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Research article

The contrasting mosaic of consumers' knowledge on local plant genetic resources sustainability vis a vis the unawareness for indigenous farm animal breeds

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Abstract: Unlike the conservation of wild plants and animals, which is a global policy issue, the conservation of locally cultivated plant varieties and indigenous breeds of farm animals is largely dependent on the farmers' choice to exploit them. This choice is subsequently influenced by consumer perceptions. As various local genetic resources of local plant varieties and farm animal breeds are of low productivity, they are not preferred by farmers and are therefore at risk of extinction. Consumer perceptions of food products originating from local genetic resources play a crucial role in the conservation of agrobiodiversity and sustainability of the primary sector, particularly in rural areas where short food supply chains can be more easily developed. The present study investigated consumer knowledge and opinions regarding products from local indigenous genetic resources in a rural area of particular agricultural importance: Western Macedonia, Greece. According to the findings, consumers have positive perceptions concerning local plant varieties and indigenous farm animal breeds, indicating their willingness to pay, but highlighting the requirement for reliable labeling. Interestingly, although Greece has a great diversity of indigenous farm animals, the public in the research area is only familiar with local plant varieties. Factors such as age, income and education level show a positive correlation with awareness for sustainability and conservation of local genetic resources.

Keywords: local plant varieties; indigenous farm animal breeds; consumers; perceptions; food products; genetic resources; sustainability

1. Introduction

A sustainable food sector may be greatly enhanced by the production and marketing of local products. This hypothesis is strengthened by the adoption of the holistic concept of "local seasonal food", which could be approached according to the pillars of sustainability and conservation, allowing green growth of lower environmental footprint [1]. Seasonality of products may be responsible for reduced fruit and vegetable consumption; however, the environmental impacts on water stress, land-use alterations, and biodiversity could be mitigated when local genetic resources are valorized in balanced diets in comparison with food of international origin [2], which entails significant losses of resources such as energy and water. Thus, maintaining environmental sustainability in food systems may be influenced by consumers' dietary choices as well.

Local products from indigenous genetic resources cannot be simply equated with sustainable products and, more importantly, do not have necessarily a lower carbon footprint [3]. Indeed, the sustainability of food systems is not possible to be characterized a priori, needing to be determined by considering a variety of factors and assessed on an ad hoc basis. The terms "traditional foods" and "indigenous foods" may sometimes overlap, but they are not always synonymous. Considering cultural origins, traditional food usually refers to dishes and cuisines that have been passed down from generation to generation in a particular culture or region. It may include foods that have been influenced by various cultures over time. More specifically, traditional food derives from traditional production practices as well as local heritage related to gastronomy identifying specific geographical areas of oriented territories [4]. On the other hand, indigenous is a term for the description of local genetic resources that have evolved through time. Traditional foods do not necessarily come from indigenous resources. For instance, in Greece, fried Atlantic cod is considered a traditional dish for an annual national celebration. Nevertheless, this fish does not inhabit the Greek Seas, thus is not an indigenous food.

At the same time, the phenomenon of globalization has affected traditional foods, which evolve and adapt over time according to dietary preferences. They incorporate new ingredients and cooking techniques while maintaining their core identity. On the other hand, indigenous foods face challenges from globalization, including the loss of traditional knowledge, cultural assimilation, and environmental threats to indigenous ingredients. Efforts are often made to preserve and promote indigenous foods as part of cultural heritage conservation. In summary, we could conclude that while traditional food includes culinary traditions from various cultures and regions, indigenous food is connected with specific geographic areas. Indigenous foods are deeply connected to the cultural identity and livelihood of local communities and often reflect their historical relationship with the land and natural resources. The actual meaning of "local food" is described by three components with characteristics of a geographical, a geopolitical, and a biological point of view. In this context, it is important to investigate each time which local food products perform best and on which sustainability criteria [5]. The elaboration of these criteria is quite complex and a considerable part of them relates to subjective perceptions related to the preferences of individuals. Therefore, the concept of sustainability and conservation is not necessarily linked with local products but is related

to consumers' perceptions of them. Nevertheless, consumers understand that there is a link between the conservation of local genetic recourses and the production of local food, whereas knowing the concept of sustainability can convince them to modify their preferences [6]. Therefore, reducing the range of agri-food chain transactions at the local level may be a promising solution for more sustainable food production systems [7].

Insecurity prevails in the food industry, as environmental pollution, questionable food safety, and social unrest constitute factors that tend to drive consumers to seek reliable sources of supply that ensure food authenticity [8]. Trust, which is a characteristic that develops between consumer and producer, can be very easily lost and is quite difficult to rebuild [9]. Consumers' attitudes towards nutrition are greatly influenced by the lack of trust in the producer-entrepreneur of local products [8]. Additionally, the trust that can exist between producer and consumer through common points of contact can contribute to healthier and more sustainable local community food supply practices [10], as well as to the conservation of local genetic resources [11]. The expectation of good-quality local food products, environmental protection, local development, and accessibility to the producer turns into a one-way path in the light of the concept of green growth [6]. Local farmers are interested in supporting consumers, thus enhancing the development of local food chains, an approach challenging for them and for researchers [12].

Overall, consumer perceptions regarding local products from local genetic resources are considered very important for a comprehensive view of the local traditional food products of each region and their importance for society, the natural environment, sustainability, and conservation of agrobiodiversity. At this point it is necessary to mention the importance of nutrition supported by goal 2 of the SDGs, i.e., zero hunger. Thus, ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture are the actions supported and strengthened through the United Nations. The point that directly concerns and reinforces the theme of our research is target 2.5, i.e., to maintain the genetic diversity of seeds, cultivated plants, and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional, and international levels. Additionally, this target promotes access to fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed [13]. In this context, the present study evaluated consumers' perceptions of products derived from local varieties and indigenous breeds, in an area of low population density and particular rural importance. In particular, the paper presents the results of a questionnaire survey of consumers with regards to their preferences about these products and their perceptions about their contribution towards elements of regional economic, social, and environmental sustainability. To our knowledge, this is the first study in Greece that evaluates consumer preferences about indigenous plant varieties and livestock breeds.

Overall, the paper's structure will be as follows. After presenting the method and the research tools, the analysis and description of the research results follow, utilizing the IBM SPSS software (version 29.0) with a defined level of significance $P \leqslant 0.05$. Finally, the discussion and the conclusions that will arise from the research data are inferred from the findings in combination with previous studies comparisons and investigation.

1.1. Literature review

Recent challenges such as climate change require adjustments that support the balance and

sustainability of the agroecosystem. Indigenous crop and livestock genetic resources are often better adapted to local agroecosystems, possessing sufficient genetic diversity to successfully withstand the effects of climate change [11]. Nevertheless, in order to preserve these indigenous plants and animals, it is necessary to ensure that their products are accepted by consumers at the same time. Consumers often prefer indigenous plant varieties for a number of reasons. In a study carried out in Spain to explore consumer perceptions of purple carrots from the Teruel region, an indigenous variety at risk of genetic erosion, there was a positive acceptance of purple carrots by the majority of the region, which could contribute to a sustainable recovery of this market [14]. Additionally, in a survey carried out in Italy, consumers attached great importance to the local origin of food products, especially if they are consumed fresh. At the same time, it was indicated that better taste and higher quality are auxiliary characteristics, which enhance the choice of local foodstuffs [15]. During the coronavirus pandemic, a survey was conducted to investigate consumer perceptions of traditional products produced in the Epirus region of Greece. The respondents chose traditional products because of the quality-price ratio, their nutritional properties, the strengthening of the local economy and, more generally, because of the social impact they believe they cause by purchasing these products. An important point worth mentioning in the results is that the respondents would recommend the specific local products to other consumers as well [16]. In a similar survey carried out in Romania, the results showed that consumers buy at least one traditional local food. In addition, the same research concluded that consumers attach great importance to the content of their products, their origin, and taste, while the categories of local products that are chosen in high proportion are milk and dairy products, followed by honey and other local meat products [12]. In all aforementioned surveys, external characteristics such as color, local variety, and organic production were considered, along with consumers' socio-demographics, their consumption and purchasing habits for plant products, knowledge about them, hedonic preferences, and the intention to buy at better prices.

It is also of high importance for farmers to realize the benefits of constant agrobiodiversity monitoring, which may influence the effectiveness of market interventions and collective actions, as well as following-up events in development and conservation initiatives [17]. In Finland, the results of a survey on local products promoted and sold on a social networking platform demonstrated that, regardless of age, gender, and household size, consumers have a favorable attitude and emotional attachment to local foods distributed by the specific platform. On the other hand, it is important to emphasize the price factor, which was shown to be an obstacle to the choice of these products [18]. In the tourist destinations of Trebizond and Podhale, in Turkey and Poland, respectively, visitors are very familiar with their local products supporting their traditional cuisines and emphasizing the value of their certification [19].

According to the perceptions of farmers and consumers regarding local food products, they are considered of better quality, safer, and more affordable than imported ones. At the same time, local products may contribute to the promotion of the local community, as consumers are willing to pay more to acquire them [10]. For instance, the trade of indigenous chicken products in Ghana can be improved to contribute to its future potential success in local markets while achieving satisfactory prices for both the producer and the consumer [20]. Consumers are often open and interested in high-quality meat products from local breeds, but with additional information that should be highlighted. Some consumers wrongly attribute the cause of wildlife extinction to high demand for the products of local breeds, confusing the concept of endangered animals with rare indigenous breeds of reared animals [21].

It should be noted, however, that indigenous breeds are often of lower productivity and have evolved through local adaptations and genetic isolation [22]. For instance, the seasonality in the reproduction of local small ruminant breeds in the Mediterranean leads to the production of cheese and other dairy products only in specific periods annually [23]. Thus, farmers tend to replace indigenous breeds with improved ones, usually from other origin, leading the former to the risk of extinction. For instance, in Greece, more than 10 sheep breeds are considered to be endangered, counting less than 1500 animals each, whereas the French breed Lacaune is the major sheep breed currently reared in Greece. Interestingly, EU regulation labels certifying the origin of local food products, namely Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI), do not always require indigenous local genetic resources, but only cultivation or rearing and processing in a defined geographical area, following traditional methods [24]. One stage of the production process in a specific geographic area is sufficient for labeling a product as PGI, whereas all production stages in combination with recognized know-how are needed for PDO labeling [25], but not necessarily a local plant variety or an indigenous farm animal breed. For instance, feta cheese and Prespa bean, two representative Greek PDO products, may be produced by the non-Greek sheep breed Lacaune and the Elephant bean variety, respectively. According to the Greek law, feta cheese can be produced by any sheep breed traditionally reared and adapted to the Greek local environment that has also fed on local flora. Thus, those EU regulations do not necessarily ensure conservation of local genetic resources; instead, market orientation and consumer preferences are elements that are more likely to ensure the preservation of these resources, particularly in rural areas of low population density [17].

2. Materials and methods

2.1. Study area

The study took place in the region of Western Macedonia (RWM), Greece (Figure 1), the one with the lowest population density (26.9 residents per square kilometer) among the nine Administrative Regions of mainland Greece [26]. According to the 2021 census, the region of Western Macedonia had 283,689 inhabitants. The region is considered to be sparsely populated, but is nevertheless known for its rich natural beauty, mountainous landscapes, as well as its cultural richness. It is an area with significant agricultural activity. However, agriculture faces challenges such as unemployment and a shrinking labor force due to migration to urban centers. Therefore, unemployment is a serious problem in the region, especially among young people. The region presents the highest rates of population reduction in the whole country [26] over the last decades; this is largely due to the transition that the regional economy is actually experiencing. Indeed, electricity production accounts for more than 50% of regional gross domestic product but, following the implementation of recent European Union directives, electricity production based on lignite is due to cease until 2033. This radical and abrupt change highlights the need to restructure the local economy, either by finding new income-generating activities or by rediscovering and reconfiguring existing ones.

In this context, the primary sector is a safe and promising alternative. The agriculture sector in the area includes mainly arable crops, viticulture, and tree cultivation; concerning animal production, the vast majority of the farmed animals are sheep, as it is a typical Mediterranean semi-mountainous area with diverse rangelands. Among these, the identified indigenous breeds of farm animals in the region of Western Macedonia are the Florina sheep breed and the Prespa cattle breed. Local varieties

of cultivated plants are the Florina pepper and the Prespa bean. Apart from these, numerous other indigenous farm animal breeds and local plant varieties from other parts of Greece are exploited in the region. Land uses in RWM (Figure 1) comprise agricultural areas (49%) equally with forests and semi-natural areas (47%). RWM also produces numerous certified products, including feta cheese and crocus (which are certified PDO; beans and apples are PGI). Taking into account the importance and tradition of agriculture and livestock farming in RWM, the area is indicative to explore consumers perspectives concerning local indigenous sources of the primary production sector as a working example of how local genetic resources can provide an alternative development pattern for other areas in transition. Thus, the agricultural sector in RWM enacts an expected decisive role in the local economy, whereas the region is indicative for the investigation of consumers' views on indigenous resources as a simulation model for sparsely populated rural areas.

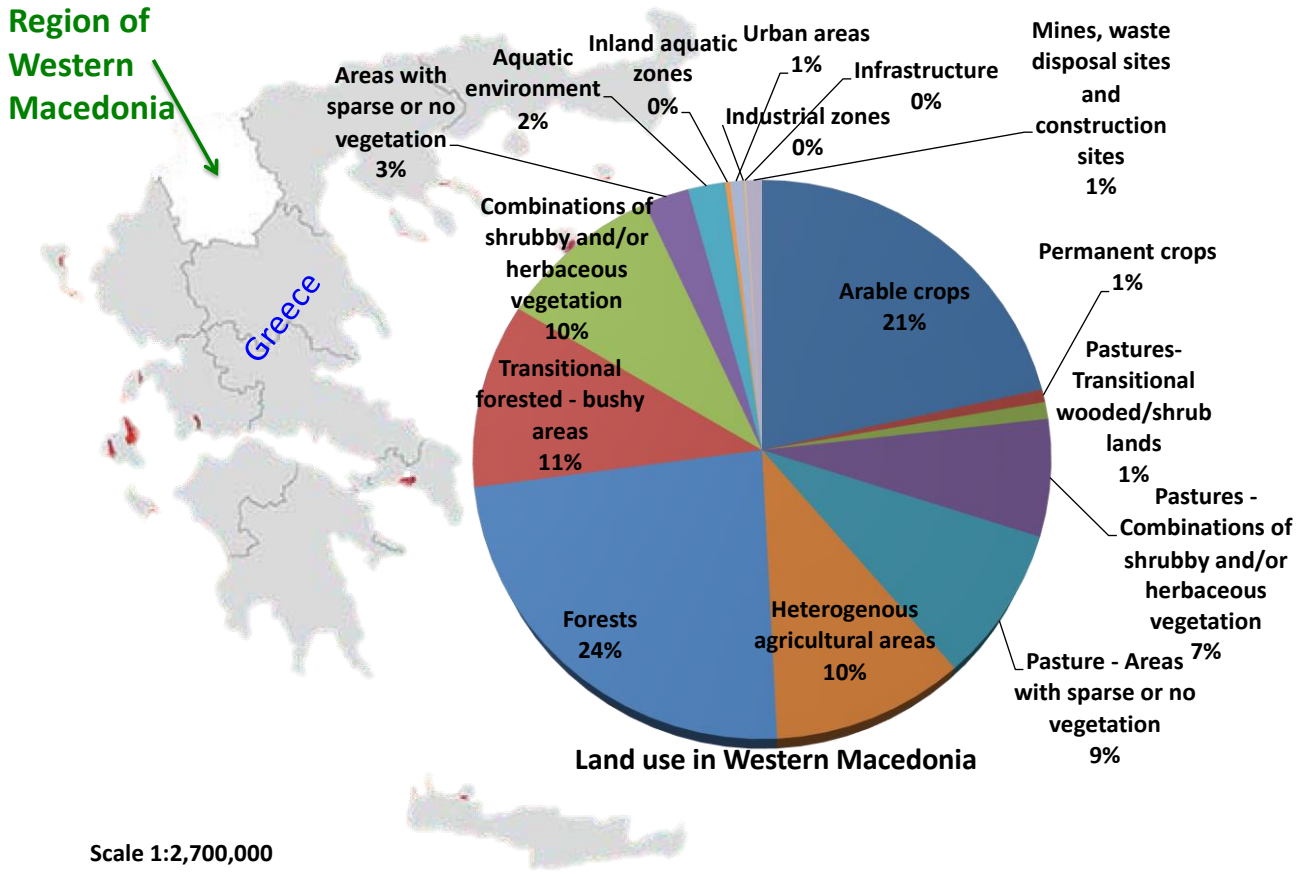

Figure 1. Location of the region of Western Macedonia and land use in the area.

2.2. Sampling, data collection, and research tool

The collection of data was conducted in accordance with the Declaration of Helsinki in the framework of M. Tampaki PhD and was approved by the Administrative Assembly Institutional Board of the Department of Agriculture of the University of Western Macedonia (protocol number

1470/29-07-2021). The survey took place from September to December 2022, using a structured questionnaire that included close-ended questions. Most closed-ended questions were formulated with a Likert scale. The choice of Likert scale over alternatives is briefly attributed to the following reasons. Likert scales are scales of respondent agreement with a point of view. The case of using a five-point scale presents the positive characteristic that it enables the respondent to position himself in a neutral-middle point or to choose a clear position towards one or the other direction of the scale. At the same time, on a five-point scale (odd number of positions) the respondent can choose the middle answer if he/she wants to indirectly avoid answering the question or take a position. The data were collected using the questionnaire, the construction of which was based on criteria examining the perceptions, attitudes, and preferences of the residents of the Western Macedonia region in relation with products derived from local varieties of plants and indigenous breeds of animals. In particular, questions examined the willingness to pay for products originating from local genetic resources, trust for their origin, the potential of these products to provide satisfactory incomes to producers and local economy, labeling, perceptions on product pureness and quality, contribution towards the protection of tradition and cultural heritage, the potential to increase the recognizability of RWM, and the need of conservation of these resources for future generations. In addition, a few open-ended questions were presented to respondents, in order to record the degree to which participants recognized local plant varieties and farm animal breeds from Western Macedonia and Greece in general. Particularly, the participants were asked to refer to plant varieties and indigenous animal breeds from Western Macedonia and Greece in general. Analysis of open-ended questions was conducted in correlation to close-ended ones related to knowledge, in an attempt to confirm the validity of the answers as well as to evaluate the true recognition of local plants and animal breeds.

The initial form of the questionnaire was tested on a small sample of 20 respondents in order to detect potential ambiguities or parts that were not clear and required additional clarifications. After that, the questionnaire was finalized and was addressed to respondents through in-person interviews. In order to strengthen the reliability of our findings, it is deemed necessary to clarify that the sample was random and defined within specific geographic boundaries. In addition, as mentioned above, the same research tool was reviewed at the beginning of our research to confirm the reliability of our findings. The collection of research data was performed by the authors in various ways. Some of the respondents were located and interviewed on the street, others in the squares, and some of them via the internet since the questionnaire had a digital format in addition to the printed one.

2.3. Statistical analysis

The statistical exploratory analysis was carried out based on the Chi-Square test (x^2 test) with a mixed model test according to a number of hypotheses. Chi-square test is not recommended to be used if the sample size is less than 50. In our study, 146 consumers were explored for the needs of the survey, providing the required power for the analysis. The aim of our work was to capture and present consumer views on agricultural products from indigenous genetic resources while Chi-square tests were applied to validate for goodness of fit, homogeneity, and independence. Further, the Pearson correlation method [27] was carried out to investigate the dependence between the variables related to the profile of the respondents such as gender, age, place of residence, level of education and income, and the variables that express the perceptions and preferences of the consumers concerning the purchase of products from local plant varieties and indigenous animal breeds. All

analyses were performed in the software IBM SPSS (version 29.0) and significance was set at $P \leqslant 0.05$. In addition, to further explore the consumer's willingness to pay for products derived from local plant varieties and/or indigenous breeds of farm animals according to Polanco et al., we also used the interpretation shaped by the methodology of Choice Experiment [13].

3. Results

The survey was conducted on 146 consumers from all four Regional Units in RWM, i.e., prefectures of Kozani, Grevena, Florina, and Kastoria (Table 1). Descriptive details for the sample are provided in Table 1.

Table 1. Descriptive details of the sample investigated.

	Age (N)	Population of place of residence (N)	Education level (N)	Personal Income (Monthly) (N)
Female (80)	18 to 25 years old (23)	under 1,000 inhabitants (11)	I haven't finished primary school (0)	Up to €800 (47)
	26 to 44 years old (38)	1,000 to 5,000 inhabitants (5)	Primary school diploma (3)	801 - 1500 € (24)
	45 to 56 years old (14)	5,000 to 20,000 inhabitants (49)	High school diploma (3)	1501 - 2000 € (5)
	57 to 67 years old (3)	20,000 to 50,000 inhabitants (10)	General/Vocational High School Diploma (9)	2001 - 2500 € (0)
	over 67 years old (2)	over 50,000 inhabitants (5)	Technical Education/Private Schools/IEK (10)	over 2501 € (4)
			TEI – University (46)	
			Master's degree holder (9)	
			Other (0)	
Male (66)	18 to 25 years old (13)	under 1,000 inhabitants (7)	I haven't finished primary school (1)	Up to €800 (24)
	26 to 44 years old (29)	1,000 to 5,000 inhabitants (2)	Primary school diploma (1)	801 - 1500 € (33)
	45 to 56 years old (18)	5,000 to 20,000 inhabitants (44)	High school diploma (2)	1501 - 2000 € (5)
	57 to 67 years old (4)	20,000 to 50,000 inhabitants (10)	General/Vocational High School Diploma (17)	2001 - 2500 € (2)
	over 67 years old (2)	over 50,000 inhabitants (3)	Technical Education/Private Schools/IEK (4)	over 2501 € (2)
			TEI – University (32)	
			Master's degree holder (7)	
			Other (2)	

Elements of the respondents' profile were correlated with the degree of knowledge about local genetic resources, interest in their conservation, and perceptions of products derived from them. The data collected through the primary survey open-ended questions demonstrated that the majority of the respondents, at a percentage greater than 95% in all profile categories, regardless of age, gender, income, education, or place of residence, are aware of at least one local plant variety cultivated in the study area. These correct answers included Prespa beans, Florina pepper, and Krokos Kozanis (suffrom). On the other hand, interestingly, only a total of 6.1%, i.e., 9 out of the 146 respondents, could correctly name an indigenous farm animal breed, which was the Florina sheep breed, with wrong answers including "local sheep" and "local goats". Thus, it can be concluded that consumers' knowledge regarding local genetic resources is mostly limited to plant varieties. From the results of the statistical correlation test, it emerged that there is a statistically significant relationship [x^2 (4) = 14.261, p-value = 0.007 <0.05] between the gender of the respondents and their view on whether products from local plant varieties provide a satisfactory income to producers. 44.5% of all participants agree that products from local plant varieties provide a satisfactory income to producers, while only 21.3% disagree (Table 2), with women expressing uncertainty more often and opting twice as much for the "Neither agree/nor Disagree" option than men.

Table 2. Perceptions for satisfactory income from local plant varieties in correlation to gender.

		Gender			
		Female	Male	Total	P-value
		N (%)	N (%)	N (%)	
Satisfactory income	*Strongly disagree*	8 (5.5)	0 (0)	8 (5.5)	0.007
	Disagree	8 (5.5)	15 (10.3)	23 (15.8)	
	Neither agree nor disagree	33 (22.6)	17 (11.6)	50 (34.2)	
	Agree	22 (15.1)	23 (15.8)	45 (30.8)	
	Strongly agree	9 (6.2)	11(7.5)	20 (13.7)	

Concerning age, there was a statistically significant relationship [x^2 (16) = 33.957, p-value = 0.006 < 0.05] between the age of the respondents and their opinion on whether products from local plant varieties provide an adequate income to producers. Table 3 shows in detail the responses of all the age groups. It is noteworthy to mention that nearly half (45.9%) of the respondents between 26 and 44 years old, which is 18.5% of all respondents, agree that these products offer a satisfactory income.

Furthermore, a statistically significant relationship [x^2 (16) = 37.080, p-value = 0.002 < 0.05] was observed between the age of the respondents and their opinion of labeled products from indigenous breeds of animals. It appears that 77.4% of all respondents want product labeling, while only 0.7% do not. It is worth noting that 44.5% of respondents between 26 and 44 years old want product labeling. This is consistent with the lack of knowledge noted by the open-ended questions, regarding indigenous farm animal breeds.

Notably, the answer "the products are not pure" to the multiple-choice question "Products derived from local plant varieties and/or indigenous animal breeds" was not statistically significant [x^2 (4) = 9.650, p-value = 0.047 < 0.05] in all age groups (Table 3). It is noteworthy to mention that 98.6% of responders believe that the products are pure. According to the scale of age, 45.2% of responders between 26 and 44 years old have the same opinion.

Table 3. Quality of products, labeling, and income perceptions in relation to age.

		Age						
		18–25	26–44	45–56	57–67	over 67	Total	P-value
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Satisfactory income	*Strongly disagree*	4(2.7)	2(1.4)	1(0.7)	0(0)	1(0.7)	8(5.5)	0.006
	Disagree	3(2.1)	7(4.8)	7(4.8)	4(2.7)	2(1.4)	23(15.8)	
	Neither agree nor disagree	10(6.8)	31(21.2)	8(5.5)	1(0.7)	0(0)	50(34.2)	
	Agree	13(8.9)	15(10.3)	14(9.6)	2(1.4)	1(0.7)	45(30.8)	
	Strongly agree	6(4.1)	12(8.2)	2(1.4)	0(0)	0(0)	20(13.7)	
Labeling of products	*Not at all*	0(0)	0(0)	0(0)	1(0.7)	0(0)	1(0.7)	0.002
	A little	2(1.4)	2(1.4)	0(0)	1(0.7)	0(0)	5(3.4)	
	To a moderate extent	9(6.2)	10(6.8)	3(2.1)	3(2.1)	2(1.4)	27(18.5)	
	A lot	16(11)	41(28.1)	19(13)	2(1.4)	2(1.4)	80(54.8)	
	Too much	9(6.2)	14(9.6)	10(6.8)	0(0)	0(0)	33(22.6)	
Quality of product	the products are pure	36(24.7)	66(45.2)	32(21.9)	6(4.1)	4(2.7)	144(98.6)	0.047
	the products are not pure	0(0)	1(0.7)	0(0)	1(0.7)	0(0)	2(1.4)	

The statistical correlation test demonstrated a significant relationship [x^2 (16) = 26.605, p-value = 0.046 < 0.05] between the respondents' place of residence and the Likert scale question "Are you willing to pay more for products from local plant varieties and/or indigenous animal breeds?". It appears that almost half (49.3%) of all respondents have the intention to pay more for these products, while about 16% of them may not, with only 7.5% of the sample explicitly saying no. It is worth mentioning that 32.2% of those who live in small towns, with 5,000-20,000 residents, have the same opinion. In the questionnaire, there are questions referring to food products derived from local varieties of cultivated plants and/or indigenous breeds of farm animals. In all these questions, the study objective was the concept of local and indigenous origin and not whether the product is plant or animal. Thus, the wording of these questions was such that it included all plant and/or animal food products.

Similarly, by examining the same variable, the statistical correlation test demonstrated a statistically significant relationship [x^2 (228) = 276.175, p-value = 0.016 < 0.05] between the respondents' place of residence and the multiple-choice question "The purchase of products from local varieties of plants and/or from indigenous breeds of animals", with the options "has a moral interest for me" and "makes me feel proud" (Table 4). Willingness to pay was estimated based on monetary terms, i.e., how much money the participants are willing to pay for local genetic resources.

Table 4. Willingness to pay and place of residence.

		Place of residence						
		Under 1000	1000–5000	5000–20000	20000–50000	Over 50000	Total	P-value
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Intention to pay	*No*	0(0)	0(0)	9(6.2)	2(1.4)	0(0)	11(7.5)	0.046
	Probably not	3(2.1)	0(0)	9(6.2)	1(0.7)	0(0)	13(8.9)	
	Maybe not/Maybe yes	9(6.2)	4(2.7)	28(19.2)	5(3.4)	4(2.7)	50(34.2)	
	Probably yes	3(2.1)	0(0)	31(21.2)	2(1.4)	1(0.7)	37(25.3)	
	Yes	3(2.1)	3(2.1)	16(11)	10(6.8)	3(2.1)	35(24)	

The education level seems to play an important role in several aspects related to agricultural products from local genetic resources, since a statistically significant relationship [x^2 (12) = 21.246, p-value = 0.047 < 0.05] was observed between the respondents' level of education and the Likert scale question "Products from indigenous animal breeds protect the tradition of a region". It is worth mentioning that 80.1% of all respondents agree with that statement, and that 45.8% of respondents with university education also endorse the same response.

Another statistically significant relationship that emerged [x^2 (12) = 21.119, p-value = 0.049 < 0.05] is between the respondents' level of education and the Likert scale question "Products from indigenous breeds of animals provide a good income for producers", with the five response options strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree. Nearly a third (30.2%) of all respondents disagree with the above sentence, while 23.9%, of them who have university education have a different opinion.

A statistically significant correlation [x^2 (12) = 21.160 p-value = 0.048 < 0.05] occurred between the respondents' level of education and the Likert scale question "Would you like there to be relevant labeling on products from indigenous breeds of animals?". Table 5 shows in detail the different responses by level of education, with 77.4% of all respondents agreeing that they want relevant labeling on products, while only 0.7% saying no. This could be due to the desire of consumers to know more about the nutritious characteristics of these meats; food labelling also communicates confidence to the consumer that those characteristics are available on the product. It is also noted that 45.8% of respondents with university education endorse this specific option.

Finally, results indicate a statistically significant correlation [x^2 (16) = 31.637, p-value = 0.011 < 0.05] between the respondents' income and the Likert scale question "Products from indigenous animal breeds protect the tradition of a region". Table 6 shows in detail the responses of people with different categorized income and as a whole. It appears that 80% of all respondents agree that products from local genetic resources protect the tradition of a region and that 37.3% of those with income under 800 euros per month also agree with this statement.

Apart from tradition, a statistically significant relationship [x^2 (16) = 28.362, p-value = 0.029 < 0.05] occurred between the respondents' income and the Likert scale question "Are you willing to pay more for products from local plant varieties and/or indigenous animal breeds". Table 6 also shows in detail the responses per income group and as a whole. It appears that half (49.6%) of all respondents would pay more for these products, while only 15.9% would not. Also, 22.8% of those with income under 800 euros per month would also pay more for products from local genetic resources.

Table 5. Statistical correlation of education level with views on protection of tradition, income and labeling.

Level of education							
		Primary school education	High school education/Technical Education/Private Schools	T.T.E—University	Master degree	Total	P-value
		N (%)	N (%)	N (%)	N (%)	N (%)	
Protection of tradition	*Strongly disagree*	1(0.7)	0(0)	1(0.7)	0(0)	2(1.4)	0.047
	Disagree	0(0)	2(1.4)	1(0.7)	1(0.7)	4(2.7)	
	Neither agree nor disagree	1(0.7)	8(5.5)	10(6.8)	4(2.7)	23(15.8)	
	Agree	1(0.7)	24(16.4)	37(25.3)	4(2.7)	66(45.2)	
	Strongly agree	2(1.4)	12(8.2)	30(20.5)	7(4.8)	51(34.9)	
Satisfactory Income	*Strongly disagree*	0(0)	0(0)	1(0.7)	0(0)	1(0.7)	0.049
	Disagree	4(2.7)	20(13.7)	16(11)	3(2.1)	43(29.5)	
	Neither agree nor disagree	0(0)	15(10.3)	27(18.5)	9(6.2)	51(34.9)	
	Agree	0(0)	8(5.5)	24(16.4)	2(1.4)	34(23.3)	
	Strongly agree	1(0.7)	3(2.1)	11(7.5)	2(1.4)	17(11.6)	
Labeling of products	*Not at all*	0(0)	1(0.7)	0(0)	0(0)	1(0.7)	0.048
	A little	1(0.7)	2(1.4)	2(1.4)	0(0)	5(3.4)	
	To a moderate extent	3(2.1)	9(6.2)	10(6.8)	5(3.4)	27(18.5)	
	A lot	1(0.7)	24(16.4)	50(34.2)	5(3.4)	80(54.8)	
	Too much	0(0)	10(6.8)	17(11.6)	6(4.1)	33(22.6)	

Following the above responses, the multiple-choice question "I seek to consume products from local plant varieties and/or indigenous animal breeds so that..." shows a significant correlation [x^2 (224) = 281.637, p-value = 0.005 < 0.05] between respondents income and the two main response options, i.e., "to protect the cultural heritage" and "to make my area more widely known", followed by the answer "to save these resources for future generations".

Table 6. Statistical correlation of income levels with "protection of tradition" and "intention to pay" for local genetic resources.

Income								
		Under 800 euros	801–1500 euros	1501–2000 euros	2001–2500 euros	Over 2501 euros	Total	P-value
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Protection of tradition	*Strongly disagree*	1(0.7)	0(0)	1(0.7)	0(0)	0(0)	2(1.4)	0.011
	Disagree	1(0.7)	2(1.4)	0(0)	1(0.7)	0(0)	4(2.8)	
	Neither agree nor disagree	15(10.3)	6(4.1)	1(0.7)	0(0)	1(0.7)	23(15.9)	
	Agree	31(21.4)	30(20.7)	2(1.4)	0(0)	2(1.4)	65(44.8)	
	Strongly agree	23(15.9)	19(13.1)	5(3.4)	1(0.7)	3(2.1)	51(35.2)	
Intention to pay	*No*	6(4.1)	2(1.4)	1(0.7)	0(0)	2(1.4)	11(7.6)	0.029
	Probably not	5(3.4)	6(4.1)	0(0)	0(0)	1(0.7)	12(8.3)	
	Maybe not/ Maybe yes	27(18.6)	18(12.4)	2(1.4)	2(1.4)	1(0.7)	50(34.5)	
	Probably yes	11(7.6)	18(12.4)	6(4.1)	0(0)	2(1.4)	37(25.5)	
	Yes	22(15.2)	13(9)	0(0)	0(0)	0(0)	35(24.1)	

4. Discussion

The survey revealed that while the majority of consumers seem to be aware of several local varieties of plants produced in their area, they show a significant lack of knowledge about indigenous livestock breeds, despite the recognition of the need for their conservation. In line with this lack of knowledge, consumers generally prefer food labeling that includes information on environmental and social responsibility but also motivation for human health [28]. The label should become an element of identification and personalization of each local traditional product as well as the geographic region of origin, since it seems that people have some confidence in the information they receive from the labels of traditional local foods [12]. Regulating geographical proximity or political boundaries indicated on labels can increase the consumption of local seasonal products and reverse the aforementioned lack of knowledge. Both young people and those with a high level of education consider the label to be very important for local products, especially those of animal origin. In agreement with these findings, in tourist destinations, visitors are often very familiar with local products and even find traditional cuisines attractive. At the same time, they consider that the labeling of local products is a very important element that facilitates the recognition of products that have the relevant certificate [19]. Nevertheless, the knowledge that the respondents have about these products is not so accurate, since they do not know that in many cases the alleged local products are imported varieties, such as the Florina pepper, which comes from Mexico.

The production line for a local food product does not ensure a reduced environmental impact compared to a global product simply because it is produced close to consumption. On the other hand, a smaller carbon footprint of a global food does not ensure greater sustainability than a local product [1]. Labeled agri-food products because of their characteristics, such as selected ingredients and specific

production processes, generate additional marketing costs that result in higher prices. However, consumers expressed the desire to consume certified or labeled agri-food products, particularly due to health safety and a perceived commitment to sustainability and local development [29]. Consistent with the pattern of knowledge about local plants versus local farm animal breeds that has emerged, the majority of previous studies have focused on branded local plants of various regions [30]. In a survey that took place in Italy, there was a very positive perception of the local dairy product Toma di Lanzo. Specifically, it was found that regarding cultural identity, the conservation of genetic resources, and the choice of the specific local product, women, non-permanent residents, and respondents with an average educational level had the most positive perception [31]. It is worth mentioning that, in Asia, the consumer's intention to purchase sustainable food is greater than what prevails in America and Europe. This may be due to the lower price of the products and the diversified market but also the appropriate label indicating the quality of sustainable food. At the same time, the same survey concluded that young people prefer sustainable food more than older people [32]. It should be noted that European consumers in general are convinced that labeled food products are of better quality [25], whereas only those whose priority is related with convenience do not prefer labeled traditional products [4]. On the other hand, for farm animals, when local consumers know the local breed, they are willing to pay more for its meat [33]. In a survey conducted among young residents of European countries, the results showed that some of the traditional products they consume can affect their close environment, while the media can enhance their choice in acquiring traditional foods [34]. The level of education of consumers can indeed influence their decision to consume products with a low impact on the environment [35]. Effective and transparent communication between farmers and consumers is of high importance, pointing out that gender, age, place of residence, the educational level, and family size significantly influence the consumption of local dairy products in the region [36]. Nevertheless, it should be kept in mind that these do not necessarily come from indigenous farm animal breeds but are only reared in the region.

The results also indicated that mainly low-income consumers intend to consume products from local plant varieties and/or from indigenous animal breeds in order to strengthen the local community. At the same time, mainly women, young people, and those with post-graduate education consider that growing local varieties and/or breeding indigenous breeds can provide a satisfactory income for the producer. In most cases this is a misconception, since indigenous animal breeds are usually not improved and are hence of lower productivity. Demographic variables, such as age, education level, gender, social class, and place of residence can provide important information on consumer perceptions of local food products. A higher social class is associated with higher income and usually with a higher educational background, thus requiring higher quality and more expensive food products. Gender can also affect food purchasing, as women are sometimes the ones who choose to operate or shop in short food supply chains [8].

Although it is expected that the majority of the respondents, mainly the educated and with higher incomes, consider the raising of indigenous breeds and local crops important, it is interesting that they have a strong view on the value of their conservation. It has been proposed that the intention to buy local products represents a desire to satisfy emotional needs, connected to the feeling of moral obligation to support the local economy and society [37,38]. At the same time, it has been shown that the role of government intervention, especially in developing countries, can help the participation of producers in short food supply chains [39]. It should be noted that EU policies support the cultivation of local indigenous genetic resources with financial support for the producer.

Nevertheless, it is important to mention the financial difficulties faced by producers in the province during the pandemic. Recent research conducted in the Region of Epirus, Greece, confirms these results, i.e., that even in the pandemic, consumers felt that local products could help strengthen the local community [16]. Despite the social adversity of the coronavirus pandemic, local communities face new challenges and opportunities related to enhancing local food production [6]. In particular, after the pandemic, a pattern of consumer behavior has emerged, characterized by a change in purchasing behavior. Consumers are now choosing local products to a greater extent, even in the food sector, while online shopping has now gained a large share of the market [40]. During the pandemic, food was bought mainly from supermarkets and not yet via the Internet [16]. This particular period increased the commitment to localism and the demand for products from nature-friendly production systems. Further, consumers prefer to buy local products either directly from farmers or from a store directly managed by the farmers themselves [41]. Similarly, research has indicated that consumers express a clear preference for buying national food products, such as bread and tomatoes, due to cultural choices. At the same time, they consider the proximity of consumers and producers as a top selection criterion for local food markets [15].

An important information about consumers in the study area is the intention to pay for products derived from local varieties and/or indigenous breeds. In this light, the data collected led to the conclusion that rural community respondents as well as low-income earners are willing to pay more for products from local plant varieties and/or indigenous animal breeds. Consumers' willingness to pay for sustainable food products and conservation-related issues varies with different sources of heterogeneity. Thus, it is observed that gender, region, sustainable characteristics, and categories of food influence the perceptions and intention of consumers to buy sustainable food [32]. However, the price of traditional products may influence young people mainly from Western Europe regarding their decision to buy these products [34]. Similar results were found in a study conducted in China, in the Naxi minority, known for producing "Dongba" paper in a traditional way. The raw material they use in the area comes from an indigenous variety of forest trees; the socio-economic study conducted on visitors showed that the sample respondents did not know about the history and indigenous variety of trees, but were willing to pay for their protection and acquisition, and considered it important to highlight the authenticity of the products in order to establish consumer confidence [42]. Similarly, research was conducted in Hawaii, a tourist destination of global interest, and the origin of some of the local products that make up the famous Hawaiian food: Kona coffee, Mahi Mahi fish, Maui golden pineapple, and raw Poke fish. Surveys revealed that visitors are willing to pay more for local products and are interested in buying them and also being informed about them by participating in special cultural food experiences, a fact observed in different animal products elsewhere, too [43,44]. Furthermore, in a survey carried out in Kenya on whether consumers are willing to pay a higher price for meat and eggs from indigenous chickens, the results obtained were interesting, as it appeared that consumers were willing to pay more for meat and even more for eggs from that breed of chicken. However, factors that influence this behavior include age, educational level, family size, prices of substitute products, and other sensory characteristics of the native chicken products they purchase [41]. In a study conducted in Italy, with local food being cheaper than imported food, consumers were willing to pay an average price for local food due to its higher quality and freshness [15]. Research in Serbia showed that consumers with a higher level of education responded positively to the willingness to pay more for local honey products, which is reinforced by the assumptions that, in this way, the environment is protected and at the same time

consumers' eating habits improve [45]. Last but not least is the case of Polanco et al.: in the choice experiment methodology, they mention how attributes and levels are used in choice sets. In agreement with this research, we could relate the results of our own research and report that, also in our case, the respondents' desire to pay showed statistically significant results in the category of their salary and in the population of the place of residence. There were five levels for each category, and those with an income of 800 euros and a population of 5,000–20,000 inhabitants were distinguished, respectively [46]

The sustainability, viability, and economic efficiency of the primary production sector are, to a great extent, influenced by consumer behavior. Conservation of local genetic resources is closely linked to the perceptions of consumers who may choose to support local small food supply chains. Interpretation of public opinion for local food resources can be a reference point in the design of future agricultural policies, strengthening the local communities. The current study investigates consumers' views on local indigenous plant varieties and farm animal breeds, in a sparsely populated rural area.

The findings of the present study emphasize the interest of consumers to buy products originating from local varieties and/or indigenous breeds, because they consider them safe. Young people aged 26–44, low-income earners up to 800 euros, and residents of rural areas with up to 20,000 inhabitants consider these products to be safe and pure. In the agriculture and food sector, consumer confidence has sometimes been affected by problems arising from a lack of food safety as well as inappropriate production practices used, including the use of new technologies. However, to establish trust, the creation of shared values between producer and consumer is considered by many to be very important, even though values vary according to socio-demographic variables as well as culture. An important element in enhancing trust may be the implementation of more points of contact and connections between consumer and producer in the production and supply chain. At the same time, the consumer could be more extensively informed about the value chain of primary products, which would increase transparency and trust [9]. Food safety related to traditional foods can stand in the way of young people's decision to buy them, although the appropriate packaging and the necessary certifications tend to improve young people's abstinence and tend to motivate them to choose traditional products [34].

This research reveals consumers' views on products from local varieties and/or indigenous breeds while considering the protection of tradition in the specific areas. It is important that the areas that make up the region of Western Macedonia have kept many of their customs and traditions unchanged over the years. This fact alone could be a bridge for the preservation of all the local and traditional food products of the region. But the question is whether the consumer public has realized it. The research showed that low-income and highly educated consumers believe that local products can protect the tradition of the region. From a survey conducted in European countries, it emerged that consumers consider the effect of sensory properties in relation to traditional foods, and especially pork, and sensory quality played an important role in consumer preferences. At the same time, combining product information with its taste sensory properties tended to reduce any differences in expectations. In the same research, it appears that information about traditional products from indigenous pig breeds has significantly increased consumer expectations, especially when consumers know the product as well as its production system [38]. The production of local products is considered particularly important, as it has been shown that it can benefit their sustainability and the conservation of genetic resources. This is understandable as local food producers share a common heritage due to cultural and historical ties to their regions, while at the same time consumers appear to value local food products. Using the concepts of supply and demand

in a local food market requires improved credibility features and a stronger label image in order to differentiate products and achieve an increase in their supply and demand [10].

5. Conclusions

In conclusion, despite the lack of knowledge about farm animal breeds, there is a strong consensus in support of local genetic resources of both plants and animals, which is reflected in the demand for reliable labeling. Agricultural policy should focus more on raising public awareness, particularly on indigenous farm animal breeds [47]. Hence, the agricultural policy model of Figure 2 is proposed for future research, based on consumer perceptions, towards sustainability and conservation of local plant varieties and indigenous farm animal breeds. Of course, in a theoretical framework, products derived from local plant varieties and/or indigenous breeds of farm animals would be expected to be acceptable in the daily diet of consumers. Nevertheless, in practice, social factors shape very differently what ultimately happens in a society and how each consumer decides to get involved. Recapitulating, it is worth mentioning that the limitations of this research are mainly limited to the defined geographical boundaries, the defined time of use of the research tool, and the availability of human resources to collect the data. As far as the future research agenda is concerned, it would be of great interest having specific research with appropriate adaptation to be performed only in a specific social group of the region, e.g., women, teenagers (15–17 years), or young people (18–25 years).

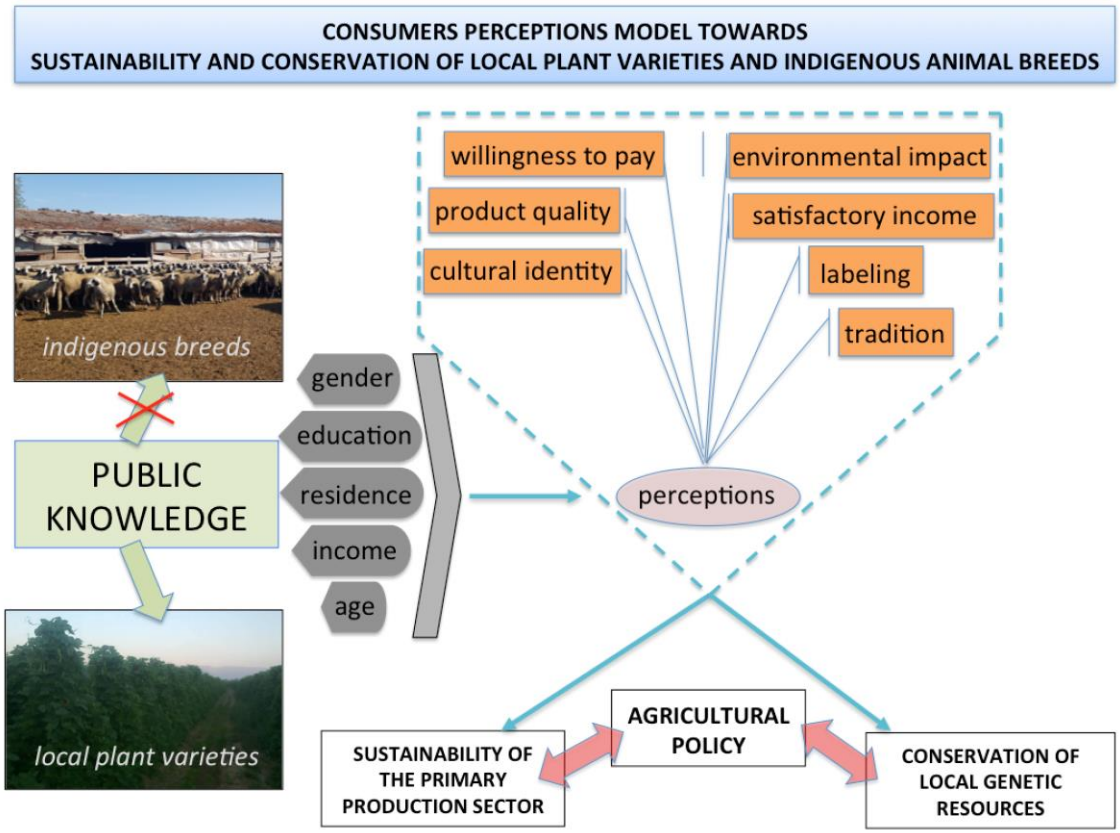

Figure 2. Proposed agricultural policy model, reflecting consumer views on local plant varieties and indigenous livestock breeds, with sustainability and conservation as its scope.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Conflict of interest

The authors declare no conflict of interest

Authors contributions

Conceptual idea: M. Tampaki; I. A. Giantsis; Data collection: M. Tampaki; A. Ragkos; Data analysis and interpretation: M. Tampaki; G. Koutouzisou; K. Melfou; Writing and editing: M. Tampaki; I. A. Giantsis.

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