulla *et al.*, 2014; Guirado *et al.*, 2017; Hassink *et al.*, 2016). There is diversity in goals, type of organisations promoting the activities and target group to which the practices are addressed. For instance, SF is primarily managed by third-sector organisations in Italy, while in Netherlands and Belgium by the private sector. In Ireland, institutional initiatives are dominant (Di Iacovo, 2020; Di Iacovo, O'Connor, 2009; Nazzaro *et al.*, 2021).

As the literature shows, SF is a phenomenon rich in innovative practices, which has been drawing the attention of a larger crowd, from researchers and scholars to politicians and policymakers. SF initiatives are considered innovative both from an economic and a social point of view (Hassink *et al.*, 2020). SF provides essential services to local communities through an intersectoral approach (De Vivo *et al.*, 2019, Borgi *et al.*, 2020). It links different sectors (social assistance, health services, agriculture, food processing, landscape conservation, etc.) by creating networks of cooperation aimed at meeting the needs of disadvantaged people (Borsotto *et al.*, 2019;

Dalla Torre *et al.*, 2020). Moreover, the collaboration between private and public actors is essential since SF responds to multiple difficult situations and aims at a plurality of target audiences (Di Iacovo & O'Connor, 2009). In this way, SF represents an innovative, multi-actor, and interdisciplinary approach able to create social cohesion and support the quality of life of the most vulnerable segments of the population. Furthermore, sectors that have rarely been considered related can respond in an unconventional way to the many challenges the rural world faces (Di Iacovo *et al.*, 2014, 2017; Gramm *et al.*, 2019). As a model based on the interaction of different stakeholders, it may generate benefits for all sectors involved (Bassi *et al.*, 2016). It differs from other innovative practices in farming (e.g., extension activities in helping new farmers, farming in prison grounds to provide food, subsidies to help out-of-school youth to undertake farm-related entrepreneurship), as clear social objectives are for the well-being of a wide range of marginal groups of the population.

Several benefits and positive externalities arise from the SF practices, as demonstrated by recent research (Borgi *et al.*, 2020; Di Iacovo, 2020; Finuola & Pascale, 2008; Hemingway *et al.*, 2016; Musolino *et al.*, 2020). Considering the main target of these practices is to the most vulnerable and marginal socio-demographic groups, their primary benefits encompass a general improvement in skills, opportunities for work placement and social integration, self-confidence and assumption of responsibility for their actions etc. (Bassi *et al.*, 2016; Di Iacovo & O'Connor, 2009; Giaré, 2012; Giaré & Macrì, 2012; Hine, 2008; Hine *et al.*, 2008). In addition, there are long-term advantages that can affect the farmers, the local institutions, and the entire community. Such as:

- benefits for the public sector which, thanks to the additional and innovative services supplied by SF, can overcome constraints due to the limited availability of financial resources (Di Iacovo, O'Connor, 2009; Di Iacovo *et al.*, 2017; Giaré *et al.*, 2018; Guirado *et al.*, 2017; Hine *et al.*, 2008);
- opportunities for the farms to expand and diversify their business and extend their reputation in the local market, either in rural or urban areas (Di Iacovo, O'Connor, 2009; O' Connor *et al.*, 2010, Tulla *et al.*, 2014);
- chances for the whole community to increase the supply of essential services in rural areas, generating and strengthening a network of relations and connections (effects in terms of social capital). Indeed, the interaction and cooperation among many sectors and actors spread information and knowledge throughout the territory and then contribute to the development of the countryside itself (Hassink *et al.*, 2020; Hine *et al.*, 2008; Leck *et al.*, 2014; Musolino *et al.*, 2020; Tulla *et al.*, 2014);
- outcomes for sustainability by safeguarding the environment and supporting lively and healthy rural communities. Primarily, SF uses

natural organic farming techniques. In Italy, more than 60% of the social farms have turned to organic farming (CREA, 2018). Thus, SF may contribute to generating economic, social, and environmental sustainability (FAO, 2015).

A growing number of scholars have been investigating SF in Europe and Italy (Carbone *et al.*, 2009; Ciaperoni, 2011; Dell'Olio *et al.*, 2017; Di Iacovo & O'Connor, 2009; Giaré *et al.*, 2018; Gramm *et al.*, 2019; Hassink & van Dijk, 2006; Hassink 2009; Hudcová *et al.*, 2018; Leck *et al.*, 2014; Moriggi, 2019; Musolino *et al.*, 2020). Nevertheless, there is a shortage of specific studies focused on extremely marginal areas, especially on remote regions like mountain regions – e.g., the Alps.

Mountain regions more than others are experiencing a socio-economic and demographic decline, due to several reasons such as lack of services, climate change and decrease of winter tourism. Mountain regions are therefore in search of new models of socio-economic development, i.e. new drivers of development capable of producing positive effects on the territory economically, socially, and culturally. In this respect, it is relevant to know whether new activities, especially new agricultural practices like SF, can contribute and reverse the declining trend observed in the last decades. Therefore, this paper aims to fill the research gap concerning this "branch" of agriculture in high mountain regions.

This study aims to analyse and discuss the phenomenon of SF in the Aosta Valley, focusing on the findings of a qualitative investigation on the valdostan social farms, based on case studies using face-to-face semi-structured interviews. The research questions of this paper can be summarized as follows:

1. Can SF be implemented in a remote high mountain region such as the Aosta Valley? Is SF suited to high mountain regions' geographical, social and economic characteristics?
2. What are the unique features of SF in high mountain regions?
3. What is its role, and what socio-economic benefits it can have on the local communities?

This paper is structured as follows. The next section presents the literature review on SF, focusing on the Italian model and the remote areas. The third section presents SF in Italy, as defined and framed by the national laws, also describing the main characteristics of Italian social farms (and social services offered) based on the empirical evidence coming from the latest surveys. The fourth section focuses on SF in the Aosta valley and on the qualitative field investigation: first, it describes the Aosta valley, its main geographical and socio-economic characteristics, focusing on the agricultural sector; secondly, it defines the method used for the field investigation; thirdly, it describes and analyses the three case studies of social farms investigated, both taken

individually and comparatively (the three social farms are analysed each of them individually, and from a comparative perspective). The last section contains conclusive remarks and policy implications.

2. International studies on social farming, with a focus on highly remote areas

The first experiences of SF in Europe developed around the 1960s but have been kept aside from the institutions and the scientific community for a long time (Di Iacovo *et al.*, 2014; Genova *et al.*, 2020). Finally, since 2000 scientific and public debates started talking about SF (Braastad & Bjornsen, 2006; Dessein *et al.*, 2013; Giarè *et al.*, 2018a; Hassink & van Dijk, 2006; Gallis, 2007; Gallis, 2013).

Numerous health, economic and social benefits of SF have allowed these practices to spread all over Europe (Di Iacovo & O'Connor, 2009). In every European country, SF has developed to include specific categories of vulnerable subjects such as people with disabilities, detainees or ex-prisoners, drug or alcohol addicts, unemployed.

The common feature in SF throughout Europe is that it represents an innovative approach to facing the social crisis in rural and peri-urban areas. It provides types of social services other than the typical standard offered by the welfare program. The numerous benefits are for the farmers, the beneficiaries of the services offered and the whole community (Katonane *et al.*, 2016; Lanfranchi *et al.*, 2015). SF has reached a significant level of development in the Netherlands, Norway, France, Germany, and Belgium, though different business models have been applied (Carbone *et al.*, 2009). For some social farms, agriculture and farming still represent the main business and income, while the therapeutic aspect is prevalent for others.

A recent study by Di Iacovo (2020) focuses on the different forms of SF in the EU, offering some interesting considerations about the basic principles of the ventures according to the welfare models, together with the analysis of their strengths and weaknesses. The author underlines that in Northern Europe, SF is supported by robust state intervention and accompanied by the public health system. Thus, social farms are suppliers of social services based on the needs of public institutions. In France and Germany, most social services are undertaken and supplied by medium and large organisations supported by the government. In this case, SF makes it possible to involve vulnerable people, supporting and taking care of them in a sheltered environment upheld by public policies. In the UK and Ireland, SF is characterised by the relevant presence of foundations and NGOs that play a crucial role in sustaining social farms. Instead, in Italy, Spain and Portugal,

but also Greece, Malta, and Cyprus, SF derives from mixed welfare models, which include the public sector and private stakeholders such as NGOs, farms, households and individuals.

The Netherlands is one of the pioneering countries of SF in Europe. SF in the Netherlands developed more rapidly and massively than the other European countries, based on the number of social farms and the government support policies (Hassink *et al*., 2014; Hassink *et al*., 2018; Hassink *et al*., 2020). The Dutch experience is well represented by the care farms, often born from family-run businesses (Berget *et al*., 2008; Di Iacovo & O'Connor, 2009; Elings *et al*., 2008; Hassink *et al*., 2009; Hassink *et al*., 2020). In the Dutch care farms, social activities have a principal therapeutic goal (Hassink *et al*. 2018), differently from other countries, like Italy, where SF is more aimed at social inclusion (Di Iacovo, O'Connor, 2009).

As seen above, the literature on social farming is vast and varied. However, specific studies focused on highly remote regions, like high mountain regions are lacking. However, there are some recent studies focused on Trentino-Alto Adige, Northeastern Alps, dealing with SF and social innovation (Gramm *et al*., 2019; Gramm *et al*., 2020; Gretter *et al*., 2019); and an investigation of SF in Calabria, a high remote region in southern Italy (and prevailingly mountainous region, although surrounded by the sea) with extremely low socioeconomic development (Musolino *et al*., 2018; Musolino *et al*., 2020). In addition, some studies on diversification and multifunctionality in mountain farming in the Pyrenees mountains (López-i-Gelats *et al*., 2011; Barnaud & Couix, 2020) also deserve to be mentioned. Interestingly, several positive effects produced by SF in these highly remote regions came up. They are:

- territorial dispersion of essential services, which might be characteristic of rural and poorly inhabited areas like mountain regions, may be limited or reduced. Due to the multifunctional and diversified nature of farms engaged in SF, it can create proximity for the users and easier access to social services;
- contribute to fostering the reputation of local products and services in areas where remoteness and marginality limit their visibility. This was evident in a marginal region like Calabria, where many social farms were started on the land confiscated from organised crime (in this respect, SF contributed to reversing the image of these places);
- enhance relations and networks both formal and informal, which are generally weak in remote regions. As said above, it usually involves a specific number and range of participants: users, producers, institutions, associations, local communities and more, therefore increasing potential and actual relationships and networks;

- create new job opportunities, not only for vulnerable people but also for professionals, in areas where employment is still unattainable for specific social groups, like females, due to gender inequality and discrimination. In Bolzano province, SF is mainly run by women who also offer educational services, especially in petting farms, thus tackling the rural society based on a patriarchal system;
- provision of educational services on social farms located in remote areas has proven to be an effective strategy for transmitting traditional knowledge and practices, respect for the environment and social values from the rural community to the urban context.

3. Social farming: evidence from the italian experience

In Italy, SF has developed since the mid-1970s (Giarè *et al*., 2018) due to economic and social factors which have contributed to the recognition and strengthening of the disadvantaged people's constitutional rights, like addicts, people with mental disorders or disabilities, unemployed, and detainees (Di Iacovo & O'Connor, 2009). The first experiences were born without any institution support or regulation and by getting inspiration from the principles of self-help and solidarity. Finally, though, with some delay[1], SF was reformed in 2015 with law *141*, «Disposizioni in materia di agricoltura sociale». This law defines SF as the sum of all the activities performed by the farmers and agricultural entrepreneurs and by social cooperatives, as listed below:

a) social inclusion and work placement for people with disabilities and disadvantaged workers, disadvantaged and vulnerable people[2], and young working-age people in rehabilitation projects and social support protocols;
b) services and social activities for the local communities through the use of tangible and intangible agricultural resources aimed at promoting and developing skills and abilities, fostering social and working integration, and providing valuable services for daily life;
c) performances and services to support medical, psychological and rehab therapies aimed at improving health, social, emotional, and cognitive functions in the subjects involved, with the help of pets and livestock, crops and plants;
d) environmental and food education projects aimed at safeguarding biodiversity and transmitting knowledge of the territory through social and

1. See the Italian laws l. 118/1971, 180/1978, 381/119.
2. Disabled and disadvantaged workers are defined in reg. (UE) 651/2014 (Art. 2, n. 3); disadvantaged and vulnerable people are defined by l. 381/1991 (Art. 4).

didactic farms that host children of preschool age and people with social, emotional, and physical disabilities.

Moreover, interestingly law 141/2015 also states that in Italy, SF businesses encourage cooperating with other entities, such as public healthcare services, NGOs, volunteering organisations, social assistance associations, foundations, charitable institutions etc.

SF in Italy, whose quantitative relevance cannot be precisely measured due to the lack of systematic and periodic surveys, presents a wide variety of initiatives, subjects, products, and services offered and beneficiaries and goals are reported by the recent study by CREA (2018). The primary legal status of Italian SF companies is the social cooperative, with 46% of the subjects interviewed and their companies being type B[3] (19% refers instead to individual companies, while 24% to associations and organisations from the third sector). The role of social cooperatives is a feature of SF in Italy, as several authors underlined (Di Iacovo & O'Connor, 2009; Finuola & Pascale, 2018).

According to the categorisation introduced by law *141/2015*, the most popular activity achieved by Italian SF companies is the social and working integration of disadvantaged people. Regarding the beneficiaries, the survey observed that 54% of the Italian SF companies work with people with disabilities. However, relevant is also the share of SF companies serving the types of vulnerable people, like unemployed with socio-economic disadvantages (31%), minors (27%), students in *alternanza scuola lavoro* - work-school young apprenticeship programmes (30%) and ex-prisoners and inmates (27%). Data also reveals that all the types of people involved but the minors and students are hired as employees.

As far as production is concerned, 63% of the production is annual crops, particularly highly labour-intensive horticulture. Perennial crops represent 24% and animal husbandry 23%. Moreover, the survey showed that 6% do beekeeping also. Greenhouses and garden centres, on the contrary, are the less represented category, probably because of the investments required. In addition, as reported by the survey, SF companies carry out more than farming. Didactic farms or direct selling are the most popular ones, followed by garden maintenance, stables, products processing, *agrinido-agriasilo* (nursery/kindergarden on a farm) catering and food service, social tourism,

3. According to the Italian law 141/2015, there are two types of social cooperatives: Cooperative A deal with the management of social-health, training and lifelong learning services; Cooperative B instead deal with the management of activities aimed at the employment of disadvantaged people in the sectors: industry, commerce, services and agriculture.

and hospitality. It is significant to notice the association between SF and organic farming and 68% of Italian social farms adopted this practice.

The social farms surveyed by CREA (2018) are mainly classified as small to medium size companies due to their revenue: only 10% reached an annual income of over 1 million euros. The social cooperative type B is the most common among the largest social farms. To achieve their economic sustainability, it has been proved that in the last five years, the investments have been 55% either self-funded or private, including crowdfunding and donations, while only 20% were funded by public resources and 17% by banks or foundations. However, it is also said that one of the most relevant threats for SF remains the lack of financial resources. Moreover, 87,6% of the social farms surveyed sell to private individuals and more than 67% get 50% of their income from transactions with private individuals. Finally, creating networks and agreements is a fundamental feature of Italian SF companies. The most common agreement with external parties is the informal one (46,8%), followed by the formal one (22,8%).

4. The analysis of social farming in mountain areas: the Aosta Valley

4.1. *The socio-economic context and agriculture*

Aosta Valley is the tiniest Italian administrative region, with a 3.263 km^2 surface, bordering France and Switzerland (Figure 1). The area is small even in demographic terms. According to ISTAT[4], in 2021 there were 124.089 inhabitants, corresponding to only 0,21% of the national population. It is an entirely mountainous region with a predominantly rural character. It has the lowest population density rate in Italy (only 39 persons per km^2), presenting only a relatively large urban center, the capital city Aosta, which has about 27% of the total population living in the region. According to the most recent classifications carried out at the EU level (Dijkstra & Poelman, 2018), Aosta Valley is a remote region.

It is a region with a high level of economic development. According again to ISTAT, in 2020, GDP per capita was 36,295 euros, the third among the Italian regions, while the employment rate of 15-64 years old people was 66.5%, higher than the national employment rate. However, both indicators in the region are declining in the medium and long run, in particular the GDP per capita (since 2011, it has been decreased in real terms by almost 15%). Even the population has been in declining in the last five years, Aosta

4. demo.istat.it.

valley lost about 3k inhabitants. The most important economic sector is the services sector, which is the public sector, based on the relevant role of the Regional Government (Regione Autonoma Valle d'Aosta), and tourism (thanks to important winter tourist resorts, like Cervinia, Courmayeur, la Thuile, Pila). The number of employees in Aosta valley in 2018 nearly reached 55k people, with more than 77% employed in the tertiary sector, 19% in industry and construction, and 3,6% (corresponding to about 2k people) in agriculture and forestry. The number of employees in the primary sector is slightly lower than the national average but in line with other European countries.

In Aosta Valley, there are 2.320 farms, 0,20% of all the Italian farms (ISTAT, 2016). Importantly, though agriculture is a small economic sector, agriculture represents the only job opportunity contributing to the survival of a vital social fabric and producing public goods (e.g. landscape conservation). Women working in agriculture are only 26,8%, in line with the national trend. Foreign immigrant workers are an important share of regional employment in agriculture, as they are 41% of all Aosta Valley employees (ISTAT, 2018).

The morphology and climate of the mountain region with average altitude is over 2k m AMSL, with steep slopes, low amount of flatland and having a long cold winter, makes for sure Aosta Valley extremely attractive for winter and summer tourists (but also for tourists coming out of the peak seasons), and for residents as well (Baldazzi *et al.*, 2016; Musolino & Silvetti, 2020). However, clearly it is the main factor which limits agricultural productivity.

Aosta Valley agriculture also has a strong environmental added value, which derives from the care of the territory and the landscape. Traditional farming practices, such as the practice of montication or the cultivation of vines on characteristic terraces (terracing), contribute to the maintenance of environmental public goods, through the prevention of hydrogeological risks, the promotion of biodiversity and landscape conservation

Traditional farming includes permanent crops, forage vineyards and fruit farming. The rearing of cattle also has a very important role in Aosta valley farming. The Census data (Eurostat, 2010) highlights that pastures and fields cover 97,7% of the regional agricultural utilized area. In some of the most remote zones of the Aosta Valley (e.g., the least touristic and inhabited lateral valleys), bovine zootechnics constitutes a fundamental driver of the local economic system.

4.2. *Methodological approach*

4.2.1. The field research approach: case studies and direct interviews

Considering the lack of studies about SF in mountainous areas like the Aosta Valley, and the shortage of data and literature referring to SF in Italy, the best methodological approach to investigate and study SF in Aosta valley be the exploratory and qualitative through the conducting case studies of individual social farms. This research, therefore, has followed a case study approach, particularly trying to develop an exploratory and instrumental type of case study (Stake, 1995; Yin, 2009).

Figure 1 - Map of Aosta valley and location of the case studies of valdostan social farms

Source: www.freeworldmaps.net/europe/italy/aostavalley.html.

The case studies of social farms located in Aosta valley (Figure 1) were in total of three entities (see Table 2). They were identified using, sources like the report by CREA (2018) and the online database built by the same institution (CREA)[5]. At the same time, we have also used a snowball approach (Biernacki & Waldorf, 1981), in the case of a new research population, a "hard-to-reach population" (Goodman, 2011) such

5. https://rica.crea.gov.it/APP/agricoltura_sociale.

as this study. We have not been able to find other social farms in the Aosta valley considering the demographic and economic size of the Aosta valley, which means that all the valdostan social farms, at the time of our study have been included in this field investigation.

All these social farms in this study conduct activities for social inclusion and work placement of disadvantaged and vulnerable people, and they grow crops. They are different in terms of economic size, the number of employees, and other essential characteristics (see Table 1).

Table 1 - Profile of surveyed social farms in the Aosta valley

Company	Founded (year)	Revenues* (Euros)	Employees	Main agricultural products	Social services offered	Other services offered	Role of the interviewee
A	2019	25.000-30.000	4 seasonal employees with disabilities and 1 expert agronomist	Potatoes and berries	Work placement, social inclusion, training for people with disabilities	–	Founder of the cooperative
B	1988	2.000.000-2.500.000	35 permanent employees and 105 seasonal employees (part of them with disabilities)	Floriculture	Work placement, social inclusion, training for people with disabilities and disadvantaged people	Social activities; conservation of green spaces, 2 laundry services (subcontract)	Manager and administrative assistant in charge of the plant nursery
C	1999	< 8.000	9 permanent employees (farm workers and social educators); and 26 beneficiaries with disabilities	Horticulture, ancient grains, vineyard, beekeeping, poultry	Work placement, social inclusion, training for people with disabilities	Educational activities, projects for students with learning difficulties, lab and training	Agriculturalist

* Coming from market activities.

The three cases of valdostan social farms have been studied and data gathered through face-to-face semi-structured interviews with one company's representative (Cardano & Ortalda, 2016; Silvermann, 2003). The semi-structured interviews were based on an outline survey with open ended

questions, made of three sections: the first section contained questions about the social mission of the social farm (type of social services provided, categories of disadvantaged people benefiting from them, relationships with the local community, etc.); the second section included questions about the company (structure, organisation and processes, human resources, performance, strategies and business model, etc.); finally the third section focused on the specific characteristics of the social cooperative (partners, funding, the role of the public institutions, etc.). As said in ch.3, indeed social cooperative is the most typical legal form taken by social farms in Italy. At the beginning of the interviews, we also asked for basic information about the interviewee (role, age, education level, etc.) and the social farm (year founded, location, number of units, etc.). In total, the survey contained almost forty questions.

Interviews lasted from one and a half to two hours. Interviewees were later contacted by email or phone to ask if they were fine with the release of the interview data. Then, the date was arranged, and interviews were conducted at the social farm. So, the interviewer could visit the social farm, see and experience the activities there, and take some pictures. Therefore, on top of the transcripts of the direct semi-structured interviews, additional elements, like pictures, have enriched and completed the information and data on the three social farms (Corbetta, 2015). Interviews were conducted from January to March 2021. The interviews have been recorded upon informed consent of the interviewee and later transcribed.

4.3. *Cases of social farming in the Aosta Valley: a description based on a field investigation*

4.3.1. Company A

Company A is a social cooperative of the type B situated in a small village in the Aosta Valley at 1.176 m AMSL. Due to the location in the central valley, the company site benefits from a pleasant climate all year. The company has an innovative approach to business combining it with social goals, environmental sustainability, and producing high-quality products.

This social farm was created in 2019 complementary to the activities carried out by a previous association founded in 2015 to create job opportunities for people with disabilities.

Its mission is clear:

> *"The mission is not to make a profit, but to create job opportunities and develop working independence for people with disabilities who may emancipate through it…".*

"The main goal, the only one, is working inclusion. Workers come from different associations and have different disabilities. Our mission is to integrate everybody, even the weakest".

The social cooperative cultivates potatoes and berries such as raspberries and blueberries. Their farm use different areas of the region, reaching 1.190 m AMSL. Along with farming, they carry out other activities like promoting and selling their products at social events, and making handicrafts, like building wooden cases for potatoes or wrapping cakes produced by local bakeries.

Figure 2 - Workers in Company A

The farming techniques used are natural and respectful of the health of the environment and the people. The social cooperative avoids any chemical pesticides and synthetic fertilisers and uses crop rotation:

> *"We decided to grow crops respecting strict standards, with no chemicals, because our children are growing crops with us […] and in high mountain fields, potatoes get no parasites".*

The social farm employs 4 seasonal workers with disability, who have a regular contract, and an expert agronomist as a tutor. Several volunteers also work for the farm for free, helping and supporting the workers with disability. The employees with disability do the harvesting of potatoes and berries and create wooden handicrafts. They even take part in social events to promote and sell their products. The workers work for 4 hours per day. The company pursues its social mission by trying to satisfy the real needs of all the beneficiaries involved:

> *"Our cooperative helps young people get adults through a job and economic emancipation".*

> *"If you do not know the need, it is hard to satisfy it, you can try hard, but you will end up investing your resources in the wrong way […] our motto is nothing for us without us".*

The social component plays a central role in the choices of the cooperative, including the crops chosen:

> *"We grow simple crops to simplify the work for our employees: they can harvest strawberries and potatoes without difficult tasks, feeling skilled and confident".*

Their mission and approach aim at economic independence and self-sufficiency. The business strategy implies quality products in the medium-high price category:

> *"Poor quality products are bought once, while our goal is to offer a good product at the right price, and customers trust us buying our products for their quality, and because they have been grown and harvested by workers with disabilities".*

The social farm's primary income comes from selling potatoes and berries, with only a tiny part of the production stored for self-consumption. The

average annual income is quite low, between 25 thousand and 30 thousand euro. They do not make profits, and occasionally they also benefit from donations from individuals.

Collaborations with other subjects in the region are crucial. In particular, company A cooperates with a well-known Aosta Valley cooperative with several shops selling local products. Thanks to this collaboration, Company A benefits from the partner's visibility and popular stores for its products. The company has also established informal relations with other more experienced cooperatives to seek advice and exchange information. For instance, the social farm also cooperates with Company B:

> *"One year, we had to prepare a plot of land by removing shrubs that looked like trees; it was not a job we could do. We asked Company B for help, and they did it for us".*

The social farm approaches food production and social services innovatively. Their products are characterised by high ethical and social content recognised by consumers. Growing exclusively organic products, with full respect for the environment and people's health, combined with the work of people at risk of social exclusion, gives excellent added value to the company's products.

However, since the company is strongly dependent on agriculture for its survival and has limited resources to deal with natural risks, and with other types of risks, any unforeseen reduction in agricultural production can have a significant impact of the farm's performance. For example, in 2021, the social cooperative suffered from a theft of its strawberries production, resulting in a economic loss of 7 thousand euros.

4.3.2. Company B

Company B was created in 1998 but started its activity in 1990. It is a social cooperative type B, located in a village with almost 5 thousand inhabitants, with excellent exposure for cultivation.

They started with 1,2 hectares of vineyard and also created a plant nursery (Figure 3) where they cultivate aromatic herbs, plants and flowers, plants for viticulture, fruit, and garden transplants. They also produce and sell soil, fertilisers, and pots. Unfortunately, the vineyard was not economically sustainable, so they sold the vineyards to a local producer in 2000. On the contrary, the floriculture and nursery grew and became the core business with two points of sale open, one in Aosta, the main town in the region, and the other in the plant nursery. In total, the company has an administrative office, two shops, plant nurseries and a warehouse for storage.

Quality product is fundamental in the business model of company B:

"What we want to make it clear is that the product you buy from us, flowers, for example, is not that we do it worse, that the flowers are not beautiful, or our product is uglier than the others, none of this… We care about the final product, which is produced on time, and which respects the wishes expressed by the customer… So, I would say that the quality of the products is our strength…".

The customers of the floricultural business are mainly residents, locals, and hospitality entrepreneurs from the different mountain villages, who appreciate these products. They recognise and reward the social value incorporated in their products, which fit their needs well:

"Our relationship with the residents is generous and supportive; the population comes to us to buy flowers because there is a social added value. People buy flowers, and they know the added value that these flowers have been produced by workers who make a certain path in our cooperative…".

"For the floriculture activity, the territory of the Aosta Valley is, in my opinion, very suitable, because it is a tourist region… so there are hotels and restaurants that buy flowers and buy a lot from us".

The social mission includes work placement, training, and social inclusion of the disadvantaged people. Its employment-oriented initiatives are directed at people with gambling disorder or ludopathy, recovering from drug and alcohol abuse (Aosta valley is the Italian region with the highest share of alcohol consumers[6]), ex-offenders in rehabilitation, people with disabilities and socio-economic disadvantage people certified by the local institutions.

The mission of company B, better defined by the manager as its *"dream"*, is:

"To spread the culture of social inclusion and work placement for disadvantaged people, not only in social farms. Our goal is that those people will find their future even in other types of companies […]".

The company accomplishes its goal of work placement and social inclusion of vulnerable people through internships and hiring with a fixed-term

6. See Osservatorio Nazionale sulla salute nelle regioni italiane (2019).

employment contract. The company carries out different projects, responding to the diverse needs of the vulnerable workers. The duration of these contracts can vary, they may be renewed, and in some cases, they may even be transformed into permanent contracts. Hence, the social farm is meant to be a training centre for the disadvantaged people.

The company cooperates with public institutions such as departments of the Regional Government (e.g., Dipartimento delle politiche del Lavoro e formazione della Regione Autonoma), centres specialised in support and assistance to the disadvantaged and disabled people (e.g., Centro per il Diritto al Lavoro dei Disabili e degli Svantaggiati), the regional healthcare service for addiction and dependence (Servizio per le dipendenze azienda USL), and with other private associations working in the non-profit sector.

Figure 3 - Plant nursery in Company B

Although specialized in floriculture, the company has been able to diversify its activities in the last two decades. It offers additional services like:

- management of community services promoted by local public bodies (e.g. Comunità montane della Valle d'Aosta) to support work placement for people at risk of social and working exclusion (since 2005). Community services include public urban and rural ambience maintenance and

care, decoration of the cultural, environmental, and artistic heritage[7]. In particular, local public bodies entrust the management of these services using direct assignment or tendering. This represents the primary source of income for the company, allowing it to carry out further investments in future social projects;

- environmentally friendly maintenance of the public green areas like parks and gardens, and of public building decorations, paths and streets, cemeteries, roundabouts; bush and tree pruning, felling logging, and steam weeding (since 2006);
- laundry service for the regional jail and for a local nursing home (since 2013).

Other projects are carried out by cooperating with private partners, such as an important iron and steel factory, a graphic design and publishing company, and a brewery in Aosta.

There are 35 people employed in company B, and during the peak season, there can be around 140 employees, including social workers.

The activities not linked to farming represent an important opportunity to integrate disadvantaged people and help the company grow significantly. Diversification is fundamental to achieve economic sustainability. Thanks to the additional and diversified activities, the cooperative can be self-sufficient in generating relevant revenues and profits (Total annual revenue in 2020 was around 2.400.000 euros, upward trending in the last three years, and profit was 110.000 euros). In addition, this has allowed the company to be more flexible than a typical agricultural firm, enabling it to work even in the winter. Similarly, some workers in cooperatives benefit from annual contracts and not just seasonal ones.

Company B is well-known in the region. The company created its brand and identity that the workers themselves sponsor, as the company manager explains:

> *"Every morning, the company's employees carry out environmental maintenance in our territory wearing our uniform. In this way, citizens see the employees of the cooperative taking care of the territory, for example by cleaning up green spaces. The local community thus recognizes and appreciates us…".*

Therefore, the local community associates the company with care of the territory and social and work inclusion. It is a great added value in places with a strong natural and environmental characterization.

7. Workers are supported by the healthcare system and registered as social workers by the local job centers. Municipalities and public associations may ask for these disadvantaged workers through a direct agreement or a bidding process.

The cooperative represents an innovative business management model based on a system of integrated skills. Diversifying activities allows the social farm to deal with the many risky situations the agricultural sector faces. The distinctive feature of the cooperative is the presence of solid entrepreneurship alongside the provision of social services. In addition, the company represents an innovative business model as it collaborates effectively with different organisations in the area, both public or private. These collaborations stimulate the company to grow economically and in terms of skills training. Finally, the cooperative's entrepreneurship enables social and employment opportunities for many people.

4.3.3. Company C

Company C is situated in one of the widest municipalities of the region, on a hill at 700 m AMSL. It is a farm for people with disabilities and differs from the two companies analyzed above for its peculiar features.

The social farm is managed by a Foundation owned by the Regional Government. The company promotes activities and services linked to farming, and supports people with physical, intellectual, sensory, and psychiatric disabilities. It started its activity in 2001.

The company has a large building with a kitchen and leisure rooms, owned by the Regional Government. Next to it, there is the store where products are sold. Around the building, there are 3 hectares of cultivated land, mainly dedicated to horticulture.

Horticulture is the leading business; however, the social farm is also involved in other farming activities such as beekeeping, cultivation of medicinal plants and herbs, ancient varieties of grains, maize, and other crops (7000 m^2 are dedicated to grow potatoes, rye, and corn).

The company also run a small vineyard and a henhouse. They adopted organic farming with the aim of respecting the health of their workers, customers, and nature. The products have been certified organic since 2016. Every year the social farm is inspected to guarantee its quality and meeting the organic protocol. They also introduced biodynamic methods, such as crop rotation and conservation practices.

The employees work on the farm, in the kitchen and take care of the cleaning and housekeeping of the premises. The company provides daily meals to the workers, prepared with self-made products. It also prepares and delivers daily meals to two assistance centres in the Aosta Valley. Moreover, the company makes cosmetic products.

The company hosts over 18 people with mental, intellectual, and sensory disabilities with limited working abilities. Its goals are:

- promoting and supporting work placement;
- working, educating and training activities for people with disabilities;
- providing temporary housing of patients in psychiatric therapy;
- training disadvantaged workers in cooperation with public institutions (such as school and local government);
- hosting internships for students and employees of the healthcare service dealing with people with disabilities;
- promoting partnerships in social projects and initiatives.

The farm opens from Monday to Friday from 9.00 am to 5.00 pm. Employees with disabilities work on the farm, in the kitchen, and they also take care of the cleaning, generally rotating. They carry out different farming activities and tasks: sawing, planting, seeding to harvesting, poultry farming, feeding, and collecting eggs. The social farm does not pay the workers, but they receive their wages from the government.

There are nine permanent employees, including three farmers and a qualified expert in agriculture who supervise and tutor the workers with disabilities; a cook with some assistants among the employees with disabilities; two instructors taking care of the educational activities and the relationship with families and healthcare staff. The number of beneficiaries of the services of Company C is 26.

Its products can be found and bought at the point of sale next to the headquarter:

> *"We decided not to distribute our products to retailers because we want our customers to come and see what we are doing to understand our mission and the history of our company and products; we love people to come and visit our farm".*

The farm also dedicates some initiatives to school children in cooperation with local schools: it involves them in a wide range of educational activities such as the petting zoo.

Company C is funded by the Regional Government, which covers the bulk of the costs through a fund budgeted yearly by the Regional Council (Giunta Regionale). For the period 2021-23, it assigned an annual grant of 400.000 euros, same as what they have received in the previous years[8]. The Regional Government may also give additional grants when specific conditions occur.

The sale of products contributes only partially to the cost coverage (see Table 1). Indeed, the grant from the regional government is essential to cover company costs. However, it is necessary to consider that about 50% of the production is destined for self-consumption.

8. Approval by Giunta regionale n. 244, 9 March 2021.

Figure 4 - Main building of Company C

This social farm cooperates mainly with public institutions: the Regional Government, in particular with one of its Departments (Assessorato alla sanità, all'agricoltura e alle politiche sociali); and the *Institut Agricole Régional*, the local agrarian high school. Further partnerships involve other local cooperatives, social farms, and associations in the Aosta Valley.

Company C responds innovatively to the need to find new non-medicinal approaches to social services. Indeed, social service users actively participate in agricultural tasks in a familiar and pleasant context.

4.4. *Similarities and differences among the cases: a comparative perspective*

Our case studies have been analysed cross-comparatively with the aim, on the one hand, to find out and highlight the common features of SF in a mountain region like the Aosta Valley; on the other hand, to observe and understand the differences in their activities.

We have compared their social mission and their economic sustainability, particularly, their business models.

4.4.1. The social mission

The three case studies analysed, albeit starting from different approaches, are all pursuing the same goals and social mission: to integrate and include disadvantaged and vulnerable workers and improve their social status.

Company A's beneficiaries are people with disabilities hired with a contract: the goal is to promote the economic independence of workers with disabilities. Company B, instead, organizes activities for disadvantaged people with gambling disorders, drug and alcohol addicts, ex-offenders in rehabilitation and people with disabilities and socio-economic disadvantages certified by the local institutions. People with disabilities can be hired on a regular contract or can have their internship and training. The goal is to offer better employment opportunities and to enhance the worker's potential and personal capabilities and skills to facilitate their future working life. Company C's beneficiaries are people with disabilities who can't be hired because they are supported by a different social programme managed by other public bodies. They can be hosted and receive boarding for a short or long time in a protected and tutored environment where they live and work with experts taking care of their health, education, and training.

Diversity in the approach to the social mission is a unique added value for the whole valdostan community and territory, which may have access to and benefit from the heterogeneous and complementary social and healthcare services otherwise not available in such a remote and sparsely populated region. This heterogeneity shows the flexibility and innovative drive of SF i.e. the ability to adapt and meet the new and changing needs of society in a rural mountain context.

The three companies analysed have also some common features, which is the model of social inclusion of vulnerable people and the benefits for social life in rural areas:

- the beneficiaries of social services are actively involved. Active participation and integration is an element that can be defined as vital for SF, as underlined by Di Iacovo & O'Connor (2009);
- they follow a generative model of social inclusion, therefore acting as an alternative to the traditional models of social and healthcare assistance and public welfare (Giarè *et al.*, 2018);
- they contribute to creating and enhancing social relationships and networks, formal and informal, which are usually weak in remote mountainous areas.

The social mission of these three companies, with their differences and common features, is recognised as an added value for their products and services, which add reputation and visibility. Therefore, residents, tourists and the whole community "reward" the social farms by buying their products and services:

"People buy flowers and know that they have been grown by vulnerable workers protected and assisted by the cooperative".

"Since we started working in the fields, people passing by and the locals stared at us with curiosity and then immediately rolled up their sleeves and helped us, even people we didn't know. This is an amazing experience. After curiosity comes commitment, and people love us".

Finally, the achievements of the three companies interviewed are gratifying from the community support, thus, stimulating the social farms to grow, evolve and innovate:

"Our strength is represented by the guys with disabilities working with us who can surprise us day after day […], reaching goals we could not even imagine".

4.4.2. Economic sustainability and business models

The comparison among the three cases of SF revealed heterogeneous business models. An outstanding characteristic performed by company B is its economic performance, i.e., its annual revenue and profit. According to the report on SF in Italy (CREA, 2018), only 10% of the social farms have an income of over a million euros. The entrepreneurial skills of this company are evident from the ability to diversify the initiatives and activities carried out, allowing the firm to reduce the risks considerably, as opposed to the experience by company A:

"We lost all our strawberries because of two violent storms, a hailstorm I had never seen before. We lost all our crops in the most crucial time of the harvest".

Company A in 2020 recorded only 30.000 euros in revenue, much lower than company B's. Company A's business model is the typical small family-run business and the cooperative's founders are parents of young people with disabilities.

"Our strength is the enthusiasm which has risen from the direct involvement in the business because it is about our children and their future, and it gives us the energy to face and overcome any trouble anyway".

In this context, the founders have a significant interest in the company's success, constantly tackling the problems with entrepreneurial skills. However, the strictly sectoral and non-diversified activity offers limited resources to deal with agricultural and related types of risks.

An interesting common feature shared by companies A and B is the total lack of support from public funds. However, it does not prevent them from achieving economic sustainability. The excellent entrepreneurial skills of B and the strong emotional motivation of A have allowed both companies to overcome the challenges and constraints of SF in the mountains (Gramm *et al.*, 2019). Company B is a clear example of a modern enterprise that combines social welfare organisations and for-profit companies, responding to the crisis of traditional welfare systems.

The business model of company C stands out for its different approach, being deeply connected with public institutions on this social farm. Here public financial support is necessary to cover the operating costs. But it is more than financial aid. Company C is a well-defined organisation with the management, monitoring and evaluation of the company made possible by public ownership through establishing specific corporate bodies (for example, the appointment of three experts in environmental and scientific matters). Not all agricultural firms, in fact, have an expert in environmental disciplines, social policies or labour policies. The public partner's economic and management support creates a model that is not easily replicable.

It is not easy to identify the best management and business model; however, the different models analysed enrich and represent an added value for the community, with social farms being collaborative and supportive even among themselves.

A key element for economic sustainability that emerged from the interviews and case analysis is the relevance of collaborations. As observed in the case of company A, partnerships with other cooperatives are crucial for placing products on the market and to deal with difficulties in managing the social farm. Relations with local public bodies also represent a significant opportunity, as demonstrated by the case of company B.

An interesting final reflection may derive from the traditional differentiation between social welfare institutions and profit organisations. Company B is a clear example of a successful modern combination of the two, solving the old issue of the crisis of the social healthcare system. Company A represents a valuable and meaningful example of SF as a new welfare model. Finally, the experience of company C, notwithstanding the public support, represents an alternative to the traditional medical approach to caring for people with disabilities followed by the public social healthcare system (which is carried out in nursing homes).

Lastly, a common factor of the business model of these social farms is the naturalness of their products, which is something associated with their location in a high mountain region like Aosta valley, recognized and appreciated by the consumers. In particular, Company C has adopted a biodynamic cultivation system and, since 2016, has been certified as an organic producer. Company A provides for the total absence of chemical treatments and offers consumers the opportunity to visit the farm one day a week to show how they cultivate. Using natural cultivation methods represents an important competitive factor, as it benefits the organoleptic quality and safety of the products.

5. Conclusions

In conclusion, the findings of this investigation answer to the research questions of this study. Even in a remote high mountain region like the Aosta Valley, SF may be implemented suiting its geographical, social and economic characteristics, and taking advantage of unique features which are different from other rural and peri-urban contexts (i.e., unpolluted and pure natural environment, landscape, characteristics and quality of agricultural products, territorial identity). Moreover, it produces benefits for the community and region.

The three social farms analyzed share the achievement of the social goals as the fundamental and primary principle of their existence. Their social function is appreciated as an added value by the customers which enables SF practices to be economically sustainable (at least in the two cases which do not benefit from the support of the government), but also by the entire local community. The whole community benefits from the wide and diverse range of services that they supply, which in a remote region like this are not easily accessible. The appreciation of the local community is also demonstrated by the numerous collaborations and the partnerships of the three companies investigated with local actors. Not by chance, indeed, they cooperate (and not compete) not only among themselves, but also with companies of other sectors, and with other public institutions, associations or private entities in the Aosta Valley.

The varied models of SF in terms of products and services, governance, partnerships, etc. investigated here demonstrates again how widely is the range of actions and practices of SF can be, therefore to what extent that SF is flexible and able to adapt to different needs even in the most marginal contexts. This flexibility shows also that mountain areas can be a suitable place for SF.

From the cases analysed, the mountain territory in fact does not represent a limitation but rather a place rich of unique assets which can

be advantageously exploited for the social mission and the and economic sustainability of these social farms. If when traditional agriculture in the mountain territory poses a constraint, such as not to achieve scale economies and affects negatively yields and productivity, having SF, which represents quality and naturalness, unique location in the alpine areas, it represents an advantage.

In exploring the literature on the history of Aosta valley, we can point out that high mountain regions might even have a vocation for practices like SF. The Aosta Valley, indeed, has developed several forms of collective ownership and social solidarity over time (Brix *et al.*, 2013; Louvin, 2012). This is why SF may be a rediscovery of what already happened in the past, i.e. what was probably normal in mountain regions in ancient times.

SF, providing an innovative, modern, and stimulating response to the needs of local community, has the potential to affect the future development of this region and, generally speaking, of high mountain regions. SF manages to restore meaning to agricultural work, enabling the work placement and social inclusion of disadvantaged people. It represents an important opportunity for innovating mountain farming, typically more backward than that of the lowland areas. At the end, it might contribute to reversing the processes of depopulation of rural areas that seem to be inevitable in several European countries (ESPON 2018; Pociute-Sereikiene *et al.*, 2014). This is why policymakers at the national, supranational and local level should give SF sector a central role in the future strategies and policies for rural and mountain development (Chmielinski *et al.*, 2018).

Policies for developing social farming in mountain areas should be given priority to support recruitment and training of qualified technical and managerial staff. As we have seen from our investigation, some of these social farms have poor entrepreneurial and managerial skills. Second, it is no less important to support them when they make new investments to increase their technological level and to improve their processes. Third, they should be supported to improve the distribution and sales stages, which are crucial in order to expand their market area. Currently, it is still very limited at the local scale.

Clearly, this research has several limitations; it is solely based on a qualitative methodological approach, and it is an investigation on some case studies limited to a very small Alpine region. Future research may widen the geographical scope of the investigation, for example, to the entire Alpine arc, focusing on a much higher number of cases. Therefore, researchers in the future might even realize quantitative analyses on social farming in mountain regions. Moreover, future research could better focus on the analysis of the economic performance of social farms in mountain regions, for example using balance sheet data.

References

Baldazzi, B., Morricone, M., Talucci, V., & Ungaro, P. (2016). L'impatto turistico nelle regioni italiane: un indicatore composito di attrattività e sostenibilità turistica. In: F. Mazzola, R. Nisticò (Eds.), *Le Regioni Europee. Politiche per la coesione e strategie per la competitività*. Milan: FrancoAngeli.

Barnaud, C., & Couix, N. (2020). The multifunctionality of mountain farming: Social constructions and local negotiations behind an apparent consensus. *Journal of Rural Studies*, *73*, 34-45. doi: 10.1016/j.jrurstud.2019.11.012.

Bassi, I., Nassivera, F., & Piani, L. (2016). Social Farming: a proposal to explore the effects of structural and relational variables on social farm results. *Agricultural and Food Economics*, *4*, 13. doi: 10.1186/s40100-016-0057-6.

Biernacki, P., & Waldorf, D. (1981). Snowball Sampling: Problems and Techniques of Chain Referral Sampling. *Sociological Methods & Research*, *10*(2), 141-163. doi: 10.1177/004912418101000205.

Borgi, M., Collacchi, B., Correale, C., Marcolin, M., Tomasin, P., Grizzo, A., Orlich, R., & Cirulli, F. (2020). *Annuario Istituto Superiore Sanità*, *56*(2), 206-214.

Borsotto, P., Gaito, M., Papaleo, A., De Vivo, C., Ascani, M., Ricciardi, G., & Guccione, G.D. (2019). An exploratory study on the construction of networks in social farming. *Economia agro-alimentare / Food Economy*, *21*(2), 481-506. doi: 10.3280/ECAG2019-002015.

Brix, T., Gal, M., Impérial, A., Perruchon, J.P., Roullet, S., & Vassallo, M. (2013). *Solidaritè et Subsidiaritè en Vallèe d'Aoste. Une symbiose seculaire*. Edizioni Fondazione Comunitaria della Valle d'Aosta.

Carbone, A., Gaito, M., & Senni, S. (2009). Consumer Attitudes toward Ethical Food: Evidence from social farming in Italy. *Journal of Food Products Marketing*, *15*(3), 337-350. doi: 10.1080/10454440902925831.

Cardano, M., & Ortalda, F. (2016). *Metodologia della ricerca psicologica. Metodi quantitativi, qualitativi e misti*. Torino: UTET Università.

Chmielinski, P., Faccilongo, N., Fiore, M., & La Sala, P. (2018). Design and implementation of the Local Development Strategy: a case study of Polish and Italian Local Action Groups in 2007-2013. *Studies in Agricultural Economics*, *120*(1)*,* 25-31. doi: 10.7896/j.1726.

Corbetta, P. (2015). *La Ricerca Sociale: Metodologia e Tecniche. Le Tecniche Qualitative*. Bologna, Italy: il Mulino.

CREA - Centro Politiche e Bioeconomia (2018). *Rapporto Sull'agricoltura Sociale in Italia*. Ministero Delle Politiche Agricole Alimentari e Forestali, Rete Rurale Nazionale, Rome, Italy. -- Retrieved from: www.reterurale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/18108 (accessed on 21 July 2022).

Dalla Torre, C., Ravazzoli, E., Dijkshoorn-Dekker, M., Polman, N., Melnykovych, M., Pisani, E., Gori, F., Da Re, R., Vicentini, K., & Secco, L. (2020). The role of agency in the emergence and development of social innovations in rural areas. Analysis of two cases of social farming in Italy and the Netherlands. *Sustainability*, *12*(11), 4440. doi: 10.3390/su12114440.

Dell'Olio, M., Hassink, J., & Vaandrager, L. (2017). The development of social farming in Italy: A qualitative inquiry across four regions. *Journal of Rural Studies*, *56*, 65-75. doi: 10.1016/j.jrurstud.2017.09.006.

Dessein, J. (2008). *Proceedings of the Community of Practice Farming for Health, 6-9th November.* Farming for Health. ILVO, Merelbeke, Belgium.

Dessein, J., Bock, B.B., & de Krom, M.P. (2013). Investigating the limits of multifunctional agriculture as the dominant frame for Green Care in agriculture in Flanders and The Netherlands. *J. Rural Stud*., *32*, 50 e 59.

Di Iacovo, F., & O'Connor, D. (2009). *Supporting Policies for Social Farming in Europe: Progressing Multifunctionality in Responsive Rural Areas*. Firenze, Italy: ARSIA, Agenzia Regionale per lo Sviluppo e l'Innovazione nel settore Agricolo-forestale.

Di Iacovo, F. (2020). Social Farming Evolutionary Web: from Public Intervention to Value Co-Production. *Sustainability*, *12*(13), 5269. doi: 10.3390/su12135269.

Di Iacovo, F., Moruzzo, R., & Rossignoli, C.M. (2017). Collaboration, knowledge and innovation toward a welfare society: The case of the Board of Social Farming in Valdera (Tuscany), Italy. *The Journal of Agricultural Education and Extension*, *23*(4), 289-311.

Di Iacovo, F., Moruzzo, R., Rossignoli, C., & Scarpellini, P. (2014). Transition management and social innovation in rural areas: Lessons from social farming. *The Journal of Agricultural Education and Extension*, *20*(3), 327-347. doi: 10.1080/1389224X.2014.887761.

Dijkstra, L., & Poelman, H. (2018). *Regional typologies overview. Statistics Explained*. Eurostat.

Elings, M., & Hassink, J. (2008). *Green Care Farms, A Safe Community Between Illness or Addiction and the Wider Society.*

ESPON 2020 (2018). *Transnational Observation. Fighting rural depopulation in Southern Europe*. -- Retrieved from: www.espon.eu/sites/default/files/attachments/af-espon_spain_02052018-en.pdf (accessed on 21 July 2022).

FAO (2015). *Technical Workshop: The Implications of social farming for Rural Poverty Reduction, 15 December 2014. Final Report*. -- Retrieved from: www.fao.org/3/a-i5148e.pdf (accessed on 02 June 2021).

Finuola, R., & Pascale, A. (2018). *L'agricoltura sociale nelle politiche pubbliche*. Ministero Delle Politiche Agricole Alimentari e Forestali, Rete Rurale Nazionale, Rome, Italy.

Galardi, M., Filugelli, L., Moruzzo, R., Riccioli, F., Mutinelli, F., Espinosa Diaz, S., & Contalbrigo, L. (2022). Challenges and Perspectives of Social Farming in North-Eastern Italy: The Farmers' View. *Sustainability*, *14*(14), 8390.

Genova, A., Maccaroni, M., & Viganò, E. (2020). Social Farming: Heterogeneity in Social and Agricultural Relationships. *Sustainability*, *12*(12), 4824. doi: 10.3390/su12124824.

Giarè, F. (2012). *Coltivare salute: agricoltura sociale e nuove ipotesi di welfare*. Rome, Italy: Inea.

Giarè, F., & Macrì, M. (Eds.) (2012). *La valutazione delle azioni innovative di agricoltura sociale*. INEA. -- Retrieved from: http://dspace.crea.gov.it/bitstream/inea/513/1/SE5-2013-23.pdf (accessed on 21 July 2022).

Giarè, F., Borsotto, P., & Signoriello, I. (2018). Social farming in Italy. Analysis of an «inclusive model». *Italian Review of Agricultural Economics*, *73*(3), 89-105. doi: 10.13128/REA-25107.

Goodman, L.A. (2011). Comment: On Respondent-Driven Sampling and Snowball Sampling in Hard-to-Reach Populations and Snowball Sampling Not in Hard-to-Reach Populations. *Sociological Methodology*, *41*, 347-353. -- www.jstor.org/stable/41336926.

Gramm, V., Torre, C.D., & Membretti, A. (2020). Farms in Progress-Providing Childcare Services as a Means of Empowering Women Farmers in South Tyrol, Italy. *Sustainability*, *12*(2), 467. doi: 10.3390/su12020467.

Gramm, V., Hoffman, C., & Cattivelli, V. (2019). Transmitting and Transforming (Agri)-Cultural Values of Mountain Farming: Farm-Based Educational Services in South Tyrol. *Mountain Research and Development*, *39*(4), 21-28. doi: 10.1659/MRD-JOURNAL-D-19-00009.1.

Gretter, A., Dalla Torre, C., Maino, F., & Omizzolo, A. (2019). New Farming as an Example of Social Innovation Responding to Challenges of Inner Mountain Areas of Italian Alps. *Journal of Alpine Research - Revue de géographie alpine*, 107-2. doi: 10.4000/rga.6106.

Guirado, C., Valldeperas, N., Tulla, A. F., Sendra, L., Badia, A., Evard, C., … & Vera, A. (2017). Social farming in Catalonia: Rural local development, employment opportunities and empowerment for people at risk of social exclusion. *Journal of Rural Studies*, *56*, 180-197.

Hassink, J., & Van Dijk, M. (2006). *Farming for Health: Green-Care Farming Across Europe and the United States of America*. Berlin, Germany: Springer Science & Business Media.

Hassink, J. (2009). Social Farming across Europe: Overview. In: F. Di Iacovo & D. O'Connor (Eds.), *Supporting Policies for Social Farming in Europe: Progressing Multi-Functionality in Responsive Rural Areas* (pp. 21-42). Firenze, Italy: Arsia.

Hassink, J., Hulsink, W., & Grin, J. (2016). Entrepreneurship in agriculture and healthcare: different entry strategies of care farmers. *Journal of Rural Studies*, *43*, 27 e 39.

Hassink, J., Agricola, H., Veen, E.J., Pijpker, R., de Bruin, S.R., Meulen, HABvd., Plug, L.B. (2020). The Care Farming Sector in The Netherlands: A Reflection on Its Developments and Promising Innovations. *Sustainability*, *12*(9), 3811. doi: 10.3390/su12093811.

Hemingway, A., Ellis-Hill, C., & Norton, E. (2016). *What does care farming provide for clients?* The views of care farm staff, NJAS - Wageningen Journal of Life Sciences, vol. 79, pp. 23-29. doi: 10.1016/j.njas.2016.09.001.

Hine, R. (2008). Care farming: bringing together agriculture and health. *ECOS*, *29*, 42-51.

Hine, R., Peacock, J., & Pretty, J. (2008). Care farming in the UK: contexts, benefits and links with therapeutic communities. *International Journal of Therapeutic Communities*, *29*(3), 245-260.

Hudcová, E., Chovanec, T., & Moudry, J. (2018). Social Entrepreneurship in Agriculture, a Sustainable Practice for Social and Economic Cohesion in Rural Areas: The Case of the Czech Republic. *European Countryside*, *10*(3), 377-397. doi: 10.2478/euco-2018-0022.

Katonane, K.J., Varga, E., & Nemes, G. (2016). Understanding the process of social innovation in rural regions: some Hungarian case studies. *Studies in Agricultural Economics*, *118*(1), 1-8. doi: 10.22004/ag.econ.234967.

Knapik, W. (2018). The innovative model of Community-based social farming (CSF). *Journal of Rural Studies*, *60*, 93-104. doi: 10.1016/j.jrurstud.2018.03.008.

Lanfranchi, M., Giannetto, C., Abbate, T., & Dimitrova, V. (2015). Agriculture and the social farm: Expression of the multifunctional model of agriculture as a solution to the economic crisis in rural areas. *Bulgarian Journal of Agricultural Science*, *21*(4), 711-718.

Leck, C., Evans, N., & Upton, D. (2014). Agriculture – Who cares? An investigation of 'care farming' in the UK. *Journal of Rural Studies*, *34*, 313-325. doi: 10.1016/j.jrurstud.2014.01.012.

López-i-Gelats, F., Milán, M.J., & Bartolomé, J. (2011). Is farming enough in mountain areas? Farm diversification in the Pyrenees. *Land Use Policy*, *28*(4), 783-791. doi: 10.1016/j.landusepol.2011.01.005.

Louvin, R. (2012). *Un bene comune tra pubblico e privato.* Aosta: Le Château Edizioni.

Moriggi, A. (2019). Exploring enabling resources for place-based social entrepreneurship: A participatory study of Green Care practices in Finland. *Sustainability Science*, *15*, 437-453. doi: 10.1007/s11625-019-00738-0.

Musolino, D., Crea, V., & Marcianò, C. (2018). Being Excellent Entrepreneurs in Highly Marginal Areas: The Case of the Agri-Food Sector in the Province of Reggio Calabria. *European Countryside*, *10*(1), 38-57. doi: 10.2478/euco-2018-0003.

Musolino, D., Distaso, A., & Marcianò, C. (2020). The Role of Social Farming in the Socio-Economic Development of Highly Marginal Regions: An Investigation in Calabria. *Sustainability*, *12*(13), 5285. doi: 10.3390/su12135285.

Musolino, D., & Silvetti, A. (2020). Are Mountain Areas Attractive for Investments? The Case of the Alpine Provinces in Italy. *European Countryside*, *12*, 469-493. doi: 10.2478/euco-2020-0025.

Nazzaro, C., Uliano, A., & Marotta, G. (2021). Drivers and Barriers towards Social Farming: A Systematic Review. *Sustainability*, *13*(24), 14008. doi: 10.3390/su132414008.

O'Connor D., Lai M., & Watson, S. (2010). *Overview of Social Farming and Rural Development Policy in Selected EU Member States.* NRN Joint Thematic Initiative on Social Farming, European Communities -- http://enrd.ec.europa.eu/enrd-static/fms/pdf/A9746FA3-0D7E-1772-5CC7-11217C8EC059.pdf.

Osservatorio Nazionale sulla salute nelle regioni italiane (2019). *Rapporto Osservasalute 2019.* -- Retrieved from: https://osservatoriosullasalute.it/osservasalute/rapporto-osservasalute-2019 (accessed on 21 July 2022).

Pociute-Sereikiene, G., Kriauciunas, E., & Ubareviciene, R. (2014). Peripheralisation trends in rural territories: the case of Lithuania. *Studies in Agricultural Economics*, *116*(3), 122-130. doi: 10.7896/j.1421.

Rete Rurale Nazionale 2014-2020 (2019). *Bioreport 2017-2018. L'agricoltura Biologica in Italia*, Rome, Italy. -- Retrieved from: www.reterurale.it/Bioreport201718 (accessed on 21 July 2022).

Silverman, D. (2013). *Doing qualitative research: a practical handbook*. London: Sage Publications.

Stake, R.E. (1995). *The Art of Case Study Research*. Thousand Oaks, CA, USA: Sage.

Sempik, J., Hine, R., & Wilcox, D. (Eds.) (2010). *Green care: a conceptual framework*. COST 866, Green Care in Agriculture. Centre for Child and Family Research, Loughborough University, Loughborough.

Sempik J., Rickhuss C., & Beeston A. (2014). The effects of social and therapeutic horticulture on aspects of social behaviour. *British Journal of Occupational Therapy*, *77*(6), 313-319.

Tulla, A.F., Vera, A., Badia, A., Guirado, C., & Valldeperas, N. (2014). Rural and regional development policies in Europe: social farming in the common strategic framework (Horizon 2020). *J. Urban Regional Analysis*, VI(1), 35e52.

Tulla, A.F., Guirado, C., Badia, A., Vera, A., Valldeperas, N., & Evard, C. (2015). La agricultura social a Catalunya. Uma doble alternativa: desenvolupament local i ocupaciò de col lectius em risc d'exclusiò social. *Quad. Agrar.*, *38*, 23 e 49, Juny.

Yin, R.K. (2009). *Case Study Research: Design and Methods.* Los Angeles, CA, USA: Sage.

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Wheat or cassava flour? Marketing and willingness to pay for cassava flour confectionery in Nigeria

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Abstract

Food systems and diets are constantly evolving, and the contributing factors are complex and have remained controversial among researchers. While studies have considered and compared utilization of wheat flour and High Quality Cassava Flour (HQCF) in confectioneries, no study has assessed willingness to purchase confectioneries made from cassava flour in relation to the global supply disruption emanating from the Russia-Ukraine war, leading to high demand and pressure on wheat flour. This study examined consumers' perception of cassava flour confectioneries and estimated contributing factors. A cross-sectional survey and multi-stage random sampling technique were employed to select 120 respondents from Abia State, Nigeria, while the Researchers analyzed the data with descriptive and regression statistics. Findings show that taste, awareness, odour, and availability of confectioneries with cassava flour inclusion shaped consumers' perceptions. The majority of the samples from our study believe that the taste and odour (aroma) of the product must be tweaked to suit global best practices, as well as the need to make the product readily

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available at strategic location and at the right price to reflect the prevailing income and economic realities in Nigeria. Therefore, these factors can be improved and used to build a positioning and brand strategy.

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Introduction

One of the significant lessons from both the Covid-19 pandemic and the Russia-Ukraine war is that the global food system is broken (Arndt *et al*., 2020). This is hardly surprising given the relationship between adverse economic and social shocks on the one hand and conflicts related to food and nutrition insecurity on the other (D'Souza & Jolliffe, 2013), which further exacerbate food insecurity, child malnutrition, hunger, poverty, and other health-related crises (Headey *et al*., 2020). Ukraine and Russia are the major exporters of agricultural commodities worldwide, including wheat, a major food security crop (Acevedo *et al*., 2018), supplying more than 45% of the global wheat market (FAO, 2022). Unfortunately, the war has disrupted the supply of wheat and the global supply chain in a magnitude the world has not experienced since World War II and Covid-19 (Jagtap *et al*., 2022), with a spillover effect on the price of essential commodities and energy crisis in Europe and America (Mbah & Wasum, 2022). This has further increased food insecurity in many parts of developing economies such as Africa, including those with a severe humanitarian crisis like Ethiopia (Analytica, 2022; Ben-Hassen & Bilali, 2022), since they import more than 85% of their wheat for value-added production from Russia and Ukraine (Kammer *et al*., 2022), despite their capacity to produce wheat in large quantity.

Although Nigeria produces wheat and has fertile soil under irrigation in most parts of the northern geopolitical zones, its combined production capacity is low (Hesser, 2019) compared with countries with less agricultural land mass. According to Nigeria Bureau of Statistics (NBS) report, in 2021, despite annual wheat demand of between 4.5 million to 5 million metric tons, Nigeria produced only 36,943.8 metric tons (Okojie, 2022), hence it is dependent on importation of wheat to meet local demand of its confectionery and food market. The implication is a demand-supply gap with spillover effect on the price of Nigeria-produced wheat; hence unattractive to large agribusiness enterprises that depend on wheat for production (Hesser, 2019). Wheat importation in Nigeria rose from 78,000 metric tons in 1960 to 4,051,000 MT in 2010; to 4,800,000 MT in 2018 (Shittu & Sowunmi, 2019), with estimated import cost of over $ 2.15 billion in 2020 (Balana *et al*., 2022). This shows that as the population and demand for wheat by-

products increases, importation also increases, with its attendant effect on the consumer food price index, foreign exchange reserve and the drive for wheat self-sufficiency plans. Unfortunately, this import trend will continue unless there is a potential change in strategy and policy that ensures higher availability of improved seeds and the adoption of mitigation and adaptation strategies for climate change (Balana *et al.*, 2022; Tadesse *et al.*, 2018; Falola *et al.*, 2017).

Wheat production and consumption in Nigeria are not mutually exclusive. Two key factors are mentioned in this context. First, the high demand for confectioneries such as bread, cake, meat-pie, doughnut and others (Ohimain, 2014; Shittu & Sowunmi, 2019), has led to the proliferation of fast-food restaurants in major cities across Nigeria (Mustapha *et al.*, 2014). Second is the issue of low production capability of Nigeria because it is produced by resource-poor farmers who constitute more than 60% of all farm holdings in Nigeria (Oteh & Nwachukwu, 2014), lack of availability of improved seeds (Tadesse *et al.*, 2018) leading to inability of the local farmers to meet with rising demand. These impacts negatively on access, availability, and affordability of wheat by agribusiness enterprises, with spillover effect on the price of essential food products in Nigeria.

High Quality Cassava Flour – A viable food security alternative

For several years now, Nigeria government has consistently tweaked its policy to reduce wheat importation since the gap between local production and importation is wide. In order to reduce importation of wheat by 50%, the government launched the Presidential Cassava Master Plan in 2003, which targets the inclusion of 10% High Quality Cassava Flour (HQCF) in confectioneries (Ohimain, 2015), because pieces of evidence have shown that wheat flour can be successfully substituted with cassava flour in bread and other confectioneries (IITA, 2002; Giami *et al.*, 2004; Nangano *et al.*, 2005). This potential strategy was strategic to the 2011 cassava master plan under the Agricultural Transformation Agenda (ATA) to improve the cassava value chain and replace imported wheat flour in confectioneries with a USD 60 million cassava bread fund (Hesser, 2019).

Cassava is an essential staple and cash crop providing diets to billions of people globally (Zhu *et al.*, 2015). Nigeria is the world's highest cassava producer (Ikuemonisan *et al.*, 2020) because its agroecological terrain favours its cassava production (Akinwale *et al.*, 2010). In Africa and many developing countries, most people depend on and consume it to obtain their daily 40-50% calories (Oteh & Nwachukwu, 2014). As a food security crop (Wilson *et al.*, 2015), cassava is produced widely by poor resource food producers in many rural areas of Nigeria (Adepoju &

Oyewole, 2013), producing more than 60 million metric tons (FAOSTAT, 2019). Unfortunately, about 90% of the combined production is consumed locally (Ikuemonisan *et al.*, 2020), so Nigeria is not considered a major global player in the global cassava trade (Hesser, 2019).

In recent time, as food system and diets are evolving due to enhanced globalization and rapid urbanization, improved value addition in cassava products have made cassava now more popular. and demand has continued to rise, creating economic opportunities and incentives for economic agents in the cassava market system (Ezedinma *et al.*, 2007). This has led to a significant focus on cassava diversification to industrial-scale food and value addition such as soy-cassava flour (Ugwu & Ukpabi, 2002), 10% ethanol in gasoline (Olakunle, 2016), and replacing up to 20% of imported wheat flour with cassava flour (Hershey, 2017). Thus, helping to alleviate poverty and improve food security for consumers and producers in Nigeria (Adebayo & Siberberger, 2020). Therefore, introduction of cassava floor in confectioneries aimed to utilize cassava in bridging food security, rural development, and economic growth in Nigeria (FAO, 2018).

Cassava flour food system and challenges

Although challenges of cassava production and marketing have been extensively researched (See, Nwachukwu & Oteh, 2014; Ezedinma *et al.*, 2007; Akerele *et al.*, 2019; Agbaeze *et al.*, 2020; Elegbede *et al.*, 2018; Ehinmowo *et al.*, 2015), also, cassava flour in Nigeria (Otekunrin & Sawicka, 2019; Adefisayo *et al.*, 2022; Ohimain, 2014), there is a need for further insights as food systems evolve to incentivise local production of alternatives to wheat flour following the disruption in wheat supply in recent time (Ben Hassen & Bilali, 2022; Liadze *et al.*, 2022). Globally, the demand-supply gap on wheat has opened economic opportunities for Nigeria's cassava value chain, including enhancing value and access for HQCF, starch, ethanol and animal feed. Particularly on the producer side, HQCF faces demand/supply and acceptance issues (Lamboll *et al.*, 2018). It is not enough to produce a unique product and price it attractively (Kotler & Armstrong, 2015); central to demand is consumer capabilities in terms of availability of resources, knowledge and mindset to purchase (Oteh *et al.*, 2020). As such, willingness is at the bedrock of consumer demand (Ahmad-Hanis *et al.*, 2012). Given this, the study considers the willingness of Nigerians to accept, in absolute value terms, the inclusion of cassava flour in the production of confectioneries.

Generally, food system is complex (De Carvalho *et al.*, 2021), with several trade-offs (Mausch *et al.*, 2020) and often challenged by inconsistent policies (Hoes *et al.*, 2019). Over the years, Nigeria has witnessed a plethora of agri-

food policies that changes frequently (Arif, 2019; Owolabi *et al.*, 2016). This was the experience of the composite flour and cassava flour with government policies in Nigeria. Prior evidence shows that incoherent policies affected the adoption of Nigeria's national food policy on the use of composite flour; hence millers are reluctant to implement it in their production (Ohiamain, 2014). The initial 5 year implementation gap of mainstreaming cassava flour into confectionery products created mistrust among stakeholders, negatively impacting investment in cassava production and processing by large integrated processors. Only one of the 12 processing factories operated above 50% capacity (Hesser, 2019). Delayed implementation of policies leads to policy failure, market access and supply chain dynamics (Ambali & Murana, 2017; Blizkovsky *et al.*, 2018) and an exacerbate food security crisis (Eme *et al.*, 2014). Although the USAID-funded program called MARKET II, which developed a Cassava Supply Management System to manage supply chain activities in the cassava value chain (Hesser, 2019), has been successful and has increased production and adoption of cassava flour by confectioneries from 3.3% in 2010 to over 90% in 2017; recent evidence shows the initial reluctance persists. The reluctance to adopt is attributed to the producers' perception and quality assurance crisis (Onyekuru *et al.*, 2019), availability and price of cassava (Lamboll *et al.*, 2018; Hershey, 2017), lack of collaboration between the public and private sector in the food ecosystem (Pereira, 2019), including lacks market infrastructures.

Marketing issues: Consumer willingness

This current study is based on the premise that consumer demand determines supply. Therefore, the theoretical basis hinged on consumer willingness to buy confectioneries made with cassava flour. Consumers are critical to adopting confectioneries made from cassava flour as they represent the market for such products and determines its adoption. From the marketing perspective, consumer willingness to buy is explained from the lens of intention to purchase (Phau *et al.*, 2009; Purnama *et al.*, 2021), and lies between attitudes and behaviour (Yadav & Pathak, 2016), which is influenced by convergence of factors.

The adoption process follows diverse patterns and involves complex interactions of factors. They involve the convergence of social, economic and environmental factors such as seen and unseen relative cognitive values that includes taste, colour, odour (Nwachukwu *et al.*, 2010; Ohiamain, 2014), socioeconomic factors (Kohansal & Firoozzare, 2013) and food safety (Yang & Fang, 2021) that shape food choices. Other factors include certification and regulatory system (Yormirzoev & Teuber, 2021), perception of benefits and risk (Ali & Ali, 2020; Zhu *et al.*, 2018), economic and environmental

factors (Kucher *et al*., 2019; De Steur *et al*., 2019) such as consumer response to price (Kamaludin *et al*., 2013), trust (Purnama *et al*., 2021), information and consumer knowledge (Zhu *et al*., 2018; Piha *et al*., 2018), and food expenditure and budget (Buder *et al*., 2014), market structure and infrastructures (Elemo, 2013).

Progress in scaling up the adoption and marketing of HQCF made confectioneries must focus only on understanding dynamics of consumer demand. This understanding is consequential in improving marketing and investment in the cassava value chain. This study examines the need to understand consumer attitude towards confectioneries made with HQCF, focusing on Nigeria inclusion and use of cassava flour as an alternative to wheat. The analysis of this study from the perception and estimated factors are critical as it provides information to address policy gaps, investment, and diversification of consumer food baskets. Therefore, this will help agri-marketing institutions to be more effective in building a food system that delivers better outcome for both the consumer and firms.

1. Methodology

Study area

The study was carried out among consumers of cassava confectioneries in the three geographical zones of Abia State, Nigeria. Abia state is one of the states in Nigeria with high investment in cassava production and consumption; as a result, Nigeria Government planned to set up cassava processing plant in the State through the Federal Institute of Industrial Research Oshodi (FIIRO) (Abdulkareem, 2019).

Sampling procedure

In close consultation with the Small and Medium Enterprise Development Agency of Nigeria (SMEDAN) and the Agricultural Development Programme (ADP), a cross-sectional survey research design was developed for the target consumers. As a result, a multi-stage random sampling technique was employed in selecting locations and respondents. The first stage involved a purposive selection of major cities in each of the three agricultural and senatorial zones in Abia-Aba (Abia South), Umuahia (Abia Central) and Ohafia (Abia North). The selected locations were chosen based on their cosmopolitan nature and high consumption of cassava value additions.

The second stage involved a random selection of three axes from each of the elected cities; hence we have Aba-Ogbor-hill axis, Ngwa Road axis and

Osisioma axis; the Umuahia-Agbama Housing Estate axis, World Bank and Ehimiri Housing Estate axis; and Ohafia-Isiama axis, Arochukwu axis and Bende axis. The final stage involved a random selection of 15 households from each of these axes. A total of one hundred and twenty (120) respondents were targeted and used for this study.

Method of Data Analysis

A mixture of descriptive and inferential statistics such as logistic regression was used to analyse this study's data based on the study objectives' characteristics and nature.

The simple Probit regression model is specified as:

$$Y = \beta_i X_i + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \ldots \beta_n X_n + U_i$$

Where Y = Consumers' willingness to pay for confectioneries with cassava flour inclusion (willingness to pay = 1, otherwise = 0)

The dependent variables are as earlier defined, and the explanatory variables are defined in Table 1. The explanatory variables constitute identified factors consistent with a *priori* theoretical expectations and the results from previous empirical factors that mitigate the production and marketing of food and cassava flour.

Table 1 - Description of Covariates used in the regression

Variables	Description	Type	Measurement	Expected sign
Household size (X1)	Number of household members living in the same house	Continuous	Number	+/–
Age (X2)	Age of head of household	Continuous	Number	+
Education (X3)	Years spent in school	Continuous	Number of years	+
Sex (X4)	Gender of the respondents	Binary	1 = male, 0 = female	+/–
Perception (X5)	Interpretation and feeling toward cassava made from HQCF	Binary	1 = favorable, 0 = unfavorable	–
Household income (X6)	Monthly income of the household	Continuous	Currency (Naira)	+/–
Share of food Expenditure (X7)	Share of expenditure spent on confectioneries	Continuous	Naira	–

Source: Computed by authors.

2. Results

Sample Descriptive

Analysis of the socio-demographics of the respondents reflects the diversity of the study population (Table 2) and shows that majority were young and within their economically active or working-age population. The majority of the respondents are female (57.5%), which shows that females dominate decision concerning food decisions in the family and reflects a typical household reality (See, Sariyev *et al*., 2020; Wood *et al*., 2018). Most of the

Table 2 - Socio-demographic characteristics (n = 120)

Socio-demographic variables	Frequency	% of sample n = 120
Age		
20-29	38	31.7
30-39	38	31.7
40-49	22	18.3
50-above	22	18.3
Sex		
Male	51	42.5
Female	69	57.5
Household size		
0-3	49	40.8
4-7	63	52.5
8-10	8	6.7
Educational level		
FSLC	7	5.83
WAEC/GCE	77	64.2
OND/NCE	31	25.8
HND/B.Sc	5	4.2
Income (₦)		
Less than 3000	2	1.7
3,000-30,000	44	36.7
31,000-43,000	39	32.5
44,000-150,000	29	29.2
Marital Status		
Married	70	58.3
Single	50	41.7

NB: FSLC = First School Leaving Certificate; WACE = West Africa Examination Certificate; GCE = General Certificate Examination; OND = Ordinary National Diploma; HND = Higher National Diploma, B.Sc = Bachelor of Science Degree.

respondents' highest education level was secondary school level (64.2%), with about 36% earning at least the National minimum wage of NGN 30 000. Interestingly, most of them are married (58.3%), which implies that they have added responsibility in terms of increased food expenditure. Evidence shows a nexus between family size, food expenditure and food security (Ahmed *et al*., 2017; Zani *et al*., 2019).

Confectioneries preferred by consumers

Regarding the type of confectioneries preferred by consumers, on average, consumers prefer bread more than other types of confectioneries in the study area, as shown in Table 3. The four significant preferences are bread (58.3%), egg rolls (10.8%), Chin-Chin (A famous Nigerian fried snack) (9.2%) and meat pie (7.5%). This result suggests that majority of the respondents would also prefer bread to other cassava flour confectioneries given that it is a choice food due to its accessibility, affordability, and preference among all age brackets and because it delivers daily energy requirements for households (llktac *et al*., 2021).

Table 3 - Types of confectioneries preferred by consumers

Types	**Frequency**	**Percentage**
Bread	70	58.3
Chin-Chin	11	9.2
Cake	5	4.2
Doughnut	4	3.3
Meat pie	9	7.5
Egg roll	13	10.8
Buns	8	6.7
Total	*120*	*100.0*

Source: Author's computation.

Perception of Consumers

Regarding consumer perception of confectioneries made from cassava flour, Table 4 shows consumer disagreement based on some sensory evaluation of the confectioneries, awareness and economic factors such as price. Most consumers (66.7%) perceived cassava confectioneries are not tasty, while a small proportion, 33.3%, perceived the confectioneries to be tasty. The high percentage difference indicates a more profound concern

for the taste of confectioneries made with cassava flour. More so, there is poor awareness of cassava flour confectioneries among consumers (60.3%), which has affected its popularity and limited knowledge of its advantages and nutritive properties. The lack of awareness has affected the popularity of cassava flour-baked confectioneries.

Regarding smell and odour, 62.5% of the sample complained that confectioneries with cassava flour have unpleasant smells or odours which are unattractive to them. This could be a result of the poor quality of the cassava and the supply of partially fermented cassava to bakers; this affects the product quality hence the offensive odour (Ohimain, 2014; UNIDO/FGN, 2006).

Despite the criticism and efforts by the government to improve knowledge, the majority of the sample (72.5%) complained of the unavailability of baked goods with cassava flour; most bakers deny the use of cassava flour in baking and this has increased the scarcity of cassava baked products in the study area. A plausible explanation could be the lack of differentiation between confectioneries made from wheat and cassava due to the absence of labelling information. Finally, the respondents were indifferent to the price of cassava-baked products in the study area. This could result from the relatively low price paid for cassava flour confectioneries, as wheat importation has made the confectioneries highly expensive (Maziya-Dixon *et al.*, 2017).

Table 4 - Perception of consumers on the purchase of cassava flour confectioneries

Perception		**% of sample**
Taste	Tasty	33.3
	Not tasty	66.7
Awareness	Poor awareness	60.3
	High awareness	39.2
Odour	Bad odour	62.5
	Odour free	37.5
Availability	Available	27.5
	Unavailable	72.5
Price	Expensive	50.0
	Not expensive	50.0

Source: Author's computation.

Factors influencing Consumer's willingness to pay for Cassava Confectioneries

A probit regression was performed to identify impact of explanatory variables on the likelihood that consumers would be or not be willing or indifferent to pay for confectioneries baked with cassava flour. The result of the Probit regression, including the estimates (Exp (β)) and their confidence intervals and significance levels, and Chi-square of the model are presented in Table 5. The full model with all eight predictors was statistically significant as shown by the $\chi^2 = 110.64$ ($p < 0.001$), indicating that it captures the preference of consumers who are willing and those not willing to pay for confectioneries made form cassava flour.

Table 5 - Factors influencing consumer's willingness to pay for Cassava confectioneries

Variable	Estimate	Std. Error	Z-statistics	Sig
Age	-0.0008	0.066	-1.383	0.167
Sex	-0.229	0.091	-2.516**	0.010
HHS	0.049	0.025	1.988*	0.054
Education	-0.003	0.025	-0.103	0.918
Income	1.354	0.303	4.469***	0.000
Size of Bread	-0.844	0.311	-2.714***	0.000
Cassava flour perception	0.745	0.37	5.440***	0.000
Marital Status	-0.023	0.093	-0.250	0.803
Chi-square	110.638**			

* Significant 10%, ** Significant 5%, *** Significant at 1%.

Source: Author's computation.

Table 5 shows that five independent explanatory variables were found to be significant, and they include sex, household size, education, income, size of bread, and perception. From the result, consumers are less likely to purchase confectioneries made from cassava flour if they are male than female; because female consumers make most of the household food decisions or when their household size is large, as economic benefits will determine their purchase more than other factors. The result shows that a unit increase in income will increase the likelihood of paying for confectioneries made from cassava flour by a factor of 1.35, or 0.84 for a unit decrease in size of the bread or 0.75 for each unit increase in how consumers perceive cassava flour as shown by the co-efficient.

3. Discussion

Consumers are vital when discussing potential strategies to scale up demand for any product because they constitute the market for goods and services (Kotler & Armstrong, 2015; Plasek & Temesi, 2019). Our study examined the key factors influencing willingness to purchase confectioneries made from cassava flour. Cassava flour is among the alternatives to wheat flour and provides many economic benefits such as availability and affordability, including nutritional benefits and advancing food security conversation (Eleazu *et al*., 2014; Maziya-Dixon *et al*., 2017; Lamboll *et al*., 2018). This research contributes to measures to scale up cassava diversification and identify the right market for this product. In doing this, we examined the potential market opportunity for cassava flour and confectioneries' potential alternatives. Our study area is a strategic cassava hotspot in Nigeria, with huge production and consumption of cassava; therefore, our findings provide important insights that will improve marketing, diversification and investment in the cassava value chain in Nigeria.

Perception of consumers on confectioneries made from cassava flour

Taste is an important consideration that people bring to food decisions, including cost and health (Sobal & Bisogni, 2009), even among children (Pearce *et al*., 2020). Our study shows that consumers believe that confectioneries made from cassava flour are not as tasteful as those from wheat flour. This finding is disturbing and does not agree with other sensory studies on HQCF in Nigeria and other African countries. Prior studies show that sensory evaluation shows a high level of acceptance in terms of aroma, taste, colour and crispiness (Sampson, 2020; Maziya-Dixon *et al*., 2017; Nurdjanah *et al*., 2020). The study of Owusu *et al*. (2017) observed that consumers are aware of products made from cassava flour and, based on their taste, are willing to purchase it. The plausible explanation for this difference is the subjective nature of taste and consumer preference (Chen, 2010). This study, therefore, highlights the importance of using taste as a critical element in branding and positioning strategy in order to build a strong perception (Ghose & Lowengart, 2001) for cassava flour blended confectioneries, given that evidence shows that consumers will buy and pay a premium more cassava based product if they are tasty (Adepoju, & Oyewole, 2013; Akanwasa, 2007).

Concerning awareness, consumer knowledge about cassava flour blended confectioneries is poor. This study highlighted this poor awareness, as more than half of the sample (60.3%) confirmed. The poor awareness level may be

because the machinery of communication employed by both government and private businesses is not deep enough to steer overwhelming patronage (Oteh *et al*., 2020), affecting the drive to scale up demand and change consumer perception (Elemo, 2013). Evidence indicated a nexus between awareness and food acceptance (Foley *et al*., 2021; Zhang *et al*., 2020). This result indicates that knowledge about cassava flour inclusion can be improved and supports the need to enhance consumer education and information machinery to change consumer perception and enhance demand for confectioneries with cassava flour inclusion. While our study established that a majority of consumers are concerned about the product's odour, which makes it unattractive to them. A plausible explanation could be the poor quality of the cassava and the supply of partially fermented cassava to bakers, leading to an offensive odour (Ohimain, 2014; UNIDO/FGN, 2006). However, recent studies such as Sampson (2020) show a high level of acceptance based on its sensory properties. Improvement in cassava varieties and methods of production of cassava flour over the years and in recent times may have contributed to improving the quality of HQCF because evidence shows that bread from HQCF is not different from those made from 100% wheat flour in texture and colour though the flavour may not be the same (Akintayo *et al*., 2020). Therefore, quality cassava flour can serve as a viable alternative to wheat (Sampson, 2020) with good outcomes.

The availability of cassava flour is determined by two factors – investment and production of cassava and supply of HQCF in the market. Unfortunately, policy inconsistency, demand and supply of HQCF, and seed and energy issues disrupt the availability of HQCF and its utilisation in confectioneries (Lamboll *et al*., 2018). Evidence shows that bakers are willing to use and include HQCF in their operations if it is readily available in the market (Olayimika *et al*., 2015). Our study suggests that improving the supply of HQCF may also result in improved utilisation and consequent consumer demand. Lack of availability creates scarcity and an impact on price. Although the result shows that consumers are indifferent concerning price, it contradicts Adepoju & Oyewole (2013) and Chabikuli (2011) findings. The cost of production determines the price. A producer will conduct a cost-benefit analysis to determine an acceptable price for its product taking into cognisance other factors. Evidence shows that the market price for HQCF is lower than wheat flour (Olayimika *et al*., 2015) and this may impact on final price consumers pay for choice confectioneries, given that a typical Nigeria consumer is price sensitive (Nwachukwu *et al*., 2011) and want to maximise value for amount paid. However, where product information is absent, consumers may not be averse to changes in production and may base their decision on experience. The reality of Nigeria's confectionery market shows that most consumers are unaware that most bread they consume is blended with cassava flour in line with Nigeria's agricultural food policy.

Factors influencing willingness to purchase

Our study identified several factors that influence willingness to pay for cassava flour blended confectioneries and advanced the conversation around building a strong positive perception for novel food to enhance its brand image (Owusu *et al*., 2017). The perception coefficient was positive and significant at a 1% level, indicating that as perception increase, more consumers will be willingness to pay for the product (Oni *et al*., 2005). This could be sustained by improving awareness and food literacy through advertising and other communication machinery. Also by positioning the brand using identified intrinsic and extrinsic value of cassava flour to Nigeria cassava diversification and food systems.

From the result, gender significantly affected the likelihood to pay for confectioneries made from cassava flour. This suggests that though both genders make household food decision, females as homemakers and caregivers will be more likely to pay for cassava confectioneries than their male counterparts. This contradicts other studies where a positive effect of gender on willingness to pay was established (Osuji, 2010). Our result lends credence to the difference that manifest in overall preference between male and female in food selection and aligns with the view that preference for snacks is influenced by social-environmental and biological factors than based on gender (Alamu *et al*., 2020).

Cassava is known to possess a high level of starch. With this quality, the consumption of it can take care of family needs in terms of satisfaction. Besides, evidence shows that cassava flour blended confectioneries are cheaper than those made from 100% wheat due to the cost of HQCF (Olayimika *et al*., 2015). Therefore, this may appeal to large families due to current food inflation and general economic situations in Nigeria, leading to demand for alternatives (Adeyonu *et al*., 2021) to escape the food insecurity trap. This underpins the importance of advancing conversation for buying locally to grow the local economy and also segmenting this product as a cost-effective food alternative because it provides economic value and other benefits, hence serving as a motivating factor (Klümper& Qaim, 2014). This result justified the significant positive effect of income on the likelihood of paying. Evidence shows a nexus between income growth and willingness to pay for food items (Wang *et al*., 2020). As income increases, the probability of a household's willingness to pay for cassava flour confectioneries increases because they consider them as better alternatives. From the economic theory perspective, an income increase will result in higher demand for food. Therefore, given Nigeria's population and income growth, cassava flour blended confectioneries have huge market potential, as an example of China shows (See Riccioli *et al*., 2020), as they may see this product as a novel

brand, thus enhancing its value (Lusk, 2019). Therefore, like other brands, it needs to enhance its packaging and ensure availability.

From this result, our sample believed that the breads' size is unimportant given the significant negative value it commands. This implies that, on average, if an extra size is to be added to bread, it will lead to a decrease in willingness to pay in the area, but concerns about quality and satisfaction obtainable from consuming good bread may compensate for the quantity.

Conclusion and implication on agri-marketing

The Russia-Ukraine war is having a direct effect on most agricultural commodities, especially wheat. This has put a lot of strain on the confectioneries industry, which depends on wheat to bake confectioneries. This study has, however, opened conversation on the value of cassava flour as a viable alternative to wheat flour. Importantly, it gave insight into the willingness of Nigerian consumers to pay for it and escape the food insecurity trap occasioned by disruption in global food supply. The majority of the samples from our study believe that the product's taste and odour (aroma) must be tweaked to suit changing global best trends, as well as the need to make the product readily available at strategic locations, with improved marketing communication strategy. Therefore, these factors can be improved and used to build a good positioning and brand strategy. Cassava is a staple food with numerous uses and by products; The same is true of confectionery foods with diverse uses, such as bread, biscuits, cakes, and Chin-chin and could be made from cassava flour and consumed by people of different classes, as evidence shows that it is not different from 100% wheat flour. However, in most places, there is low awareness of its existence and nutritional and economic values. Increasing knowledge about this product, packaging and labelling improves consumer's attitudes toward cassava flour blended confectioneries.

Based on preference and evidence, this product has high market potential, but its success will not hinge only on consumers; the government needs to improve policies around the cassava value chain and diversification. Poor policy and lack of consistency of policies towards the use of composite flour and cassava flour in baking has affected its use in baking, hence it is recommended that government should ensure implementation of its polcies on mainstreaming at least 20% cassava flour on confectioneries. This will drive demand and improve investment in cassava production and its value chain, with a spillover effect on other aspect of the marketing and market system.

Quality is a serious concern to consumers as it impacts their health. Improving quality through adopting modern cassava processing

infrastructures will enhance the development of composite flour and cassava flour confectioneries, and further influence consumer interest. Finally, government and other stakeholders should embark on rigorous campaigns and educate Nigeria's about the health benefits of consuming confectioneries with percentage of cassava inclusion. Our study provided valuable insight into the need to improve awareness and perception to improve demand for cassava-based confectioneries.

We acknowledged that our study faces some limitations. Our data was drawn from one State in Nigeria, which may raise a concern about its use in generalization but notwithstanding, our study achieved its objectives. The variables we have included also may not have captured all the basic values, but we are mindful that some of those have been taken care of by other studies including the issue of sensory evaluation and other properties and chemical. This study aims to identify fundamental contributing factors influencing willingness to pay and improve demand. It also serves as a major contribution to other studies in advancing conversation around cassava value chain diversification in Nigeria. Future studies may benefits from including more variables and test sensory attributes that are consistent with changing consumer trends. Importantly, increasing the sample may give the work a much different outcome.

References

Abdulkareem, M. (2019). *FG to Set Up Cassava Processing Plants in Arochukwu*. -- www.premiumtimesng.com/regional/ssouth-east/344067-fg-to-set-up-cassavaprocessing-plants-in-arochukwu.html.

Acevedo, M., Zurn, J.D., Molero, G., Singh, P., He, X., Aoun, M., & McCandless, L. (2018). The role of wheat in global food security. In: *Agricultural Development and Sustainable Intensification* (pp. 81-110). Routledge.

Adebayo, W.G., & Silberberger, M. (2020). Poverty reduction, sustainable agricultural development, and the cassava value chain in Nigeria. In: *The Palgrave Handbook of Agricultural and Rural Development in Africa* (pp. 525-551). Palgrave Macmillan. doi.org/10.1007/978-3-030-41513-6_24.

Adepoju, A.O., & Oyewole, O.O. (2013). *Households' perception and willingness to pay for bread with cassava flour inclusion in Osogbo Metropolis, Osun State, Nigeria*. 4th International Conference of the African Association of Agricultural Economists (pp. 1-17). Hammamet, Tunisia.

Adefisayo, A., Adesina, S., & Omonona, B.T. (2022). Profitability analysis among actors of High-Quality Cassava Flour (HQCF) in South West Nigeria. *International Journal*, *9*(3), 129-139. doi.org/10.18488/ijsar.v9i3.3089.

Adeyonu, A.G., Shittu, A.M., Kehinde, M.O., & Adekunle, C.P. (2021). Farm households' demand response to escalating food prices in Nigeria. *Journal of Applied Economics*, *24*(1), 555-576. doi.org/10.1080/15140326.2021.1980351.

Agbaeze, E.K., Ohunyeye, F.O., Obamen, J., & Ibe, G.I. (2020). Management of food crop for National Development: Problems and challenges of cassava processing in Nigeria. *SAGE Open*, *10*(2), 2158244020919778. doi.org/10.1177/2158244020919778.

Ahmad Hanis, I.A.H., Jinap, S., Mad Nasir, S., Alias, R., & Muhammad Shahrim, A.K. (2012). Consumers demand and willingness to pay for rice attributes in Malaysia. *International Food Research Journal*, *19*(1).

Ahmed, U.I., Ying, L., Bashir, M.K., Abid, M., & Zulfiqar, F. (2017). Status and determinants of small farming households' food security and role of market access in enhancing food security in rural Pakistan. *PloS one*, *12*(10), e0185466. doi.org/10.1371/journal.pone.0185466.

Akerele, E.O., Odojukan, D.M., Yangomodou, O.D., Olugbemi, M.T., Solana, O.I., Ilori, A.R., & Fadipe, M.O. (2019). Productivity and technical efficiency of cassava production in Ogun State, Nigeria. *Journal of Agriculture and Veterinary Science*, *12*(11), 33-40.

Akintayo, O.A., Oyeyinka, S.A., Aziz, A.O., Olawuyi, I.F., Kayode, R.M., & Karim, O.R. (2020). Quality attributes of breads from high-quality cassava flour improved with wet gluten. *Journal of Food Science*, *85*(8), 2310-2316. doi.org/10.1111/1750-3841.15347.

Akinwale, M.G., Akinyele, B.O., Dixon, A.G.O., & Odiya, A.C. (2010). Genetic variability among forty-three cassava genotypes in three agroecological zones of Nigeria. *Plant Breed. Crop Sci*, *2*(5), 104-109.

Alamu, E.O., Maziya-Dixon, B., Olaniyan, B., Pheneas, N., & Chikoye, D. (2020). Evaluation of nutritional properties of cassava-legumes snacks for domestic consumption – Consumer acceptance and willingness to pay in Zambia. *AIMS Agriculture and Food*, *5*(3), 500-520. doi.org/10.3934/agrfood.2020.3.500.

Ali, T., & Ali, J. (2020). Factors affecting the consumers' willingness to pay for health and wellness food products. *Journal of Agriculture and Food Research*, *2*, 100076. doi.org/10.1016/j.jafr.2020.100076.

Ambali, A.R., & Murana, A.O. (2017). A reflection on the challenges in Nigerian agricultural policies and the way forward. *Journal of Administrative Science*, *14*(1), 1-17.

Analytica, O. (2022). Russia-Ukraine war will disrupt global wheat trade. *Expert Briefings*. doi.org/10.1108/oxan-es268196.

Araujo-Enciso, S.R., & Fellmann, T. (2020). Yield variability and harvest failures in Russia, Ukraine and Kazakhstan and their possible impact on food security in the Middle East and North Africa. *Journal of agricultural economics*, *71*(2), 493-516. doi.org/10.1111/1477-9552.12367.

Arif, S. (2019). Cursed by Oil? Rural Threats, Agricultural Policy Changes and the Impact of Oil on Indonesia's and Nigeria's Rural Development. *Journal of International Development*, *31*(2), 165-181. doi.org/10.1002/jid.3399.

Arndt, C., Davies, R., Gabriel, S., Harris, L., Makrelvo, K., Robinson, S., Levy, S. & Simbanegavi, W. (2020). Covid-19 lockdown, income distribution, and food security: An analysis for South Africa. *Global food security*, *26*, 100410. doi: 10.1016/j.gfs.2020.100410.

Balana, B., Amare, M., Adeyanju, D. & Laborde, D (2022). *The Russia-Ukraine crisis presents threats to Nigeria's food security but potential opportunities for the fertiliser, energy sector.* -- Accessed from www.ifpri.org/blog/russia-ukraine-crisis-presents-threats-nigerias-food-security-potential-opportunities.

Ben Hassen, T., & El Bilali, H. (2022). Impacts of the Russia-Ukraine War on Global Food Security: Towards More Sustainable and Resilient Food Systems? *Foods*, *11*(15), 2301. doi.org/10.3390/foods11152301.

Blizkovsky, P., Grega, L., & Verter, N. (2018). Towards a common agricultural policy in Africa? *Agricultural Economics*, *64*(7), 301-315. doi.org/10.17221/310/2016-agricecon.

Buder, F., Feldmann, C., & Hamm, U. (2014). Why regular buyers of organic food still buy many conventional products: Product-specific purchase barriers for organic food consumers. *British Food Journal*, 116(3), 390-404. doi: 10.1108/BFJ-04-2012-0087.

Chen, Y.C. (2010). Conceptualisation of incorporating subjective taste preference, subjective psychometric constructs, and objective alternative attributes into consumer choice behavior models. *Social Behavior and Personality: an international journal*, *38*(1), 143-145. doi.org/10.2224/sbp.2010.38.1.143.

D'Souza, A., & Jolliffe, D. (2013). Conflict, food price shocks, and food insecurity: The experience of Afghan households. *Food Policy*, *42*, 32-47. doi.org/10.1016/j.foodpol.2013.06.007.

De Carvalho, A.M., Verly Jr, E., Marchioni, D.M., & Jones, A D. (2021). Measuring sustainable food systems in Brazil: A framework and multidimensional index to evaluate socioeconomic, nutritional, and environmental aspects. *World Development*, *143*, 105470. doi.org/10.1016/j.worlddev.2021.105470.

De Steur, H., Van Loo, E. J., Maes, J., Gheysen, G., & Verbeke, W. (2019). Farmers' willingness to adopt late blight-resistant genetically modified potatoes. *Agronomy*, *9*(6), 280. doi.org/10.3390/agronomy9060280.

Ehinmowo, O.O., Afolabi, J.A., & Fatuase, A.I. (2015). Determinants of profitability among small scale cassava processors in South Western Nigeria. *Russian Journal of Agricultural and Socio-Economic Sciences*, *37*(1), 23-28. oi.org/10.18551/rjoas.2015-01.03.

Eleazu, C., Eleazu, K., Aniedu, C., Amajor, J., Ikpeama, A., & Ebenzer, I. (2014). Effect of partial replacement of wheat flour with high quality cassava flour on the chemical composition, antioxidant activity, sensory quality, and microbial quality of bread. *Preventive nutrition and food science*, *19*(2), 115. doi.org/10.3746/pnf.2014.19.2.115.

Elegbede, V., Dipeolu, A., & Shittu, A. (2018). Value chain analysis of cassava products in Ogun state, Nigeria. *Journal of Humanities, Social Science and Creative Arts*, *13*(1), 75-88. doi.org/10.51406/jhssca.v13i1.1930.

Elemo, G.N. (2013). *The prospects and challenges of cassava bread and confectioneries in Nigeria*. A Seminar Presented During the NISER Research Seminar Series (NRSS) at Premier Hotel, Ibadan, Nigeria. Ibadan.

Eme, O.I., Onyishi, T., Uche, O.A., & Uche, I.B. (2014). Challenges of food security in Nigeria: Options before government. *Arabian Journal of Business and Management Review (OMAN Chapter)*, *4*(1), 15.

Ezedinma, C.I., Kormawa, P.M., Manyong, V.M., & Dixon, A.G. (2007). Challenges, Opportunities and strategy for cassava sub-sector development in Nigeria. In: *Proceedings of the 13th ISTRC Symposium* (pp. 627-640).

Falola, A., Achem, B.A., Oloyede, W.O., & Olawuyi, G.O. (2017). Determinants of commercial production of wheat in Nigeria: a case study of Bakura Local Government Area, Zamfara State. *Trakia Journal of Sciences*, *15*(4). 397-404. doi.org/10.15547/tjs.2017.04.024.

FAO (2018). *Food Outlook - Biannual Report on Global Food Markets – November 2018*. Rome, p. 104.

FAO (2019). *FAOSTAT: Food and Agriculture Data*: www.fao.org/faostat/en/#data.

FAO (2022). *The Importance of Ukraine and The Russian Federation for Global Agricultural Markets and The Risks Associated with The War in Ukraine*. -- Accessed from www.fao.org/3/cb9013en/cb9013en.pdf.

Foley, J.K., Michaux, K.D., Mudyahoto, B., Kyazike, L., Cherian, B., Kalejaiye, O., Ifeoma, O., Ilona, P., Reinberg, C., Mavindidze, D., & Boy, E. (2021). Scaling Up delivery of biofortified staple food crops globally: Paths to nourishing millions. *Food and Nutrition Bulletin*, *42*, 116-132. doi: 10.1177/0379572120982501.

Giami, S., Amasisi, T., Ekiyor, G. (2004). Comparison of breadmaking properties of composite flour from kernels of roasted and boiled African breadfruit (Treculia Africana decne) seeds. *Journal of Raw Material Resources*, *1*, 16-25.

Headey, D., Heidkamp, R., Osendarp, S., Ruel, M., Scott, N., Black, R., Shkar, M., Bouis, H., Flory, A., Haddad, L., & Walker, N. (2020). Impact of Covid-19 on childhood malnutrition and nutrition related mortality. *Lancet*, *396*, 10250, 519-521. doi: 10.1016/ S0140-6736(20)31647-0.

Hershey, C.H. (2017). Drivers of change in cassava production in SSA: 4.1 Adoption of improved cassava varieties. In: *Achieving sustainable cultivation of cassava Volume 1* (pp. 158-166). Burleigh Dodds Science Publishing.

Hesser, L. (2019). *Against all odds; World food prize laureate Dr Akinwumi Adesina and his drive to feed Africa*. Indiana, USA; Author House.

Hoes, A.C., Jongeneel, R., van Berkum, S., & Poppe, K. (2019). *Towards sustainable food systems: a Dutch approach*. Wageningen Economic Research.

IITA (2002). *Opportunities for Cassava in Nigeria. Competitiveness workshop.* Bokanga, IITA, Ibadan.

Ilktac, H.Y., Sadik, M., & Garipagaoglu, M. (2021). Types of bread preferred by adult individuals and bread's place in daily nutrition. *Progress in nutrition*, *23*(3), e2021096.

Ikuemonisan, E.S., Mafimisebi, T.E., Ajibefun, I., & Adenegan, K. (2020). Cassava production in Nigeria: trends, instability and decomposition analysis (1970-2018). *Heliyon*, *6*(10), e05089. doi.org/10.1016/j.heliyon.2020.e05089.

Jagtap, S., Trollman, H., Trollman, F., Garcia-Garcia, G., Parra-López, C., Duong, L., … & Afy Shararah, M. (2022). The Russia-Ukraine Conflict: Its Implications for the Global Food Supply Chains. *Foods*, *11*(14), 2098. doi.org/10.3390/ foods11142098.

Kamaludin, M., Radam, A., Abdul R.K. & Yacob, M.R. (2013). Consumer willingness to pay for domestic water services in Kelantan. *Pertanika Journal of Social Sciences & Humanities*, *21* (spec. Sep.), 1-12.

Kammer, A., Azour, J., Selassie, A.A., Goldfajn, I., & Rhee, C. (2022). *How war in Ukraine is reverberating across the world's regions*. Washington: IMF, March 15.

Klümper, W., & Qaim, M. (2014). A meta-analysis of the impacts of genetically modified crops. *PLoS One*., *9*, e111629. doi.org/10.1371/journal.pone.0111629.

Kohansal, M.R., & Firoozzare, A. (2013). Applying multinomial logit model for determining socio economic factors affecting major choice of consumers in food purchasing: The case of Mashhad. *Journal of Agricultural Science and Technology*, *15*(7), 1307-1317.

Kolawole, A. (2017). Targeting smallholder farmers to adopt improved cassava technologies: challenges and opportunities. *Achieving sustainable cultivation of cassava*, *1*, 217-230. doi.org/10.19103/as.2016.0014.09.

Kotler, P., & Armstrong, G. (2015). *Principles of Marketing.* 16TH edition. Pearson Education Publishers.

Kucher, A., Heldak, M., Kucher, L., Fedorchenko, O., & Yurchenko, Y. (2019). Consumer willingness to pay a price premium for ecological goods: a case study from Ukraine. *Environmental & Socio-economic Studies*, *7*(1), 38-49. doi.org/10.2478/environ-2019-0004.

Lamboll, R., Martin, A., Sanni, L., Adebayo, K., Graffham, A., Kleih, U., Abayomi, L., & Westby, A. (2018). Shaping, adapting and reserving the right to play: Responding to uncertainty in high quality cassava flour value chains in Nigeria. *Journal of Agribusiness in Developing and Emerging Economies*, *8*(1), 54-76. doi.org/10.1108/jadee-03-2017-0036.

Liadze, I., Macchiarelli, C., Mortimer-Lee, P., & Juanino, P.S. (2022). The economic costs of the Russia-Ukraine conflict. *NIESR Policy Paper*, *32*.

Lusk, J.L. (2019). Income and (Ir) rational food choice. *Journal of Economic Behavior & Organization*, *166*, 630-645.

Maziya-Dixon, B., Alamu, E.O., Popoola, I.O., & Yomeni, M. (2017). Nutritional and sensory properties: Snack food made from high-quality cassava flour and legume blend. *Food Science & Nutrition*, *5*(3), 805-811. doi.org/10.1002/fsn3.464.

Mausch, K., Hall, A., & Hambloch, C. (2020). Colliding paradigms and trade-offs: Agri-food systems and value chain interventions. *Global Food Security*, *26*, 100439. doi.org/10.1016/j.gfs.2020.100439.

Mbah, R.E., & Wasum, D.F. (2022). Russian-Ukraine 2022 War: A review of the economic impact of Russian-Ukraine crisis on the USA, UK, Canada, and Europe. *Advances in Social Sciences Research Journal*, *9*(3), 144-153. doi.org/10.14738/assrj.93.12005.

Mustapha, A.M., Fakokunde, T.O., & Awolusi, O.D. (2014). The quick service restaurant business in Nigeria: Exploring the emerging opportunity for entrepreneurial development and growth. *Global Journal of Commerce and Management Perspective*, *3*(3), 8-14.

Nangayo, F., Omanya, G., Bokanga, M., Odera, M., Muchiri, N., Ali, Z., & Werehire, P. (2005). *A strategy for industrialisation of cassava in Africa: Analysis of the status of cassava food sub-sector.* Proceedings of a small group meeting, 14-18 Nov., Ibadan, Nigeria, pp. 11-14.

Nurdjanah, S., & Nawansih, O. (2020, June). Physico-Chemical and Sensory Properties of Kelanting Made from High Quality Cassava Flour. In: *IOP*

Conference Series: Earth and Environmental Science, *515*(1), 012066. IOP Publishing. doi.org/10.1088/1755-1315/515/1/012066.

Nwachukwu, I.N., Nduka, J.O., & Okoye, B.C. (2010). Resource Productivity among Cocoyam Producers in Abia State, Nigeria. *Nigerian Journal of Farm Management*, *11*(2), 61-65.

Nwachukwu, I.N., Oteh, O.U., Ugoh, C.C., & Ochomma, C. (2010). Buying attitude of yam consumers in southeastern Nigeria. *Tropicultura*, *29*(4), 238-242.

Ohimain, E.I. (2014). The prospects and challenges of cassava inclusion in wheat bread policy in Nigeria. *International Journal of Science, Technology and Society*, *2*(1), 6-17.

Ohimain, E.I. (2015). A decade (2002-2012) of presidential intervention on cassava in Nigeria; the successes and challenges. *Asian Journal of Agricultural Extension, Economics and Sociology*, *6*(4), 185-193. doi.org/10.9734/ajaees/2015/16979.

Okojie, J. (2022). *Wheat production drops despite FG's funding, surging demand*. -- Accessed from https://businessday.ng/agriculture/article/wheat-production-drops-despite-fgs funding-surgingdemand.

Olayimika, O.M., Oose, M.O., Apantaku, O.S., Adebowale, A.A., & Ashimolowo, O.R. (2015). Baker's willingness to utilise high quality cassava flour (HQCF) for bread production: experience from Ogun State, Nigeria. *International Journal of Applied Agriculture and ApicultureResearch*, *11*(1-2), 146-155.

Oni, O., Oladele, O., & Inedia O. (2005). Consumer willingness to pay for safety labels in Nigeria: A case study of potassium bromate in bread. *Journal of Central European Agriculture*, *6*, 381-388.

Onyekuru, N.A., Chidimma, E., Agu, E., Abugu, C.G., & Uchua, D. (2019). Effectiveness of Nigeria Policy on Substitution of Wheat for Cassava Flour in Bakery Products: Empirical Evidence from Enugu State, Nigeria. *Nigerian Agricultural Policy Research Journal (NAPReJ)*, *6*(2237-20211441), 11-20.

Osuji, C. (2010). *Importance and use of additives in bread making. A paper presented at a training workshop on the use of cassava/wheat composite flour and non-bromate additives for making bread and other confectioneries.* Held at Michael Okpara University of Agriculture, Umudike on the 10-12 October 2006.

Oteh, O.U., Hefferon, K., & Agwu, N.M. (2020). Moving biofortified cassava products closer to market in Nigeria. *Frontier in Sustainable Food Systems*, 4, 589424. doi: 10.3389/fsufs.2020.589424.

Oteh, U.G., & Nwachukwu I.N. (2014). Effect of Commercialisation on Productive Capacity among Cassava Producing Households in Ikwuano Local Government Area of Abia State, Nigeria. *Scientific Papers Series in Management, Economic Engineering in Agriculture and Rural Development*, *14*(3), 213-220.

Otekunrin, O.A., & Sawicka, B. (2019). Cassava, a 21st century staple crop: How can Nigeria harness its enormous trade potentials. *Acta Scientific Agriculture*, *3*(8), 194-202. doi.org/10.31080/asag.2019.03.0586.

Owolabi, I.O., Ashaolu, J.T., & Twumasi-Ankrah, S. (2016). The new Nigerian agricultural policy: Efficient for food security. *Food Science and Technology*, *4*(1), 1-6. doi.org/10.13189/fst.2016.040101.

Owusu, V., Owusu-Sekyere, E., Donkor, E., Darkwaah, N.A. &Adomako-Boateng Jr, D. (2017). Consumer perceptions and willingness to pay for cassava-wheat

composite bread in Ghana: A hedonic pricing approach. *Journal of Agribusiness in Developing and Emerging Economies*, *7*(2), 115-134. doi: 10.1108/JADEE-11-2014-0044.

Pearce, A.L., Adise, S., Roberts, N.J., White, C., Geier, C.F., & Keller, K.L. (2020). Individual differences in the influence of taste and health impact successful dietary self-control: A mouse tracking food choice study in children. *Physiology & behavior*, *223*, 112990. doi.org/10.1016/j.physbeh.2020.112990.

Pereira, L. (2018). Cassava bread in Nigeria: the potential of 'orphan crop' innovation for building more resilient food systems. *International Journal of Technology and Globalisation*, *8*(2), 97-115. doi: 10.1504/IJTG.2017.088958.

Phau, I., & Teah, M. (2009). Devil wears (counterfeit) Prada: A study of antecedents and outcomes of attitudes towards counterfeits of luxury brands. *Journal of Consumer Marketing*, *26*(1), 15-27. doi: 10.1108/07363760910927019.

Piha, S., Pohjanheimo, T., Lähteenmäki-Uutela, A., Křečková, Z., & Otterbring, T. (2018). The effects of consumer knowledge on the willingness to buy insect food: An exploratory cross-regional study in Northern and Central Europe. *Food Quality and Preference*, *70*, 1-10. doi.org/10.1016/j.foodqual.2016.12.006.

Plasek, B., & Temesi, Á. (2019). The credibility of the effects of functional food products and consumers' willingness to purchase/willingness to pay-review. *Appetite*, *143*, 104398. doi.org/10.1016/j.appet.2019.104398.

Purnama, R.P., Agustina, R.D., Pitriana, P., Andhika, S., Setia, M.D.D., & Nurfadillah, E. (2021). Developing HOT-LAB-Based Physics Practicum E-Module to improve Practicing critical thinking skills. *Journal of Science Education Research*, *5*(2), 43-49. doi: 10.21831/jser.v5i2.41904.

Riccioli, F., Moruzzo, R., Zhang, Z., Zhao, J., Tang, Y., Tinacci, L., Boncinelli, F., De Martino, D. & Guidi, A. (2020). Willingness to pay in main cities of Zheijiang province (China) for quality and safety in food market. *Food Control*, *108*, 106831. doi.org/10.1016/j.foodcont.2019.106831.

Sampson, G.O. (2020). Assessing Consumer Acceptability of Composite Cassava (Manihot esculenta) Bread. *Food and Nutrition Sciences*, *11*(11), 990-1002. doi.org/10.4236/fns.2020.1111070.

Sariyev, O., Loos, T.K., Zeller, M., & Gurung, T. (2020). Women in household decision-making and implications for dietary quality in Bhutan. *Agricultural and Food Economics*, *8*(1), 1-20. doi.org/10.1186/s40100-020-00158-0.

Shittu, G.A., & Sowunmi, F.A. (2019). Willingness to Use Composite Flour that contains High Quality Cassava Flour (HQCF) among Bread and other Confectioneries Producers in Oyo State, Nigeria. *Canadian Journal of Agriculture and Crops*, *4*(2), 41-55. doi: 10.20448/803.4.2.41.55.

Sobal, J., & Bisogni, C.A. (2009). Constructing food choice decisions. *Annals of behavioral medicine*, *38*(suppl_1), s37-s46. doi.org/10.1007/s12160-009-9124-5.

Tadesse, W., Bishaw, Z., & Assefa, S. (2018). Wheat production and breeding in Sub-Saharan Africa: Challenges and opportunities in the face of climate change. *International Journal of Climate Change Strategies and Management*, *11*(5), 696-715. doi.org/10.1108/ijccsm-02-2018-0015.

Ugwu, B.O., & Ukpabi, U.J. (2002). Potential of soy-cassava flour processing to sustain increasing cassava production in Nigeria. *Outlook on Agriculture*, *31*(2), 129-133. doi.org/10.5367/000000002101293976.

UNIDO/FGN (2006). *Nigeria Cassava Master Plan (NCMP)*. United Nations Industrial Development Organization and Federal Government of Nigeria.wila.

Wang, E., An, N., Gao, Z., Kiprop, E., & Geng, X. (2020). Consumer food stockpiling behavior and willingness to pay for food reserves in Covid-19. *Food Security*, *12*(4), 739-747. doi.org/10.1007/s12571-020-01092-1.

Wilson, M.C., Mutka, A.M., Hummel, A.W., Berry, J., Chauhan, R.D., Vijayaraghavan, A., Taylor, N.J., Voytas, D.F., Chitwood, D.H., & Bart, R.S. (2017). Gene expression atlas for the food security crop cassava. *New Phytologist*, *213*(4), 1632-1641. doi.org/10.1111/nph.14443.

Wood, E.A., McNamara, K., Kowalewska, A., & Ludgate, N. (2018). Household decision-making around food in rural Tajikistan: a cross-sectional study to help extension workers in the field. *Food & nutrition research*, *62*. doi.org/10.29219/fnr.v62.1330.

Yadav, R., & Pathak, G.S. (2016). Intention to purchase organic food among young consumers: Evidences from a developing nation. *Appetite*, *96*, 122-128. doi.org/10.1016/j.appet.2015.09.017.

Yang, W., & Fang, L. (2021). Consumer Willingness to pay for food safety attributes in China: A meta-analysis. *Journal of International Food & Agribusiness Marketing*, *33*(2), 152-169. doi.org/10.1080/08974438.2020.1754316.

Yormirzoev M., Li T., Teuber R. (2021). Consumers' willingness to pay for organic versus all-natural milk. Does certification make a difference? *International Journal of Consumer Studies*, 45, 1020-1029. doi: 10.1111/ijcs.12622.

Zani, M., Saediman, H., Abdullah, S., Daud, L., & Yunus, L. (2019). Determinants of household food expenditure in a cassava growing village in southeast Sulawesi. *Academic Journal of Interdisciplinary Studies*, *8*(3), 302-302. doi.org/10.36941/ajis-2019-0028.

Zhang, M., Li, L., & Bai, J. (2020). Consumer acceptance of cultured meat in urban areas of three cities in China. *Food Control*, *118*, 107390. doi.org/10.1016/j.foodcont.2020.107390.

Zhu, W., Lestander, T.A., Örberg, H., Wei, M., Hedman, B., Ren, J., Xie, G., & Xiong, S. (2015). Cassava stems: a new resource to increase food and fuel production. *Gcb Bioenergy*, *7*(1), 72-83. doi.org/10.1111/gcbb.12112.

Zhu, W., Yao, N.C., Ma, B., & Wang, F. (2018). Consumers' risk perception, information seeking, and intention to purchase genetically modified food: An empirical study in China. *British Food Journal*, *120*(9), 2182-2194. doi.org/10.1108/bfj-11-2017-0622.

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An overview of state subsidies in Italian agriculture in the period 2000-2019

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Abstract

This paper provides a descriptive analysis of the trends and the main components of public support for agriculture in Italy over the two decades (2000-2019) preceding the outbreak of the Covid-19 pandemic. For this analysis, the wealth of highly informative data contained in the CREA database "Agricultural expenditure of the Regions" was used. This is the most up-to-date and consistently available source of information on public spending in agriculture, with regional details that distinguish it from other official statistical sources.

Overall public support for the agriculture sector in the period under consideration decreased by over EUR 4 billion (from EUR 15,613 billion in 2000 to just below EUR 12 billion in 2019). The share of support in agricultural added value has also decreased: from 55% in 2000 to about 34% in 2019.

Looking at the individual categories of support (EU CAP 1st and 2nd pillar funds, tax and social security reliefs, State transfers and regional funds) included in the analysis, it is clear that this decrease was due to the halving of tax and social security reliefs (from 26.6% to 15.8%), and the significant reduction in the support provided by the budgets of the Regions and Autonomous Provinces (from over 4 billion euros in 2000 to 1,7 billion euros in 2019). To this must be added a reduction in government contributions (from 4.3% to 4.1%). As a result,

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EU support was consequently stable in the first decade and increased in the last ten years (from 43.1% in 2000 to 63.9% in 2019).
This analysis highlights the various support models derived from each Region's particular production and political-administrative situations.

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1. Introduction

In Italy since the 1980s, the analysis of public support for the agricultural sector has been a strand of study and reflection (Antonelli, Bagarani, and Mellano, 1989; Antonelli and Mellano, 1980, 1981; Colombo, 1990, 1991; Orlando, 1984) that has been widely developed by the scientific community. Today the question of agricultural expenditure seems to be of less interest in Italy and in the developed countries. The issue remains of interest in developing countries (Allen and Qaim, 2012), where national governments have limited budgets to support agricultural programs (Olomola *et al.*, 2014). In these contexts, methodologies to track spending in agriculture are still an important area of interest (Govereh *et al.*, 2011), although the methodology developed by FAO has now become widespread (FAO, 2022).

Since the 90s, the Italian Council for Research in Agriculture and Economics (CREA) has been "quantifying and analysing public intervention in agriculture through the expenditure directed to the sector thanks to an analysis methodology that makes it possible to detect the extent of financial resources, the methods of disbursement, the subjects who disburse them, and the respective beneficiaries" (Briamonte and Vaccari, 2021). All this information has given birth to a database that constitutes the most up-to-date and constant historical series of data of the last thirty years on public expenditure for agriculture, which makes it possible to quantify European Union, national and regional expenditure and its allocation to investments, direct income support or tax and social security benefits.

CREA's database and its analysis provide an important support for the understanding of public interventions in agriculture and of the level of implementation of sector policies over time and in the different regions.

The purpose of this paper is to provide an analysis of public support for agriculture over the past twenty years. Its usefulness lies in identifying the main components of the support and how they behave in the disbursements. The analysis carried out by CREA researchers of public support for agriculture, updated annually, enables regional and national administrations

to understand the changes that have affect the sector and to improve the control and quality of agricultural policy interventions.

2. Materials and methods

Over the years, CREA's analysis has taken into account the reforms that have affected the Italian public administration, including decentralization of territorial and functional competencies and the evolution of related regulatory and financial framework (Briamonte and D'Oronzio, 2004; Briamonte and Ievoli, 2010). In this context, regional administrations constitute a central point for public intervention in agriculture and 'through the analysis of the agricultural expenditure of each region it is possible to grasp significant elements of the weight and characteristics of support at a territorial level, of its 'adequacy' to socio-productive fabric, as well as of changes in the overall intervention strategies and institutional set-ups referred to above' (Briamonte and Vaccari, 2021).

CREA's analysis considers the chapters in budgets and general accounts of the Regions and Autonomous Provinces, as well as of the central authorities that transfer resources to the agricultural sector. The analysed data, linked to the individual budget chapters, take on a financial, regulatory and qualitative character. Individual budget items pertaining to regional agricultural expenditure are reclassified on the basis of CREA's methodology (Briamonte and D'Oronzio, 2004; Sotte, 2000):

- Functional economic types of agricultural policy intervention;
- Type of support provided;
- Final beneficiaries targeted by agricultural policy interventions;
- Expenditure management, how funds are disbursed to the final beneficiary;
- Expenditure decision-making function;
- Financial means, origin of resources disbursed;
- Production sectors to which expenditure is allocated;
- Environmental protection interventions;
- Interventions relating to natural disasters.

Data considered in this paper refer to the general accounts of the regions, accruals and cash allocations, accruals and residual payments, transfers of ministries to expenditure items, subsidies and lost revenues for the legislative provisions implemented for the agricultural sector. Finally, figures provided by the Italian Agency for Disbursements in Agriculture (AGEA) or by individual regional paying agencies provide information on related EU transfers.

Support for the agricultural sector arrives in the territory from three main sources: the EU, the State, and the single Region, through which public

resources dedicated to the sector come in relation to various agricultural policy objectives which are also decided outside the territory itself.

The methodology used allows a comparison between the different policies in the different territories in order to:

- highlight choices made by national and regional authorities on agricultural policies;
- quantify and describe policies adopted;
- analyse the results of regional policies in terms of efficiency and effectiveness.

Data available for analysis are homogeneous precisely because they are classified with the same methodology every year for all regions (Briamonte, Pergamo, and Cristofaro, 2012; Gaudio, 1996; Nencioni and Vaccari, 2002).

In particular, in this paper the analysis focuses on the last twenty years (2000-2019), with the objective of highlighting the evolution and dynamics of the different support components.

3. Results

Total public support for the agri-food sector in 2000 was EUR 15,613 billion, while twenty years later this amount has decreased to about EUR 12 billion euros (11,916), as shown in Table 1. As a result, the share of support on added value drops from 54.2% in 2000 to 33.6% in 2019 (Figure 1).

As can be seen in Table 1, the reduction in total support (over EUR 4 billion) is due to the reduction in subsidies by about EUR 2,4 billion euros (social contributions reliefs 1 billion and 315 million) more marked than those for taxes reliefs (1 billion and 67 million) and Regional transfers (2,2 billion euros) for a total of 4,6 billion euros.

In the years considered, resources from the EU have the most significant impact and are also those that almost remain constant for the entire period considered (from 7,9 billion euros in 2009 to 7,2 in 2019).

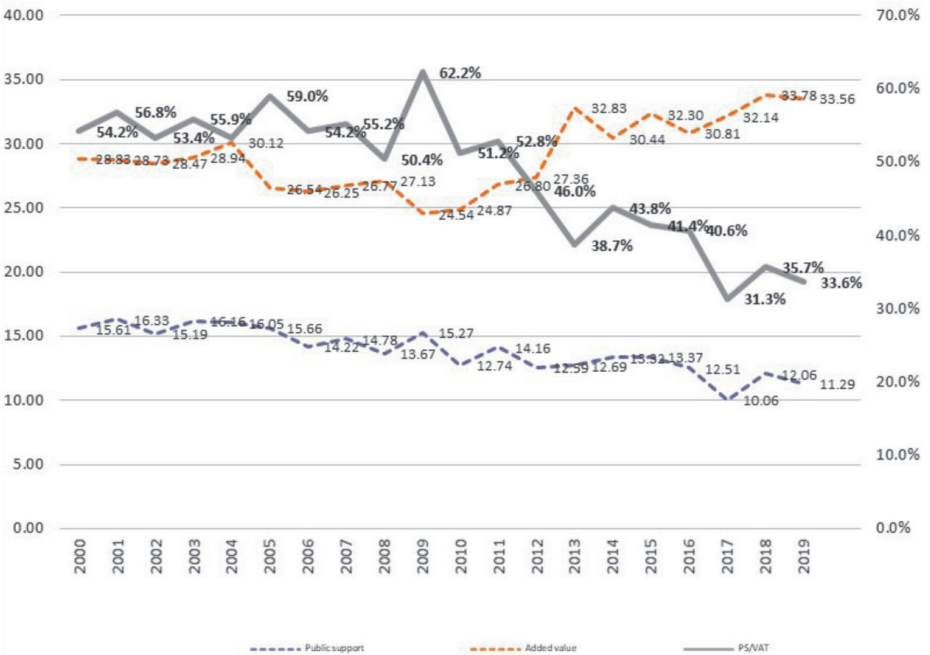
Support from EU sources shows significant increase in the second decade, while transfers from Ministries decreased from EUR 677 million to EUR 467 million (from 4.3% to 4.1%).

The percentage weight of EU transfers in total support grows from 43.1% in 2000 to 63.9% in 2019.

In contrast, the share of subsidies in total support over the 20-year period decreased from 26.6% to 15.8%.

Within concessions, those on mineral oils were the main form of tax relief (30.0%), followed by social contribution reliefs (27.0%), which show a significant decrease in the second decade, and by tax reliefs (24.0%) average for the period 2000-2019.

Figure 1 - Development in public support and added value (absolute value, billion euro) in Italy (%) (2000-2019)



Source: 'Agricultural expenditure of the regions' database, CREA-Research Center for Agricultural Policies and Bioeconomy (CREA-PB).

The decrease of the initially more than 1,8 billion euros of regional resources was largely determined by Trentino-Alto Adige, Veneto and the Regions of Central Italy. Resources contributed by Lombardy, Tuscany, Emilia-Romagna, and the Southern Italian regions were substantially stable, with the exception of Basilicata (Briamonte and Vaccari, 2021).

Overall, public support for the agricultural sector mainly rewards the Northern regions with 43.7%, followed by the Southern regions with 27.0% (Figure 3). The incidence of support in the central parts of the country and on the islands is much lower, with a percentage of 14.3% and 15.0% respectively[1].

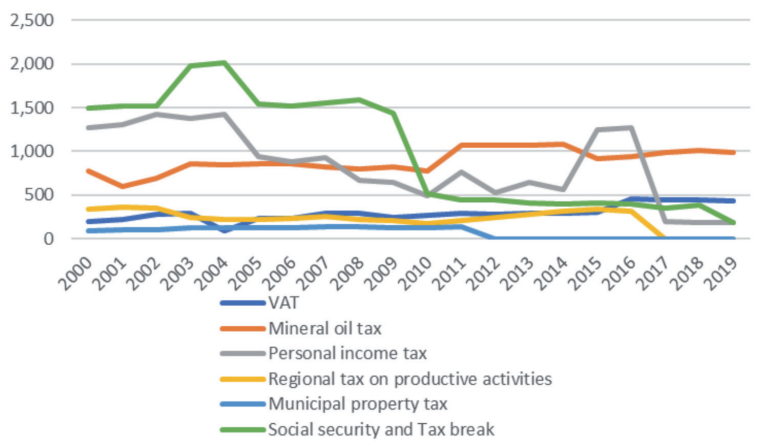
1. The proposed analysis uses the data at national level of the annual values of the various types of support indicated above from 2000 to 2019, the last pre-Covid year. Since 2010, the breakdown of the above types of support at the regional level, proposed in the following paragraph, has also been available in the database.

Table 1 - Trends in public support for agriculture by type of transfer and subsidies (in millions of euros, 2000-2019)

Anno	*EU and national transfers*	Of which AGEA and OOPP	Of which Ministries	*Regional transfers*	*Tax and social security reliefs*	Of which tax reliefs	Of which social contributions reliefs	Total support
2000	***7,407***	6,730	677	***4,047***	***4,160***	2,662	1,498	***15,613***
2001	***7,946***	7,064	882	***4,289***	***4,095***	2,576	1,519	***16,330***
2002	***7,405***	6,503	902	***3,417***	***4,367***	2,846	1,521	***15,189***
2003	***7,682***	6,622	1,060	***3,622***	***4,860***	2,883	1,977	***16,164***
2004	***7,633***	6,651	982	***3,700***	***4,719***	2,700	2,019	***16,052***
2005	***7,937***	7,060	878	***3,810***	***3,911***	2,373	1,538	***15,659***
2006	***6,717***	5,969	749	***3,647***	***3,853***	2,333	1,520	***14,217***
2007	***7,185***	6,198	987	***3,618***	***3,978***	2,429	1,549	***14,781***
2008	***6,443***	5,662	781	***3,522***	***3,704***	2,117	1,588	***13,669***
2009	***8,740***	7,917	823	***3,060***	***3,470***	2,037	1,433	***15,270***
2010	***7,427***	6,714	713	***2,956***	***2,360***	1,840	520	***12,743***
2011	***8,202***	7,552	650	***3,041***	***2,913***	2,474	440	***14,156***
2012	***7,717***	7,164	552	***2,310***	***2,562***	2,121	441	***12,589***
2013	***7,789***	7,227	562	***2,211***	***2,695***	2,289	406	***12,695***
2014	***8,845***	8,278	567	***1,837***	***2,639***	2,248	392	***13,322***
2015	***8,048***	7,535	514	***2,123***	***3,199***	2,791	408	***13,370***
2016	***7,211***	6,704	507	***1,934***	***3,370***	2,977	393	***12,514***
2017	***6,284***	5,818	466	***1,794***	***1,984***	1,632	352	***10,062***
2018	***8,380***	7,910	470	***1,639***	***2,038***	1,654	384	***12,057***
2019	***7,678***	7,212	467	***1,825***	***1,789***	1,606	183	***11,292***

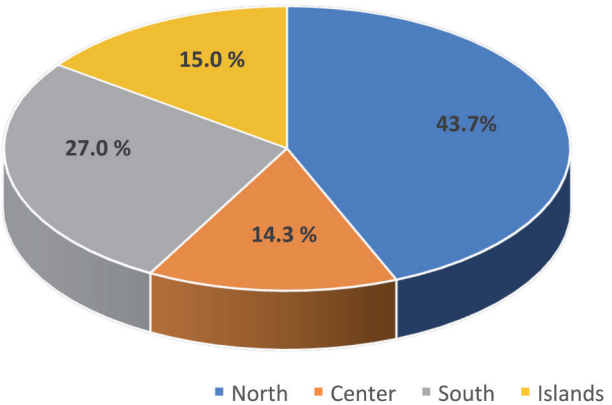
Source: 'Agricultural expenditure of the regions' database, CREA-Centro PB.

Figure 2 - Trend in tax and social security reliefs in agriculture (in millions of euros, 2000-2019)



Source: 'Agricultural expenditure of the regions' database, CREA-PB.

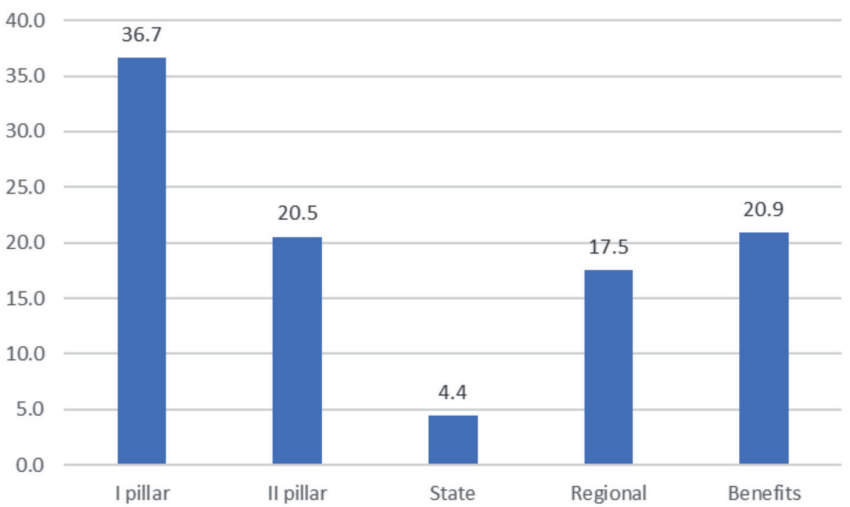
Figure 3 - Percentage distribution of overall public support by geographical district (2010-2019 average)



Source: 'Agricultural expenditure of the regions' database, CREA-Centro PB.

Public support for the sector is dominated by EU funds (36.7% I pillar and 20.5% II pillar), followed by benefit which account for 20.9%. Resources from regional budgets account for 17.5% while those from the State account for 4.4% (Figure 4).

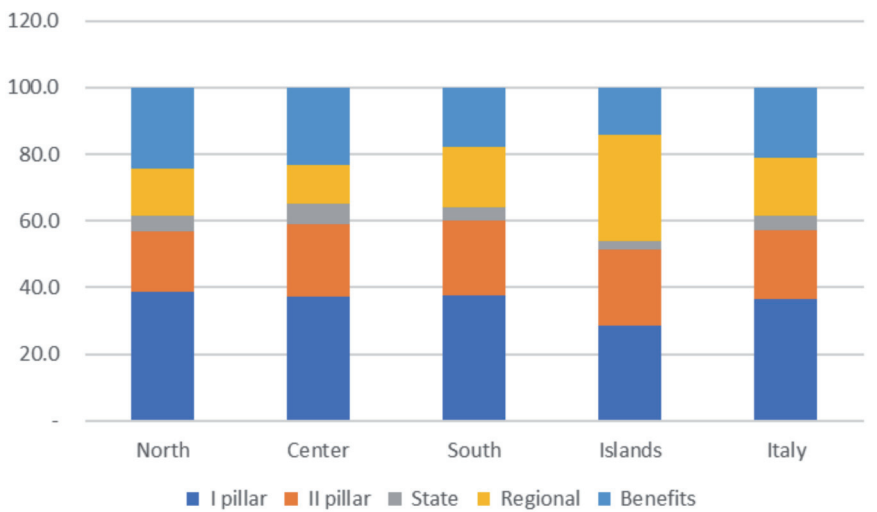
Figure 4 - Incidence of public support by source of origin (2010-2019 average)



Source: 'Agricultural expenditure of the regions' database, CREA-PB.

This incidence varies slightly by area. The incidence of resources relating to the first pillar of the CAP exceeds 36.7% for each geographical district, with the exception of the Islands where stands at 28.5%. The resources of the Second pillar have a higher impact in the Central, Southern and island regions (over 20.5%) and less in the North (18.1%). State transfers affect each district in the same way (on average below 4.4%). Resources from regional budgets are higher in islands (32.1%) and in the South (18.1%) compared to other districts, where they account for less than 15.0%. Contrarily, tax and social reliefs show higher impacts in the North and Center (respectively by 24.4% and 23.1%), but less in the South (17.9%) and in the Islands (14.0%).

Figure 5 - Incidence of public support by source of origin and by geographical district (2010-2019 average)



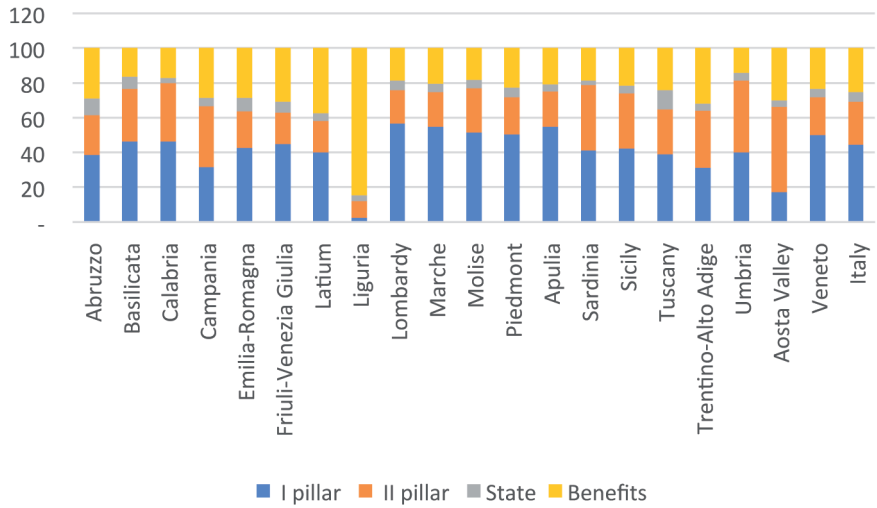
Source: 'Agricultural expenditure of the regions' database, CREA-Centro PB.

Using the database, support patterns can also be analyzed at regional level.

The following figure shows the weight of the different funding sources by region. Pillar I resulted in the higher share in Lombardy (56.6%), Marche (54.8%), Apulia (54.7%), Molise (51.5%), Piedmont (50.3%), Veneto (50.2%).

Pillar II is relatively more important in Aosta Valley (49.2%), Umbria (41.4%), Sardinia (37.6%), Campania (35.1%), Calabria (33.3%) (Briamonte and Vaccari, 2021).

Figure 6 - Incidence of public support by source of origin and by region (2010-2019 average)



Source: 'Agricultural expenditure of the regions' database, CREA-Centro PB.

Tuscany, Abruzzo, Emilia-Romagna, Basilicata, Friuli Venezia-Giulia, Lombardy are among the Northern regions and Tuscany is among the central ones that benefit most from State transfers.

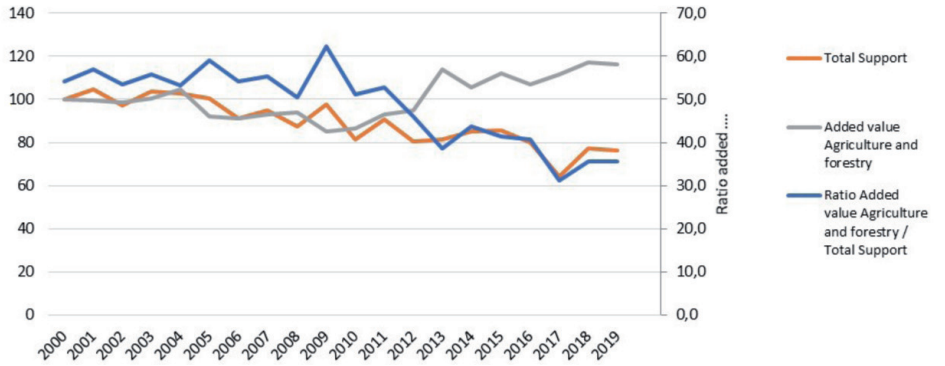
The highest support deriving from the benefits is observed in Liguria, Latium, Trentino South Tyrol, Friuli Venezia-Giulia, Aosta Valley, Abruzzo, Emilia-Romagna.

As we have seen, public support decreased especially over the last decade, while the added value shows an increasing trend in this period. Consequently, the ratio between the two quantities decreases from 54.6% in 2000 to 33.6% in 2019.

The report of support to Value Added in Italy is 41.8%. Regions where this value is higher than average are Aosta Valley (132%), Liguria (73%), Calabria (64%), Basilicata and Umbria (57%), Marche and Sardinia (52%), Piedmont (47%). Apulia, Molise, Sicily, Friuli-Venezia Giulia and Veneto regions are in line with the national average, while in the remaining regions the incidence of support is lower than the national average.

The information contained herein, in fact, highlight how public interventions in agriculture contributed to the development and evolution of the structural characteristics of agriculture in the Italian regions thanks to a comparison with one of the main economic indicators: the Added Value (Prestamburgo, 2001).

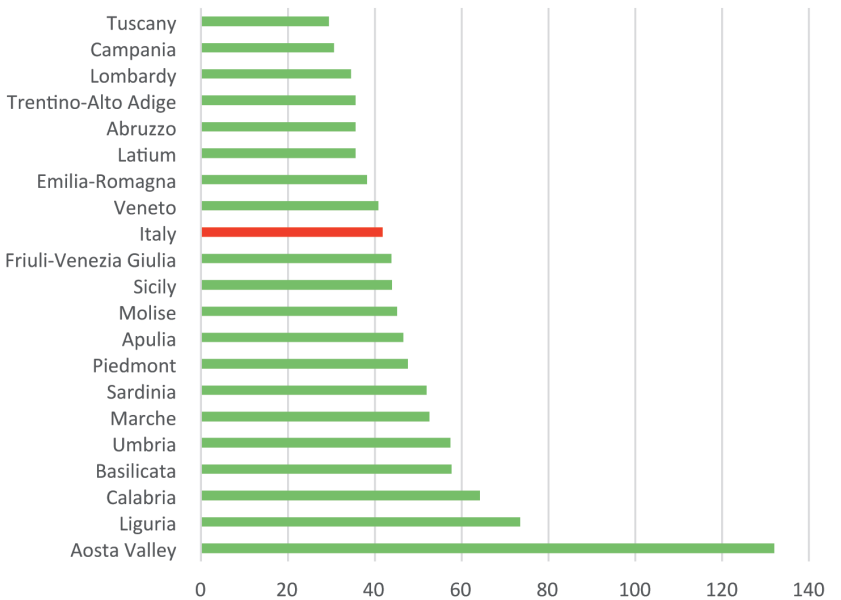
Figure 7 - Trends in public support and agricultural added value in Italy and their ratio (2000 = 100)



Source: 'Agricultural expenditure of the regions' database, CREA-PB.

The following figure shows the impact of support on added value in the different regions in the period 2010-2019.

Figure 8 - Incidence of public support on agricultural added value by regions (2010-2019 average)



Source: 'Agricultural expenditure of the regions' database, CREA-Center PB.

4. Conclusions

Government finance statistics are a basis for fiscal analysis, and they play a vital role in developing and monitoring fiscal programs and in conducting surveillance of economic policies (International Monetary Fund, 2014).

Over the last twenty years, public support for agriculture has decreased significantly (EUR-4 billion). This decrease is mainly found in tax and social security reliefs and Regional transfers. Transfers from Ministries are also decreasing. In contrast, in the period 2010-2019, EU transfers increase (+ € 705 million) and essentially stop the decrease in support. Overall, public support rewards the North (43.7% of resources), followed by the South (27.0%) and the Centre and Islands are clearly detached.

On average in the last ten years, it is the first pillar of the CAP that has the highest impact on support (36.7%), followed by benefits (20.9%) and the resources of the second pillar (20.5%). Regional transfers account for 17.5% and finally State transfers for 4.4% (Galluzzo 2022).

Finally, it can be said that agriculture is less and less an assisted sector (from 54.2% to 33.6% the incidence of support on value added in the last twenty years) and that it is more assisted in the North than in the South (43.7% versus 27.0%).

In Italy, different patterns of territorial support and different support impact capacities are evident, demonstrating the necessity for greater diversification of support according to the different morphological and economical characteristics of each region.

The lower weight of support on added value indicates that Italian agriculture is performing better and that some products (such as wine), even without aid, manage to perform well without support.

Among the Northern regions those that manage to receive most support are Lombardy, Emilia-Romagna and Veneto. The Southern regions like Apulia and Sicily follow only in fourth and fifth place.

In conclusion, it should be pointed out that the presented results are strictly linked to the methodology adopted by CREA. This methodology adopts a specific framework considering the different sources of financial resources and the complex multi-level governance system of public intervention in agriculture. The purpose of CREA is to deepen further this framework with regard to the issues of comparability between countries.

Also, with regard to the photograph illustrated in this article, it would be interesting to evaluate with a next review the possible additions to the public support currently activated and to see the changes that have taken place in the Italian agricultural system after Covid-19 phase.

References

Allen, S.L., & Qaim, M. (2012). *Agricultural Productivity and Public Expenditures in Sub-Saharan Africa*. Washington, DC: International Food Policy Research Institute. -- Retrieved from https://tapipedia.org/sites/default/files/ifpridp01173.pdf.

Antonelli, G., Bagarani, M., & Mellano, M. (1989). *Modelli di spesa e politica agraria regionale: Un'analisi della spesa pubblica delle regioni a statuto ordinario*. Milano: FrancoAngeli. -- Retrieved from www.francoangeli.it/Ricerca/Scheda_libro.aspx?isbn=9788820434311&titolo=Modelli+di+spesa+e+politica+agraria+regionale.+Un%27analisi+della+spesa+pubblica+delle+regioni+a+statuto+ordinario.

Antonelli, G., & Mellano, M. (1980). La spesa per l'agricoltura delle regioni a statuto ordinario. Un bilancio di politica agraria. *Rivista di economia agraria*, *3*(3), 597-628.

Antonelli, G., & Mellano, M. (1981). La politica agraria delle regioni attraverso la spesa pubblica. *Questione Agraria*, (3), 67.

Briamonte, L., & D'Oronzio, M.A. (2004). *Analisi e monitoraggio della spesa agricola: La Basilicata*. Roma: INEA. -- Retrieved from www.researchgate.net/publication/345627022_ANALISI_E_MONITORAGGIO_DELLA_SPESA_AGRICOLA_LA_BASILICATA.

Briamonte, L., & Ievoli, C. (2010). *Spesa agricola regionale e federalismo fiscale: Problemi di determinazione dei fabbisogni finanziari*. Napoli: Edizioni scientifiche italiane. -- Retrieved from www.researchgate.net/profile/Lucia-Briamonte-2/publication/345740315_SPESA_AGRICOLA_REGIONALE_E_FEDERALISMO_FISCALE_Problemi_di_determinazione_dei_fabbisogni_finanziari_a_cura_di_Lucia_Briamonte_e_Corrado_Ievoli_Edizioni_Scientifiche_Italiane/links/5fac2ef092851cf7dd12bcf9/SPESA-AGRICOLA-REGIONALE-E-FEDERALISMO-FISCALE-Problemi-di-determinazione-dei-fabbisogni-finanziari-a-cura-di-Lucia-Briamonte-e-Corrado-Ievoli-Edizioni-Scientifiche-Italiane.pdf.

Briamonte, L., Pergamo, R., & Cristofaro, A. (2012). *Fiscalità in agricoltura: Struttura normativa e quadro statistico a livello nazionale e regionale*. Napoli: Edizioni scientifiche italiane.

Briamonte, L., & Vaccari, S. (Eds.) (2021). *Venti anni di sostegno pubblico al settore agricolo*. Roma: CREA. -- Retrieved from www.crea.gov.it/web/politiche-e-bioeconomia/-/indagine-spesa-pubblica-agricoltura.

Colombo, G. (1990). *La politica agricola delle regioni a statuto ordinario (1970-1985)*. Padova: CEDAM.

Colombo, G. (1991). *Il filo di Arianna della politica agricola regionale*. Bologna: il Mulino.

FAO (2022). *Government expenditures in agriculture 2001-2020 Global and regional trends*. Rome: FAO.

Galluzzo, N. (2022). Estimation of the impact of CAP subsidies as environmental variables on Romanian farms. *Economia agro-alimentare*, (3), 1-24. doi: 10.3280/ecag2021oa12772.

Gaudio, F. (1996). La spesa agricola regionale in Calabria. In: Anania G. (a cura di), *Spesa pubblica e politiche per l'agricoltura in Calabria*. Catanzaro: Ursini Editore.

Govereh, J., Chilonda, P., Malawo, E., Jayne, T.S., & Rugube, L. (2011). Methodological guidelines for tracking public agricultural expenditure with illustrations from Zambia. *Journal of Development and Agricultural Economics*, *3*(5), 210-221.

International Monetary Fund (Ed.) (2014). *Government finance statistics manual 2014*. Washington D.C: International Monetary Fund. -- Retrieved from www.imf.org/external/Pubs/FT/GFS/Manual/2014/gfsfinal.pdf.

Nencioni, M.C., & Vaccari, S. (Eds.) (2002). *La dinamica territoriale della spesa per l'agricoltura. Gli anni del decentramento amministrativo*. Roma: INEA.

Olomola, A., Mogues, T., Olofinbiyi, T., Nwoko, C., Udoh, E., Alabi, R.A., Onu, J., & Sileshi, W. (2014). *Analysis of agricultural public expenditures in Nigeria: Examination at the federal, state, and local government levels*. International Food Policy Research Institute. (Discussion Paper 1395). -- Retrieved from http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/128804.

Orlando, G. (1984). *La politica agraria italiana attraverso l'analisi della spesa pubblica*. Milano: FrancoAngeli.

Prestamburgo, M. (Ed.) (2001). *La politica agraria delle regioni italiane: Caratteristiche strutturali e tendenze evolutive*. Milano: FrancoAngeli. -- Retrieved from www.francoangeli.it/Ricerca/scheda_libro.aspx?Id=7502.

Sotte, F. (2000). *La spesa agricola delle regioni: Quadro evolutivo e analisi quantitativa*. Roma: Istituto nazionale di economia agraria. -- Retrieved from www.researchgate.net/publication/345749260_LA_SPESA_AGRICOLA_DELLE_REGIONI_Quadro_evolutivo_e_analisi_quantitativa_a_cura_di_Franco_Sotte.

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Commentary on Italy's international seafood trade and its impacts

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Abstract

Being within a geographical area, EU-27, which imports a large proportion of the fish products consumed annually from abroad, Italy finds itself in a particularly critical situation; domestic production from fishing and aquaculture on the whole accounts for only 20% of consumption and even less in the case of crustaceans and cephalopods.
Despite its strong dependence on foreign countries, per capita consumption is quite high, at 31 kg/y in recent times; furthermore, among the imports from abroad there is a large number of species (or their families) mostly obtained through fishing. A wiser exploitation of national fishing resources, a greater development of domestic aquaculture and consumption patterns relying less on wild fish and shellfish are desirable.

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Introduction

Aquatic animals derived from fisheries and aquaculture and the products derived from them are widely traded, generating an international flow of exports worth, on a global scale, approximately USD 164 billion in 2018, in terms of custom value (FAO, 2020).

Worldwide, a large amount of fish products tend to converge towards areas with a high standard of living, such as the EU-27 (as well as the former EU-28, including Great Britain), the USA and Japan, while the countries of origin are mainly China, Norway, Vietnam, India, Ecuador and other minor areas (EUMOFA, 2017a, 2018 and 2019).

The volume of flows, the large number of involved aquatic species, the great distances travelled and the various processes to which the meat of many species is subjected lead to questions about the "sustainability" of the international fish product trade today. In fact, the carrying out of every human activity in terms of "sustainable development" (which was shortly defined as "development that meets the needs of the present without compromising the ability of future generations to meet their needs" in a seminal report by the UN Burtland's committee, 1987) implies a short and long-term vision of it from the point of view of environmental, social and economic impacts (Barclays, 2012; Stanton, 2012).

Consequently, in this note, the net flows of fish arriving to Italy from abroad have been examined (considering both the consignments coming from and going to the other EU-27 states, which, according to current legislation, are to be considered exchanges within the European Union, as well as imports and exports with third states) from the perspective of the statistics on Italian foreign trade published on a specific website of the national statistical body (part of the EUROSTAT network), focusing on products deriving from fishing activities for which Italian imports are particularly large (in terms of biomass or fraction of world catches or those in the European seas) and attributable to one or few populations of marine animals. The identification of these fish products whose consumption is particularly high in Italy can be useful to induce greater awareness in citizens of the unsustainability of this pattern, as national fish consumption may contribute to excessive withdrawals from wild stocks that could eventually jeopardize the state of the same populations. This applies in particular to those not subject to regular scientific assessments on their abundance and productivity, and/or induce an increase in fishing effort on these populations or those of related species to meet the growing worldwide demand for fish products (Harding, 1968; FAO, 2018 and 2020).

A greater awareness of the multiple impacts of their fish consumption can, in turn, lead many Italians to selectively reduce it, to further favour

purchasing products derived from aquaculture, and to have a more positive attitude towards the installation of more fish and shellfish farms in national freshwaters, lagoons and coastal marine waters.

1. Methodology

For the purposes of this note, the trend of net trade flows to Italy and EU-27 of fresh or frozen "fish" (mostly teleosts) or fillets, crustaceans and marine molluscs was examined for the period 2012-2019 and then focused on 2016-2019.

Since the Italian and EU trade statistics provide data on the quantities of fish products as "commodity weight" (CWE, the weight of each product, excluding the preserving liquid of many canned preparations), they have been transformed into "equivalent live weight" (LWE) based on the conversion factor tabulated for each fish or shellfish product listed in the EU Common Nomenclature of goods (EUMOFA, 2020a) to reconstruct the original biomasses and compare them with the estimates of fishing and aquaculture production, which have been presented in live weight for years (EUMOFA, 2018 and 2019; FAO, 2018 and 2020). Data on the exchanges of fish products with foreign countries have been traced at the maximum available detail on the websites of ISTAT Coeweb or EUROSTAT; the codes relating to the various items of the EU Common Nomenclature are based on the worldwide Harmonised System of commercial goods (WCO, 2018), where the codes can be two, four or six digits, and the number of items and the detailed descriptions of goods increase with the number of digits.

In particular, the EU Common Nomenclature (previously in force in the EEC) can further subdivide the most detailed six-digit (HS6) commodity codes of the Harmonized System by adding two terminal digits to them to describe the various product in more detail; these CN codes are 8 digits (with the last two being 00 if a certain HS code remains undivided). The Common Nomenclature 8-digit codes (hereafter referred to as CNCs) are used to describe goods in trade among member states and their exports to non-EU states. However, products from non-EU states (constituting imports in the strict sense, under EU legislation) can be described in greater detail through the TARIC system (in which the codes assigned to the various goods are derived from those of the Common Nomenclature by adding two further terminal digits and are 00 in each unseparated category) with 10-digit codes that characterize the goods in greater detail so duties can be imposed depending on the nature of the products and the country of origin (EEC, 1987; EU, 2021; footnote 1).

Foods derived from aquatic animals used for direct human nutrition are part of sections HS03 and HS16 of the Harmonized System, which refer, respectively, to "Fish and crustaceans, molluscs and other aquatic invertebrates" (with 392-409 and 419-455 derived CNCs, respectively, in 2012-2015 and 2016-2019) and "Preparations of meat, fish and crustaceans or molluscs or other aquatic invertebrates" (55-61 and 61-62 CNCs during the same periods). For the products of these two HS sections, we searched for all derivative 8- digit CNCs listed in EUMOFA (2020a) for each of the years between 2012-2019, with a description of the nature of the product identified with each EU Common Nomenclature code and the corresponding factor of conversion of the commodity weight into the live weight of the aquatic animals of origin. It is important to note that since the work of EUMOFA (2020a) is based on the subdivision of fish products in the EU Common Nomenclature, the conversion factors defined to estimate the LWEs from CWEs are valid only for those categories.

Using the 8-digit CNCs, data on the commercial flows of fish and shellfish commodities to and from Italy were obtained on the ISTAT Coeweb website (URL: www.coeweb.istat.it) (considering both non-EU countries and the other state members of the European Union), which were then turned into LWE using the conversion factors in EUMOFA (2020a). As ISTAT is part of EUROSTAT, the identical data could have been obtained on the latter body's website (URL: https://ec.europa.eu/eurostat/data/database), but the ISTAT Coeweb site was preferred because it is focused on the trade of Italy with foreign countries; therefore, the search of the relative data is done simply by entering the year and the CN code, with the website presenting both the trade flows in and out of Italy for the three-year period ending in the required year and showing some of the main countries (or customs areas) of origin or destination. On the EUROSTAT website, the search methods for these data are more complex, and responses take much more time because every member state and the whole EU are considered.

For the data relating to the quantities of the various marine species landed yearly by the fleets of the EU states (as well as for the quantities of the species raised in aquaculture), it is necessary to use the EUROSTAT website (which uses the data obtained for both activities, for over 20 years, from specific surveys partially financed with EU funds; EU, 2017), as they are not available on the aforementioned ISTAT website. These data are then communicated by EUROSTAT to FAO (entering the FISHSTATJ database) and to other international organizations.

Despite being the most detailed classification available in the EU Common Nomenclature, most of the 8-digit CNCs it contains only allow for the identification of products obtained by several related species; for example, those of the same genus or the same family, but also groups of species

"assembled" for commercial or practical reasons would be grouped under the same 8-digit CNC. This is the case of category CN03038910 concerning "unidentified and frozen fish" in the current version of the Common Nomenclature (EUMOFA, 2020a). Only some CNCs pick out single fish or shellfish species (or a cluster of few species) and, therefore, the commercial data relating to the corresponding net flows to Italy in 2012-2015 and 2016-2019.

The net commercial flows of species or groups of species for which intense breeding activities are known are attributed to aquaculture (salmon, trout and other salmonids, seabasses and seabreams, mussels, oysters) as are the set of fish products attributed to freshwater teleosts, regardless of the systematic level in which they are classified (or grouped) in the statistics of ISTAT Coeweb. However, the teleosts described as "marine" or "unidentified" were all considered to be derived only from fishing. Moreover, the EU Common Nomenclature codes labelling crustacean products of the items CN03061792 (frozen Peneid shrimps other than *Penaeus longirostris*), CN16052110, CN16052190, and CN16052900 (prepared or preserved shrimps and prawns in various packages) were entirely attributed to reared species on the basis of several bibliographic sources (Ngamprsertkit, 2018; World Bank, 2018; Cai *et al*., 2019; DIT, 2019).

For the commercial categories of the EU common nomenclature concerning single (or few) fish species mainly obtained through fishing activities, the Italian yearly *per capita* consumption was compared with that of the remaining population of the world or of the EU-27 for species mainly caught outside or within European seas, respectively. The comparisons between *per capita* consumption in Italy and all the other countries examined were made using the Mann-Whitney nonparametric test (which has the great advantage of not implying that data are distributed according to a Gaussian curve) relating only to the years 2014-2018 or 2014-2019 because the frequent updates to both the Harmonised System and the EU common nomenclature do not allow long time series (EUMOFA, 2020a). In some cases, missing or even presumably spurious data (because they are strongly incoherent within a time series) on the annual landings of some species (or their groups) have been estimated by averaging data from contiguous years; nevertheless, the data were all considered independent because the few adjustments affected modest portions of the biomass consumed in the geographical areas being compared.

Per capita consumption was estimated by dividing the annual quantities of one or more fish species by the total population attributable to a given area, rounding the figures to the nearest 0.01 kg and giving them distinct ranks in the statistical test if they differed by at least 0.03 kg; additionally, to avoid misclassification and/or misreporting of products invalidating the

comparisons, the values relating to the area with the higher *per capita* consumption were deliberately reduced by 20% in the Mann-Whitney tests (Table 1).

Moreover, the net LWE flows of products originating from elasmobranchs as well as from "forage fish" (i.e., schooling fish species located at low or middle levels of the trophic chains in marine or fresh waters, with populations that are usually abundant, allowing large quantities to be easily caught while maintaining mortality at levels acceptable for the stocks; Alder *et al*., 2008; Mkunda *et al*., 2018) have been noted, as their consumption should be avoided or, conversely, increased (at least to some extent; Kim *et al*., 2020).

For the purposes of these comparisons, the world population was estimated at 7.21 and 7.55 billion people for the periods 2012-2015 and 2016-2019, respectively, while for the EU-27 and Italy, it was accepted that the respective populations remained at approximately 380 and 60 million individuals, respectively.

2. Results

In 2016-2019, under item HS0302 (fresh or chilled fish; see footnote 2), there was an overall net flow towards Italy corresponding to a biomass of 134,000-162,500 t/y, with parallel customs cash flows between € -850 and € -960 million per year, for 89-97% towards the other states of the current EU-27; 60-65% of the biomass came from abroad (considering jointly trade with other EU states and import proper, i.e. from non-EU areas) derived from fish farming (the main species being Atlantic salmon, seabream and European seabass). In 2012-2015, the net inflow from abroad under the same HS0302 item ranged from 103,500-123,000 t/y in LWE, mainly deriving from pisciculture (only 30,000-35,500 t/y from foreign fisheries).

For frozen fish, whole or headless or eviscerated (HS0303), in 2016-2019, the net flow from abroad was -89,000/-96,000 t/y LWE (corresponding to financial liabilities between € 285 and € 305 million per year), with products from fish farming accounting for a modest amount, which contributed approximately 9-13%. In the previous four years, the net flows to Italy of HS0303 goods were rather stable, between -86,700 and -88,800 t/y in live weight (ISTAT Coeweb).

The net flow of fish fillets (HS0304) to Italy was between -296,500 and -311,500 t/y in estimated live weight and between -658 and -777 € million in 2016-2019; farmed species accounted for 20% LWE, although there is some uncertainty in the products attributed to aquaculture. In the previous four

years, analogous flows had been -262,000/-292,000 t/y, with an incidence of reared fish of 63,000-74,000 t/y.

Taking into consideration the smoked, dried, salted or marinated fish (HS0305) in 2016-2019, Italy recorded a deficit of -115,000/-120,000 t/y LWE (in financial terms, between -440 and -475 € million per year), and the fraction attributable to farmed species was 33-36%. In 2012-2015, the analogous flows were between -102,000 and -122,000 t/y, with 27-34% of that due to farmed species (ISTAT Coeweb).

The net flows of crustaceans (HS0306) to Italy were -122,000/-130,000 t/y LWE 2016-2019 (ISTAT Coeweb), to which similar flows between -9,800 and -11,800 t/y were added due to the preserves of animals from this phylum (7 CNCs within the chapter HS1605, concerning prepared or preserved aquatic invertebrates), so that the national production of crustaceans, on average approximately 22,000 t/y (EUROSTAT), covered only 15% of consumption. In 2012-2015, the net flows of chapter HS0306 were -109,500/-118,000 t/y as estimated biomass, with further analogous flows between -8,000 and -9,000 t/y in the form of prepared or preserved crustaceans. Yearly liabilities due to foreign trade of crustaceans and derived products fluctuated between 694-753 € million in 2016-2020.

Crustaceans from aquaculture (CN03061792, CN16052110, CN16052190 and CN16052900, entirely originating from outside of European areas) consisted of net flows between -43,600 and -46,700 t/y LWE in 2016-2019, approximately one-third of the net inflows from abroad of these invertebrates when considering fresh and chilled or frozen crustaceans together with those of chapter HS1605. In 2012-2015, the contribution of the mentioned CNCs was higher, i.e., 37-42% of the crustacean biomass estimated in the various years (ISTAT Coeweb; EUMOFA, 2020a).

The net flow of molluscs from abroad was -304,000/-361,000 t/y in LWE in 2016-2019 when considering jointly the product classified under chapter HS0307 and that of chapter HS1605 used for preserves of the animals of that zoological *taxon* living in the sea and between -301,500 and -378,000 t/y in the previous four years, with liabilities between € 1,075 and 1,162 million/y during the first period (ISTAT Coeweb).

Considering the cephalopods alone (EU Common Nomenclature codes from CN03074110 to CN03075990 in 2016 and from CN03074210 to CN03075900 in 2017-2019, with 19 and 24 CNCs, respectively, plus CN16055400 and CN16055500 for the preserved individuals; EUMOFA, 2020a), the net flow fluctuated between -234,000 and -251,000 t/y in LWE during 2016-2019 (with liabilities between € 808 and 1,055 million per year), while in 2012-2015, the analogous flows were -218,000/-232,000 t/y including the small share of preserved cephalopods. Consequently, the national catch,

approximately 16,000-21,000 t/y in 2012-2019 (EUROSTAT), covered only 7-8% of domestic consumption.

Examining canned fish (HS1604), net flows from abroad fluctuated (after conversion of the CWEs reported in the ISTAT Coeweb statistics into LWEs) between -368,000 and -386,000 t/y in biomass (€ -765/-890 million per year) during 2016-2019. The share of farmed species (or their groups) is not easily estimated but seems not to exceed 8,500 t/y in live weight, i.e., not more than 3.5% of the equivalent live product of section HS1604. In the previous four-year period, the net liabilities in section HS1604 were 334,500-375,500 t/y, and the role of fish farming was small in supplying products for canneries (undetailed data).

By combining the estimates relating to net product flows of sections HS0302-HS0307 and HS1604-HS1605, we arrive at totals of net fluxes ranging, in terms of equivalent live weight, between -1,507,000 and -1,525,500 t/y in 2016-2019. To these quantities is added the fleet catch and national aquaculture production, for a total of approximately 355,000 t/y in fresh weight in 2016-2018 (out of which approximately 90,000 t/y were molluscan bivalves; Anonimo, 2019; EUROSTAT; Tudini, 2020).

The estimate in terms of equivalent live weight of the Italian commercial flows of fish product makes it possible to evaluate the incidence of domestic consumption on the world catches (alternatively, on those from the European seas) of some species (or their groups) that are obtained almost exclusively through fishing. In particular, the commercial statistics in ISTAT Coeweb (therefore also in EUROSTAT) made it possible to detect the following cases (see Table 1):

Monkfish (*Lophius* spp.) (ALPHA3 codes = MON, MVJ, ANG and ANK) (EUROSTAT code: MNZ)

In the EU Common Nomenclature, starting from 2012, there were the following four numerical codes concerning products taken from specimens of *Lophius* spp.: CN03028950, CN03038965, CN03048960 and CN03049965 (EUMOFA, 2020a). Considering these codes together, it was inferred that the net inflows to Italy were, in terms of LWE, 13,000-16,500 t/y in 2014-2019 (ISTAT Coeweb). Unfortunately, estimates are lacking for most of the period on the national catch of monkfish, but the EUROSTAT data on landings of the Italian fishing fleet show a production of approximately 1,400 t/y at the end of the period 2004-2014, and the same can be admitted for the following years (EUROSTAT). Consequently, the Italian *per capita* consumption of monkfish is estimated at 0.24-0.28 kg/y in the period 2014-2019.

In the same period, the EU-27 imports were 47,500-57,500 t/y in terms of LWE, whereas total landings of all national fleets can be roughly estimated at 30,000 t/y by gathering data from various sources (EUROSTAT; ICES, 2019 and 2021). Consequently, the *per capita* consumption rates of the remaining

EU-27 (i.e., the EU- 27 excluding Italy) citizens result in 0.17-0.18 kg/y, which is significantly lower than those of Italians (Table 1). Moreover, in Italy, the level of procurement through the national fleet was 8-10% in 2014-2019 vs. 40- 45% for all the other EU member states.

European plaice (*Pleuronectes platessa*) (ALPHA3 code = PLE)

By combining the items CN03022200, CN03033200 and CN03048310, it was possible to deduce that in terms of estimated live weight, the net flow to Italy was -24,500/-30,400 t/y in 2014-2014, while FAO data show that the fishing carried out in the European seas (species' area) gave annual landings of 80,100-116,700 t in the same period (EUROSTAT; FAO's FISHSTATJ). Since the species is mainly consumed in the EU-27, the *per capita* consumption rates in Italy and all other countries of the current EU were compared (Table 1), and it was found that in the former case, the average annual consumption was 0.41-0.49 kg vs. 0.12-0.21 kg in the rest of the EU-27, with the two clusters of values statistically differing from each other ($U=36$; $p<0.01$).

Table 1 – List of some marine animal species (or groups) whose national consumption mainly derives from foreign fisheries and comparison of the per capita consumption rates in Italy and in the rest of the world or the EU-27

Consumption in Italy during the period, in tons and live weight [data source(s)] (range of the annual *per capita* consumption rates)	**Consumption in the rest of the EU-27 in the period, in tons and live weight [data source(s)] (range of the annual *per capita* consumption rates)**	**Consumption in the rest of the world in the period, in tons and live weight [data source(s)] (range of the annual *per capita* consumption rates)**
Monkfish (*Lophius* spp., years 2014-2018) 78,200 t [EUROSTAT; ISTAT Coeweb] (0.24 kg – 0.28 kg)**	338,500 t [EUROSTAT] (0.17 kg – 0.19 kg)**	- -
European plaice *(Pleuronectes platessa*, years 2014-2019) 166,300 t [EUROSTAT; ISTAT Coeweb] (0.41 kg – 0.51 kg)**	381,700 t [EUROSTAT; FISTSTATJ] (0.12 kg – 0.18 kg)**	- -
Swordfish (*Xiphias gladius*, years 2014-2019) 187,900 t [EUROSTAT; ISTAT Coeweb] (0.45 kg – 0.56 kg)**	- -	534,000 t [FISHSTATJ] (0.01 kg – 0.01 kg)**
Yellowfin tuna (*Thunnus albacares*, years 2015-2019) 650,800 [EUROSTAT; ISTAT Coeweb] (1.85 kg – 2.39 kg)*	- -	6,785,600 [FISTATJ] (0.18 kg – 0.19 kg)*

Table 1 – Continued

Consumption in Italy during the period, in tons and live weight [data source(s)] (range of the annual *per capita* consumption rates)	**Consumption in the rest of the EU-27 in the period, in tons and live weight [data source(s)] (range of the annual *per capita* consumption rates)**	**Consumption in the rest of the world in the period, in tons and live weight [data source(s)] (range of the annual *per capita* consumption rates)**
Lobsters (*Homarus* spp., years 2014-2019) 25,550 [EUROSTAT; ISTAT Coeweb] (0.07 kg – 0.08 kg)**	84,700 [EUROSTAT] (0.04 kg – 0.04 kg)**	- -
Norway lobster *(Nephros norvegicus*, years 2014-2019) 114,300 [EUROSTAT; ISTAT Coeweb] (0,27 kg – 0,36 kg)**	136,300 [EUROSTAT] (0.05 kg – 0.06 kg)**	- -
[a]Argentine shrimp (*Pleoticus muelleri*, years 2015-2019) 162,300 [EUROSTAT; ISTAT Coeweb] [b](0.47 kg – 0.55 kg)	- -	- -
All other wild crustaceans (many species, years 2014-2019) 319,700 [EUROSTAT] [c](0.65 kg – 1.05 kg)**	901,500 [EUROSTAT] [c](0.31 kg – 0.47 kg)**	- -
Cephalopoda spp. (years 2014-2018) 1,180,000 [EUROSTAT; ISTAT Coeweb] (3.49 kg – 4.20 kg)*	- -	19,280,000 [Arkhipkin, 2020] (0.45 kg – 0.65 kg)*
Atlantic scallop (*Pecten maximus*, years 2014-2019) 85,000 [EUROSTAT; ISTAT Coeweb] (0.15 kg – 0.55 kg)*	243,500 [FISHSTATJ] (0.07 kg – 0.19 kg)*	- -

*: data clusters related to species (or group of species) whose *per capita* consumption rates differed in distinct geographic areas with $p<0.02$;
**: data clusters as above, differing from each other with $p<0.01$;
[a]: identified as CN03061799 crustaceans coming from Argentina;
[b]: see text on the *per capita* consumption rates in Italy and Spain;
[c]: all crustacean products except those listed above or classified CN03061792, CN16052100, CN16052190 and CN16052900 in the EU Common Nomenclature

Swordfish (*Xiphias gladius*) (ALPHA3 code = SWO)

This valuable teleost is present on the market in various preparations – fresh or chilled, frozen, filleted or with minced meat – so by combining the linked items, it is possible deduce that the net flows to Italy were, as

LWE, between 24,600 and 30,000 t/y in 2014-2019, while the national fleet landed approximately 1,800-4,000 t/y (EUROSTAT), reaching a domestic consumption of 28,000-33,400 t/y.

In the same period, the FAO estimated the world catches of the species at 111,200-120,300 t/y (FISHSTATJ); therefore, the great weight of national consumption on the global scale is clear, with an average *per capita* consumption of 0.45-0.56 kg/y in Italy vs. 0.01-0.01 kg/y in the rest of the world ($U=36$; $p< 0.01$; Table 1).

Yellowfin tuna (*Thunnus albacares*) (ALPHA3 code = YFT)

Summing up the net flows of the CNCs concerning the various market preparations of this species (eight CNCs in 2015-2016 and seven in 2017-2019), after conversion of the commercial data in the corresponding live weights, total arrivals of 111,300-143,200 t/y were obtained in 2015-2019 (ISTAT Coeweb), which was approximately 8-9% of the annual catches of *T. albacares* during that period (FISHSTATJ).

The strong inflows of this tropical tunnid allowed *per capita* consumption rates in Italy of 1.85-2.39 kg/y in the five-year period compared to 0.18-0.19 kg/y for the rest of the world population, and the difference was statistically relevant ($U=25$; $p<0.02$).

Lobsters (*Homarus* spp.) (ALPHA3 codes = LBA and LBE)

FAO data show that the world catches of lobsters, *Homarus* spp., were approximately 163,000-168,000 t/y in 2014-2019, consisting of 96-97% *Homarus americanus* (present in the coastal waters of the NW Atlantic) and the remainder from the European congener *H. gammarus* (FAO; FISHSTATJ).

By summing up the CNCs related to *Homarus* spp., there were 13,000-19,300 t/y imports in live weight to the EU-27, to which are added the modest catches of the Union fleet of *H. gammarus*, equal to 725-1,255 t/y in the period (EUROSTAT). Although the Italian catches of European lobster are nearly zero (EUROSTAT; Pavicic *et al*., 2020), the domestic *per capita* consumption, 0.07-0.08 kg/y, was significantly higher than in the rest of EU-27 in 2014-2019, although the difference was small (Table 1).

Norway lobster (*Nephrops norvegicus*) (ALPHA3 code = NEP)

Norway lobster is a very popular crustacean in Italy, feeding net inflows from other European or Mediterranean countries (the species is spread in the NE Atlantic and connected seas) of 15,000-20,500 t/y in 2014-2019 in terms of estimated biomass (in 2014-2016 through the codes CN03061510, CN03061590, CN03062510 and CN03062590; in the following three years with the items CN03061500, CN03063400 and CN03069400), while from the national fleet 1,300-1,800 t/y were obtained (EUROSTAT). Italian

consumption was therefore 16,250-21,850 t/y during that period, equal to 31-43% of world catches in the various years (EUROSTAT; FISHSTATJ).

The Italian consumption was therefore estimated to be 0.29-0.36 kg/y compared to 0.05-0.06 kg/y for the remaining population of the EU-27, and the difference between the two ranges was highly significant ($U=36$; $p<0.01$); furthermore, in Italy, the langoustine catches of the Italian fleet were 7-9% of national consumption, while that of the remaining population of the EU-27 was almost exclusively covered by the pertinent cumulative catches of the other national fishing fleets (EUROSTAT).

Argentine shrimp (*Pleoticus muelleri*) (ALPHA3 code = LAA)

Since 2015, the Argentine shrimp *Pleoticus muelleri* has been part of a heterogeneous group of crustaceans coded CN03061799 in the EU Common Nomenclature (frozen shrimps and shrimps other than Pandalidae spp., *Crangon* spp. and Peneidae spp.); however, the species in question accounts for almost all exports from Argentina for this group of crustaceans (CEDEPESCA, 2017), and thus, all Italian imports from that country under item CN03061799 refer to *P. muelleri*. By adopting a conversion factor to live weight of 1.38, we found that the Italian net imports from Argentina for this shrimp were 19,000-28,350 t/y in 2015-2019. Similar imports passing through Spain must be added to these direct imports, accounting for approximately 4,500-6,500 t/y LWE in the same period, meaning that Italian consumption was approximately 14-18% of the annual catches of the species (ISTAT Coeweb; FISHSTATJ).

However, within the EU-27, the largest imports of *P. muelleri* (of which the Argentine's fishing fleet takes almost all the world catches) are by Spain, which, despite sending some to other member states (especially Italy), is the largest European market for this species (EUROSTAT); their consumption levels are equal to or slightly higher than those of Italy in the same years (undetailed data).

Other wild crustaceans

Once all CNCs derived from crustacean aquaculture (CN03021792, CN16052100, CN16052190, CN16052900) have been eliminated along with all CNCs concerning lobsters, Norway lobsters and *P. muelleri* quantities directly reaching Italy from Argentina and indirectly through Spain, the remaining crustacean products come mostly from wild species. Table 1 shows that the *per capita* consumption rates on this heterogeneous cluster of crustaceans ranged from 0.65-1.05 and 0.31-0.47 kg/y in Italy and the rest of EU-27, respectively, during 2014-2019, and the value sets significantly differed from each other ($U=36$; $p<0.01$).

Cephalopoda spp.

As previously stated, almost all cephalopods present on the Italian market are supplied from abroad; however, it is not easy to assess the extent of the national consumption, estimated at approximately 210,000-265,000 t/y in live weight in 2014-2019 (ISTAT Coeweb), compared to the world catches of this class of animals because on a global level, the estimates are quite uncertain and are often the sum of the data relating to the most abundant species (Clark, 2020). However, referring to a graph in Arkhipkin (2020), it appears that in 2014-2018, the world catch of this molluscan subgroup was approximately 3.65-4.85 million t/y, and therefore, the national consumption equalled approximately 4-7% of the annual catches.

In *per capita* terms, Italian consumption was 3.49-4.20 kg/y in the five-year period, while for the remaining world population, it was 0.45-0.65 kg/y, i.e., 6-8 times lower. Despite the few years of comparison, the mentioned differences are highly significant ($U=25$; $p<0.02$).

Furthermore, it should be noted that in 2016-2018, the Italian consumption of cephalopods was about one- third of that of the then EU-28 (EUMOFA, 2017a, 2018, 2019).

Great Atlantic scallop (*Pecten maximus*) (ALPHA3 code = SCE)

The EU Common Nomenclature codes CN03072910 and CN03072210 refer, for the years 2014-2016 and 2017-2019, respectively, to frozen specimens of *P. maximus*, which are the major commercialized form of the species and usually have no valves (or only part of them), for which the LWE/CWE ratio is 6.50:1.00 (EUMOFA, 2020a). Considering only this item, in 2014-2019, the Italian net flow had a peak of -37,000 t live weight in 2016 (mostly coming from the United Kingdom) and between -9,000 and -12,500 t in the other years of the period (EUMOFA, 2020a). In 2016, national consumption corresponded to 56% of the species catch; in the other years, it constituted shares of 14-18% (FISHSTATJ).

In Italy, the *per capita* consumption of Atlantic scallops was 0.15-0.55 kg/y (therefore 0.12-0.44 kg/a taking the precaution of "cutting" these values by 20%) compared to 0.07-0.19 kg/y for the other 380 million citizens of the EU-27; however, the two clusters of values do not differ in statistical terms ($U=31$; $p = 0.05$). This implies that mislabelling/misreporting of products obtained by this molluscan bivalve could hinder an appropriate comparison among the *per capita* consumption rates.

3. Discussion

The EU is the economic area that imports the most fish products from external areas worldwide, with trade liabilities for the EU-28 of 19.7 billion € in 2016, 20.3 billion € in 2017 and 20.8 billion € in 2018 (EUMOFA, 2017a, 2018, 2019).

In the case of Italy, the dependence of the fish market on products of foreign origin is particularly notable because *per capita* consumption is somewhat higher than the average in the former EU-28 states (but not in comparison with consumption in Portugal, Spain, France and Greece as a whole; EUMOFA, 2017b), with 30.9-31.1 kg/y in 2016-2019 (for a total of approximately 1,850,000 t/y in live weight); moreover, fishing is not very productive, aquaculture is mostly stable, and the market demand is concentrated on a few species or groups of species (EUROSTAT).

Therefore, in 2016-2019, Italy recorded a trade deficit (considering jointly the flows with the EU-27 states and those with third countries) of -20.20 billion € in the four-year period, followed by France with a similar deficit of -17.45 billion and Germany with -10.87 billion (EUMOFA, 2017a, 2018, 2019). In 2016-2019, the net inflow of fish was approximately -1,050,000 t/y in terms of estimated biomass (including approximately 10,000 t/y of elasmobranchs and positive or negative net flows of several hundred tons LWE per year of "forage fish", mainly sardines, anchovies and horse mackerels), out of which 815,000 t/y of teleosts resulted from fishing activities; for comparison, the national production of teleosts was approximately 210,000 t/y (out of which approximately 60,000 t/y were from pisciculture), and therefore, the ratio with teleosts of foreign origin was 4:1 in terms of biomass (Anonimo, 2017; EUROSTAT; Tudini, 2020).

In the case of crustaceans and cephalopods, net flows from abroad were approximately 135,000 and 240,000 t/y, respectively, in live weight over the four-year period, which covered approximately 88% and 94% of national consumption, respectively; for crustaceans, it must also be noted that the contribution of farmed species (CN03061792, CN16052100, CN16052190, CN16052900) amounted to approximately 33% of Italian consumption and 50% of that in the rest of the EU-27.

The strong inflows from abroad imply that supplies to the Italian market can form nonnegligible shares of the catches made on certain fish stocks, so in Table 1, the flows relating to ten fish or shellfish species (or their groups) have been examined as well as their impacts on the corresponding global catches and *per capita* consumption rates in Italy and other broad geographical areas of comparison.

Luckily, for some of the species under examination, fairly frequent scientific monitoring is available to ensure that their populations are not

overexploited (at least this was known or hypothesized at the date of publication of the examined papers), a fact sometimes confirmed by stable or increasing catches in previous years (CEDEPESCA, 2017; ICES, 2019, 2020 and 2021, Myers and Moore, 2020); however, this is not the case for populations of other species or of heterogeneous groups of species.

In this regard, it should be noted that the situation of the *X. gladius* stocks is not well known worldwide, and in the Mediterranean Sea, a multiyear plan has been adopted to ease the reconstitution of the local population, and the global catches of the species have been decreasing in recent years (FISHSTATJ; ICCAT, 2021a, 2021b). For cephalopods, it is known that the world production of this large group of marine animals has greatly increased over the last 50 years and the populations of various species nevertheless appear to have a positive trend (perhaps in relation to the increase in water temperature and the rarefaction of some teleosts which are potential predators; Doubleday *et al*., 2016); however, the number of stocks being fished has also increased and global catches, after a peak of 4.70 million t/y in 2014-2015, were approximately 3.70 million t/y in 2016-2019 (FAO, 2018; Arkhipkin, 2020; Clark, 2020); thus, the possibility that some stocks are overexploited, especially in recent years, cannot be excluded.

If we consider that there has been a growing demand for fish products from fishing and aquaculture worldwide for years (FAO, 2018 and 2020), the strong Italian consumption of some species mainly obtained through fishing can be an excessive burden on the biological resources and persistently unbalances in the consumption of the resulting foodstuffs, laying the groundwork for an intensification of fishing in some areas (as each subject aims to have a greater share of common catches, even when they are declining; Harding, 1968) or an expansion of fishing towards new areas or new stocks and/or species.

The data reported in Table 1 show that for nine out of the ten fishing resources listed therein, the Italian *per capita* consumption rates were statistically higher than those in the other broad geographic areas taken as a reference for the periods under examination, with ratios in the *per capita* quantities which for *X. gladius* and the cephalopods were almost 40 and 8 times higher, respectively. Moreover, for all listed biological resources, domestic consumption is almost exclusively based on products of foreign origin.

In the case of American lobsters, it should also be noted that the commercialization of live specimens (CN0302210 in 2014-2016 and CN03063210 in 2017-2019, EUMOFA, 2020), which accounted for approximately 80% of the estimated biomass arriving in Italy during 2014-2019, is presumably the main factor in the expansion of this species in the coastal waters of the NE Atlantic and Mediterranean Sea (Pavicic *et al*., 2020).

Conclusion

This work highlights that within the EU-27, Italy has commercial deficits significantly higher than those of the other member states with similar populations. Inflows from abroad in 2016-2019 were approximately 1.50 million t/y in terms of live weight and were considerably concentrated on some species (or their groups), including those identified in Table 1 based on codes of the EU Common Nomenclature. For some of the listed species, Italian consumption makes up a significant part of their catches worldwide.

With a view to achieving more sustainable fish consumption in the short and long term, both in relation to the level of exploitation of wild stocks in the social equity of said consumption, it appears important that in Italy information campaigns are carried out to make citizens aware of the excessive consumption of some products and the need to further favour those derived from aquaculture and the importance of taking into consideration species little appreciated on the domestic market (e.g., tilapias).

Although for some species (or their clusters) listed in Table 1, FAO data and those from the examined literature show that there are no signs (or did not exist in the recent past) of their stocks being exploited outside their appropriate BRPs (Biological Reference Points, concerning the spawning biomass, fishery mortality and catches); however, this reassuring picture may not be true for stocks of swordfish and various species of cephalopods. Moreover, scientific assessments mainly concern the most economically relevant stocks, belonging to few target species, while many other fisheries are managed on the basis of historical official (often underestimated) data on fleets and catches and on knowledge of conspecific stocks, those of akin species or with interventions not strictly targeted (Carruthiers *et al*., 2014; STECF, 2021).

Beyond the lack of knowledge on the present and past status of many "minor" commercial stocks, there is the problem that among bony fishes and elasmobranchs, the adults of many species at higher trophic levels reach on average larger sizes (Romanuk *et al*., 2010), so they often have higher prices for weight units. These species are inherently less abundant per unit area than species at lower trophic levels (in fact, the efficiency of trophic chains is approximately 10%; thus, only this percentage of the biomass ingested by animals of a certain trophic level becomes additional biomass for them; e.g., Libralato *et al*., 2015), so they provide more modest catches, and their populations can easily be exploited beyond their renewal rates. Similarly, cephalopods are globally not abundant because they are carnivorous, feeding on fishes as well as crustaceans and other cephalopods (Jereb *et al*., 2005).

Finally, it should be considered that throughout the oceans, conspicuous IUU (illegal, unreported, unregulated) fisheries exist, with catches estimated

20-25 years ago at 11-26 million t LWE per year (mainly coming from marine waters off West Africa, NW Pacific and SW Atlantic), equal to 13-30% of the total catches at that time (FAO, 2002; Soldo, 2014; GFCM, 2022). Consequently, a high demand for products from wild fish stocks can facilitate the persistence, at high levels, of IUU fishing to meet the demands of these products in various parts of the world. Despite the actions taken by the EU to deter and repress IUU fishing (for example, through rules for precise labelling of fish products or to exclude nontraceable products from the market; EU, 2008 and 2013), bibliographic data show that the situation is still serious (Pramod *et al*., 2014 and 2017), although presumably less than in the recent past.

With regard to aquaculture, it is necessary to keep in mind that within 15-20 years, 70% of fish products will presumably come from this source (Black and Hughes, 2017), and it is considered important to develop mariculture (currently, freshwater aquaculture still prevails in biomass and economic turnover; FAO, 2018 and 2020) to allow marine ecosystems to significantly contribute to human nutrition, partly safeguarding terrestrial ecosystems (SAPEA, 2017).

In Italy, a better exploitation of fishing resources and a greater development of national aquaculture (a sector that in the last 30 years has encountered considerable difficulties in finding new production sites, as has also happened in other EU-27 countries, due to bureaucratic hurdles, competition with other uses of freshwater and coastal marine areas and, implicitly, also due to the large inflow of cheap fish products from abroad; Macias *et al*., 2019) would allow an increase in domestic production, which would not be very high due to the limited availability of suitable sites and adverse climatic factors (e.g., Rodrigues *et al*., 2015).

Nonetheless, it is desirable that aquaculture can grow in Italy, with a view of reducing the dependence on foreign fish products and producing local economic development. In this regard, Directive 2014/89/EU provided an important legal tool to identify new areas for aquaculture, i.e., AZA zones in the coastal waters of the various Italian administrative regions (by mid-2020, this process had been completed in two regions; in two other regions, it had not yet started, and in the others, it was in a "state of progress" of 25-75%; MiPAAFT, 2022a). Regardless, in recent years, the average time for authorizing new aquaculture plants has been decreasing (particularly for those of bivalve molluscs), and guidelines have been developed for the identification of AZA areas and for environmental assessments on farm plants (Marino *et al*., 2020). Moreover, the use of antibiotics in intensive pisciculture has been decreasing; in approximately one-third of freshwater fish farms, interventions have been made to reduce the nutrient loads in effluents and in plants at sea, there is interest in jointly growing fish, filtering

bivalves and/or seaweeds (IMTA aquaculture; Chopin, 2012) to have less phosphate and nitrate in the seawater masses flowing away (MiPAAFT, 2022a and 2022b). Therefore, it is desirable that Italian consumers increase their appreciation of domestic aquaculture products, rewarding their quality and, indirectly, the better environmental sustainability of that activity in comparison with most catches from wild stocks. Consequently, it is advisable for the Italian public to hold a more positive attitude towards this kind of livestock farming.

Moreover, by new institutional public campaigns, it is advisable to reduce, to some extent, the *per capita* consumption rate of certain products, such as those related to clearly (or presumably) overexploited fish or shellfish wild stocks (e.g., North Atlantic swordfish), and to increase the processing and/or consumption of massive species ("forage fish").

Footnote 1: In this note, the 8-digit codes of the EU Common Nomenclature have been used, instead of the 10-digit TARIC codes, because they are common to all trade flows of fish products.

Footnote 2: Section HS0301 of the Harmonised System has not been considered because it concerns the trade in live fish (for fish farming or aquarophilia), not intended for direct human consumption.

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References

Alder, J., Campbell, B., Karpouzi, V., Kaschner, K., & Pauly, D. (2008). Forage fish: from ecosystems to markets. *Annual Review Environmental Resources*, (33), 153-166. doi: 10.1146/annurev.environ.33.020807.143204.

Anonimo (2019). Le produzioni ittiche. In *Annuario agricoltura italiana 2017* (pp. 215-245). Roma: CREA. www.crea.gov.it/documets/68457/0/Annuario_2017+%281%29.pdf/1fd6e07f-268e-982e-b8ae- 7acf9c5f6911?t=1579705767599.

Anonymous (2020). International convention on the harmonized commodity description and coding system. *OJEC*, *Series L*, (198), 3-9.

Arkhipkin, A.I. (2020). Cephalopod fisheries need regulation. *Hook & Net Magazine*, (7), unpaged.

Barclay, K. (2012). The social in assessing sustainability: fisheries in Australia. *Cosmopolitan Civil Societies Journal*, (3), 38-53. https://epress.lib.uts.edu.au/journals/index.php/mcs/issue/archive.

Black, K., & Hughes, A. (2017). *Future of the sea: trends in aquaculture*. London: Government Office for Science.

Brundtland, G.H. (1987). *Our common future*. Geneva: Report of the World Commission on Environment and Development. https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf.

Cai, J., Zhou, X., Yan, X., Lucente, D. & Lagana, C. (2019). *Top 10 species groups in global aquaculture 2017.* Rome: FAO. www.fao.org/3/ca5224en/CA5224EN.pdf.

CEDEPESCA (Centro Desarollo y Pesca Sustentable) (2017). *Indicadores preliminares de la evolución del stock del langostino argentino.*

Chopin, T. (2012). Aquaculture, integrated multi-trophic (IMTA). In *Encyclopedia of sustainability science and technology* (pp. 542-564). Springer-Verlag. www.springerreference.com/index/chapterbid/226358.

Clark, C. (2020). *A review of global commercial cephalopod fishery, with focus on apparent expansion, changing environments, and management*. Capstone, Nova Southeastern University. https://nsuworks.nova.edu/cnso_stucap/343.

DIT (Department of Trade) (2019). *Export guide: Vietnam*. OMIS Report TRM 525/18. www.studocu.com/vn/document/truong-dai-hoc-kinh-te-dai-hoc-nag/thong-ke-kinh-doanh-va-kinh- te/vietnam-export-guide/20861182.

Doubleday, Z., Prowse, T.A.A., Arkhipkin, A., Pierce, G.J., Semmens, J., Steer, M., Leporati, S.C., Lourenco, S., Quetglas, A., Sauer, W., & Gillanders, B.M. (2016). Global proliferation of cephalopods. *Current Biology*, (26), R406-R407.

Dulvy, N.K., Pacoureau, N., Rigby, C.L., Pollom, R.A., Jabado, R.W., Ebert, D.A., Finucci, B., Pollock, C.M., Cheok, J., Derrick, D.H., Herman, K.B., Sherman, S.C., Vander Wright, W.J., Lawson, J.M., Walls, R.H.L., Carlson, J.K., Charvet, P., Bineesh, K., Fernando, D., Ralph, G.M., Matsubisha, J.H., Hilton-Taylor, C., Fordham, S.V., & Simpfendorfer, C.A. (2021). Overfishing drives over one-third of all sharks and rays toward a global extinction crisis. *Current Biology*, (31), 4773-4787. doi: 10.1016/J.cub.2021.08.062.

EEC (1987). Council regulation (EEC) No. 2658/87 of 23 July 1987 on the tariff and statistical nomenclature and on the Common customs tariff. *Official Journal European Communities*, (L256), 1-676.

EU (2008). Council regulation (EC) No. 1005/2008 of the council of 29 September 2008 establishing a Community system to prevent, deter and eliminate illegal, unreported and unregulated fishing, amending regulations (EEC) No. 2987/93, (EC) No. 1936/2001, (EC) No. 601/2004 and repealing regulation (EC) No. 93/94. *Official Journal European Union*, (L286), 1-32.

EU (2013). Regulation (EU) No. 1379/2013 of the European parliament and of the council of December 11 2013 on the common organization of the markets

in fishery and aquaculture products, amending council regulations (EC) No. 1184/2006 and (EC) No. 1224/2009 and repealing council regulation (EC) No. 1047/2000. *Official Journal European Union*, (L354), 1-21.

EU (2017). Regulation (EU) 2017/1004 of the European parliament and of the council, of May 17 2017, on the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy and repealing council regulation (EC) No. 199/2008 (recast). *Official Journal European Union*, (L157), 1-21.

EU (2021). Commission implementing regulation (EU) 2021/1832, of October 12 2021, amending annex I to council regulation (EEC) No. 2658/87 on the tariff and statistical nomenclature and on the common customs tariff. *Official Journal European Union*, (L385), 1-993.

EUMOFA (2017a). *The EU fish market. 2017 Ed*. European Union. doi: 10.2771/455963.

EUMOFA (2017b). *EU consumer habits regarding fishery and aquaculture products*. European Union. doi: 10.2771/179643.

EUMOFA (2018). *The EU fish market. 2018 Ed*. European Union. doi: 10.2771/41473.

EUMOFA (2019). *The EU fish market. 2019 Ed*. European Union. doi: 10.2771/168390.

EUMOFA (2020a). *Metadata 2 – Data management. Annex 7: Conversion factors by CN-8 code, from 2001 to 2021*. European Union. www.eumofa.eu/documents/20178/24415/Metadata+2+-+DM+-+Annex+7+CF+per+CN_8%252707-%252714.pdf/7e98ac0c-a8cc-4223-9114-af64ab670532.

EUMOFA (2020b). Fisheries and aquaculture in Argentina. In *Country analyses. 2019 ed*. (pp. 1-7). www.eumofa.eu/documents/20178/136822/Caountry+Analysis+2019.pdf.

FAO. *Fishery and aquaculture statistics (Fishstatj)*. www.fao.org/fishery/statistics/software/fishstatj/en. FAO Fisheries & Aquaculture – Species Fact Sheets, *Homarus gammarus* (Linnaeus, 1758). www.fao.org/ fishery/species/2648/en.

FAO Fisheries & Aquaculture – Species Fact Sheets – *Homarus americanus* (H. Milne Edwards, 1837). www.fao.org/ fishery/species/3482/en.

FAO (2002). Implementation of the international plan of action to prevent, deter and eliminate illegal, unreported and unregulated fishing. *FAO Technical Guidelines for Responsible Fisheries*, (9), 1-122.

FAO (2018). *State of world fisheries and aquaculture*. FAO. www.fao.org/3/19540en/i9540en.pdf.

FAO (2020). *State of world fisheries and aquaculture*. doi: 10.4060/ca9229en.

Harding, G. (1968). The tragedy of the commons. *Science*, (162), 1243-1248. doi: 10.1126/science.162.3859.1243.

GFCM (2022). *Tracking illegal, unreported and unregulated fishing in the Mediterranean and Black Sea*. www.fao.org/gfcm/news/detail/en/c/1534258.

ICCAT (2021a). Recommendation [16-05] by ICCAT replacing the recommendation [13-04] and establishing multi-annual recovery plan for the Mediterranean

swordfish. In *ICCAT Compendium recommendations and resolutions adopted by ICCAT for the conservation of Atlantic tunas and tuna-like-species* (pp. 51-59). Madrid: ICCAT www.iccat.int/Documents/Recs/COMPENDIUM_ACTIVE_ENG.pdf.

ICCAT (2021b). Recommendation [17-02] by ICCAT amending the recommendation for the conservation of North Atlantic swordfish, rec. [16-03]. In *ICCAT Compendium recommendations and resolutions adopted by ICCAT for the conservation of Atlantic tunas and tuna-like-species* (pp. 60-63). Madrid: ICCAT. www.iccat.int/Documents/Recs/COMPENDIUM_ACTIVE_ENG.pdf.

ICES (2019). Anglerfish (*Lophius budegassa*, *Lophius piscatorius*) in Subareas 4 and 6 and in Division 3.a (North Sea, Rockall and West of Scotland, Skagerrak and Kattegat). In *Report of the ICES Advisory Committee, anf.27.3a46*. https://doi.org/10.17895/ices.advice.4765.

ICES (2020). Plaice (*Pleuronectes platessa*) in subarea 4, division 7d, and subdivision 20 (North Sea, eastern English Channel, Skagerrak). In *Report of the ICES Advisory Committee, cod.27.47d20*. https://doi.org/10.17895/ices.advice.5644.

ICES (2021). White anglerfish (*Lophius piscatorius*) in Subarea 7 and divisions 8.a-d (Celtic Seas, Bay of Biscay). In *Report of the ICES Advisory Committee, 2021, mon.27.78abd. https://doi.org/10.17895/ices.advice.7792*. ISTAT Coeweb, statistiche del commercio estero. www.coeweb.istat.it.

Jereb, P., Roper, C.F.E., & Vecchione, M. (2005). Introduction (pp. 1-19). In *Cephalopods of the world, vol. 1*. Rome: FAO. www.fao.org/publications/card/fr/c/bab682f4-2346-5bf1-89d7-94f276279a36.

Kim, B.F., Santo, R.E., Scatterday, A.P., Fry, J.P., Synk, C.M., Cebron, S.H., Mekonnen, M.M., Hoekstra, A.Y., de Pee, S., Bloem, M.W., Neff, R.A., & Nachman, K.E. (2020). Country-specific dietary shifts to mitigate climate and water crises. *Global Environmental Change*, (62), (101926).

Libralato, S., Caccin, A., & Pranovi, F. (2015). Modeling species invasions using thermal and trophic niche dynamics under climate change. *Frontiers Marine Science*, (2), 29. doi: 10.3389/fmars.2015.00029.

Macias, J.C., Avila Zaragozá, P., Karakassis, I., Sanchez-Jerez, P., Massa, F., Fezzardi, D., YücelGier, G., Franičević, V., Borg, J.A., Chapela Pérez, R.M., Tomassetti, P., Angel, D.L., Marino, G., Nhhala, H., Hamza, H., Carmignac, C. & Fourdain, L. (2019). Allocated zones for aquaculture. *GFCM Studies and Reviews*, (97), 1-92. www.fao.org/3/ca7041en/CA7041EN.pdf.

Marino, G., Petochi, T. & Cardia, F. (2020). *Assegnazione di zone marine per l'acquacoltura (AZA). Guida tecnica*. ISPRA. www.isprambiente.gov.it/pubblicazioni/documenti-tecnici/assegnazione-di-zone-marine- per-lacquacoltura-aza-guida-tecnica.

McKinney, R., Gibbon, J., Wozniak, E., & Galland, G. (2020). *Netting billions 2020: a global tuna valuation*. PEW Charitable Trust. www.pewtrusts.org/-/media/assets/2010/10/nettingbillions2020.pdf.

MiPAAFT (2022a). *Piano Strategico Nazionale Acquacoltura 2021-2027*. Roma: CREA. www.politicheagricole.it/flex/cm/pages/ServeBLOB.ph/L/IT/IDPagina/17193.

MiPAAFT (2022b). *VAS P.O. nazionale FEAMPA 2021-2027. Rapporto ambientale*. IZI. www.politicheagricole.it/flex/cm/pages/ServeBLOB.ph/L/IT/IDPagina/17193.

Mkunda, J.J., Lassen, J., Chachage, B., Kusiluka, L., & Pasape, L. (2018). A review of Lake Victoria sardine products business and institutional arrangements for domestic and regional trade, *Strategic Journal Business & Change Management*. (5), 596-612.

Myers, H.J., & Moore, M.J. (2020). Reducing effort in the U.S. lobster (*Homarus americanus*) fishery to prevent North Atlantic rightwhale (*Eubalaena glacialis*) entanglements may support higher profits and long-term profitability. *Marine Poli*cy, (118), e104017. doi: 10.1016/j.marpol.2020.e104017.

Ngamprsertkit, S. (2018). *Thailand seafood report*. USDA GAIN TH8067. https://apps.fas.usda.gov/newgainapi/api/report/downloadeportbyfilename?filename=Seafood%20Report_Bangkok_Thailand_5-8-2018.pdf.

Pavicic, M., Matic-Skoko, S., Vrdoljac, D., & Vujevic, A. (2020). First record of American lobster, *Homarus americanus* (H. Milne Edwards, 1837), in the Mediterranean Sea. *BioInvasions Records*, (9), 83-88. doi: 10.3391/bir.2020.9.1.11.

Pramod, G., Nakamura, K., Pitcher, T., & Delagran, L. (2014). Estimates of illegal and unreported seafood imports to the USA. *Marine Policy*, (48), 102-113.

Pramod, G., Pitcher, T., & Mantha, G. (2017). Estimates of illegal and unreported seafood imports to Japan. *Marine Policy*, (84), 42-51.

Rodrigues, L.C., Van Den Bergh, J.C.J.M., Massa, F., Theodorou, J.A., Ziveri, P., & Gazeau, F. (2015). Sensitivity of Mediterranean bivalve mollusk aquaculture to climate change, ocean acidification, and other environmental pressures: findings from a producer survey. *Journal Shellfish Research*, (34), 1161-1176. doi: 10.2938/035.034.0341.

Romanuk, T.N., Hayward, A., Hutchins, J.A. (2010). Trophic level scales positively with body size in fishes. *Global Ecology and Biogeography*. doi: 10.1111/j.1466-8238-2010.00579.x.

SAPEA (2017). *Food from the oceans*. Berlin: SAPEA. doi: 10.26536/foodfromtheoceans.

Soldo A. (2014). *Evolution and realities of the illegal fishing*. Bruxelles: European Parliament. www.europarl.europa.eu/cmsdata/67054/att_20140925ATT89814-5515190418691501142.pdf.

Stanton, E.A. (2012). The tragedy of maldistribution: climate, sustainability and equity. *Sustainability*, (4), 294-340. doi: 10.339/su4030394.

STECF (Scientific, Technical and Economic Committee for Fisheries) (2021). Additional requests submitted by the Commission to the STECF. 6.1. CFP monitoring. In *STECF 66th plenary report (PLEN-21-01)* (pp. 31-40). Ispra: STECF Secretariat. doi: 10.2760/437609.

Tudini L. (2020). Le produzioni ittiche. In *Annuario agricoltura italiana 2019* (pp. 243-268). Roma: CREA. www.crea.org.it/documents/68457/Annuario_2019.pdf/6db61aad-9e3f-ab88-3703 aae67ed29f9c?t=1622045006635.

WCO (World Customs Organization) (2018). *Harmonized System compendium – 30 years on*. Bruxelles: WCO. www.coomd.org/-/media/wco/public/global/pdf/nomenclature/activities-and-programmes/30-years- hs/hs-compendium.pdf?la=en.

World Bank (2018). Ecuador crustacean preparations: shrimps and prawns, prepared or preserved exports by country in 2018. https://wits.worldbank.org/trade/comtrade/en/country/ECU/year/2018/tradeflow/Exports/partner/ALL/product/160520.

Zar, J.H. (1999). *Biostatistical analysis, fourth ed*. Upper Saddler River: Prenctice Hall.

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