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Analysis of Consumer Behavior towards Aquaculture Products

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Dedication

*To my beloved father, **KHELIFA Ali**, and my precious mother, **LAGRAA Alia** — thank you for your unconditional love, your sacrifices, and your silent strength that carried me through every stage of this journey. Your prayers, your patience, and your unwavering belief in me are the roots of everything I have accomplished.*

*To my brothers, **Abdallah** and **Djawed**, and my sister **Imen** — thank you for your support, your laughter, and for always being there even in the smallest, quietest ways. Your presence in my life has meant more than words can express.*

*To the woman who shaped my soul, who raised me with tenderness, wisdom, and faith — **Mama Hadja,** my dearest grandmother — this is for you. You are the reason I am who I am. Your hands guided me, your prayers protected me, and your love filled every corner of my heart. I carry your voice in every decision I make, and your memory in every beat of my heart. I owe you everything. May Allah grant you a long life full of peace and reward.*

*To all my uncles and aunts, and to the **LAGRAA** and **KHELIFA** families — thank you for being my roots, my pride, and my support system. You have all played a role in my journey, and I am deeply grateful.*

*And finally, to **MESSAOUDI Hana** —To the one who was my strength and support,*
To the one who walked beside me with love and patience through every step of this journey,
To the light in my darkest days and the peace in my moments of exhaustion..
To you — my everything, my heart, my passion, and my soul.
Thank you for always believing in me and pushing me to be my best.
Today's success is a reflection of your presence in my life.
I love you, and I dedicate this achievement to you — from the bottom of my heart.

KHELIFA Oussama

Dedication

To my beloved father, ***CHELOUH Ali****, and my dearest mother,* ***BENMOUHOUB Houria***

Your love has been my shelter, your sacrifices my foundation, and your trust my greatest motivation. You gave me everything without asking for anything in return. I am who I am because of you. Thank you for walking beside me, even when the road was long and heavy.

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Your legacy lives in me. Your values, your prayers, and your quiet strength are deeply rooted in my soul. You are a part of everything I do and everything I dream to become.

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Thank you for being my roots, my name, and my home. I carry your history with pride and gratitude.

And to all my friends — old and new —

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This work is dedicated to all of you with love, respect, and a heart full of gratitude.

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Abstract

This study aims to understand Algerian consumer behavior toward tilapia, a farmed fish promoted to meet the growing demand for animal protein and reduce pressure on marine fisheries. Although national tilapia production has increased thanks to institutional efforts, its consumption remains low. Using the Theory of Planned Behavior (TPB) as a framework, the authors analyzed the attitudes, social norms, and perceived control of 475 consumers through a structured questionnaire. The results show that attitude is the only significant predictor of purchase intention, while subjective norm and perceived behavioral control have no notable effect. While many respondents view tilapia positively in terms of taste and health benefits, lack of awareness and limited availability hinder its adoption. The study recommends improving product visibility, educating consumers, and strengthening distribution networks to promote tilapia consumption in Algeria.

الملخص

يهدف هذا البحث إلى فهم سلوك المستهلك الجزائري تجاه سمك التيلابيا، وهو نوع من الأسماك المستزرعة يُروَّج له لتلبية الطلب المتزايد على البروتين الحيواني وتقليل الضغط على مصايد الأسماك البحرية. على الرغم من أن إنتاج التيلابيا في الجزائر شهد نموًا بفضل الدعم المؤسسي، إلا أن استهلاكه لا يزال ضعيفًا.

اعتمدت الدراسة على نظرية السلوك المخطط (TPB) كإطار نظري لتحليل مواقف المستهلكين والمعايير الاجتماعية والإدراك السلوكي، وذلك من خلال استبيان شمل 475 مستهلكًا من مختلف الولايات. أظهرت النتائج أن الموقف الفردي تجاه التيلابيا هو العامل الوحيد المؤثر بشكل كبير في نية الشراء، في حين أن كل من "الضغط الاجتماعي" و"القدرة المتصورة" لم يكن لهما تأثير معنوي.

ورغم أن نسبة من المشاركين يرون التيلابيا خيارًا صحيًا وذو مذاق جيد، إلا أن نقص المعرفة وصعوبة الوصول إلى المنتج يعيقان انتشاره. توصي الدراسة بتكثيف حملات التوعية، وتحسين توفر التيلابيا في الأسواق، وتعزيز الثقة بين المنتج والمستهلك من خلال المعلومات الغذائية والتجارية.

تُمثل هذه الدراسة مساهمة علمية في فهم سلوك المستهلك الغذائي في سياق التحول نحو تربية الأحياء المائية، وتؤكد على ضرورة المواءمة بين الإنتاج والتسويق من أجل إدماج التيلابيا في النظام الغذائي الجزائري بشكل فعّال ومستدام.

Résumé

Cette étude vise à comprendre le comportement des consommateurs algériens vis-à-vis du tilapia, un poisson d’élevage promu pour répondre à la demande croissante en protéines animales et aux limites de la pêche marine. Bien que la production nationale de tilapia ait augmenté grâce aux efforts institutionnels, sa consommation reste faible. À travers le modèle de la Théorie du Comportement Planifié (TPB), les auteurs ont analysé les attitudes, normes sociales et contrôles perçus de 475 consommateurs à travers un questionnaire. Les résultats ont montré que seule l’attitude influence significativement l’intention d’achat, tandis que la norme subjective et le contrôle perçu n’ont pas d’effet notable. Une perception favorable du tilapia en termes de santé et de goût est observée, mais la méconnaissance et l’accès limité freinent sa consommation. L’étude propose d'améliorer la visibilité du produit, d’éduquer les consommateurs et de structurer la chaîne de distribution pour favoriser l’adoption du tilapia en Algérie.

INTRODUCTION

INTRODUCTION

Aquaculture has gradually established itself worldwide as a strategic response to the overexploitation of natural fishery resources and the growing demand for animal protein. Today, it accounts for more than 50% of the fish consumed globally, marking a major shift in aquatic production methods (FAO, 2024). This growth has been driven by the development of species that are easy to farm, offer high added value, and can adapt to various environmental conditions. Among these, *Oreochromis spp.* (tilapia) has emerged as one of the most widely farmed fish species globally. Owing to its hardiness, rapid growth, tolerance to diverse environments, and low dietary requirements, tilapia production exceeded 7 million tonnes in 2024, ranking it fifth among the world's most cultivated fish species (FAO, 2024).

In Africa, tilapia plays a central role in food security and poverty alleviation. The continent contributes nearly 27% of global production, with a significant concentration in Egypt, the leading African producer (World Bank, 2023). In several sub-Saharan countries such as Nigeria, Uganda, and Ghana, the development of aquaculture—particularly the tilapia sector—is seen as a means to enhance food self-sufficiency and create rural economic opportunities. However, despite its potential, several constraints persist: lack of processing infrastructure, limited access to high-quality inputs, insufficient technical training, and shortcomings in marketing strategies. These barriers hinder the development of robust value chains and limit the competitiveness of tilapia in local and regional markets (Cai et al., 2017; Menezes et al., 2024; Iheanacho et al., 2025).

In Algeria, freshwater aquaculture is experiencing significant growth, particularly in the Saharan regions where underground water resources are being used for innovative aquaculture projects. As of 2023, over 1,200 aquaculture projects had been registered, approximately 75% of which were in freshwater systems (ONDA, 2024). In this context, tilapia is actively promoted due to its suitability for arid climates, its ability to thrive in water-efficient systems, and its high production potential (Hasan et al., 2022). Many Saharan farmers are turning to this species for its profitability and ease of farming. The government, through the Ministry of Agriculture, Rural Development and Fisheries (MADRP), supports this momentum through subsidies, technical assistance, training sessions, and the promotion of sustainable practices such as aquaponics in oases (MADRP, 2023).

However, despite production efforts and institutional support, tilapia consumption in Algeria remains marginal compared to more traditional fish species. The fish suffers from a poor image among consumers, who often perceive it as a low-quality product, sometimes even suspecting it to originate from polluted environments or to carry diseases. This distrust is largely due to a lack of awareness about farming conditions and the absence of communication regarding its nutritional, sanitary, and environmental benefits (Nash et al., 2022; Nakagawa et al., 2024). Algerian consumers remain strongly attached to local and wild species such as sardine, sea bream, or whiting, which enjoy historical and cultural recognition but are becoming less accessible due to the depletion of marine stocks (Alliouche et al., 2024).

Internationally, however, tilapia enjoys a highly favorable commercial trajectory. The global export value of this species exceeded $600 million in 2021, driven primarily by North American markets (FAO, 2022). China leads the market with 43% of exports in 2020, followed by Taiwan and Colombia. The United States, Mexico, and Canada are among the top importers. In these

markets, tilapia is often sold as fresh or frozen fillets, tailored to the preferences of urban consumers. The presence of international certifications such as ASC (Aquaculture Stewardship Council) or GlobalG.A.P. has reinforced the species' legitimacy within structured distribution channels, while boosting consumer confidence in responsibly sourced seafood (GlobalG.A.P., 2022). These examples demonstrate that the perception of tilapia can be improved when guarantees of quality, traceability, and sustainability are provided.

In this context, the Algerian case presents a striking contrast: while the country is actively developing tilapia production, local demand remains limited—posing a major challenge to the viability of the sector. This highlights the need to analyze the determinants of Algerian consumer behavior. Why has tilapia struggled to gain traction in the national market? What psychological, cultural, social, or economic barriers influence consumers' perceptions and purchasing decisions? Conversely, what levers could be activated to encourage its acceptance and even enhance its value within the local diet?

This research aims to address these questions through an in-depth analysis of consumers' attitudes, beliefs, intentions, and preferences regarding tilapia. Drawing on behavioral analysis tools from the social sciences—particularly the Theory of Planned Behavior—this study seeks to identify the key variables influencing purchasing decisions. It also adopts an empirical approach rooted in the Algerian context, with the goal of offering concrete recommendations to support the development of national tilapia consumption. The stakes are twofold: contributing to the success of Algeria's aquaculture strategy and promoting a sustainable, accessible source of protein well-suited to local constraints.

CHAPTER I. GENERAL BACKGROUND

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I. 1. Aquaculture Worldwide

Aquaculture has become a strategic sector globally to meet the rising demand for animal protein and compensate for the decline in wild fish stocks. In 2024, global aquaculture production exceeded 130 million tons, including approximately 94 million tons of fish, marking a historical shift where aquaculture now surpasses capture fisheries as the main source of aquatic food supply (FAO, 2024).

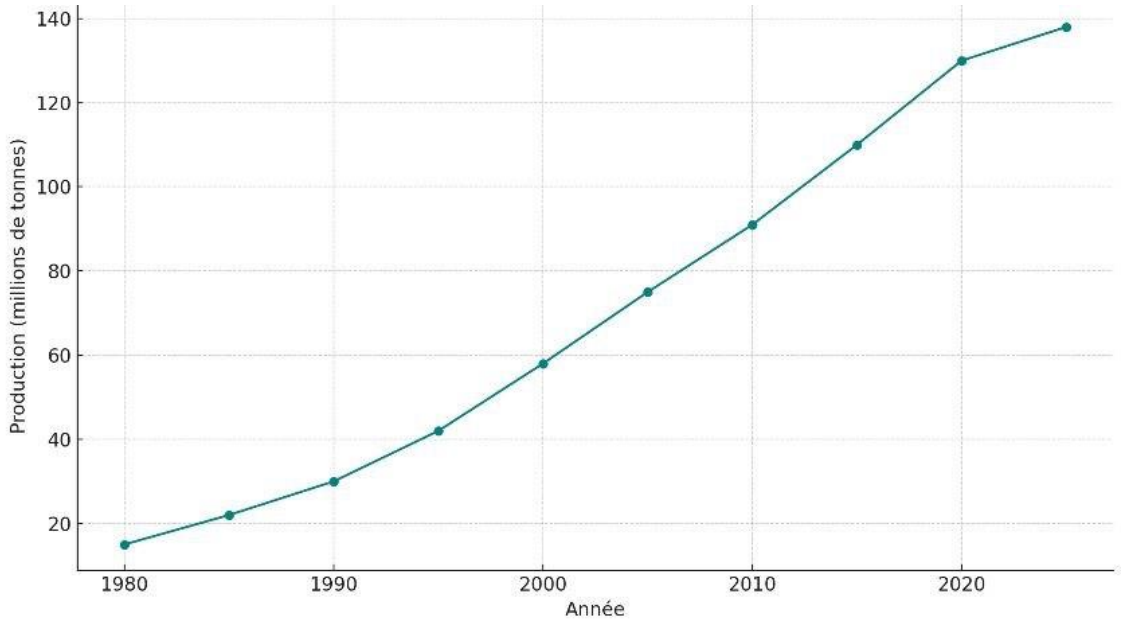

Figure 1: Estimated evolution of global aquaculture production (FAO, 2024)

Asia is the global leader in aquaculture, producing nearly 90% of total output. Major contributors include China, India, Indonesia, Vietnam, and Bangladesh. The dominant farmed species worldwide are carps, tilapia, salmon, shrimp, and mollusks, each selected based on growth rate, environmental adaptability, and market value (FAO, 2024; Cai et al., 2017).

Table 1: The state of world fisheries and aquaculture (FAO, 2024)

Région / Pays	Production 2022 (M t)	% du total mondial
Asie	119,7	91,4 %
Chine	~47,1	36 %
Inde	~10,2	8 %
Indonésie	~9,1	7 %
Viet Nam	~6,5	5 %
Bangladesh, Pérou	~3,9 chacun	3 % chacun

Aquaculture is practiced in both freshwater and marine environments, with expanding growth in developing countries due to its contribution to food security, rural employment, and resource sustainability. It plays a key role in addressing protein malnutrition and reducing pressure on wild fish populations (World Bank, 2023; FAO, 2024).

I. 2. Aquaculture in Africa

Africa, while less industrialized in the aquaculture sector, has shown remarkable growth. In 2024, African countries produced approximately 2.5 million tons of aquaculture products, of which more than 2.1 million tons were tilapia, primarily *Oreochromis niloticus*. Egypt alone accounts for over 80% of this total (Nakagawa et al., 2024; World Bank, 2023).

Other countries such as Nigeria, Ghana, Uganda, and Kenya have developed structured tilapia farming sectors, supported by investments in hatcheries, feed production, and distribution. These sectors help combat poverty and enhance food security in rural areas (Iheanacho et al., 2025).

I. 3. Aquaculture in Algeria

In Algeria, aquaculture is growing rapidly, particularly in Saharan regions, where underground water is utilized for fish farming. By 2023, more than 1,200 aquaculture projects were registered, and the national target for 2024 is set at 15,000 tons, with a strategic vision to reach 100,000 tons by 2030 (ONDA, 2024; MADRP, 2023).

Freshwater aquaculture is widely promoted, especially for red tilapia, thanks to public incentives such as subsidies, training programs, and tax exemptions. Tilapia is well-suited to arid climates due to its adaptability, fast growth, and efficient feed conversion ratio (Alliouche et al., 2024).

I. 4. Focus on Tilapia (*Oreochromis spp*)

Table 2: The genus *Oreochromis* includes several tilapia species commonly farmed worldwide

Rang taxonomique	Nom
Règne	*Animalia*
Embranchement	*Chordata*
Sous-embranchement	*Vertebrata*
Super-classe	*Gnathostomata*
Classe	*Actinopterygii*
Ordre	*Perciformes*
Famille	*Cichlidae*
Genre	*Oreochromis*
Espèces (exemples)	*O. niloticus, O. aureus, O. mossambicus, etc.*

- Oreochromis niloticus (Nile Tilapia)
- Oreochromis aureus (Blue Tilapia)
- Oreochromis mossambicus (Mozambique Tilapia)

These species are chosen for their resistance to diseases, tolerance to poor water quality, and high survival rates in intensive systems. Among them, *O. niloticus* is by far the most widely cultivated (FAO, 2024).

Global Tilapia Highlights:

- Global production (2024): 7–8 million tons.
- Commercial value: Over $600 million USD in 2021.
- Top exporters: China (43%), Taiwan, Colombia.
- Main importers: USA, Mexico, Canada.
- Market trend: Fresh or frozen fillets with certification labels such as ASC or GlobalG.A.P.

(GlobalG.A.P., 2022; FAO, 2022)

In Africa, tilapia represents 27% of global production, making it a key species for the continent's aquaculture development. In Algeria, it is promoted through sustainable initiatives like aquaponics and is central to the development of inland and desert aquaculture systems (Trends n Africa, 2025) (Trends n Africa, 2025; FAO, 2024).

I. 5. Comparative Tilapia Production

Region Estimated Production Key Producers Remarks

Global 7–8 million tons China, Egypt, Indonesia, Brazil 5th most farmed species worldwide

Africa 2.1 million tons Egypt (81%), Ghana, Uganda 27% of global production

Algeria 15,000 tons (2024 target) Cosider, Saharan farms Strong public support, low consumer perception (FAO, 2024; ONDA, 2024).

I. 6. Global Species Distribution in Aquaculture

Aquaculture production is dominated by a limited number of species. According to FAO (2024), the top five groups account for over 85% of global volume.

Estimated Production Breakdown (2022–2024)

Main Species Estimated Share (%)

- Carps (Cyprinidae) 30%
- Tilapias (Oreochromis spp) 12%
- Salmonids 10%
- Shrimps (Penaeus spp) 8%
- Mollusks (e.g., mussels, oysters) 25%
- Others (eels, catfish) 15%

Interpretation

Carps remain dominant due to historical farming practices in Asia.

Tilapias are gaining ground in tropical regions, especially in Africa.

Mollusks are often overlooked but represent a major segment in marine aquaculture.

The market shows low species diversification, which may pose a sustainability risk in case of disease or market shifts (FAO, 2024; Jayasinghe, 2019).

CHAPITRE II. MATERIAL AND METHOD

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This chapter presents the methodological approach adopted to analyze Algerian consumers' behavior toward aquaculture products, particularly tilapia, using the Theory of Planned Behavior (TPB). Proposed by Ajzen (1991), the TPB posits that human behavior is influenced by three fundamental factors: attitude, subjective norm, and perceived behavioral control, which together determine behavioral intention, considered the best predictor of actual behavior (Ajzen, 2005):

Attitude refers to the individual's favorable or unfavorable evaluation of purchasing the product (Ajzen, 1991); in our case, tilapia.

Subjective norm reflects the perceived social pressure from one's surroundings to engage or not engage in the behavior (Fishbein & Ajzen, 1975).

Perceived behavioral control refers to the perceived ease or difficulty of performing the behavior, here, buying tilapia (Ajzen, 2002).

Thus, this study aims to identify the extent to which these components influence Algerian consumers' intention to purchase tilapia.

II. 1. The Theory of Planned Behavior

The Theory of Planned Behavior (TPB) was developed by Icek Ajzen in 1985. It extends the Theory of Reasoned Action (TRA), previously formulated by Fishbein and Ajzen (1975; 1980). While the TRA explained behavior based solely on intentions, the TPB incorporates an additional component: perceived behavioral control, which allows for better prediction of behaviors that are not entirely under voluntary control (Ajzen, 1985; Fishbein & Ajzen, 1980).

I. 1.1. Theory of Planned Behavior main components

To elaborate on its main components:

Attitude Toward the Behavior

Attitude refers to the individual's positive or negative evaluation of the target behavior. It is based on behavioral beliefs (e.g., "consuming tilapia is good for health") and the evaluation of these outcomes (e.g., the importance placed on health). A favorable attitude strengthens the intention to act (Ajzen, 1991).

Subjective Norm

The subjective norm refers to the perceived social pressure to perform or avoid a behavior. It stems from normative beliefs (i.e., what important people such as family or friends think about the behavior) and the motivation to comply with their expectations. If an individual believes that their close circle approves of the behavior, it may enhance their intention to adopt it (Ajzen, 1991).

Perceived Behavioral Control

This concept relates to the individual's perception of their ability to perform the behavior. It includes the availability of resources, opportunities, and necessary skills. The greater the perceived control, the stronger the behavioral intention, and in some cases, the behavior may even occur independently of intention (Ajzen, 1991).

II. 1.2. The Role of Intention

Intention is the closest predictor of actual behavior. It represents the conscious motivation to adopt a particular behavior. It is stronger when attitude, subjective norm, and perceived control are all favorable. However, the actual performance of the behavior may be hindered by external factors (e.g., lack of time, financial constraints, unforeseen events) (Ajzen, 1991).

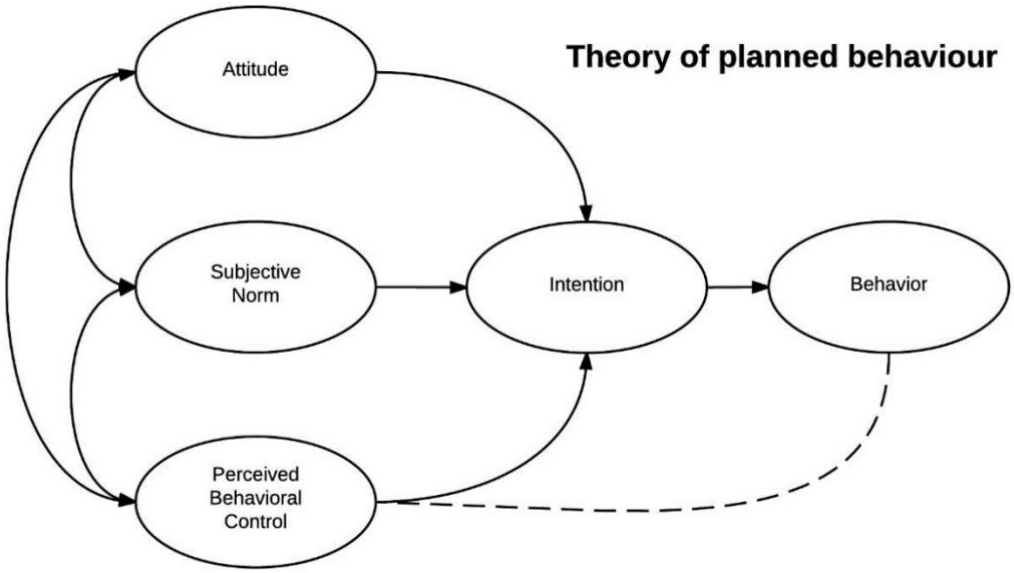

Figure 02: Diagram representing the structure of the Theory of Planned Behavior model, illustrating the determinants of intention and behavior (Ajzen, 1991).

This diagram illustrates that intention lies at the core of the decision to act, and that perceived behavioral control can also directly influence behavior, particularly when the behavior is difficult to perform (Ajzen, 1991).

II. 2. Extensions of the Model; Limitations and Strengths

Several researchers have proposed extensions to the TPB to enhance its predictive power. These include additional dimensions such as moral obligation, emotions, knowledge, and habits. These variables allow for the integration of affective and cultural influences, which are not always accounted for in the original model (Conner & Armitage, 1998; Armitage & Conner, 2001).

II. 2.1. Practical Applications

The TPB has been applied across a wide range of domains: public health (e.g., diet, tobacco use), environmental behavior (e.g., recycling, energy conservation), marketing (e.g., product purchases), and agriculture (e.g., acceptability of innovations).

In the case of tilapia consumption, one can analyze consumers' attitudes toward the fish, the social norms influencing their choices, and the perceived barriers to its consumption (e.g., price, availability, culinary culture) (Ajzen, 1991; Conner & Armitage, 1998).

Despite its robustness, the TPB has certain limitations. It assumes that individuals act rationally, overlooking the influence of emotions, habits, and deep-rooted cultural norms. It also does not incorporate feedback loops between behavior and its determinants (Armitage & Conner, 2001).

The TPB is one of the most widely used models in the social sciences for predicting and explaining intentional behaviors. It is easily operationalizable (e.g., via questionnaires) and adaptable to diverse contexts (health, consumption, environment, education, etc.). It provides a solid theoretical foundation for designing targeted behavioral interventions (Ajzen, 1991; Fishbein & Ajzen, 1980).

II. 3. Application of the TPB to the Case Study

The application of the TPB to assess tilapia consumption in Algeria is based on the collection of primary data using a structured questionnaire designed according to the model's principles. This theoretical framework guided the formulation of questions, the construction of indicators, and the interpretation of results (Appendix 01).

II. 3.1. Target Population and Sampling

The target population includes Algerian consumers who are potential fish buyers, particularly of tilapia. Participants were recruited through a non-probability sampling approach using two data collection methods:

- Online survey: Conducted via a Google Forms questionnaire shared on social media, resulting in 175 responses.
- In-person survey: Conducted face-to-face with consumers from various wilayas across the country (including Adrar, Ain Defla, Ain Témouchent, Algiers, Annaba, Batna, Bejaia, Biskra, Blida, Bordj Bou Arréridj, Bouira, Boumerdes, Chlef, Constantine, Djelfa, El Oued, El Taref, Guelma, Illizi, Tamanrasset, Jijel, Khenchela, Laghouat, M'Sila, Medea, Mascara, Mila, Mostaganem, Naama, Oran, Ouargla, Oum El Bouaghi, Relizane, Sétif, Saïda, Skikda, Souk Ahras, Tebessa, Tipaza, Tiaret, Tindouf, Tissemsilt, Tizi Ouzou, Tlemcen, and Touggourt), generating 300 additional responses.

The total sample includes 475 individuals with diverse profiles in terms of gender, age, marital status, etc. This diversity allows for a broad and contextualized understanding of consumer behavior.

II. 3.2. Data Collection Tool

As previously mentioned, the questionnaire used to collect data consisted of three main sections:

- Socio-demographic information: gender, age, marital status, wilaya of residence
- Aquatic product consumption habits: purchase frequency, supply source, fish preferences, awareness of tilapia
- Measurement of TPB components: attitude, subjective norm, perceived behavioral control, and purchase intention. These variables were measured using Likert-scale items (5-point scale from "strongly disagree" to "strongly agree").

Data from Google Forms were automatically recorded in Google Sheets, then exported and analyzed using Microsoft Excel.

II. 4. Data Processing and Analysis

To address the research questions, the data collected from 475 Algerian consumers were analyzed and interpreted using the following methods:

- **Descriptive Data Analysis**

Descriptive analysis is a fundamental step in any statistical study. It summarizes, organizes, and clearly presents the main features of the data using numerical indicators (e.g., mean, median, mode, standard deviation, percentages) and visual representations (e.g., bar charts, pie charts, frequency tables) (Gravetter & Wallnau, 2016; McClave & Sincich, 2018).

According to Gravetter and Wallnau (2016), descriptive statistics simplify complex data to make them understandable. This form of analysis helps not only in understanding the structure of the sample but also in identifying general trends, outliers, and facilitating communication of results to non-specialist audiences.

It also provides a basis for advanced statistical analysis, helping to verify assumptions such as normality or homogeneity before applying inferential tests (Field, 2013).

In the context of aquaculture, for example, a descriptive analysis might reveal that most tilapia consumers are between 25 and 34 years old, that 60% of respondents are women, or that 70% eat fish at least once a week. These insights guide strategic decisions, awareness campaigns, and commercial offerings (Salkind, 2017).

Descriptive analysis was conducted using Excel spreadsheet software (Microsoft Corporation, 2013).

- **Structural Equation Modeling (SEM)**

Structural Equation Modeling (SEM) is an advanced multivariate statistical method used to simultaneously test a set of linear relationships between observed variables (measured indicators) and latent variables (theoretical constructs not directly observable). SEM combines the principles of factor analysis and multiple regression, making it one of the most powerful tools to empirically validate complex theoretical models (Hair et al., 2010; Kline, 2016).

Unlike traditional methods, SEM accounts for measurement errors, making it especially useful in studies involving Likert-type scales (Byrne, 2013; Schumacker & Lomax, 2016).

- SEM typically includes two sub-models:

The measurement model: defines the relationship between latent variables and their observed indicators (e.g., attitude measured by several items).

The structural model: describes the relationships between latent variables (e.g., how attitude influences intention) (Hair et al., 2010).

This method is well-suited to test the validity of TPB, empirically verifying links between attitude, subjective norm, perceived control, intention, and behavior (Ajzen, 1991; Kline, 2016).

SEM is usually carried out using specialized software such as AMOS, LISREL, SmartPLS, or Mplus, depending on the chosen approach (PLS-SEM or CB-SEM). The choice depends on the research objectives, data characteristics, sample size, and distribution normality (Hair et al., 2014; Henseler, Ringle & Sinkovics, 2009).

- Use of JASP Software

To conduct the analysis, we used JASP (Jeffreys's Amazing Statistics Program), an open-source statistical software designed to be user-friendly, intuitive, and accessible, especially for students, educators, and researchers in the social sciences. Developed by a team of psychologists at the University of Amsterdam, JASP aims to make modern statistical analysis more transparent and accessible (JASP Team, 2023; Wagenmakers et al., 2018).

JASP stands out for its clean interface, real-time results, and ability to generate APA-style tables and graphs. It supports a wide range of analyses: descriptive statistics, parametric and non-parametric tests, regressions, factor analysis, and Bayesian analysis (JASP Team, 2023).

One of JASP's strengths is its transparency: every test result is immediately visible in a dedicated window with exact values, interpretations, effect sizes, and graphs. It also facilitates reproducibility through a full trace of each statistical step (Wagenmakers et al., 2018).

JASP is particularly popular for teaching statistics, as it requires no coding (unlike R or Python), and is compatible with .csv, .sav (SPSS), .ods, and .xlsx files, making it convenient for academic and research settings (JASP Team, 2023).

Supported by a rigorous methodology and the theoretical framework of the Theory of Planned Behavior, this study provides a contextualized and relevant analysis of Algerian consumers' behavior toward tilapia. Despite limitations related to the sampling method and data collection approach, the findings offer a solid foundation for identifying psychological levers that can be used in promoting this aquaculture product.

CHAPTER III. RESULTS AND DISCUSSION

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III. 1. Consumer Behavior Overview

Consumer behavior refers to all psychological, emotional, and behavioral processes by which an individual selects, purchases, uses, and disposes of a product or service. These processes include the identification of a need, information search, evaluation of options, purchase decision, and post-purchase evaluation (Solomon et al., 2019; Kotler & Keller, 2016).

In the agri-food context, these decisions are influenced by health, traceability, sensory quality, and sustainability concerns (Grunert, 2005). Consumers are increasingly attentive to the origin of products, production conditions, and the ethical values associated with them (Aschemann-Witzel & Zielke, 2017).

The determinants of behavior can be classified into two broad categories: internal (motivations, beliefs, values, attitudes, previous experiences) and external (social, cultural, economic, marketing environment) (Kotler & Keller, 2016; HRImag, 2020).

Digital tools are profoundly transforming purchasing behaviors. Social networks, online reviews, mobile apps, and digital marketing enable rapid and massive dissemination of information, influencing perceptions and purchase intentions (Deloitte, 2021).

III. 2. Descriptive Analysis

In order to better understand Algerian consumers' behavior regarding tilapia, the following descriptive analysis incorporates not only general trends, but also possible correlations between variables, typical consumer profiles, and concrete implications for this sector.

The following descriptive analysis concerns the 475 surveyed consumers:

III. 2.1. Age and Gender of Consumers

The analysis of age revealed three age groups: under 30 years old — the most dominant group at 48%. This is explained by the fact that during our field surveys, young people were more attractive and more collaborative than older ones. The second group is between 30 and 50 years old with a rate of 29%, while those over 50 represent 22%. These groups are in an active and family life stage, conducive to consideration of nutritional value and food prices.

However, the distribution of respondents between men and women is fairly equal, indicating that both genders are interested in this topic.

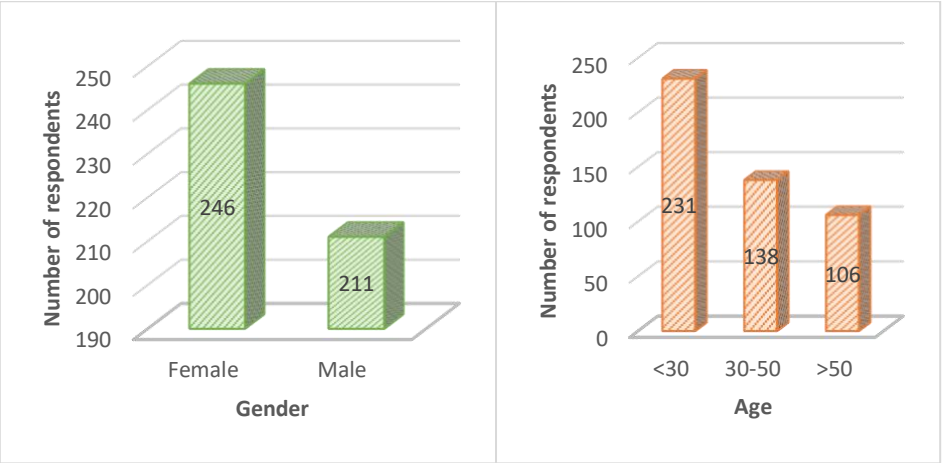

Figure 03: Distribution of respondents by gender and age

III. 2.2. Marital and Professional Status

Regarding marital status, 57% of respondents are not married, already explained by the dominant age group. Also, more than half (55%) of the sample are employees/entrepreneurs. We assume that those with salaries are more informed about the consumption of aquaculture products (Tilapia).

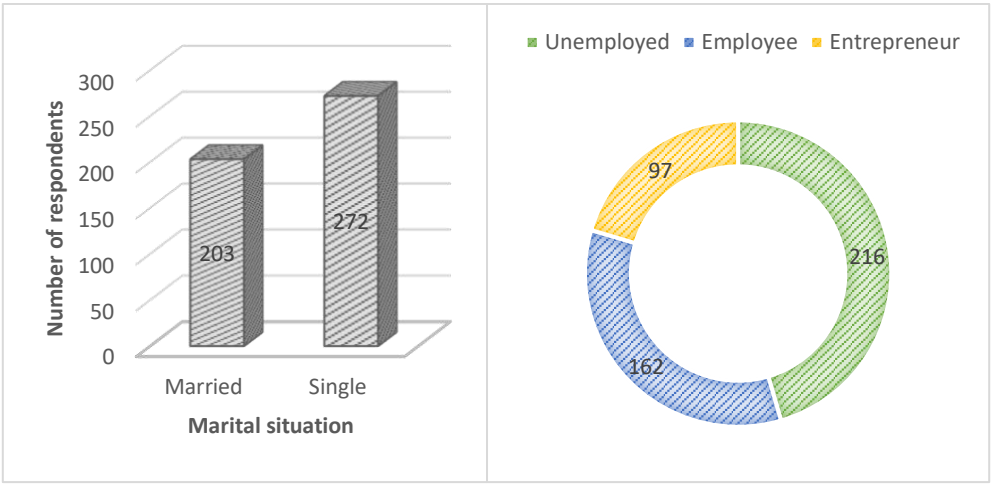

Figure 04: Distribution of respondents by marital employment status

III. 2.3. Geographic Distribution of Respondents

With regard to the geographic distribution of respondents, coastal zones group more than half of the respondents (56%), which is explained by their proximity to the product and the easier accessibility for direct interviews in these areas.

There is high access to fish. However, this also implies a preference for marine fish, perceived as fresher or more traditional. Consumers in inland areas, however, may be more inclined to adopt farmed fish such as tilapia for reasons of availability and price.

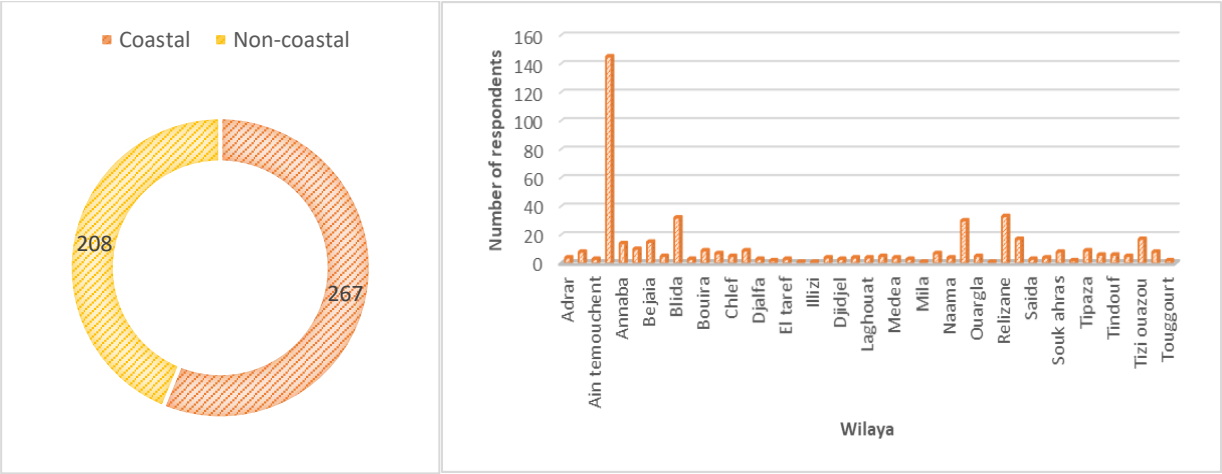

Figure 05: Distribution of respondents by wilaya of residence

III. 2.4. Fish Consumption and Purchase Frequency

Out of the 457 surveyed, 65% said they eat fish. Price is the most important criterion for 41% of consumers, followed by 24% who prioritize taste, while quality (18%) and availability (18%) appear as the last criteria among interviewees.

Furthermore, fisheries and municipal markets remain the main sources for respondents. However, some consumers buy from street vendors and very few go to aquaculture farms.

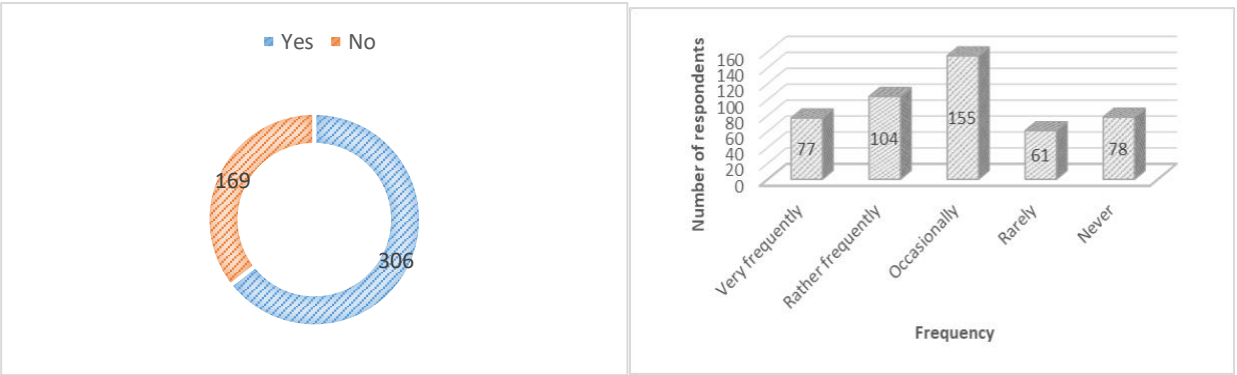

Figure 06: Consumption and frequency of fish purchases

III. 2.5. Tilapia Consumption

Slightly more than half of the interviewees (53%) reported knowing about Tilapia. This suggests that the notoriety of this species remains relatively low, as 47% are unaware of it.

From the results, even though half are aware of Tilapia, at least 70% of respondents do not consume it, compared to 21% who consume it rarely and 18% occasionally. This shows that the product is still perceived as new and unusual.

On the other hand, 24% are frequent consumers of this species.

Regarding the frequency of Tilapia consumption during the month preceding the survey, it appears that 69% did not consume it that month (February 2025). The remainder mostly consumed it once or twice during the same month.

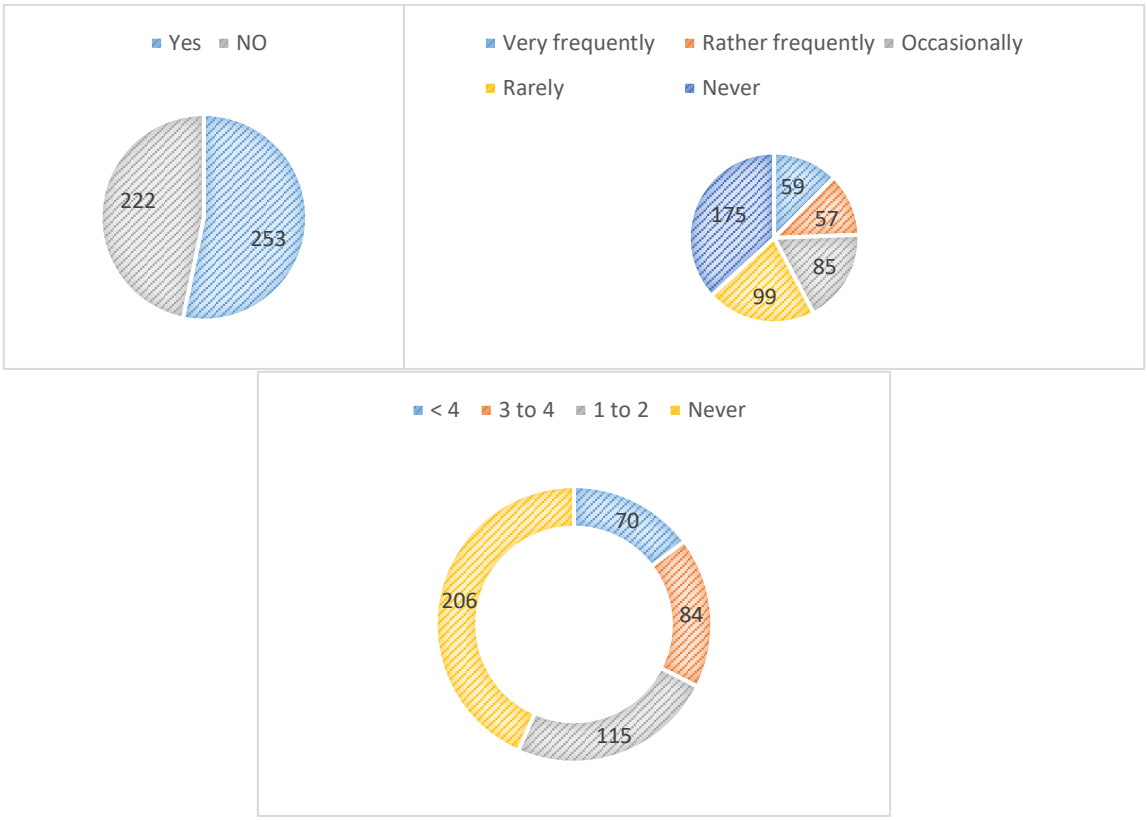

Figure 07: Awareness and frequency of tilapia consumption

III. 2.6. Place and Price of Tilapia Purchase

Like the general fish market, the purchase of Tilapia is made by most respondents at markets (29%) or fisheries (23%). Some go to aquaculture farms (20%) or street vendors (16%).

As for purchase prices, 35% of interviewees wish to buy Tilapia at a price ranging between 600 and 1000 DZD, compared to 29% who are willing to pay between 1000 and 1500 DZD. However, 59% of the sample report difficulties accessing this fish.

Figure 08: Tilapia purchase location and price perception

III. 2.7. Consumer Perception of Tilapia

When asked about Tilapia's nutritional value, 25% are aware of it, while the other half are not. This reflects the same proportions of those who know the species and those who do not.

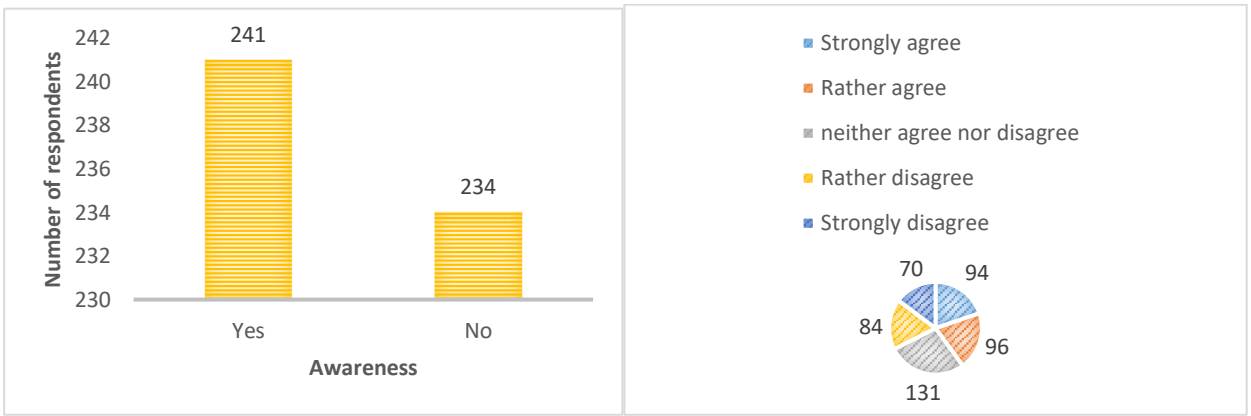

Figure 09: Awareness of tilapia's nutritional value

However, 40% find that this species tastes good, 32% find it tasteless, and 16% remain neutral.

Moreover, 53% of respondents believe that Tilapia is a healthy food choice, and 48% see it as a good alternative to marine fish.

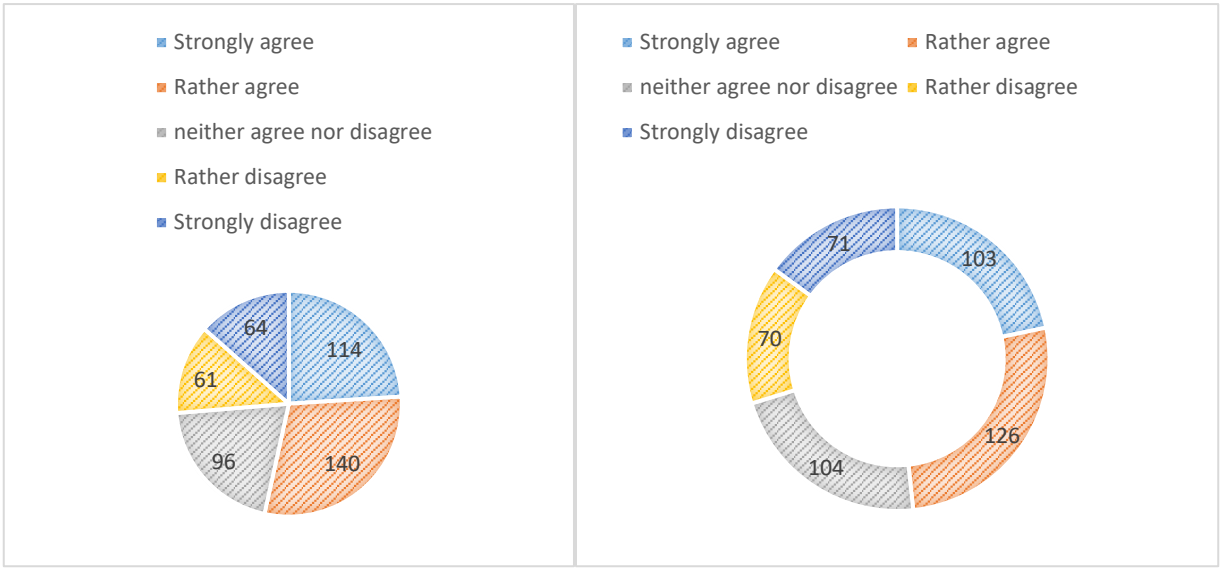

Figure 10: Preception of Tilapia as a good alternative to marine fish

Some respondents admire the species, and even those who consume it stated that 54% are ready to add Tilapia to their future grocery lists and try cooking it.

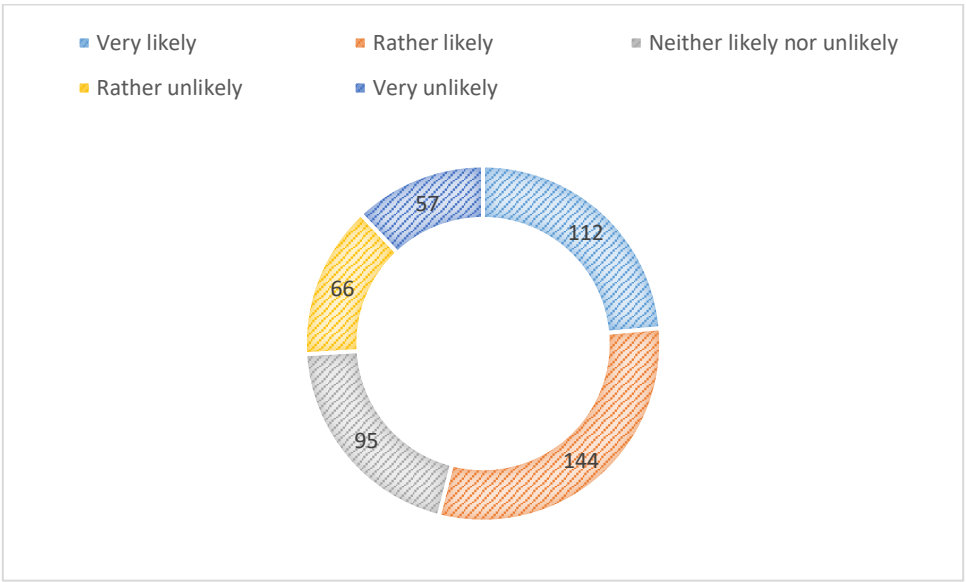

Figure 11: Likelihood of adding Tilapia to the shopping list in the future

Despite a positive sensitivity toward the health dimension of Tilapia, its consumption remains limited. This indicates a gap between perception and action. Variables such as ease of preparation or accessibility also play a secondary role, as some consumers do not know where to buy it or how to prepare it.

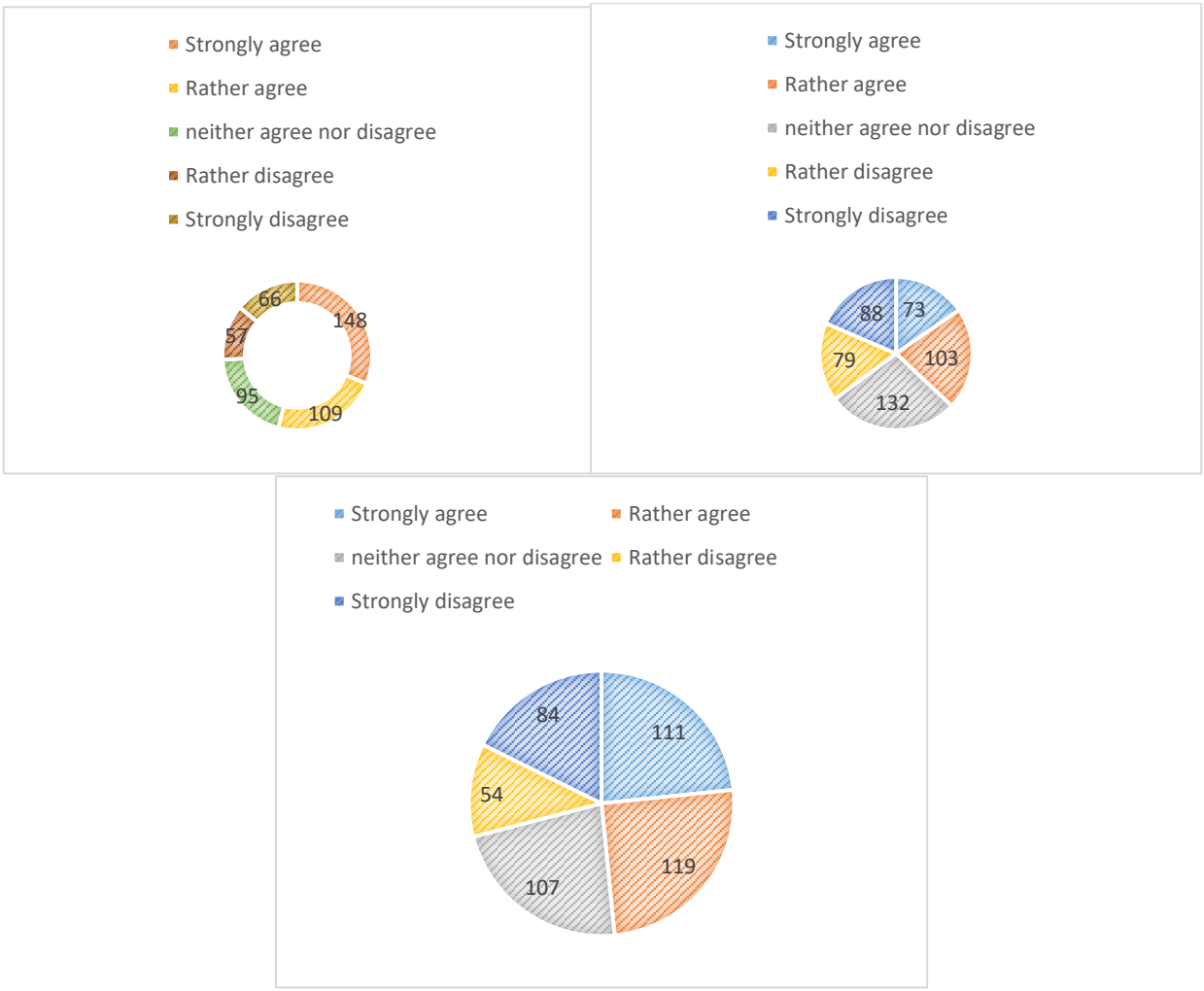

Figure 12: Link between nutritional knowledge and intention to consume

Consumers who know the nutritional values of Tilapia are more likely to want to consume it in the future.

It is important to mention that, as students in aquaculture with some knowledge of the field, we are aware that tilapia is not widely consumed in Algeria, despite what some of the results may suggest. This gap between the responses collected and the actual consumption habits observed in daily life may be due to a lack of awareness, limited market availability, or even social desirability bias in the survey. Therefore, these results should be interpreted with caution, as they may not fully represent the broader Algerian population's real behavior toward tilapia consumption.

III. 3. Structural equation modeling analysis

To confirm that this method is appropriate in our research study, we adopted the following procedures:

Table 03: Global model fit

INDICE	Valeur obtenue	Seuil recommandé	Interprétation
Chi² (Khi-deux)	78.866	p = 0.244 (> 0.05)	✓ Modèle non rejeté
CFI(Comparative Fit Index)	0.977	> 0.95	✓ Bon ajustement
TLI(Tucker-Lewis Index)	0.971	> 0.95	✓ Bon ajustement
RMSEA	0.015	< 0.05	✓ Très bon ajustement
SRMR	0.041	< 0.08	✓ Bon ajustement
GFI	0.967	> 0.90	✓ Bon ajustement

The results from the Structural Equation Modeling (SEM) analysis indicate an excellent fit of the TPB model to the empirical data.

The non-significance of the Chi-square test (p = 0.244) indicates that there is no statistically significant difference between the model's theoretical covariance matrix and the observed data matrix.

All standardized fit indices (CFI, TLI, RMSEA, SRMR) are above or below the critical thresholds, further supporting the model's quality.

The model is therefore well specified and correctly reflects the relationships between the variables.

Analysis of regression coefficients

Table 04: Regression coefficients

prédicteur	estimation	SE	Z-value	P-value	singnification
Attitude (ATT)	1.036	0.445	2.330	0.020	✓ Oui
Norme subjective (SBN)	-0.216	0.210	-1.024	0.306	✗ Non
Contrôle comportemental (BC)	-0.086	0.601	-0.143	0.887	✗ Non

The regression coefficient results show that, among the three theoretical predictors of the TPB model, only attitude toward tilapia consumption (ATT) has a statistically significant effect on behavioral intention (INT). Indeed, the standardized estimated coefficient is β = 1.036, with a p-value of 0.020, indicating that a one-unit increase in the attitude scale leads to an average increase of 1.036 units in the intention to buy tilapia, all other things being equal.

This result highlights the central importance of attitude as an explanatory driver of behavioral intention in the Algerian context studied. In contrast, the effects of the other two variables—subjective norm (SBN) with a coefficient of β = -0.216 (p = 0.306) and perceived behavioral control (BC) with a coefficient of β = -0.086 (p = 0.887)—are not statistically significant.

These values suggest that, although theoretically relevant within the TPB model, they do not have a direct measurable influence on the intention to purchase tilapia within our sample. Thus,

consumers' decisions appear to be primarily guided by their personal and emotional perceptions of the product rather than by social influences or perceived barriers to action.

Covariances between independent variables

Table 05: Independent variables covariances

Variables	estimation	SE	Z-value	P-value
ATT ↔ SBN	0.152	0.045	3.397	< 0.001
ATT ↔ BC	0.249	0.052	4.826	< 0.001
SBN ↔ BC	0.111	0.042	2.666	0.008

The covariance results between the independent variables of the model show statistically significant relationships among the three theoretical dimensions of the TPB model—attitude (ATT), subjective norm (SBN), and perceived behavioral control (BC). Specifically, the covariance between attitude and subjective norm is estimated at $\beta = 0.152$ ($p < 0.001$), between attitude and behavioral control at $\beta = 0.249$ ($p < 0.001$), and finally between subjective norm and behavioral control at $\beta = 0.111$ ($p = 0.008$).

These positive and significant values indicate that individuals with a more favorable attitude toward tilapia consumption also tend to perceive greater social pressure (subjective norm) and a stronger sense of behavioral control. Similarly, a stronger perceived social norm often goes hand-in-hand with a greater sense of control.

These links suggest some internal consistency among the latent variables of the TPB model, although not all direct relationships with behavioral intention are significant. These covariances can thus be useful for better understanding the underlying dynamics between beliefs, social influences, and self-efficacy in the context of tilapia purchase decision-making among Algerian consumers.

Summary of effects predicted by the TPB model

Table 06: Theory of planned behavior effect

Variable	Effet sur l'intention	Force	significativité
Attitude (ATT)	Positive	Fort	✓ Significatif
Norme subjective (SBN)	Négative	Faible	✗ Non significatif
Contrôle comportemental (BC)	Négative	Très faible	✗ Non significatif

The results obtained through the Structural Equation Modeling (SEM) analysis help clarify the respective roles of the three independent variables of the TPB model—attitude toward behavior (ATT), subjective norm (SBN), and perceived behavioral control (BC)—in predicting the behavioral intention (INT) to purchase tilapia among Algerian consumers.

The analysis of standardized coefficients reveals that attitude plays a central and statistically significant role in the formation of behavioral intention ($\beta = 1.036$, $p = 0.020$). In other words,

the more favorable the consumer's attitude toward tilapia consumption, the stronger their intention to purchase this product.

This result underscores the importance of cognitive and emotional factors such as perception of quality, taste, or nutritional benefits in the purchase decision.

In contrast, neither the subjective norm (SBN) ($\beta = -0.216$, $p = 0.306$), nor the perceived behavioral control (BC) ($\beta = -0.086$, $p = 0.887$), show statistically significant influence on behavioral intention. These findings suggest that, although these two dimensions are theoretically relevant in explaining behavior, they do not exert measurable effects in the studied context.

This may reflect either a low level of social pressure regarding tilapia consumption or a lack of concrete barriers preventing individuals from purchasing the product.

These observations invite further exploration of moderating variables that may influence relationships within the TPB model. For instance, future research could test the effect of geographic location (coastal vs. inland areas), considering that tilapia is a farmed fish and not a wild marine fish. It is possible that consumers living in coastal areas prefer traditional marine fish, while those in inland areas may be more inclined to consume farmed fish.

Moreover, purchasing power could also play an important role, especially since the price of tilapia can vary depending on local markets and may influence the relationship between attitude and purchase intention.

In summary, the TPB model proves to be partially valid in this specific context: while the overall model structure fits the observed data very well, only one of its three main predictors—attitude—effectively contributes to explaining the intention to purchase tilapia.

A promising direction for future research would be to enrich the model with socio-geographical and economic variables to better identify the determinants of purchasing behavior across different consumer profiles.

Path diagram

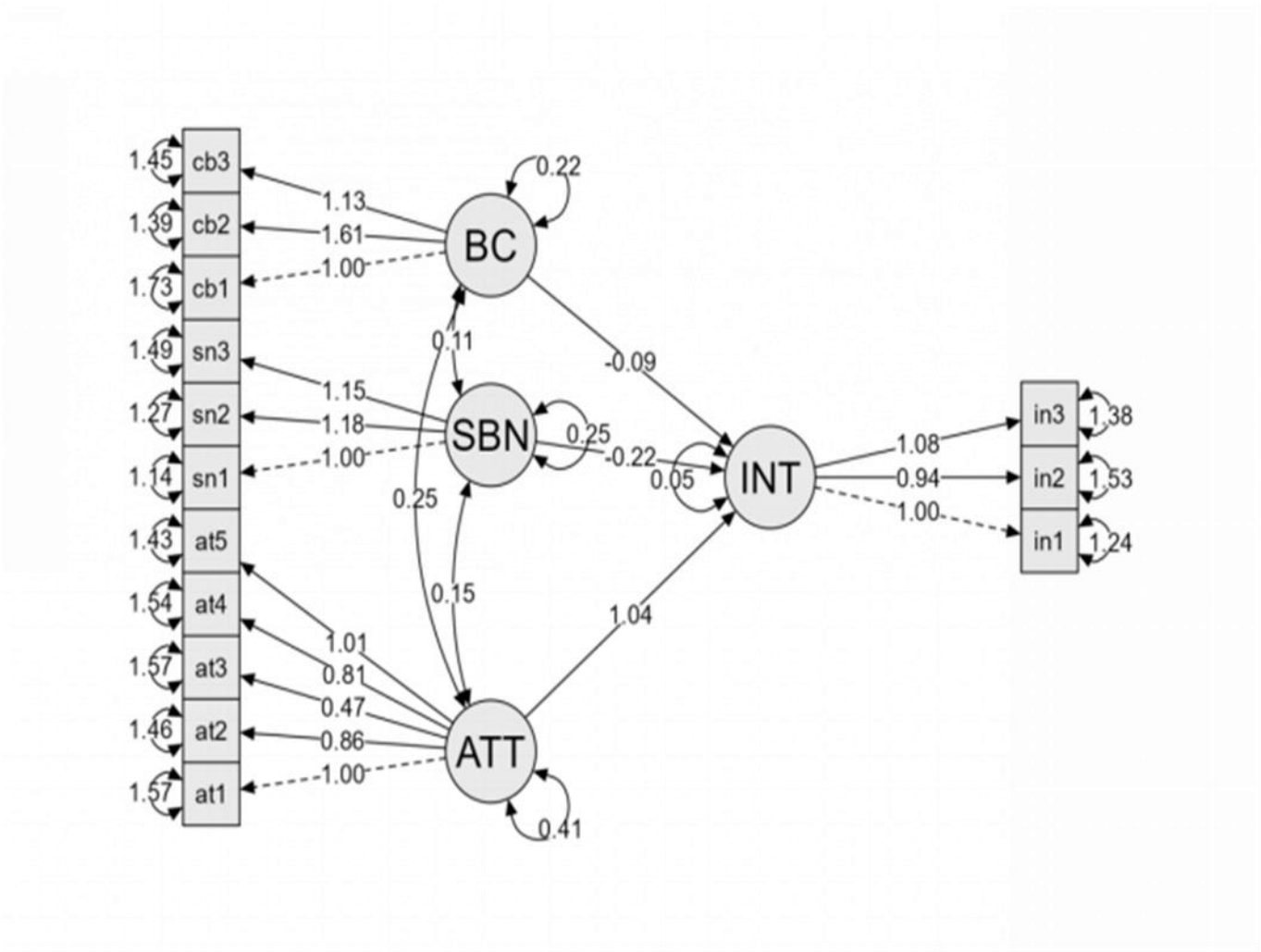

Figure 13: Path diagram

External Validity

Although this study provides robust results based on a sample of 475 respondents, its external validity remains limited due to the non-probabilistic nature of the sampling. The profiles of participants—especially their digital exposure or access to fish markets—may not accurately reflect the entire Algerian population. Consequently, the conclusions should not be generalized without caution to all consumers in the country.

However, the observed trends—particularly the dominance of individual attitudes in the formation of purchase intention and the weak influence of social norms—align with findings from other African contexts, notably in Ghana, Nigeria, and East Africa (Nakagawa et al., 2024; Nash et al., 2022). This suggests that certain behavioral dynamics are shared beyond local specificities, reinforcing the relevance of coordinated regional approaches for promoting tilapia and educating consumers.

CONCLUSION

CONCLUSION

This research work focused on analyzing the determinants of Algerian consumers' behavior towards tilapia, in a context where this farmed species is arousing growing interest in terms of production, yet still struggles to find its place in national consumption habits. By using the Theory of Planned Behavior (TPB) as a theoretical framework, the study identified the key psychological variables influencing purchase intention, while also taking into account the socio-economic and cultural dimensions specific to the Algerian context.

The descriptive analysis revealed a relatively low level of knowledge about tilapia, marginal consumption frequency, and an ambivalent perception regarding its taste and nutritional qualities. The strong preference for traditional marine fish, the sometimes negative image of aquaculture, as well as difficulties in accessing the product, are all obstacles to the development of tilapia on the local market.

The structural equation modeling analysis highlighted the central importance of individual attitude in the formation of purchase intention, while subjective norm and perceived behavioral control showed no significant effect in the studied model. These results confirm that the purchase decision is more strongly based on personal evaluations (taste, health, price) than on social pressure or perceived access conditions.

Based on these findings, several practical recommendations emerge: strengthening communication around the qualities of tilapia, improving its visibility in distribution networks, proposing educational and culinary initiatives (recipes, demonstrations, campaigns), and supporting stakeholders in structuring the supply chain. These levers, adapted to the identified consumer profiles, could contribute to sustainably promoting this species in the Algerian diet.

To overcome the current lack of consumer engagement, awareness campaigns should be developed at the national level. In particular, social media platforms offer a powerful tool to promote tilapia through educational content, nutritional facts, cooking tips, and influencer-driven outreach. These initiatives could help build a more positive image of tilapia, improve familiarity with the product, and support its integration into Algerian food culture.

Ultimately, this thesis provides an empirical contribution to the understanding of food behaviors in a context of aquaculture transition, while highlighting the need for targeted support to transform intensive production into effective consumption. The future of tilapia in Algeria will depend as much on production dynamics as on the ability to build a relationship of trust between the product, its producers, and consumers.

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APPENDICES

Code : **Enquête consommateur** **Date :**

Général

1. Sexe : Masculin Féminin
2. Age : moins de 30 30-50 50 et plus
3. Situation familiale : Marié Célibataire
4. Situation professionnelle : Salarié Entrepreneur Sans emplois
5. Lieu de résidence : Zone côtière Zone non côtière
6. Consommez-vous du poisson ?: Oui Non
7. Quelle est la fréquence à laquelle vous achetez des poissons habituellement ?

   Très fréquemment Plutôt fréquemment Occasionnellement Rarement Jamais

8. Quel type de poisson achetez-vous habituellement ?: Marin Aquaculture
9. Quelle espèce de poisson consommez-vous?:

   Marin : Sardine/Allache Merlan Rouget Crevette Autres :

   Aquaculture : Carpe Loup Daurade Tilapia Autres :

10. Quels sont vos critères d'achat du poisson ?

    Prix Goût Qualité Disponibilité

11. Quels sont vos lieux d'achat du poisson ?

    Pêcherie Marchés Vendeurs ambulants Fermes aquacoles

12. Connaissez- vous le Tilapia ? : Oui Non
13. A quelle fréquence consommez-vous le Tilapia ?

    Très fréquemment Plutôt fréquemment Occasionnellement Rarement Jamais

14. Combien de fois avez-vous mangé du tilapia au cours du dernier mois ?

    Jamais / 1-2 fois / 3-4 fois / Plus de 4 fois

15. Quels sont vos critères d'achat du poisson ?

    Prix Goût Qualité Disponibilité

Quels sont vos lieux d'achat du Tilapia ?

Pêcherie Marchés Vendeurs ambulants Fermes aquacoles

Quelle est votre fourchette de prix d'achat du Tilapia ?

600-1000 Da 1000-1500 Da plus de 1500 Da

Code : **Enquête consommateur** **Date :**

Attitudes

1. Je pense que manger du tilapia est bon pour ma santé.

Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord

2. Je trouve que le tilapia a un bon goût.

Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord

3. Je préfère le goût du tilapia à celui des poissons de mer.
Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord
4. Je considère que le tilapia est un choix alimentaire sain.

Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord

5. Je pense que manger du tilapia est une bonne alternative au poisson de mer.

Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord

Normes Subjectives

6. Mes amis et ma famille mangent souvent du tilapia.

Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord

7. Les gens que j'admire mangent du tilapia régulièrement.

Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord

8. Je me sens pressé par mon entourage pour manger du tilapia.

Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord

Contrôle Comportemental Perçu

9. Je pense que je peux facilement acheter du tilapia dans les magasins près de chez moi.

Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord

10. Je suis capable de préparer du tilapia de manière simple et rapide.

Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord

11. Je pense que le prix du tilapia est abordable pour moi.

Très d'accord / Plutôt d'accord / Ni d'accord ni en désaccord / Plutôt en désaccord / Très en désaccord

Code : **Enquête consommateur** **Date :**

Intention

12. Tilapia sera sur ma liste de courses à l'avenir.

Très probable / Plutôt probable / Ni probable ni improbable / Plutôt improbable / Très improbable

13. Je prévois de manger du tilapia au cours des prochaines semaines.

Très probable / Plutôt probable / Ni probable ni improbable / Plutôt improbable / Très improbable

14. Je suis prêt à essayer de nouvelles recettes avec du tilapia.

Très probable / Plutôt probable / Ni probable ni improbable / Plutôt improbable / Très improbable

Général

1. Saviez-vous que le Tilapia est riche en protéine, vitamine B12, phosphore, potassium, sélénium ? Oui Non
2. Saviez-vous que le Tilapia est par excellence le 2ème poisson d'élevage consommé après la carpe à l'échelle mondiale ? Oui Non
3. Saviez-vous que l'Etat Algérien a investi dans la production du Tilapia ? Oui Non

Avec un prix d'achat de poisson variant entre 600 et 700Da/Kg ?

4. Saviez-vous que Cosider Agriculture a réalisé 100 tonnes de Tilapia en 2023 ?

This is the questionnaire used in our expirements

الجمهورية الجزائرية الديمقراطية الشعبية
République Algérienne Démocratique et Populaire
وزارة التعليم العالي والبحث العلمي
Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
المدرسة الوطنية العليا لعلوم البحر وتهيئة الساحل
Ecole Nationale Supérieure des Sciences de la Mer et de l'Aménagement du Littoral

ENSSMAL

Attestation de participation

Cette attestation est dévirée à

Mme MAOUEL Djamila

A participé à la conférence intitulée « Interactions anthropiques avec la mer et le littoral : Perspectives scientifiques et stratégiques « CIAMEL 2025 » qui a eu lieu à l'ENSSMAL le 28 mai 2025 par une communication écrite intitulée :

«Analysis of consumer behavior toward aquaculture products: Tilapia»,

Co-auteurs: YAHIAOUI D., KHELIFA Oussama, CHELOUH Mourad, MESSAOUDI Hana, KEDOUI Sara

Alger, le 28 mai 2025

Directrice de l'ENSSMAL

الأستاذة لمين حاجة
المديرة

BUSINESS MODEL CANVA

Aquaponic system: Tilapia farming and Cherry Tomato cultivation

INTRODUCTION

Aquaculture is currently one of the fastest-growing food sectors worldwide. According to the FAO report (2022), it accounts for more than 50% of the global fish production intended for human consumption. This growth can be attributed to the increasing demand for animal protein, the overexploitation of natural fishery resources, and technological advances in sustainable production.

In Algeria, aquaculture remains relatively underdeveloped despite significant potential, particularly in coastal areas and inland water resources. In 2022, Algerian aquaculture production reached approximately 8,000 tonnes, which remains modest compared to the government's medium-term target of 100,000 tonnes per year (MPPH, 2022). The primary cultivated species include gilthead seabream, European seabass, and more recently, tilapia, especially in Saharan regions.

In response to challenges related to food security, water resource management, and sustainable agriculture, aquaponics is emerging as an innovative solution. This integrated system combines aquaculture (fish farming) and hydroponics (soil-less plant cultivation), enabling a circular economy where fish waste serves as nutrients for plants.

Globally, several countries have already made substantial investments in large-scale aquaponic systems, notably the United States, Australia, Canada, and Europe (Love et al., 2015; Goddek et al., 2019). These projects are often supported by ambitious environmental policies, scientific research, and technological development.

In Algeria, aquaponics remains in its infancy; a few private or small-scale experimental initiatives exist, primarily for educational purposes or self-consumption. However, no structured large-scale investment projects have yet been launched despite significant potential in arid zones where water is a precious resource. The absence of a clear regulatory framework, lack of investor awareness, and insufficient specialized training continue to hinder the sector's development.

Axe 01 : Project presentation

1.1. Project idea

Our activity falls within the domain of integrated sustainable aquaculture through an aquaponic system combining tilapia farming and cherry tomato cultivation. The project is the result of a synergy among our group members, based on research conducted during our final-year projects (FYP). It is from this foundation that the idea to realize a future-oriented project was born.

Two members conducted a study on consumer behavior regarding aquaculture products in Algeria, particularly tilapia. The findings indicate that tilapia enjoys a positive image and that its consumption is expected to increase in the coming years, provided that its market visibility is enhanced and consumers are better informed about its nutritional and economic benefits.

The other two members performed a study on the composition of effluents from tilapia farming, revealing a high concentration of essential nutrients for plants, notably phosphorus (PO_4^{3-}), ammonium (NH_4^+), and nitrates (NO_3^-). This observation strengthened our conviction to valorize this water within an aquaponic system, thereby eliminating the need for chemical fertilizers while promoting circular and environmentally friendly agriculture.

These two complementary approaches, developing a market for fish and vegetables alongside environmental valorization, motivated our group to unite and realize a common project with significant technical, economic, and sustainable potential.

The selected site for implementation is located in the Lichana region of the Wilaya of Biskra. This location was secured through family connections and offers major agro-climatic, water, and regulatory advantages suitable for aquaponic tilapia farming and cherry tomato cultivation. The choice was guided both by the biological requirements of the targeted species and by the recommendations of the Ministry of Fisheries and Fishery Productions (MPPH) for aquaculture projects in Saharan zones.

Climatic and Agricultural Advantages:

- Biskra benefits from a hot and dry climate, with average annual temperatures around 26 – 30 ° C, which are ideally suited for tilapia, a thermophilic species that thrives between 25 and 30 ° C (FAO, 2011).
- Annual sunshine exceeds 3,500 hours, creating optimal conditions for greenhouse cultivation of cherry tomatoes, a crop that requires high levels of light and heat.
- The region is endowed with available agricultural land, a skilled workforce, and well-developed logistical infrastructure that facilitates the distribution of products to markets in both the northern and southern regions.

Our objective is to produce 4 tons of tilapia per year in integration with a hydroponic cultivation of 25 tons of cherry tomatoes. At this scale, our project is classified as a small integrated fish farming unit and complies with the specific requirements set by the Ministry of Fisheries and Fishery Productions (MPPH) for this category (MPPH, 2021; Algérie Invest, 2023; Algérie Éco, 2023).

Table 1 : Technical, Regulatory, and Environmental Requirements for a 4 Tons/Year Tilapia Aquaponics Project in Algeria

Element	**Ministerial requirements for a 4 Tons/Year project**
Required Area	Arround 500 to 600 m^2 for the entire integrated aquaponic system
Fish tanks	2 to 3 tanks of 10 m^3 each (stocking density: 30–40 kg/m^3)
Authorized Species	*Tilapia nilotica* or red tilapia (regulated and encouraged species)
Water Temperature	Must be maintained between 25–30 °C

Element	Ministerial requirements for a 4 Tons/Year project
Water Access	Authorized agricultural borehole or irrigation network – permit required
Operating Authorization	Aquaculture farming license issued by the local fisheries department
Biosecurity	Site fencing, bird protection, water control
Health Monitoring	Veterinary check recommended once a year
Aquaculture Effluents	Recycled through plant cultivation – no pollution discharged
Tax Benefits	VAT suspended on direct sales, customs exemption on inputs
Production Bonus	Eligible for a bonus of 50 DA/kg if conditions are met

Biskra is one of the wilayas designated by the Ministry as favorable for freshwater fish farming, particularly within the Saharan programs integrating agriculture and aquaculture (MPPH, 2021). The compactness of the aquaponic system allows us to meet the project's objectives within a limited space while respecting the environment, complying with regulatory requirements, and leveraging local resources. This region represents an ideal ecosystem for piloting circular, sustainable production models that can be scaled and replicated in other arid regions of Algeria.

Our project will be structured as a limited liability company (SARL), registered under the CNRC activity code 03.22Z, with the commercial name chosen by the group: "TILATO."

1.2. Value Propositions

Our project, TILATO, positions itself as an innovative and sustainable initiative within the Algerian agri-food sector. While integrated aquaculture and agriculture exist locally, large-scale aquaponics as a closed, circular, and zero-discharge system remains absent in Algeria. Our project aims to seize this opportunity by offering an ecological, economical, and efficient solution.

The TILATO aquaponics project enables the following:

- **Réduire considérablement les coûts de production, notamment en supprimant l'usage d'engrais chimiques**
- **Valoriser les effluents de tilapia, riches en nutriments essentiels (azote, phosphore), comme fertilisant naturel pour les cultures de tomate cerise,**
- **Éviter les traitements coûteux des eaux usées, puisque l'eau circule en boucle et est intégralement utilisée par les plantes,**

- **Contribuer à une économie circulaire, où rien ne se perd et où chaque ressource est optimisée.**

Our project also aligns with a national momentum: the Algerian government actively supports tilapia projects through production subsidies (50 DA/kg), fiscal incentives (exemption from customs duties, reduced VAT of 9% for processors, zero VAT at production), and incentives for sustainable freshwater aquaculture, as outlined in the 2024 Finance Law and confirmed by a ministerial decree dated June 24, 2024 (APS, 2023a; APS, 2023b; APS, 2024; Algérie Invest, 2024).

During the launch phase, we will use a controlled industrial feed to nourish the tilapias. Starting from the third year, we plan to transition to local production of our own organic feed, leveraging the expertise of a team member who completed specialized training in this area. The objective is to offer a 100% organic, healthy, and locally produced product, both in terms of fish and vegetables.

1.3. Tilato project team

The team consists of four fifth-year aquaculture students, as detailed in the following table:

Project team names	Background	Role
CHELOUH Mourad	Scuba diving certification Training in tilapia feed production Internship at the Directorate of Agricultural Production (DPA), Relizane: monitoring of aquaculture projects Internship at GARDEN nursery Internships at various aquaculture farms: AQUATOUR farm OURICIA farm Private fish farm Internship at CULTMARE Internship at LNCAPPASM (National Laboratory for Fishery and Aquaculture) Internship at CNRDPA (National Research Center for Development of Aquaculture and Fisheries) Formal training in aquaculture	Financial Plan
KEDOUI Sara	**Aquaculture Training in Turkey:** Fish feeding, farming techniques, fish feed production, fish diseases. **Internship at MDPPH:** Monitoring of aquaculture projects, investments. **Internship at Aquaculture Farms:**	BMC Table

	Internship at **GARDEN nursery** Internship at **AQUATOUR Farm** Internship at **OURICIA Farm** Internship at a **private fish farm** **Internship at CULTMARE** **Internship at LNCAPPASM** **Internship at CNRDPA** **Entrepreneurship Training** **Microalgae Cultivation Training** **Aquaculture Training**	
KHELIFA Oussama	Scuba diving certification Training in tilapia feed production Internship at the Directorate of Agricultural Production (DPA), Relizane: monitoring of aquaculture projects Internship at GARDEN nursery Internships at various aquaculture farms: AQUATOUR farm OURICIA farm Private fish farm Internship at CULTMARE Internship at LNCAPPASM (National Laboratory for Fishery and Aquaculture) Internship at CNRDPA (National Research Center for Development of Aquaculture and Fisheries) Formal training in aquaculture	**Market Study**

MESSAOUDI Hana	**Scuba Diving** **Internship at MDPPH:** Monitoring of aquaculture projects and investments **Internship at GARDEN nursery** **Internships at Aquaculture Farms:** AQUATOUR Farm OURICIA Farm Private fish farm **Internship at CULTMARE** **Internship at LNCAPPASM** **Internship at CNRDPA** **Entrepreneurship Training** **Internship at PROMASIDOR** **Microalgae Cultivation Training** **Aquaculture Training**	Manages the project

1.4. Project Objective

The **TILATO** project aims to achieve, during the first three years of operation, an annual production of **4 tons of tilapia** and **25 tons of cherry tomatoes**. Starting from the fourth year, taking into account projected growth and system optimization, we plan to **double production volumes**, reaching **8 tons of tilapia** and **50 tons of cherry tomatoes** per year.

Tilapia production in 2023 was approximately **7,000 tons**, representing around **60% of freshwater fish** in Algeria (Algérie Eco, 2024). A production of 4 tons per year would represent **0.057% of the current national production**, and **0.033% of the 2024 target of 12,000 tons**.

There are no official statistics specific to cherry tomato production. However, according to some sources, its cultivation remains **marginal**, often carried out on a **small scale in family farms**, particularly in **Oued, Biskra, or Blida**, with modest annual volumes (Bennaceur, 2020). If we take the example of one of these small farms (e.g., **Souakri**) with a targeted production of **6,000 tons/year**, our production of **10 tons** would represent **0.17%** of the current production.

1.5. Project Implementation Timeline

Mois									
		Oct	**Nov**	**Déc**	**Jan**	**Fév**	**Mars**	**Avr**	**Mai**
	Études préalables et préparation des documents nécessaires	✔							
	Commande de materiel et équipements (pompes, filtres, matériel de récolte,….etc)		✔						
	Construction des infrastructures de production (bassins, batiments,bureaux)			✔	✔	✔			
	Installation des équipements					✔			
	Achat de matières premières							✔	
	Réalisation du prototype								✔

Axis 02: Innovative Aspects

2.1. Nature of Innovations

The **TILATO** project represents an **incremental innovation** (existing elsewhere, but implemented for the first time in our country) at the national level. While cherry tomato cultivation and tilapia farming already exist separately in Algeria, their integration into a structured **aquaponic system** at a commercial scale has not yet been realized.
Our project proposes a new **techno-economic combination** tailored to the local context, based on an **ecological synergy** between aquaculture and agriculture—still untapped in the country.

2.2. Field of Innovation

TILATO belongs to the domain of **aquaculture and agriculture innovation**, introducing a new **circular production model** based on aquaponics. This model integrates **tilapia farming** and **cherry tomato cultivation** in a **closed-loop symbiotic system**, where fish waste is repurposed as natural fertilizer for plants.
In other words, the **ammonia** excreted by tilapia is converted (via nitrifying bacteria) into **nitrates** that are directly absorbable by plants. This eliminates the need for chemical fertilizers while reducing pollution—addressing sustainability, food security, and responsible water management

in Algeria, especially in arid areas like **Biskra**.
The direct valorization of aquaculture effluents for crop production marks a **breakthrough** from traditional agricultural systems. It enables **dual production (fish + vegetables)** from a single water source while reducing input and operational costs.
Thus, TILATO offers an **innovative, scalable, and replicable model** perfectly aligned with today's priorities: **sustainable agriculture**, **circular economy**, and **ecological transition**.

Axis 03: Strategic Market Analysis

3.1. TILATO Market

TILATO's potential market is **broad and diverse**, covering a wide range of consumers regardless of age, gender, or location. It targets:

Children and adults, particularly those concerned with nutritional quality—through households, school cafeterias, and healthcare institutions.

Restaurants, hotels, and caterers, seeking fresh, sustainable, and premium ingredients for a discern

Distributors and supermarkets aiming to expand their range of eco-friendly, local products.

Processors, such as fishmeal or compound feed manufacturers using tilapia as raw material.

Agricultural cooperatives and fair-trade players, interested in sustainable partnerships and short supply chains

Key market trends:

Continuous demand for **local, chemical-free products**

Growing awareness of **health and food quality issues**

Increasing interest in **local economies and ecological transition**

Market Location

High consumption potential exists in **major Algerian cities** like **Algiers, Oran, and Constantine**, where demand for **organic and healthy food** is growing. There is also strong interest in **southern regions** (e.g., **Biskra, Ouargla, El Oued**), where access to **fresh, quality, and sustainable produce** is limited, making aquaponics a particularly suitable solution.

3.2. Competitive Landscape

National competitors include:

A. Tilapia Producers

Cosider Group - Agrico: Public-sector player with multiple tilapia farms, e.g., 60 t/year red tilapia in Djelfa and a pilot farm in Khenchela (800 t/year capacity)

Private farms:

El Kerma Farm, Oran: ~300 t/year

Belassel Bouzegza Pilot Farm: ~400 t/year

Oued Djemaa (Relizane): 100 t/year since 2010

Bedrani Bedrane Farm, Hamadia: 50 t/year, with 1 million fry hatchery

Serghine Projects: 24 ponds each, ~22 t/year

Benbouha Brothers, Mohammadia: Integrated agri-aquaculture on 19 ha with 5,000 m^3 pond

Note: 40 freshwater aquaculture farms are planned in the **southeast**, with a combined potential of 2,100+ t/year

B. Cherry Tomato Producers

Nour/Mohamed Tahraoui – Biskra: Algeria's first large-scale cherry tomato grower (20 t/day, 9 ha greenhouses)

Souakri Group – El Meghaïer: 1,000 ha mega-project with Dutch greenhouse tech

Other producers: bio tomato growers offering round and pear-shaped varieties, and open-field/greenhouse growers like **Topagri**, Kabylie and other fertile northern regions.

C. Fish Sellers

Fish markets (Algiers, Béjaïa, Annaba)

Specialized distributors: Pêche Plus, Poissonnerie El Bahri, etc.

Competitor strengths:

Established infrastructure

Existing distribution networks

Strong local market presence

Competitor weaknesses:

Lower product quality (due to antibiotics/chemical inputs)

Environmental impact (water waste, soil pollution)

Import dependency and **long supply chains**, reducing freshness

Higher production costs

3.3. Marketing Strategy

TILATO adopts a **differentiation strategy** based on the **environmental value** of its products. Positioned as an **innovative sustainable farming model**, the project promotes **local, healthy, and eco-friendly products** from a **chemical-free and pollution-free aquaponic system**.

Communication Strategy:

Strong presence on **social media** (Facebook, Instagram, TikTok)

Educational and visual content showing our production cycle

Partnerships with **eco-friendly or culinary influencers**

Distribution Channels:

Direct farm sales

Weekly subscription boxes

Specialty stores (organic shops, restaurants)

Medium-term goals: **digital platforms and exports**

Pricing Policy:

Affordable for direct consumers

Premium pricing in stores (justified by quality, traceability, and sustainability)

Launch offers to build customer loyalty

Branding:

Clear and meaningful name ("**TILATO**")

Eco-responsible packaging

Nature-inspired logo for a strong and recognizable identity

Long-Term Vision:

Obtain environmental certification or create a private label ("Clean Aquaponics") to enhance credibility and stand out in the growing organic market.

Axis 04: Production and Organization Plan

4.1. Production Process

The **TILATO** project's production process is based on an **integrated aquaponic system**, combining **tilapia farming** and **cherry tomato cultivation**. This innovative model enables cross-utilization of aquatic and plant-based resources in a **circular, sustainable, and highly efficient system**.

The system is designed for **two production cycles per year**, each yielding **2 tons of tilapia** and **12.5 tons of cherry tomatoes**.
Thus, the **annual production capacity** reaches **4 tons of tilapia** and **25 tons of cherry tomatoes**.

The process consists of four main phases:

- **Procurement of raw materials**
- **Aquaponic production phase**
- **Harvesting and packaging**
- **Distribution of final products**

A. Procurement of Raw Materials

To reach the goal of 4 tons of tilapia annually, approximately **8,000 fingerlings** are required, assuming an average yield of **500 g per adult fish**.
This ratio aligns with standards set by Algeria's Ministry of Fisheries and Fishery Production (MPPH), which recommends a density of **12 kg/m²** in intensive continental farming systems (MPPH, 2020).

For cherry tomatoes, the target of 12.5 tons per cycle requires **about 5,000 to 5,200 plants**, equating to **50–55 grams of seeds**, assuming a **>90% germination rate**. Each plant yields around **2.5 kg of fruit**, in line with aquaponics yield averages of **10–12 kg/m²** (Somerville et al., 2014; Rakocy et al., 2006).

B. Aquaponic Production

The fingerlings will be stocked in **four fish tanks of 42 m² each** (dimensions: 7m x 6m x 1.5m), totaling **168 m²**. At 12 kg/m², these tanks will produce **~2 tons of tilapia per cycle**, or **4 tons annually** across two cycles.

Simultaneously, cherry tomato seeds are germinated in a suitable substrate for ~20 days, then transplanted into **eight plant-growing basins of 157 m² each** (total **1,256 m²**), with **4 plants per m²** for a total of **~5,024 plants**.

The tilapia produce nutrient-rich waste (mainly **ammonia**), which is biologically converted into **nitrates** via a **biofilter**, then absorbed by the tomato plants.
It's estimated that **1 ton of tilapia generates ~100 kg of usable nutrients** (Endut et al., 2010), meaning **200 kg** per cycle—enough to fertilize **~1,250 m²** of plant area.

With an average yield of **10 kg/m²**, the **1,256 m²** area can yield **~12.5 tons of cherry tomatoes**.

Water Circulation Loop:

Water flows from fish tanks → **gravel mechanical filter** → **biofilter** → **plant basins** → back to fish tanks.
This **closed-loop system** ensures **high productivity**, **low water consumption**, and **environmental sustainability**.

C. Harvesting and Packaging

Once tilapia reach market size (**~250 g**) and cherry tomatoes are ripe, the products are harvested. Customers are encouraged to pick up products directly from the farm, with **local delivery services** planned in the future.

Packaging Standards:

Tilapia: packed in fish-specific crates

Cherry tomatoes: sorted, graded, and packed in **food-safe plastic crates**, suitable for direct sales or distribution.

4.2. Strategic Procurement

This section outlines TILATO's sourcing policy, identified suppliers, and results from pilot-scale procurement tests.

Procurement Policy:
TILATO uses a sourcing model based on:

Local proximity

Certified input quality

Reliable logistics

Cash-on-delivery terms

This approach reduces financial risk and ensures fast delivery, especially for **perishable and live inputs**.

A. Tilapia Fingerling Suppliers:

- **Benrekia Hatchery (Relizane)** – certified fry supplier, internship partner
- **MOULAY Tilapia (Ouargla)** – genetic diversity and seasonal availability
- **Cosider Agrico (Tipaza)** – industrial-level facilities
- **AquaFerme du Nord (Blida)** – intensive farming specialist
- **Atlantica Pêche (Annaba)** – known for sanitary and environmental standards

B. Cherry Tomato Seed Suppliers:

- **Semences Merzouga (Oran)** – high-yield, disease-resistant varieties
- **AgriSeeds Algérie (Algiers)** – certified seeds for soilless/aquaponic systems
- **GreenTom Horticulture (Tizi Ouzou)** – hybrid seeds optimized for closed-loop systems

These partnerships were tested during the **pilot project**, and confirmed in terms of reliability and quality.

Procurement of Technical Equipment

Equipment suppliers were selected based on:

- ✓ **Technical specialization**
- ✓ **Durability**
- ✓ **Aquaponics certifications**

Key Suppliers:

- Water pumps: **Aquaflow Systems (Alger), Irritech Algérie (Blida)**
- Air pumps: **AirTech Pisciculture (Tipaza), OxyPure SA (Djelfa)**
- Fish crates: **PoissonPack (Mostaganem)**
- Tomato crates: **PackHorti (Sétif)**
- Industrial scale: **Metrix Pro (Alger)**
- Harvest tools: **AquaHarvest (Annaba), HarvestPlus (Bejaia)**
- Water circulation & drainage: **HydroFlow (Oran), EvoDrain (Constantine)**
- Mechanical filter: **FilterMax (Blida)**
- Biofilter: **BioPure Systems (Alger)**
- Bell siphon: **AquaSiphon Co. (Tipaza)**
- Specialized LED lighting: **GrowLight Algérie (Alger)**

All items have been tested for **technical compatibility, energy efficiency, and sustainability**.

4.3. Key Partners

To ensure the project's technical, financial, and social viability, TILATO relies on a **network of strategic partners**:

Financial Partners**: BADR Bank, BEA, Al Baraka Bank, CPA**

These institutions offer **specialized loans** and **support programs** for agriculture and youth entrepreneurship.

Technical & Scientific Partners:

- **Veterinarians** (aquaculture specialists)
- **Incubators & support centers**: e.g., **CADA**, **Algérie Venture**
- **Research institutions**:

  CNRDPA (Fisheries R&D Center)

  INRAA (Agronomic Research Institute)

  Universities and veterinary schools (e.g., ENSSMAL)

- **Institutional Partners:**

  Local authorities (Daira, Wilaya, Chambers of Agriculture) for **permits and infrastructure**

Local Farmers: Possible partnerships for **composting**, **knowledge exchange**, and **logistics sharing**

Workforce

The core team includes **four co-founders**, all **state-certified aquaculture engineers** with field experience from internships in farms, labs, and research centers.

Initial hires:

1 agricultural technician (horticulture specialist)

2 multipurpose workers (feeding, quality control, cleaning)

2 security agents (day/night monitoring)

1 financial officer (accounting, cash flow, liaison with banks/admin)

The team is **scalable**: logistics, marketing, and maintenance roles will be added as production grows.

Axis 05: Financial Plan

To assess TILATO's **economic feasibility**, the project team conducted calculations of key **financial indicators** with help from **finance specialists**.

5.1. Costs and Expenses

Table 01 : Tilato project investments and finaning breakdown

INVESTISSEMENTS		Montant DA hors taxes
Immobilisations incorporelles		**847OOO,00**
Frais d'établissement		*400000,00*
Frais d'ouverture de compteurs		*300000,00*
Logiciels, formations		-
Dépôt marque		*17000,00*
Droits d'entrée		-
Achat fonds de commerce ou parts		-
Droit au bail		-
Caution ou dépôt de garantie		-
Frais de dossier		*100000,00*
Frais de notaire ou d'avocat		*30000,00*
Immobilisations corporelles		**14897000,00**
Enseigne et éléments de communication		*500000,00*
Achat immobilier		-
Travaux et aménagements		*9000000,00*
Matériel		*4877000,00*
Matériel de bureau		*520000,00*
Stock de matières et produits		-
Trésorerie de départ		**5000000,00**
	TOTAL BESOINS	**20744000,00**

FINANCEMENT DES INVESTISSEMENTS			Montant DA hors taxes
Apport personnel			**1000000,00**
Apport personnel ou familial			*1000000,00*
Apports en nature (en valeur)			-
Emprunt	*taux*	*durée mois*	**19744000,00**
Prêt bancaire	*0,00%*	*60*	*19744000,00*
Prêt bancaire			-
			-
Subvention			-
			-
Autre financement			
		TOTAL RESSOURCES	**20744000,00**

Table 02: Depreciation Schedule

	Année 1	Année 2	Année 3
Amortissements incorporels	**53000,00**	**53000,00**	**53000,00**
Frais d'établissement	*40000,00*	*40000,00*	*40000,00*
Logiciels, formations	*0,00*	*0,00*	*0,00*
Droits d'entrée	*0,00*	*0,00*	*0,00*
Frais de dossier	*10000,00*	*10000,00*	*10000,00*
Frais de notaire ou d'avocat	*3000,00*	*3000,00*	*3000,00*

Amortissements corporels	**1 489700**	**1 489700**	**1 489700**
Enseigne et éléments de communication	*50000,00*	*50000,00*	*50000,00*
Achat immobilier	*0,00*	*0,00*	*0,00*
Travaux et aménagements	*900000,00*	*900000,00*	*900000,00*
Matériel	*487700*	*487700*	*487700*
Matériel de bureau	*52000,00*	*52000,00*	*52000,00*
Total amortissements	**1 542700**	**1 542700**	**1 542700**

5.2. Revenue (Turnover)

Table 03 : Intermediate management balances

	Année 1	**%**	**Année 2**	**%**	**Année 3**	**%**
Chiffre d'affaires	12145560,00	100%	14574670,00	100%	18947080,00	100%
Ventes + autres services	12145560,00	100%	14574670,00	100%	18947080,00	100%
Achats consommés	-	0%	-	0%	-	0%
Marge globale	**12145560,00**	**100%**	**14574670,00**	**100%**	**18947080,00**	**100%**
Charges externes	5036000,00	41%	5018000,00	34%	5512000,00	29%
Valeur ajoutée	**7109560,00**	**59%**	**9556670,00**	**66%**	**13435080,00**	**71%**
Impôts et taxes	30000,00	0%	36000,00	0%	46,80	0%
Charges de personnel	1951400,00	16%	1961400,00	13%	1971400,00	10%

Excédent brut d'exploitation	**5128160,00**	**42%**	**7559270,00**	**52%**	**11416880,00**	**60%**
Dotation aux amortissements	1542700,00	13%	1542700,00	11%	1542700,00	8%
Résultat d'exploitation	**3585460,00**	**30%**	**6016570,00**	**41%**	**9874180,00**	**52%**
Charges financières	200000,00	2%	200000,00	1%	200000,00	1%
Résultat financier	- 200000,00	-2%	- 200000,00	-1%	- 200000,00	-1%
Résultat courant	**3385460,00**	**28%**	**5816570,00**	**40%**	**9674180,00**	**51%**
Résultat de l'exercice	**2877640,00**	**24%**	**4944090,00**	**34%**	**8223050,00**	**43%**
Capacité d'autofinancement	4420340,00	36%	6486790,00	45%	9765750,00	52%

5.3. Projected Income Statements

Table 04: 03 year forecast income statement

	Année 1	**Année 2**	**Année 3**
Produits d'exploitation	**12145560,00**	**14574670,00**	**18947080,00**
Chiffre d'affaires HT	*12145560,00*	*14574670,00*	*18947080,00*
Chiffre d'affaires HT autres services	-	-	-
Charges d'exploitation	**-**	**-**	**-**
Achats consommés	-	-	-
Marge brute	**12145560,00**	**14574670,00**	**18947080,00**

Charges externes	**5036000,00**	**5018000,00**	**5512000,00**
Assurances	*500000,00*	*500000,00*	*500000,00*
Téléphone, internet	*60000,00*	*65000,00*	*70000,00*
Autres abonnements	-	-	-
Carburant, transports	*300000,00*	*350000,00*	*400000,00*
Frais de déplacement et hébergement	-	-	-
Eau, électricité, gaz	*500000,00*	*550000,00*	*600000,00*
Mutuelle	*456000,00*	*528000,00*	*612000,00*
Fournitures diverses	*20000,00*	*25000,00*	*30000,00*
Entretien matériel et vêtements	*300000,00*	*400000,00*	*500000,00*
Nettoyage des locaux	-	-	-
Budget publicité et communication	*2000000,00*	*1500000,00*	*1500000,00*
Loyer et charges locatives	*700000,00*	*800000,00*	*900000,00*
Expert comptable, avocats	*200000,00*	*300000,00*	*400000,00*
	-	-	-
	-	-	-
	-	-	-
Valeur ajoutée	**7109560,00**	**9556670,00**	**13435080,00**
Impôts et taxes	**30000,00**	**36000,00**	**46800,00**
Salaires employés	**470000,00**	**470000,00**	**470000,00**
Charges sociales employés	338400,00	338400,00	338400,00

Prélèvement dirigeant(s)	**40000,00**	**50000,00**	**60000,00**
Charges sociales dirigeant(s)	1103000,00	1103000,00	1103000,00
Excédent brut d'exploitation	**5128160,00**	**7559270,00**	**11416880,00**
Frais bancaires, charges financières	**200000,00**	**200000,00**	**200000,00**
Dotations aux amortissements	**1542700,00**	**1542700,00**	**1542700,00**
Résultat avant impôts	**3385460,00**	**5816570,00**	**9674180,00**
Impôt sur les sociétés	**507820,00**	**872490,00**	**1451130,00**
Résultat net comptable (résultat de l'exercice)	**2877640,00**	**4944090,00**	**8223050,00**

5.4. Cash Flow Plan

Table 05 : Cash-flow variation

	Mois 1	Mois 2	Mois 3	Mois 4	Mois 5
Apport personnel	1000000,00				
Emprunts	19744000,00				
Subventions	-				
Autres financements					
Ventes	-	1104140,00	1104140,00	1104140,00	1104140,00

Ventes autres services	-	-	-	-	-
Chiffre d'affaires (total)	**-**	**1104140,00**	**1104140,00**	**1104140,00**	**1104140,00**
Immobilisations incorporelles	847000,00				
Immobilisations corporelles	14897000,00				
Immobilisations (total)	**15744000,00**				
Acquisition stocks	-				
Échéances emprunt	329070,00	329070,00	329070,00	329070,00	329070,00
Achats de marchandises	-	-	-	-	-
Charges externes	419670,00	419670,00	419670,00	419670,00	419670,00
Impôts et taxes	2500,00	2500,00	2500,00	2500,00	2500,00
Salaires employés	39170,00	39170,00	39170,00	39170,00	39170,00
Charges sociales employés	28200,00	28200,00	28200,00	28200,00	28200,00
Prélèvement dirigeant(s)	3330,00	3330,00	3330,00	3330,00	3330,00
Charges sociales dirigeant(s)	91920,00	91920,00	91920,00	91920,00	91920,00
Total charges de personnel	**162620,00**	**162620,00**	**162620,00**	**162620,00**	**162620,00**
Frais bancaires, charges financières	16670,00	16670,00	16670,00	16670,00	16670,00
Total des décaissements	**16674520,00**	**930520,00**	**930520,00**	**930520,00**	**930520,00**
Total des encaissements	**20744000,00**	**1104140,00**	**1104140,00**	**1104140,00**	**1104140,00**

Solde précédent	-	4069480,00	4243110,00	4416730,00	4590360,00
Solde du mois	**4069480,00**	**173630,00**	**173630,00**	**173630,00**	**173630,00**
Solde de trésorerie (cumul)	**4069480,00**	**4243110,00**	**4416730,00**	**4590360,00**	**4763980,00**

Mois 6	Mois 7	Mois 8	Mois 9	Mois 10	Mois 11	Mois 12	TOTAL
							1000000,00 **19744000,00** **-** **-**
1104140,00 -	1104140,00 -	1104140,00 -	1104140,00 -	1104140,00 -	1104140,00 -	1104140,00 -	**12145560,00** **-**
1104140,00	**1104140,00**	**1104140,00**	**1104140,00**	**1104140,00**	**1104140,00**	**1104140,00**	**12145560,00**
							847000,00 **14897000,00**
							15744000,00
329070,00 - 419670,00 2500,00	329070,00 - 419670,00 2500,00	329070,00 - 419670,00 2500,00	329070,00 - 419670,00 2500,00	329070,00 - 419670,00 2500,00	329070,00 - 419670,00 2500,00	329070,00 - 419670,00 2500,00	**-** **3948800,00** **-** **5036000,00** **30000,00**

39170,00	39170,00	39170,00	39170,00	39170,00	39170,00	39170,00	**470000,00**
28200,00	28200,00	28200,00	28200,00	28200,00	28200,00	28200,00	**338400,00**
3330,00	3330,00	3330,00	3330,00	3330,00	3330,00	3330,00	**40000,00**
91920,00	91920,00	91920,00	91920,00	91920,00	91920,00	91920,00	**1103000,00**
162620,00	**162620,00**	**162620,00**	**162620,00**	**162620,00**	**162620,00**	**162620,00**	**1951400,00**
16670,00	16670,00	16670,00	16670,00	16670,00	16670,00	16670,00	**200000,00**
930520,00	**930520,00**	**930520,00**	**930520,00**	**930520,00**	**930520,00**	**930520,00**	**26910200,00**
1104140,00	**1104140,00**	**1104140,00**	**1104140,00**	**1104140,00**	**1104140,00**	**1104140,00**	**32889560,00**
4763980,00	4937610,00	5111240,00	5284860,00	5458490,00	5632110,00	5805740,00	
173630,00	**173630,00**	**173630,00**	**173630,00**	**173630,00**	**173630,00**	**173630,00**	
4937610,00	**5111240,00**	**5284860,00**	**5458490,00**	**5632110,00**	**5805740,00**	**5979360,00**	

Axis 06: Experimental Prototype

To validate the technical and economic feasibility of the TILATO project, a practical testing phase was carried out at the ENSSMAL pilot farm. The team attempted to create a small-scale aquaponic system using **one tank for tilapia farming**, in which **6 tilapia individuals** were placed, and **three grow beds for cherry tomato cultivation**. The two compartments were connected by a **mechanical pumping system** that allowed the cherry tomato plants to be irrigated using the water from the tilapia tank.

This experiment aimed to simulate, under real conditions, the operation of the aquaponic system envisioned for industrial-scale implementation.

The prototype was developed in collaboration with the school technician, **Mr. Hassen**, who supervised the technical operations related to plant cultivation and water parameter monitoring. This experimental phase made it possible to test the **compatibility of plant varieties**, observe the

plant behavior in an aquaponic environment, and adjust **management parameters** such as water flow rate, nutrient concentrations, and lighting.

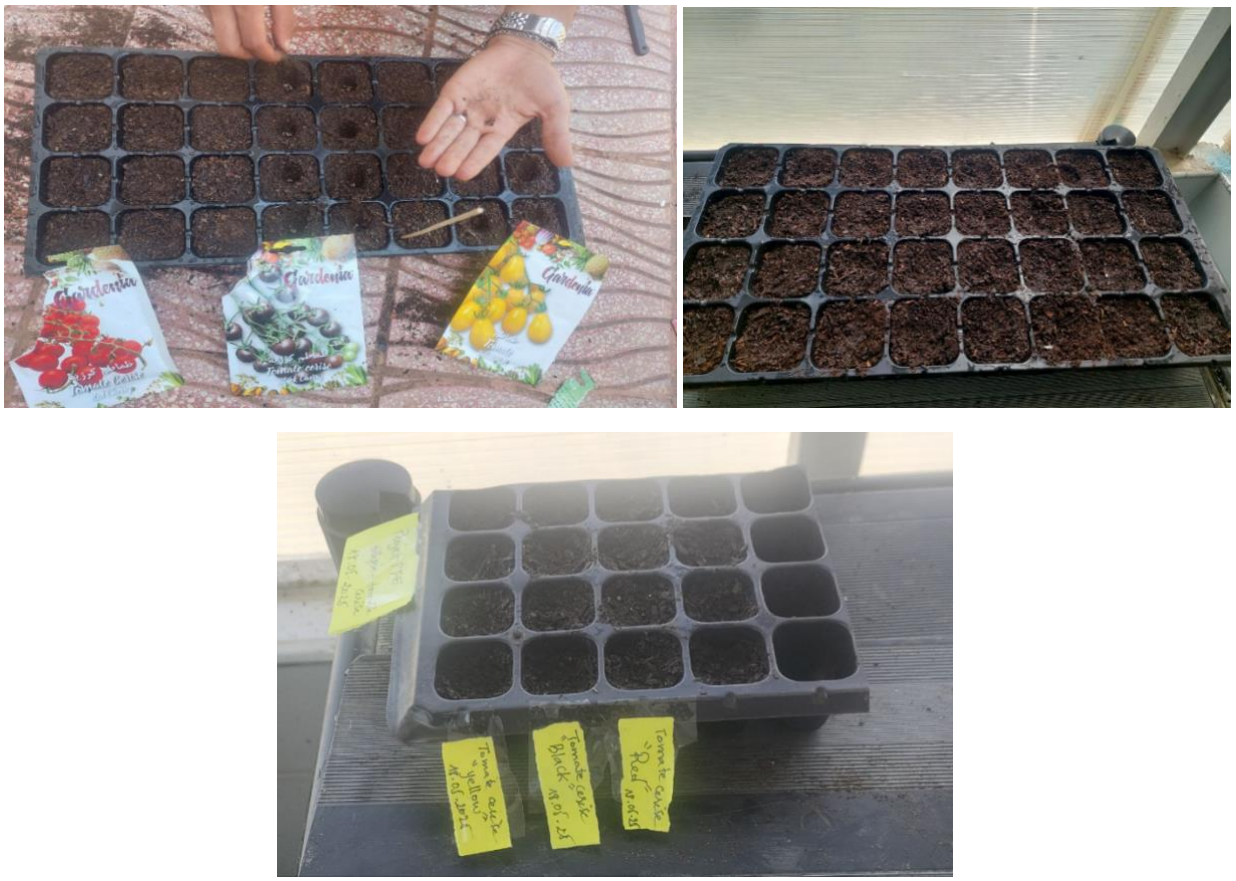

Figure 1: Planting cherry tomato seeds (ENSSMAL, 2025)

Figure 2: Cherry tomato deeds germination (ENSSMAL, 2025)

Figure 3: Putting cherry tomato seedlings in the pot (ENSSMAL, 2025)

Figure 4: Cleaning and preparing cherry tomato raceways (ENSSMAL, 2025)

Figure 5 : Place the cherry tomato seedlings in the racways (ENSSMAL, 2025)

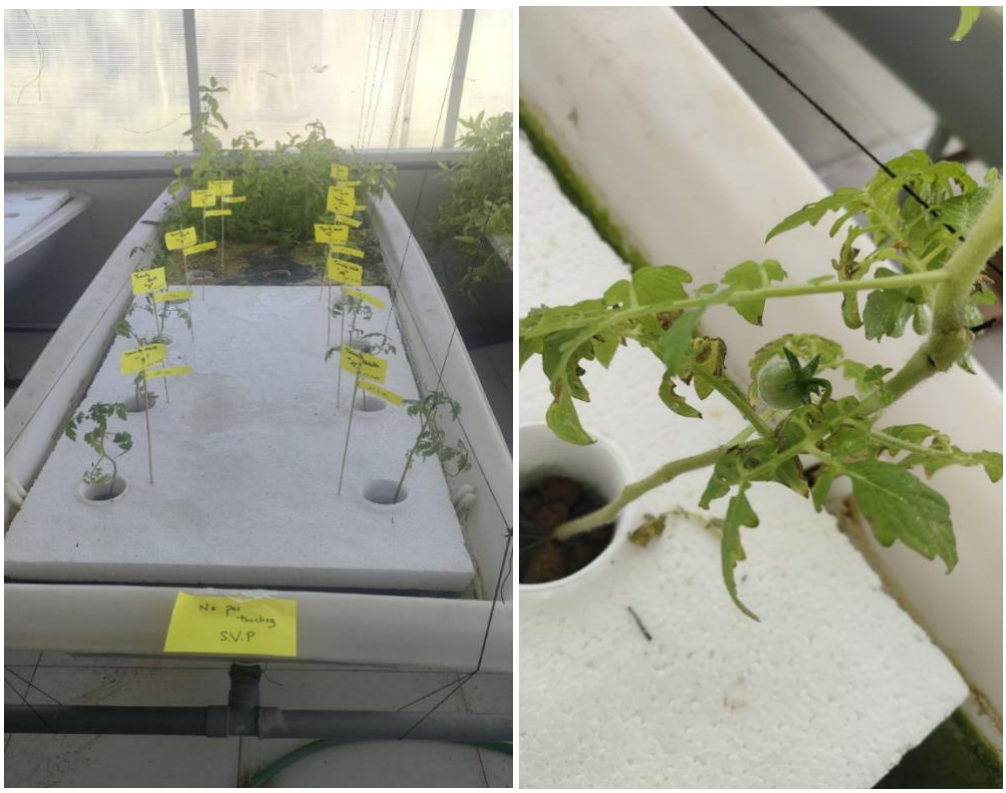

Figure 6: Tomato seedlings grow and tomatoes emerge (ENSSMAL, 2025)

These photos show the prototype of the Tilato project

Three types of cherry tomato seeds were selected for this experiment:

- **Red cherry tomato** (standard high-yield variety)
- **Yellow cherry tomato** (sweet, short-cycle variety)
- **Black cherry tomato** (rustic variety rich in antioxidants)

The seeds were sown in a suitable substrate, and after about **10 days of germination**, the young seedlings were **transplanted into the aquaponic grow beds**. This timeframe allowed for the development of strong, healthy plants ready to benefit from the **nutrient solution naturally generated by the fish**.

The experiment showed that **all three varieties adapted well to the aquaponic system**, with **uniform growth rates** and **satisfactory plant health**. These results reinforced the team's decision to include all three varieties in the final version of the project, aiming to offer an **attractive and diverse selection for the local market**.

BUSINESS MODEL CANVA

<table>
<tr>
<td rowspan="2">Key Partners

A. Financial Partners
BADR
BEA
El Baraka Bank
Crédit Populaire d’Algérie (CPA)
B. Fry Suppliers
Benrekia Hatchery (Relizane)
Moulay Tilapia (Ouargla)
Cosider Agrico (Tipaza)
Aquaferme du Nord (Blida)
Atlantica Pêche (Annaba)
C. Seed Suppliers
Merzouga Seeds (Oran)
AgriSeeds Algeria (Algiers)
GreenTom Horticulture (Tizi Ouzou)
D. Equipment Suppliers
Aquaflow Systems (Algiers): Water pump
AirTech Pisciculture (Tipaza): Air pump
PoissonPack (Mostaganem): Fish crates
PackHorti (Setif): Cherry tomato crates
Metrix Pro (Algiers): 50 kg industrial scale
AquaHarvest (Annaba): Nets and fish scoops
HarvestPlus (Bejaia): Precision scissors and small containers
FilterMax (Blida): Mechanical filter
BioPure Systems (Algiers): Biofilter
AquaSiphon Co (Tipaza): Bell siphon
GrowLight Algeria (Algiers): Specialized lighting</td>
<td>Key activities

Production of Tilapia.
Production of Cherry tomato.</td>
<td rowspan="2">Value Proposition

Affordable aquaponic products.
Significant reduction in water usage.
No use of fertilizers or chemical products.
Sustainably produced goods aligned with circular economy principles.</td>
<td>Customer Relationships

Pre-purchase contracts.
Loyalty programs.
Personalized customer service.</td>
<td rowspan="2">Customer Segments

General consumers of fish and vegetables</td>
</tr>
<tr>
<td>Key Resources

Physical Resources: Construction of tanks, pumping systems, and other infrastructure
Financial Resources: Funding for purchasing raw materials such as fry, seeds, and feed
Human Resources: Agricultural technicians, aquaculture engineers, and multi-skilled workers</td>
<td>Distribution Channels

Direct sales at the farm.
Social media platforms.</td>
</tr>
</table>

EvoDrain (Constantine): Water circulation system, overflow, drainage **E. Tilato's Clients** Restaurants, hotels, and caterers seeking fresh, consistent, and high-quality ingredients Distributors and supermarkets aiming to expand their range of local and eco-friendly products Processors, such as fish meal or compound feed manufacturers using tilapia as raw material Agricultural cooperatives and fair trade stakeholders interested in sustainable partnerships and short supply chains				

Cost of Production	**Revenue**
Production of 4 tons of Tilapia + 25 tons of cherry tomatoes = 20744000.00 DA per year	Sale of Tilapia = 2000000,00 DA per year Sale of Cherry tomato = 11250000,00 DA per year The amount = 13250000 DA per year

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