ECONOMIA AGRO-ALIMENTARE
FOOD ECONOMY

*An International Journal
on Agricultural and Food Systems*

ECONOMIA AGRO-ALIMENTARE
Food Economy

(Rivista fondata da Fausto Cantarelli)

Sommario

Editorial

With this issue, we close the Volume 22 of *Economia agro-alimentare / Food Economy*, the first one using the Open Access publishing model. The publication is now partly supported by authors, instead of readers, through the article-processing charges (APC), but it is still strongly supported by the Italian Society of Agri-food Economics (SIEA). The APC only partially covers the publication cost of the journal incurred by SIEA, which also give a full waiver of the APC to its members.

The switch into the new publication model has been rather seamless, thanks to the dedication of the publisher FrancoAngeli Edizioni that provided access to the published articles on its Open Acces platform (https://ojs.francoangeli.it/_ojs/index.php/ecagoa/index) and created a new page dedicated to the Open Access edition on its Institutional website (https://www.francoangeli.it/riviste/Sommario.aspx?idRivista=214&lingua=EN).

In this issue, we feature seven regular Articles, all written in English. The authors are affiliated to Institutions based in Italy, Argentina, Ireland, Bangladesh, USA, Croatia. The range of the analysis spans from local, to national, to international. The topics span from the relationship between the Mediterranean diet and obesity to food security fo young students, from rural development to sustainability policies, from the preservation of traditional farming systems to consumer preferences and product information.

Danijel Nestic and Tomislav Vukina, in the article "Examining the Prevalence of Obesity in Croatia: The Story of the Mediterranean Diet", aim to assess the relationships between Mediterranean diet and various measures of overweightness (body mass index, waist-to-hip ratio and obesity) using the Croatian Adult Health Survey 2003 data. Empirical findings highlight that there is a significant relationship between the BMI and the Mediterranean diet. The waist-to-hip ratio and obesity are significant when considering specifically the ten food elements which constitute the aggregate index of Mediterranean diet.

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In the article "The food insecurity and the young generations' perception: A systematic review", Muslima Zahan and Alessandro Bonadonna address a relatively new and emerging theme within the scientific community: the effects of food (in)security on University students all over the world. They conduct a systematic literature review of 29 papers identified in the Web of Science (Clarivate Analytics) and Scopus (Elsevier) databases and categorise them according to five main research topics. Students are considered a weak category in terms of access to food due to various issues, situations and conditions affecting the availability and price of food products. Food insecurity has effects on students' physical and mental health and on their academic performance. The review identifies the research gaps in the academic literature, and comparative studies on food insecurity among University and/or college students in developed and developing countries are suggested as a potential future research topic to understand this global problem better.

Angela Polito, Elena Azzini, Lorenzo Barnaba, Milena Verrascina, Barbara Zanetti, Alessandro Monteleone, Federica Intorre, Donatella Ciarapica, Stefano Tomassini, and Laura Guidarelli, in their paper "Socio-economic drivers in productive rural activities and their impact on the eating habits, lifestyle and nutritional status of people living in a rural area: the Majella National Park as a case study", analyse the relationship between food system dynamics and consumer behaviours in an Italian protected mountain area. The study, using a combination of qualitative and quantitative methods, involved different local actors such as farmers, local authorities, and inhabitants. The results indicate that local products are widely known and consumed, even if price levels are not always cheaper. However, local consumption seems to be strongly influenced by global products, which will lead to homogenisation of eating behaviour and this could affect the erosion of plant and animal heritage and local traditions in the mountains and the most rural marginal areas. Though, some consumer groups appear to be health-conscious and believe that food, nutrition and physical activity could improve their health. The study indicates the need for joint action among the different institutional players for regional dissemination of the importance of maintaining the biodiversity of local products and a balanced diet for a healthy life.

In the article "Insights in overcoming the non-adoption of voluntary agricultural GHG mitigation measures in Ireland", Lucie Adenaeuer, James Breen and Anne Hayden investigate, through a systematic review of the literature, the non-price determinants of the voluntary adoption of greenhouse gas (GHG) mitigation measures in the Irish agriculture, forestry and land use (AFOLU) sector. The authors assess the adjusted AFOLU abatement potential for each mitigation measure, identify which measures tend to be impacted

the most and evaluate the influence of non-price determinants. The article provides recommendations to overcome the non-adoption of voluntary agricultural GHG mitigation measures.

Graziella Benedetto and Maria Bonaventura Forleo, in the article "Foodies' movement fostering stakeholders' network: a regional case study" analyse the phenomenon of foodies' movement and its relationship with the local stakeholders through a case study conducted in Alghero (Italy). The analysis revealed the existing barriers and opportunities related to the networks between local stakeholders and how the awareness and belief of local actors play a crucial role in the requalification of the supply of typical products.

The paper by Made Ika Prastyadewi, Indah Susilowati, and Deden Dinar Iskandar about "Preserving the Existence of Subak in Bali" is focusing on the increasing population in Bali that threatens the existence of current farming systems, agricultural land and institutions. The authors investigate the existence of Subak, a farming system and form of local wisdom listed as World Cultural Heritage in Bali, Indonesia, which needs protection due to pressure on land from an increasing population and tourism. By using a mixed-method approach, this paper looks into farmers perception of Subak as a World Cultural Heritage, and it analyses the role of institutions in maintaining the existence of Subak. The authors show that most farmers do not plan to sell their agricultural land since agricultural land is regarded as heritage that must be preserved. Finding further indicate that customary institutions play a dominant role both socially, culturally and economically in maintaining Subak so that it continues to function locally on the Island. However, regulation is needed when agricultural land is converted to non-agricultural activities. Therefore, support from the government to conserve Subak is needed.

Julieta Alejandra Rodriguez, Elsa Mirta Margarita Rodríguez, Beatríz Lupín in their paper "Consumers' assessment of labelled and packaged fresh potato: Evidence from an Experimental Auction" identify the attributes that influence the assessment that consumers make of a potato with differentiated quality. Quantitative analysis by a Vickrey Second Price Experimental Auction and Multiple Correspondence Analysis were applied to data collected from a sample of Argentine students. The results indicate that potato is an important element in a healthy, balanced diet. After receiving information about the culinary aptitude of the differentiated potato and its production method, consumers were willing to pay a higher price for the product. Moreover, participants opted for a higher price of potato when it was presented in a labelled package. This analysis gives producers information on what consumers value when buying. Regarding potato variety, it would be apt for producers to gradually incorporate other potato varieties and offer a wider

range of potato with diverse culinary characteristics. Producers should also label the potato grown in an eco-friendly environment.

Like every year since 2011, we made some changes in the Scientific Advisory Board, substituting some of the members, to ensure that more scholars have the opportunity to contribute to the scientific development of our journal's community of practice. We express our warmest appreciation to those SAB members who have served until 2020 and now leave the Board. The contribution to the development of the journal of all the SAB members has been invaluable, especially for their help in reviewing, suggesting reviewers, and evaluating the papers published in the previous year as candidates to the "Best Paper Award".

Regarding the "Best Paper Award" for the papers published in the English language in 2019, the SAB selected the article authored by Pappalardo, Di Vita, La Via, Romano, Vastola, Cozzi, & D'Amico, titled "Exploring gender differences in the Italian traditional pizza consumption".

We also welcome the new SAB members for the year 2021. With their appointment, the new SAB maintains and improves its strong international character. The updated full list of SAB members is available in the journal front matter 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.

We also have some updates regarding the journal's Editorial Board. With this issue, Christine Mauracher and John L. Stanton conclude their fruitful collaboration with the journal. The editors and the SIEA Presidential Board are very grateful for their dedication and commitment during the last years; they gave a substantial contribution as managing editors of numerous submissions and supported the process that led to the acceptance of Economia agro-alimentare in the Scopus database. Starting from the next issue, we welcome three new members of the Editorial Board: Alessio Cavicchi, Catherine Chan, and Maro Vlachopoulou. They were already members of the Scientific Advisory Board, and have already joined our team, collaborating to manage manuscripts currently in the pipeline. We are grateful to them for being available to serve as Associate Editors and to broaden the expertise available in our team.

We express our heartfelt gratitude to the new SIEA Presidential Board, elected during the last Annual Congress of SIEA on "Agri-food enterprises in a changing international context" that took place in Parma on September 24-25, 2020. We appreciate that the new President Biagio Pecorino and the whole Presidential Board decided to renew their trust in the current Editorial Board of the journal.

We also wish to thank once again the staff of FrancoAngeli Edizioni for the hard work they continued to do during the hard times we all experienced

in the year 2020, making sure that our journal has been published timely and complying with the usual high-quality standards. 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, and in this last issue of Volume 22, we express our special gratitude to the reviewers who helped us to evaluate the papers submitted to *Economia agro-alimentare / Food Economy* during the year 2020; the complete list is available at the end of the issue.

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Examining the Prevalence of Obesity in Croatia: The Story of the Mediterranean Diet

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Abstract

The objective of this study is to establish a causal relationship between the Mediterranean diet (MD) and various measures of overweightness using the Croatian Adult Health Survey 2003 data. Our results show that among three measures of obesity (body mass index, waist-to-hip ratio (WHR) and obesity (BMI ≥ 30), we found statistically the most convincing relationship between the BMI and the MD. Our results show that an increase in the Mediterranean diet aggregate index by 10% reduces the BMI by about 0.9%. When the MD10 index is replaced with the set of its ten constituent food groups, as a group, these food variables are jointly statistically significant, most of them have expected (negative) signs, and some of them are also individually significant. For the other two overweight measurements (WHR and obesity) we found that the impact of MD aggregate index is insignificant but when the index is replaced by its ten constituent food elements, these are jointly statistically significant in explaining the variation in the obesity measures.

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Danijel Nestić, Tomislav Vukina

Introduction

Obesity has risen throughout much of the world in the past several decades. In United States, the prevalence of obesity defined using body mass index (BMI) rose slowly from 13.3% in 1960-1962 to 15.1% in 1976-1980, then rose dramatically to 23.3% in 1988-1994 and to 35.3% in 2007-2010. Among the OECD countries, the U.S. has the highest prevalence of adult obesity, followed by Mexico (32.4%), New Zealand (31.3%), Hungary (28.5%), Australia (28.3%), Canada (25.4%), Chile (25.1%), U.K. (24.7%) and Ireland (23.0%). East Asian countries such as Japan (3.6%) and Korea (4.6%) have the lowest prevalence, whereas for some of the small Pacific island nations like Nauru, Tonga and Samoa, the prevalence is even higher than in the U.S. and exceeds 50%; see Cawley (2015) and references therein.

An important and unanswered question about obesity is why it varies so much across countries and various race, ethnic and other groups. In the U.S. National Health and Nutrition Examination Survey (NHANES) data for 2011-2012, the prevalence of obesity was 10.8% among Asian-Americans, 32.6% among non-Hispanic whites, 42.5% among Hispanics and 47.8% among non-Hispanic blacks (Ogden *et al.*, 2014). Similarly, based on the second round of the European Health Interview Survey (EHIS), the data indicate that substantial inequalities exist in the EU concerning the proportion of adults who are overweight or obese (Eurostat). For example, in the EU-28 the proportion of adults (aged 18 years and over) who were considered to be overweight varied in 2014 between 36.1% in Italy and 55.2% in Malta for women and between 53.6% in the Netherlands and 67.5% in Croatia for men. Differences in obesity among countries are even more striking. Between Romania and Malta there was a 19.0 percentage points difference in the proportion of obese men and a 14.2 percentage points difference in the proportion of obese women. For the population 18 years and over, the lowest proportions of obese women in 2014 are in Romania (9.7%), Italy (10.3%), Cyprus (12.9%) and Austria (13.4%), and obese men in Romania (9.1%), Italy (11.3%), Netherlands (11.6%) and Sweden (13.6%). The highest proportions of women who were obese are in Malta (23.9%), Latvia (23.3%), Estonia (21.5%) and the United Kingdom (20.4%), and of men in Malta (28.1%), Hungary (22.0%), Slovenia (21.0%) and Croatia (20.7%).

Given the direct association between eating and body weight, obesity is easily explained using simple physics. According to the first law of thermodynamics, in a closed system, energy can be neither created nor destroyed but only transformed. This implies that calories consumed must be either expended, excreted or stored as fat. Rearranging this energy balance equation indicates that obesity must be due to either an increase in calories consumed or a decrease in calories burned. Rather limited data on calories

consumed and expended that do exist, seem to suggest that the observed rise in obesity was more likely due to an increase in calories consumed than a decrease in calories burned (e.g. Swinburn, Sacks and Ravussin, 2009). However, thermodynamics is of no use when trying to understand the rapid and continuous increase in obesity in modern times and significant differences in obesity rates across countries and ethnic groups.

To what extent can the standard microeconomic theory model explain these phenomena? Economists typically emphasize reductions in food prices and higher costs of expanding calories as explanations for obesity (e.g., Cutler, Glaeser and Shapiro, 2003). The problem with this is that: (a) food prices declined substantially from early-1970s to mid-1980s, when obesity began to rise, but changed little thereafter while body weight continued to grow, and (b) employment-related calorie expenditures have fallen as the economy shifted to more sedentary jobs but this long-run trend was largely complete by mid-1970s before obesity took off (Ruhm, 2012). In fact, what we frequently observe are eating patterns that look like ex-post economic mistakes rather than the outcomes of rational decisions. This is because rational consumers should generally be at or near their utility maximizing weight to begin with and should not subsequently require large expenditures to reach desired levels. However, the fact that the U.S. weight loss industry in 2009 exceeded $50 billion (MarketData Enterprises, 2009) and that 200,000 people receive bariatric bypass surgery annually (National Institute of Diabetes and Digestive and Kidney Diseases, 2008) are telling examples that rational economic agent model does not work very well.

The alternative approaches to studying the prevalence of obesity include micro-theory models with added features such as habit formation, social norms, etc., see Cawley (2015) for a review. For example, Atkin (2013), for the purposes of investigating regional food consumption differences in India, introduces habit formation into an overlapping-generation general equilibrium model. In his model, households develop tastes for locally abundant foods that they were fed as children. That way, regional differences in preferences and consumption patterns arise endogenously over generations. He concludes that an interaction between preferences and economic environment is needed to explain the observed regional differences. Similarly, Dubois, Griffith and Nevo (2014) found that the prices and food attributes can have large impact on food purchases and the nutritional composition of consumption but economic factors do not tell the whole story. The differences in preferences and eating habits are also very important and in some cases can offset the influences of prices and attributes. For example, they found that UK households purchase healthier foods than US households, despite the prices and product offerings they face and not because of them. Secondly, recent work in behavioral economics (e.g., Ruhm, 2012) emphasizes the importance

of systematic errors. The key insight is that many decisions are the results of the brain interaction of a utility-max deliberative system and affective system, dominated by semi-automatic (but potentially learned) responses. There is vast body of psychological research examining conflict resolution between the two systems in decision-making (e.g., Kahneman, 2011) which is very difficult to fully incorporate into an economic model.

In this paper we look at the Mediterranean diet (MD) as a possible explanation for the observed regional differences in the prevalence of obesity in Croatia. Three main reasons motivated this research. First, as emphasized later in the text, the empirical literature on benefits of MD provides a rather compelling evidence of the beneficial effects of the MD on obesity prevention. Second, Croatia is an excellent candidate for studying regional differences in the prevalence of obesity because it consists of two distinct geographical regions: the continental part and the Mediterranean coast. If people of the Mediterranean region predominantly eat MD and people in the continental region do not, then the observed differences in the obesity rates between the two regions should be, *ceteris paribus*, attributable to the differences in diets. Finally, the research into obesity differences across various groups within a country is comparatively easier than international comparisons, because of the common social policies, regulatory and general macro-economic environment and the similarity of wages and prices.

An earlier study of the regional differences in the prevalence of obesity among adult population in Croatia is Music-Milanovic *et al*. (2009). The authors found a significant Mediterranean-continental difference in obesity prevalence among women but not men. The study looked at the relationship between obesity and small group of demographic and behavioral factors such as age, binge drinking, smoking, and regular leisure exercise and did not specifically address the impact of Mediterranean diet on obesity short of looking at the importance of the consumption of fats (vegetable versus animal). They found that in the continental part of Croatia the odds of being obese increases significantly with age and among non-smokers in both men and women and no relationship between any of analyzed behavioral factors and obesity in men and women in the Mediterranean part. Another related paper is Costa-Font, Fabbri and Gil (2010) who tried to explain the differences in levels of obesity and overweight between Italy and Spain. These two countries share the same Mediterranean diet and have similar GDP per capita but have markedly different patterns of obesity. Their decomposition results indicate that the model covariates (eating habits and education) explain about 27-42% of the obesity and overweight gaps between two countries. However, when controls for social environment are included, the model explains 76-92% of the cross-country gap.

The objective of this study is to try to establish a causal relationship between the MD and different measures of overweightness using the single-period cross-sectional data from the 2003 Croatian Adult Health Survey (CAHS). We use a heuristic approach to modeling the relationship between obesity and eating. After experimenting with several obvious model specifications, we venture into a somewhat unchartered territory by augmenting our model with two features. First, we hypothesize that eating habits could also depend on information that is socially learned from mimicking others, i.e., from the existing social norms or peer pressure. Therefore, it is possible that the decision what to eat is not exclusively made at the individual consumer's or the household's level, but rather within a specific community of people, and therefore depends on the local culture and tradition. Second, we also realize that, conceptually, obesity is a stock measure that is impacted not just by current eating (and exercise), but by the cumulative addition of caloric intake and expenditure over the lifetime. Hence, in this sense, the fact that we are using a single-period survey data, forces us to think about the MD measures not so much as a current consumption of foods but more as a proxy for current as well as past habits. If, however, there has been some erosion of adherence to MD due to changes in tastes or culture (for example caused by *Westernization*), then this would show up in cohort differences.

1. Mediterranean diet and Obesity

In 2013 the Mediterranean diets of Cyprus, Croatia, Spain, Greece, Italy, Morocco and Portugal have been inscribed on the Representative List of the Intangible Cultural Heritage of Humanity. According to UNESCO website: "The Mediterranean diet involves a set of skills, knowledge, rituals, symbols and traditions concerning crops, harvesting, fishing, animal husbandry, conservation, processing, cooking, and particularly the sharing and consumption of food. Eating together is the foundation of the cultural identity and continuity of communities throughout the Mediterranean basin. It is a moment of social exchange and communication, an affirmation and renewal of family, group or community identity. The Mediterranean diet emphasizes values of hospitality, neighbourliness, intercultural dialogue and creativity, and a way of life guided by respect for diversity. It plays a vital role in cultural spaces, festivals and celebrations, bringing together people of all ages, conditions and social classes. It includes the craftsmanship and production of traditional receptacles for the transport, preservation and consumption of food, including ceramic plates and glasses. Women play an important role in transmitting knowledge of the Mediterranean diet: they

safeguard its techniques, respect seasonal rhythms and festive events, and transmit the values of the element to new generations. Markets also play a key role as spaces for cultivating and transmitting the Mediterranean diet during the daily practice of exchange, agreement and mutual respect"[1].

Epidemiological studies have found increased longevity and reduced morbidity in Mediterranean countries compared to USA or Northern Europe. These health benefits were mainly attributable to the dietary patterns found in these countries in the early 1960s, before their westernization (Keys *et al.*, 1986). Although there are variations in the components of the traditional MD between and within the Mediterranean countries, the common characteristics are: (a) high consumption of plant-based foods (fruits, vegetables, legumes, nuts and seeds and wholegrain cereals); (b) the consumption of seasonally fresh and local foods; (c) olive oil as the main source of dietary lipids; (d) a frequent but moderate intake of wine (especially red) with meals; (e) consumption of fresh fish and seafood; (f) a moderate consumption of dairy products, poultry and eggs; and (g) low frequency and amounts of red and processed meats (Buckland, Bach and Serra-Majem, 2008).

There is also a substantial body of research on the relationship between the MD and low prevalence of obesity. Interestingly enough, the aforementioned globally increased trends in obesity did not completely bypass the Mediterranean countries. As documented in Costa-Font, Fabbri and Gil (2010), the prevalence of obesity in Italy and Spain was between 6% and 7% in 1990 and the gap was not statistically significant, by 2003 the obesity in Italy remained at 8% but grew to 14% in Spain. There has been a decrease in adherence to the MD in Southern European countries through the similar period as well as the tendency to lead more sedentary lifestyles, but it is not clear to what extent the changing dietary patterns account for the increases in obesity (Serra-Majem and Helsing, 1993).

Studies dealing with the association between the MD and obesity belong to three groups: cohort studies, cross-sectional studies and intervention studies. In a systematic review of these studies, Buckland, Bach and Serra-Majem (2008) found that one out of three cohort studies provided evidence of a significant protective effect of the MD against obesity, four out of seven cross-sectional studies found that a higher adherence to MD had a significantly negative association with overweight/obesity and eight out of eleven intervention studies found that the adherence to MD significantly decreased weight/BMI. The cross-studies comparison of results is difficult because of the variations in definitions and evaluation of the MD, control diets and additional non-dietary interventions and statistical methodologies.

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1. https://ich.unesco.org/en/RL/mediterranean-diet-00884.

However, while the empirical results are far from unanimous, these studies provide rather compelling evidence of the beneficial effects of the MD on obesity prevention.

2. Data

The data used in this study comes from the Croatian Health Survey (CHS), which was conducted in 2003 by interviewing 9,070 adult individuals aged 18 years and more. The CHS aims to collect health information primarily to support the national campaign for cardiovascular disease prevention but also to support other public health initiatives (Vuletic *et al.*, 2009). The survey was carried out by public health nurses in face-to-face interviews in the respondents' houses, which is the reason for rather high response rate of 84%. The design of the CHS intended to provide a representative sample of adult population for the entire country. Five years later there was a follow-up survey (Croatian Adult Health Cohort Study – CroHort) whose aim was to contact and re-interview the original respondents of the CHS 2003 survey. However, various logistical problems contributed to a significantly lower response rate in 2008 (3,229 respondents) and potential selection problems are making the second survey essentially unusable; for details see Uhernik *et al.* (2012).

The survey contains information coming from physical measurements (height, weight, waist and hip circumference, blood pressure and pulse) and answers to questions on the health perception, the use of health care, chronic diseases, the use of medication and lifestyle (physical activity, smoking, dietary habits, alcohol consumption). Main information on socio-economic characteristic of the individual and the household are also provided. As depicted in Figure 1, geographically Croatia is comprised of two regions: the Mediterranean and the continental region. Because of the large immigration flows from the periphery of country and from the neighboring state of Bosnia and Herzegovina into the capital city of Zagreb during the Croatian War of Independence 1991-1995, we decided to extract the City and County of Zagreb from the rest of the continental region[2]. We believe that the

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2. These two regions are formed for analytical purposes of this study. They are not official administrative units of Croatia. Mediterranean region is defined as covering the following 6 counties (zupanija): Dubrovacko-neretvanska, Istarska, Primorsko-goranska (without municipality of Vrbovsko), Sibensko-kninska, Splitsko-dalmatinska and Zadarska. All of them are influenced by the mediterranean climate and have access to the Adriatic Sea. The remaining 13 counties (not counting the city and county of Zagreb) form the continental region. One of those 13 counties (Licko-Senjska) has also access to the sea, yet it was clasiffied into the continental region because all survey respondents of that county were from its continental section.

metropolitan area is too diverse to reflect any discernable attributes of either continental or Mediterranean eating patterns and hence we treat Zagreb as a separate region.

Figure 1 - Regional Map of Croatia

As a measure of obesity/overweight, we use the standard definition of BMI, constructed by dividing an individual's weight (in kilograms) by the square of the height (in meters). The four main BMI categories are: underweight (BMI < 18.5), normal weight (BMI ≥ 18.5 and BMI < 25), overweight (BMI ≥ 25 and BMI < 30) and obese (BMI ≥ 30). The waist-to-hip ratio (WHR)

is another way of assessing abdominal obesity. WHR has been shown to be more reflective of visceral fat and central adiposity, as well as a better predictor of obesity related disorders, such as stroke, myocardial infarction, or cardiovascular death, than BMI (WHO, 2008). In women, the ratio should be 80% or less, and in men, it should be 100% or less.

Table 1 presents the raw survey data on BMI, the percentage shares of obese people and the WHR for both men and women in the two regions of the country, Zagreb metropolitan area, and the country as a whole. The data indicates that in all three types of measurements, the Mediterranean region has significantly lower numbers than the continental region whereas Zagreb metropolitan area tracks closely the averages for the entire country. The biggest difference between the Mediterranean and the continental region is in the percentage of the obese people. There are 16.8% of obese people in the Mediterranean part and 25.4% in the continental part. Another interesting result is that the regional differences in obesity are almost completely attributable to the differences in obesity measures among women. The average BMI for women is lower by 1.39 points, the average WHR is lower by 2.21% and the prevalence of obesity in the Mediterranean region is lower by more than 12 percentage points than in the continental part. The differences in all three obesity measures between regions are statistically insignificant among men.

Table 1 - Regional Prevalence of Obesity in Croatia

	Mediterranean Region	Continental Region	Zagreb Region	Croatia Total	Diff. (Mediterranean-Continental)
Total					
Average BMI	26.15	27.08	26.66	26.72	-0.93***
Obese (% of pop.)	16.79	25.44	22.27	22.25	-8.64***
Average WHR (%)	86.48	88.08	87.08	87.39	-1.60***
No. of observations	2,483	4,242	2,034	8,759	
Women					
Average BMI	25.70	27.09	26.37	26.52	-1.39***
Obese (% of pop.)	15.09	27.13	22.46	22.60	-12.04***
Average WHR	83.20	85.41	83.96	84.44	-2.21***
No. of observations	1,690	2,846	1,416	5,952	
Men					
Average BMI	27.10	27.05	27.33	27.12	0.05
Obese (% of pop.)	20.42	21.99	21.84	21.52	-1.56
Average WHR	93.49	93.52	94.20	93.66	-0.03
No. of observations	793	1,396	618	2,807	

Notes: *** p<0.01, ** p<0.05, * p<0.1 of two-sample t-test for unpaired data with unequal variances.
Number of observations are for BMI and obesity; for WHR there are 11 observations less.

The initial dataset containing valid measures of height and weight that has been converted into the BMI values consists of 9,040 observations. While cleaning the dataset, we excluded 281 observations due to missing data for some of the explanatory variables. The working data set consists of 8,759 observations, 11 of those do not have valid measures of waist and hips. The dataset is unbalanced in the sense that it has more than double the number of observations for women than for men, whereas in the 2001 Census, in the age group of 18 and older, there are only 11% more women than men. This is not necessarily a problem because, as we said earlier, the main drivers of the regional obesity differences are women. When it comes to the regional distribution of survey respondents, the data set is more balanced with 2,483 observations (28.4%) in the Mediterranean part, 4,242 in the continental part (48.4%) and 2.034 (23.2%) in the Zagreb metropolitan area.

In order to explain the individual BMIs, WHRs or obesity incidences by MD, we use ten food variables: (i) type of fat/oil used for cooking, (ii) consumption of bread, (iii) fruits, (iv) various salads (excluding potato and mayonnaise dressing), (v) cabbage, broccoli, cauliflower and similar, (vi) legumes, (vii) root vegetables, (viii) leafy vegetables, (ix) smoked/processed meats and (x) wine. Given the constraints imposed by the availability of the survey data, we chose our food variables trying to reconstruct the basic features of the MD as closely as possible to the common characteristics of the MD spelled out in Buckland, Bach and Serra-Majem (2008). It is worth mentioning that, for unknown reasons, CHS 2003 does not contain questions on fresh meat and fish consumption, hence our Mediterranean diet lacks these components[3]. Next, we use this ten food variables to construct a MD10 index. As seen from Table 2, each of the 10 food items are coded as dummy variables such that the value of 1 indicates a beneficial potential effect on obesity (lowering BMI) and 0 otherwise. By summing up all these food dummies, our MD10 food index has the maximum value of 10, which indicates the highest exposure to MD and the minimum value of 0 that indicates no exposure to MD.

To accommodate the idea that the observed eating patterns and obesity could also depend on the persistent effects beyond the current time period while our data set is a single period cross-section, we use two more variables measuring person's geographical origin and regional peer effects. To identify

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3. As suggested by one of the referees, the fact that we do not have all food categories that typically comprise the Mediterranean diet could potentially raise some concerns about the appropriateness of using the term "Mediterranean diet". However, following the UNESCO definition by which the Mediterranean diet consists of not only food items but in fact describes a way of life, and given our empirical approach to explaining the differences in obesity between Croatian regions, we believe that the use of the terminology is appropriate.

Table 2 - Definition of variables

Name	Type	Description/Calculation
BMI index	Number	Body Mass Index (BMI) weight (kg) /height squared (m²)
Obese	Binary	Obesity (1 if BMI>=30)
WHR (Waist-to-hip ratio)	Number	Waist-to-Hip Ratio Waist (cm) /hip (cm) (×100)
Age	Number	Age at time of survey (Year of birth from BKI_1)
Household size	Number	Household size HOU_02a+HOU_02b+HOU_02c
Urban	Binary	Urban residence (1 if HOU_06=1 or HOU_06=2)
Female	Binary	Female (1 if BKI_02=2)
Married or cohabitate	Binary	Married (1 if BKI_03=1)
College education	Binary	College education (1 if BKI_07=4 or BKI_07=5)
High income	Binary	High income (1 if person belongs to top quartile of HOU_04/ hhsize (income at midpoint of interval)
MD10	Number	Mediterranean diet score (Sum of 10 food binary variables)
Vegetable oil	Binary	Vegetable oil or no fat at all (1 if FHA_02=1 or FHA_02=3)
Bread low	Binary	Bread: max 3 slices per day (1 if FHA_10=1 or FHA_10=2)
Salads often	Binary	Often eat salads (1 if FHA_13=3 or if FHA_13=4)
Cabbage often	Binary	Often eat cabbage, broccoli, cauliflower (1 if FHA_15=3 or if FHA_15=4)
Legumes often	Binary	Often eat legumes (1 if FHA_16=3 or if FHA_16=4)
Carrots often	Binary	Often eat carrots, turnip, parley (1 if FHA_17=3 or if FHA_17=4)
Spinach often	Binary	Often eat spinach, chard and similar (1 if FHA_18=3 or if FHA_18=4)

Table 2 - continued

Name	Type	Description/Calculation
Fruits often	Binary	Often eat fruit (1 if FHA_12=3 or FHA_12=4)
Smoked meat	Binary	Rarely eat smoked meat (1 if FHA_19=1 or FHA_19=2)
Wine often	Binary	Often drink wine (1 if FHA_25=5 or FHA_25=6)
Non-smoker	Binary	Nonsmoker (1 if SMO_05=1)
Walk/Bike to work	Binary	Walks or ride a bike to work (1 if PHA_01=3 or PHA_01=4 or PHA_01=5)
Med-origin	Binary	Mediterranean origin (1 if county of residence in 1991 Census was in Mediterranean region)
Peer pressure	Number	Peer pressure effects (Mode of silhouette from PHM_13 for each reference group determined by: 6 food clusters*, gender (M/F) and age (18-29; 30-49; 50-65; 65+)

* *Northern Adriatic*: Istarska and Primorkso-Goranska counties; *Dalmatia*: Zadarska, Sibensko-Kninska, Splitsko-Dalmatinska, Dubrovacko-Neretvanska; *Slavonia*: Brodsko-Posavska, Vukovarsko-Srijemska, Osjecko-Baranjska, Pozesko-Slavonska; *North-Western Croatia*: Krapinsko-Zagorska, Medjimurska, Varazdinska, Viroviticko-Podravska, Koprivnicko-Krizevacka; *Central Croatia*: Bjelovarsko-Bilogorska, Karlovacka, Sisacko-Moslavacka, Licko-Senjska; *Zagreb*: City and Zagreb county.

the person's geographical origin, we use the survey question asking people which county they lived in during the 1991 Census. The variable is coded as equal to 1 if on March 31, 1991 the person lived in one of the Mediterranean counties and 0 elsewhere. The presumption here is that, other things being equal, somebody who lived in the Mediterranean region in 1991, is likely to have been exposed to the MD longer than the person who did not.

The second variable in this group is what we term peer effects. To construct this variable we start by defining food clusters. Excluding Zagreb metropolitan area, there are 6 counties (zupanija) in the Mediterranean region and 13 counties in the continental region. We consolidated these self-governing political units into 2 food clusters in the Mediterranean region (Northern Adriatic and Dalmatia) and 3 food clusters in the continental region of the country (North-Western Croatia, Slavonia and Central Croatia) plus Zagreb metropolitan area. These areas are supposed to reflect

the geographical and cultural diversity of Croatia revealing the fact that Mediterranean and continental regions are not internally homogeneous. For example, within the Mediterranean region, Istria (Istarska zupanija) in the north (bordering Slovenia) that very much resembles Tuscany or Dordogne-Perigord region in France, with abundance of truffles and amazing olive oils is very different from Dubrovnik region (Dubrovacko-Neretvanska zupanija) in the south with tangerine groves in the river Neretva delta and zinfandel-

Table 3 - Regional averages of main socio-demographic and dietary variables

	Mediterranean Region	Continental Region	Zagreb Region
Socio-demographic indicators			
BMI index	26.1	27.1	26.7
Obese (%)	16.8	25.4	22.3
WHR: Waist-to-hip ratio (avg.)	86.5	88.1	87.1
Age (years)	54.6	53.8	53.4
Female (%)	68.1	67.1	69.6
Married or cohabitate (%)	64.7	61.5	59.3
Household size (members)	305.4	317.0	311.7
Urban (%)	81.1	50.2	79.7
College education (%)	15.8	8.7	21.6
High income (%)	27.5	15.9	37.5
Lifestyle			
Non-smoker (%)	72.9	75.0	71.6
Walk/Bike to work (%)	10.9	9.2	6.5
Diet			
MD10 (avg.)	6.1	5.1	5.6
Bread low (%)	66.4	71.0	73.5
Salads often (%)	30.7	31.1	34.7
Cabbage often (%)	64.7	59.3	65.3
Legumes often (%)	52.3	62.0	55.4
Carrots often (%)	77.1	81.7	76.3
Spinach often (%)	73.4	32.1	46.4
Fruits often (%)	58.8	50.5	59.8
Smoked meat rarely (%)	62.0	50.6	53.1
Wine often (%)	27.7	12.7	16.6
Other			
Mediterranean origin (%)	69.7	3.1	0.9
Peer pressure (avg.)	4.8	4.8	4.9

type red wines on the Peljesac peninsula. Similarly in the continental region, Medjimurska zupanija (in the north, bordering Slovenija and Hungary), known for its hot spas and excellent white wines is very different from Vukovarsko-Srijemska zupanija (in the east, bordering Serbia), known for its wildlife preserves and famous fresh-water fish stews. Next we form reference groups in terms of region (5+1 food clusters), gender (male, female) and age (18-29; 30-49; 50-65; 65+) and then to each individual in the data set we assign his or her reference group's mode (highest frequency) of the silhouette match from PHM_13 question of the survey. Notice from the Appendix, that the survey instruction ask the person to circle a number next to the silhouette sketch which is mostly similar to the silhouette of the respondent. The positive coefficient associated with this variable will indicate that people conform to social norms and peer pressures and align their eating patterns with what is considered socially acceptable.

Finally, as is customary in these kinds of studies, we also use individual socio-economic and demographic characteristics (age, gender, marital status, household size, education, income and urban/rural residency) and lifestyle variables (smoking and walking or riding bicycle to work). The definitions of all variables used in the econometric analyses are given in Table 2 and their summary statistics in Table 3. All relevant (used) survey questions from the CHS 2003 survey are listed in the Appendix.

3. A Heuristic Model of Obesity

In order to organize ideas, we propose a heuristic relationship between some measure of obesity and a set of explanatory variables: $\Omega_{ij} = \beta_0 + \beta_2^k F_i^k + \beta_3^m Z_i^m + \beta_4^n X^n + \varepsilon_i$ where Ω_i identifies the obesity measure of individual i that can be measured as a continuous value of the BMI and WHR or a discrete variable identifying obesity. F_i^k is a vector of k food categories consumed by an individual i, Z_i^m is an individual i's vector of socio-economic and lifestyle characteristics, X^n is a vector of other variables meant to capture the persistent effects of MD beyond the current period and ε_i is an error term. In order to learn something about the nature of the proposed relationship we need to estimate β coefficients.

Before presenting the estimation results of the above model, two characteristics of our empirical approach are worth mentioning. The first thing to notice about the suggested model is the absence of prices. This represents a departure with the traditional economic approach to explaining

obesity by increased affordability of food via decreasing relative prices. The main and obvious reason for this is the lack of food prices in the health survey data that we are using. However, the problem appears to be unimportant because the review of the regional prices (unit values) for various food items computed using the 2003 Croatian Household Budget Survey (HBS) reveal the fact that prices do not vary substantially across households of similar characteristics. As a result, prices are unlikely to have significant explanatory power when it comes to understanding the observed regional differences within the country.

Secondly, a more careful inspection of the survey instrument in the Appendix reveals the fact that consumed quantities were not precisely measured in standardized units like pounds, servings, cups, etc. The survey questions typically ask respondents, how many times a week did they eat a certain food item but did not ask them about the actual quantity consumed. As a result, we have no information on the exact daily or weekly caloric intakes of various food items for the survey respondents. This unfortunate feature of our data set is quite common in many of the previously cited observational and cohort studies which attempt to explain the relationship between the MD and the prevalence of obesity, e.g., Costa-Font, Fabbri and Gil (2010).

We follow the estimation strategy similar in spirit to the one employed by Levinson (2016) by starting with the simple model that contains only the MD and age and sex variables and then subsequently adding groups of socio-demographic, lifestyle and other variables of interest. The idea is to see how the signs and significance of the MD variables, which are of principal interest, change from one specification to the next. We always estimate three versions of various model specifications: two OLS models with the continuous BMI or WHR dependent variables and the linear probability model with discretely defined obesity (if BMI≥30) variable[4]. We present the results in Tables 4a, 4b and 4c.

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4. We use linear probability model for obesity for the ease of interpreting coefficients. Probit results are qualitatively indistinguishable and are not presented to economize on space but are available upon request.

Table 4a - OLS regressions results for BMI

	Model					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
MD10	-0.076***	-0.033	-0.011	-0.232***	-0.240***	
Vegetable oil †						-0.992**
Bread low †						-0.594*
Salads often †						0.491
Cabbage often †						-0.056
Legumes often †						-0.122
Carrots often †						-0.197
Spinach often †						0.259
Fruits often †						-0.843**
Smoked meat rarely †						-0.736**
Wine often †						1.405***
Age	0.458***	0.455***	0.425***	0.411***	0.418***	0.403***
Age^2	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
Female	-0.407***	-0.573***	-0.467***	-0.456***	-0.226*	-0.220
Married		0.215*	0.230**	0.240**	0.244*	0.263*
Household size		0.081**	0.082**	0.082**	0.090**	0.086**
High education		-1.397***	-1.401***	-1.387***	-1.413***	-1.391***
High income		0.098	0.093	0.095	0.023	0.009
Urban		-0.367***	-0.268**	-0.283***	-0.293**	-0.334***
Non-smoker		1.156***	1.139***	1.140***	1.285***	1.270***
Walk/Bike to work		-0.678***	-0.670***	-0.659***	-0.866***	-0.849***
Med-origin			-0.678***	-0.469	-0.262	-0.022
Peer pressure			0.260***	0.245***	0.309***	0.300***
MD10*Age †				0.004***	0.005***	incl.
MD10*Med-origin †				-0.035	-0.023	incl.
Mediterranean					1.788	1.996*
Mediterranean*Age					-0.050	-0.054
Mediterranean*Age^2					0.001	0.001
Mediterranean*Female					-0.849***	-0.920***
Mediterranean*Married					0.014	0.020
Mediterranean*Hh size					-0.038	-0.039
Mediterranean*High educ.					0.071	0.119
Mediterranean*High inc.					0.195	0.155
Mediterranean*Urban					0.316	0.265
Mediterranean*Nonsmoker					-0.581**	-0.535**
Mediterranean*Walk					0.743**	0.760**
Mediterranean*Med-origin					0.241	0.317
Mediterranean*Peer press.					-0.151	-0.193
Constant	14.412***	13.844***	13.560***	14.555***	13.987***	14.623***
Number of obs.	8,759	8,759	8,759	8,759	8,759	8,759
Adj. R-squared	0.117	0.143	0.147	0.148	0.151	0.154

*** $p<0.01$, ** $p<0.05$, * $p<0.1$.
† Joint test for all food variables and interactions with age and Med-origin: $F_{(30, 8703)}$ = 2.51; Prob.>F = 0.0000.

Table 4b - OLS regressions results for WHR

	Model					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
MD10	-0.257***	-0.143***	-0.116**	-0.044	-0.060	
Vegetable oil †						-0.885
Bread low †						-1.122*
Salads often †						0.917
Cabbage often †						0.111
Legumes often †						0.536
Carrots often †						-1.232*
Spinach often †						1.056
Fruits often †						-0.352
Smoked meat rarely †						-0.639
Wine often †						1.595*
Age	0.413***	0.397***	0.366***	0.370***	0.365***	0.350***
Age^2	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
Female	-8.911***	-9.032***	-8.929***	-8.936***	-8.614***	-8.510***
Married		0.522**	0.539***	0.538***	0.617**	0.711***
Household size		-0.001	0.001	0.001	0.053	0.060
High education		-1.716***	-1.724***	-1.728***	-1.923***	-1.853***
High income		-0.455**	-0.461**	-0.465**	-0.442	-0.416
Urban		-1.180***	-1.063***	-1.062***	-1.225***	-1.245***
Non-smoker		0.562***	0.543***	0.546***	0.654***	0.664***
Walk/Bike to work		-0.831***	-0.824***	-0.823***	-0.775**	-0.741*
Med-origin				-0.817***	-0.485	2.072**	1.906*
Peer pressure				0.259*	0.263*	0.369*	0.349*
MD10*Age †					-0.001	-0.001	incl.
MD10*Med-origin †					-0.055	-0.034	incl.
Mediterranean						1.987	1.814
Mediterranean*Age						-0.021	-0.017
Mediterranean*Age^2						0.000	0.000
Mediterranean*Female						-1.104**	-1.302***
Mediterranean*Married						-0.262	-0.349
Mediterranean*HH size						-0.180	-0.175
Mediterranean*High educ.						0.549	0.569
Mediterranean*High inc.						-0.036	-0.005
Mediterranean*Urban						1.019**	0.989**
Mediterranean*Nonsmoker						-0.489	-0.419
Mediterranean*Walk						0.008	0.003
Mediterranean*Med-origin						-2.423***	-1.964**
Mediterranean*Peer press.						-0.195	-0.226
Constant	80.054***	80.666***	80.384***	80.046***	79.315***	80.286***
Number of obs.	8,748	8,748	8,748	8,748	8,748	8,748
Adj. R-squared	0.289	0.300	0.301	0.301	0.303	0.305

*** $p<0.01$, ** $p<0.05$, * $p<0.1$.
† Joint test for all food variables and interactions with age and Med-origin: $F_{(30, 8692)}$ = 1.53; Prob.>F = 0.0315.

Table 4c - Linear probability model regressions results for Obesity

	Model					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
MD10	-0.007***	-0.003	-0.001	-0.006	-0.008	
Vegetable oil †						-0.034
Bread low †						-0.027
Salads often †						0.053*
Cabbage often †						-0.049
Legumes often †						0.012
Carrots often †						-0.027
Spinach often †						0.047
Fruits often †						-0.037
Smoked meat rarely †						-0.011
Wine often †						0.081*
Age	0.024***	0.024***	0.023***	0.023***	0.023***	0.022***
Age^2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
Female	0.022**	0.009	0.013	0.013	0.039***	0.037***
Married		-0.004	-0.003	-0.002	0.004	0.005
Household size		0.007**	0.007**	0.007**	0.009**	0.009**
High education		-0.104***	-0.105***	-0.105***	-0.112***	-0.112***
High income		0.015	0.014	0.014	0.017	0.017
Urban		-0.032***	-0.022**	-0.023**	-0.028**	-0.033***
Non-smoker		0.071***	0.070***	0.070***	0.081***	0.082***
Walk/Bike to work		-0.044***	-0.044***	-0.044***	-0.069***	-0.067***
Med-origin			-0.070***	-0.024	-0.020	-0.001
Peer pressure			0.010	0.010	0.023**	0.022**
MD10*Age †				0.000	0.000	incl.
MD10*Med-origin †				-0.008	-0.006	incl.
Mediterranean					0.239**	0.243**
Mediterranean*Age					-0.003	-0.004
Mediterranean*Age^2					0.000	0.000
Mediterranean*Female					-0.091***	-0.093***
Mediterranean*Married					-0.018	-0.016
Mediterranean*HH size					-0.008	-0.009
Mediterranean*High educ.					0.019	0.023
Mediterranean*High inc.					-0.014	-0.016
Mediterranean*Urban					0.047**	0.047*
Mediterranean*Nonsmoker					-0.046**	-0.044*
Mediterranean*Walk					0.089***	0.088***
Mediterranean*Med-origin					0.038	0.050
Mediterranean*Peer press.					-0.032**	-0.035**
Constant	-0.418***	-0.463***	-0.474***	-0.452***	-0.523***	-0.493***
Number of obs.	8,759	8,759	8,759	8,759	8,759	8,759
Adj. R-squared	0.038	0.054	0.059	0.059	0.063	0.065

*** $p<0.01$, ** $p<0.05$, * $p<0.1$.
† Joint test for all food variables and interactions with age and Med-origin: $F_{(30, 8703)}$ = 1.38; Prob.>F = 0.0830.

4. Results and Discussion

We start with the simple model that contains only the MD10 food index, age, age squared, and gender variables (and the intercept term). We see that in all three version of the model (BMI, WHR and obesity), the MD10 variable has the expected (negative) sign and is statistically significant at 1% level. The results also show that, *ceteris paribus*, women have on average lower BMI and lower WHR than men but higher probability of being obese. All three measures of obesity increase with age but at the decreasing rate.

Next, we add the set of socio-economic and lifestyle variables. Somewhat unexpectedly, the significance of the MD10 drops in the BMI and the obesity model but not in the WHR model where it is still significant at 1% level. Among the newly included variables in the WHR model, whether a person is married or not and the household size are insignificant, education coefficient is negative (and significant) indicating that people with more education tend to have lower WHR. The same is true for urban residents and people with higher incomes. Finally, people that walk or bike to work have lower WHR and people who do not smoke have higher WHR.

In the Model 3 we introduce additional two variables for which we believe can address the problem that the relationship between the diet and obesity is not only contemporaneous and direct but also depends on the host of other factors whose influences are more prolonged, sometimes even permanent. The motivation behind including this group of variables is the presumption that, of course, peoples' decisions about what they eat are based on the relative prices and income, but their preferences and the choice sets they face are determined by cultural factors such as tradition, collective memory and habits. First, borrowing from Atkin (2013), who claims that households develop tastes for locally abundant foods they were fed as children, we submit that a person's geographical origin could be exploited to explain the rigidities in eating patterns. As it turns out, the Mediterranean origin appears to be important in explaining obesity in all three models. Survey respondents that lived in the Mediterranean region in 1991, exhibit the tendency of having the lower BMI, lower WHR and lower probability of being obese. In all models, these coefficients are highly statistically significant.

The second variable in this group is what we term as peer effects. Peer effects are guided by social norms regarding peoples' beliefs about what is considered aesthetically acceptable or pleasing regarding how people look. We interpret social norms as a behavioral regularity that can be measured by the behavior of a reference group, such that any deviation from the established norms results in a cost (Akerlof and Kranton, 2000). The coefficient associated with the peer effects variable have the expected sign (positive) in all three models and are statistically significant in the BMI

and WHR models. Recall the variable has been constructed by assigning the most frequently observed silhouette in a given reference group to the person belonging to that reference group. As an illustration, this means that if most of the people whom I associate with, i.e. my peers, are little bit on the chubby side, it is perfectly acceptable for me to be chubby as well, hence the expected sign of this coefficient is positive. The results show that increasing the most observed (mode) silhouette in the reference group by 1 (one position to the right), the BMI of the person belonging to that reference group would increase by 0.26 points and his or her WHR would increase 0.26 percent.

As a group, these two variables performed reasonably well in explaining the prevalence of obesity in Croatia. Their inclusion in the model did not affect the significance of the MD10 variable which continued to be insignificant in the BMI and obesity models and significant in the WHR model.

The notion that obesity is not a flow but rather a stock variable is captured by the idea that the duration of exposure to particular set of habits matter for obesity. In other words, the longer one eats MD, the more pronounced will be its impact on obesity. Similarly, to the extent that there has been some differences in the adherence to or the composition of MD due to changes in tastes or culture, this should show up in age cohort differences. In all these cases, there should be some interaction effect between age cohorts and eating a MD. To harness this idea, in Model 4 we include two more variables. The expected sign of the interaction effect MD10*age is negative, reflective of the idea that, *ceteris paribus*, the older the person is, the longer should be his exposure to MD and hence the more pronounced its impact on obesity prevention and hence lower the obesity measure. Notice that the interpretation of this coefficient is somewhat complicated by the fact that the model contains age variables as well, which show that the obesity is increasing with age but at a decreasing rate. Therefore, combined with natural biological aging effect on obesity, the expected negative sign of the interaction between age and MD means that the negative effect of aging on obesity should be mitigated (slowed down) by eating MD. The estimation results show that in the WHR and obesity models this interaction effect is effectively zero, whereas in the BMI model we got an unusual result of the positive effect, which turns out to be very small, albeit statistically significant.

A similar effect can be also captured by introducing the interaction between MD10 and Mediterranean origin dummy. The expected sign of this coefficient is also negative because people of any age with the Mediterranean background should have had longer exposure to MD and this effect should intensify for older folks, of course controlling for the natural effect of aging on obesity. The estimation results for all three models show that this tendency is detectable in the data in the sense that all estimated coefficients are in fact negative. However, none of the coefficients are statistically significant.

The inclusion of these two variables had an opposite effect on the significance of the MD10 variable in the BMI and WHR models. In the BMI model, previously insignificant effect of the Mediterranean diet on the BMI score is now significant at the 1% level, whereas the previously significant coefficient of MD10 in the WHR model is now insignificant. The inclusion of these two variables did nothing to the significance of the MD10 variable in the obesity model, which continues to be statistically insignificant. One has to be careful when interpreting these results. We are reluctant to conclude that the history of eating patterns do not matter for obesity. We are more inclined to accept our earlier premise that the single-period survey data serve as good proxies for current consumption as well as past habits.

Another question of interest is how much of the observed variation in three different obesity measures is explained by our last model? Because we are primarily interested to measure the effect of the Mediterranean diet, an obvious thing to ask is whether the Mediterranean region is somehow different from the rest of the country in addition to the fact that people residing there are likely to have higher exposure to MD than the rest of the country. For example, the fact that people, especially women, are thinner in the coastal area could be attributable to the proximity of the ocean (beaches), better air quality, higher proportion of sunny days during the year, or who knows what. Another possibility could be the stronger presence of the short food supply chains in all its configurations, such as farmers' markets, farm shops, community-supported agriculture and solidarity purchase groups in the Mediterranean region relative to other regions[5]. An obvious way to obtain an answer to this question is to saturate the model with the full set of Mediterranean dummy variables except for the interaction with the food variable MD10. We do this in Model 5.

In case of the BMI model, the results show that all estimated coefficients, and their t-statistics, stayed very close to their previously estimated values and that the single Mediterranean dummy and most of the interactions are statistically insignificant. The exceptions are the interaction of regional dummy with the female variable, which is negative showing that women in the Mediterranean region have lower BMI than women in the rest of the country for reasons unaccounted for by our model. The other two examples are interactions with smoking and walking to work. For unknown reason, nonsmokers have lower BMI in the Mediterranean region then their nonsmoking counterparts in the rest of the country, and people who walk to work have higher BMI than their counterparts in the rest of the country. These results lend support to the conclusion that the Mediterranean diet based

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5. The benefits of short food supply chains on the reduction of BMI scores in the group of adult Italians are documented in Bimbo *et al.* (2015).

model explains the BMI variation in Croatia reasonably well. The MD10 coefficient shows that an increase in index by 1 point reduces the BMI score by 0.24 points. Given that the average BMI for the country as a whole is 26.7, this means that an increase in Mediterranean diet exposure by 10% reduces the BMI by about 0.9%.The effect is modest but statistically significant.

The introduction of the full set of Mediterranean region dummy variables into the model did not improve the statistical significance of the MD10 index in the WHR and the obesity models. Clearly, the within country variations in these two obesity measures are not very well explained by one summary index of Mediterranean diet. This is also seen from the estimation results that show more interactions between the Mediterranean region dummy variable and other covariates are being statistically significant than in the BMI model.

Finally, we want to look at the impact of the individual components of the MD10 index on various measures of obesity. In Model 6 we replace the MD10 variable with the set of its ten constituent food groups. As mentioned before, the way these food variables are coded, the negative coefficient means beneficial effect of the food group on the BMI, WHR or obesity reduction. Starting with the BMI model, from the last column in Table 4a we see that most but not all food groups have expected (negative) sign and some of them are statistically significant. Testing for the joint significance of all food variables and their interactions with age and the Mediterranean origin variables show that F statistics with 30 and 8703 degrees of freedom equals 2.52 which indicates that the Mediterranean diet is statistically significant in explaining the variation in the BMI at 1% level. The results show that consuming olive oil, low amounts of bread, large amounts of fruits and rarely eating smoked meat, all have statistically significant beneficial effects on the reduction of the BMI. For example, a person eating fruits very often or every day has a lower BMI by 0.84 points than a person who does not eat fruit at all or eats fruit only occasionally. Our results also show that wine consumption increases the BMI. In particular, we show that a person who drinks wine 2-3 times a week or every day has higher BMI by 1.4 points than a person who drinks wine once a week or less[6]. This result is interesting as it raises question of what moderate consumption of wine, or alcohol in general, really means.

Moving on to two other models for the WHR and obesity, we find the results pretty much in line with our earlier findings. In both of those models,

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6. These findings are somewhat contrary to the extant literature in the field. In general, recent prospective studies show that light-to-moderate alcohol intake is not associated with adiposity gain while heavy drinking is more consistently related to weight gain. Experimental evidence is also mixed and suggests that moderate intake of alcohol does not lead to weight gain over short follow-up periods, see Traversy and Chaput (2015).

the number of individual food items constituting the MD that have the expected (negative) signs and statistical significance is lower than in the BMI model. However, testing the statistical significance of the entire MD complex of variables with an F-test indicates that they are jointly significantly different from zero. Related to Mediterranean region and diet, we found two statistically significant results that are consistent across all three overweight measurement models. First, drinking wine two to three times a week or more definitively increases BMI, WHR and obesity. Second, for reasons not attributable to Mediterranean diet and other model covariates, women in the Mediterranean region are thinner than in the rest of the country. The Mediterranean women have 0.92 points lower BMI score, 1.3% lower WFR and are 9.3 percent less likely to be obese than women in the rest of the country.

5. Conclusions and Policy Implications

Obesity has risen throughout much of the world in the past several decades. An important and unanswered question about obesity is why does it vary so much across countries and various race, ethnic and other groups. Whereas the conclusions in the literature are not unanimous, numerous empirical studies provide a rather compelling evidence of the beneficial effects of the Mediterranean diet on obesity prevention. In this paper, we investigate the effects of Mediterranean diet on the prevalence of obesity in Croatia. The country is a good candidate for studying regional differences in the prevalence of obesity because it consists of two distinct geographical regions: Mediterranean and continental part. Whereas it is reasonable to assume that people in the Mediterranean region are more exposed to the MD, the question remains whether the observed differences in obesity between the two regions are solely explicable by the differences in what people eat or are there other significant factors that play an important role.

In this study, we seek to establish a causal relationship between the MD and three different measures of overweightness using the single-period cross-sectional data from the 2003 Croatian Adult Health Survey (CAHS). We hypothesize that people conform to social norms and peer pressures and try to match the way they look and behave with what is considered socially acceptable. We found strong support for this hypothesis in all our regression models. We also explicitly acknowledge that fact that obesity is not a flow but rather a stock variable that is impacted not just by current eating, but by the cumulative effect of overeating during the lifetime. The fact that we are using a single-period survey data motivated the search for ways to incorporate the idea that the duration to exposure to a particular diet matters for obesity

into the regression analysis. We discovered that differential cohort effects are largely insignificant and concluded that the reported contemporaneous consumption of foods is a good proxy for current as well as past dietary habits.

Among three measures of obesity, we found statistically the most convincing relationship between the BMI and the MD. Our results show that an increase in the Mediterranean diet aggregate index by 10% reduces the BMI by about 0.9%. The effect is modest but statistically significant. When we replaced the MD10 index with the set of its ten constituent food groups, we found that, as a group, these food variables are jointly statistically significant, most of them have expected (negative) signs, and some of them are also individually significant. The results show that consuming olive oil, low amounts of bread, large amounts of fruits and rarely eating smoked meat, all have statistically significant beneficial effects on the reduction of the BMI. However, contrary to the literature that claims the beneficial effect of moderate consumption of red wine on obesity control, our results show that wine consumption of more than two-to-three times per week increases the BMI significantly.

Our findings are in line with the most recent evidence of significant health benefits associated with the MD. According to the just published Global Burden of Disease study by the Institute of Health Metrics and Evaluation (see Afshin *et al.*, 2019), unhealthy diets are responsible for 11 million preventable deaths globally per year, more than any other factor, even smoking tobacco. The study suggest that the leading dietary risk factors are high intake of sodium and low intake of healthy foods, such as vegetables, whole grains, legumes, fruit, nuts and seeds. Other risk factors considered were consuming high levels of red and processed meat and sugary drinks and low milk and fiber consumption. Heart attacks and strokes are the main diet-related causes of death, followed by cancers and type 2 diabetes. The study also found that countries that have a mainly Mediterranean diet (e.g., Lebanon, Israel and Iran) eat more fruit, vegetables, nuts and legumes and are among the better performers. But no country has an optimal level of consumption of all the health foods. Even in countries that have a Mediterranean diet, the current intake of many other dietary factors is not optimal. Therefore, while perhaps the relationship between different obesity measures and the Mediterranean diet is somewhat tenuous, the health benefits of the MD seem indisputable.

Our results have a couple of important policy implications. First, relevant to countries with high wine consumption, we showed that as a standard element of the MD, moderate wine consumption is an exception in that it does not provide positive effect on obesity prevention. For example, Croatia has either the largest or the second largest consumption of wine per capita

in Europe. According to 2014 Wine Institute data, Croatians consume 44 liters of wine per capita, Slovenians consume the same amount and France is third with 43 liters. According to WHO 2010 data (published in 2014) for the population of 15 and older and assuming 13% alcohol content in wine, Croatia consumed on average 42 liters per capita, Slovenia has the same consumption, but France has the consumption of 53 liters per capita per year[7]. Given the fact that the average BMI for the entire country of 26.72 is in the overweight category and close to a quarter (22.25%) of the population is obese, perhaps a sound public policy proposal would be to increase the consumption tax on wine or introduce some other measure to deter over-consumption.

Secondly, our results could be helpful in formulating new and enforcing old national nutritional guidelines. In Croatia, and in the EU, prevention of obesity with early intervention in school lunch programs has been the target of numerous public health initiatives. The National Guidelines for Nutrition in Primary Schools was lunched by the Croatian Ministry of Health in 2013 aiming at prescribing groups of normative menus of balanced diet in terms of daily nutrition and energy intakes as well as food selections. All these prescriptions have a lot in common with the Mediterranean diet as commonly understood. In 2017, Croatia adopted the National Strategy for Implementation of the School Scheme for Food, Vegetables and Diary Products with the intention to increase the consumption of these products by children. The Strategy was a part of the European Union program to support the supply of fruit and vegetables, bananas and milk in educational establishments, as requested by the European Parliament regulation No. 1308/2013. Despite the fact that our analysis does not pertain to children, our results showing benefits of eating Mediterranean type diet, reach in fruits and vegetables, could be extrapolated to give credence to school lunch and other nutritional programs targeting children and young adults.

Acknowledgements

7. The data taken from https://jakubmarian.com/wine-consumption-in-europe-by-country-per-year-per-capita/.

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Appendix

CHS 2003: CROATIAN HEALTH SURVEY
(Selected questions from the questionnaire by sections)

HOUSEHOLD

HOU_01
In which county do you live?
23 possible choices (21 counties of Croatia, country from ex-Yugoslavia, and other country)

HOU_02a
Household size – under 18 years old?

HOU_02b
Household size – 19-64 years old?

HOU_02c
Household size – 65 years old and above?

HOU_04
Monthly household income (in average)?
1 - Less than 1000 kuna
2 - Between 1000 and 2000 kuna
3 - Between 2000 and 3000 kuna
4 - Between 3000 and 4000 kuna
5 - Between 4000 and 5000 kuna
6 - Between 5000 and 6000 kuna
7 - Between 6000 and 10000 kuna
8 - More than 10000 kuna

HOU_06
Level of urbanization
1 - Urban settlement
2 - Suburban settlement
3 - Village settlement
4 - Isolated house

MIG_01
In which county did you live during the census in 1991 (March, 31)?
23 possible choices (21 counties of Croatia, country from ex-Yugoslavia, and other country)

EATING HABITS

FHA_02
What kind of fat do you mostly use for food preparation at home?
1 - Vegetable oil, vegetable oil or margarine

2 - Butter, pork lard or any kind animal fat
3 - Does not eat fat at all

FHA_10
How many slices of bread do you usually eat per day?
1 - None
2 - Not more than 3 slices
3 - 4 slices and more

FHA_12
How often do you usually eat fruit?
1 - Does not eat fruits
2 - Occasionally
3 - Very often
4 - Every day

FHA_13
How often do you usually eat salads (green, tomato, cabbage, beetroot, carrot and similar)?
1 - Does not eat salads
2 - Very rarely (several times a month)
3 - Twice a week
4 - Every day or almost every day

FHA_15
How often do you usually eat cabbage, broccoli, cauliflower and similar?
1 - Does not eat cabbage, broccoli, cauliflower and similar
2 - Very rarely (several times a month)
3 - Twice a week
4 - Every day or almost every day

FHA_16
How often do you usually eat legumes (pod, bean, peas, soya bean and similar)?
1 - Does not eat legumes
2 - Very rarely (several times a month)
3 - Twice a week
4 - Every day or almost every day

FHA_17
How often do you usually eat root vegetables (carrot, turnip, parsley and similar)?
1 - Does not eat root vegetables
2 - Very rarely (several times a month)
3 - Twice a week
4 - Every day or almost every day

FHA_18
How often do you usually eat spinach, chard and similar vegetables?
1 - Does not eat spinach, chard and similar vegetables
2 - Very rarely (several times a month)

3 - Twice a week
4 - Every day or almost every day

FHA_19

How often do you usually eat smoked meat, sausage-meat, ham, bacon and similar?
1 - Does not eat smoked meat, sausage-meat, ham, bacon and similar
2 - Very rarely (several times a month)
3 - Twice a week
4 - Every day or almost every day

FHA_25

How often do you usually have wine?
1 - Never
2 - A few times a year
3 - 2 to 3 times a month
4 - Once a week
5 - 2 to 3 times a week
6 - Every day

SMOKING

SMO_05

Do you smoke at the present time (cigarettes, cigars, pipe)?
1 - Not at all
2 - Occasionally
3 - Yes, every day

PHYSICAL ACTIVITY

PHA_01

How many minutes a day do you spend walking or riding bicycle to and from work? (combine time spent both ways)
1 - Does not work at all or works at home
2 - Goes to work by car, public transportation or similar
3 - Walks (ride a bike) less than 15 minutes a day
4 - Walks (ride a bike) between 15 to 30 minutes a day
5 - Walks (ride a bike) for more than 30 minutes a day

BACKGROUND INFORMATION

BKI_01
Year of birth?

BKI_02

Sex
1 - Male
2 - Female

BKI_03
Marital status
1 - Married or living in partnership
2 - Single
3 - Separated or divorced
4 - Widowed

BKI_07
Education
1 - Unfinished primary school
2 - Primary school
3 - High school or similar school
4 - College
5 - University
6 - Unknown

PHM_13
Silhouette
(circle a number next to the silhouette which is most similar to the silhouette of the respondent)
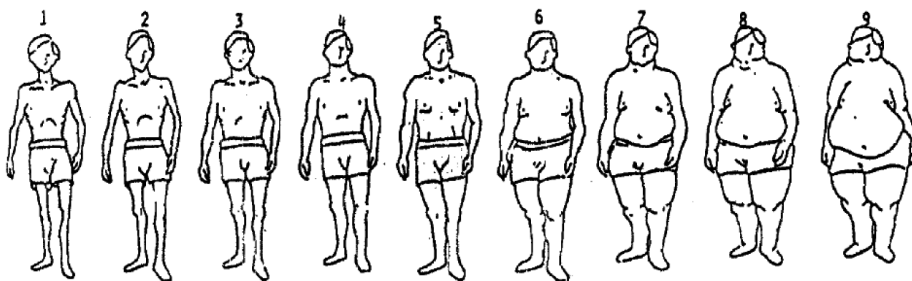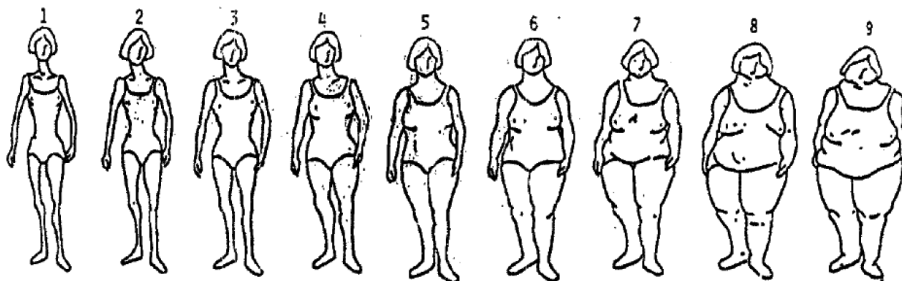
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The food insecurity and the young generations' perception: A systematic review

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Abstract

Food insecurity is a global problem mainly generated by financial issues, critical geopolitical situations and constantly changing weather conditions that have direct effects on availability and prices of food products. These issues reduce capacity to manage the available resources with the consequence of obtaining an approximate distribution of food all over the world. Food insecurity involves multiple population groups and different generations, including University students. In order to evaluate the relationship between food insecurity and University students investigated from different points of view, this article provides a systematic literature review dedicated to this topic with the aim of identifying any research gaps. For this purpose, a selection of 29 articles was created and the subsequent analysis highlighted the main objectives dedicated to this topic i.e. "Food safety, nutrition and health", "Food safety and determinants", "Food security linked to financial issues", "Food security linked to school performance" and "Food security and socio-demographic variables". In particular, food insecurity exists in campuses mainly due to living costs, income and budget, dietary priority; it affects physical health, mental health and ultimately impacts on students' academic performance. All surveys mainly concern

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individual University campuses in countries developed or in development and therefore a lack of studies dedicated to the comparison of campuses belonging to countries with different socio-economic conditions is highlighted. In light of the results obtained, the authors propose further comparative studies on the perception of food insecurity among University campuses in different geographical areas in order to provide new knowledge on the subject.

Introduction

Food security is a real global problem. The United Nations identified it as one of the sustainable development goals, i.e. Goal 2 - Zero Hunger. Indeed, the "State of Food Security and Nutrition in the World 2018" report drafted by FAO, and other international agencies and programs indicate that the number of people suffering from hunger and malnutrition is on the rise after a prolonged decline. Analyses show that the number of undernourished people has increased to 821 million in 2017 from 804 million in 2016 (FAO *et al.*, 2018). This new trend amplifies the scope of the problem and emphasizes how it can be considered relevant for the entire planet and not only for developing countries.

The situation is worsening in South America and in most parts of Africa, meanwhile in Asia the trend towards food insecurity seems to slow down significantly. On the other hand, overweight and obesity increase and coexist with malnutrition, i.e. there is a "double burden" phenomenon. Indeed, poor access to food, particularly healthy food, contributes not only to malnutrition, but also to overweight and obesity (Popkin *et al.*, 2020). The implementation and strengthening of interventions aimed at guaranteeing access to food is necessary to interrupt the intergenerational cycle of malnutrition and a change of food production systems is needed to produce safe foods and promote healthier diets (Baker & Friel, 2016).

Some countries suffer from food insecurity more than others and motivations are numerous. On the one hand, geopolitical situations e.g. military conflicts, and weather conditions e.g. climate change, do not allow production, conservation and supply of food useful to guarantee an adequate level of food security. Meteorological adversities have as a direct consequence on available foodstuffs and increase in the price of food due to the reduced presence in market. To these are added, the increase in world population and therefore the increase in demand for food, and the reduced capacity to manage the economically more evolved resources in a geographical area e.g. the food waste phenomenon, with the consequence of obtaining an

approximate management of the planet's food capacities (Munesue *et al.*, 2015).

On the other hand, other issues are determinant to reduce the food access to the population. Indeed, the definition of food security, although it incorporates the concepts of availability, access, use and stability of food, seems to be oriented mainly towards increasing the quantity of food available. However, the current trend suggests that access to food is significantly limited even in times of increasing food availability. This phenomenon leads to the distinction between household food security and individual food security i.e. families can have immediate access to food supplies but an individual level access to food requires adequate resources, markets and social networks (Stringer, 2016). More generally, the reduction in food access can be caused by critical issues in the area of economic and financial resources, e.g. in 2007 several States chose austere economic measures to counter the period of economic and financial crisis, with enormous nutritional and health implications. Therefore, a reduction in food security can be mainly caused by a limitation of financial resources dedicating to social policies (Caraher & Coveney, 2016; Riches & Silvasti, 2014).

The continuous transformations of the political and operational frame of reference have for a long time limited the possibility of reaching a univocal definition of the concept of "food security". Consider that around two hundred definitions were still counted in the early 1990s (Smith *et al.*, 1992).

The evolutionary path in the field of food security began in the 1970s in conjunction with the great world food crisis, aggravated by the oil shock, when the United Nations gave a first definition of food security, i.e. "*Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices*" (United Nations, 1975).

Since the early 1980s, the availability of access to food has been increasingly recognized as a determinant of food security. In 1983, FAO expanded its concept by emphasizing the importance of guaranteeing access to food at any time, understood as basic food, both in terms of the economic sphere and the physical sphere: "*Ensuring that all people at all times have both physical and economic access to the basic food that they need*" (FAO, 1983). In 1986, the World Bank gave a further clarification of the concept of food security, highlighting the importance of leading an active and healthy life, i.e. "*Access of all people at all times to enough food for an active, healthy life*" (Reutlinger, 1986).

The definition of officially recognized food security was given as part of the World Food Summit, convened by FAO in 1996, i.e. "*Food security exists when all people, at all times, have physical and economic access to*

sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" which in fact also underlines the nutritional aspect of food (FAO, 1996).

In 2001 a clarification on the social aspect was introduced into the notion of food security, i.e. "*A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*" (FAO, 2002). The social character of access to food is extremely important in contexts where belonging to a certain social group, ethnic group or gender is an obstacle to healthy eating. In this case, the concept of food security is close to the concept of consumption and, especially, of food demand by the most vulnerable people, highlighting the right of access to food for individuals and families. Indeed, Sen showed that in times of famine, food was often available but did not reach the population, and sometimes even was destined for export with greater harm to the local people. These findings led Sen to highlight the key role of the lack of rights as the main cause of death and suffering on a large scale rather than the insufficient availability of food (1981). Different tools have been activated to reduce hunger also in recent times e.g. food banks, but are not the final response for a durable free food access (Riches & Silvasti, 2014).

The definition of food security prepared by FAO evidences the two dimensions that make up food security, one physical and one temporal. The physical dimension is divided into three sub-dimensions: food availability, food accessibility, and food use. The temporal dimension is understood as the stability of the offer. All four dimensions must be met simultaneously to reach the food security objectives (VAM, 2009).

The concept of availability is closely connected to the need to have enough food for oneself and for one's own family in order to guarantee an active and healthy life. However, the real availability of produces should be matched with their accessibility to satisfy people's needs.

The definition of access is divided into physical, social and economic access. The food raw materials can be physically available to the consumer who also needs to have the necessary resources to acquire them, but there may be non-economic barriers that limit access to food i.e. social reasons, wars, civil conflicts, poor infrastructures and inadequate logistics. Physical access refers to a logistical aspect, to the presence of infrastructures that allow food to be present in all places even if characterized by conflicts. Social access underlines the fact that food security is granted only when all people have adequate access to food, regardless of the social group, ethnic group or gender they belong to. Economic access indicates the possibility of buying food regularly using family income, without having to give up basic needs; it also implies that food is available at reasonable prices.

The definition of use by the World Food Summit is "*safe and nutritious food that meets dietary needs*". Use relates to the adequacy of food with respect to physiological needs and cultural needs and is strictly connected to the possibility of following a balanced diet, having access to clean water, living in adequate hygienic-sanitary conditions, relying on assistance and health care and having the necessary data on food preservation and preparation. In this case, the connection between food security and food safety is evident.

Finally, the concept of stability refers to the constant presence of the other three components over time. The dimension of stability makes it possible to make a distinction between chronic food insecurity and transitory insecurity (Maxwell & Frankenberger, 1992). In the first case, this is a long-term condition linked to the persistent impossibility of satisfying basic food needs due to poverty, lack of own resources and inadequate access to other financial or productive resources. On the other hand, transitory insecurity is temporary or cyclical/seasonal. Stability is particularly important for assessing whether a territory suffers from food insecurity only over a short period, or has structural difficulties in the nature of the offer, and therefore there are deeper reasons for fearing the chronic appearance of this phenomenon.

In order to appraise the concept of food security, the Economist Intelligence Unit has structured a tool called the global food security index (GFSI), meant to understand the root causes of food insecurity by looking at food system dynamics around the world (The Economist, 2017). Indeed, the meaning of food security and its interpretation can be influenced by culture, environment and geographical location, but the index provides a useful approach to understanding food security risks without capturing the characterizing elements of each individual country. Since its establishment, the GFSI has become a means of political control for governments and a national diagnostic tool for investments. Non-governmental organizations have turned to the GFSI as a research key to identify countries in which to focus advocacy efforts on changes to food security and development policy.

At the same time, other measurement tools were carried out e.g. Food Insecurity Experience Scale (FIES). Indeed, Cafiero *et al.* (2018) describe the procedures for defining the FIES in eight headings as a contribution to the creation of an indicator for the global monitoring of food insecurity. Obtained results from their study would allow annual monitoring of performances and any improvements in the Agenda 2030 perspective.

On the other hand, some systematic reviews were carried out on the food insecurity topic. Candel (2014), through the systematic review, underlined the importance of the role of governance in the management of food security, highlighting, on the one hand, its value in solving problems, on the other, the need to resort to new empirical investigations to analyze

governance agreements also at subnational level. Moreover, Bruening *et al.* (2017) and Nikolaus *et al.* (2020) evidenced several studies dedicated to University students and food (in)security. Bruening *et al.* (2017) highlighted that food insecurity seems to be quite widespread among the University student population, with particular reference to gray literature, and it is associated mainly with financial independence, poor health and unfavorable academic results. Nikolaus *et al.* (2020) carried out a review dedicated to food insecurity among US University students using peer-reviewed literature and gray literature. The results of the study suggest the need to change conventional detection methods to have a more precise classification of University students.

In this context, this paper aims to select the pertinent research studies i.e. peer-reviewed papers, and highlights the following key questions i.e.

- "What are the most salient issues investigated on food insecurity among University students?"
- "Are there studies dedicated to the comparison on food insecurity perception among University students from Universities in developed and developing countries?"

To this end, a systematic review was carried out to collect studies dedicated to this phenomenon among University students and related concerns the world over. The paper is structured as follows: the first section describes the methodology used to carry out the systematic review and the analysis of the process to select the eligible papers (Methodology section); the second section presents the findings of the review underlining the main issues and concerns on interaction between food security and University students (Findings section); the third section is dedicated to synthesis of the aspects emerged from the present study with indication of potential applications, feasible implications and suggestion for future researches (Conclusion section).

1. Methodology

A systematic literature review was carried out, in line with other authors (Moher *et al.*, 2009; Briner & Denyer, 2012; Poulsen *et al.*, 2015). This activity allowed to identify, assess and define an in-depth analysis on literature in order to address the research questions of this paper. Beginning on PRISMA guidelines (Moher *et al.*, 2009), a systematic literature review was conducted following a six-step analysis (Table 1) (McGrath *et al.*, 2012; Boren & Moxley, 2015).

The first step was dedicated to identify and well-define the research topic based on available literature related to the link between food security issues and University students all over the world.

The second step defined the databases used to select papers on the research topic. In this case, Scopus (Elsevier) and Web of Science (WoS) (Clarivate Analytics) were chosen for an identification of research papers considered appropriate for a systematic literature review on this topic.

The third step formulated the search strategy, in line with the topic identified in the first step. The literature search was carried out in 2019, on the 28th of August, using in Scopus the TITLE-ABS-KEY search query for "food security" AND "University student". Then, the TITLE-ABS-KEY search query was also used for "food insecurity" AND "University student". At the same time, a literature search was carried out in the Web of Science Core Collection database using the ALL FIELDS search query for "food security" AND "University student" and then for "food insecurity" AND "University student". Other words in search queries were not considered to obtain as many papers as possible dedicated to the topic. The time period used was "All years" for each search query to the scope of verifying relevant time evolution in this topic. In total, 76 papers were initially identified through these search processes; 27 out of 76 papers were duplicated and, therefore, removed.

The fourth step was dedicated to applying the screening criteria for analysing the contents of the abstracts. The authors separately analysed the subjects of selected papers in order to identify the papers that satisfied the scope of the research and separate the papers that were not relevant. In the latter case, the exclusion criterion was if the topic was not in line with the scope of this study. This situation can occur if the title and abstract reply positively to the research query, but the abstract contents of the candidate papers are not in line with the scope of research. In this case, several papers investigated the food insecurity phenomenon on the whole population and University students were cited in the abstract but they were not the main subject of the study. Moreover, only peer-reviewed articles were considered excluding other contributions such as reviews, notes to editors and comments.

After this first individual screening, authors divided the candidate papers into two lists, one of papers "probably accepted" and one of papers "probably rejected", both integrated by a brief comment. Thus, authors compared their results, discussed differences in order to warrant a double examination of each paper and defined the potential eligible abstracts. This stage enabled to select the papers deemed suitable for systematic review. At the end of this phase, 19 out of 49 papers were declared not eligible for the aim of this research and, therefore, rejected. Moreover, authors carried out a full-text availability check at the libraries of the authors' institutions in order to assess potentially eligible papers and ensure that the contents of the papers were in line with the aim of the study. At the end of this stage, 29 articles were available (Figure 1).

Figure 1 - Systematic review process and number of selected papers

Identification databases	Scopus (Elsevier) and Web of Science (WoS)

Papers identified through databases searching by selected keywords (TITLE-ABS-KEY and ALL FIELDS screening)	N=76

Papers duplicated	N=27	

Screening after exclusion of duplicates	N=49

Contents abstract not eligible	N=20	

Selected papers after contents analysis	N=29

The fifth stage was based on a paper content analysis by main data and information extraction in order to satisfy the scope of review. In this phase, selected papers were coded on the basis of year of publication and later classified according to the content analysis on the basis of two requirements: the scope of the study and related issues, i.e., presentation of the study problem and research questions, the research main results, implication and conclusion.

The sixth step was structured as an in-depth assessment of papers related to the main classification criteria of the fifth step and a synthesis of the systematic review based on the main topic and the aim of the study.

Table 1 - Synthesis of the six-step systematic review

Steps	Activities
First	Identifying and well-defining the research topic based on available literature
Second	Selecting databases to extract probably eligible papers
Third	Formulating search strategy and extracting potentially eligible papers
Fourth	Screening criteria analysis to define selected papers
Fifth	Extraction of the main data and information
Sixth	Synthesis of the systematic review

2. Results and discussion

2.1. *Descriptive analysis of the selected papers*

The main evidences obtained from the systematic review dedicated to the relationship between the concept of food (in)security and University students are shown as follows. The application of the constraints in the systematic review has led to the identification of 29 papers. The selected papers are reported with the indication of an identification code (code), useful for reading and linking the following analysis, and with the main information i.e. authors, title, year of publication and language used (Table 2).

Table 2 - Selected Papers with code and main information

Code	Authors	Year	Title	Language
1	Hughes *et al.*	2011	Student food insecurity: The skeleton in the University closet	English
2	Sulaiman *et al.*	2013	Food insecurity among public University students receiving financial assistance in Peninsular Malaysia	English
3	Munro *et al.*	2013	Hunger for knowledge: Food insecurity among students at the University of KwaZulu-Natal	English
4	Gallegos *et al.*	2014	Food insecurity: Is it an issue among tertiary students?	English
5	Micevski *et al.*	2014	Food insecurity among University students in Victoria: A pilot study	English
6	van den Berg & Raubenheimer	2015	Food insecurity among students at the University of the Free State, South Africa	English
7	Anuar *et al.*	2015	Pilot study on the prevalence of food insecurity among sub-urban University students during Holy Ramadan	English
8	Morris *et al.*	2016	The Prevalence of Food Security and Insecurity Among Illinois University Students	English
9	Deepika Priyadarshani *et al.*	2017	Access to healthy foods and indications of food insecurity among private University students in a Colombo suburb, Sri Lanka	English
10	Farahbakhsh *et al.*	2017	Food insecure student clients of a University-based food bank have compromised health, dietary intake and academic quality	English
11	Reynold *et al.*	2018	Prevalence and correlates of food security among students attending a small, rural Canadian University	English
12	van Woerden *et al.*	2018	Food insecurity negatively impacts academic performance	English
13	Cuy Castellanos & Holcomb	2018	Food insecurity, financial priority, and nutrition literacy of University students at a mid-size private University	English

Table 2 - continued

Code	Authors	Year	Title	Language
14	Lee *et al.*	2018	Exploring the Experience of Food Insecurity among University Students Caring for Children: A Qualitative Descriptive Study	English
15	Davidson & Morrell	2018	Food insecurity prevalence among University students in New Hampshire	English
16	Martinez *et al.*	2018	Food insecurity in California's public University system: What are the risk factors?	English
17	Olauson *et al.*	2018	Student food insecurity: Examining barriers to higher education at the University of Saskatchewan	English
18	Bruening *et al.*	2018	Hungry to learn: The prevalence and effects of food insecurity on health behaviors and outcomes over time among a diverse sample of University freshmen	English
19	Theodoridis *et al.*	2018	Food insecurity and Mediterranean diet adherence among Greek University students	English
20	McArthur *et al.*	2018	A High Prevalence of Food Insecurity Among University Students in Appalachia Reflects a Need for Educational Interventions and Policy Advocacy	English
21	Eche & Hernández	2018	Studying food security among students: A comparative case study between public and private Universities in Quito-Ecuador	English
22	Sabi *et al.*	2019	Students' vulnerability and perceptions of food insecurity at the University of KwaZulu-Natal	English
23	Weaver *et al.*	2019	University student food insecurity and academic performance	English
24	Hattangadi *et al.*	2019	"Everybody I know is always Hungry. But nobody asks why": University students, food insecurity and mental health	English
25	Raskind *et al.*	2019	Food insecurity, psychosocial health and academic performance among college and University students in Georgia, USA	English
26	Ramlee *et al.*	2019	Food insecurity among University students at two selected public Universities in Malaysia	English
27	Abu & Oldewage-Theron	2019	Food insecurity among college students in West Texas	English
28	Ukegbu *et al.*	2019	Food Insecurity and Associated Factors Among University Students	English
29	Martinez *et al.*	2019	Pathways from Food Insecurity to Health Outcomes among California University Students	English

The theme appears to be relatively new and emerging, raising a growing interest in the scientific community and gaining popularity over the last few years i.e. 19 out of 29 papers have been published in the last two years. Indeed, in the 2013-2017 period the topic was investigated with a certain

consistency i.e. 1-2 papers per year, followed by 11 publications in 2018 and 8 in 2019 (partial, January-August period).

The geographical area of study provides some interesting indications on the subject. First of all, the investigated issues seem to be of particular interest to North America, indeed 11 out of 29 studies were carried out in the USA and 5 out of 29 in Canada, mainly orientated on and nutrition and financial issues. Other studies were implemented in Africa (1 in Nigeria and 3 in South Africa), in Asia (3 in Malaysia and 1 in Sri Lanka), in Australia (3), in South America (1) and in Europe (1). Moreover, the North American interest is also recent since all papers with the study area in North America have been published in the 2016-2019 period. The papers published in Australia, Asia and South Africa are mainly more dated: indeed, the first 7 (out of 10) papers were published in the 2011-2015 period in these areas (Table 3).

Table 3 - Papers by study area

Continent	Nation		Author code	No. of articles
North America				
	USA			11
		California	(29) (16)	
		Texas	(27)	
		Georgia	(25)	
		New Jersey	(23)	
		North Carolina	(20)	
		Arizona	(18) (12)	
		New Hampshire	(15)	
		Ohio	(13)	
		Illinois	(8)	
	Canada			5
		Alberta	(24) (14) (10)	
		Nova Scotia	(11)	
		Saskatchewan	(17)	
Africa				
	Nigeria		(28)	1
	South Africa		(22) (6) (3)	3

Table 3 - continued

Continent	Nation		Author code	No. of articles
Asia				
	Malaysia		(26) (7) (2)	3
	Sri Lanka		(9)	1
Australia and Oceania				
	Australia			3
		Victoria	(5)	
		Queensland	(4) (1)	
South America				
	Ecuador		(21)	1
Europe				
	Greece		(19)	1

The journals interested in publishing on this subject are numerous i.e. 15 out of 21 journals have published only one paper on this topic; 5 out 21 journals have published two or more papers. The involved research categories of these journals are "Nursing: Nutrition and Dietetics" (14 times), "Medicine" (10), "Agricultural and biological sciences" (6), "Social sciences" (5), "Environmental science" (1), "Health professions" (1) and "Economics, Econometrics and Finance" (1) (Table 4).

Table 4 - Sources and categories

Source	No. of articles	Author code	Category
Journal of Hunger and Environmental Nutrition	4	(17) (16) (15) (14)	Social Sciences: Health (social science). Medicine: Public Health, Environmental and Occupational Health. Nursing: Nutrition and Dietetics.
Nutrition and Dietetics	3	(10) (5) (1)	Nursing: Nutrition and Dietetics.
Journal of American College Health	2	(23) (13)	Medicine: Public Health, Environmental and Occupational Health.
South African Journal of Clinical Nutrition	2	(22) (6)	Nursing: Nutrition and Dietetics. Medicine: Medicine (miscellaneous).
Journal of Nutrition Education and Behavior	2	(20) (8)	Medicine: Medicine (miscellaneous). Nursing: Nutrition and Dietetics.

Table 4 - continued

Source	No. of articles	Author code	Category
Canadian Journal of Dietetic Practice and Research	1	(11)	Medicine: Medicine (miscellaneous). Nursing: Nutrition and Dietetics.
Nutrients	1	(29)	Agricultural and Biological Sciences: Food Science. Nursing: Nutrition and Dietetics.
Food and Nutrition Bulletin	1	(28)	Social Sciences: Geography, Planning and Development. Agricultural and Biological Sciences: Food Science. Nursing: Nutrition and Dietetics.
British Food Journal	1	(27)	Agricultural and Biological Sciences: Food Science.
Malaysian Applied Biology	1	(26)	Agricultural and Biological Sciences: General Agricultural and Biological Sciences.
Public Health Nutrition	1	(25)	Medicine: Public Health, Environmental and Occupational Health; Medicine (miscellaneous). Nursing: Nutrition and Dietetics.
Sustainability	1	(24)	Social Sciences: Geography, Planning and Development. Environmental Science: Management, Monitoring, Policy and Law.
Nutricion Hospitalitaria	1	(21)	Medicine: Medicine (miscellaneous). Nursing: Nutrition and Dietetics.
Nutrition, Metabolism and Cardiovascular Diseases	1	(19)	Medicine: Cardiology and Cardiovascular Medicine; Endocrinology, Diabetes and Metabolism; Medicine (miscellaneous). Nursing: Nutrition and Dietetics.
International Journal of Behavioral Nutrition and Physical Activity	1	(18)	Health Professions: Physical Therapy, Sports Therapy and Rehabilitation. Nursing: Nutrition and Dietetics. Medicine: Medicine (miscellaneous).
Journal of Public Affairs	1	(12)	Social Sciences: Political Science and International Relations; Public Administration.
Malaysian Journal of Nutrition	1	(9)	Agricultural and Biological Sciences: Food Science. Nursing: Nutrition and Dietetics.
Pakistan Journal of Nutrition	1	(7)	Nursing: Nutrition and Dietetics. Agricultural and Biological Sciences: Food Science. Medicine: Public Health, Environmental and Occupational Health.
Higher Education	1	(6)	Nursing: Nutrition and Dietetics.
Perspectives in Education	1	(3)	Social sciences: Education.
Malaysian Journal of Consumer and Family Economics	1	(2)	Economics, Econometrics and Finance: General Economics, Econometrics and Finance.

A total of 117 authors participated in the selected papers. The number of authors per paper is between 2 i.e. 5 times, and 9 i.e. 1 time. The number of authors is 4 in 11 papers, the most frequent (Table 5).

Table 5 - Number of authors per paper and authors with two papers on the topic

No. of authors	Authors code
9	(19)
7	(23)
6	(10) (9)
5	(29) (28) (26) (7)
4	(24) (22) (20) (18) (17) (16) (14) (8) (3) (1) (11)
3	(25) (12) (5) (4) (2)
2	(27) (21) (15) (13) (6)

A total of 7 out of 117 authors have taken part in two research teams. The most influential authors in the research strand have different affiliations located in North America i.e. University of California, Arizona State University, University of Alberta. More details are presented in Table 6.

Table 6 - Affiliations of the most influential authors in the research strand

Authors	Affiliation	Author code
Souzanna M. Martinez	Department of Epidemiology and Biostatistics, University of California, San Francisco, CA, USA	(29) (16)
Lorenne D. Ritchie	Nutrition Policy Institute, University of California Division of Agriculture and Natural Resources, Berkeley, CA, USA	(29) (16)
Meg Bruening	College of Health Solutions, Arizona State University, Phoenix, USA	(18) (12)
Irene van Woerden	College of Health Solutions, Arizona State University, Phoenix, USA	(18) (12)
Geoff D.C. Ball	Department of Pediatrics, University of Alberta, Edmonton, Canada	(14) (10)
Anna Farmer	Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada	(14) (10)
Noreen D Willows	Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada	(14) (10)

2.2. *Assessment of contents of the reviewed papers and related classification*

After the description of the selected papers by different characteristics i.e. main information, publication year, study area, sources and study categories, number of authors per paper and number of papers per author, a new process of classification was implemented. On the basis of this process, the literature review was divided into five research topics: Food insecurity and determinant factors; Food insecurity, nutrition and health; Food insecurity related to financial issues; Food insecurity related to academic performance; Food insecurity and socio-demographic variables (Table 7).

Table 7 - Literature classification on the basis of content assessment

Topics	Author code
Food insecurity, nutrition and health	(29) (25) (24) (20) (19) (18) (10) (9)
Food insecurity and determinant factors	(28) (26) (17) (16) (14) (5) (4) (3)
Food insecurity related to financial issues	(27) (21) (15) (13) (2) (11)
Food insecurity related to academic performance	(23) (22) (12) (10)
Food insecurity and socio-demographic variables	(8) (7) (6) (1)

The following sub-paragraphs briefly discuss each identified group of papers showing main characteristics of the selected researches and related aim and findings. The provided information will be useful to identify the research gaps in the academic literature and describe the conclusion of this review and related implications for future researches.

Food insecurity, nutrition and health: Food security in a healthy college experience is important. Studies (**18; 29**) show that it affects the health related outcome for college students. Food insecurity, psychological and/or mental health do also matter for academic performance (**20; 24; 25**). Research also shows that Food insecurity compromises students' health, limits their diet and academic performances. Moreover, inadequate accessibility to acquire food can turn into food insecurity, and campus food banks do not seem to be a solution for student hunger (**10**); even a relationship between diet adherence and food insecurity is evidenced (**19**). Finally, lack of access to healthy foods might indicate the risk of food insecurity among University students (**9**).

Food insecurity and determinant factors: The prevalence of food insecurity and related consequences among University students can be due

to monthly allowance, daily amount spent on food, and source of income (**28**). Food access and financial aid with age, race as well as ethnicity are considered as risk factors for food insecurity (**16**). Government student loans, government payments and financial aid are also found as determining factors (**3; 4; 17**). High cost of living (**26**), living arrangements (**5**), student with children (**14**) are also found causing food insecurity in campuses.

Food insecurity related to financial issues: Food insecurity and prevalent coping strategies are also investigated. Food budget seems to be the main determinant of food insecurity; financial aid displays similar effects as well (**2; 11; 27**). Along with economic restrictions, students are food insecure due to the increase in food prices and household food spending (**21**). Financial priorities and dietary literacy are also linked (**13**) and, lastly, financial aid might cause food insecurity among University students (**15**).

Food insecurity related to Academic Performance. Food insecurity among University students can be linked to reduced academic performance and poor health conditions (**12; 22; 23**). In the latter case, the learning abilities of University students are reduced to the risk of compromising their level of education. Government and University institutions should plan policies and programs to improve the situation of students at risk of food insecurity (**10**).

Food insecurity and socio-demographic variables: Food security among University students can be related to factors such as race, average grades, loan use and place of residence in order to identify the most effective tools to develop services for those in need (**8**). Severe food insecurity in University students can contribute to increasing the attrition rate that can be found in Universities (**6**). University students could be helped by the establishment of food banks to reduce their needs (**7**) but in any case other studies should be carried out to carefully assess the determinants of food insecurity and, therefore, identify fitting strategic solutions, including social support policies, in this population group (**1**).

3. Conclusion, limitations and future research

The concept of food security can have two declinations. On the one side, the quantitative meaning, i.e. meeting the product-market system requirements of a defined group of population; on the other, the qualitative meaning, i.e. meeting the intrinsic quality requirements of food so as to satisfy the health needs of a defined group of population. The provided review demonstrates that food insecurity also involves University students who can be considered a weak category in term of access to food. Sometimes it is about perception, in some cases it is about financial issues, governance, income or family matters, in line with other authors (Candel, 2014; Bruening

et al., 2017). Not only in poorer countries, but also in developed countries, students and authorities should be more aware of the need, habit and supply of food in college campuses for better health and academic performance. The discussion of the above mentioned literature shows that further investigation is required to identify the ways to improve the situation. Moreover, the review shows a lack in students' perception of food security when considering a comparison amongst University students in different geographical areas with diverse economic development.

However, collected data have some limitations. Some identified criteria for the papers selection present lacks by e.g. the choice to limit the search to two databases and the "University student" key-search. WoS and Scopus are the most popular repositories with multidisciplinary products. This choice has allowed to access contributions and papers belonging to the peer-reviewed literature only, excluding gray literature. The "University student" key-search limited the extraction to the papers where this key was present in the title, abstract or keywords, excluding papers with e.g. "post-secondary student" or "tertiary student".

Lastly, findings show food insecurity in developed countries such as US and Canada as well as Malaysia and South Africa. Seemingly, a comparative study can be depicted on food insecurity in developed and developing countries. The study would explain relative prevalence, coping strategies, academic performance, demographic status, financial issues and government policy in a comparative manner. It would provide new insights for researchers to fill the gap in focusing on comparative food insecurity in colleges and Universities in both developed and developing countries. Therefore, this situation leaves space to further focusing on relative food insecurity among college students. In this context, the Nikolaus *et al.* (2020)'s considerations could contribute to identify the adequate methods of analysis.

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Socio-economic drivers in productive rural activities and their impact on the eating habits, lifestyle and nutritional status of people living in a rural area: The Majella National Park as a case study

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Abstract

This paper analyses the relationship between food system dynamics with consumer behaviors, in population within a protected mountain area in Italy. In order to obtain socioeconomic and nutritional data, a combination of qualitative and quantitative research was employed to group farmers, local authorities, and inhabitants. Our research highlighted the close relationship between local food productive sector with consumption habits of local communities. The experience of the Majella National Park can be taken as an example of promoting environmentally friendly agriculture that enhances food quality, increases resource management and preserves local cultural heritage.

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Introduction

Italy's wide and diversified agrobiodiversity reflects a significant agricultural heritage of food traditions, particularly relevant from a socio-economic perspective. Many Italian rural areas are strongly characterised by farms with small-scale local production, cultivated with techniques derived from the historical and cultural tradition of that specific region (Azzini *et al.*, 2012). Crops are often grown using sustainable agricultural systems and old cultivation practices that are more respectful of the environment. Moreover, local food products are of great interest from a sociological point of view as they represent the legacy of a traditional food diet that also offers regional-based cuisine beyond local boundaries. However, within the globalised economy, many food products have become commodities produced and traded in a market that has expanded from an essentially local to an increasingly global base. Modern supermarkets are rapidly replacing traditional grocery outlets (Beghin *et al.*, 2015). Economic development, urbanisation and market globalisation also contribute to evolving lifestyles, involving changing consumer preferences, purchasing habits, food environments, and a shift towards Western-style diets. Traditional food components are increasingly being replaced by processed foods and convenience products with low fibre and high fat, sugar and salt contents. (Gómez & Ricketts, 2013). This nutritional shift to high fat and sugar intakes combined with decreasing levels of physical activity increased overweight and obesity, as well as non-communicable diseases (Hawkes, 2008; Gayathri *et al.*, 2017). Recently, this phenomenon has also been observed in rural areas around the world (Popkin, 2001; Liebman *et al.*, 2003). If an adequate diet, combined with a healthy lifestyle, is the key factor for preventing diseases and maintaining people's health, agri-food productions should influence consumer demand.

Rural areas subject to a protection regime, such as parks, represent an interesting "place" of investigation due to their support for a new agriculture paradigm enabling the achievement of several major dimensions of development, most particularly economic, environmental and social sustainability (De Janvry, 2010).

Italy is characterised by the presence of many natural parks. The park system covers more than 10% of national territory and agricultural activities carried out in this context play a strategic role in the economy of such areas. The Majella National Park is a good example here. It features hilly and mountainous areas which, as a consequence, have different types of agricultural models (subsistence, marginal and intensive agriculture). With the aim of preserving natural resources, the Park promotes sustainable agricultural production, mainly characterised by a strong agri-food identity

and traditional, local products. Various local bodies, including the Park and LAG[1], have launched policies to preserve and enhance natural resources, combining them with the economic and social components of the system in which they exist. The experience of the Majella National Park can be taken as an example of promoting environmentally friendly agriculture that enhances the environment with typical niche products, activating all possible synergies with the region, starting with agricultural production. These actions impact the local population above all because, due to proximity to the source of production, they are the main consumers of local products.

Based on the foregoing considerations, the aim of this work is to describe the influence of the dynamics of local agri-food production and trade on the eating habits, lifestyle and nutritional status of a population living in specific rural area: the Majella National Park.

1. Material and Methods

In the framework of TERRAVITA's "Biodiversity, Territory and Nutrition: the sustainability of Italian agro-food" project, the demographic, economic and production trends as well as their possible implications on the nutritional status and well-being of a population group living in Majella National Park were analysed jointly by the Research Centre for Food and Nutrition and Research Centre for Politics and Bioeconomy.

This section includes selection of the study sites and how data was collected for the different analyses. Three surveys were carried out: supply, consumption and nutrition.

Criteria and selection of study sites

The Majella National Park, which covers an area of around 73 thousand hectares with heights above sea level of between 205 and 2800 metres is home to just over 88,000 resident inhabitants and has slightly lower depopulation rates than other areas in Italy (–2% in the comparison between the ISTAT 2001 and ISTAT 2011 censuses). The area's agriculture can be divided into that practised in the mountain areas and that practised on the hills and valley floors. The former is mainly marginal and subsistence farming while the latter is more productive with two prevalent crops, i.e. vines and olives, as well as intensive livestock farming.

Thanks to the Park Authority, the Regional Agency for Agricultural Development Services (ARSSA) and Majella Verde LAG collaborating within

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1. Local Action Group is a group (generally a consortium) made up of public and private subjects which works for local development in a rural area through structural funds.

the Rural Development Programme (RDP) of the Abruzzo Region, there has been renewed interest in local food production and the recovery of ancient cultural traditions. At the same time, these initiatives build a stable connection with tourism thanks to the growing interest of visitors in the environment, local traditions and high-quality healthy products of the area.

In order to respond to the research objectives, a limited area was identified: a group of municipalities with "marginal geographic" features and potentially less affected by standard eating habits depending on large-scale distribution. The study restricted its analysis to areas that were overwhelmingly rural with a sustainable environment and a marked presence of typical, local food products featuring in the diet of the local population. In this way, we were able to "isolate" a marginal, peripheral area that is still characterized by a great deal of agricultural activity and a high number of typical, local food products. In addition to territorial analyses, territorial statistical data and socio-economic characteristics of the Majella National Park area (ISTAT Population Census 2011 and Agriculture Census 2010) and indicators for the definition and implementation of the National Strategy for Inner areas (NSIA)[2] were used to identify the limited area.

The sampling criteria adopted for the area identification included:
- location of the municipalities within the Park;
- altitude definition (mountain 700 mt. above sea level);
- resident population (< 3500 inhabitants);
- depopulation rate (> 5% compared with the last two ISTAT censuses 2001-2011);
- elderly population (> 30% of total local population);
- the presence of peripheral or ultra-peripheral municipalities within the classification of internal areas defined by the Ministry of Economic Development in its Inner Area Strategy.

The study was carried out in a peripheral area within Majella National Park and included the five municipalities of Chieti, Gamberale, Pennapiedimonte, Pizzoferrato, Lama dei Peligni and Montenerodomo.

Analysis of the agricultural system within the limited area showed that during the decade 2000-2010 the average size of farms increased by

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2. NSIA represents direct action to support sustainable territorial competitivity, with the aim of halting, in the medium term, the demographic decline that characterises the Italian interior. The aim is to create new earning opportunities, ensure inhabitants have access to essential services and improve maintenance of the land itself. For help with funding for local projects, NSIA has recourse to European funds (EFRD, EFS e EFARD) and national resources. Indicators for the choice of areas for action are: number of hospitals, SED (Specialised Emergency Department), existence of secondary schools, a railway station, places in facilities for the elderly, the share of the population without access to fixed broadband networks, and share of the population with access to fixed and/or mobile broadband networks.

about 27% (ISTAT, 2010) and these were largely farms dealing with semi-native crops and sheep farming. Agriculture in the Majella National Park is therefore important for preventing the abandonment of mountain lands.

To define the relationships existing between the production sector, local trade and the composition of consumer demand in this area in order to understand the consumption choices, eating habits and lifestyle of a population subgroup, three surveys were conducted.

1.1. *Supply survey for agri-food products*

To understand the consumption choices and–food habits of the study population, two surveys (***Supply survey for agri-food products*** and ***Consumption survey***) were carried out aimed at defining the relationships existing between the production sector and local trade and the composition of consumer demand.

For analysis of the dynamics of the trade of local food products, a "face to face" questionnaire was given to farmers, retailers and commercial dealers in the municipalities covered by the investigation in order to carry out a survey of the production origin of food products and the type of distribution. The analysis is based on the offer and related supply methods of so-called "fresh" products, including fruit and vegetables, milk and processed meat (ham), flour, pasta, bakery products and eggs. The questionnaire was also given to privileged observers such as mayors and reference LAGs for the area who know the food businesses and the food product supply chain at local level.

The questionnaire was divided into three parts. The first part focused on the type of sales outlet and was aimed at identifying:
• The nature of the sales outlet and thus the commercial environment in which food products are offered to consumers (for example, farm/farm holiday, general grocery shop, dairy products shop, butchers, etc.).
• The position occupied by the sales outlet in the supply chain and whether it operated as a direct seller or intermediary.

The second part aimed to investigate the way in which the products sold were supplied and the reasons on which this choice was based, as well as the seller's perception as to what guided or attracted the local population with regard to purchasing local products.

Finally, the third part aimed at identifying the type of food products habitually bought by the local population and to what extent these formed part of the traditional, local food product heritage.

In addition, information relating to the privileged observers was also collected which made it possible to complete analysis of the offer of agri-food products locally. In this way it was possible to draw the first qualitative

conclusions, albeit not statistically comparable, on food "habits". as well as on the origin of the food itself, whether produced mainly at local level, originating in neighbouring areas or coming from large-scale distribution.

1.2. *Consumption survey*

With the collaboration of local authorities and primary care physicians, subjects were recruited through special community presentation and meetings, dissemination notes and project posters to give visibility to the project. Enrolment of subjects was carried out using the probability sampling method on municipal lists of residents. Participants living in the five municipalities selected for the economic survey included 198 healthy free-living volunteers (61 males and 137 females), aged 18-86 years. Following a detailed remote and close history, volunteers were selected based on the absence of pathologies potentially interfering with the parameters studied, the absence of ascertained viral infections, allergies and food intolerances. Subjects who did not meet these criteria were excluded and among the recruited subjects a high percentage of male volunteers did not join the study. The sample size was proportional to the number of residents in the various municipalities and was not meant to be representative of the population.

To study the eating and buying habits of local population, data from the population survey were obtained by interviewing selected subjects. The questionnaire was divided in two parts: the first was structured to identify the main place of purchase of the main food products (pasta, bread, meat, eggs, milk, fruit, vegetables, etc.) and to investigate the selection criteria adopted for their purchase (such as, for example, price, origin, etc.). The second part aimed to investigate the degree of knowledge about and consumption of typical local products (place of purchase, motivation behind choice, etc.).

1.3. *Nutritional survey on study subjects*

The nutritional survey was conducted to evaluate anthropometric measurements, lifestyle, physical activity and diet of the selected sample. On enrolment, qualified interviewers administered a questionnaire on lifestyle and a semi-quantitative food frequency questionnaire (FFQ) to the 198 participants. The lifestyle questionnaire consisted of a series of questions specifically designed to obtain different information about socio-demographic factors (marital status, education and occupation), smoking habits and alcohol consumption. Food consumption was detected by a validated food diary on four consecutive days including the weekend. All foods and beverages

consumed were recorded by participants and verified by a dietician for correctness of recording. Furthermore, in order to improve accuracy on the estimation of portions, a photo album (Dietometro, 1999) was used. Italian food composition tables were used to calculate energy, macro and micronutrients from daily consumption (Italian Food Composition Tables - INRAN, 2000). Anthropometric measurements including body weight and stature were assessed in accordance with the techniques described by Lohman *et al.* (1988) and body mass index (BMI) was calculated (kg/m^2). Self-reported levels of physical activity were measured using the short-form International Physical Activity Questionnaire (IPAQ-SF). A lifestyle score was developed by selecting 4 lifestyle-related variables including fruit and vegetable consumption, smoking status, alcohol consumption and level of physical activity. A binary score was defined for each variable (fruit and vegetable consumption over or under 750 g/day and more or less than 5 portions altogether a day; smoker or non-smoker; alcohol consumption under or over 30 g/day for men and 18 g/day for women; more or less than 150 minutes of moderate/vigorous physical activity per week), with a score of 1 awarded for each healthy behaviour. The addition of points for fruit and vegetable consumption, smoking habits, alcohol consumption and physical activity amounted to a comprehensive lifestyle score ranging from 0 (least healthy) to 4 (healthiest) for each subject (Tagoe & Dake, 2011).

The study was conducted in accordance with the Declaration of Helsinki on performing trials on humans and participants provided informed consent. The Ethics Committee of "Lazio 2" approved both the procedure and the method of conducting this study.

1.4. *Statistical analysis*

Statistical analyses were performed with StatSoft® STATISTICA 8 for Windows (StatSoft, Italia Srl). To analyse data on consumption and nutritional surveys the differences between groups of different purchasing channels, or in general characteristics of subjects between municipalities, were analysed using ANOVA analysis, χ2 test and the non-parametric U-test of Mann-Whitney. For all statistical analyses, a significance level of P <0.05 was used. The socio-demographic variables of volunteers by municipalities, food purchase channels, and sample distribution by purchase habits are presented as percentages; the physical characteristics of volunteers and diet are presented as mean and standard deviation.

2. Results

Supply survey for agri-food products

Majella National Park is rich in a wide variety of plant species. These include products certified according to the EU European certification system (PDO and PGI quality scheme), Geographical Indication (PDO and PGI) as well as "Italian Traditional Foodstuffs" regulated by the MIPAAFT list (PAT). Furthermore, some products are defined as "typical" by commercial brands such as Slow Food or Parks (ARSSA Abruzzo, 2016; Touring Club Italiano, 2015). Table 1 shows the typical agri-food products categories present in this area.

Table 1 - Typical agri-food products in Majella National Park (investigation area)

Product name	Category	Certification type	Year
Caciotta frentana	Cheeses and dairy products (Caciotta)	Other	/
Salsicciotto di Pennapiedimonte	Cold cuts, fresh meat and their preparations (sausages)	PAT	2000
Salsiccia di fegato	Cold cuts, fresh meat and their preparations (sausages)	PAT	2000
Salsicciotto frentano	Cold cuts, fresh meat and their preparations (sausages)	Slow Food Presidia	/
Broccolo riccio	Vegetables and Legumes (Broccoli)	Parks	/
Fagioli a olio	Vegetables and Legumes (Beans)	PAT	2000
Fagioli a pane	Vegetables and Legumes (Beans)	PAT	2000
Fagiolo 'Socere e Nore'	Vegetables and Legumes (Beans)	Parks	/
Fagiolo a caffè	Vegetables and Legumes (Beans)	Parks	/
Fagiolo aquilano	Vegetables and Legumes (Beans)	Parks	/
Fagiolo Borlotto Antico	Vegetables and Legumes (Beans)	Parks	/
Fagiolo cannellino	Vegetables and Legumes (Beans)	Parks	/
Fagiolo Gentile Munitilio o Monachelle	Vegetables and Legumes (Beans)	Parks	/
Fagiolo quaranta giorni	Vegetables and Legumes (Beans)	Parks	/
Fagiolo Tondino	Vegetables and Legumes (Beans)	Parks	/
Pomodoro a pera	Vegetables and Legumes (tomato)	PAT	/
Mezza Fava, Fava Nostra	Vegetables and Legumes (Broad bean)	Parks	/
Patata di montagna del medio Sangro	Vegetables and Legumes (potato)	Other	

Table 1 - continued

Product name	Category	Certification type	Year
Peperone dolce di Altino	Vegetables and Legumes (Pepper)	Slow Food Presidia	2009
Farro d'Abruzzo	Fruit, vegetables, table olives and preserved (Spelt)	PAT	2000
Tartufo d'Abruzzo	Fruit, vegetables, table olives and preserved (truffle)	PAT	2000
Grano tenero Carosella	Rice, Pasta and Cereals (wheat)	Parks	/
Grano tenero Solina	Rice, Pasta and Cereals (wheat)	PAT	/
Segale Secina	Rice, Pasta and Cereals (rye)	Parks	/
Mela Gelata	Fruit (apple)	Parks	/
Mela Limoncella, Meloncella Mela limone	Fruit (apple)	Parks	/
Mela Mangione	Fruit (apple)	Parks	/
Mela Paradiso	Fruit (apple)	Parks	/
Mela Piana, Mela Casola o Mela di Altin	Fruit (apple)	Parks	/
Mela Rosa	Fruit (apple)	Other	/
Mela Tinella	Fruit (apple)	Parks	/
Pera "De vièrne"	Fruit (pear)	Parks	/
Pera Campanella	Fruit (pear)	Parks	/
Pera San Giovanni	Fruit (pear)	Other	/
Pera San Domenico	Fruit (pear)	Parks	/
Pera Trentatrè Once	Fruit (pear)	Other	/
Pesca Pomo di Renzo	Fruit (peach)	Parks	/
Pesca Testa "Rosce"	Fruit (peach)	Parks	/
Trebbiano d'Abruzzo	Wine	PDO	1972
Valle Peligna	Wine	PGI	1995
Terre di Chieti	Wine	PGI	1995
Colline di Teatine	Wine	PGI	1995
Colline di Teatine	Extra virgin olive oil	PDO	1997
Sfogliatelle di Lama	Bakery and pastry products	PAT	2000
Sise delle monache di Guardiagrele	Bakery and pastry products	PAT	2000
Torrone di Guardiagrele	Bakery and pastry products	PAT	2000
Vino cotto	Bakery and pastry products	Other	/

These are local food products obtained using typical cultivars and indigenous varieties, extensive livestock farming and artisan production methods based on local traditions and knowledge.

According to the selected area analysis, the main agri-food products include meat (bovine, ovine, pork), milk (mainly bovine used for small production derivatives like *caciotta* and *scamorza*), fruit (typical mountain products such as apples and nuts), vegetables (especially red potatoes), mushrooms (local inhabitants collect instead of buy them so their sales are not traceable), black and white truffle (their sales to small artisan businesses are not traceable), legumes and cereals(mainly for feeding livestock and self-consumption).

The information collected from the survey of local retailers allowed us to obtain a picture of the local food product sales outlets in the delimited area, which can be divided into the following types (Table 2):

• Direct sales outlets of farm products in urban centres. In some cases, they sell a variety of foods while others sell specific categories (feed, fruit and vegetables, meat, etc.).
• Direct sale of products at the farm (meat, milk and dairy products).
• Food shops, more or less specialised and not necessarily specialising in the sale of local products (meat and dairy products, fruit and vegetables, eggs, wine, potatoes, etc.).
• Mid-sized distribution (supermarkets) that mainly sell industrial products.

It should be noted that there are many family gardens. These are supply outlets that are not included in the census data, but which provide resident families with olive oil, potatoes, fruit and vegetables, legumes, eggs and even meat from farmyard animals.

Table 2 - Agri-food product sales channels in investigated municipalities

Municipalities	Sales Point in city centre					Supermarket
	Food shop	Fruits and vegetables	Butcher's shop	Bakery shop	Farms	
Montenerodomo		1			6	
Pizzoferrato	1		1	1	3	1
Lama dei Peligni	2	2	1	1		2
Gamberale					3	
Pennapiedimonte	1			1		
	4	**3**	**2**	**3**	**12**	**3**

Analysis of the questionnaires identified two main purchase channels (Table 2):

• *Direct* supply channel: food products are acquired directly from the producer without the intervention of intermediaries: the products are therefore local.

• *Mixed* supply channel: food products are purchased both directly from the producer and from a large-scale retail channel or small local shop as well as through intermediaries and wholesalers. The products are locally produced (vegetables, potatoes and eggs) or are products of neighbouring areas (fruit, cold cuts, fresh meat and their preparations and dairy products), as well as from other areas of the region or Italy.

To these channels should be added the *occasional* offer of guaranteed products at the weekly market, which is populated by local producers, producers of neighbouring areas and ambulant sellers from Val di Sangro and Molise. Thus, the market frequently offers products (vegetables, fruit, oil, dairy products and fish) that are not produced in the area surveyed and the Majella National Park. This channel is the answer both to the progressive reduction of the resident population that has led to a consequent closure of the already few existing commercial retailers and to the difficulty for the elderly population to move from one municipality to another

Data from the analyses show that the main supply source for fresh products in this area is sale at farms.

Comparison of the data for the last 40 years allows us to understand how the phenomenon of depopulation has brought with it the contraction of commercial businesses (Figure 1). The data, which refer exclusively to

Figure 1 - Presence of retail businesses selling fresh food products (1971-2011)
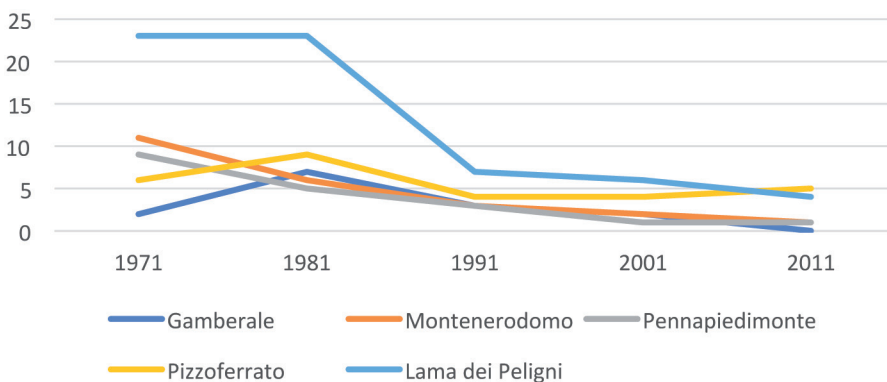
Source: ISTAT (2011).

commercial retailers selling fresh products, highlight the vertiginous collapse in all the area's municipalities with a notable decrease in Lama dei Peligni. This is because inhabitants of Lama dei Peligni are able to reach those municipalities in the valley where the presence of large-scale distribution is greater. In Lama dei Peligni, the weekly market plays an important role in the supply of fresh products for the population of the municipality and neighbouring areas.

Consumption and nutritional surveys

Study participants included 198 healthy free-living volunteers (61 males and 137 females). The physical characteristics of the total sample by municipality are shown in Table 3. The mean BMI (from 26.7 ± 4.9 kg/m^2 to 28.9 ± 5.1 kg/m^2) indicates the presence of an overweight status, without significant differences among the five municipalities. 37.2% of subjects studied were overweight, while 34.6% were obese. Our sample shows a different distribution according to the BMI compared with national data (Istituto Superiore della Sanità Passi, 2018a). The latter show an overweight percentage of 37.2% and obesity of 10.9% for Italy, while in Abruzzo is the figures are 33.2% and 11.4% respectively.

Table 3 - Physical characteristics and body composition of volunteers by municipalities (mean value ± standard deviation)

				Municipality				
	MON	PIZ	GAM	LdP	PEN	Total sample	P*	
							C	G
N	34	68	27	36	38	198		
Weight (kg)	74.4±16.1	74.6±13.5	69.2±11.9	68.3±12.4	72.8±14.9	72.6±14.0	n.s.	0.000
Height (cm)	161.3±7.8	160.9±8.4	157.8±10.1	160.2±7.8	159.5±9.0	160.2±8.5	n.s.	0.000
BMI (kg/m²)	28.6±5.6	28.9±5.1	27.8±4.2	26.7±4.9	28.7±5.8	28.3±5.2	n.s.	n.s.

MON = Montenerodomo; PIZ = Pizzoferrato; GAM = Gamberale; LdP = Lama dei Peligni; PEN = Pennapiedimonte. Statistical analysis: *ANOVA: C = differences by centres, G = differences by genders; P = level of significance; n.s. = not significant.
Source of data: Our analysis in the field (data set are measured during the study, see material and methods section).

Table 4 shows the specific socio-demographic variables of the sample studied. Since there were no significant differences between the genders, the results are reported for the total sample by municipality. Volunteers are predominantly married (62%) while only about 3% are separated or divorced. Moreover, 45.3% of volunteers have a high school diploma and 0.5% have not studied. Among the different municipalities, the highest prevalence of graduates is in the municipality of Lama dei Peligni (20.0%), while the lowest is in the municipalities of Gamberale (0%) and Pennapiedimonte (5.3%). In the municipalities of Gamberale and Lama dei Peligni, there are no separated or divorced people, but these municipalities have the highest percentages of widowers, respectively 18.5% and 10.7%. In Figure 2, socio-demographic data were compared with national data ((Istituto Superiore della Sanità Passi, 2018b). To do this, no education and primary education were placed together and the data show different values with the highest percentage in our sample (16.7% vs 5.9%). This difference was also observed in the higher education level with values of 9.9 % for our sample and 17.3% for national data. Regarding marital status, national data show higher percentages of singles (34%) than in our study (26.2%), while the opposite is found for widowers with only 2.3% for national data and almost 10% for our sample.

Table 4 - Socio-demographic variables of volunteers by municipalities (%)

| | **Municipality** | | | | | | |
	MON	PIZ	GAM	LdP	PEN	P*	Total sample
Marital status							
Single	22.6	42.9	22.2	10.7	15.8		26.2
Married/Full-time relationship	67.7	46.0	59.3	78.6	73.7	0.03	62.0
Separated/Divorced	3.2	3.2	–	–	5.3		2.7
Widow	6.5	7.9	18.5	10.7	5.3		9.1
Education							
No education	3.2	–	–	–	–		0.5
Primary education	9.7	4.6	25.9	30.0	23.7		16.2
Junior high school diploma	19.4	39.4	33.3	13.3	23.7	0.008	28.1
High school diploma	54.8	45.5	40.7	36.7	47.4		45.3
University degree	12.9	10.6	–	20.0	5.3		9.9

MON = Montenerodomo; PIZ = Pizzoferrato; GAM = Gamberale; LdP = Lama dei Peligni; PEN = Pennapiedimonte *P level of significance χ^2 test.
Source of data: Our analysis in the field (data set are measured during the study, see material and methods section).

Figure 2 - Comparison of socio-demographic variables (%) in the studied sample with national data (Istitùto Superiore della Sanità Passi, 2018b)
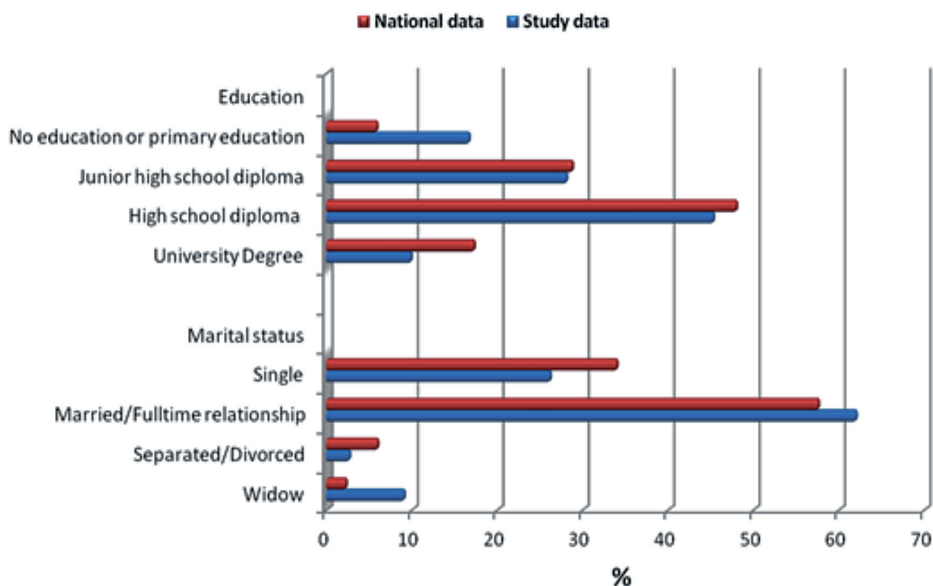
Regarding food purchase channels, 40% of volunteers studied (N = 198) purchase food by direct supply channel, 48% of consumers by mixed supply channel and 12% by weekly/occasional supply channel (Figure 3).

Figure 3 - Food purchase channels for agri-food products
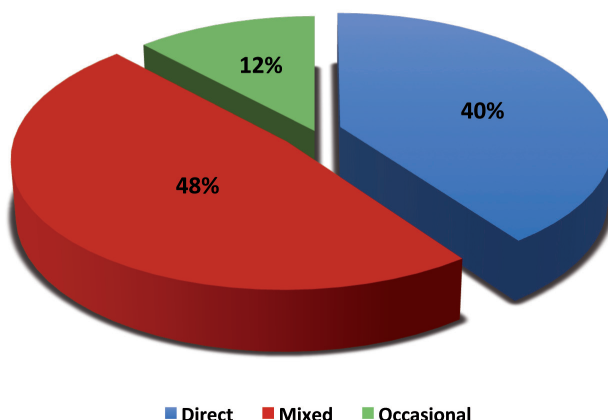
Figure 4 - Food purchase channels by food categories
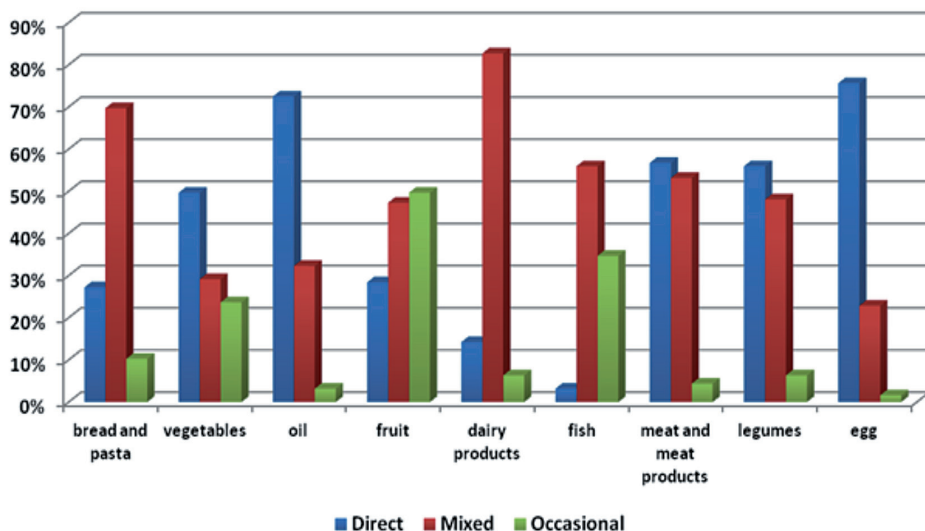
Considering food categories, the direct supply channel is mainly used for vegetables, oil, meat and meat products; the mixed supply channel for bread and pasta, dairy products and fish; the weekly/occasional supply channel for fruit (Figure 4).

Habitual purchase behaviour appears to be rather consolidated; as reported in Table 5, over the years only 17.5% of those interviewed changed their purchase habits even though they were unable to clarify the reason for doing so. Among the criteria that guide purchase choices, attention to the origin of the product is the most relevant. In fact, only 22% of those interviewed stated that they do not pay attention to this, mostly due to lack of credibility in labelling. With reference to product origin, the analysis shows an average attention towards nationality; 61% of respondents state that they do not buy foreign products because they consider them "less safe" in terms of authenticity and quality. A second criterion of choice is price; in fact, 71% of those interviewed stated that they pay attention to the price of all food products, particularly cereals, fruit, vegetables, meat and dairy.

Assessing consumers' food choices is challenging in itself, given the large number of factors that affect such decisions. Regarding socio-demographic factors, it is difficult to hypothesise relations between specific demographic variables and consumer choice. The results suggest that socio-demographic variables have relatively weak explanatory power in relation to the attitudes of

Table 5 - Sample distribution (%) by purchase habits

Have you changed the place of purchase? (%)	Yes	No							
	17,5	82,5							
For what reason? (%)	Cohabitation/ marriage	Birth of children	Change of residence	Change in economic conditions	Greater awareness	Other	No answer		
	2,9	0,0	14,7	0,0	8,8	8,8	64,7		
Do you ask or read place of provenance?	Yes	No							
	78,0	22,0							
If No, why? (%)	I do not care	I am ashamed	The labels are not legible	The labels are incomprehensible	They are not all true	I have no time	No answer		
	31,0	0,0	9,5	2,4	14,3	16,7	26,2		
Do you pay attention to the price? (%)	Yes	No							
	71,1	28,9							
If yes, for which products?	All products	Cereals	Fruits	Meat	Vegetables	Cured meats	Dairy	Fish	Legumes	Olive oil	Non-food products
	45	15	10	6	4	3	8	2	2	2	2
Do you buy non-Italian products? (%)	Yes	No							
	38,9	61,1							
If No, why? (%)	I do not care	Less genuine	Less healthy	Less secure	Less cheaper				
	17,8	12,6	12,6	55,6	1,5				

consumers towards food choice factors (Cranfield *et al.*, 2012). Our study shows no difference between the choice of food purchase and lifestyle, including marital status and level of education (Table 6). However, subjects with university degrees buy more non-Italian products compared with other levels of education. Regarding marital status, the separated/divorced subjects surveyed do not pay attention to price and also buy more non-Italian products compared with the other marital statuses that show a similar trend, although these data are not statistically different (data not shown). Differences in the supply channel, on the other hand, were observed between municipalities: Pennapiedimonte and Lama dei Peligni show a higher purchase preference than other municipalities (40.43% and 36.36% respectively) (Table 7).

Table 6 - Food purchase channels by socio-demographic variables (%)

	Direct	**Mixed**	**Occasional**	
	%	%	%	P*
Marital status				
Single	26.0	27.1	27.9	
Married/Full-time relationship	61.6	60.8	59.7	n.s
Separated/Divorced	2.8	2.8	2.3	
Widow	9.6	9.4	10.1	
Education				
No education	0.5	0.5	0	
Primary education	16.5	16.7	13.5	
Junior high school diploma	28.6	28.0	30.1	n.s.
High school diploma	46.2	45.7	48.9	
University degree	8.2	9.1	7.5	

*P level of significance c^2 test; n.s. = not significant.

Source of data: our analysis in the field (data set are measured during the study, see material and methods section).

Table 7 - Food purchase by municipalities (%)

	Direct	**Mixed**	**Occasional**	P
	%	%	%	
Montenerodomo	36,05	34,88	29,07	n.s.
Gamberale	34,18	34,18	31,65	n.s.
Pizzoferrato	35,06	38,51	26,44	n.s.
Lama dei Peligni	36,36	36,36	27,27	n.s.
Pennapiedimonte	40,43	39,36	20,21	n.s.

*P level of significance c^2 test; n.s. = not significant.

Source of data: Our analysis in the field (data set are measured during the study, see material and methods section).

Data concerning food intake and lifestyle of the studied population are shown in Table 8. There are no differences between the municipalities regarding food intake and macronutrients, except for carbohydrates ($p < 0.05$). However, in all municipalities, differences with respect to the

recommendations for macronutrients (SINU, 2012) were observed, with a higher percentage of energy provided by fats (on average 37.3% of energy) and a lower percentage by carbohydrates (on average 46.9% of energy), confirming the trend of the general Italian population (Sette *et al.*, 2011). On the other hand, differences in the consumption of some food groups are observed especially in the categories to which local products belong. For example, volunteers living in the municipalities of Lama dei Peligni and Pennapiedimente consumed more legumes, fruit and vegetables and less meat and meat products (P<0.05) with respect to other municipalities. If we analyse the sample by lifestyle score, we can observe an adherence to higher scores (score 4) in the municipalities of Lama dei Peligni and Pennapiedimonte (53.8% and 51.4 respectively).

Table 8 - Energy and average daily per capita consumption of food by volunteers by municipality

	Municipality					
	MON	PIZ	GAM	LdP	PEN	P
	mean ± sd	mean ± sd	mean ± sd	mean ± sd	mean ± sd	
Energy Intake kcal/die	1890±391	1812±394	1839±363	1920±498	1792±426	n.s.
Proteins % of energy	16.4±2.4	15.6±2.5	15.3±2.5	14.6±4.2	15.2±2.7	n.s.
Lipids % of energy	38.4±5.5	38.4±6.5	35.3±3.6	37.9±8.1	38.5±7.3	n.s.
Carbohydrates % of energy	45.2±5.1[a]	45.8±7.4 [a,c]	50.3±4.8[b]	48.5±9.1[c,d]	48.0±7.0[c,d]	0.01
Food group	mean ± sd (median)	mean ± sd (median)	mean ± sd (median)	mean ± sd (median)	mean ± sd (median)	
Cereals	215±60 (216)	208±70 (206)	229±56 (216)	187±106 (192)	204±90 (189)	0.008
Legumes	29±43 (10)	16±26 (5)	18±31 (10)	37±58 (0)	25±54 (0)	0.01
Meat and meat products	131±63[a] (121)	114±54[a] (104	100±58[a] (98)	91±84[b] (100)	77±67[b] (57)	0.05
Fruit & vegetables	437±145[a] (408)	454±147[a] (500)	447±172[a] (451)	533±263[b] (525)	565±283[b] (570)	0.02
Lifestyle score	%	%	%	%	%	P[§]
1	6.5	1.5	0	3.8	2.7	n.s.
2	16.1	26.2	14.8	7.7	10.8	
3	58.1	43.1	37.0	34.6	35.1	
4	19.4	29.2	48.1	53.8	51.4	

MON = Montenerodomo; PIZ = Pizzoferrato; GAM = Gamberale; LdP = Lama dei Peligni; PEN = Pennapiedimonte. Statistical analysis *P level of significance = ANOVA; different letters in the same row indicate a statistically significant difference (p<0.05); P[§] level of significance χ^2 test; n.s. = not significant.

Concluding remarks

The socio-economic analyses conducted to identify the limited area revealed a very strong geographical isolation for the 5 municipalities under investigation.

Analysis of structural and demographic data showed that the area was characterised as a depressed area with very small municipalities and significant rates of depopulation, especially with reference to the low number of resident populations. Differences between the five municipalities under study were observed. Two clearly distinct areas can be recognised: the first, with a fair presence of commercial farms (Lama dei Peligni and Pennapiedimonte), the second including municipalities where the link with agricultural activities has been progressively lost over time (Montenerodomo, Gamberale, Pizzoferrato).

Furthermore, data on consumption and nutritional surveys confirm differences between the two areas identified. In both cases, farms constituted the main sales channel for fresh products, reflecting a strategy for dealing with the progressive reduction in shops in the 5 municipalities. Local products are widely known and consumed even if price levels are not always cheaper (greater production costs resulting from artisan processing and limited quantity of products). Based on these purchase choices, there appears to be widespread knowledge of the "origin" of products, intended both in terms of local origin and production technique used, which ensures higher quality products with better organoleptic characteristics (tastes that appeal to the local population) and the link between the product and local tradition, a symptom of a deeply rooted territorial identity. In spite of this, local consumption seems to be prevalent and strongly influenced by *global* products. Global markets can reach the population living in small mountain towns, so the threat of the erosion of livestock and agricultural products and plant and animal heritage and local traditions in the mountains and in the most rural marginal areas is increasing. The reduction in inhabitants in the areas has led to a decrease in businesses that inevitably reflects on consumer choices. Our results hypothesise that rural populations are affected by global changes, which will lead to homogenisation of eating behaviour; however, there are some population groups that appear to be health conscious and believe that food, nutrition and physical activity could improve their health. These aspects relating to well-being can also be linked to additional awareness that the consumer places on the purchase of products. In a survey on consumer lifestyles conducted in New Zealand, Mirosa & Lawson (*2012*) concluded that "*Consumers who express an interest in purchasing local food are a demanding segment of the population whose interest in food makes them critical judges of produce. Local food must thus be fresh and value for money. Increasing this sector requires making local food more accessible through mainstream retail outlets*".

In conclusion, the results of the study conducted in the rural area of Majella National Park reinforce the need for joint action among the different institutional players for regional dissemination of the importance of maintaining the biodiversity of local products and a balanced diet for a healthy life. Local products should be considered a "plus" for rural development in sustainable areas in order to increase the national and international markets supply and to promote agricultural production and productivity at regional level. At the same time, local products allow maintaining agricultural and food production diverse and varied, with benefits for the preservation of typical habitats and bringing back indigenous breeds, species and cultivars, as well as for diet. The spread of these products would increase the profitability and competitiveness of local producers and small and medium-sized enterprises and improve the quality of life and the diet of the local population.

Acknowledgement

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Insights in overcoming the non-adoption of voluntary agricultural GHG mitigation measures in Ireland

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Abstract

Agricultural Greenhouse Gas (GHG) emissions in Ireland are projected to increase up to 21 Mt CO_2eq by 2030 mainly driven by increased dairy cow numbers and increased nitrogen fertiliser use. In response to the growing public awareness of the GHG emissions' environmental impact, the Irish government published the Climate Action Plan in 2019, which identifies the agricultural sector's leading role in reducing GHG emission and increasing carbon removals to achieve the national GHG emission targets by 2030. Marginal Abatement Cost Curves (MACCs) on Irish GHG emissions have projected the total technically feasible mitigation potential for the Irish agriculture, forestry and land use (AFOLU) sector to be sufficient enough to achieve the set targets by 2030. Although these mitigation measures are available and when implemented, would mostly lead to a win-win situation, the voluntary adaptation rate by farmers is low. This study addresses the most significant determinants of voluntary adoption of mitigation measures by systematically examining existing literature on how and to what extent non-price determinants affect the voluntary adoption rate of technically feasible mitigation measures in the Irish AFOLU sector. The main identified non-price determining factors were the degree of farmers'

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awareness regarding man-made GHG emissions, receiving agri-environmental advice, implementation costs, profitability and size of farms, land quality and the type of farm enterprise. Integrating the gained results in the former MACC analysis enabled us to adopt the implementation rates of the cost-efficient AFOLU mitigation measures accordingly. The non-price determinants impact the voluntary uptake rate of AFOLU mitigation measures to the extent that the adjusted total Irish AFOLU abatement potential is 47% lower than technically feasible. Considering that 51.6% of the total estimated AFOLU abatement potential in 2030 is offset through Irish forestry, which at current afforestation rate will turn into a net carbon source by 2035, a significant gap occurs to any potential Irish and EU GHG reduction targets. To substantially help bring the nexus between agricultural development and GHG emission targets in Ireland closer together, policy measures, that differentiate between the different type of AFOLU mitigation measures, need to be implemented to enhance the uptake rate of cost-beneficial and cost-effective measures. This would have the potential to reduce the level of agricultural GHG emissions by 2030 in a way that it would converge towards possible EU and Irish GHG emission reduction targets.

Introduction

The Irish economy continues to grow rapidly and has come a long way since exiting the EU-IMF financial assistance programme in late-2013. It is widely recognised that the Irish agri-food sector (7.7% of the total GDP in 2017) has played a key role in Ireland's export-oriented economic recovery (DAFM, 2018; DAFM, 2010). The agri-food sector is one of the fastest growing sectors in the Irish economy and therefore, makes a significant contribution to the economic, social, and environmental wellbeing of the country and rural areas (Joint Committee, 2018). This growth is projected to continue, mainly due to a projected increase of ruminant livestock numbers (dominated by an increase in dairy cattle in response to the abolition of the EU milk quota system) (CSO, 2020; Duffy *et al*., 2019).

At the same time, greenhouse gas (GHG) emission reduction targets have been set for Ireland's Emission Trading Scheme (ETS)[1] sector and also for the non-ETS[2] sector, which includes agriculture (accounting for 52% of non-

1. The EU Emissions Trading Scheme (EU ETS) launched in 2005 and covers more than 11,000 heavy energy consuming installations in power generation and manufacturing including food processing and manufacturing (EPA, 2019).
2. The non-ETS sector consists of those sectors not included in the EU ETS including agriculture, transportation, households and waste (EPA, 2019).

ETS emissions). The non-ETS sector reduction target for Ireland is amongst the highest in the EU Member States (Reduction of 20% in 2020 and 30% in 2030 relative to 2005 levels) (EPA, 2019). The recently published Climate Action Plan has outlined specified actions for all sectors to reach the set targets. The agriculture sector's leading role becomes thereby apparent in reducing GHG emissions and increasing carbon removals up to –15% by 2030 relative to 2030 emission projections (DCCAE, 2019).

A range of technically feasible mitigation actions for the Irish agriculture, forestry and land-use (AFOLU) sector up to 2030 and their GHG abatement potential have been identified through Marginal Abatement Cost Curves (MACCs) on GHG emissions (DCCAE, 2019; Lanigan and Donnellan, 2018; Schulte *et al.*, 2012). Although these mitigation measures are available and when implemented would mostly lead to a win-win situation, the voluntary adaptation rate through farmers occurs to be low, considering that agricultural GHG emissions have continued to increase since 2011 (Duffy *et al.*, 2019; DCCAE, 2019)[3].

Existing Irish studies on the real term realisation of mitigation measures such as Tzemi & Breen (2018, 2019), Buckley *et al.* (2015) and Ryan & O'Donoghue (2016), identify determining factors that influence the level of adoption of mitigation tools such as degree of awareness on man-made emissions, farms' profitability, and farm type. The aim of the present study is to investigate how the most determining characteristics of Irish farmers and farms to not adopt agricultural GHG mitigation measures voluntarily, impacts the estimated Irish AFOLU abatement potential of technically feasible mitigation measures by applying a meta-analysis on the existing literature. Integrating the real term realisation studies of technically feasible mitigation measures into the Irish MACC analysis, enables to show the possible impact range that the determining factors have on the Irish AFOLU abatement potential. Determining the reasons and the degree of impact on the adoption of GHG mitigation measures enables the discussion of recommendations to overcome the non-adoption of voluntary agricultural GHG mitigation measures that can be derived for Ireland. Policy measures that address the increase of the up-take rate of specific AFOLU mitigation measures can be identified.

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3. Agricultural emissions are currently not included in any trading regime and agricultural payments are not granted for the implementation of most mitigation measures.

Lucie Adenaeuer, James Breen, Anne Hayden

1. Irish ᴀꜰᴏʟᴜ Abatement potential of Greenhouse Gas Emissions

In the last two decades, the main Irish sources of GHG emissions have been the agriculture (2018: 34%), transport (2018: 20.2%) and energy sector (2018: 17%) (ᴇᴘᴀ, 2019b; Duffy *et al*., 2019). Distinguishing between ETS and non-ETS emissions, agricultural and transport ɢʜɢ emissions account for 75% of the total Irish non-ETS emissions (Figure 1). This highlights not only the Irish agriculture's sizeable contribution as the largest single contributor to the overall ɢʜɢ emissions, but also the importance of agriculture in trying to limit overall ɢʜɢ emissions (ᴅᴄᴄᴀᴇ, 2017; Duffy *et al*., 2019; ᴇᴘᴀ, 2019b)[4].

Figure 1 - Trends in Irish Greenhouse Gas Emissions 1990-2018 (Mt CO$_2$eq)
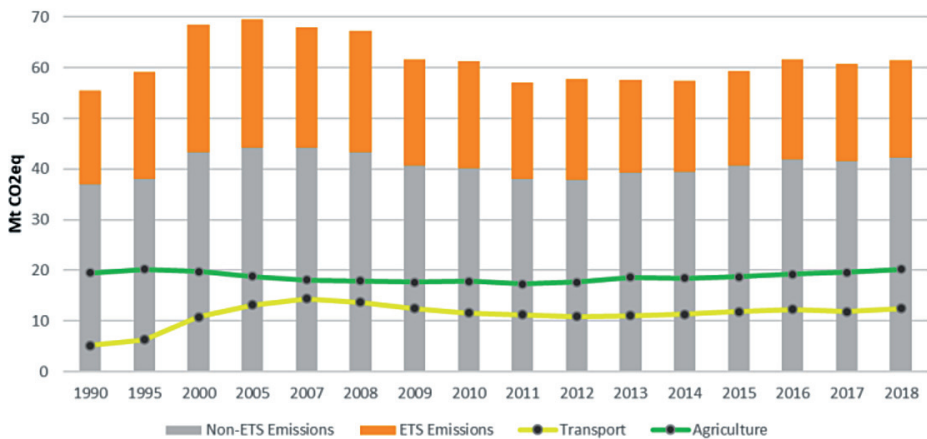
Source: Duffy *et al*. (2019); EPA (2019b).

Methane (CH4) and Nitrous Oxide (N$_2$O) are the most significant GHGs emitted from agricultural activities in Ireland due to the dominance of dairy and beef cattle and, to a lesser extent, sheep production (ᴅᴄᴄᴀᴇ, 2017). Cattle account for 90.4% of CH4 emissions from Irish agriculture (Duffy *et al*., 2019). Enteric fermentation accounts for 51% of total agricultural emissions (ᴅᴄᴄᴀᴇ, 2017).

The recent growth in the Irish agricultural sector has had a substantial impact on agricultural GHG emissions. Since the abolition of the EU milk quota system, the dairy cow herd has increased by 31%, accounting for

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4. In Germany the agricultural GHG emissions contribute to 7.1% of the overall emissions, in Italy 7.1%, in France 16.7%, in the Netherlands 9.8% and in Spain 10.5% (Eurostat, 2019).

approximately 20% of the total cattle herd in 2017 (CSO, 2019)[5]. Hence, the initially observed decrease in agricultural GHG emissions, after the peak in 1998, has therefore been entirely negated, currently reaching the 1990 level (Figure 1). From 2011 on, the GHG emissions in the agriculture sector have witnessed a further increase of 13.4% up to 2018 (Figure 1).

GHG emissions from Irish Agriculture are projected to increase even further (up to 21 Mt CO_2eq by 2030), even when allowing for the implementation of Project Ireland 2040 measures (DCCAE, 2019). This projected increase is mainly driven by increased dairy cow numbers (+22% on current levels) and increased nitrogen fertiliser use (+21% on current levels) (Lanigan and Donnellan, 2018; EPA, 2019b). This development will present significant challenges for Ireland to meet its targets stated under the Climate Action Plan as well as its non-ETS 2020/2030 targets under the EU Effort Sharing Regulation (Regulation (EU) 2018/842) (European Council, 2018; DCCAE, 2019). Hence, managing these emissions will become a new challenge for farming (Wreford *et al*., 2010).

With the new EU Effort Sharing Regulation (Regulation (EU) 2018/842) in place, greater flexibilities have been provided for Member States, such as Ireland, that have been targeted with a high emissions reduction targets for their non-ETS sectors up to 2030. As well as reducing the emission intensity of agricultural produce, Ireland has the flexibility to realise 4% (1.91 Mt CO_2eq yr-1) reduction of their 2030 non-ETS GHG emission targets through the use of EU ETS allowances and 5.6% (2.68 Mt CO_2eq yr-1) through offsetting emissions by sequestering CO_2 potential through LULUCF activities during the time period 2021-2030 (European Council, 2018, Lanigan and Donnellan, 2018). The theoretical abatement potential occurring through technically feasible agricultural and land-use mitigation measures for Ireland has been assessed by Lanigan and Donnellan (2018) using the MACC approach.

MAC curves have been developed to provide a solid analytical foundation on the most cost-effective pathway to reduce GHG emissions in line with decarbonisation targets (DCCAE, 2019; Bockel *et al*., 2012)[6]. They can thereby, graphically visualise the abatement potential of GHG mitigation measures

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5. The presence of the milk quota system up to 2015, effectively capped the number of dairy cows, with the percentage of dairy cows within the national cattle herd remaining relatively stable at around 16-17% (CSO, 2020). After removal, a shift in livestock farms occurred due to the potential for higher returns in dairy production compared with other enterprises. Mixed dairy farms specialize in becoming pure dairy farms and some larger-scale beef and cereal farms converted to dairy production, with this trend more commonplace amongst the younger generation of farmers (DCCAE, 2017; DAFM, 2018).

6. MAC curves are thereby used to demonstrate how much abatement an economy can afford and the area of focus to achieve the emission reductions (Bockel *et al*., 2012).

and the marginal costs per abated tonne of CO_2eq associated with each of the included measures (DCCAE, 2019; Lanigan and Donnellan, 2018)[7]. The GHG MACC analysis of Irish agriculture included 14 agricultural and 5 LULUCF specific mitigation measures (Lanigan and Donnellan, 2018)[8]. The final AFOLU abatement potential incorporates all cost- efficient measures, meaning measures that reduce GHG emissions either at negative marginal costs (cost-beneficial) or at marginal costs not exceeding a carbon price of €50/tonne CO_2 (Lanigan and Donnellan, 2018). Hence, the total AFOLU abatement potential of GHGs for the Irish agriculture sector at a carbon price of €50 per tonne CO_2 by 2030, when maximum linear uptake of cost-efficient voluntary mitigation measures is assumed to have occurred, is estimated to be 6.39 Mt CO_2eq per year (Table 1).

Table 1 - Agricultural GHG emissions projected to 2030 and the cost-effective Irish AFOLU abatement potential at a carbon price of €50/tonne

	Projected emissions or abatement (Mt CO2eq yr-1)	
	Mean over 2021-2030 period	**Abatement in 2030**
Total Agriculture emissions (ex. Fuel)	20.82	21.04
Cost effective Agriculture mitigation	1.76	2.89
Cost effective LULUCF offsets[9]	2.80	3.50
Total AFOLU	4.56	6.39

Source: EPA (2019b); Lanigan and Donnellan (2018).

The identified feasible agricultural mitigation measures can be divided into two groups – production efficiency measures and technical efficiency measures (Lanigan & Donnellan, 2018). An increase in production efficiency is a win-win situation that leads to lower emissions and lower costs per unit

7. The costs include the costs of the initial investment, the costs of operation for the full lifetime as well as net lifetime cost savings of the technology (DCCAE, 2019). It ranks the mitigation measures from cost-beneficial measures (measures that not only reduce GHG emissions, but also save money in the long-term) to cost- prohibitive measures (measures that reduce GHG emissions but are expensive in the long-term) (Lanigan and Donnellan, 2018).
8. For more detail on the Irish MACC analysis please see Lanigan and Donnellan (2018).
9. According to the EU Effort Sharing Regulation (EU 2018/842) the offset of GHG emissions through LULUCF will be capped at 2.68 Mt CO2eq per year (European Council, 2018).

product. All production efficiency measures included in the Irish agricultural MACC analysis are cost-beneficial. Contrary to production efficiency measures, technical efficiency measures mainly impact on emission factors of a production system rather than the produced unit. Even though most of them incur a cost of implementation, technical measures result in a non-negatable emission reduction (Lanigan & Donnellan, 2018; IPCC, 2014). Most of those mitigation measures, except adding lipids and low emission slurry spreading, have been identified as cost-efficient in the MACC analysis.

Box 1 - Irish Forestry Sector

The dominant carbon sinks in Ireland are forests (11% of total land area), grassland (58.5%) and wetlands (16.4%) (Duffy *et al*., 2019). While total forest area increased by nearly 290,000 ha between 1990 and 2017, wetlands (especially peat) have declined by nearly 132,000 ha (–9.7%) and grassland area declined by 178,000 ha (–4.1%) (Duffy *et al*., 2019; DAFM, 2018b).

Ireland's total area of forestry covers 769,395 ha (end of 2017), or close to 11% of the total land area, which is well below the EU-28 average of 38% (Duffy *et al*., 2019; Eurostat, 2018). Nearly half (49.2%) of forests are in private ownership. Since 1990, 72% of the newly afforested area was planted by the private sector of which 82% was afforested by farmers (DAFM, 2018b). 67% of afforestation occurs on marginal agricultural land. Of this, 56% is marginal grassland (Farrelly & Gallagher, 2015). Over the same period public afforestation declined to close to zero since 2005 (IFFPA, 2018). As a result, forestry and agriculture are intimately intertwined, aiming at the most efficient use of natural resources (DCCAE, 2017; Schulte & Lanigan, 2011).

This change from public to private afforestation was largely a result of the introduction of a range of farm afforestation schemes in 1989 that offered planting grants and annual forestry premia to cover forest establishment costs and offset the lost income from agricultural livestock production (Teagasc, 2018b). In 2007, farm afforestation was made even more financially attractive given that farmers who planted continued to receive agricultural direct payments on the afforested land (Duesberg *et al*., 2014; Breen *et al*., 2010). Now, forestry returns exceed those from beef and sheep farming (Ryan & O'Donoghue, 2016; Breen *et al*., 2010).

Under the current Forestry Programme and endorsed by the Food Wise 2025 strategy paper, Ireland has a target to expand forest cover to 18% of the land area by 2050 (approximately 1.25 M ha) in order to maintain a sustainable processing sector (DAFM, 2018b; DAFM, 2015). To achieve this target, an annual afforestation target of 16,000 ha per year would be required (Farrelly & Gallagher, 2015). Whether a planting rate of 16,000 ha per year is achievable is uncertain, particularly given the recent decline in afforestation from 15,696 ha per year in 2000 to just over 5,500 ha per year in 2018 (DAFM, 2018c; IFFPA, 2018).

For the LULUCF sector associated with the agricultural sector, a GHG MACC was generated that encompasses those measures that enhance carbon sinks or reduce carbon loss from agricultural soils in Ireland. Of the five measures, only grassland management was cost-beneficial with an abatement potential of 0.26 Mt CO_2eq per year. The usage of cover crops and straw incorporation were not incorporated in the analysis as they were identified as cost-prohibitive measures. The bulk of carbon sequestration is thereby due to forestry (2.10 Mt CO_2eq per year) (Lanigan & Donnellan, 2018; see Box 1).

Considering all technically feasible cost-effective mitigation measures, theoretically, an abatement of agricultural GHG emissions in the region of the stated EU targets for non-ETS emission reduction by 2020/2030 as well as the agriculture sector target by 2030 stated in the Irish Climate Action Plan (DCCAE, 2019) is mostly achievable.

2. Methodology

Major underlying assumptions, when assessing the Irish abatement potential of the AFOLU sector through the MACC approach by Lanigan and Donnellan (2018), are that the uptake rate of the identified mitigation measures is linear over the investigated time and that the mitigation measures are adopted by all farmers possible with the best available technology (Lanigan & Donnellan; 2018, DCCAE, 2017)[10]. The main factor underlying these assumptions is thereby the individual farmer.

The farmer's individual behaviour influences the outcome considerably according to the Behavioural Economics approach which incorporates the Theory of Planned Behaviour (TPB) (Azjen & Madden, 1986) and the Theory of Adoption and Diffusion of New Technologies (Rogers, 1962)[11]. The decision-making process with regards to land-use change according to the Giddens' theory of structuration (Giddens, 1984) is influenced by structural, socio-demographic and individual farmer factors (Duesberg *et al.*, 2014). Numerous studies (Buckley *et al.*, 2015; Tzemi & Breen, 2018; Hamilton-Webb *et al.*, 2017; Duesberg *et al.*, 2014) identified several major determining factors that influence the behaviour of individual farmers (OECD,

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10. The maximum uptake rate reflects thereby the full biophysical potential occurring by 2030 (Lanigan & Donnellan, 2018).

11. The TPB can be used to predict behaviour and explore the underlying motivations for adopting a particular behaviour. It consists of behavioural intentions, attitudes, subjective norms and perceived behavioural control (OECD, 2012).

2012)[12]. These studies mainly use multi/binomial logit or probit models and descriptive statistics on representative farm surveys.

To systematically examine existing literature following Minviel and Latruffe (2017) on how non-price determinants affect the voluntary adoption rate of technically feasible mitigation measures in the Irish AFOLU sector, eligibility criteria for selecting cited studies have been set. Studies have been included that have undertaken an analysis of the decision-making process in the (Irish) AFOLU sector influencing the uptake of GHG mitigation measures. These criteria have led to the inclusion of fourteen studies in our analysis which were carried out during the period 2005-2017. The strength of systematically examining existing literature lies in its ability to combine the results from various studies (Russo, 2007).

In the next step, we adopt the implementation rate of the cost-efficient AFOLU mitigation measures according to the non-price determining factors. This enables us to derive an adjusted possible AFOLU abatement potential for each mitigation measure. Furthermore, this analysis reveals the predominantly impacted mitigation measures and the extent to which they are impacted by non-price determinants.

3. Best practice adoption – Determining Factors

The identified non-price determining factors for Ireland can be divided into three groups – the farmer's individual attitudes, the farm structure and its business profile and LULUCF related factors (Buckley *et al.*, 2015; OECD, 2012; Duesberg *et al.*, 2014). From the studies undertaken for different countries, it appears that there is no single formula for determining the most important factors in the farmer's decision- making process. Furthermore, an understanding of the local conditions is key to understanding this decision-making process (OECD, 2012).

Determining farmer's attitudes to AFOLU mitigation measures

Recent representative studies on Irish farmers have found the following individual farmers' attitudes significantly impact the uptake of mitigation measures in Ireland. The principal attitudes identified concern:
1. The degree of awareness that man-made GHG emissions contribute to global climate change increases the willingness to adopt mitigation measures.

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12. Contrary to the Behavioural Economics approach, determining factors not found significant for Irish farmers to implement agricultural mitigation measures are own equipment, age, stocking rate of livestock, land-owned and farm size (Tzemi & Breen, 2019; Tzemi & Breen, 2018; Howley *et al.*, 2012).

2. Receiving or seeking agri-environmental advice increases the willingness to adopt AFOLU mitigation measures.
3. Cost occurring through the uptake of mitigation measures decrease the willingness to adopt mitigation measures

In general, it is observed that people tend to underestimate the cumulative effects of singular behaviour (OECD, 2012). The awareness of the contribution of man-made GHG emissions to global climate change of Irish farmers at 53% is slightly lower than the awareness of the Irish general public at 68% (Tzemi & Breen, 2018). However, Irish farmers' degree of awareness appears to be much higher compared to farmers from other developed countries. In a survey of tillage farmers in 11 U.S. States, 68% of the farmers believed that climate change is occurring, but only 10% were aware that it is man-made (Arbuckle *et al.*, 2013). A survey with Australian agricultural advisors came up with similar results (Fleming & Vanclay, 2010).

It is of interest to note that 58.1% of Irish farmers do not consider GHG emissions from agriculture, more specifically ruminants and land tilling (Lynch *et al.*, 2016), to be significant sources of GHG emissions (Tzemi & Breen, 2018). Farmers have been found to view other sectors such as the automotive, aviation and manufacturing industries as pollutants (Bruce, 2013). As a result, they fail to recognise agricultural practices like the use of artificial fertilisers, as an important source of GHG emissions (Tzemi & Breen, 2018)[13]. Receiving agri-environmental advice, as well as advice on afforestation schemes and adopting advisory systems plays, therefore, a significant role in increasing the awareness of the impact of agriculture on the environment and its contribution to global climate change[14]. This also significantly increases the willingness of farmers to adopt AFOLU mitigation measures such as adjusted growing practices, nutrient management practices and afforestation (OECD, 2012; Tzemi & Breen, 2018; Hamilton-Webb *et al.*, 2017; Buckley *et al.*, 2015; Ryan & O'Donoghue, 2016b; Duesberg *et al.*, 2014)[15].

Receiving environmental subsidies, on the other hand, increases awareness but not necessarily the willingness to adopt mitigation measures (Tzemi & Breen, 2018; Howley *et al.*, 2012; Hamilton-Webb *et al.*, 2017)[16]. The rate of

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13. The same can also be seen for farmers in other countries such as UK (Bruce, 2013).

14. The causality between the farmers' awareness of potential GHG emission sources and receiving agri- environmental advice is thereby not clear (Tzemi & Breen, 2018).

15. Of Irish farmers questioned, 87% were aware of the availability of the afforestation scheme of which only 10% were interested in afforesting. Respondents with no intention of planting were provided with detailed information of the scheme. This increased the total numbers of farmers considering afforestation from 10% to 26% (Duesberg *et al.*, 2014).

16. The direction of causality is thereby not clear – either Irish farmers are more environmentally conscious and therefore they receive subsidies, or the subsidy raised their

farmers adopting mitigation measures, even in the absence of subsidies, is similar to the rate of adoption among those receiving subsidies (OECD, 2012).

In general, the win-win outcome of a mitigation measure must be greater and more direct than the possible medium-term trade-offs of the adopted measure, such as a decrease in yield or an increase in pesticide or fertiliser usage (OECD, 2012)[17]. Of Irish farmers, 77.6% stated that they would be unwilling to take up any measures that would incur any increase in their production costs (Tzemi & Breen, 2018). The higher the additional costs of new technology, the less likely farmers are to adopt this new measure such as slurry amendments or addition of lipids (Howley *et al*., 2012). Farmers undertake actions that are seen as part of standard practices leading to a win-win situation as these actions increase productivity, reduce energy, reduce inorganic fertiliser usage, improve field drainage. Currently, these actions are primarily undertaken for their risk reduction and not for climate change effects (Hamilton-Webb *et al*., 2017; Lanigan & Donnellan, 2018; Ghadim *et al*., 2005). Although aware of climate change, it has been observed that farmers feel they had more critical immediate concerns to worry about other than climate change (Hamilton-Webb *et al*., 2017; OECD, 2012), 76.3% of the Irish farmers either felt climate change is only a long-term problem, no problem or are unsure as to whether it is a problem (Tzemi & Breen, 2018).

Determining economic farm structure for AFOLU mitigation measures

The main determining factors significantly impacting the uptake of mitigation measures in Ireland derived from the economic structural profile of a farm are (Buckley *et al*., 2015; Tzemi & Breen, 2018; Howley *et al*., 2012):

1. Profitability and size of farms increases the willingness to adopt AFOLU mitigation measures.
2. Dairy farmers are more willing to adopt agricultural mitigation measures than farmers in other sectors.

Profitability has a significantly positive effect on the uptake of mitigation measures such as nutrient management practices, spring slurry spreading and water table management (Tzemi & Breen, 2019; Buckley *et al*., 2015). Irish farmers with higher family farm income, indicating a higher production efficiency, have a greater willingness to adopt AFOLU mitigation measures

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environmental consciousness (Tzemi and Breen, 2018). In a study of English farmers, even when funded, only 24% of the farmers stated that they would install mitigation activities that lead to additional costs (Hamilton-Webb *et al*., 2017).

17. The win-win situation of mitigation measures occurs if the implemented mitigation measure leads to lower emission and lower costs per unit product (Lanigan & Donnellan, 2018).

(Tzemi & Breen, 2018; Buckley *et al*., 2015). It appears that profitable farmers recognise the potential to increase their profitability even further by adopting these win-win measures (Howley *et al*., 2012; Hamilton-Webb *et al*., 2017). Furthermore, these Irish farmers appear to be more open to changing farm management practices to increase profitability further (Tzemi & Breen, 2019).

The size of a farm also determines the likelihood to uptake AFOLU mitigation measures such as improvement of genomics, sexed semen, or afforestation. Therefore, based on literature, these technologies are most likely to be adopted on larger farms of 56 ha or more (Duesberg *et al*., 2014; Howley *et al*., 2012b; Hamilton-Webb *et al*., 2017; Ryan & O'Donoghue, 2016, 2016b).

The willingness to adopt agricultural mitigation measures which increase the production efficiency or reduce nitrogen and methane emissions differs between different farm enterprises. Generally, in Ireland, livestock production and the livestock production intensity increase the adoption rate (Buckley *et al*., 2015). Among livestock farms, those Irish farmers with the highest gross margins per livestock unit were found more likely to use new technology (Howley *et al*., 2012). As dairy farms in Ireland throughout the years have had the highest average family farm income, dairy enterprises significantly show the highest willingness to adopt mitigation measures (Tzemi & Breen, 2018; Teagasc, 2018). At the same time, dairy farms have the highest investment rate of all farm types and have increased their investment substantially over the last decade (Dillion *et al*., 2018)[18]. Significantly, sectors that are willing to adopt mitigation measures are also those sectors that invest the most in Ireland (Tzemi & Breen, 2019). As dairy farmers are also the biggest group to receive agri-environmental advice, this result corresponds with the finding that receiving agri-environmental advice significantly increases the willingness of Irish farmers to adopt a tool that would quantify potential reductions in GHG emissions (Tzemi & Breen, 2019; Tzemi & Breen, 2018; Buckley *et al*., 2015; Howley *et al*., 2012).

Determining factors for LULUCF mitigation measures

Specific determining factors occur which influence the probability of farmers to take financial risks and consider changes in land-use, mainly afforestation under the current Irish support scheme (Duesberg *et al*., 2014; Ryan & O'Donoghue, 2016). Taking into account that land-use change from agriculture to forestry in Ireland is a permanent decision due to the

18. From 2016 to 2017 the on-farm investments in Ireland went up by 16%. Thereby 49% of the farm investment was on dairy farms (Teagasc, 2018).

1946 Forestry Act (Breen *et al*., 2010), the determining factors appear to be slightly different to the ones for agricultural mitigation measures.

The land-use and land-use change decisions towards afforestation by Irish farmers are influenced by the farm structure and the individual farmers' actions which go beyond merely maximising economic returns (Ryan & O'Donoghue, 2016; Duesberg *et al*., 2014):
1. Farmers are more likely to afforest land that is less suitable for agriculture.
2. Dairy farmers are less likely to afforest than other farmers.

The highest rate of willingness to adopt land-use mitigation measures such as grassland management or afforestation is seen among Irish farmers who manage grassland on lesser quality soils, where the compensation for extreme weather effects (like floods, droughts and other natural hazards) are more complicated (Tzemi & Breen, 2018; Hamilton-Webb *et al*., 2017). Farming on marginal agricultural land significantly increases the probability of Irish farmers changing land use, e.g. afforesting (Howley *et al*., 2015; Duesberg *et al*., 2014). Afforestation stands in conflicting land-use with food production, and hence productive agricultural land has a significantly negative impact on the probability to afforest (Ryan & O'Donoghue, 2016; Duesberg *et al*., 2014). Of the Irish farmers, 40% regard forestry as a land use only for marginal land that is not suited to other agricultural activities (Howley *et al*., 2015). Productive agricultural land that generates a positive return under agricultural usage is not considered for afforestation by many farmers.

In deciding to afforest or change land-use of some of the farmers' agricultural land, it is assumed that farmers are unlikely to change land-use on land which gives a higher return in another farm enterprise (such as dairy) (Ryan & O'Donoghue, 2016). Hence, especially dairy farmers in Ireland are less likely to afforest, even when they have been in receipt of advice on the benefits of the afforestation scheme (Ryan & O'Donoghue, 2016b; Duesberg *et al*., 2014; Howley *et al*., 2012b). These farms are specialised and highly profitable (having the highest family farm income on average) and higher returns per hectare than the other main farming enterprises on average. Generally, higher family farm income negatively impacts on the probability to afforest, and dairy farms do not generate any financial benefits through afforestation, no matter what type of soil their farm consists of (Ryan & O'Donoghue, 2016, 2016b; Duesberg *et al*., 2014).

Cattle and sheep farms which account for 76% of all Irish farms have been found to be more likely to afforest (Howley *et al*., 2015). With an average family farm income that does not cover all production costs through market returns and a less intensive farm system, they may try to increase their family farm income by diversification through afforestation, as they will typically benefit financially from afforestation irrespective of the type of soil they farm (Ryan & O'Donoghue, 2016, 2016b; Duesberg *et al*., 2014; Howley *et al*., 2012).

Still, 74% of farmers do not intend to afforest their land for any level of forest subsidy. Even if made aware that they would achieve a higher income through afforestation than through agriculture (even when taking agricultural subsidies into account), only 6% of farmers would consider planting (Ryan & O'Donoghue, 2016).

Impact of behavioural barriers on the Irish AFOLU *Abatement potential*

As agricultural emissions are largely regulated on a voluntary basis and not included in any trading regime, taking the determining characteristics of individual farmers into account when projecting the abatement potential in the Irish agriculture sector is a key factor to be considered. The systematic examination of existing literature on how non-price determinants affect the theoretically possible adoption rate of technically feasible mitigation measures in the Irish AFOLU sector has indicated to what degree these characteristics affect the theoretically feasible adoption rate of the different AFOLU mitigation measures.

Currently, as pointed out in our literature analysis, production efficient and cost-beneficial agricultural mitigation measures included in the MACC analysis (Lanigan & Donnellan, 2018) such as improved liveweight gain, nitrogen-use efficiency, economic breeding index (EBI), extended grazing, animal health, sexed semen and the inclusion of clover in pasture swards are undertaken by farmers as they are embedded in good agricultural practices and achieve positive profitability and production potential at farm level (Buckley *et al*., 2015). However, most of the farmers do not consider (76.3% of the Irish farmers) the importance of agriculture's contribution to GHG emissions even though 32% of the Irish farmers receive agri-environmental advice (Tzemi & Breen, 2018). It should therefore be assumed that currently, less than 32% of the Irish farmers implement mitigation measures to reduce GHG emissions.

Technically it would be feasible to adopt most of the cost-beneficial mitigation measures in 2030 by nearly 100% of all relevant farmers. Bearing in mind that 39.3% of the Irish farmers have stated that they do not want to receive advise (Tzemi & Breen, 2018), and receiving agri-environmental advice is a significant factor for the willingness to adopt mitigation measures, the possible uptake rate of cost-beneficial mitigation measures applied in the MACC analysis in 2030 should not exceed 60.7% assuming a linear up-take rate from 2021 on. This would assume that all farmers who receive agri-environmental advice consequently implement relevant mitigation measures.

Although the identified cost and technical efficient agricultural mitigation measures in the MACC analysis such as replacing 50% of CAN fertiliser, reducing crude protein in pig diets, draining wet mineral soils and the

amendment of slurry can be adopted at lower costs than an assumed shadow carbon price of €50/tonne (Lanigan & Donnellan, 2018), it has been shown that 77.6% of the Irish farmers are not willing to pay any additional costs to adopt mitigation measures. Among Irish farmers, 18% are willing to pay an additional 5% of their production costs to adopt mitigation measures (Tzami & Breen, 2018). The additional costs stated in the MACC approach for the cost-efficient measures lie below 5% of the average farm production costs taken from the Annual Review and Outlook by DAFM (2018). Therefore, it is assumed that 18% of the farmers will voluntarily take up these cost-efficient mitigation measures by 2030 assuming a linear up-take rate from 2021 on.

According to our analysis, the voluntary uptake of the cost-efficient LULUCF mitigation measures associated with the agricultural sector is also impacted through farmers' behaviour. Managing grassland efficiently is identified as a cost-beneficial mitigation measure in the MACC analysis when implemented by farmers (Lanigan & Donnellan, 2018). In 2017, the improvement of grassland management was not put into practice in Ireland (DCCAE, 2019). As a win-win situation occurs for the farmers, determining factors are very low, and adoption of more efficient grassland management, embedded in good agricultural practice could lead to a possible increase in the area being managed efficiently of up to 273,000 ha by 2030. This would assume that a linear uptake rate occurs from 2021 on and that all farmers who receive agri-environmental advice in the future (up to 60.5% according to Tzemi & Breen, 2008) will adopt more efficient grassland management.

Efficient water table management as a cost-efficient mitigation measure has not exceeded 800 ha per year since 2005 on all kinds of organic soils (grassland, forest, and wetland) ranging mostly around 400 ha per year (Duffy *et al*., 2019). Assuming a voluntary rewetting of 40,000 ha by 2030 (Lanigan & Donnellan, 2018) seems, therefore, out of reach. An abatement potential of 756 ha by 2030, assuming a linear up-take rate from 2021 on, seems more likely in the absence of policy or regulation. This increase in the rewetting rate would assume that farmers who wish to receive agri-environmental advice in the future (28.5% according to Tzemi and Breen, 2018) will adopt efficient water table management.

In 2018, the rate of Irish afforestation, as a cost-efficient mitigation measure, was at its lowest level since 1998 of 4,000 ha even though subsidies have continuously improved (Duffy *et al*., 2019). One main determining factor in the decision-making process by farmers to afforest is the quality of their land. Of the area identified as suitable for forestry (3.75 M ha in Ireland), 1.08 M ha is identified as marginal agricultural land, of which 61% is marginal dry grassland (COFORD, 2016). Considering, that dairy farmers rarely take up afforestation and that mainly farmers above a farm size of 56 ha afforest, without a change in farmers attitudes to afforestation the available land for possible conversion into forestry would be reduced to

56,378 ha. Afforestation undertaken to the predicted extent would lead to low land-use competition, as it is undertaken on marginal agricultural land, which according to Farrelly and Gallagher (2015) is not predicted to be brought back into agricultural production at reasonable costs. Taking these behavioural factors into account, a yearly voluntary rate of 6,000 ha up to 2030 is projected, assuming a linear up-take rate from 2021 on.

Cost-prohibitive AFOLU mitigation measures, meaning that the marginal abatement costs of these measures exceed the set shadow carbon price, such as adding lipids, low emission slurry spreading, cover crops, and straw incorporation, will not be considered as our systematic examination of the existing literature has shown that they are unlikely to be adopted widely by farmers unless some form of policy incentives are introduced (Lanigan & Donnellan, 2018; Tzemi & Breen, 2018).

Considering all the derived adjustments of the single AFOLU mitigation measures, the voluntarily achievable cost-effective abatement potential at a shadow carbon price of €50 per tonne for total agricultural GHG emissions projected to 2030 could amount to 3.49 Mt CO_2eq annually (Table 2). This would result in an Irish AFOLU abatement potential 45% lower than technically feasible.

Table 2 - Agricultural GHG emissions projected to 2030 and the adjusted cost-effective abatement potential at a carbon price of €50/tonne

|	Projected emissions and adjusted abatement (Mt CO_2eq yr-1)	
	Mean over 2021-2030 period	Abatement in 2030
Total Agriculture emissions (ex. Fuel)	20.82	21.04
Cost effective Agriculture mitigation	1.08	1.52
Technically feasible MACC estimate	1.76 (–38%)	2.89 (–47%)
Cost effective LULUCF offsets	1.74	1.97
Technically feasible MACC estimate	2.80 (–38%)	3.50 (–44%)
Total	2.82	3.49
Technically feasible MACC estimate	4.56 (–38%)	6.39 (–45%)

Source: Own compilation.

The adjusted estimated cost-effective agricultural abatement potential would amount to 1.52 Mt CO_2eq per year in 2030 (Table 2). This accounts for 7.2% of the total estimated agricultural GHG emissions in 2030, which is 47%

below the technically feasible agricultural abatement potential. The highest difference between technically feasible and newly estimated abatement potential of agricultural mitigation measures can be seen for production efficient mitigation measures. As these measures are cost-beneficial, the implementation should technically be feasible for most farmers, and therefore, the impact of the determining factors is most pronounced.

LULUCF mitigation measures undertaken by farmers, associated with the agriculture sector, can effectively offset agricultural GHG emissions by 1.97 Mt CO_2eq per year by 2030 (Table 2). This would offset 9.4% of the total estimated agricultural GHG emissions, which would be 44% less than predicted as technically feasible in the MACC approach. The reduction in abatement potential is higher than for agricultural mitigation measures due to a lower estimate of afforestation potential.

Attaining this total adjusted AFOLU abatement potential in 2030 would reduce the agricultural GHG emissions level below the 2005 EU reference level of 18.75 Mt CO_2eq reaching the emission target set under the Climate Action Plan of 17.5 Mt CO_2eq (Figure 2). This would slow down the increase in projected agricultural GHG emissions to be produced by 2030.

Figure 2 - Irish agricultural GHG emissions projected to 2030 without additional mitigation (green) and with adjusted agricultural (yellow) and AFOLU (red) GHG abatement potential
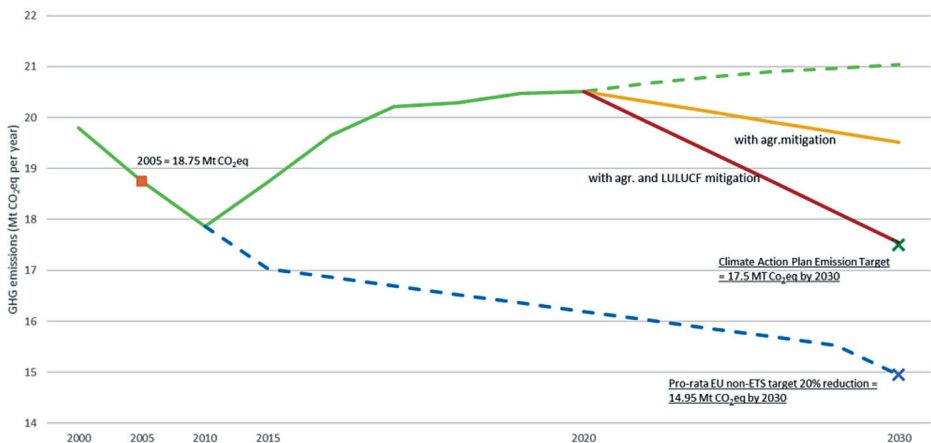
Note: In the EU Effort Sharing Decision, the 2005 level of non-ETS GHG emission sets the reference point for future reductions of non-ETS GHG emissions. For the Agriculture sector, following the assumptions made in Lanigan and Donnellan (2018), this would result in a pro-rata reduction of GHG emission down to 15 Mt CO_2eq by 2030 (blue line). In 2019, in the Climate Action Plan, a target for the AFOLU sector of 10%-15% reduction in 2030 was set, resulting to 17.5 Mt CO_2eq by 2030 (dark green).
Source: Own compilation, Duffy *et al.* (2019); DCCAE (2019); EPA (2019b).

It should be noted, that 1.8 Mt CO_2eq in 2030 (51.6% of total abatement potential) will be offset through Irish forestry. Simulations undertaken by COFORD have shown that for the national forest resource to remain as a net carbon sink beyond 2035, the annual afforestation rate needs to be above 7,500 ha per year (COFORD, 2016). Remaining at the adjusted afforestation rate of 6,000 ha per year will lead to a situation where the Irish forest area becomes a net source of GHG emissions from 2035 onwards. Hence, if the Irish afforestation rate does not increase strongly in the next ten years, the total AFOLU abatement potential is reduced to 1.69 Mt CO_2eq per year (cost-effective agriculture abatement in 2030, yellow line) leaving a significant gap to the emission target under the Climate Action Plan and any potential reduction target derived from the EU non-ETS emission reduction targets for Ireland (Figure 2). This demonstrates the intertwined nature of the AFOLU sector and GHG emissions. Currently, the Irish agricultural and GHG emission targets appear to be in contradiction as they drift further apart (Figure 2).

4. Policy implications

The Irish agriculture sector is the most significant contributor to total Irish GHG emissions (33.34% of total GHG emissions in 2020) and will likely continue to be (28.85% of total GHG emissions in 2030) if the adoption of AFOLU mitigation measures remains voluntary (Figure 3).

Figure 3 - Irish GHG emission projections by sector out to 2030 with adjusted voluntary AFOLU abatement included
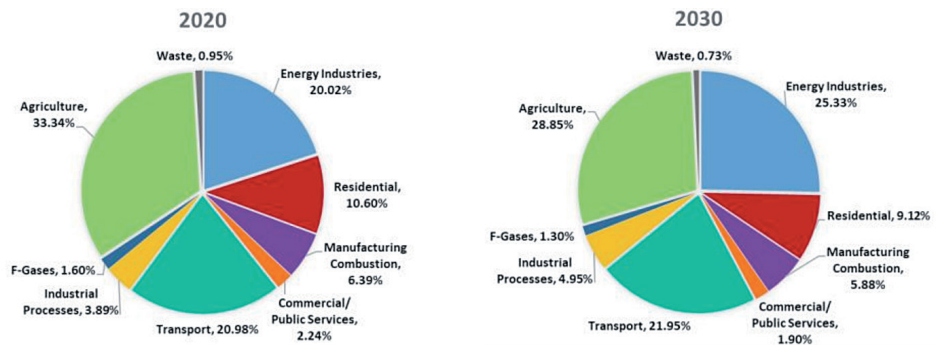
Source: EPA (2019b), Own compilation.

To increase the efficiency of the actions stated under the Climate Action Plans (DCCAE, 2019) and to move into the direction of the pro-rata EU agricultural target, Irish farmers' need to be encouraged to incorporate low carbon farming into their best agricultural practice. Therefore, the farmer's decision-making process needs to be supported to remove barriers that determine their behaviour (OECD, 2012). Gray *et al*. (2017) argue that the occurring market failure between technical achievable and voluntarily undertaken abatement should be addressed through politically implemented market-based instruments. Depending on the type of AFOLU mitigation measure, different approaches to overcome the market failure need to be followed.

Due to the high reluctance towards agri-environmental advice (39.3% of Irish farmers, Tzemi and Breen, 2018), it can be derived that voluntary adoption of cost-beneficial agricultural mitigation measures encouraged through knowledge transfer will not lead to the technically feasible uptake rate necessary to meet national and EU targets. The Irish Climate Action Plan states the improvement of animal production efficiency (through EBI) and the improvement of animal health as major production efficiency measures to reduce GHG emissions (DCCAE, 2019). Linking GHG mitigation measures which improve the productivity and competitiveness of the agriculture sector and also reduce GHG emissions such as improved liveweight gain, nitrogen-use efficiency, EBI, animal health, and extended grazing, to carbon abatement support payments could increase the uptake rate of these agricultural mitigation measures. With a transition period in which the stringency of conditions is phased in, there could be an improvement not only in the productivity but also in the environmental performance of the Irish agriculture sector (Gray *et al*., 2017). Increasing the uptake rate of cost-effective, cost-beneficial mitigation measures to the technically feasible potential could increase the abatement considerably[19].

The main cost and technically efficient agricultural mitigation measures stated by the Climate Action Plan are the 50% replacement of CAN fertiliser and the implementation of slurry amendments (DCCAE, 2019). As these measures impact on the emission factors of a production system rather than the produced unit, their abatement potential is less likely to be offset by an increase in production ensuring GHG emission reduction in the long-term (Lanigan & Donnellan, 2018). To increase the uptake rate of these mitigation measures as well as crude protein in the diet of pigs, and draining wet mineral soils that all incur marginal abatement costs, farmers would

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19. The abatement potential of production efficiency measures can be slightly offset by a possible increase in production due to the increase in productivity (Lanigan & Donnellan, 2018).

need to receive support in the form of on-farm investments in carbon-reducing innovations targeted towards increasing climate efficiency. Specific instruments might include innovation allowances and credits. Thereby, it would be essential to coordinate any new measure with existing frameworks (Gray *et al.*, 2017).

Due to natural restrictions of the agriculture sector (especially in the ruminant livestock sector), the prospect of an increase in the agricultural abatement potential above the technically possible potential is limited. Adding the cost-efficient LULUCF abatement potential to the agricultural abatement capacity has the potential to abate a significant share of agricultural GHG emissions. As the main potential of LULUCF abatement occurs through forestry and rewetting of organic grassland soils in Ireland also stated in the Climate Action Plan, and the main proportion of afforestation and rewetting is undertaken by farmers, future expansion will thereby depend on a change in land use from agriculture to forestry or wetlands (Farrelly & Gallagher, 2015).

To increase the annual farm afforestation rate, this study has pointed out that farmers need to be informed more about existing afforestation scheme benefits to incorporate afforestation as a part of a broader farm management decision. Reaching those farmers through a linked agriculture and forestry advice could possibly increase the farm afforestation rate (Ryan & O'Donoghue, 2016). In addition, Irish cattle farmers could be encouraged to become low carbon producers by certifying low carbon Irish beef (Lau, 2019)[20]. Carbon farming could be supported through additional carbon abatement support payments. The farm's cattle emissions could thereby be offset through paying other farmers to sequester carbon through Irish afforestation or rewetting or through sequestering carbon themselves (European Commission, 2020).

By highlighting LULUCF mitigation measures such as afforestation and agricultural land use-change decisions as a way of diversifying and stabilising farmers' income could increase the up-take rate of these measures substantially[21]. This would ensure GHG emission reduction in the Irish agriculture sector in the long-term.

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20. In 2019, Australia's largest beef producer got its beef certified as carbon-neutral beef. This was mostly achieved through purchasing offsets (Lau, 2019).

21. Taking into account, that over 600,000 ha of dry grassland have been identified as being of limited agricultural use (COFORD, 2016), converting 7,500 ha per year of marginal land into forest, to maintain the Irish forest as a net carbon sink, will change the structure of some farms but will increase land-use competition in Ireland only marginally.

5. Conclusion

The agricultural sector has been over time the largest single contributor to Irish overall GHG emissions. Thereby, methane and nitrous oxide are the most significant agricultural GHGs emitted mainly through Irish cattle. The strong growth of the Irish agriculture sector (mainly dairy) up to 2018 has led to a substantial increase in agricultural GHG emissions (+4.4% since 2005). This growth is projected to continue, mainly due to an excepted increase in dairy cow numbers and nitrogen fertiliser use.

Under the Climate Action Plan (DCCAE, 2019) and the EU Effort Sharing Regulation (European Council, 2018) GHG reduction targets have been set that make the agriculture sector's leading role apparent in reducing GHG emissions and increasing carbon-removals. With the new EU Effort Sharing Regulation (2019), Ireland is given the flexibility to reduce their agricultural GHG emissions by offsetting them through LULUCF activities.

This study addresses some of the main potential barriers of voluntary adoption of mitigation measures by systematically examining existing literature on how non-price determinants affect the voluntary adoption rate of technically feasible mitigation measures in the Irish AFOLU sector. The main identified non-price determining factors were the degree of farmers' awareness regarding man-made GHG emissions, receiving agri-environmental advice, implementation costs, profitability and size of farms, land quality and the type of farm enterprise. Through integrating the results on the extent of adoption on the former MACC analysis it enabled the implementation rates of the cost- efficient AFOLU mitigation measures to be adapted accordingly.

These factors impact the voluntary uptake rate of AFOLU mitigation measures to the extent that the adjusted total Irish AFOLU abatement potential is 47% lower than technically feasible. This would slow down the increase of the projected agricultural GHG emissions by 2030 but still leave the Irish agriculture sector as the most significant contributor of GHG emissions in 2030. Considering that 51.6% of the total estimated AFOLU abatement potential in 2030 is offset through Irish forestry, which at current afforestation rate will turn into a net carbon source by 2035, a significant gap occurs to any potential Irish and EU GHG reduction target.

While the systematic approach on examining existing literature has allowed the results from various studies to be incorporated, basing the analysis on published studies can lead to a publication bias meaning that the impact of an identified non-price determinant may be overestimated as studies that do not report significant results are generally not published. Furthermore, for some feasible mitigation measures, studies have not been conducted regarding their potential up-take rate. Up-take rates have been

generalised for the different groups of mitigation measures. Further research on the individual up-take rate of mitigation measures could improve the outcome.

Policy measures need to be implemented to increase the abatement potential of the AFOLU sector, to substantially help bring the nexus between agricultural development and GHG emission targets in Ireland closer together. Polices are needed that remove the barriers to farmers' behavioural change. Incorporating carbon abatement policy more directly into agricultural policy and establishing LULUCF mitigation measures as a way to diversify and stabilise Irish farmers' income could open the possibility of reversing the recent trend of continuously growing agricultural GHG emissions.

Unlike many other sectors, the agriculture sector has the ability to sequester carbon out of the atmosphere, contributing to Ireland's image as a green and sustainable food producer. Enhancing the uptake rate of cost-beneficial and cost-effective AFOLU mitigation measures to achieve the technically feasible uptake rate that has the potential to reduce the level of agricultural GHG emissions by 2030 in a way that would converge towards possible EU GHG emission reduction targets.

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Foodies' movement fostering stakeholders' networks: A regional case study

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Abstract

The central theme of this work revolves around the foodies' movement under three perspectives: firstly, from a conceptual point of view to give account of its relevance in terms of consumer demand; secondly, to verify how, from the supply side, this movement can to some extent encourage and/or strengthen the creation of networks of local actors indispensable to encourage the meeting between the needs of the demand and supply of typical food products; thirdly, based on a case study to demonstrate that the movement of foodies can be exploited within a political action aimed at reorienting local tourism development. A national case study – Alghero, IT – was analysed. By positioning the rural and urban spaces with respect to the foodies' phenomenon, the existence/absence of networks between local stakeholders some obstacles emerged so as many opportunities. The stakeholder analysis was applied and discussed. This method was very useful for identifying the role, power and leadership that the various local actors have in favoring or hindering the creation of connection networks between the city and the countryside, and in the requalification of the supply of typical foods that fit well into the current demand trend.

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Introduction

The growing mobility of people and foodstuffs outlines new and multiple connections between tourism, food and agriculture, and new scenarios for territorial relations between urban and rural actors mediated by food consumption and production linkages. This is certainly an ancient theme for agrarian-economic research. Barberis saw the epochal passage from the conception of food as a means of sustenance to an idea of 'eating as a source of entertainment', reasoning on the rebalancing between city and countryside (2009): an almost prophetic statement when looking at food tourism growth and the current foodie phenomenon that drives an important part of the current tourist movement.

Almost a decade ago, a UNWTO report (2012) highlighted the importance of food tourism:

In recent years, Food Tourism has grown considerably and has become one of the most dynamic and creative segments of tourism. Both destinations and tourism companies are aware of the importance of gastronomy in order to diversify tourism and stimulate local, regional and national economic development (p. 5).

Still, it was remembered that 'For many of the world's billions of tourists, returning to familiar destinations to enjoy tried and tested recipes, cuisine, gastronomy has become a central part of the tourism experience' (UNWTO, 2012, p. 4).

As far as the foodies' movement, the book of Getz *et al.* (2014) provides an exhaustive description and definition of the 'foodie' that should be recalled in some steps as useful to clarify the point of view adopted in this paper. These authors reported that the term was coined by Harpers and Queen Magazine, but it jumped to the fore thanks to Barr and Levy (1984), who reported this definition:

a foodie is a person who is very very very interested in food. Foodies are the ones talking about food in any gathering – salivating over restaurants, recipes, radicchio. They don't think they are being trivial – Foodies consider food to be an art, on a level with painting or drama (recalled from Getz *et al.*, 2014, p. 53).

In 1992, the American Heritage Dictionary provided a similar definition, emphasising the appearance of the *pleasure*: 'A foodie is a person who has an ardent or refined interest in food' and who eats food not out of hunger but due to its interest or hobby. In the literature, the term foodie has replaced the snob 'epicure' or 'gourmet' (Watson *et al.*, 2008, Watson, 2013; Weston, 2006) and proposed a sort of identikit of the two figures of *gourmet*

and *foodie*: the former typically refers to a man of advanced age and high social level, while the foodie, described as a 'son of consumerism', usually refers to young couples belonging to rising social classes who appreciate the food tasted in restaurants and try to replicate it at home. Foodies collect food experiences and celebrate restaurants much more than tourists collect souvenirs (Morgan *et al.*, 2008).

The central theme of this work revolves around the foodies' movement, which contains a multiplicity of expressions of interest in food: from the food sciences to health and nutrition, from food fads to university courses and cooking schools.

Within the study framework, the foodies' movement is considered interesting under an agricultural and territorial development perspective, and, specifically by focusing attention on the basic connection between urban and rural actors and sectors as a prerequisite for satisfying the foodies' research for food excellence.

In this paper, the foodies' movement remains to the back from the demand side and is considered for its supply side implications in fostering the linkage between the spaces of food production and consumption.

Specifically, as a basis of argument, the study wants to discuss if and how much the foodie culinary phenomenon can really induce rural/local development.

In this context, rural development passes through the construction of networks between local actors, networks that develop on several levels: within the more specifically rural space (the space of food production, but also of its consumption); within the urban space (the space of food consumption with specific reference to culinary and tourist phenomena); in the connection between rural and urban space (Benedetto, 2011). The greater the networks of relationships and tight linkages – and the stronger the integration between actors operating in the agricultural sector and those operating in other segments of the economy – the greater the agricultural development, but also that of the entire local territorial system.

The study subject is somewhat 'ancient' because, starting from a case study, it aims at nurturing a discussion around which much has been debated: namely the *relationship* between city and countryside. As an issue, awareness of which among Italian agrarian economists goes back to the past and passes through the extensive literature that revolves around the definition and characterisation of rural and local systems and the role played by agriculture within them (Basile & Cecchi, 2001) and which was reaffirmed around fifteen years ago (Basile & Franceschetti, 2004). It is still alive and should be possibly reinforced for opening new and future directions in the light of some recent phenomena (Bazzani & Canavari, 2013).

Therefore, the paper intends to tackle an old theme in the light of a renewed and expanding tourism movement linked to the use of food, and to investigate how the creation/induction to the construction of social capital can create local/rural development through the analysis of a case study. It is believed that this is a privileged observation point, from which to observe policy in action.

The study presents a 'regional case study' and discusses it with the support of a stakeholder analysis approach. This is a very useful tool to build the map of relationships and analyse the role that each local actor plays within a network, and to identify any critical issues and/or opportunities for successfully implementing a local development policy. In this case study, the development policy adopted aimed precisely at exploiting the phenomenon of foodies for the purposes of territorial development, aiming to create a close link between local actors, food producers and intermediate and final consumers of food.

1. Background

1.1. *Foodies: a constantly evolving multi-faceted movement between urban and rural*

Over the years, the term foodies has incorporated several figures that revolve around food and that are not necessarily associated with the consumption experience. As a broader definition that gives an account of this terminological expansion, we report that of Getz *et al.* (2014) which defines the 'foodie' as:

a food lover; one whose personal and social identity encompasses food quality, cooking, sharing meals and food experiences; foodies incorporate all aspects of food into their lifestyle, which often leads them to travel for new and authentic food experiences (p. 6).

It is just looking at the experiential component that the terminological difference between food tourist and foodie clearly emerges. In the first case, the same work of Getz *et al.* (2014) defines food tourism as 'travel for the specific purpose of enjoying food experiences' and therefore, represents only part of the term foodie, but does not exhaust it. In the second case, in fact, the experience of the journey is not separated from the pleasure of food that becomes charged with symbolic meanings, such as an expression of the local identity of the host or of the health-related properties of some foods, on which the foodie seeks the greatest amount of information. In addition, the

foodie phenomenon includes a wider audience of consumers who look to the tasting of food as a pleasure and opportunity to share 'zero km' products, both in urban and rural areas.

The foodies' phenomenon is also linked to the emergence of the so-called 'locavores': as recalled in Brain (2012), this term was added to the New Oxford American Dictionary in 2007 and refers to a person who attempts to eat food produced within a 100-mile radius. Therefore, these are foods that are preferably typical products closely related to the places of production. The new consumers look for emotions and want to taste the food, but also listen to the production history (the origins, the production process, the recipes, the name of the grower and his story) and interact directly with the producer or any actor that plays a major role in producing typical food that they are buying.

The term foodies is associated with an experience or a search for pleasure (Yeoman *et al.*, 2015) that is expressed in the most varied ways whenever 'you consider the permutations of food with cooking, socializing, lifestyle' (Getz *et al.*, 2014, p. 68). Moving away from the experiential dimension, intended as a specific tasting of food, a plethora of various manifestations are included in the same term, such as food events, shows and awards, food festivals, culinary journalism, courses, books and fantasies, all of them representations of said metamorphosis. This new phenomenon implies a shift of attention from the realisation of the product to its tasting, from the purchase of the goods to their preparation and consumption, from the product to the relative health content, from the agricultural production field, mainly rural, to the predominantly urban one.

If, on the one hand, the foodies' phenomenon represents a new and powerful marketing lever to be exploited in the valorisation of agricultural productions, on the other hand, it imposes an examination of the balances existing in the relationship between city and countryside. In other words, a sort of competition between rural space and urban space, but also within rural areas and within urban spaces, has been created in terms of tourist attraction in which food is at the heart of the experience and the object on which to focus the debate. From the phenomena of rural tourism and experiential tourism, in which there is a movement of consumers moving from the city to the countryside, we have also observed the presence of an inverse flow, or of a multidirectional flow that moves from city to city while remaining in an urban or peri-urban space. Catalysts of this second flow are typical restaurants, specialty cafés and resorts, where special menus are designed as a tourist attraction with food as the main element.

Therefore, urban spaces and rural spaces, which are non-homogeneous economic entities that interact and influence each other need a balanced development and this objective must be placed at the centre of the policies

adopted in both areas of intervention (Rinaldi, 2017; Cavicchi & Stancova, 2016; Hall & Gössling, 2016). However, in most cases 'urban-biased policies have prioritized urban development and opportunities over agriculture and peasants during the first three decades' (Chen *et al.*, 2016, p. 2).

Figure 1 shows a representation of the supply methods applied to meet the food demand based on values such as exclusivity, quality, authenticity, co-creation with foodies. Here, we are clearly in the field of urban creativity and food initiatives.

The other theme is that of rural creativity and food. In this regard, one observes (Meo, 2015) that the food marketing approach has become part of the rural space where farms and agri-food companies are increasingly applying various information channels to their products and/or the firm, that are typical of urban space but also global: TV, social networks or the web, using these media to sell the product. Several successful cases make the direct relationship with customers a strength factor of the agri-food firms paying great attention to modern means of communication.

Figure 1 - A conceptualisation of urban food tourism (from Getz et al., 2014, p. 116)

1.2. *Building social capital, the better way to fostering local/rural development*

A theme already discussed in the literature that deals with local and rural development returns: it is the presence/absence of social capital and the relative ability to influence the performance of economic policy actions.

The notion of social capital referred to is that of a neo-institutional approach, according to which this is represented by institutions, relationships, norms that shape the quality and quantity of social interactions within a society. This capital is not only the sum of institutions that build a society but represents the glue that maintains unity in a society.

Therefore, the theme that we want to recall, once again, is associated with the different capacity of places to put in system manifest and hidden skills and attitudes, so that such a political approach will lead, and have led to different results in the European and national sphere. As already highlighted (Benedetto, 2011), the ability to cooperate in a community (individuals, firms) is one of the determinants of the economic development of a territory and categories such as trust, loyalty, and social cohesion are fundamental for this economic coordination mechanism.

There is copious literature dealing with the role that social capital has assumed in the theories of growth and development. Here, we recall three forms of social capital which are very useful to accompany the path of reflection that we will develop in this paper, starting from the schematisation proposed by Ostrom and Ahn (2003). These are forms of capital that are fundamental in inducing collective action and are represented by: 1. Loyalty; 2. Networks; and 3. Formal and informal rules or institutions. These three forms of capital contribute to the success of collective action thanks to the presence of a fundamental category which is represented by trust. This category is nurtured and strengthened precisely within the networks, institutions and mutual loyalty in which groups of individuals of a society are immersed. This is an operating mechanism that has also become fundamental to explaining the success and development of various economies.

It was widely argued that the creation and/or strengthening of social capital is a priority objective in the policies of development of rural areas: the greatest emphasis must be placed on the backward and inner areas, where the construction of social capital even becomes a development output.

Even the World Bank, since the late 1990s, included the creation of social capital as a goal to be achieved in development interventions at the level of individual communities, as well as the EU which started procedures for measuring social capital in individual Member States (Benedetto, 2011).

The problem then becomes that of identifying the mechanisms that induce individuals to cooperate and the contextual factors that favour the

strengthening or the creation of social capital, in order to choose the most suitable instrument to achieve this goal.

The reference to the rural development policies adopted by the EU since the 1990s seems almost obvious: great emphasis was given to local participation and concertation in order to promote an endogenous development of areas falling under Objectives 1 and 5b; the partnership between the various subjects is formalised within Local Action Groups (LAGs) that manage the funds disbursed to implement local action plans. Throughout its evolutionary path, this policy has placed at the centre of development the vision of the territory as a 'network of relations', as a source of contextual knowledge and behavioural codes that are classified by the neo-institutionalist theory as unwritten rules, intangible factors that have a fundamental weight in the development of a territory. Thus, these local action plans have played a fundamental role in the development of institutional capacity of rural communities and brokering connections in the local economy (Scott, 2004). Furthermore, analyses carried out in specific territorial contexts have shown that animation actions are an important element of operation (Katona-Kovacs *c*, 2011).

Yet, with specific reference to the LEADER programme it was emphasised (Idda & Benedetto, 2003) that rural development policies were lowered in areas characterised by a potentially different response capacity. The primary objective then becomes that of maturing the conditions that favour the emergence or strengthening of cooperation.

The results of some studies highlight the path of external solicitation through the role played by formal institutions (local administrations) and by the political class that governs the territory. Basically, they focus on the role of formal institutions in the production of social capital. Indeed, a 'correct' strategic approach in which the planning process is born with a specific objective, that is, to exploit the tourism development of the city to ensure economic impact on both urban and rural areas.

The construction of social capital/networks becomes, therefore, fundamental as a link between city and countryside, with a view to exploiting the phenomenon of foodies for the purpose of local development. In this regard, while much has been said at a theoretical level about the role of social capital as a driver of local and rural economic development, less investigated and certainly more critical is the topic of building and strengthening the social capital in a given territory. Some international studies (Putnam *et al.*, 1993; Putnam, 2000) focused on the measurement of social capital also using Italy as an object of observation, but they mainly addressed the topic to the national or, at best, the regional scale.

The case study analysis approach allows seeing some theoretical frameworks in action within micro-realities where no statistical data for

measuring social capital can be found. This is because intangible factors, such as loyalty, trust, informal or unwritten rules are difficult to measure while being very powerful in ensuring the formation of lasting and successful relationships.

2. Materials and methods

Figure 2 shows the path of analysis that is addressed in the study. Specifically, the main question to be answered is if, through the impulse promoted by the foodies' movement, opportunity arises to strengthen the link between the city and the countryside, and to favour the activation of local animation policies aimed at building a network between actors belonging to different sectors of the local economy.

Regarding the aim of our investigation, as suggested in the literature, it is particularly useful adopting the case study method to deepen specific and unique activity and to collect individual opinions (Yin, 1994; Schell, 1992; Stake, 1995; Zainal, 2007).

The analysis of case studies will allow highlighting the structure of the relationships, the category and the role of the actors involved, the functioning mechanisms of the policies adopted, the results achieved, the criticalities and problems encountered.

The material on which the analysis was focused relates to a bottom-up approach born to link urban and agricultural sectors, actors and local institutions.

The investigated experience was the Mondo Rurale case study, aimed at implementing food policies through a model of relationship between city and countryside, and the adoption of procedures aimed at supporting local productions within the circuits enjoyed by tourists visiting the city of Alghero (Northern Sardinia) and its surroundings. A detailed description of the policy implementation path will be described in the next paragraph; here we just want to say that the University of Sassari was involved, through an agreement, to apply stakeholder analysis (SA) in support of political action.

This method is widespread in several spheres: for example, it is applied at European level to share reforms with stakeholders before their adoption in order to identify and overcome any critical issues, as well as to strengthen possible alliances that guarantee the success of the initiatives. Several studies have applied this tool with the aim of promoting participatory management of rural and local resources (Álvarez-Fernández' *et al*., 2020; Mannetti *et al*., 2019; Benedetto *et al*., 2014a, 2014b).

Additionally, in the case of the Rural World, it was considered appropriate to combine political action with the use of this tool, precisely to qualify

and identify the various stakeholders, to know their points of view with the ultimate goal of favouring the success of the strategy of local development.

Among the different SA approaches, that proposed by Schmeer (2000) was chosen, as it best meets the needs of the present study.

Figure 2 - The research path

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┌─────────────────────────────────────────────────┐
│              The research question               │
│ Foodies as a driver for the construction of       │
│ social capital: are there case studies that       │
│         allow us to test this link??              │
└─────────────────────────────────────────────────┘
              A case study method

                      ⇩

┌─────────────────────────────────────────────────┐
│        The case of Mondo Rurale in Alghero: a     │
│      territorial policy aimed at encouraging the  │
│      creation of 'social capital' in the process  │
│      of building the brand 'Alghero City of Good  │
│                      Food'                        │
└─────────────────────────────────────────────────┘

                      ⇩

┌─────────────────────────────────────────────────┐
│           Results, Discussion and                 │
│                Perspective                        │
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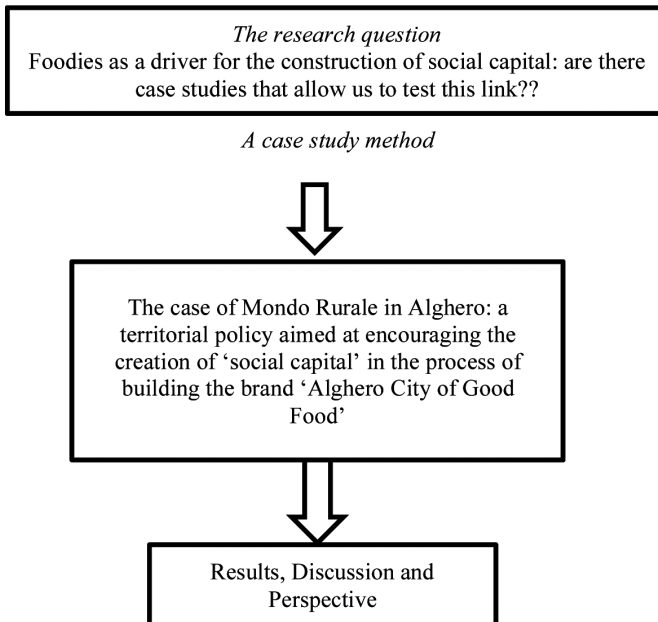
The guidelines for this approach follow five steps:
1. Identifying key stakeholders;
2. Collecting and recording information;
3. Filling in the stakeholder table;
4. Analysing the stakeholder table;
5. Using the information.

As suggested by Schmeer (2000), this study collected stakeholder' (S) information and characteristics such as: name, role and organisation, internal/external position of stakeholders (internal are those that work within the organisation promoting or implementing the policy, while all others are external); interest, the S's interest in the policy or the advantages or disadvantages that policy implementation may bring to the S; alliances, organisations that collaborate to support or oppose the policy; resources, the

quantity of resources (human, financial, technological, political and other) available to the S and his/her ability to mobilise them; power, the ability of the S to affect the implementation of the local development policy; and leadership, the willingness to initiate, convoke or lead an action for or against the local development policy (Schmeer, 2000, p. 8).

The approach followed was substantially generative and the analysis was essentially focused on highlighting possible future research developments, based on the use of foodies as a tool for enhancing rural areas and responding to new stimuli for tourist demand. Within this conceptual framework, the aim was twofold: to analyse the reaction of a local territorial system in the face of the challenges posed by the final demand for food; and, to study through which mechanisms it is possible to activate this reaction in such a way that the results can be effective and long lasting.

The case study selected in order to support our path of analysis is presented below.

3. A regional case study: the city of Alghero and the action of Rural World

The 'Rural World' initiative was started in the Municipality of Alghero (Sardinia Region) in 2015, as a tool of local animation aimed at creating a link between rural space and urban space, while exploiting the tourism phenomenon, in continuous expansion in the Catalan city. The project aimed to combine the demand and the purchasing behaviour of intermediate and final consumers by offering food produced from raw materials coming from the agricultural territory of Alghero. The problem was very urgent, mainly due to the severe crisis in the agricultural sector – with almost 4,000 uncultivated hectares – which led local farmers to ask for support from the institutions, having no indications on how to direct their production and being disconnected from the rest of the market.

The 'Rural World' initiative was a step of a medium–long-term strategic development path, supported by the Department of Economic Development, which had as its objective the elaboration of the Food Plan that aimed to 'implement food policies through a model of relationship between city and countryside and the adoption of acts and procedures to promote food policies in support of local production'.

For this purpose, a coordination group for the 'Alghero, City of Good Food' project was set up, which had the task of governing the process and identifying logistical and promotional organisational models for the achievement of some main objectives:
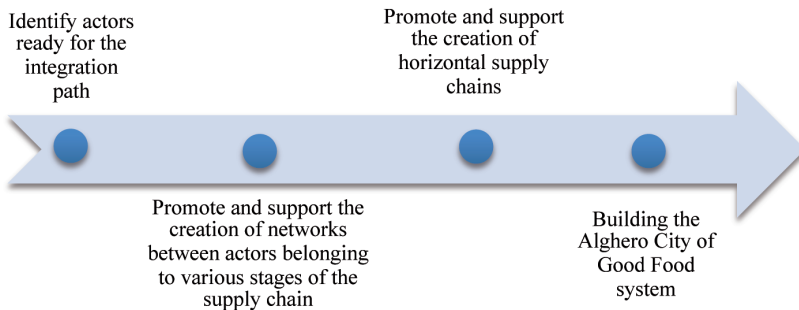1. Rural World. To support farmers' incomes through initiatives that allow them to intercept the most important consumption centres in the city and in the area and to build commercial synergies with other economic sectors;

2. Support the strengthening of the entrepreneurial capacity of farmers, supporting them in the promotion and marketing of products;
3. Strengthen the economic system of the city of Alghero, with a view to integration between sectors and the intersection of supply and demand, between agricultural and agri-food businesses and catering businesses;
4. To increase the innovation, aggregation and cooperation capacity of enterprises;
5. To build a gastronomic circuit of quality cuisine that is characterised by strong territorial roots of food; food as a cultural and emotional experience capable of representing and describing Alghero and its territory;
6. To promote local, typical and quality food and wine choices among consumers;
7. Reposition Alghero among the most popular gastronomic destinations;
8. Build the image and reputation of the company, overcoming the flattening and downward homologation that destroys distinctiveness;
9. Differentiate the catering on offer by creating added value that derives from the use of local quality products;
10. Connect the food and wine offered to quality tourist itineraries, promoting the local agri-food products, through the creation of support and coordination tools that characterise the tourist offers by integrating the cultural dimension with the landscape and environment and with the food and wine.

The connection with the foodies' movement was very clear: this was a strategy that aimed to adapt and build a food supply capable of meeting the needs of a demand that was becoming increasingly evident. The municipal administration's goal was precisely to exploit the phenomenon in terms of local development, repositioning the city of Alghero in terms of food and wine.

The path of animation was structured in different steps as indicated in Figure 3, exactly because of the awareness that the process would bear fruit only in the long run, and of the difficulties to create shared intentions and vision among the many operators involved. Several meetings were attended by operators belonging to the various sectors of the local agriculture (fruit and vegetables, wine, cheese, oil, flour/bread) and by small and large firms. In several meetings, which took place over the course of two years of activity (2015-2016), all the different operators involved in the production and consumption of food (farmers, restaurateurs, hoteliers, farms) were called to express the problems encountered in the sale of products on the one hand, and in the purchase of local raw materials on the other.

Fig. 3 - Path of animation aimed at linking supply and demand for agricultural goods

Identify actors
ready for the
integration
path

Promote and support
the creation of
horizontal supply
chains

Promote and support the
creation of networks
between actors belonging
to various stages of the
supply chain

Building the
Alghero City of
Good Food
system

The aim of the local administration was to support a concertation action between the parties, that firstly met at separate tables, and then at several plenary meetings organised in the country districts with the help and technical-scientific support of the regional institutions (Research and Development Institutions, LAORE, University, Porto Conte Regional Park) (Figure 4). This action apparently seems very simple, 'let's put people together': easy to say but certainly difficult to translate into practice. In this regard, it is worthwhile underlining the Councillor's foresight, who wanted this initiative by giving ample space to the operational activities, which were the most difficult for a politician to activate.

During these meetings, the case study of the 'Flour Pact' was presented. This was the first agreement adopted in the Friuli Venezia Giulia Region (IT) for the production of high-quality flours and derivatives with sustainable methods and economically accessible to all. It was considered of fundamental importance to present this successful initiative that was born voluntarily from the bottom through a participatory path, in order to show that when the initiatives are shared, they are effective and last over time. Within the Flour Pact, farmers, processors and consumers jointly started a path during which the costs of production and processing of wheat were shared. Buyers decided in advance the quantity of product to be purchased, assuming part of the business risk and committing to anticipate part of the final expenditure; thus, covering the initial costs incurred by the farmers. An element of fundamental importance in the pact was the creation of a loyalty relationship and trust among the active parties, guaranteeing highest quality through the total chain of production, transparency and mutual exchange, thus making certifications redundant, and succeeding in fixing prices of the final product. The bases were therefore laid for the building of a short supply chain where crops, farms and artisanal factories could also be visited thanks to their

Figure 4 - The path of connections of the urban-rural network in the Alghero case study
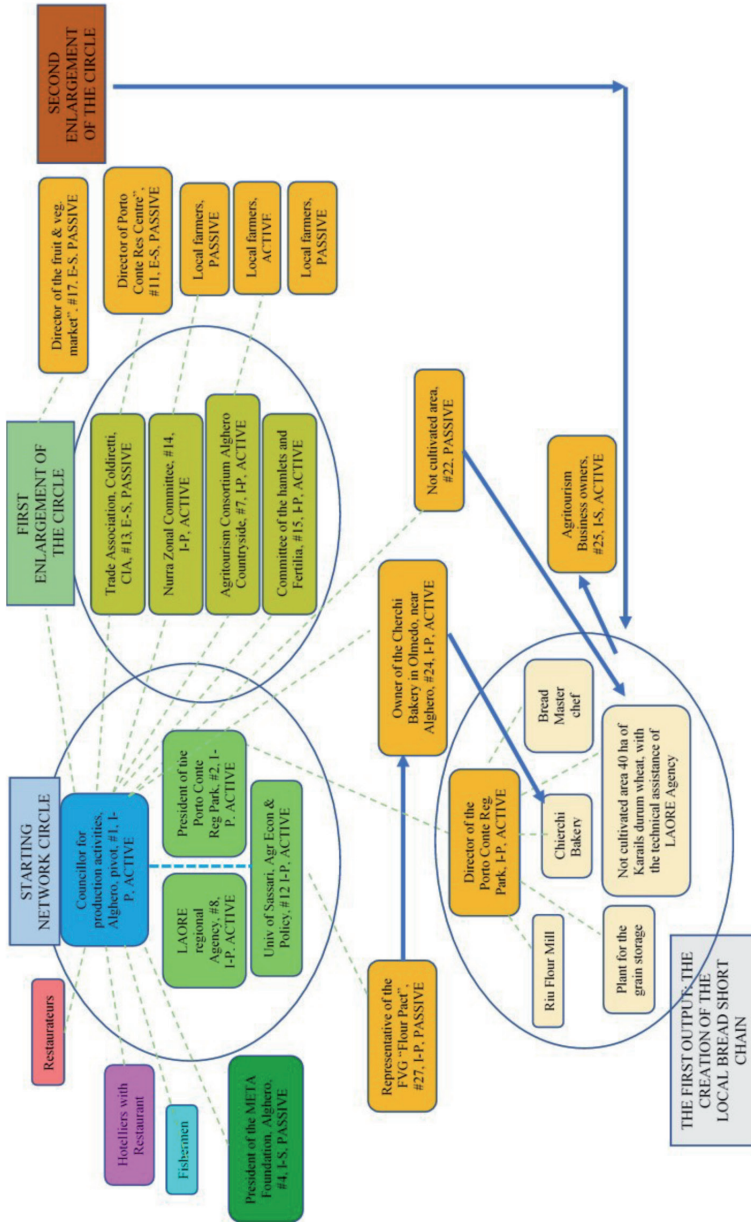
geographical proximity. The University of Sassari actively participated in this initiative, supporting the process with different skills (economists, agronomists, microbiologists, oenologists). From an economic point of view, SA, was conducted directly by the university staff that joined the municipal administration in its action of animation.

The policy subjected to evaluation with the SA was represented, specifically, by a series of action lines aimed at building networks between city and countryside. The possibility for creating stable commercial relationships with restaurants by sharing a protocol for the experimentation of the 'Alghero City of Good Food' project in which restaurateurs undertake to guarantee the presence of typical products/dishes in their menu according to precise minimum percentages divided by type of food (e.g. in the case of 100% craft beer, 70% local and regional wines, 100% extra virgin olive oil, 100% bread, 80% local/regional fruit and vegetables, 50% water) was outlined.

The objective of the SA was to categorise the stakeholders based on their interest and influence with respect to the context of analysis. In the approach used (Schmeer, 2000), 'interest' was defined as a flow of benefits with respect to the implementation of a specific policy, while the 'influence' of the category of actors was synonymous with power: within the latter were more variables such as the presence of resources and the ability to mobilise them, knowledge of processes and leadership.

Policymakers should use the information generated by the SA to develop and implement strategic communication and negotiation plans.

Furthermore, policymakers may use the results in open discussions with stakeholders in an effort to build consensus. This allows stakeholders to see where they are relative to others and encourages discussion on how to address the opposition's concerns.

The results of the SA are presented below; which was carried out largely during the internal meetings of the Rural World programme (October–November 2015) and partly during the following year, moving us within the process of development of the 'Alghero City of Good Food' project.

3.1. *The results of the SA*

Table 1 presents the list of actors who could have an interest in the selected policy, classifying them by organisation, role and position. The position of each stakeholder was assigned on the basis of a double classification: internal (I) if operating in the organisation/body that is promoting the implementation of the policy (in this case within the project promotion group, see Figure 4, starting network circle); external (E) in all other cases.

According to Reid and Arcodia (2002), each stakeholder was also labelled as 'primary' or 'secondary' based on their direct or indirect involvement in the implementation of the policy. In order to assess the 'importance' of each organisation, stakeholders were assessed for their power and leadership and classified into four groups of importance as shown in Table 2.

Table 1 - Priority stakeholders: organisation, role, position, reason

Organisation	Role	Position	Reason
1 Municipality of Alghero	Councillor for Production Activities	I-P	Organisation and logistics
2 Regional body	President of the Porto Conte Park	I-P	Organisation and logistics
3 Director of the Porto Conte Park	Director of the Porto Conte Park	I-P	Organisation and logistics
4 Municipal body	President of the META Foundation	I-P	Organisers
5 Social cellar of Santa Maria La Palma	President	I-P	Providers of supply chain
6 Trade association	Representative of the Italian Farmers Confederation	I-P	Sponsor
7 Agrotourism Consortium of Alghero	Vice President	I-P	Human Res. supporting
8 Regional body	LAORE regional agency representative	I-P	Political Res. supporting
9 Regional body	Department of Agriculture assessor	E-S	Political Res. supporting
10 Regional body	Department of Tourism assessor	E-S	Political Res. supporting
11 Porto Conte Research Centre	Representative	E-S	Research supporting
12 University of Sassari	Different skills	I-P	Research supporting
13 Trade association (Coldiretti, CIA)	Representative	E-S	Human Res. supporting
14 Nurra zonal committee	Different figures	I-P	Organisers
15 Committees of the hamlets and of Fertilia	Different figures	I-P	Organisers
16 Humanitarian Association Rural Commitment	Representative	E-S	Human Res. supporting

Table 1 - continued

Organisation	Role	Position	Reason
17 Fruit and vegetable market	Director	E-S	Supply chain buyers
18 Local farmers	Grapes	I-S	Providers of supply chain
19 Local farmers	Olive	I-S	Providers of supply chain
20 Local farmers	Fruit and vegetables	I-S	Providers of supply chain
21 Local farmers	Cheese	I-S	Providers of supply chain
22 Owners of land in Nurra	Not cultivated areas	I-S	Potential providers of supply chain
23 Local processing industries	Owner of San Giuliano oil company	I-S	Providers of supply chain
24 Local processing industries	Owner of the Cherchi Bakery in Olmedo	I-P	Proponent of the establishment of the typical Algherese bread chain
25 Agritourism business owners	Ledà d'Ittiri Agritourism	I-S	Supply chain buyers
26 Accommodation	B&B owner	E-S	Supply chain buyers
27 Regional association	Representative of Friuli Venezia Giulia "Flour Pact"	E-P	External example of integration process in flour production

* I = Internal; E = External; P = Primary; S = Secondary.

Group 1 includ es stakeholders with leadership and high power;
Group 2 includes stakeholders with leadership and medium power;
Group 3 includes stakeholders with leadership and little power;
Group 4 includes stakeholders without leadership and medium and little power.

Power refers to the ability of the stakeholder to affect the implementation and the efficacy of the 'Mondo Rurale' policy, due to the strength or force possessed (for the calculation, see Schmeer, 2000). In other words, power was associated with the resources a stakeholder could mobilise in order to support their position.

Leadership was specifically defined as the willingness to initiate, convoke or lead an action for or against the implementation and efficacy of the 'Mondo Rurale' animation. The stakeholder either had this characteristic ('yes') or lacked it ('no').

Another element evaluated for each stakeholder was the knowledge of policy: the level of accurate knowledge the stakeholder had regarding the

policy under analysis, and how each stakeholder defined the policy question. This was important for identifying stakeholders who opposed the policy due to misunderstandings or lack of information.

Stakeholders included in Group 1 belonged to institutions with high capability of influencing the event implementation by means of their ability to mobilise several resource types (human, structural, professional and political, but not financial). The final position of stakeholders #24 and #27 within this group was due to the fact that, thanks to the example of the Flour Pact described during the 'Mondo Rurale' animation days, a definitive impulse was given to the establishment of the local durum wheat chain. Stakeholder #24, but also #3, were decisive in the implementation of the supply chain.

Group 2 gathered stakeholders representing different categories of entrepreneurs that drew income from the main activity they carried out (agricultural, industrial, catering and hospitality); they therefore represented the 'operating workforce', whose absence could have seriously affected the success of the Mondo Rurale action.

Most local associations were perceived as not having leadership and were ranked in Group 3; this means that, even without their financial support, the organisers and other stakeholders had the power of carrying out the Mondo Rurale policy due to the community's capability of self-financing. This group also contained industrial wine producers and the director of the fruit and vegetable market.

Group 4 included local institutions that had low power and lacked leadership; it also included two representatives of regional institutions that could have had high power (having financial resources) but were just external supporters of the initiative and had a low leadership.

Table 2 - Classification of stakeholders by level of importance (leadership and power analysis)

Group 1	Group 2	Group 3	Group 4
#1	#7	#5	#4
#2	#18	#6	#8
#3	#19	#12	#9
#24	#20	#13	#10
#27	#21	#14	#11
	#22	#15	
	#23	#16	
	#25	#17	
	#26		

With regard to the level of knowledge of the territorial management policy, it was clear that primary internal stakeholders and the direct animators of Mondo Rurale had high knowledge (Table 3, Group 3).

Table 3 - Classification of stakeholders by knowledge levels

Group 1: Low	Group 2: Average	Group 3: High
#6	#5	#1
#9	#7	#2
#10	#8	#3
#13	#11	#4
#17	#16	#12
#27	#18	#14
	#19	#15
	#20	#24
	#21	
	#22	
	#23	
	#25	
	#26	

All other actors directly affected by the political action were involved in a cascade: Group 2 that included stakeholders with an average level of knowledge, as they were not the direct creators of the initiative; Group 1 that included secondary and external stakeholders.

Table 4 presents the stakeholders' position map of supporting/opposing actors, built on the basis of significance and sector of activity. The category of institutions was generally favourable to the activation of this city/countryside relationship management policy, with 'strong' or 'moderate' supporting levels. A 'strong' attitude was defined as an attitude that supported or opposed the whole line of intervention; 'moderate' when the opposition or support referred only to some aspects of the policy.

Table 4 - Stakeholders' position map

Position	Strong supporters	Moderate supporters	Neutral	Moderate opponents	Strong opponents
Institutions (regional, local)	#1 #2 #3 #8 #9 #10	#11 #12	#4 #6 #17	#5	
Association		#13 #14 #15 #16		#7	
Local farmers		#18 #19 #20 #21 #22			
Agritourism		#25		#26	
Agroindustry	#24		#23		
External institution			#27		

All actors that fell into the group of moderate supporters were public and private institutions (local entrepreneurs, trade associations) that could certainly have benefitted from building the network, but that were not direct animators of the initiative. Stakeholder #24 was certainly a very important local actor that participated at all meetings, and for this reason was placed among strong supporters. It was a master baker, owner of a company located in a municipality near Alghero (Olmedo), that already had the idea of revitalising the production of some typical breads of the Alghero tradition (*Pa Punyat, Pa de Casa, Coca Orida*) through the completion of the supply chain by introducing the production phase of the raw material (durum wheat). The storytelling of the Friuli Venezia Giulia experience gave a strong boost to its activation: the relevance of typical regional breads and sweets was a long-term problem, also in relation to complaints about the poor quality of durum wheat flour imported from America compared with the wheat grown in the Sardinian region. Rather than commenting on local actors who were neutral with respect to the implementation of the policy, it is

worth spending a few words on stakeholders who were positioned among the group of opponents, albeit moderate. This group was made up of operators from different segments of the economy (production and/or services) who always attended the meetings, animated the debate and expressed a positive opinion about the initiative undertaken: this was the reason why they were considered 'moderate' opponents. However, their position revealed a significant disconnection between administrative, institutional and economic institutions: in other words, they underlined the fact that the success of their economic activities, in terms of business growth and promotion of territorial development, was due to their individual merits in financing themselves thanks to the proper functioning of their economic activities, without the support of local institutions. From this position, they demonstrated a certain diffidence on the success of local animation in terms of concrete results: in short, even if they believed that cooperation was useful for the development of relations between city and countryside, they were not entirely convinced that administrative institutions were able to provide the necessary support to facilitate the development of the cooperation itself. The group was represented by active and lively actors who participated autonomously in the local economy, but that who needed the support of local administrations in terms of services (transport and promotion actions). Indeed, many accommodation businesses (agritourism and B&B), which were located in the Alghero countryside far from the city centre, underlined the need to activate services that would allow more effective touristic connections between the city and the countryside: these services were completely absent or inefficient and everyone had to provide the service privately.

3.2. *The first outcome derived from the local development strategy*

As highlighted in Figure 4, the first effect of the action aimed at enhancing and facilitating local cooperation was the creation of the durum wheat bread supply chain.

An agreement was signed between the Porto Conte Park – which was in charge of aggregating the agricultural producers operating in areas around the Park, the Riu flour mill, the Cherchi bakery and a bread master chef. Karalis durum wheat, a typical native Sardinian wheat, was sown on 40 hectares and about 1,000 quintals were produced; the grain was then purchased by the Park, collected and stored in a plant under concession by the region, and then purchased by the mill to be transformed in separate production lines. The flour was finally purchased from the Cherchi bakery, also equipped with a retail network in the city of Alghero. Another element shortening the supply chain, which was certainly at zero km, was the

production of the yeast obtained from the strawberry/Arbutus tree plants in the mountains near Alghero. In this way, the whole process was carried out on a strictly local scale. This experience of recovering the bread tradition found its roots in the strong motivation of the master baker together with his family. The quality of the product/process was guaranteed by the location within the Park, which provided its own brand, by the prohibition of the use of pesticides or chemical agents and strict specification. The bread entered the circuit of the most important agritourism restaurants in Alghero and its surroundings. The prospects of this bread supply chain experience were already outlined: building the Sardinian bread quality brand as well as enlarging the number of wheat producers; and widening the experience to include other sectors, such as fruit and vegetables, and the production chain of wild pigs fed with legumes derived from the crop rotation of local grain. The goal of building a successful little-case, even if partial, was achieved putting the premises for widening its sphere of action and relying on the effectiveness of the imitation process by other local farmers. Meanwhile, a similar action was replicated in other areas of Sardinia, such as Sanluri (in the south of the island) where Civraxiu, a typical bread, is produced.

However, despite this partial result, a long way has yet to be built for the final result.

From the point of view of the characterisation of the relationships set in motion in building the supply chain, the rules-in-use (Ostrom, 1992) certainly played a fundamental role, aimed at implementing repetitive actions that produced results both for individuals themselves and for others. For example, this was in the case of the relationships activated by the University of Sassari (# 12), by the Director of the Park of Porto Conte (# 3) and by the master baker (# 24) who became pivotal figures of this secondary network.

At the same time, great importance must be attributed to the trust and loyalty on which a large part of the relationships put in place were built, in so confirming what has been maintained in the literature: the role of man, the sum of values recognised and experienced through consolidated interpersonal relationships. This consideration was true especially if associated with the pivotal figure (# 1) of the entire network of relationships. In fact, although the path of Mondo Rurale is still in operation, it has undergone a change caused by institutional breakdown due to a new governance of Alghero's Productive Activities Department. This change has produced a slowdown in the activities planned along the path of local animation, the easing of the liveliness of the relationships between institutions that had formed the control room from the beginning and a change in the direction taken. As the reference figure disappeared, some mistrust emerged on the part of local actors regarding the possibility of relying on the same operating mechanisms: people change and the cutting of animation policies changes.

However, the policy output obtained continues its development process by being able to govern itself with the support of the institutions, as has already been observed in other regional case studies (Benedetto & Corinto, 2014).

The process of building the Alghero City of Good Food was long and complex, but it is an example of a desirable development path that, starting from the bottom, has spread along concentric circles through the construction of a network of relationships based on intangible but 'strong' values like loyalty and trust. Indeed, a 'proper' strategic approach in which the planning process was born with a specific objective, that is to exploit the tourism development of the city and ensure economic impact on both urban and rural areas (Mayer *et al.*, 2016).

4. Discussion

Moving along the path of analysis (Figure 2), this section tries to interpret our results with the help of some theoretical frameworks, without which it would be difficult to develop rules and suggestions, and intertwine the positive and normative economy.

The case study of Mondo Rurale represents a privileged point to analyse the issue of creation and/or strengthening of social capital, to categorise stakeholders and investigate the functioning mechanisms of relationships among them. Furthermore, the application of the SA allowed determination of the final position of each group of stakeholders interviewed – in favour or against the animation policy promoted by the Municipality of Alghero. The objective of the action was to encourage a balanced development between the city and the countryside, directing the use of uncultivated lands towards productions that surely had a market within the city of Alghero – in the Ho.Re.Ca. channel – but also in the surrounding countryside, where agritourism or rural tourism are widespread.

The action path, structured in sequential stages, was guided by a proper marketing approach aimed at satisfying the tourist demand, increasingly oriented towards the search for typical products and recreational experiences where food occupies a central place. The ultimate goal was to create 'Alghero City of Good Food' by a structured project.

However, it is clear that the political action was driven by the need to overcome a crucial 'knot' that had led to a crisis in the countryside, where agricultural producers had given up cultivating the land due to the lack of an outlet in the market for cultivated products, which often were not even collected, or because of a real lack of market orientation. On the other hand, a demand for local products, from short and typical supply chains, was expressed by the catering and city hotel operators.

This separation can be framed both as a poor entrepreneurial attitude but also as a poor attitude in local operators towards the creation of relationships and cooperation networks. This is a limiting factor for the economic development that characterises the whole territory of Sardinia, for which the construction of social capital becomes itself a development output. From this point of view, the action carried out by the Municipality of Alghero can be considered from a local empowerment perspective (Ostrom, 1990) aimed at encouraging and supporting the management of natural resources and production activities through long-term self-organised and self-governed systems.

The primary objective of Alghero Municipality was that of maturing the conditions that favoured the emergence or strengthening of a cooperative attitude, being convinced that it could trigger a virtuous circle of cooperation-social capital (networks). This approach, adopted by the municipality, was consistent with part of the literature that states that the stock of social capital, by leveraging on cooperation, can be increased thanks to external solicitations by formal institutions (local administrations) and by the political class that governs the territory (i.e. Leonardi & Nanetti, 2010; Nanetti & Holguin, 2016). However, the case study illustrates how it is not easy to settle the situation because it was a problem to identify the origin of this virtuous circle and answer the questions widely debated in the literature (i.e. Boix & Posner, 1998): is it the attitude towards cooperation that leads to the formation of social capital? or is it cooperation that takes root where there is a certain set of political and social relations?

The case study of Mondo Rurale presents itself as a middle ground between the two options, in the sense that in the face of an effective inability to make a urban-rural system and in the face of a still weak attitude for cooperation – both within the urban and agricultural spaces – the municipal administration proceeded to build a network of basic relationships that would then guide the whole process in a cascade.

Figure 4 shows the path of construction of the network of relationships that revolved around a pivotal figure represented by the Councillor for Productive Activities of the Municipality of Alghero who had the ability to build an institutional bridge seeking collaboration with other local institutions, such as the university, the Porto Conte Regional Park and the META Foundation; in the case of the university, creating relationships ex novo and sewing previously disconnected threads. It can be observed that this process took place in successive steps involving the main actors, always preceded by official but private meetings with each stakeholder. Subsequently, meetings were organised with homogeneous groups of stakeholders: firstly, trade associations, then agricultural operators gathered in small groups in all the villages located in the countryside near Alghero. The step-by-step process

served to prepare the ground before starting the public confrontation with the complex social system, by bringing together different social partners and stakeholders, and producers with different entrepreneurial skills.

For its part, the university, taking advantage of its network of relationships based on its knowledge and consolidated contacts, involved one of the stakeholders active in an extra-regional case study in the belief that only a concrete example would have provided the right push to start a locally constructive cooperation. The choice was dictated by the fact that the environment in which it was necessary to sow the seed of cooperation was difficult to govern. The direct testimony from the case study of the 'Flour Pact' help to overcome the difficulties that even the farmers of the Nurra of Alghero were facing. The environment of the villages, as mentioned, was animated by heated and often sterile competition and strong individualism, where some operators were unwilling to share their entrepreneurial successes with others.

The creation of the short chain of typical Algherese bread, described above, represents an important outcome of the action of Mondo Rurale and allows us to learn some lessons that can be replicated in the same territory by other entrepreneurs, or even in other territories (in Sardinia or other regions).

The first lesson was closely related to the quality and role of the stakeholders involved in local political action. Including the university in the project group, for example, was fundamental: it made it possible to use not only scientific knowledge indispensable for identifying development strategies and monitoring tools, but also to exploit existing and consolidated relationship networks, shortening, in this way, the time necessary to search for information essential to the success of the initiative. This confirms what has been well highlighted in the literature (Leonidou *et al.*, 2018), namely that 'higher education could facilitate innovation management and entrepreneurship development successfully' (p. 7). Similarly, the involvement of some subjects belonging to the local community, endowed with power and leadership and who enjoyed the trust of the community, facilitated the participatory process.

The creation of the bread supply chain was a very important result, and it was also greatly hoped for by the project group to support and accompany local operators already open to cooperation and ready to create rural/urban networks with facilitation actions already discussed above, especially by the Porto Conte Park. Furthermore, it is useful to add that a sort of farmers' market was conceived and launched following the days of Mondo Rurale, creating an emporium of typical products made by about twenty companies that boast the quality seal of the Porto Conte Park.

The success of the bread supply chain was to serve as an example to follow, by imitation, in the medium and long term by suspicious operators.

Basically, by tracing a path for the diffusion of organisational innovation, well known to agricultural economists, which sees agricultural entrepreneurs classified as innovators, intermediate adopters and laggards (De Benedictis & Cosentino, 1982).

A second lesson that is worth underlining concerns the fact that the external facilitation action carried out by administrative institutions brings almost immediate results where it finds fertile ground: where the subjects are open to cooperation and building networks. However, it also produces humus on which it can germinate and continue its development path.

The third lesson we have learned was that the foodies' phenomenon has proved to be a fundamental driver in the local development path, aimed at creating a typical product to be included in the catering circuit, activating the desired link between production space and consumption space, rural and urban. Linking the urban brand (Alghero City of Good Food) to the consumption of local products becomes an indispensable policy to facilitate and encourage the development of the link between city and countryside, preventing the food and wine offered from being provided by extra-local or extra-regional producers. This lesson is considered relevant in the light of the growing attention put to the UNESCO brand of Creative Cities of Gastronomy, where it has been noted that this link is not always required within the objectives and documents necessary for the attribution of the brand (Forleo & Benedetto, 2020).

5. Conclusions and future research directions

The connection between quality food production and tourism is one of the bases of the sustainable development of a territory.

The reported experience of a local initiative aimed at enhancing the territorial resources and opportunities offered by tourist flows, highlighted that the creation, especially from the bottom, of networks joining local actors becomes fundamental for the purposes of urban-rural development.

This paper reports a case study analysis and suggestions that will be deepened both by implementing wider research over different animation experiences located in other areas, and by enriching the case studies' analysis and comparison.

What is interesting to point out about the experience of Mondo Rurale linking Alghero city and its rural surrounding areas is summarised below.

Firstly, the experiences and paths emerging from the real world and territories, with their limits and merits, show the need for building valuable territorial relationships between different segments of the local economy. On the other hand, the well-known fragmentation of Sardinian local systems and

the poor attitude of Sardinian operators to cooperate is in itself an index of economic fragility.

Secondly, the focus on the need for strong linkages between people and places with different characteristics is crucial in order to build local reliable and durable development prospects. The case study put emphasis on two relevant dimensions to be associated with the local food 'product': networks or the relational dimension; resources and places, or the territorial dimension.

Thirdly, strictly related to the previous comment, the linkages between the creation of a network and territorial development requires the interplay of macro, meso and micro levels of social capital by linking, along a long-term path, both public institutions at different governance levels and sectorial spheres and private entities.

Finally, the action of Mondo Rurale made it possible to start a process of redevelopment of typical local products, to be offered to tourists and to be introduced within the foodies' movement. This process, even if still limited to a single typical product, could be replicable for the realisation of other local products that can contribute to valorising the food offers of local restaurants, in so satisfying and strengthening specific tourist targets, generally with high income level. At this regard, a limitation of the study is that it mainly reflects the point of view of rural operators captured by the stakeholders' analysis, while a lower attention was paid to the voices of urban actors and tourists.

Acknowledgements

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Preserving the Existence of Subak in Bali: The Role of Social, Cultural, and Economic Agencies

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Abstract

This study focuses on the existence of *Subak* in Bali as a form of agricultural local wisdom that needs preserving and protecting. This study was conducted in Jatiluwih *Subak* in Tabanan Regency – Bali as an icon of the World Cultural Heritage. The analysis relied on the mixed-method approach, with 94 farmers as the research respondents. Findings from this study demonstrate that only some farmers understood *Subak's* status as the World Cultural Heritage. In addition, most of them did not plan to sell their agricultural lands because those lands were inherited from their ancestors that need preserving and inheriting their offspring. *Subak*, as a customary institution, plays a dominant role socially, culturally, and economically in preserving well-functioning *Subak*. However, the government's supports are still crucial in preserving *Subak* to remain as a World Cultural Heritage.

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1. Research Background

Productive agricultural land is an irreplaceable natural resource (Paster, 2004). However, an increase in population with the need for housing and various supporting facilities is increasingly threatening the existence of productive land, which causes land-use change in all areas. The rapid conversion of rice fields in Bali, as a result of development, threatens the existence of agricultural land as well as farmer organizations and institutions, especially the existence of the *Subak* as a customary institution. As a customary law community, *Subak* has socio-agrarian-religious characteristics, which is a farmer association that manages irrigation water in rice fields, based on the philosophical concept of *Tri Hita Karana* (Windia *et al.*, 2005). The existence of subak as a local wisdom in the agricultural sector is closely related to the existence of agricultural land. The survival of the agricultural sector means that the subak institution and the *Subak* landscape are one of the main tourist attractions. Maintaining Subak means maintaining agricultural traditions that have been passed down from generation to generation, coupled with the status of Subak as a world cultural heritage.

Bali as one of the provinces in Indonesia with the largest tourism sector also has the potential in agriculture which is no less competitive with other provinces. Agricultural productivity in Bali reaches almost 6 tons per hectare of milled dry unpulled rice or *gabah kering giling* (GKG). However, data from the Central Statistics Agency or *Badan Pusat Statistik* (BPS) from 2013 to 2018 shows that rice production in Bali has decreased from 882,092 tons to around 650,245 tons per year 2018. This decrease was accompanied by a decrease in harvested area, which in other words decreased the area of agricultural land is in Bali. Furthermore, also from BPS data in 2013, the area of agricultural land was recorded at 81,165 hectares, then in 2017 it was 78,626 hectares and according to data from the Bali Province Agriculture and Food Crops Office that the conversion of rice fields in Bali reached an average of 419.76 hectares (0.51%) per year.

The Central Bureau of Statistics of Bali Province or *Badan Pusat Statistik Provinsi* Bali (BPS, 2020) shows that there has been a change of land function to non-agriculture in nine districts/cities in Bali Province amounting to 915 ha from 2016 to 2017 followed by a reduction in 138 *subak* in the same period. *Subak* is a traditional organization with unique cohesive and coercive binding power at different level of hierarchy (Suradisastra *et al.*, 2002). *Subak* as customary institution regulates *subak*; the complexes of rice fields obtaining water from one branch of a conduit or "joining waters" (Birkelbach, 1973). The retention of the amount of agricultural land will have an impact on the sustainability of the *subak*. Conversely, the reduction in agricultural land area as a result of land conversion will also have an impact

on the increasingly threatened existence of *Subak* and the joining water irrigation system in Bali farming as a form of local agricultural wisdom in Bali Province.

Even though *Subak* in Bali Province has been designated a World Cultural Heritage (WCH) site, special attention is needed to the sustainability of the *subak*. The existence of hotels and restaurants that take advantage of the *subak* landscapes further adds to the threat of its sustainability. The construction of hotels and restaurants occurs almost every year in strategic locations in Bali as shown by the following data.

Figure 1 - The Number of Starred Hotels in Bali Province, 2011-2019
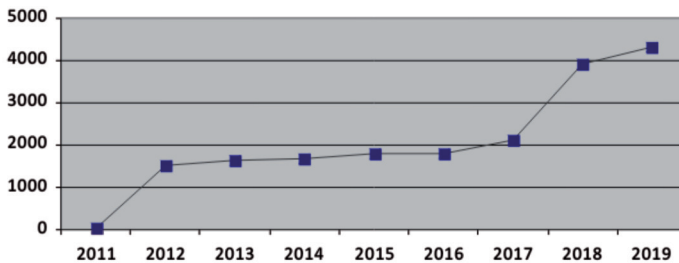
Note:
X (Ordinate): Years
Y (Axis): The Number of Star Hotels

The number of star hotels has increased every year in line with the increasing number of tourist visits. The demand for an increase in tourism-supporting facilities and infrastructure increasingly threatens the existence of productive agricultural land with *Subak* organizations in it. The tourism sector, which is more promising than agriculture, will increasingly threaten the existence of *subak*. This is proven by the depletion of young people who work in the agricultural sector (Susilowati, 2016). Although it has high cultural value, economic factors will eliminate the existence of *subak* in Balinese agriculture. Economic encouragement will always be the reason for the formation of an ecotourism which sometimes changes or even removes the original value of a tourist attraction and tourism objects in Bali (Vogt, 2014).

Research conducted by Marzuki (2011); Wanda George (2010); Yang. H.C, (2010); and Lee (2011) concluded that gradually, tourism development will increasingly erode the indigenous culture of the community. Tourists prefer places and attractions that have historical and cultural value. The continuity of a WCH can be maintained if the people who are supported by interested parties have high enthusiasm to maintain their cultural heritage. Likewise,

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the *subak* landscape in Bali will last for all time if agriculture in Bali can be sustained as inherited as long as it is getting more attention from citizen and government.

The sustainability of *Subak* institution and *subak* irrigation system can be maintained and protected if the agricultural sector in Bali is revisited and rebuilt. Moreover, the agricultural sector in Bali Province has local wisdom values that should be preserved. *Subak* as a community with local wisdom that has even been recognized by the world is increasingly under threat along with the shrinking amount of productive land in Bali as a result of land conversion. Therefore, this study aims to: 1) determine the extent to which farmers care and understand about the status of *Subak* as a WCH by maintaining their agricultural land and 2) to analyze the correlation between the role of *Subak* customary institutions as a mean to maintain the existence of subak socially, culturally and economically.

2. Literature Review

Local wisdom is a cultural value that is used to regulate the order of people's lives wisely. Local wisdom is a form of knowledge, belief, understanding and insight as well as customs and habits in ecological communities (Indrawardana, 2013). Local wisdom becomes important and useful only when local people inherit this knowledge system and accept it as a part of their life. So, when the community accepts local wisdom, it is then referred to as local culture. This local culture then becomes the identity of a community that can be used as a strength to achieve the builder's current goals (Kuasa *et al.*, 2015). It is hoped that local wisdom can become the basis for the sustainability of the agricultural sector. Local wisdom is believed to be able to increase the value of productivity with social capital as part of it (Fatmasari, Waridin & Kurnia, 2020). Even though they are considered to be less prosperous economically, but as a characteristic in people's lives, the agricultural sector should be maintained. Apart from maintaining the balance of nature and the environment, the existence of the agricultural sector will also be a source of food security (Rahayu *et al.*, 2019). Although, increasing productivity does not only depend on the performance of farmers, but will be highly supported by government policies, and other related parties such as microfinance institutions and communities such as the Subak institution in Bali.

Institutions have an important role in development. The belief that institutions can be a source of economic efficiency and prosperity has been accepted by most economists, even the most liberal. In historical studies the roots of institutional theory have actually been started a long time ago, especially by institutional experts from the US (American institutealist

tradition) such as Thorstein Veblen, Wesley Mitchell, John R. Commons, and Clarence Aires. Besides that, there are also those attached to classical economists such as Adan Smith and John Stuart Mill; Karl Marx and other Marxians, as well as neoclassical figures in particular Marshall. The former tradition, known as "Old institutional economics", while the latter is generally seen as a continuation and extension of the institutional elements found in classical, neoclassical and Austrian schools of economics, called New Institutional Economics (Yustika, 2008). The majority of qualitative and quantitative studies related to the role of institutions/institutions in the development process find a strong positive correlation between quality and institutional performance on the one hand and development outcomes on the other. The survey shows that the three main themes of economic analysis, such as transaction costs, property rights and collective action, can effectively address issues that remain enigmatic when analyzed using conventional approaches (Khan & Saghir, 2008).

Subak is a form of local wisdom in the agricultural sector in Bali which is based on *Tri Hita Karana* (Niswanti *et al.*, 2016). Where the agricultural sector cannot be separated from the life of its people (Pemprov Bali, 2012). The existence of *Subak* in Bali is regulated and based on the Bali Provincial Regulation No. 2/DPRD/1972 regarding Regional Irrigation. *Subak* is defined as a socio-agrarian religious customary community which has historically been established since time immemorial and continues to develop as an organization of land rulers in the field of water management and other rice fields (Jansing, Mahichi and Dasanayake, 2020). The form of local wisdom from *Subak* is the *Tri Hita Karana* concept which consists of the relationship humans and God (*Parahyangan*), the between human relationship (*Pawongan*) and the human relationship with nature and the environment (*Palemahan*). Apart from being the local wisdom of the agricultural sector, the *Subak* landscape that is inseparable from the *Subak* customary institution in Bali is one of the Common Pool Resources (CPR) natural resources whose use is open to anyone, so efforts are needed to protect and preserve its existence along with its status as WCH.

CPR or shared resources are natural resources and artificial resources that are used collectively. Included in this category of shared resources are water sources, added, irrigation, agricultural landscapes, pastoral fields, lakes, and forests (Ostrom, 2008). Infrastructure such as transportation, communication, and energy are also classified as a CPR pattern that aims to serve the community (Kunneke & Finger, 2009). Even today, knowledge, information data, and internet access are also classified as CPR (Ostrom & Hess, 2007). Often people think that shared resources can be used according to their wants and needs regardless of the consequences that will arise afterward. This then tends to cause the use of natural resources to quickly run out, and even

destroying reserves. In other words, the mistake of the term shared resources causes excessive depletion (Suparmoko, 2008).

In fact, the management of CPR often encountered problems. Overuse, free riders, difficulty in collective action and the non-excludable nature of CPR make it difficult to properly manage this common resource. The fact that CPR in this world is very large and varies in its use and users, so there will not be an institutional design that suits the various existing CPRs. However, according to Ostrom (2008) a good performance for an institutional design in handling CPR must: 1) involve resource users' participation in policy making by the government or institution; 2) encourage the government to create regulations that are easy to monitor and supervise in their implementation; 3) make the rules enforceable; 4) take a leap in regulating and implementing a sanction mechanism by violators; 5) put adjudication as if it is available at low cost; 6) hold monitoring institutions with accountable officials; 7) collaborate institutions that regulate CPR are made in hierarchical levels according to their function; and 8) allow the pass as there is a procedure that allows for revision of regulations.

However, as previously explained, resources in large numbers, having high complexity, and sensitivity to externalities require an institutional design that is not only hierarchical but interrelated. The effectiveness of institutions in regulating CPR is currently designed by calculating it economically. Besides that, it compares with other subregions. This is intended to allow communication between policy makers and coordination about the institutions adopted in designing an institution to regulate CPR. Although observations so far show that there has been a tendency for users to control themselves in the use of natural resources which constitute CPR, such as waters, fisheries and agricultural resources for centuries, for Indonesia, the tendency to reduce rice fields, especially in Java, continues. and there have been no effective policy steps or actions taken by local communities to control the conversion and land-use change of these rice fields through proper policy (Pasandaran, 2006).

3. Research Methodology

3.1. *Research Location*

The research focus on the *Subak* Jatiluwih Landscape. The *Subak* Jatiluwih Landscape area is one of the *Subak* Landscape which has become an icon of the WCH. Jatiluwih is located at the foot of Mount Batukaru, Penebel District, Tabanan Regency, Bali Province, Indonesia. The focus of research was on the existence of *Subak* in Bali as a form of local wisdom in the agricultural sector that must be maintained and extended.

3.2. *Data, Population and Samples*

The population in this study were farmers with the qualification as the members of each *Subak* institution divided into seven (7) *subak* landscape areas. A total of 94 farmers were chosen as research respondents to answer the questionnaire. This research uses primary and secondary data. Collecting data and information required for analysis is carried out by: 1) a documentation study, which is aimed at obtaining secondary data held by related agencies; 2) field observation, which is in the form of observation or direct observation of the area which is the research location; and 3) interview technique, where this technique is carried out if the data or information as input material is not contained in secondary data. Primary data is obtained through questionnaires to respondents, while secondary data comes from data published by related agencies and communities. Primary data in this study include the socio-economic characteristics of the respondents, in this case farmers, and their perceptions and concerns about the status of *Subak* as a world cultural heritage. Meanwhile, secondary data from agencies includes an overview of the amount of agricultural land obtained from the BPS Bali Province. The mixed methods approach, is based on a combination of quantitative and qualitative approaches (Creswell, 2009), is used as an analysis to answer the problem so that relevant conclusions can be obtained in accordance with the research objectives.

3.3. *Qualitative Research Approach*

This research uses a qualitative approach. The snowballing sample approach was used to obtain informants in the interview. Qualitatively, the results of the interviews were analyzed using Atlas.ti software to find out the reasons for farmers to maintain agricultural land and farmers' exceptions in maintaining the existence of *Subak* as perseverance of local wisdom in the agricultural sector in Bali.

3.4. *Quantitative Research Approach*

Quantitatively, the data obtained through questionnaires were analyzed descriptively. Descriptive statistics is an analytical method used to solve problems related to the measurement of quantity (number and data) (Ardiansyah and Susilowati, 2019). This method is explained using a descriptive statistical approach which is used to explain the profile of respondents so as to produce the socioeconomic characteristics of the respondents and the respondents' perceptions of the existence of *Subak*. Descriptive analysis here is a description of the frequency value and standard deviation of the data to be able to describe the real conditions in the field.

The correlation between the social, cultural, and economic roles of Subak institutions on farmers' perceptions of maintaining the existence of Subak was analyzed by using SPSS version 22 software.

4. Results and Discussion

4.1. *Social and Economy Characteristics of Respondents*

The research questionnaire was submitted to 94 farmers in Subak Jatiluwih, Tabanan Regency, Bali Province, Indonesia. Jatiluwih Village is geographically located at an altitude of 500-750 meters above sea level. Jatiluwih Village has a rainfall of 2,500 mm per year and has temperatures between 26-29°C. *Subak* Jatiluwih Landscape is an icon of Bali's agricultural landscape as a WCH with extraordinary natural scenery (Philander & Barnhill, 2012). Agriculture in Jatiluwih is not only traditional in its pure sense with the aim of rice production, but also becomes an ecotourism area that attracts tourists to visit to enjoy views of the *subak* cultural landscape and also learn related to traditional Balinese agriculture. The characteristics of the respondents in this study are described in Table 1.

Table 1 - Characteristics of Respondents

| No	Variable	Criteria	Frequency	
			n	**%**
1.	Age of Respondent	30-40 years old	28	29
		41-50 years old	22	23
		51-60 years old	30	32
		> 60 years old	14	16
2.	Formal Education	Did not attend school	4	4
		Did not graduate from primary school	5	5
		Primary school	37	40
		Junior high school	20	21
		Senior high school	28	30
3.	Number of Dependents	≤ 2 people	70	74
		3-5 people	17	18
		> 5 people	7	8
4.	Average Wage	< 2 million rupiah	39	41
		2-3 million rupiah	49	52
		> 3 million rupiah	6	7

Source: Data collected from the research, 2019.

Table 1 shows the characteristics of the research respondents. The majority of farmers are under 60 years of age, where as many as 32 percent of farmers are in the age range of 51-60 years and only 14 percent are over 60-year-old. Most of the formal education they have completed is primary school graduates (it is amounted to 40%) and senior high school (as much as 30% from total respondents). For the number of dependents, the average farmer has 2 dependents (as much as 74%) and only 8% of the farmers bear more than 5 people in their hood. Meanwhile, on average, the average wage or income they get per month only from agricultural activities is between 2-3 million rupiah (52%) and only 7% earn more than 3 million rupiah. This value can only be used to meet daily needs, so that most of the farmer's wives also work to help meet their needs other than clothing, food and shelter.

4.2. *Farmer's Awareness of the Status of* Subak *as World Cultural Heritage*

The development of the tourism sector should be followed by the development of other supporting sectors, especially the agricultural sector. Efforts to empower the agricultural sector as a supporter of the tourism sector should continue to be improved with a more integrated empowerment pattern. As an economic sector that is full of uncertainty, farmers in Jatiluwih Village are faced with a dilemma to survive or give up their agricultural land. In fact, the status of WCH has not been accompanied by a welfare program for farmers to survive in the agricultural sector. Despite the economic pressure and environmental changes, most farmers still hopes to survive with agricultural activities agricultural activities. They also hope that their agricultural land will be maintained for generations. The desire of farmers to sell agricultural land and their understanding of the status of *Subak* as WCH is shown in Figure 2.

Figure 2 shows a summary of the tabulated data in the form of flowchart questions related to farmers' understanding of the status of *Subak* as a WCH and the desire whether the farmers want to sell their agricultural land or not. The results show that the farmers in Jatiluwih Village know the status of *Subak* as a WCH, but not all understand the meaning of WCH itself. Of the total respondents, only three farmers have the desire to sell their agricultural land because their income from farming is not able to meet their daily needs. In in-depth interviews, farmers who chose to sell agricultural land described:

Figure 2 - Flowchart of Farmer's Awareness to have Desire in Selling Agricultural Lands and Farmer's Knowledge of Subak *as* wch
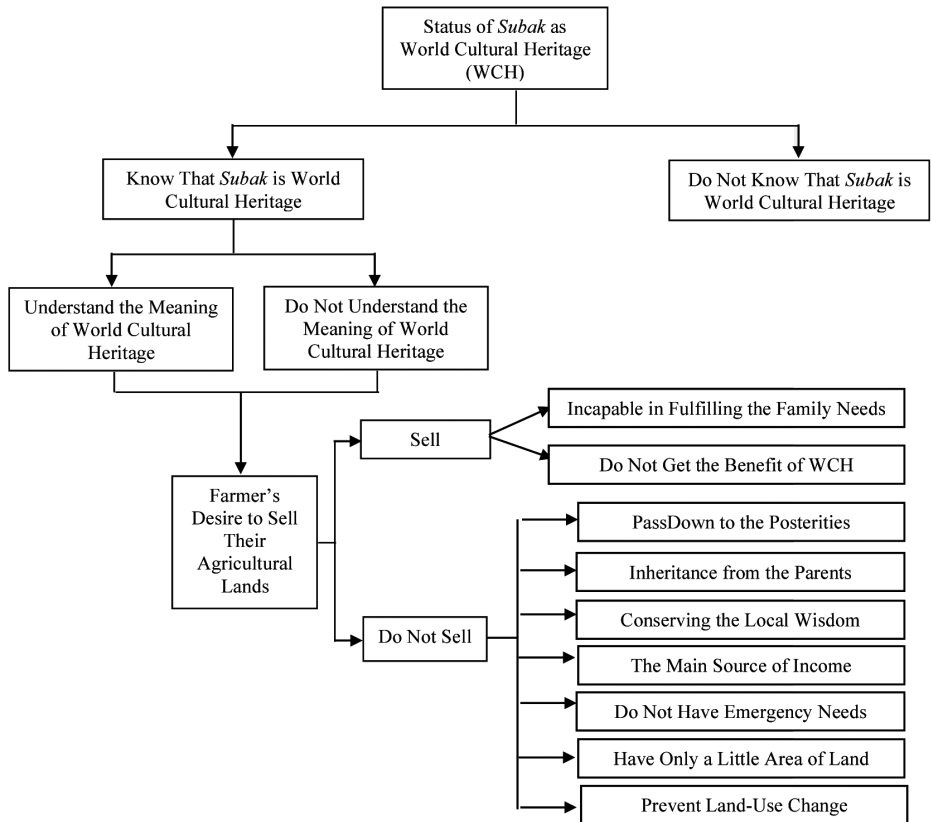
"*Berapa, sih, pengahasilan petani. Kebutuhan banyak. Tidak bisa mengandalkan ini saja. Anak-anak juga maunya sekolah. Siapa yang mau nerusin jadi petani. Kalau dijual kan bisa untuk sekolahkan anak. Biar mereka bisa jadi pegawai.*" – 1 (ID)
"How much does the farmer earn? Family needs are a lot. We can't rely on the farm alone. Children also want to go to school for better education. Who wants to continue being a farmer? If it is sold, it can be used for sending children to school. So they can become public or private employees at the office." – 1 (EN)

The majority of farmers do not want to sell their agricultural land. Most of them argued that the land they owned was inherited from their parents who wanted to be passed on to their children and grandchildren. Some others argue that farming is their main job and the income from these activities has been able to meet their daily needs. There are even those who argue that the

lack of land they own makes them reluctant to sell the land. As stated by Sumatra:

"*Dapat tanah warisan sedikit. Masa mau di jual. Kalau ada rejeki malah kepingin beli lagi. Jadi nanti biasa dikasikan ke anak cucu. Walaupun anak cucu jadi pegawai tapi kan bisa suruh orang lain untuk garapnya. Jadi tidak di jual lah, sayang tanahnya.*" – 2 (ID)
"We got a small inherited land and we don't want to sell it. If there is luck, we even want to buy other land again. So later our land is usually given to the posterities. Even though the children and grandchildren become employees, they can ask other people to work on the farm. Yes, it is not for sale and we will keep owning the land." – 2 (EN)

In Balinese culture there is the terminology of *tetamian/cecatu* or it is called inheritance of the land from ancestors to posterities. *Tetamian/cecatu* is an ancestral heritage that is not only seen from the material side, but also the concept of inheritance as the value of the ancestors that is used and must be maintained for the continuity of the next generation. Therefore, farmers defend their agricultural land more in the belief that the rice fields they own are *tetamian/cecatu* or ancestral cultural heritage that must be maintained and preserved. As stated by Guru Sueden, one of the elders in the *Subak* Jatiluwih area who revealed:

"*Mewariskan ilmu, apalagi ilmu tentang pertanian ini ke anak muda memang susah. Tapi harus tetap diajarkan. Sama seperti sebuah kebiasaan. Seperti menyuapkan sarana upacara, belajar dari mana? Kita bisa karena diajarkan dan dibiasakan. Seharuskan tidak masalah menurunkan pengetahuan terkait Subak ke generasi muda. Tidak harus meminta mereka menjadi petani, tetapi mereka harus tau nilai apa yang terkandung dalam pertanian tradisional tersebut. Dan yang terpenting mereka harus paham, sesuatu yang diberikan secara turun temurun atau warisan pantang untuk dijual.*" – 3 (ID)
"Passing on knowledge, especially about agriculture to young people, is indeed difficult. But it must be taught. Just like a habit. Like providing for ceremonial means, where do you learn from? We understand because we are taught and conditioned. There should be no problem passing knowledge related to *Subak* to the younger generation. They don't have to ask them to become farmers, but they must know what value is contained in traditional agriculture. And most importantly they must understand, something that is given from generation to generation or inherited never to be sold." – 3 (EN)

The opinions of respondents show that there is a great need for our agreement and consistency in suggesting the younger generation about the obligation to preserve culture, especially the *subak*. They were not forcing the younger generation to farm, but making the younger generation aware

of the importance of agricultural values in Bali so that its sustainability will be maintained from generation to generation. This is not only for Balinese agriculture, but also for all local beliefs in Indonesia, considering that Indonesia is an archipelago with a diverse ethnic group and different customs and traditions.

4.3. *The Role of Social, Cultural and Economic Aspects to Maintain the Existence of* Subak *as World Cultural Heritage*

As a customary institution that is held based on local wisdom that regulates the agricultural sector, *subak* has its own regulations known as *awig-awig*. This rules must be followed and obeyed by all *Subak* members. The role of *Subak* customary institutions will be discussed from the social, cultural and economic aspects which is explained in Table 2.

The social role of *Subak* customary institutions is quite good, with an average score of 4.2. The role of this *Subak* customary institutions is also very important in conducting socialization so that farmers have an understanding of the regulations (*awig-awig*) related to appliance rules, have an understanding of the strictness of *awig-awig* about *Subak* customary institutions, and have an understanding of the existence of social sanctions in *Subak* customary institutions. In general, the farming community views that the *Subak* customary institutions has an important and very important role in disseminating the regulations and the rules (*awig-awig*), the strict aspects of *awig-awig*, as well as socializing social sanctions or penalties if the peasants who are members of the *Subak* violate the established rules. Farmers see that the social role of *Subak* customary institutions is important and very vigilant in providing an understanding of various rules (*awig-awig*) and encouraging the farming community to remain as farmers. Thus, it can be said that the social role of *Subak* customary institutions will greatly support the existence of the *Subak* Jatiluwih area as a WCH.

The role of the culture of the *Subak* customary institutions that was responded by farmers from the four questions asked was responded quite well as indicated by the average indicator score of 4.07. This means that the cultural role of *Subak* customary institutions related to the existence of these institutions has been responded quite well. Thus, it can be said that the role of traditional institutions so that farmers maintain the *subak* culture as local wisdom of traditional institutions has been responded very well by farmers to maintain the existence of the agricultural culture. It can be said that the *Subak* customary institutions have an important role in the efforts made to maintain the existence of Jatiluwih Village as a WCH area.

Table 2 - Perception Scores on Social, Cultural and Economic Aspect of Customary Institutions in Subak

Indicator		Mean*	Deviation Standard
Social Aspect	Understanding of regulations (*awig-awig*)	4.22	0.57
	Understanding of social penalty	4.29	0.54
	Karmic impulse (*karma*) or the desire to planting rice	4.20	0.52
	The urge of being farmer	4.27	0.57
Cultural Aspect	Maintaining and conserving custom and culture through farm products	4.11	0.54
	Preserving the harmonious environment between farmers	4.00	0.43
	Preserving the harmony of relationship between farmers and other karmic impulses (*karma*) to support the existence of customary institutions in maintaining the irrigation system of farming (*Subak*)	4.10	0.55
Economic Aspect	Understanding the importance of physical development	4.23	0.45
	Understanding the importance of *punia* fund (good and holy giving as one of the Dharma values in Hinduism) in physical development	4.23	0.42
	Understanding the importance of *punia* in *Subak* as customary institution during religious activities	4.26	0.51
	Understanding the role of farming yields distribution	4.14	0.62
	Understanding the role of capital loan assistance	4.13	0.64
	Understanding the role of expense in religious ceremonial activities	3.77	0.77

* Perception Scores on Social, Cultural and Economic Aspect of Customary Institution in Subak (Using 5 point Likert scale) (1 = strongly disagree and 5 = strongly agree).
Source: Primary data collected from the research, 2019.

Perceptions of farmer respondents on statement items related to the economic role of *Subak* customary institutions ranged from good to very good with an average score of 4.13. This means that farmer respondents perceive that physical development activities, *punia* activities for physical development and *punia* related to religious activities carried out by farmers in *Subak* institutions are very important to be carried out. *Punia* fund is good and holy giving as one of the Dharma values in Hinduism. Thus, it can be said that *Subak* customary

institutions have a very strategic economic role in the efforts made to maintain the consistency of the Subak as an organization that regulates the distribution of water needed by farmers. The higher the role of this *Subak* customary institutions is for providing support to their regular daily activities, especially farmers, to be involved in physical development, punish activities, and religious activities related to the preservation of this *Subak* institution, then this *Subak* customary institutions can support the existence of Jatiluwih as a wcн area.

The correlation between the social, cultural and economic roles of *Subak* institutions on farmers' perceptions of maintaining the existence of *Subak* is shown in Table 3.

Table 3 - Correlation Between the Roles of Customary Institution and the Existence of Subak

Variable	Pearson Correlation	Sig*
Social Aspect	0.714	0.000
Culture Aspect	0.780	0.000
Economy Aspect	0.978	0.000

* Correlation is significant at the 0.01 level (2-tailed).
Source: Data from spss output, 2020.

The results of the correlation analysis show that both the social, cultural and economic aspects have positive impact after the correlation with farmers' perceptions in maintaining the existence of the *Subak* were determined. The social role of *Subak* customary institutions has a correlation value of 71.4%, the role of correlated culture is 78% and the highest correlation value is through the role of the economy which is 97.8%. This shows that, the existence of *Subak* customary institutions both socially, culturally and economically will greatly influence the desire of farmers to maintain their agricultural land, which means that it will further increase the existence of *Subak* customary institutions in Balinese agriculture. This is also in line with the results of the previous qualitative approach which show that although economic factors will be the main driver for the conversion of agricultural land functions, the value of local wisdom will always be the reason for maintaining Balinese agriculture.

4.4. *Discussion*

The social, cultural and economic aspects in between roles of *Subak* customary institutions can be seen in their efforts to encourage their citizens

especially farmers to remain consistent in planting rice and of course remain to stay as farmers for their occupation. The role of this *Subak* customary institutions is also very important in conducting socialization so that farmers have an understanding of the regulations (*awig-awig*) related to *Subak* customary institutions, have an understanding of the strictness of *awig-awig* about *Subak*, and have an understanding of the existence of social sanctions in *Subak*. In general, the farming community views that the subak customary institution has an important and very important role in disseminating the regulations, strict, as well as socializing social sanctions if the peasants who are members of the subak violate the established rules.

Staying in one sector to improve the economy will always lead to a decline in other fields as in equilibrium of sectors. Although the progress of one sector will advance other sectors, the negative impact of these conditions will always exist. Like the development of the tourism sector in Bali, which is the foundation of the community's economy level of regional wage, even the highest source of regional income plays a role in the progress of the trade, transportation sector, even has a significant impact on the development of Small and Medium Enterprises (SMEs) in a local or regional area such as Tabanan (Yuliarmi *et al.*, 2012). However, the progress of the tourism sector has gradually had an unfavorable impact on the environment, even affecting the socio-cultural conditions of the community of certain region.

The research on the impact of tourism on the behavior of local communities was carried out by Marzuki (2011) which took place on the island of Langkawi, Malaysia. His research concludes that the development of tourism in Langkawi contributes to local communities, especially from an economic standpoint, by increasing employment and infrastructure development, and even expanding opportunities for local people in entrepreneurship. However, the research also revealed that the development of tourism also raises social and environmental costs that are higher than the resulting economic benefits.

Research related to the protection of agricultural land was carried out in Sweden. This research is based on concerns about food sovereignty, where most agricultural land is very easy to convert into housing. The results show that the existence of agricultural laws in Sweden reflects an ambivalent discourse about preserving agricultural land. The government views land use for other functions as more important than agriculture. The current Swedish government system is built on the belief that the relevant institutions will make satisfactory decisions regarding land and water use. In this condition, community cultivation is needed to prevent land conversion. This relates to the power of the community to protect agricultural land from conversion to other uses of applied lands (Slätmo, 2017).

As a form of local wisdom in the agricultural sector, the existence of *Subak* customary institution and *subak* irrigation system in farming should be maintained, preserved and protected for its sustainability. The decreasing area of land is an indication of the increasingly threatened *Subak* customary institution and the existence of the *subak* landscape. Research related to the sustainability of *Subak* activities based on the *Tri Hita Karana* concept was carried out by Arnawa (2011). This study aims to analyze the sustainability of subak seen from its activities based on *Tri Hita Karana*, to analyze the influence of the two *Tri Hita Karana* elements related to *Subak* customary institution and *subak* sustainability, and to analyze *Subak* solutions to overcome the problems faced today by the farmers. The results of the study concluded that the activities of the *Subak* were still quite sustainable, the *subak* that had not undergone land-use change were more sustainable than those that had changed the function of land. *Tri Hita Karana* elements, namely *parahyangan*, *pawongan* and *palemahan* as explained before having a significant influence on the preservation of subak. Conflict resolution can be resolved with the concept of "*parasparos selunglung sebayantaka sarpanaya*" which means that all good or bad and light or heavy should be borne together.

Evidence related to the decreasing area of agricultural land in Bali was carried out by Lanya *et al.* (2015). The research aims to map and determine land use and land use change in Bali Province from 2002 to 2013. The results show that of the total *subak* area in Bali Province, 53% of the total area is the core *subak* that needs to be continuously preserved, 40.31% of the area is a buffer zone that requires special attention for its utilization, and the rest is an area that can be converted to other functions because its benefits are no longer for the agricultural sector. The results of the analysis also state that there is a decline in the use of agricultural land for housing and for non-agricultural purposes every year.

The low interest of the Balinese youth in agriculture will also be one of the causes for the loss of *Subak* in the future. The current generation knows the existence of *Subak* but does not understand the meaning and values contained in it. Even though the application of local wisdom values will be very helpful in maintaining and preserving local culture and customs (Yuliana, Sriyati & Sanjaya, 2017). An educational research and *Subak* concluded that, most teachers and students in Bali have limited knowledge regarding *Subak* even though they consider it important to maintain a culture in agriculture (Surata & Vipriyanti, 2018). So that it is necessary to add cultural values, especially *Subak* values in education in Bali to maintain the cultural values that are owned from generation to generation.

5. Conclusions and Suggestions

Based on the results of our analysis, we conclude that only some farmers understand the status of *Subak* as a World Cultural Heritage (WCH). The majority of farmers do not want to sell their agricultural land on the grounds that agricultural land is *tetamian/cecatu* or ancestral heritage that must be preserved and passed on. *Subak* customary institutions play a dominant role both socially, culturally and economically. This is indicated by the positive correlation value between the social, cultural and economic roles of traditional institutions on farmers' perceptions of maintaining the existence of *subak* as local wisdom in the agricultural sector in Bali.

Nevertheless. The absence of a clear clause in the *Subak* regulations related to land-use change, land sales and land conversion to non-agricultural makes it easier for *Subak* members to sell their agricultural land. Therefore, adding a clause that regulates the procedures and sanctions in the form of social penalties or interventions that can be imposed on land owners who sell their agricultural land for non-agricultural activities is needed. In this regard, support from the government in efforts to conserve subak so that it remains a WCH is also very much needed to perform properly.

When the world is currently facing the threat of Covid-19 which has a huge impact on Bali tourism, we need to revisit the *subak* regulations so that farmers can continue to preserve the farming. The conditions that paralyzed tourism and the economic downturn had quite an impact on the agricultural sector, especially in relation to the supply chain for agricultural products, which normally were distributed quite a lot to hotels and restaurants. For this reason, in addition to focusing on maintaining the existence of *subak* from tourism growth, interested parties should also be able to formulate mitigation strategies, especially for the supply chain of agricultural products, so as to be able to anticipate uncertain conditions in the tourism sector, either due to disasters or outbreaks such as what is happening today.

Acknowledgements

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Consumers' assessment of labelled and packaged fresh potato: Evidence from Experimental Auctions

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Abstract

Worldwide, the potato is the third more important crop, coming after wheat and rice. In Argentina, it is the horticultural product with the highest consumption in fresh state, but Argentine consumers know little to nothing about potatoes attributes.

The objective of this research is to identify the attributes that influence the assessment that consumers make of a potato with differentiated quality. Due to this, a Vickrey Second Price Experimental Auction took place in April 2017. The experiment involved 155 participants, who were students and employees of the School of Economic and Social Sciences of the National University of Mar del Plata. A Multiple Correspondence Analysis was applied based on the data of the bids and the survey carried out at the Auction.

The main results showed that the participants, after receiving information about the culinary aptitude of the differentiated potato and its production method – its lower content of agrochemicals –, were willing to pay a higher price for the product. Additionally, participants opted for a higher price of potato when it was presented in a labelled package. Likewise, an identify group of participants were shown to be willing to pay more for this differentiated food.

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Introduction

The potato is an important source of carbohydrates, proteins, vitamins and minerals. In Argentina, it is the horticultural product with the highest consumption in fresh state; the average consumption reaching almost 60 kg/per capita/for year. This figure is above the normal consumption of many countries. Potato production is carried out in many regions of the country at different times of the year, therefore providing year-long supplies. As in other countries, fresh potato is commercialized particularly in the domestic market; a weak selling point is the lack of consumer knowledge regarding the qualities of this vegetable. Although the potato is a staple food, it is found in the diet of all socio-economic levels, in Argentina. Despite the widespread potato consumption, little is commonly known about its varieties and characteristics (Napolitano *et al.*, 2011; Cacace y Huarte, 1996). Consumers associate variety with skin colour, pulp texture, harvest care and origin (Lupín *et al.*, 2010). This misinformation promotes the availability of only one potato variety for fresh consumption (Spunta). This variety is the more popular among national producers due to its high-yielding ability, even though its quality is not the best.

The south-east region of the Buenos Aires province is an area of fertile lands with a mild climate and constitutes one of the main potato producing areas of Argentina. In this region, 30,000 ha of potatoes are produced. The production in this region is for fresh consumption and industrial processing. Potato production is highly dependant on imported inputs, and therefore it is characterized by high costs, relative to other crops. Low product price mean, that in some cases, costs are not covered in full (Huarte *et al.*, 2011). This situation creates the necessity to explore new productive alternatives, allowing for costs reduction and possible higher prices. New products can become feasible if it conforms to consumers demands, regarding quality information and safety controls (Rodriguez, 2018).

Rodríguez *et al.* (2015) carried out a survey based on 402 potato consumers who lived in various neighbourhoods of Mar del Plata city (Argentina) all of them belonging to different social-economic levels. This survey showed that the majority of consumers surveyed chose a potato with low agro-chemical content and good culinary aptitudes. These results promoted this investigation and raised the following research questions: would consumers pay a higher price for a low agro-chemical content potato? Would their decision be influenced by more or less information about the potato features? How does tagging and packaging affect the potato's value? Consumers' demographic and socio-economic characteristics influence choice?

The aim of this research is to identify the attributes that affect consumer assessment make of a potato with differentiated quality. Hypotheses proposed are:

H1) Information provided, packaging and labelling contribute to the price that consumers are willing to pay for a differentiated potato.

H2) People who are willing to pay an additional price for a differentiated potato have common characteristics in reference to quality perceptions and the information that they prioritize.

This research uses data from an Experimental Auction (EA). EA is a method of preference assessment, carried out in a laboratory environment, whose implementation has increased in recent years, mainly in studies on products related to the Agricultural Economy (Lusk & Shogren, 2007). But EA studies have not been carried out in Argentina. So, through this investigation we hope to achieve two aims: first, to make known to the public the aspects of an EA, but also to put forward to potato producers the qualities that consumers look for.

This article is organized in the following manner. Section 1 describes the conceptual framework on which this research is based. Section 2 details the materials and methods used, emphasizing the EA design. Section 3 presents results and Section 4, the discussion. Concluding remarks are provided in Section 5 and finally, limitations and future research are exposed in Section 6.

1. Theoretical framework

The conceptual back-up of this investigation is "Quality perceived - quality attributes". Issanchou (1996), believes that product quality is found in the belief of just that. Bearing this in mind, the quality concept can be seen as relevant when studying consumer choice and preferences. Economic status is connected to personal preferences. Steenkamp (1990), pointed out that quality judgement in reference to food is based on perception, needs and objectives.

In order for consumers to evaluate product quality, information must be gotten by signs; these can be put into categories and integrated in such a way as to generate an expectation of purchase or not.

Following this line Caswell (2002) proposed an analysis breakdown involving 3 different dimensions:
1. Depending on whether they modify, alter or not the physical characteristics of the product: intrinsic attributes or extrinsic indicators and cues. Potato variety and its content of agrochemicals are intrinsic attributes. Instead, label and packaging are extrinsic indicators and signs.
2. According to the environmental information: search, experience and credibility. When the nature of the product quality information is searchable, the buyer can judge the quality of the product by evaluating it before purchase. On the other hand, if the nature of the information is from personal experience, the buyer has to use the product to assess its

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quality. Finally, if the nature of the information is credibility, the buyer cannot judge the quality of the product even after purchase and use. In this case, the variety and content of agrochemicals can be classified as belief attributes but the label and packaging as search attributes.

3. According to the ranking that consumers have with respect to an attribute: vertical differentiation and horizontal differentiation. The first one occurs when consumers have the same ranking with respect to an attribute, while the second if consumers have different classifications. Agrochemical content is an example of vertical differentiation because consumers, in general, have a tendency to lean towards safe and innocuous food. For its part, variety, label and packaging are examples of horizontal differentiation because consumers' choices can vary according to their preferences.

In reference to the afore-mentioned, the Experimental Auction method allows us to perceive consumer evaluation by way of an integral analysis of the product in question and determine certain attributes.

2. Materials and Methods

An EA was developed, during the month of April 2017. EA is a method of preference assessment, carried out in a laboratory environment, whose implementation has increased in recent years, mainly in studies on products related to the Agricultural Economy (Lusk & Shogren, 2007). There are different types of EA-BDM, Random n^{th} price auction, Second Price- but particularly in this study, Vickrey Second Price EA was developed (Vickrey, 1961).

In Vickrey Second Price EA the utility expected by the participant is maximized when his bid is equal to the valuation he makes of the product. Bids are simultaneous and individual but should not be known by the rest of the participants. The one who issues the highest bid wins the auction but has to pay the second highest price to access the product. Among its main advantages, it is possible to mention that it has theoretical robustness, it is revealing of the demand and it is relatively easier to apply than other auctions. Its main disadvantage is that it does not work well for bidders that are located in the lowest tail of the supply distribution (their value is not close to the second highest price) (Alfnes, 2007; Lusk *et al*., 2004; Shogren *et al*., 2001).

EA was carried out selecting students and staff from the Economics and Social Sciences School at Universidad Nacional de Mar del Plata, in Mar del Plata, Argentina (Nalley *et al*., 2004). The sample included 155 participants. A representative sample of FCEyS population was selected by gender and age (Zhang & Vickers, 2014; Martínez-Carrasco *et al*., 2012). Additionally, it is

possible to indicate that participants reside in neighborhoods of Mar del Plata city with different socioeconomic levels (Restrepo-Bentancurt *et al.*, 2016).

Participant recruitment carried out at the University is a common practice implemented in similar studies. It allows us to save time and money (the experiment goes on at people's work or study place, therefore the participants cost are lower). Furthermore, methodology comprehension is easier (Nalley *et al.*, 2004; Kajale & Becker, 2014; Zhang & Vickers, 2014; Strzok & Huffman, 2015). This study group is certainly not representative of the general population in terms of demographics; this study does not set out to make productions about potato marketing for the entire city (Nalley *et al.*, 2006).

Volunteers were invited to participate in market study, not knowing what the methodology would be nor about the product to being evaluated (Lusk & Shogren, 2007). Nine groups were formed. The groups were called on different days and times with the objective of recruiting people from the three different faculty shifts. Multiple experimental auction groups maximize independent observations.

Another advantage of multiple auction groups is that it can reduce the risk of interrupting the experiment in case that one of the participants decides to leave during the experiment; in this case, it would be possible discard only the auction group affected by the participant's defection (Canavari *et al.*, 2019).

The EA was carried out in the month of April, according to potato produce in the south-east of Buenos Aires. The produce on auction were two fresh varieties of potato: Spunta and Frital INTA. Spunta was produced by the conventional way and Frital INTA, with a lesser use of agro-chemicals, for this particular study. It must be clarified that both varieties can be produced by either of the afore mentioned methods (conventional or reduced agro-chemicals). Six rounds were done in each group during the experiment, betting simultaneously on both varieties.

Protocol was set up with the guidelines for the moderator. This ensured replicating the call for participants and the development of the auction with each group (Fox *et al.*, 1995). At the beginning of each session, participants were identified with a letter to maintain anonymity (Depositario *et al.*, 2009). Then, the moderator explained the methodology and invited participants to go on a pilot round with a bottle of water. Next, 50 argentine pesos were given to each participant (50 argentine pesos were equivalent to 3.22 American dollars), a pen and cards to register their bids. The moderator highlighted the importance of betting the real price that they would pay for the auctioned product. Sessions are always moderated by the same person (the first author of this paper), accompanied by an assistant who registered the bids in a computer.

This experiment was carried out in a developing country. Canavari *et al.* (2019) said that these kind of countries possess particular characteristics, like bartering. This isn't the case of Argentina where bartering isn't common. But a characteristic that Argentina has as developing country is that has to work with a slim university budget; this do not allowed do the EA with computers in laboratories so bets were done with pens and cards.

Participants received different stimuli as the rounds progressed: presentation of both types of potatoes without identification of the varieties name – just named A and B – (Nalley *et al.*, 2004) and without packaging and labelling; reference price information – the average price of 1 Kg of Spunta because it is the variety more available at the local market – (Gil & Soler, 2006); information about Frital INTA properties, provided by a specialized INTA technician, using oral guides, video and leaflets (Gil y Soler, 2006); finally, Spunta was displayed as in previous rounds and Frital was presented with packaging and labelling.

One of the six rounds was randomly selected and the participant who had bet the highest price was identified. In order to take the product, this participant had to pay the second highest price bet on that round. After that, participants had to answer a survey consisting of two sections: the first one referred to potato consumption, and the second part related to demographic and socioeconomic characteristics (Vecchio *et al.*, 2016; Zhang & Vickers, 2014; Gil & Soler, 2006).

Figure 1 - Steps of Experimental Auction
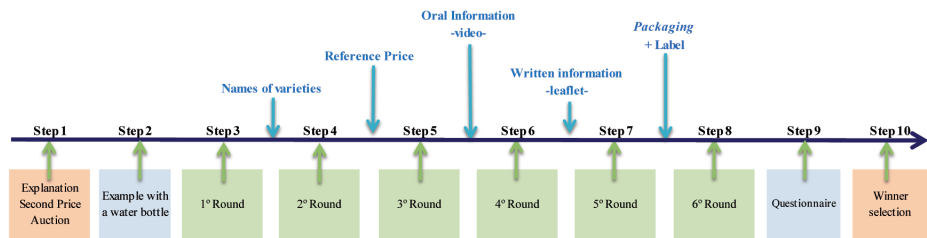
Source: Author's calculation, Experimental Auction – April 2017 (Rodriguez *et al.*, 2018).

The data obtained was analysed using descriptive statistics and Multiple Correspondence Analysis (MCA) (Johnson & Wichern, 2007), by InfoStat® software (Balzarini *et al.*, 2017).

3. Results

Analysis of the prices bet in the Experimental Auction

Bids were higher for Frital INTA potato than for Spunta potato, showing a notable distance from each other after participants were informed about the reference' price. The highest average bid for Frital INTA coincides with the lowest average bid for Spunta (1.61 US\$/kg and \$ 0.77 US\$/kg respectively)[1], registered in the last round, after the presentation of the Frital INTA with packaging and labelling. It was also observed that as the rounds progress, the percentage of participants who bet more on Frital increased (from 58.71% in Round 1 to 96.77% in Round 6).

Furthermore, when comparing each round with Round 1, it is possible to indicate that the proportion of participants that increase their bids increases as rounds follow each other – from 38.71% Round 2 with respect to Round 1 to 74.84% Round 6 with respect to Round 1 – (Table 1). Hypothesis 1 is verified.

Table 1 - Proportion of participants who increase, decrease or maintain bids on Frital in view of the variation in information regarding Round 1 – total sample, 155 cases

| Bid variation	Round 2 - Round 1	Round 3 - Round 1	Round 4 - Round 1	Round 5 - Round 1	Round 6 - Round 1
Increases	38.71%	40.00%	63.23%	65.16%	74.84%
It keeps	49.03%	21.94%	12.26%	10.32%	7.74%
Decreases	12.26%	38.06%	24.52%	24.52%	17.42%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Author's calculation (Experimental Auction – April 2017).

In reference to the variability of bids, it decreases as the participants receive information on the quality differentiating attributes, being higher for the Frital than for the Spunta.

Then, in Figure 2 and in Figure 3 it can be seen that, in all groups, there was a similar behavior with respect to the decrease that occurs in medium bids with reference to the Spunta variety; and the increase in the prices of the variety Frital INTA. This happened as the participants received information about Frital INTA variety. The adjustment in bids for both varieties in Round 3 is also noticeable, in which participants are notified about the reference price.

1. April 2017, nominal exchange rate between US\$ and Argentinean Peso was 1 to 15.50.

Figure 2 - Bidding evolutions in subsequent EA Rounds – Average Prices for Spunta variety – total sample, 155 cases
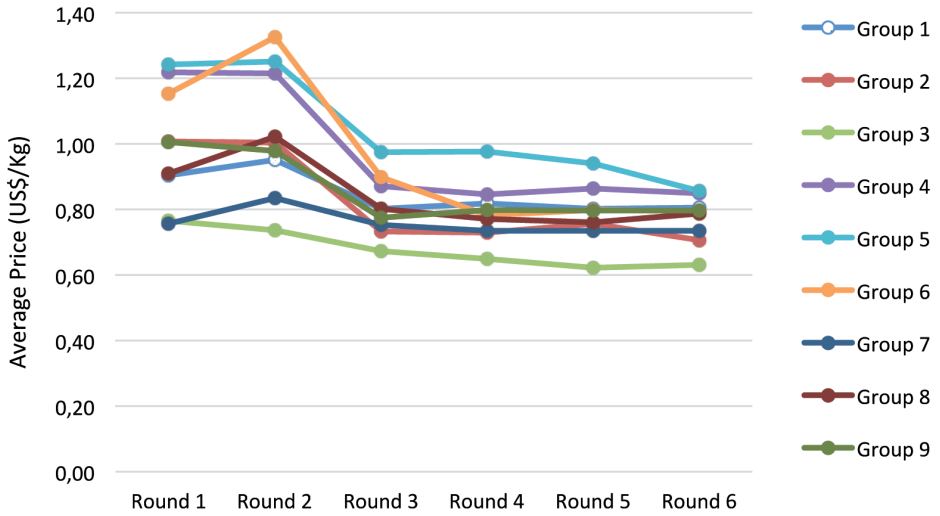
Source: Author's calculation (Experimental Auction – April 2017).

Figure 3 - Bidding evolutions in subsequent EA Rounds – Average Prices for Frital INTA *variety – total sample, 155 cases*
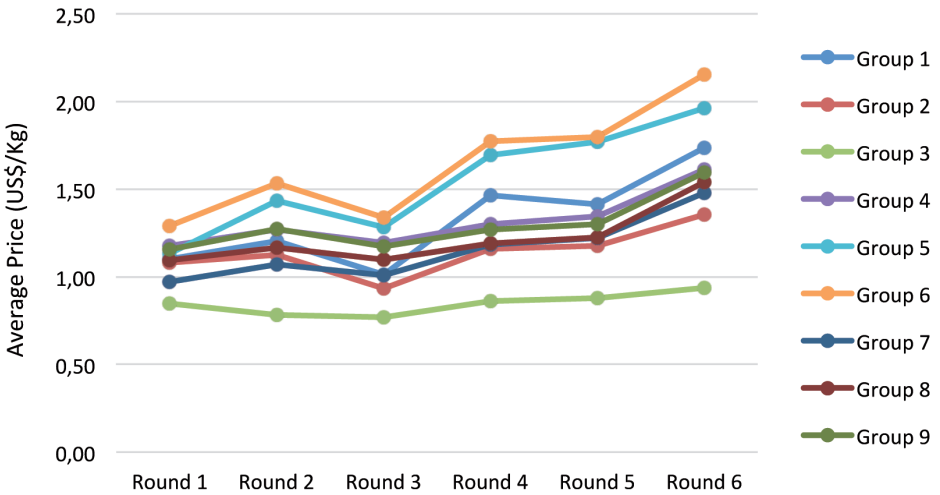
Source: Author's calculation (Experimental Auction – April 2017).

Analysis of participants' preferences

In order to explore the perceptions and choices of the participants, with the data provided by the EA and the survey, a MCA was applied using InfoStat® Software.

After analyzing various configurations that involve different variables, it was decided to select the most appropriate configuration according to the objectives of this investigation, the economic foundation and the statistical methodology applied. Therefore, Table 2 details the variables that make up this configuration:

Table 2 - Variables used in Multiple Correspondence Analysis

Variables	Definition	Categories
WTP	The participant is willing to pay more for a potato produced with lower agrochemical content.	1 = Yes 2 = Another case
SEX	Participant's sex.	1 = Female 2 = Male
PLAC	Participant prefers that a potato label contains a print that guarantees a lower content of agrochemicals.	1 = Yes 2 =Another case
LNC	Participant prefers that a potato label contains information about the nutritional content of the potato.	1 = Yes 2 = Another case
IIT	Participant prefers to be informed about the potato by means of internet and/or television.	1 = Yes 2 = Another case
VPLAC	Participant prefers to eat vegetables produced with lesser agrochemical content.	1 = Higher preference 2 = Another case
CONT	Participant considers that there must be an entity that controls the quality of the food and that it must be state-run.	1 = More agree 2 = Another case
BHD	Participant considers that eating potato is foremost in having a balanced and healthy diet.	1 = Higher importance 2 = Another case

*Source*: Author's calculation (Experimental Auction – April 2017).

The survey that complements and completes the Auction includes questions that underline categorical variables. Such is the case of the variables SEX, PLAC, LNC and IIT. But, also questions that reflect numerical variables, such

as VPLAC, CONT and BHD. These variables arise from the statements that the participants had to rate according to their degree of satisfaction with a scale ranging from 1 – nothing – to 10 – totally agree –. In order to transform them into categorical variables, the category "1" was assigned to the grades between 8 and 10 points, category "2" to the rest.

Regarding the WTP variable, it was found, taking into consideration two issues. As described in similar EA, such is the case of Roosen *et al.* (1998), in the survey, participants were asked to indicate whether they were willing to pay more for a potato with a lower content of agrochemicals. For all those participants who answered "Yes", it was verified if in Round 5 of the EA – after receiving oral and written information – they had opted more for the Frital INTA variety than for the Spunta variety. Then, category "1" of the WTP variable represents the desire to pay more and to have bet more on the variety of potatoes produced with less use of agrochemicals (Frital INTA).

The corresponding biplots allow us to observe the separation of the participants who are willing to pay more for a potato produced with a lower content of agrochemicals (WTP1) than those who are not (WTP2)[2]. The accumulated inertia in the first three axes was 51.64%.

Figure 4.1 - Participants' characterization – MCA –, axis 1and axis 2
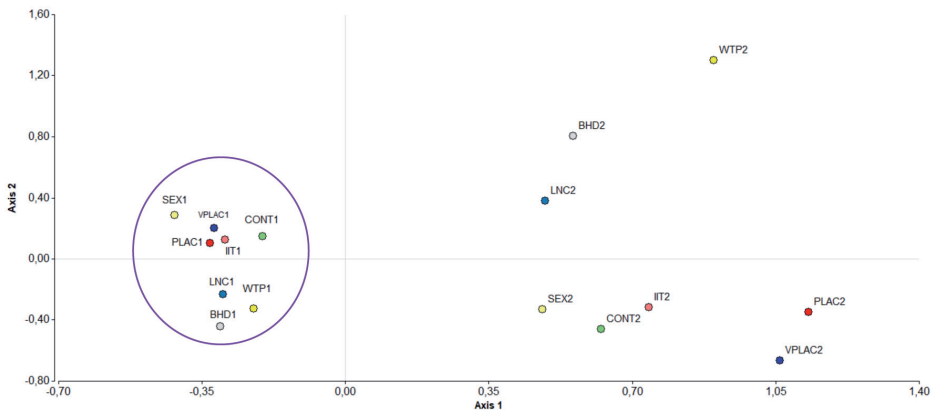
2. The WTP variable was constructed considering the desire to pay more (data that arises from the survey) and to have bet more on the INTA Frital potato variety produced with less use of agrochemicals (data that arises from the EA). Then, category 1 of the variable brings together both issues.

Figure 4.2 - Participants' characterization – MCA –, axis 1 and axis 3
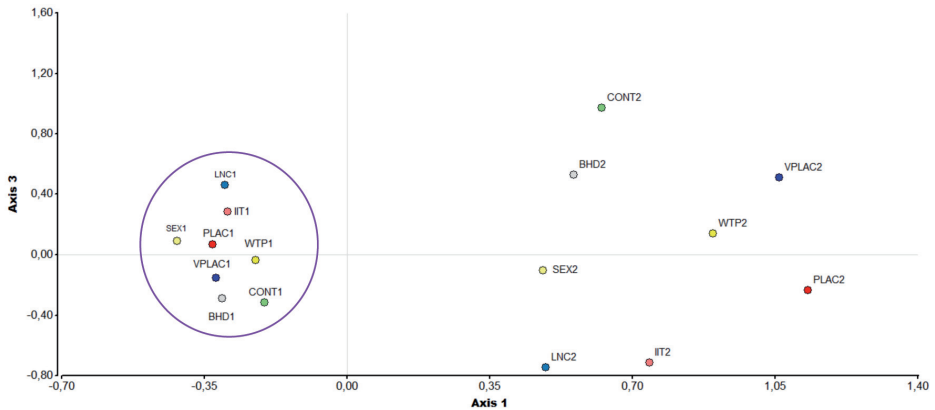
An association pattern is distinguished between those who are willing to pay and the "female" sex (SEX1); the preference for a seal that guarantees the lowest content of agrochemicals (PLAC1) and information on nutritional composition (LNC1) on labels. A predilection was also seen regarding potato information gotten through the Internet and/or television (IIT1); the consumption of vegetables produced with less environmental impact (VPLAC1) and the opinion that there should be a state agency that controls the quality of food (CONT1); and that eating potatoes is relevant to following a balanced diet (BHD1). Hypothesis 2 is verified.

Eighty percent of the participants in the sample (124 cases) are willing to pay more for Frital INTA potato produced with a lower content of agrochemicals. Out of these 124 cases, 54.03% (67 cases) are women; 81.54% (101 cases) believe that potato labels must include a stamp that certifies the lowest content of agrochemicals and 65.32% (81 cases) information about their nutritional value. 72.58% (90 cases) choose the Internet and/or television as sources of information about the potato; 77.42% (96 cases) prefer vegetables produced with low environmental impact; 75.81% (94 cases) are in favor of the setting up of a state agency that controls the quality of food and 71.77% (89 cases) believe that potatoes are important for a balanced and healthy diet.

4. Discussion

This research paper addresses four research questions regarding the implementation of an Experimental Auction. Firstly, we obtained WTP

estimates on two varieties of potato and some basic information. We investigated further so as to see if additional product information influences the WTP, and if tagging and packaging could affect value. In addition to this socio-economic characteristics were analyzed, along with attitudes and purchase behavior.

Regarding our first question results showed that bids were higher for Frital INTA – produced with a low agrochemical use- than for Spunta variety – produced conventionally – from the beginning of the EA where the only information that consumers had was visual and tactile appreciation of the potatoes. There are many studies in which more than one product is compared, that is, researchers are usually interested in comparing bets for a conventional good with a similar good but that has at least one differentiated attribute (Lusk y Shogren, 2007; Martinez-Carrasco *et al*., 2006; Thorne *et al*., 2014; Nalley *et al*., 2004).

Our second research question showed us that when additional product information was available, bids modified. In the third round of bidding, when price references were known, a considerable change was seen in bidding. This result goes along with our expectations because participants possessed a current market price of Spunta. A behavior similar to that found by Gil y Soler (2006). Other authors, instead of price information being made avaible during the auction, preferred to make it available before the beginning of the EA (Martínez-Carrasco *et al*., 2012; Thorne *et al*., 2014). Likewise, rounds four and five, where in participants receive oral and written information in the Frital INTA potato's method of production, bets varied significantly. Results showed a bid rise of 63.23% in Round 4 and a rise of 65.16% in Round 5, compared to Round 1. Similar results were shown by Martinez-Carrasco *et al*. (2012) in a tomato study in Spain. The way in which the EA had been designed, didn't allow us to determine the best way of communication. Gil and Soler (2006) carried out a a study on organic olive oil and came to the conclusion that oral information is more efficient than written. Other auctions offered positive, negative and both information to participants and analyzed the effect on every consumer (Lacy & Huffman 2016; Kajale y Becker, 2014; Colson, 2009).

Regarding our third research question, we think it is of the utmost importance that consumers know about the attributes of a differentiated product at the moment of purchase. Grunert (2011) believed that sustainability alongside other food qualities (for instance, less chemical content) had to be communicated to consumers, because it cannot be observed or tested by consumers. So, food stuffs produced in a more sustainable manner, should carry this information via labelling. In the final auction round INTA Frital potato was shown in a new packaging with the afore-mentioned labelling and bidding was seen to rise considerably compared to that of Spunta. Drichoutis

(2009) asked if consumers really gave much importance to labelling, keeping in mind the higher costs this brings to the companies. This particular paper does not estimate packaging and labelling costs but we do think it is necessary to do so, so as to inform producers of the viability of a value-added product. Lastly, Lacy y Huffman (2016) found from a study carried out in the USA that consumers will pay more when it comes to food safety. It was seen that a higher price was paid because safety is associated with information.

Our fourth question was answered, by way of a questionnaire participants completed during the auction. Information was sought about participants' socioeconomic situations, demographics and preferences at the moment of purchase. Nayga Jr. (1996) found that gender, age and education influenced the buyer's trust (with or without agro-chemicals) and that these factors must be kept in mind when implementing information programmes. Our study showed that women were more agreeable to paying a higher price, coinciding with Govindasamy e Italia (1997) y Buzby y Skees (1994). Neither age nor family size came into the question differing what found Loureiro & Hine (2001) y Villano *et al.* (2016). Coinciding with Lacy y Huffman (2016), our analysis didn't show an influence of education or income regarding WTP. Quite different to what was found by Boccaletti y Moro (2000) on studying WTP in foodstuffs in Italy. People that perceive their diets as a life-style are more concerned about finding out product information regarding nutrition and health characteristics on labelling, as an example, chemical free (Drichoutis *et al.*, 2006). The importance a consumer gives to certain quality attributes influences labelling, an important factor at the moment of purchase. It can't be doubted that people who follow a healthy diet and lifestyle, will look for nutrition information in the labelling (Nayga Jr., 2000). Similar results were found in that in our analysis, consumers who were willing to pay more were those who believed that potatoes are a valuable contribution to a healthy diet and that labelling must give information about product nutrition.

5. Concluding Remarks

Given to the present day trend of "new consumers", researchers on this topic find themselves constantly updating methodology regarding products perception and the willingness to pay for quality. This research betters the information available to everybody concerned in the agro-alimentation field and those responsible for promoting better political policies regarding production and food sales. The purpose of this investigation was to identify the main attributes that coincide with potatoes of various qualities. For that, a Vickrey Second Price EA was developed so as to analyze prices that participants would pay for the auctioned product. The experiment was

backed up with a questionnaire, therefore obtaining further information about the participants' potato knowledge, more their individual social-economic situations and buying habits. Lastly, on compiling all the above-mentioned data, a MCA was set up, which showed a particular group of participants who were willing to pay a superior price for differential potatoes.

The results obtained can be analyzed from three different perspectives:

A. Consumer's view. At the beginning of the auction, it was evident that participants could only evaluate the potato visually and by touch, and that bets placed for a differential potato were higher, in general, that those for a classic potato. Moreover, as the participants received more information, both verbally and by leaflets, information in reference to culinary aptitudes and production methods, values were seen to change.

The Frital INTA variety rose in price, whereas the Spunta dropped. This price difference between both varieties broadened even more during the last round of the auction in which Frital INTA was presented with a particular tagged packaging. So, it was shown that consumers preferred differential potato, for its variety and production, and its novelty packaging. H1 was proved.

Finally, the MCA carried out allowed the identification of a group of participants with common characteristics willing to pay an additional value for the differentiated potato. H3 was proved.

From the data collected from the participants survey, it can be seen that the potato is an important element in a healthy, balanced diet. More so it was noted the necessity of a government entity to control food quality. Participants also added that they prefer a label that indicates low agro-chemical use and nutritional content. It was noted that consumers value the intrinsic information found on the potato label. This coincides with a higher price being paid for the Frital variety, packaged and labelled, at the EA.

B. Production perspectives. This analysis gives producers information on what consumers value when buying. Even though it is expected that producers will not make any changes regarding production methods or varieties produced in the near future, the possibility of access to participants views in this investigation may promote change in the following campaigns.

Regarding potato variety, it would be apt for producers to gradually incorporate other potato varieties; alternatives to Spunta. In this way, producers could offer a wider range of potato with diverse culinary characteristics. Also, it is evident that consumers like to be informed about the produce; producers must label the potato grown in an eco-friendly environment, so that at the moment of moment of purchase consumers know what they are buying.

C. Academic views. The contribution made by this research focuses on the implementation of the EA for the collection of primary data. Although over

the last years this method has been applied internationally for food study, Argentina presents little or no evidence of such a method. This experimental method allows us to try some theories out regarding auctioning as a way to monitor participants behaviour regarding payment for a differential foodstuff.

6. Limitations and future research

Finally, we find it necessary to comment on the limitations of this investigation, for future possible studies.

The results cannot be extended to the population residing in the City of Mar del Plata, because the sample is representative of the Economics and Social Sciences School at Universidad Nacional de Mar del Plata instead of the city. Consequently, the study should be replicated with a representative sample at the local level. Also, the study should increase the number of cases. In this way, results could be specified by estimating econometric models.

Nonetheless, EA design implemented prevents determining if the bids made by participants in each round, contemplate only the stimulus received in that round or they reflect the accumulation of stimuli received in the previous rounds. The previous idea impeded the individual assessment of the attributes of potatoes in question. This could be corrected with an experiment that combines different treatments to be applied in different groups – for example, a group that do not receive information (*status quo*) vs. others that receive various stimuli –. Likewise, it would be convenient to test the experience with other potato varieties produced in the Southeast of Buenos Aires province (for example, Innovator, Kennebec, Daisy) or with a single variety but produced in a conventional way and with a lower content of agrochemicals or organic.

Also, it would be ideally convenient to calculate the cost of potatoes marketing with packaging and labelling in order to know the additional necessary price that the producer would have to obtain for a differentiated potato, and compare it with the consumers' willingness to pay.

However, the contribution made focuses on the implementation of the EA for the collection of primary data since, in Argentina, there is little evidence of the application of this method. In addition, the results indicate the relevance of making consumers aware of the attributes of a differentiated potato and identifying it correctly with a label that allows it to be distinguished. This being a guide for those Sector agents interested in improving product quality and reorienting their strategies for commercialization.

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Per la valutazione degli articoli proposti nel 2020, *Economia agro-alimentare/Food Economy* si è avvalsa dei seguenti collaboratori. A tutti loro, vanno i più vivi ringraziamenti del Comitato di Direzione e della Segreteria di Redazione.

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