AQUACULTURE STUDIES

RESEARCH PAPER

Tunisian Consumer Behavior and Acceptance of Farmed Fish Versus Wild Fish and Its Determinants Factors

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Abstract

The objectif of this article is to assess Tunisian consumer behavior towards aquatics products. It examines the main factors influencing consumption of these products and investigates farmed fish perception versus wild fish. A survey including 300 respondents was made. Descriptive statistics, factor analysis and an ad hoc model were used to analyse the data. The results revealed that all respondents have a positive perception for fish and are very aware of its nutritionnal value and health benfits. However, there is a big gap between this opinion and the actual fish purhase which remains weak among poor and very variable between consumers. Significant factors affecting Tunisian consumers behavior towards wild and farmed fish include income, price, education level, origin, age and gender. Freshness and species availability influence interest of local consumers for these products. Survey Results showed also that farmed fish remain little known by 40% of consumers and less appreciated that wild fish. About 59.7% of the interviewees didn't consume aquaculture products because of their taste, prices, feeds and veterinary treatment. About 70.3% of respondents thought that farmed fish are of a lower quality than caught fish. Raising consumers awareness about fish breeding and improving their knowledge through scientific informations related to safety and healthiness of these products could help to improve image, acceptance and consumption of aquaculture. Supplying inland area by good quality farmed fish especially cheaper freshwater species could increase demand for this type of fish.

Introduction

World fish production reached a record level of 223.2 million tons. About 185.4 millions tons are intended for human consumption (FAO, 2024). Fish products provide about 20% of animal protein (Van Hecke et al, 2023). Their role in food security and nutrition is becoming increasingly crucial thanks to its predominantly healthy and nutrition image (Verbeke et al, 2005). Fish products are recognised also as a source of a good quality protein, vitamins and minerals micronutrients. It seems to have beneficial effects on reducing the risk of certain diseases including cardiovascular diseases and tumors (Pal et al, 2018).

Likewise, the increase of the world population and the improvement of consumers purchasing power have been accompanied by an increase in fish consumption. It has grown steadily at an annual average rate of 3% since 1961 and has increased five times from the amount consumed 60 years ago. However, global fish

consumption reached 20.6 kg per capita in 2022 compared to 9.9 kg per capita in the 1960s (FAO, 2022). Indeed, this situation has increased the pressure on fish stocks around the world and has led to the depletion of certain species. Therefore, this increasing in fish consumption has been accompanied by an overfishing which made wild fish stocks unsustainable and unable to meet future needs for these products (López-Mas et al, 2021). Aquaculture has become a necessary complement of fisheries (Vanhonacker et al, 2013) to remedy the deficit between fish demand and supply and to preserve wild fish populations. Aquaculture consists on the breeding or cultivation of aquatic organisms: fish, seafood and aquatic plants by human intervention in order to improve aquatic production. It has developed very rapidly, especially since the end of 1980s. It has reached 94,4 million tons in 2022 which represented 50.91% of the total aquatic production (FAO, 2024), compared to only 17 million tons in 1960.

Thus, aquaculture has become a main producer of aquatic animals. It is increasingly expected to play a key role in food security and nutrition by offering a wide range of species at moderate prices (Belton et al, 2017). Its rapid growth has attracted the attention of researchers to study this sector in particular its acceptance by consumers. Vanhonacker and al (2011) noted that the use of antibiotics and the high density followed in cattle and sheep farms transferred a negative image in fish farms. Vanhonacker et al (2013) investigated the farmed fish image comparatively to wild fish in Europe and noted that European consumers preferred the latter. Kupsala (2013) have demonstrated that farmed fish welfare is better than that of wild fish but consumers still have little confidence in these aquaculture products. Yeşilsu et al (2019) found that Turkish consumers believe that farmed fish taste and texture is less good than that of wild fish. Consumers were also careful about the farmed fish contamination and beleive that their feeds, breeding environment and veterinary treatments were causes of this contamination.

López-Mas et al (2021) showed that the image of farmed fish among consumers is less positive than that of fish caught.

Concerning fish consumption determinants, several factors including consumers origin (coastal or continental), socio-demographic factors (traditions and habits, age, gender) are mentionned in litterature (e.g Murray et al., 2017; Govzman et al., 2021; Sacchettini et al., 2021).

This article contributes to analyse wild fish consumption versus farmed fish in Tunisia thus studying Tunisian consumer behavior toward these products and determining factors that could affect their consumption. We also analyzed the perception of farmed fish to understand whether it could replace wild fish and meet tunisian demand for animal protein. In Tunisia, so far, no study has been made on this topic.

State in Tunisia

Fisherie and aquaculture sector has a particular socio-economic dimension in Tunisia because it contributes to local consumption, gross domestic product and employment. Indeed, this sector contributes to supplying Tunisians with animal proteins at about 13.37 kg per capita per year (INS, 2021) and employs directly and indirectly about 100.000 jobs. The total average annual production during period (2000-2023) was estimated at 127952.25 tons.

Aquaculture began in 1960 with mussel culture in the north of the country (Bizerte lagoon). The breeding of carp, mullet and tilapia in fresh water followed this activity early (1970). Subsequently and in the same decade, Tunisia started the marine aquaculture with the breeding of sea bass, sea bream, sole and shrimp in the north (Ghar El Melh). More precisely in 1985, a national aquaculture center was created in order to control the artificial reproduction and to promote the private sector especially through the breeding of two species: sea bass and sea bream. Much later and specially in the 1990s, aquaculture master plan have been realised with the development of continental aquaculture. Since 2003, was born the fattening of bluefin tuna in floating cages in the open sea. The last few years have been marked by the expansion of marine aquaculture, particularly the breeding of sea bream and sea bass. This growth was, in part, the result of the adoption of national plan and strategies for the development of aquaculture sector. Indeed, the Tunisian goverment has carried out the Master Plan for Aquaculture (1996-2006) which estimated the potential and the production target for each sector. In the period (2000-2016), the national strategy for the aquaculture development was elaborated and has focused on encouraging private promoters (CTA, 2023). A technical center of aquaculture was also established in 2007.

Following State encouragement and privatisation measure, aquaculture has seen a remarkable growth, increasing from 3000 tons in 2006 to 20526.66 tons in 2023. The contribution of aquaculture production to total fish production increased from 7% during the period 2006-2016 to 14% in 2023 (ONAGRI, 2025). Its average production during period (2000-2023) was in order to 14001.405 tons (Figure 1.).

Regarding Tunisian fish consumption, the recorded quantities according to the National Institute of Statistics of Tunisia are fluctuating. In fact, in 1990, fish consumption was around 9.9 kg per capita per year followed by a decrease to 7.7 kg per capita per year in 1995. Afterward, it again recognized a raise to 11.5 kg per capita per year in 2005 followed by a decrease to 10.8 kg per capita per year in 2015. Then it has seen an arise in 2021 reaching about 13 kg per capita per year. However, the value of aquaculture consumption has not yet been quantified alone.

Materials and Methods

Data Collection

This study was carried out in Tunis city and its suburbs. This choice was jusfified by the fact that this area is characterized by the strongest popular concentration (two-thirds of Tunisian population), constitues the most important economic pole in the country and contains the widest socio-economic diversity (Mtimet et al, 202).

Survey was made in random using a pre-tested and semi-structured questionnaire. Personal face-to-face interviews of 20 to 30 minutes was adopted. The quota sampling method was elaborated with reference to the study undertaken by Mtimet et al (2020) to study Tunisian organic food consumption. Thus, the national statistical distribution of individuals considering age and gender as clusters has been followed. Consumers were interviewed near fish market and in public gardens during moments of rest and relaxation. Before that, the questionnaire was extensively tested to structure the questions well, use the suitable terminology and facilitate their understanding.

A total of 300 people were interviewed. They were all over 25 years old with a proportion of 49% men and 51% woman. About age variable, 30.7% of respondents are aged between 25 and 35 years, 31.7% belonged to the age stratum 36-45 years, 23.3% of them are aged from 45 to 55 years and the rest (14.3%) were over 60 years old. Consumers ' characteristics are summarized in Table 1**.**

To understand the Tunisian consumers' behavior towards aquatic products, a survey questionnaire constituted of 41 questions was developed. These questions were grouped into four sections : consumers socioeconomic characteristics (origin, age, gender, education level, marital status, household size, occupation and salary), consumption and attitude towards aquatic products (factors associated to seafood consumption and the reasons for non-consumption, fish purchase attributes, fish consumption frequency and quantity, purchase place, species consumed, state of purchased fish, cooking method, budget allocated), consumption of farmed fish and its image (farmed fish knowledge, ability to differentiate it from wild fish, attitudes towards these products, consumed species, consumption frequency, reasons for non-consumption, preferred calibe, willingness to by farmed fish if price drops), Quality perception (quality signs knowledge, willingness to pay a higher price for certified products, the most preferred product among meat products: fish, chicken, red meat).

Methodoly

The survey data collected was processed using the SPPS software. It followed two stages. At first, a descriptive analysis assessing the Tunisian consumer behavior and acceptance of farmed fish versus wild fish was carried out. Secondly, this work was completed by an econometric analysis using factor and ad hoc model. The principal component was used to treat variables simultaneously and condense them into a limited number of factors in order to reduce the size of the original data matrix as much as possible. (Kennedy et al., 2005; Kennedy et al., 2008; Hair et al., 2010). Principal component is purely descriptive and assumes no probabilistic model, permit to analyze the relationship between variables and simplifies results
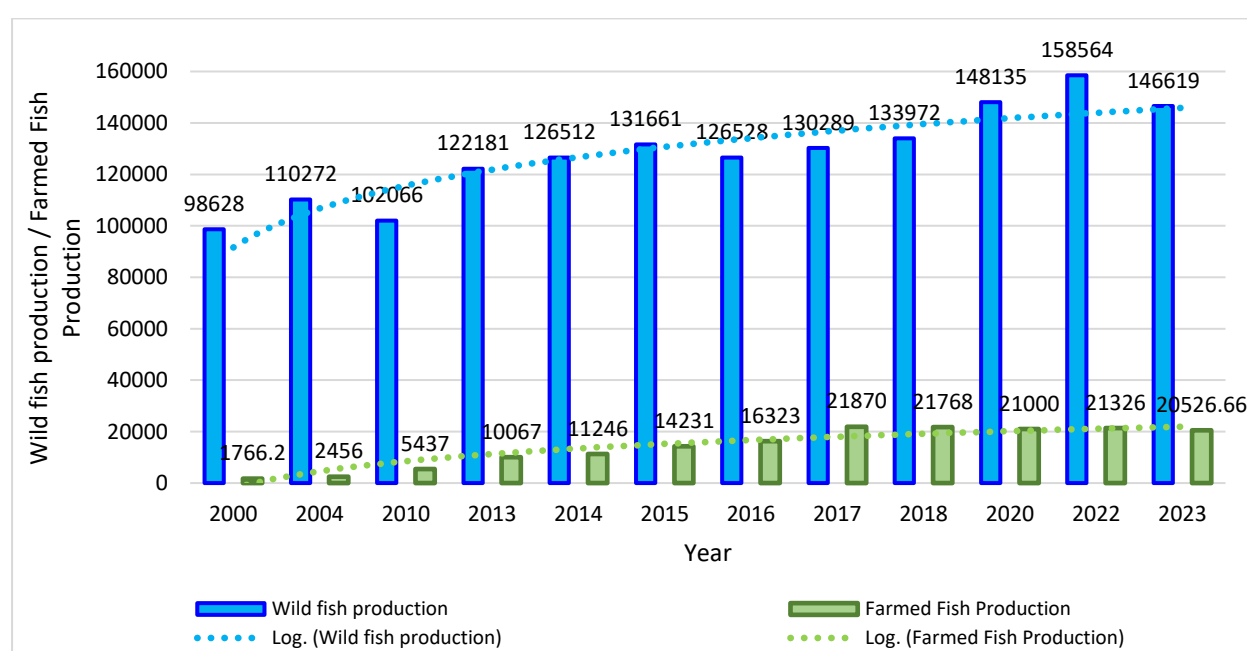

Figure 1. Evolution fish production in Tunisia (ONAGRI, 2025).

Table 1. Sample sociodemographic characteristics

		Percentage %
Gender	Woman	51
	Man	49
	Total	100
Age	25-35	30.7
	36-45	31.7
	46-60	23.3
	>60	14.3
	Total	100
Education level	Illiterate and primary	20.3
	Secondary level	24.0
	Higher level	55.7
	Total	100
Civil status	Married	68.7
	Single	28.7
	others (divorced or widowed)	2.6
	Total	100
Household size	Lives alone	4.1
	Two to three members	24.3
	Four or more members	71.6
	Total	100
Occupation	Civil servants	33.3
	Workers	34.0
	Unemployed	13.3
	Students	11.7
	Retirees	7.7
Salary	< 650 TND	59.3
	650-2000 TND	31.3
	> 2000 TND	9.4
	Total	
Origin	North	40.0
	Center	26.45
	South	33.35
	Total	100

comprehension. The ad hoc model was used to pattern the Tunisian fish consumption in aim to identify the main factors influencing its consumption. This model enabled us to study the relationship between consumption and socioeconomic variables like income, fish prices, consumers origin, education level, age and gender and other intrinsic fish properties (taste, freshness). The estimation tool used was Eviews. The logarithmic function estimating the model is as follows:

$$Log\ Q_i = C + R_i + \alpha_i\ Log(p_i) + \sum_{j=1}^{n} \beta_j\ (F_J)$$

Where, Q_i: quantity consumed of fish i (fish), C: constant, α_i: direct elasticies, β_j: cross elasticies, p_i: fish price i, R_i: consumers' income i; F_j: Socio-economic factors (j) relating to consumer i.

The model is statistically significant and consistent with economic theory. The consumption is validated at 60%.

Results

Descriptive Analysis

Tunisian Consumer Behavior Towards Wild Fish

The large majority of the interviewees consume fish (96%). The rest (only 4%) are non fish consumers because of their allergy to these products. All of them have a positive image of fish and believe that it is a healthy and nutritional food. About 45% of respondents rank it as the most preferred animal protein source surpassing red meat and chicken. Regarding consumption trend, fish consumption among necessitous is decreasing. About 65.4% mentionned that the price was the first cause of this decrease. Poor quality and the unavailability of preferred species (cheap fish) was declared also as causes of declining of their fish purchase respectly by 25.2% and 9.4% of respondents.

In terms of fish consumption frequency, those who have a very low or seasonal consumption, mainly during the spring season (when the availability of cheap fish increases especially blue fish: sardines) represent the highest percentage (39.9% of respondents). While who commonly eats fish (more than twice a week) is poorly represented and not exceeding 5%. About 21% of respondents eat fish once a week and 34.7% of them eat less than once a month.

About fish consumption quantities, the highest percentage (34.3% of respondents) corresponds to consumers who consume less than 1 kg per month, followed by those who consume 1 to 2 kg per month (56.3% of the consumers in our sample). Only 10% of respondents consume more than 10 kg of fish per month.

The largest majority (86% of respondents) consume fish at home and the grilled mode is the most pronounced (35.7% of respondents) followed by fried and baked cooking mode. The prepared cooking method is expressed by the respondents.

Results show also that wild marine fish is most preferred and purchased (78.3% of respondents) compared to other marine species (molluscs and crustaceans). The most purchased species are sardines, anchovies, mackerel, red mullet, sea bream, horse mackerel, bogue, and mullet.

Aquaculture products hold the second place after wild fish and comparetively to shellfish and frozen products but with a relatively low percentage. Only 10% of Tunisian consume farmed fish more than other aquatic products.

Regarding the fish state purshased, 86.3% of respondents mentionned that they buy it in its natural state and only 10% buy cleaned fish. Those who purchase cut and filleted fish are a minority and does not exceed 3.7% of respondents. The most frequented fish purchase place is markets. It was ranked by 38.7% of respondents followed by fishmongers then supermarket respectly with 30.3% and 17.7% of interviewees. Fishermen and itinerant vendors are the least frequented by consumers in our sample (12.7%). The fish seller choice is determined mainly by hygiene, proximity and trust in the seller (respectly 54.20% and 45.80% of respondents respectively).

Fish Intrinsic attributes influences too Tunisians fish choice. Five criterias were suggested to classify those which determine their choice: freshness, taste, price, less thorn and the presence of a label. Although the price is decisive, however, Tunisian gives an extremely attention to the freshness. In third place, comes the taste, followed by the "less thorn" criterion. The "presence of label" was mentioned at the last.

Farmed Fish Consumption and Perception

By asking consumers about farmed fish knowledge and consumption, 40% of them didn't know them and 59.7% didn't consume them. According to their statement, the causes of their reluctance are their taste (39.6%), price (33.7%), feeds and veterinary treatment (26.7%). The main aquaculture species consumed as

reported are sea bass and sea bream with the caliber of 250 gr (40%). Freshwater species are still little known by consumers. Compared to wild fish, 70.3% of respondents thought that farmed fish are of lower quality and 12% beleive that the two types of products are similar. Only 6% of the interviewees find that farmed species are of better quality, while 11.7% of them didn't differentiate the quality of these two products.

Econometric Analysis

In this section, we modelled fish consumption in Tunisia in order to identify the main socio-economic variables and intrinsic fish properties that directly or indirectly affect it. After repeated tests and combinations, 14 variables were selected from 41 in our survey data. These variables are endogenous and exogenous to consumers and cover structural, social and economic aspects.

Before proceeding with the principal component analysis, a correlation matrix analysis was carried out to verify the low correlation between variables. The results show that all variables are slightly correlated and some relationships are stronger than others. The correlation coefficients are significant, ranging from 0.02 to 0.8. The value of the correlation matrix determinant is non zero (equal to 0.001) and the problem of data matrix identity does not arise (Table 2).

To measure the degree of sample adequacy to the studied population, the Kaiser-Meyer-Olkin (KMO) index was calculated. This signficativity test is 0.7. Bartlett' sphericity test is significant (P<0.001), demonstrating good reduction (Table 3).

Principal Component Analysis

Principal component analysis was applied to determine respondents perception of wild and farmed fish in order to highlight the most factors that determine its consumption. Their perception represented by 14 components were examined to understand whether

Table 2. Correlation matrix after rotation

1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1,000	,620	,240	-,068	-,134	-,041	,026	,140	,032	-,021	-,116	,231	,305	,055
2		1,000	,386	-,020	-,158	-,017	,114	,167	-,024	-,204	-,223	,025	,093	,081
3			1,000	,017	-,174	-,404	,140	,206	-,016	-,247	-,314	,042	,053	,057
4				1,000	,042	-,132	,026	-,013	,008	-,107	-,016	-,065	-,051	-,017
5					1,000	,136	-,145	-,117	,079	,239	,150	,118	,132	,106
6						1,000	-,146	-,033	,069	,213	,161	,102	,082	,061
7							1,000	-,018	,033	-,108	-,004	-,093	-,062	-,012
8								1,000	-,489	-,424	-,711	-,300	-,301	-,315
9									1,000	,301	,670	,446	,461	,481
10										1,000	,575	,659	,594	,530
11											1,000	,407	,415	,435
12												1,000	,853	,767
13													1,000	,821
14														1,000

a. Determinant= ,001

they could be grouped into a smaller number of factors. After rotation, the fourteen initial variables were reduced to four components that explained 66% of the cumulative variance (Table 4). These components summarize wild and farmed fish perception by Tunisian consumer. It was named as follows:

The first component named "organoleptics" focuses on the impact of fish taste and other intrinsic characteristics on consumers preferences. These characteristics are related to their quality (specially feeding and veterinary treatment) as well as their availability and price. The second component entitled "Well-being" groups three variables: consumers income, educationnal levels and fish prices. The third component called "Structure" groups consumers age and their family size. The fouth component named "Social and habits" related the consumers geographic origin and their appetite for eating farmed and wild fish.

Fish Consumption Modeling

Results of fish consumption modelling are illustrated in Table 5. They confirmed that consumption of aquatic products is positively influenced by consumer income and educational levels. Indeed, the income increase is converted into a higher consumption of these products which confirm that is a normal good. Similarly, consumers with high educational levels are more willing to consume fish than those with lower educational levels. They are more likely to make better and more reasoned choices fish. The prices of aquactic products and the geographic origin of consumers are negatively correlated with fish consumption. In fact, the increase of fish prices reduces thier consumption. Seafood consumption for coastal people is much higher than that of inland people reflecting therefore the influence of local tradition and habits. Age and gender have also a negative influence on fish consumption

Discussion

Results shows that the majority of respondents, except allergic people, consume wild fish and were very aware of its nutritionnal value and health benefits. Compared to other kinds of meat notably (poultry, red meat), fish is the most preferred.

However, a big gap between consumers perception and their attitude towards fish is revealed. Indeed, despite their high awareness about the benifits of the products (being healthy and nutritious), the quantities consumed remain quite low specially among poor. Consumption among costal people is very high compared to those in the interior areas. This resultat has already been mentioned by Draief et al (2011). Inland consumers, even if they change their residence from inland to coastal area, their fish consumption remains low. Results showed tha fish prices and consumers' income influence fish consumption in Tunisia as revealed by Dhehibi et al.,1999.

This research based on consumer surveys was consistent with the results found by Barhoumi et al (2024) studying fish and others meat demand in Tunisia using national panel data during the periode (1985-2015). It showed that prices of fish and others meat,

Table 3. KMO index and Bartlett test

Kaiser-Meyer-Olkin sampling accuracy measure.		0.693
Bartlett' Test of Sphericity	Approximate Chi-Square	1754.485
	ddl	78
	Meaning of Bartlett	.000

Table 4. Principal components matrix

	Component			
	1	2	3	4
Unavailability	.829	.318	.149	.192
No aquaculture Consumption due to Feeding	.829	.384	.128	.166
No aquaculture consumption due to chemical treatments	.801	.291	-.006	.196
No aquaculture consumption due to high price	.787	-,129	.183	.077
Aquaculture consumption	.776	-.297	-.269	-.268
No aquaculture consumption due to taste	.684	.034	-.341	-.210
Frequency of aquaculture purchases	-.628	.273	.388	.238
Budget allocated	-,119	.761	.128	-.283
Quantity cons_c	,048	.743	.255	-.247
Level of education	-.193	.681	-.294	.251
Age group	.213	-.289	.605	-.399
Gender	-.092	.182	-.521	-.338
Family size	-.067	-.041	-.357	.452
Origin	.247	-.297	.256	.394

Extraction method: Principal component analysis.
a. 4 extracted components.

Table 5. Estimated model parameters

Variables	Detailed			Aggregates	
	Coefficients	Prob		Coefficients	Prob
C	0.037731	0.08085	Cte	0.434	3.323 (0,001)
Income	0.008095	0.0000	Income	0.018	0.390 (0,697)
Price kg	-0.018605	0.0000	Price	-0.142	-2.317 (0,021)
Origine (1=coastline, 0=interiors)	-0.091242	0.0112	Organoleptic factors 1=good2=no	-0.033	-1.908 (0,057)
Level (1 good; 0= no)	0.135393	0.0000	Economic and educational (well-being=1 no=0)	0.364	18.65 (0,000)
Age	-0.002067	0.3289	Structure Large=1; not=0	0.047	2.713 (0,007)
Gender(1=male;0=female)	-0.0116335	0.6530	Habits and social (Coastal region=1 no=2)	-0.077	-4.412 (0,000)
R-squared	0.596105		R2	0.70	
Adjusted R-squared	0.587778				

consumers' income and geographical area are significant factors that seem to influence Tunisian fish and meats.

Others factors such as education level, age and gender influence fish consumption and should not be neglected such as mentionned by several empirical studies (Aydin et al., 2011; Cardaso et al., 2013; CAN et al., 2015; Frakieewics et al., 2023).

All the variables mentioned as determinants of fish consumption were extrinsic to fish. The intrinsic properties such as freshness and taste influence also fish species choice as stated in literature (Lebiedziñsk et al., 2006 ; Amao et al., 2023).

Despite the good fish opinion, Tunisians perception of farmed fish is different. It is steel not well known by the half of the respondents and not yet consumed by more than the half of them. Moreover, freshwater species were little known than the marine farmed fish. Wild fish is perceived as healthier and more safe and the majority of respondents thought that farmed fish are of lower quality. (Schlag., 2013; Claret et al., 2014; Polymeros., 2015; Güney, 2019; López-Mas et al., 2021).

A few number of respondents were ready to consume aquaculture products even when their prices drop. Consumers give great importance to health, welfare and taste and it's not just a question of price and income. This attitude is related to a knowledge lack of these species and prejudices not based on scientific information that consumers had (Verbeke et al., 2005; Verbeke et al., 2007; Schlag et al., 2013; Polymeros et al., 2015; Tomić et al., 2017; Ziaul Hoque., 2022).

Thus, farmed fish could be a good alternative to wild fish which natural stocks suffers from overexploitation. They could fill the gap between fish demand and supply. The fact that more than 50% of Tunisians didn't consume farmed fish constitutes a potential to be exploited to develop this sector. This potential can be more exploited in addition to others potentialities such as extensive coastline of about 1300

km and presence of fresh water resources in all regions of the country.

Similarly, to ameliorate Tunisian farmed fish consumption, it is necessary to raise awareness among consumers and improve their knowledge about these products. Designing an effective approach based on the communication of scientific informations related to the safety and healthiness of farmed fish could help to improve farmed fish image, acceptance and consumption. It could improve to change consumer subjective and negative perception about aquaculture that contrast with scientific data. (Polymeros et al., 2015; Verbeke., 2010., Kupsala et al., 2011, Ziaul Hoque., 2022).

Furthermore, supplying inland areas with farmed fish in good quality specially cheaper freshwater fish could improve farmed fish consumption. These species could constitue a very important alternative particularly to low-wage consumers who consume cheap wild species which are not always available.

Conclusions

This present study aimed to asssess Tunisians behaviour and perception towards wild and farmed fish consumption. Farmed fish knowledge, image and consumption were evaluated versus wild fish. The most important results revealed are below:

- All respondents have a good opinion towards fish in terms of their nutritional value and beneficial effects on heath. Fish meat is even the most preferred compared to other meat products. However, a big gap between consumers opinion and actual fish purchase was noted. Their actual fish consumption remains low among poor and very varied between inland and costal consumers.
- Consumers income and educational level influence positively fish consumption.
- Fish prices affect negatively farmed and wild fish consumption.

- Consumers age, gender and others intrinsic fish properties fish determine also fish consumption.
- Fish is brougt most of the time from markets and more consumed grilled at home.
- Farmed fish remains not well known and not consumed by a large percentage of consumers. The relectance causes are their taste, prices, feeds and veterinary treatment.
- Consumers sensibilization activities on farmed fish based on scientifics results could improve their image, acceptance and consumption.
- Supplying inland areas with good quality farmed fish could imrpove demand for these products. Cheap freshwater fish could be a good alternative to cheap wild species.

This study presents as a limitation the representativeness of the whole Tunisian population because the selected sample touched only Tunis capital city and its suburbs. Completing this research with others future studies would be necessary in order to represent properly all Tunisian consumers.

Ethical Statement

All study and results have been approved by author.

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Author Contribution

First author: Conceptualization, writing - review and editing, data curation, formal analysis, descriptive analysis, survey, methodology, visualization and writing - original draft; Second author: Econometric analysis, Third author: Revision

Conflict of Interest

The authors declare that they have no known competing financial or non-financial, professional, or personal conflicts that could have appeared to influence the work reported in this paper.

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