

Consumer Preferences and Willingness to Pay for Certified Traditional Processed Fish Products in Cambodia

Ra Thorng^{ab}, Shwe Phue San^c and Buapan Promphakping^{a*}

^a*Faculty of Humanities and Social Sciences, Khon Kaen University, Khon Kaen, Thailand*

^b*United Nations Industrial Development Organization, Phnom Penh, Cambodia*

^c*Natural Resources Institute, University of Greenwich, Gillingham, United Kingdom*

^{*}*Corresponding Author. Email: buapun@kku.ac.th*

Received: February 26, 2025

Revised: July 23, 2025

Accepted: November 28, 2025

Abstract

Traditional fish products (TFPs) are a crucial component of the Cambodian diet, providing essential protein and dietary iron. This study investigated consumption preferences and willingness to pay (WTP) for certified TFPs among young urban consumers amid changing dietary habits. An online survey assessed demographics, consumption patterns, and purchase determinants among 478 university students from Phnom Penh, Battambang, and Siem Reap. Data were analyzed using descriptive statistics, cross-tabulation, and Chi-square tests. Findings indicate high baseline consumption, with 86.8 percent recently purchasing TFPs and 77 percent consuming them weekly; dried fish, fish sauce, and fermented fish (*Prohok*) were most popular. Price, convenience, and taste drive purchases, while health concerns are secondary despite awareness of food safety risks. Nearly 80 percent expressed a willingness to pay a premium for products certified to display the Cambodia Quality Seal (CQS). Chi-square tests revealed that age and household income were significantly associated with WTP ($P < 0.05$), and gender had a significant association with health concerns ($P < 0.05$), while demographics showed no statistically significant relationship with consumption frequency. Strategies should focus on improving accessibility, packaging, and targeted food safety campaigns highlighting CQS certification.

Keywords: Food safety and quality standards, traditional fishery products, consumer preferences, willingness to pay

Introduction

Fish is a globally recognized nutrient-dense food that provides essential amino acids, polyunsaturated fatty acids (PUFAs), vitamins, and minerals while remaining low in saturated fats (Kolanowski and Laufenberg, 2006). Driven by population growth, urbanization, and dietary shifts, global demand for aquatic foods is projected to double by 2050 (Food and Agriculture Organization of the United Nations, 2020; Naylor et al., 2021). In Cambodia, the fisheries subsector is a historical and contemporary pillar of food security, nutrition, and socioeconomic development (Cooke, 2011; Hartje et al., 2016; Freed et al., 2020). Backed by highly productive inland waters and expanding aquaculture (Baran, 2005), Cambodia's total fish production reached 856,400 tons in 2021, comprising 383,050 tons from inland fisheries, 125,000 tons from marine fisheries, and 348,350 tons from aquaculture (Fisheries Administration, 2022).

Aquatic resources supply approximately 75 percent of total animal protein intake in Cambodia, ranking second only to rice in overall food consumption (Olney et al., 2009). Although annual per capita fish consumption declined from a peak of 63.2 kg in 2011 to 45.75 kg in 2020, it remains more than double the global average (Hartje et al., 2016; Fisheries Administration, 2022). Developing the fish value chain is thus a primary strategy to alleviate food insecurity and malnutrition (WorldFish Center, 2010). TFPs—such as fermented fish paste (*Prahok* and *Pa-ork*), dry-salted fish, smoked fish, and fish sauce—hold immense culinary and cultural significance, with *Prahok* serving as the most vital rural staple after rice. Implementing robust food safety frameworks can enhance access to premium domestic markets and stimulate international exports (United Nations Industrial Development Organization, 2024).

Given the major contribution of traditional processing to Cambodia's agricultural GDP, ensuring product safety is paramount to mitigate foodborne illness risks (United Nations Industrial Development Organization, 2022). Paradoxically, domestic consumer demand for verified high-quality local fish has historically been low, driving higher-end retail segments to favor imported alternatives due to limited trust in local supply chains (United Nations Conference on Trade and Development, 2017). While TFPs remain widely appreciated, evolving dietary patterns among younger urban consumers raise critical questions regarding their sustained market popularity. To resolve these challenges, the Fisheries Administration of Cambodia introduced the CQS—a voluntary national certification system designed to improve hygiene, build consumer trust, facilitate formal market access, and protect public health (Fisheries Administration, 2023).

However, implementing safety compliance measures increases operational costs, which often leads to higher retail prices (Aguilar and Vlosky, 2007). This shift raises critical questions regarding consumers' awareness of the CQS framework and their explicit willingness to pay (WTP) a premium for certified safe options. While conventional research focuses on supply-side pathogen control, consumers are powerful market actors who can incentivize value-chain upgrades through their purchasing choices. Recent theoretical and empirical literature demonstrates that food safety awareness shapes food selection behaviors, with safety knowledge expanding alongside age and formal education (Henson and Northen, 2000; Bolton et al., 2008). Furthermore, consumer WTP for safe food is strongly dictated by household income, risk perceptions, and localized safety knowledge (Angulo and Gil, 2007; Loureiro and Umberger, 2007).

In Cambodia, rising health consciousness and shifting dietary trends among younger generations suggest a need for fishery processing operators to integrate safety certifications like the CQS, adopt sustainable practices, and refine products to maintain their market footprint. This study addresses a critical literature gap by evaluating the perceptions, purchasing behaviors, and WTP of young Cambodian consumers. By focusing on university students in Phnom Penh, Siem Reap, and Battambang via a structured online survey, this research delivers actionable empirical insights for producers, businesses, and policymakers, providing a baseline for targeted marketing strategies and modernization frameworks for Cambodia's fishery processing sector.

Literature Review

Transitioning Food and Agricultural Landscape of Cambodia

Cambodia's agricultural economy has undergone rapid, market-driven changes over the past three decades. Driven by neoliberal market integration, this transformation has incorporated domestic farming into global agri-food systems, emphasizing individuals as rational economic optimizers and minimizing state interventions that distort resource allocation (Hahnel, 2003; Steger & Roy, 2010; Kimkong et al., 2023). These economic dynamics have catalyzed intensified rice cultivation, cash-crop expansion via land concessions, and rapid urbanization, fundamentally altering the agrarian and food landscape (Cook et al., 2024).

Concurrently, fisheries have remained central to national food security, local livelihoods, and macroeconomic development. In 2019, the broader fisheries sector contributed approximately 21 percent to Cambodia's GDP (Ministry of Planning, 2021). Supported by the highly productive aquatic ecosystems of the Tonle Sap Lake, wild capture from the Tonle Sap River systems alone accounts for roughly 12 percent of national GDP, benefiting the wider Mekong River basin (Hortle, 2004; Teh et al., 2019). However, agricultural and urban transformations have compromised this subsector through overfishing, environmental degradation, and hydrologic alterations from cascade dams along the Mekong River and its tributaries (Lamberts, 2001).

To adapt to these pressures, smallholder enterprises must align processing operations with contemporary consumer demands. Traditional marketing theory posits that organizational market orientation (MO) must be anchored in consumer perceptions, as final users act as the primary critics of a product's consumption (Kotler, 1991). Consequently, firms must systematically fulfill evolving consumer expectations (Osterwalder et al., 2014). Integrating direct consumer feedback yields a distinct strategic advantage, establishing the empirical efficacy of customer-defined market orientation (CDMO) strategies (Krepapa et al., 2003). Evaluating consumer preferences of younger generations is therefore critical to navigating shifting dietary habits within the modern marketplace.

Young Consumer Attitudes and Preferences

Consumer preferences for TFPs are vital across the supply chain and are shaped by health consciousness, personal experience, cultural practices, and economic factors (Peulić et al., 2023). Globally, rising interest in TFPs stems from heightened awareness of health and quality risks, often as a behavioral reaction to food crises, industrialization, globalization, and environmental challenges (Trichopoulou et al., 2007). Modern consumers increasingly seek authentic, locally-sourced options that exhibit unique sensory properties, support rural economies, and remain free from synthetic chemical additives, preservatives, or colorants (Feldmann and Hamm, 2015).

Concurrently, younger demographics display strong interest in heavily-processed modern convenience foods, driven by globalization, media fashion, peer imitation, and technical advancements. While the globalization of consumption standardizes expectations and forms global segments with shared brand values, it can also stimulate consumer ethnocentrism, motivating individuals to favor native items to preserve cultural identity (Fekete et al., 2025; Hanus, 2018; Hebden et al., 2015). Locally and traditionally-produced products therefore retain structural significance among younger market cohorts.

Furthermore, advanced information and communication technologies have transformed food purchasing behaviors. Younger consumers routinely use digital e-shopping platforms as well as brick-and-mortar retail and also consult online networks to verify product quality metadata (Deng, 2022; Wang et al., 2025). To target this demographic, food manufacturers deploy interactive digital marketing strategies across multi-channel environments, utilizing cross-media campaigns, social media networks, product placements in video games, and stream-based digital advertisements (Maksi et al., 2024; Heo and Lee, 2025).

Traditional Food Products and Quality Certification Schemes

Traditional food products are consumed across distinct geographic regions over multiple generations, serving as core components of cultural heritage and identity (Trichopoulou et al., 2007; Jia et al., 2023). These products are typically manufactured using fresh, seasonal, and locally-sourced ingredients free from artificial additives, relying on small-scale facilities and inherited artisanal expertise (Peulić et al., 2023). Labor-intensive processing methods—including extended fermentation, aging, curing, and smoking—enhance their distinct sensory attributes and quality profiles (Caputo et al., 2018; Guerrero et al., 2012). Sustaining these networks supports small-scale processing enterprises and strengthens environmental sustainability within rural ecosystems (Trichopoulou et al., 2007). In commercial food markets, traditional processed fish products produced by smoking, sun drying, and salting common within small-scale value chains provide vital dietary value to localized populations despite employing low-cost infrastructure and minimal technical facilities.

Official quality and safety certification schemes are essential to protect and standardize these baseline characteristics, providing mutual benefits to both processing operators and consumers. Implementing formal quality labels enhances the positive economic impacts of traditional production by facilitating rural development and integrating smallholders into formal supply systems (Chifor et al., 2022). Food quality frameworks verify compliance with explicit sanitary, processing, and environmental requirements, utilizing third-party auditing criteria to preserve the uniqueness and hygiene of the target product (De Canio and Martinelli, 2021). Ultimately, these certification programs provide a vital signaling mechanism, ensuring that processed foods comply with specific regulatory and retail requirements (Glogoveţan et al., 2022).

The Cambodia Quality Seal (CQS) Certification Scheme

The CQS certification scheme is a voluntary standard officially approved through Prakas No. 565 by the Ministry of Agriculture, Forestry and Fisheries (MAFF). Established to ensure the quality, safety, and authenticity of processed fishery products, the scheme aims to enhance consumer confidence, protect regional culinary heritage, and foster domestic economic development through value addition and market differentiation (Fisheries Administration, 2023; MAFF, 2020). The scheme mandates explicit requirements across the post-harvest value chain, including hygienic handling, secure storage, and end-to-end traceability. Compliance is verified through a structured trajectory of application submission, on-site facility inspections, laboratory safety testing, and regular follow-up audits by the Fisheries Competent Authority (FCA), after which certified enterprises may display the CQS mark on their packaging (Fisheries Administration, 2023).

For traditional fishery processors, implementing the CQS framework encourages the adoption of improved processing techniques and rigorous quality control measures. Consequently, certified products secure greater consumer trust, gain entry into higher-value retail markets, and demonstrate improved commercial competitiveness. Ultimately, the scheme effectively preserves generational artisanal processing methods while integrating them with modern sanitary standards, thereby supporting localized value chains and enhancing national public health outcomes (United Nations Industrial Development Organization, 2024).

Methodology

Design of Consumer Survey

This study utilized a structured quantitative online survey via Google Forms to gather empirical data on consumer preferences and WTP for certified TFPs. The digital interface was selected for its high accessibility, deployment efficiency, and centralized data management. The questionnaire incorporated close-ended multiple-choice items, multi-point Likert scales, and short-answer prompts organized into distinct thematic modules to optimize response flow and reduce cognitive load. Prior to active field distribution, a pilot test was conducted with a small sample of the target demographic to refine question clarity, formatting logic, and software functionality. The final research protocol and data collection instruments were formally approved by the Khon Kaen University Ethical Committee (KKUEC), receiving Approval No. HE673281 in strict compliance with institutional research ethics standards.

Targeted Respondents and Sampling Methods

The target population consisted of young university students enrolled across higher education institutions in Phnom Penh, Battambang, and Siem Reap. This demographic was specifically sampled to evaluate consumption patterns and economic valuations within a generation frequently characterized by shifting dietary habits and a declining preference for traditional processed fish options. University students represent a critical focus group because they are highly digitally connected, enabling cost-effective and structurally secure online survey deployment. Furthermore, this cohort represents an emerging consumer segment with growing purchasing power, which directly shapes market trajectories and future agri-food demand patterns. Analyzing their behavioral drivers provides practical insights into how culturally iconic fish products, such as *prohok*, can be strategically re-positioned and marketed to preserve local culinary heritage while appealing to modern urban tastes.

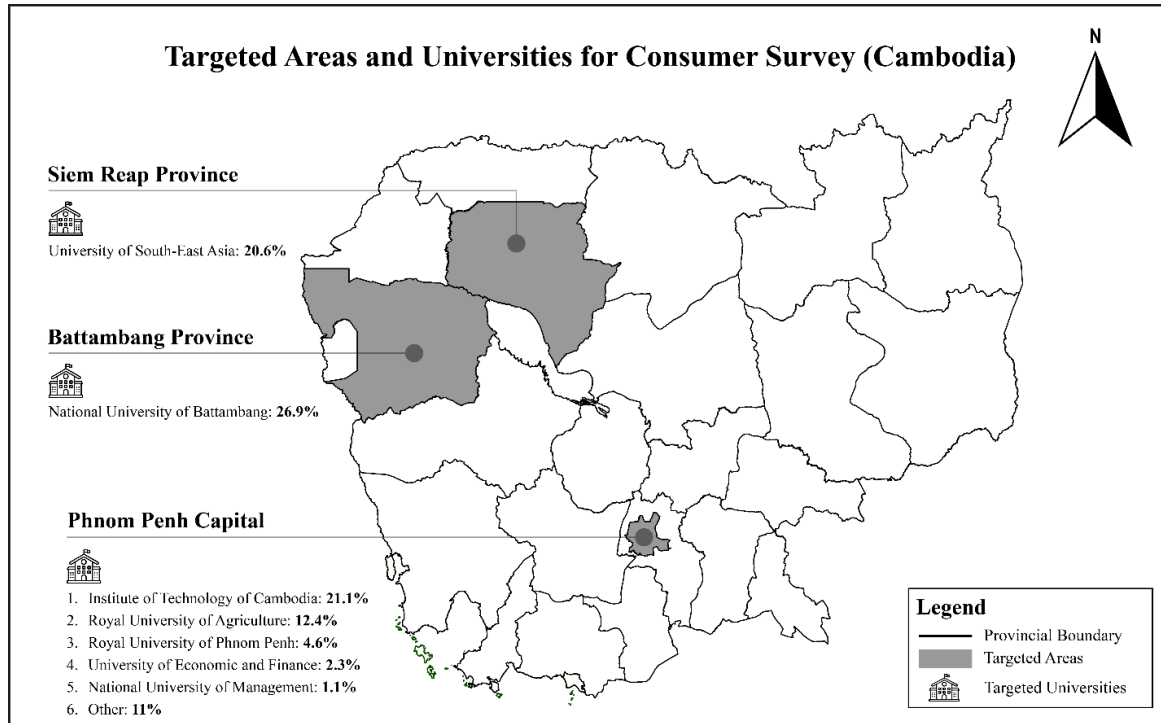


Figure 1 Location map of targeted universities and percentage that responded

To ensure statistical validity and minimize selection bias, probability sampling techniques were employed, giving each individual within the institutional registries a known, non-zero probability of selection. A stratified sampling strategy was applied to categorize the student population by academic faculty and year of study. Following stratification, a systematic 10 percent selection rule was applied to official enrollment lists provided directly by the administration offices of the participating institutions. The final field survey was deployed between October and December 2024, yielding a valid sample of 478 undergraduate and postgraduate students. Respondents were drawn from eight select universities across the three target provinces, with data collection managed under the active supervision of university administrative staff and faculty professors to ensure rigorous data quality control and baseline verification.

Data Analysis

Following field collection, raw datasets were exported from the digital survey interface into Microsoft Excel for verification, cleaning, and coding. Descriptive statistics, including absolute frequencies and percentages, were calculated to summarize the socio-demographic characteristics and baseline consumption distributions of the sample. To evaluate potential relationships between consumer patterns and key demographic characteristics—such as age, gender, monthly family income, and formal education level—cross-tabulation and contingency table analyses were executed.

The statistical significance of the observed categorical associations was verified using Chi-square (χ^2) independence tests. The resulting P -values determined the mathematical probability that the observed differences or associations occurred due to random variation. In alignment with standard econometric protocols, the significance threshold was strictly set at ($P < 0.05$). A statistically significant result ($P < 0.05$) indicated strong empirical evidence against the null hypothesis, confirming a structurally meaningful association between the cross-tabulated variables. Conversely, any result yielding ($P > 0.05$)

indicated insufficient evidence to reject the null hypothesis, demonstrating that the observed baseline variation was not statistically meaningful.

Results and Discussion

Consumer Characteristics

The survey generated a final sample of 478 valid questionnaires spanning gender, age, education, academic specialization, and monthly household income (Table 1). The sample is predominantly female (65.30 percent), and 32.80 percent male while 1.90 percent withheld their identity. Chronologically, the sample exhibits a highly concentrated youthful profile, with 83.26 percent of respondents aged between 16 and 25 years. This includes a primary group aged 21 to 25 (50.21 percent) and a secondary group aged 16 to 20 (33.05 percent). The vast majority of participants were enrolled in undergraduate curricula, with bachelor's degree students representing 87.45 percent of the total, while postgraduate tracks—comprising master's and doctoral programs—accounted for 10.46 and 0.63 percent respectively.

Table 1 Socio-demographic and economic characteristics of respondents (n = 478)

Demographic characteristics	Category	Respondents (Number)	Percentage (%)
Gender	Female	312	65.30
	Male	157	32.80
	Prefer not to say	9	1.90
Age	16-20	158	33.05
	21-25	240	50.21
	25-30	33	6.90
	31-35	32	6.69
	36-40	11	2.30
	>40	4	0.84
Level of education	Associate degree	7	1.46
	Bachelor's degree	418	87.45
	Master's degree	50	10.46
	PhD	3	0.63
Major or field of the study	Food science and technology	79	16.53
	management (Business and tourism)	75	15.69
	Finance, Banking, Marketing and accounting	74	15.48
	Fisheries science	38	7.95
	Food and Chemical Engineering	37	7.74
	Food processing	37	7.74
	Public Administration and Governance	36	7.53
	English Literature	24	5.02
	Agro-industry	17	3.56
	Animal science	11	2.30
	Agronomy and Agriculture	10	2.09
	Media and communication	10	2.09
	Other	30	6.28

Table 1 Socio-demographic and economic characteristics of respondents (n = 478) (Cont.)

Demographic characteristics	Category	Respondents (Number)	Percentage (%)
Second occupation besides student	No second job (student only)	245	51.25
	Company staff	102	21.34
	Own business (trading, processing)	53	11.08
	Farmer	47	9.84
	Government officials	31	6.49
Family Income (monthly)	\$200	149	31.17
	[\$200-500]	184	38.49
	[\$500-1000]	84	17.57
	[\$1000-1500]	30	6.28
	[\$1500-2000]	9	1.88
	\$2000	22	4.60

Academic specializations are highly diverse, providing a broad multidisciplinary perspective on consumer behavior. Students in food- and agriculture-related disciplines comprise a major cumulative share of the sample, led by food science and technology (16.53 percent), followed by fisheries science (7.95 percent), food and chemical engineering (7.74 percent), food processing (7.74 percent), agro-industry (3.56 percent), animal science (2.30 percent), and agronomy and agriculture (2.09 percent). Commercial and administrative fields are also well represented by management (15.69 percent) and finance, banking, marketing, and accounting (15.48 percent). The remaining disciplines include public administration and governance (7.53 percent), English literature (5.02 percent), media and communication (2.09 percent), and miscellaneous paths (6.28 percent).

Labor and economic metrics show that while 51.25 percent focus exclusively on their studies, nearly half engage in secondary occupations as company staff (21.34 percent), independent business operators (11.08 percent), agricultural laborers (9.84 percent), or government officials (6.49 percent). Household income distributions heavily represent low- to middle-income urban brackets. The largest stratum consists of families earning \$200-500 per month (38.49 percent), followed closely by households earning below \$200 monthly (31.17 percent). Conversely, middle- to upper-income segments remain a minority, with families earning \$500-1,000 representing 17.57 percent and households earning above \$1,000 collectively accounting for the remaining 12.76 percent.

Consumption Patterns

The evaluation of TFP consumption profiles addresses purchase recall, ingestion frequencies, typologies, acquisition nodes, and motivations (Table 2). Quantitative survey data establishes a robust baseline demand within the young urban cohort, with 86.82 percent of respondents reporting a TFP purchase within the preceding three months. Dietary integration is high; 40.79 percent consume TFPs several times per week and 17.15 percent consume them daily. Cumulatively, over 77 percent of those surveyed include TFPs in their diets at least once a week, demonstrating that these items remain central to daily urban nutrition despite expanding access to globalized fast-food alternatives.

This sustained consumption aligns with Cambodia's historical wild freshwater fish preservation practices. Commercially, the post-harvest chain relies heavily on two specific *Cirrhinus* species harvested during their annual winter migration out of the Tonle Sap Great Lake system (Hortle, 2004). The most prevalent processed items are fermented fish variants, including *prohok*, *pa-ork*, and fish pastes, which capture 30.23 percent of aggregate consumer selections. This category is followed by dried or dry-salted fish (19.70 percent) and fish sauce (17.64 percent), while smoked fish, fish balls, and ready-to-eat fermented preparations represent secondary tiers. Nutritionally, fish products constitute approximately 21 percent of total daily food intake across Cambodian households (LeGrand et al., 2020). *Prohok* consumption averages an estimated 18 grams per capita daily, providing a vital source of animal protein and dietary iron, accounting for roughly 76 and 37 percent of reference daily intakes, respectively. When paired with traditional vegetables, the bioavailability of micronutrients—including calcium, zinc, iodine, and vitamin A—is optimized, offering a low-energy, nutrient-dense safeguard against protein-energy malnutrition.

Table 2 Consumption patterns and purchasing drivers for traditional fish products (n = 478)

Questions	Answer	Percentage
Have you ever purchased TFPs for home consumption in the last 3 months?	Yes	86.82
	No	13.18
How often do you consume TFPs?	Every day	17.15
	A few times a week	40.79
	Once a week	20.08
	Once a month	21.97
What are the most TFPs you consume the most?	Fermented fish (<i>prohok</i> , <i>pa-ork</i> , fish paste)	30.23
	Dried fish (dry salted fish)	19.70
	Fish sauce	17.64
	Smoked fish	7.90
	Ready to eat fish products	7.40
	Fish balls	6.84
	Marinated fish	6.18
	Others (dried shrimp)	4.12
Where you usually purchase TFPs from?	Local markets	46.71
	Grocery stores	24.56
	Processors	14.14
	Supermarkets/marts	10.09
	Online shops	3.40
	Others	1.10
What is the most important reason you consume TFPs?	I like the taste.	32.36
	I believe it is easy to prepare.	20.02
	Traditional dishes are the choice of my family.	20.02
	Support traditional fishery products	14.90
	I believe it is a healthy food.	8.55
	I believe it is a low-calorie food.	3.53
	Others	0.62

Physical procurement pathways reflect a conventional retail infrastructure. Local wet markets serve as the predominant retail node (46.71 percent), followed by neighborhood grocery stores (24.56 percent) and direct procurement from primary processors (14.14 percent). Conversely, modern retail networks, such as supermarkets or minimarts, represent only 10.09 percent of purchases, while digital online marketplaces capture a minimal 3.40 percent share. These patterns illustrate a structural dichotomy between urban regions featuring modern grocery venues and peri-urban environments that rely almost exclusively on open-air markets. When evaluating primary purchasing drivers, sensory profile stands as the leading cause of consumption, with 32.36 percent of participants selecting authentic taste. The perceived ease of culinary preparation and inherited multigenerational family dietary preferences emerge as equal secondary drivers (20.02 percent each), while supporting local fishery value chains motivates 14.90 percent of the cohort. By contrast, specific health-seeking variables, such as general nutritional benefits (8.55 percent) or low-calorie attributes (3.53 percent), remain secondary factors.

Factors Influencing Consumer Purchasing Decisions

To understand the underlying constraints governing consumer choices within the modernizing agri-food sector, participants selected the three most significant drivers influencing their purchasing behavior from an array of product attributes. The quantitative distributions reveal a highly cost-conscious and efficiency-seeking sample segment. Out of the 478 valid respondents, retail price emerged as the predominant purchasing determinant, cited by 73.22 percent of the cohort. Operational convenience was identified as the second most critical attribute at 66.95 percent, while sensory appeal or flavor profile was selected by 52.51 percent of the participants.

Conversely, parameters linked to quality assurance and food safety standards (35.15 percent), health benefits (29.50 percent), and formal packaging or product labeling (27.41 percent) occupied a secondary position. Extrinsic commercial variables, including corporate brand name recognition (17.57 percent) and documented environmental benefits (12.97 percent), exerted the weakest structural influence on purchasing choices. These findings underscore a critical market tension: while young consumers demonstrate a strong baseline preference for traditional fish options, their final spending choices are bound by immediate financial constraints and product accessibility. Consequently, successful agri-business interventions must focus on delivering authentic sensory profiles and verified hygiene attributes at price points that remain competitive with raw alternatives.

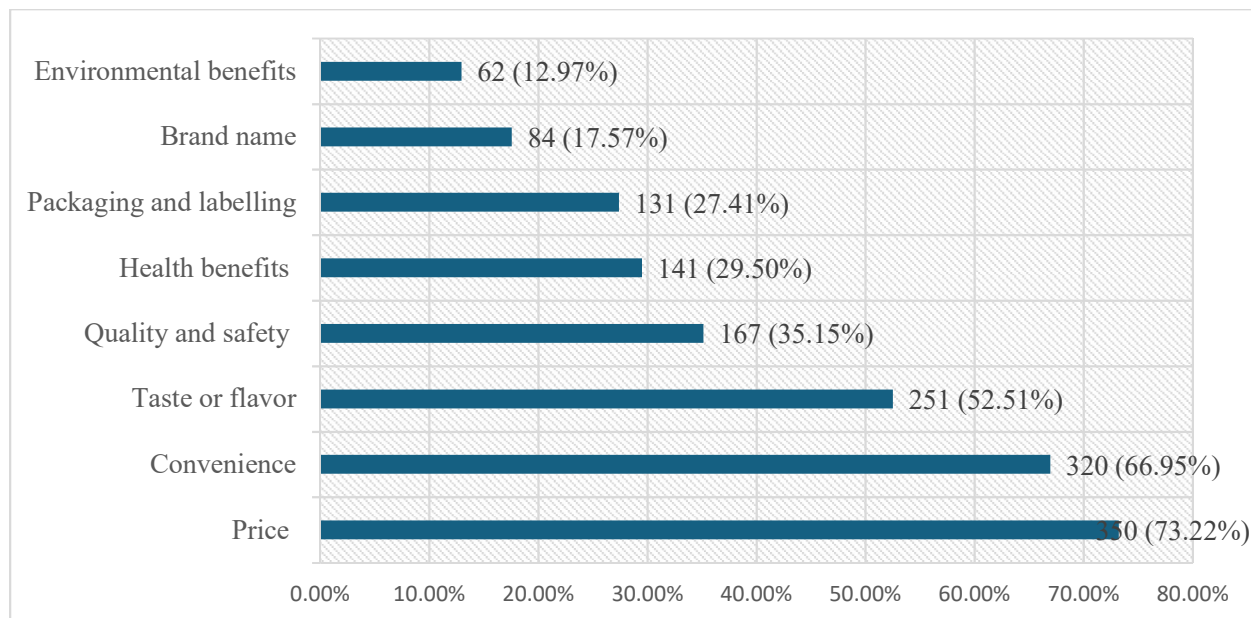


Figure 2 Factors that influence the TFP purchasing decisions

Awareness of Quality and Safety Standards

The empirical distributions compiled in Table 3 detail a substantial baseline level of risk awareness paired with a moderate degree of institutional trust. Approximately 67.15 percent of the surveyed university students reported an active awareness of health hazards linked to the ingestion of uncertified traditional fish items. When prompted to define these concerns through a multi-response tracking format, participants identified an array of chemical and biological parameters. High dietary sodium exposure and contamination by pathologically-harmful bacteria were the leading technical concerns, each selected by 13.47 percent of the cohort. Uneducated or illicit applications of prohibited food preservatives or conservative chemical substances were cited by 12.51 percent, while biological exposure to parasites (11.23 percent), viral pathogens (9.46 percent), synthetic colorants (9.06 percent), and heavy chemical contaminants (7.14 percent) represented secondary tiers of risk perception. Minor frequencies were recorded for elevated cholesterol concerns (6.58 percent), along with residues of prohibited aquatic medicines (6.26 percent, agricultural pesticides (5.93 percent), or polychlorinated biphenyls (4.25 percent).

This elevated level of baseline risk knowledge is closely tied to the socio-demographic composition of the sample. As established in the demographic profiling, a substantial cumulative share of the surveyed student body is enrolled in technical disciplines like food science and technology, fisheries science, food processing, and agro-industry. This specialized academic background provides the cohort with a multidisciplinary understanding of agri-food systems and quality control mechanisms. Consequently, this educational foundation enhances consumer recognition of food safety parameters, processing vulnerabilities, and microbiological risks, which in turn, influence consumer attitudes toward traditional processing operations and increases behavioral trust in external safety labeling frameworks.

Table 3 Consumer risk awareness and institutional trust indices (n = 478)

Questions	Answer	Percentage
Are you aware of any health concerns with traditional fishery products?	Yes	67.15
	No	32.85
What concerns would those be? (multiple answers)	High sodium intake	13.47
	Harmful bacteria	13.47
	Prohibited food conservative substances	12.51
	Parasites	11.23
	Viruses	9.46
	Colorants	9.06
	Contaminants	7.14
	High Cholesterol	6.58
	Residue of prohibited aquatic medicines	6.26
	Pesticide residue	5.93
	Polychlorinated biphenyls (PCBs)	4.25
	Others (Histamine, poor hygiene)	0.64
Do you believe traditional fishery products are being controlled/ inspected by the Fisheries Competent Authority?	Yes	66.11
	No	33.89
Do you know any food quality and safety standards?	Yes	70.08
	No	29.92

Despite the acknowledgment of these public health risks, 66.11 percent of the respondents expressed explicit confidence that traditional fisheries products are subject to adequate control and inspection protocols managed by FCA. This indicator suggests a functional level of consumer trust in the official regulatory control activities executed by the state to improve hygiene standards and protect public health. Furthermore, 70.08 percent of the participants stated they possessed a familiarity with formal domestic and international food quality standards.

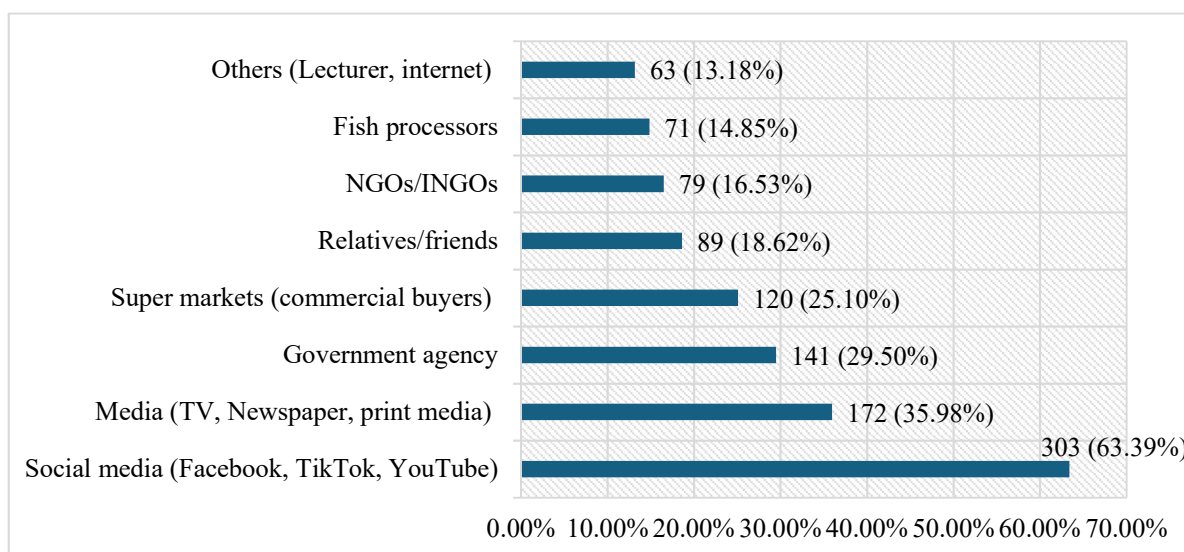


Figure 3 Sources of information on food quality and safety standards

When assessing the communication channels through which consumers acquire knowledge regarding safety codes and regulations, digital information networks demonstrate clear structural dominance. Distributed social media platforms—specifically Facebook, TikTok, and YouTube—serve as the primary source of food safety metadata for 63.39 percent of the sample. Mass media broadcasts, including television and print media, follow as a secondary stream at 35.98 percent, while formal government agency communications (29.50 percent) and point-of-sale retail displays at supermarkets (25.10 percent) capture moderate acquisition shares.

By contrast, direct information sourcing from non-governmental and international non-governmental organizations (NGOs/INGOs) registered a low frequency of 16.53 percent. This low direct recall occurs despite extensive, multi-year public outreach campaigns executed by the UNIDO under the Cambodia Programme for Sustainable and Inclusive Growth in the Fisheries Sector (CAPFISH) and World Vision under the Commercialization of Aquaculture for Sustainable Trade (CAST) initiative. Both development structures have generated substantial promotional materials, digital media briefs, and physical marketing displays across public events and retail supermarkets to build consumer demand for certified safe fisheries. This statistical gap indicates that while institutional safety interventions create high-quality technical content, their outreach frameworks must be optimized to match the rapid social media consumption behaviors of the younger urban population.

Willingness to Pay for CQS Certified Products

The deployment of the CQS certification framework for post-harvest fishery products has been extensively promoted by the FCA through the institutional mechanisms of the CAPFISH and CAST initiatives. The empirical metrics presented in Table 4 outline consumer perceptions, institutional trust, and explicit economic valuations for certified TFPs. The descriptive frequencies indicate a highly favorable consumer reception of certified food safety indicators. Approximately 92.26 percent of the surveyed university students expressed an active interest in acquiring traditional processed fish items backed by formal quality certifications. Furthermore, 79.08 percent of the participants explicitly declared a readiness to pay a financial premium for CQS-certified options to guarantee superior food safety and hygiene. This finding directly contrasts with historical sector analyses, such as the United Nations Conference on Trade and Development (2017) report, which previously characterized domestic consumer demand for verified high-quality localized fish items as stagnant or critically low.

When assessing the explicit economic premiums consumers are willing to allocate above baseline prices, the empirical feedback reveals a highly-stratified, tiered architecture of price sensitivity. Under a reference scenario where conventional uncertified traditional fish items are priced at a baseline of 10,000 riel per kilogram, consumer willingness to pay additional premiums reflects distinct margins of financial tolerance, with 35.98 percent of the respondents willing to pay a maximum premium of up to 1,000 riel per kilogram, followed closely by 28.31 percent who accept an additional cost of up to 2,000 riel per kilogram. Furthermore, 14.29 percent are willing to allocate up to 3,000 riel per kilogram, while a secondary segment of 9.52 percent accepts an increase of up to 4,000 riel per kilogram. Finally, the upper threshold of premium tolerance is defined by 6.61 percent who are willing to absorb an increase exceeding 5,000 riel per kilogram, and a resilient 5.29 percent who demonstrate the highest risk-mitigation threshold by accepting a total cost increase of up to 10,000 riel per kilogram.

These percentage distributions illustrate that while a strong majority of the younger urban demographic is open to investing in certified safety guarantees, the specific threshold of financial elasticity varies considerably across the cohort. This variation underscores the necessity of implementing flexible, market-segmented pricing strategies. Crucially, the long-term viability of this certification model is supported by solid institutional credibility, as 84.94 percent of the sample explicitly affirmed their trust in the regulatory integrity of the CQS standard for fish and fishery products.

Table 4 Consumer willingness to pay and trust indices for CQS-certified TFPs (n = 478)

Questions	Answer	Percentage
Would you be interested in buying CQS certified TFPs?	Yes	92.26
	No	7.74
Suppose your products that you purchase regularly costs 10,000 riel per kilogram. Would you pay more for CQS certified?	Yes	79.08
	No	20.92
How much you willing to pay extra?	I would pay up to 1000 riel more per kg	35.98
	I would pay up to 2000 riel more per kg	28.31
	I would pay up to 3000 riel more per kg	14.29
	I would pay up to 4000 riel more per kg	9.52
	I would pay more than 5000 riel more per kg	6.61
	I would pay up to 10000 riel more per kg	5.29
Would you trust CQS standard certification for fish and fishery products?	Yes	84.94
	No	15.06

Relationship Between Consumption Patterns and Socio-Demographic Variables

To explore the relationships between social demographic characteristics and consumer behavioral constructs within the theoretical framework, cross-tabulation analyses were executed. Specifically, demographic characteristics including gender, age, and monthly household income were examined in relation to primary purchasing behaviors, baseline consumption frequency, and self-reported health concerns associated with traditional fish products (TFPs), as detailed in Table 5.

The descriptive distributions within the contingency tables indicate that 57.11 percent of female respondents reported actively purchasing TFPs, and 65.27 percent indicated consuming these products multiple times per week. Despite these clear descriptive patterns, the inferential statistical analysis did not reveal any structurally meaningful associations between age groups and baseline consumption metrics. This independence is supported by the Chi-square test results, which yielded a non-significant association for both age versus purchasing behavior ($\chi^2 = 2.716$, $DF = 5$, $P = 0.743$) and age versus consumption frequency ($\chi^2 = 8.675$, $DF = 15$, $P = 0.893$). Similarly, no statistically significant interactions were observed when cross-tabulating gender with purchasing habits ($\chi^2 = 0.864$, $DF = 2$, $P = 0.649$) or self-reported consumption frequency ($\chi^2 = 9.071$, $DF = 6$, $P = 0.169$).

However, a critical exception to this demographic neutrality emerged regarding perceived health concerns associated with uncertified TFPs. Gender demonstrated a statistically significant association with safety considerations ($\chi^2 = 7.430$, $DF = 2$, $P = 0.024$), confirming that female respondents exhibit a significantly higher level of attention toward the quality and hygiene risks of processed fisheries compared

to their male counterparts. This interaction highlights clear gender-specific variances in food safety risk perception, suggesting that targeted consumer education campaigns should be customized to address these distinct safety orientations.

Table 5 Chi-square test results for socio-demographic variables versus TFP consumption patterns (n = 478)

Socio-Demographic Cross-Tabulations	Degrees of Freedom (DF)	Chi ² Value (χ^2)	Chi ² critical value	P-Value
Age V Purchasing of TFPs	5	2.716	11.070	0.743
Age V Frequency of TFP consumption	15	8.675	24.996	0.893
Age V Health concerns	5	8.657	11.070	0.123
Gender V Purchasing of TFPs	2	0.864	5.991	0.649
Gender V Frequency of TFP consumption	6	9.071	12.591	0.169
Gender V Health concerns	2	7.430	5.991	0.024
Income V Frequency of TFP consumption	15	10.005	24.995	0.819

* V = cross-tabulation

Regarding monthly household income, descriptive indicators revealed a higher relative preference for TFPs among lower-income families, with 69.67 percent of respondents from households earning below \$500 per month expressing a preference for traditional fish options. Nevertheless, the inferential analysis demonstrated that income level does not maintain a statistically significant relationship with the actual frequency of TFP ingestion ($\chi^2 = 10.005$, $DF = 15$, $P = 0.819$). This outcome indicates that while lower-income brackets display a strong behavioral preference for TFPs, this underlying preference does not automatically translate into an increased rate of consumption. Cumulatively, these empirical findings provide a nuanced understanding of demographic associations, showing that while gender is significantly associated with health consciousness, variables such as age and income show no statistically significant relationship with baseline purchasing and consumption frequencies.

Relationship Between Socio-Demographic Variables and Willingness to Pay

The CQS certification scheme was established by the regulatory authority to mandate enhanced food safety standards and sanitary controls while building consumer confidence. However, implementing rigorous institutional controls increases processing costs, which inevitably raises retail market prices (Angulo and Gil, 2007). Consumers within developing economies must therefore weigh these marginal price increases against the verified benefits of pathogen mitigation. While Cambodian consumers value quality assurance indicators, their final willingness to pay remains variable due to underlying price sensitivities, as noted by the United Nations Industrial Development Organization (2022). In this study, a substantial majority of 92.26 percent of respondents expressed interest in acquiring certified safe products, and 79.08 percent demonstrated an explicit WTP a premium for CQS-labeled traditional fish options.

To evaluate these economic dynamics, a secondary round of cross-tabulation analyses was conducted using Chi-square independence metrics to evaluate demographic characteristics against consumer WTP values and standard trust indices, as documented in Table 6. The statistical outputs

indicate that age has a highly significant association with contingent valuation decisions ($\chi^2 = 34.369$, $DF = 25$, $P = 0.010$). Younger consumer cohorts, particularly individuals between 16 and 25 years of age, demonstrate a significantly higher propensity to pay financial premiums for certified safe foods. This demographic segment is generally better educated, less bound by conventional brand loyalties, and highly receptive to modern quality logos, which explains their enhanced openness to absorbing safety-related premiums. Conversely, age shows no statistically significant relationship with structural trust in the certification mark itself ($\chi^2 = 5.381$, $DF = 5$, $P = 0.371$), confirming that the perceived credibility of the CQS framework is stable across all age groups.

Gender identity does not demonstrate a statistically significant relationship with either financial premium willingness ($\chi^2 = 8.989$, $DF = 10$, $P = 0.878$) or institutional trust in certified products ($\chi^2 = 3.111$, $DF = 2$, $P = 0.211$). This confirms that male and female urban consumers exhibit equivalent baseline trust levels and highly comparable margins of premium tolerance when making safe food choices.

By contrast, monthly household income level shares a statistically significant association with consumer WTP ($\chi^2 = 41.860$, $DF = 25$, $P = 0.019$). Respondents stemming from higher economic strata demonstrate a significantly greater probability of paying financial premiums for certified safe items, reflecting lower overall budget constraints and higher purchasing flexibility. Cumulatively, these statistical outcomes reveal that while younger and wealthier urban consumers display the highest economic readiness to pay for CQS-certified traditional fish items, the underlying perception of institutional trust remains uniformly distributed across the population regardless of demographic characteristics.

Table 6 Chi-square test results for socio-demographic variables versus willingness to pay indices (n = 478)

Socio-Demographic Cross-Tabulations	Degrees of Freedom (DF)	Chi ² Value (χ^2)	Chi ² critical value	P-Value
Age V willingness to pay	25	34.369	37.652	0.010
Gender V willingness to pay	10	8.989	18.307	0.878
Income V Willingness to pay	25	41.860	37.652	0.019
Age V Trust of certified product	5	5.381	11.070	0.371
Gender V Trust of certified TFPs	2	3.111	5.991	0.211

* V = cross-tabulation

Merits, Limitations, and Future Research Pathways

This study provides significant academic and practical value by establishing a comprehensive profile of young Cambodian consumers and mapping their TFP purchasing behaviors, choice drivers, and food safety awareness. Quantifying consumer WTP for CQS certified options offers an economic benchmark for scaling certified local brands, supporting domestic smallholders, and upgrading food hygiene practices. Furthermore, examining the associations between demographic characteristics and contingent valuation profiles enables the development of targeted agri-business marketing frameworks and evidence-based policy interventions to strengthen the competitiveness of traditional fisheries.

However, several methodological limitations must be considered. The online survey design introduces sampling bias by focusing on digitally-connected university students, thereby omitting rural communities and older cohorts who represent key TFP consumer segments. This structural concentration limits the generalizability of the insights to the broader nationwide population and may obscure regional variations driven by unique local subcultures. Additionally, reliance on self-reported data carries the risk of social desirability bias, which can reduce the precision of economic valuation metrics compared to actual transactions, while the absence of face-to-face interaction limits the capacity to explore deeper qualitative motivations.

To address these constraints, future research should implement a mixed-method paradigm that combines digital data collection with in-person interviews and focus groups to capture a more representative sample. Experimental frameworks, such as discrete choice experiments or field-based randomized trials, are recommended to validate stated preferences against actual purchasing actions. Longitudinal studies would help track shifting consumer sentiments over time, while deeper investigations into socio-cultural variables and the specific institutional credibility of third-party auditing bodies will clarify the underlying behavioral factors associated with standard adoption within the Cambodian food context.

Conclusion and Recommendations

This study provides empirical insights into the behavioral preferences and consumption dynamics of Cambodian university students regarding TFPs, underscoring the expanding market relevance of formal quality and safety certifications. The documented high consumption frequencies and deep consumer interest in standard verification confirm the enduring cultural and nutritional prominence of processed fisheries among the emerging young urban cohort. Although authentic sensory profiles, retail pricing, and operational convenience remain the primary factors associated with final purchasing choices, an increasing consumer awareness of microbiological or chemical risks and functional trust in the FCA reveal a progressive transition toward food safety consciousness within the domestic market.

The willingness of a substantial majority of consumers to pay a financial premium for CQS-certified TFPs signals an excellent commercial opportunity for safer, verified traditional products, provided that localized agri-business models can balance processing authenticity with price affordability. Inferential testing also identified critical demographic variances, revealing that female consumers maintain significantly higher food safety risk sensitivity, whereas lower-income groups express a strong descriptive preference for TFPs despite income having no significant relationship with baseline ingestion rates. These analytical indicators suggest that structurally targeted outreach and segmented marketing campaigns can effectively build institutional consumer trust and broaden the commercial acceptance of certified safety standards across diverse demographic groups. Nevertheless, explicit methodological constraints—including geographic sampling concentration and reliance on self-reported contingent valuation data—require cautious generalizability and point to the necessity of broader nationwide validation studies. Ultimately, this research confirms that CQS certification plays a critical role in mitigating public health risks and strengthening consumer confidence, while identifying price sensitivity as a primary economic barrier to universal standard adoption.

To preserve and expand the market footprint of traditional processed fisheries among modern young Cambodians, multi-sector stakeholders must focus on improving physical product accessibility across conventional open wet markets while adjusting final products to satisfy authentic flavor expectations and deploying streamlined, user-friendly product packaging. Blending traditional, labor-intensive preservation methodologies with modern post-harvest engineering can successfully secure baseline nutritional value while safeguarding local culinary heritage. Furthermore, developing diversified retail supply chains, including e-commerce platforms and digital online shops, will expand commercial access within modern urban centers.

Primary fish processors and producers are encouraged to optimize operational efficiencies to offer competitively priced TFPs that combine verified hygiene protocols with excellent sensory traits, thereby satisfying the practical spending priorities of the younger demographic. Concurrently, consistent food safety education initiatives and public outreach programs led by FCA and international development partners are essential to maintain institutional compliance and consumer confidence among young adult markets and commercial operators. Strengthening communication networks between centralized regulatory bodies and local processing communities will improve post-harvest hygiene practices, minimize cross-contamination risks, and optimize regional public health outcomes.

Finally, strategic marketing of the voluntary CQS label should focus heavily on its validated health, processing hygiene, and origin verification benefits, using the documented consumer premium tolerance to design tiered pricing frameworks that maximize market penetration. Communication frameworks tailored specifically to the higher health-seeking behaviors of female consumers and promotional strategies that recognize the strong cultural preferences of lower-income households will optimize intervention efficiency. Deploying targeted, digitally-driven promotional materials toward younger, higher-income segments—who demonstrate the highest statistical willingness to pay—complemented by broad mass-media messaging regarding quality assurance, will help mitigate consumer price sensitivity, stimulate value-chain investments, and secure sustainable market demand for certified traditional Cambodian fish products.

Acknowledgements

The authors thank Kong Tosoth, Chhoun Soklang, Nuth Sovannarith, Dr. Peng Chanthol, Dr. Mith Hasika, Dr. In Sokneang, and Da Vuthea for their technical assistance during this investigation. Administrative support from the Institute of Technology of Cambodia (ITC), Royal University of Agriculture (RUA), Royal University of Phnom Penh (RUPP), National University of Battambang (NUBB), and University of South-East Asia (USEA) is gratefully acknowledged. Finally, the authors thank the university student respondents for their voluntary participation and valuable insights.

References

- Aguilar, F. X. and Vlosky, R. P. (2007). Consumer willingness to pay price premiums for environmentally certified wood products in the U.S. **Forest Policy and Economics**, 9(8), 1100-1112.
- Angulo, A. M. and Gil, J. M. (2007). Risk perception and consumer willingness to pay for certified beef in Spain. **Food Quality and Preference**, 18(8), 1106-1117.

- Baran, E. (2005). **Cambodia inland fisheries: Facts, figures and context**. WorldFish Center and Inland Fisheries Research and Development Institute, Phnom Penh, Cambodia.
- Bolton, D. J., Meally, A., Blair, I. S., McDowell, D. A., and Cowan, C. (2008). Food safety knowledge of head chefs and catering managers in Ireland. **Food Control**, **19**(3), 291-300.
- Caputo, V., Sacchi, G., and Lagoudakis, A. (2018). Traditional food products and consumer choices. In A. Cavicchi and C. Santini (Eds.) **Case studies in the traditional food sector** (pp. 47-87). Elsevier.
- Chifor, C., Arion, I. D., Isarie, V. I., and Arion, F. H. (2022). A systematic literature review on European food quality schemes in Romania. **Sustainability**, **14**(23), 16176.
- Cook, B. R., Satizábal, P., Touch, V., McGregor, A., Diepart, J.-C., Utomo, A., Harrigan, N., McKinnon, K., Srean, P., Tran, T. A., and Babon, A. (2024). Historical agrarian change and its connections to contemporary agricultural extension in northwest Cambodia. **Critical Asian Studies**, **56**(1), 25-52.
- Cooke, N. (2011). Tonle Sap processed fish. From Khmer subsistence staple to colonial export commodity. In Tagliacozzo, E. and Chang, W. (eds). **Chinese circulations: Capital, commodities, and networks in Southeast Asia**, (pp. 360-379). Duke University Press.
- De Canio, F. and Martinelli, E. (2021). EU quality label vs organic food products: A multigroup structural equation modeling to assess consumers' intention to buy in light of sustainable motives. **Food Research International**, **139**, 109846.
- Deng, J. (2022). How customer behavior has transformed as e-commerce has developed in the digital economy. **BCP Business & Management**, **33**, 528-537.
- Fekete, M., Lehoczi, A., Kryczyk-Poprawa, A., Zábó, V., Varga, J., Bálint, M., Fazekas-Pongor, V., Csípő, T., Rzaşa-Duran, E., and Varga, P. (2025). Functional foods in modern nutrition science: Mechanisms, evidence, and public health implications. **Nutrients**, **17**(13), 2153.
- Feldmann, C. and Hamm, U. (2015). Consumers' perceptions and preferences for local food: A review. **Food Quality and Preference**, **40**, 152-164.
- Fisheries Administration. (2022). **Fisheries production in Cambodia 2016-2021**. Fisheries Administration, Phnom Penh, Cambodia.
- Fisheries Administration. (2023). **Cambodia Quality Seal (CQS) certification scheme for fish and fishery products: Scheme manual**. Fisheries Administration, Phnom Penh, Cambodia.
- Food and Agriculture Organization of the United Nations. (2020). **The state of world fisheries and aquaculture 2020**. FAO, Rome, Italy.
- Freed, S., Kura, Y., Sean, V., Mith, S., Cohen, P., Kim, M., Thay, S., and Chhy, S. (2020). Rice field fisheries: Wild aquatic species diversity, food provision services and contribution to inland fisheries. **Fisheries Research**, **229**, 105615.
- Glogoveţan, A.-I., Dabija, D.-C., Fiore, M., and Pocol, C. B. (2022). Consumer perception and understanding of European Union quality schemes: A systematic literature review. **Sustainability**, **14**(3), 1667.
- Guerrero, P., Beatty, E., Kerry, J. P. and de la Caba, K. (2012). Extrusion of soy protein with gelatin and sugars at low moisture content. **Journal of Food Engineering**, **110**(1), 53-59.
- Hahnel, R. (2003). **The ABC's of political economy: A modern approach**. Pluto Press, London, UK.
- Hanus, G. (2018). Traditional or modern? Preferences of young consumers in the food market. **International Journal of Economics, Business and Management Research**, **2**(1), 90-98.
- Hartje, R., Bühler, D., and Grote, U. (2016). Food security in rural Cambodia and fishing in the Mekong in the light of declining fish stocks. **World Food Policy**, **2-3**(2-1), 5-31.
- Hebden, L., Chan, H. N., Louie, J. C., Rangan, A., and Allman-Farinelli, M. (2015). You are what you choose to eat: Factors influencing young adults' food selection behavior. **Journal of Human Nutrition and Dietetics**, **28**(4), 401-408.
- Henson, S. and Northen, J. (2000). Consumer assessment of the safety of beef at the point of purchase: A pan-European study. **Journal of Agricultural Economics**, **51**(1), 90-105.

- Heo, H. and Lee, S. (2025). Consumer information-seeking and cross-media campaigns: An interactive marketing perspective on multi-platform strategies and attitudes toward innovative products. **Journal of Theoretical and Applied Electronic Commerce Research**, 20(2), 68.
- Hortle, K. G., S. L., and J. V.-J. (2004). An introduction to Cambodia's inland fisheries. **Mekong Development Series No. 4**, ISSN 1680-4023.
- Jevšnik, M., Hlebec, V., and Raspor, P. (2008). Consumers' awareness of food safety from shopping to eating. **Food Control**, 19(8), 737-745.
- Jia, Z., B., Sharma, A., Kim, N. S., Purohit, S. M., Green, M., Roche, M. R., Holliday, E., and Chen, H. (2023). Revelation of the sciences of traditional foods. **Food Control**, 145, 109392.
- Kimkong, H., Promphakping, B., Hudson, H., and Day, S. C. J. (2023). Agricultural transformation in the rural farmer communities of Stung Chrey Bak, Kampong Chhnang Province, Cambodia. **Agriculture**, 13(2), 308.
- Kolanowski, W. and Laufenberg, G. (2006). Enrichment of food products with polyunsaturated fatty acids by fish oil addition. **European Food Research and Technology**, 222(3-4), 472-477.
- Kotler, Philip. (1991). **Marketing management: Analysis, planning, implementation, and control** (7th ed.). Prentice-Hall.
- Krepapa, A., Berthon, P., Webb, D., and Pitt, L. (2003). Mind the gap. **European Journal of Marketing**, 37(1/2), 197-218.
- Lamberts, D. (2001). **Tonle Sap fisheries: A case study on floodplain gillnet fisheries in Siem Reap, Cambodia**. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.
- LeGrand, K., Borarin, B., and Young, G. M. (2020). Tradition and fermentation science of *prohok*, an ethnic fermented fish product of Cambodia. **Journal of Ethnic Foods**, 7(1), 12.
- Loureiro, M. L. and Umberger, W. J. (2007). A choice experiment model for beef: What US consumer responses tell us about relative preferences for food safety, country-of-origin labeling and traceability. **Food Policy**, 32(4), 496-514.
- MAFF. (2020). **National action plan for control and inspection of quality and safety of fish and fishery products in Cambodia**. In CAPFish-capture postharvest development project. MAFF, Phnom Penh, Cambodia.
- MAFF. (2020). A choice experiment model for beef: What US consumer responses tell us about relative preferences for food safety, country-of-origin labeling and traceability. **Food Policy**, 32(4), 496-514.
- Maksi, S. J., Keller, K. L., Dardis, F., Vecchi, M., Freeman, J., Evans, R. K., Boyland, E., and Masterson, T. D. (2024). The food and beverage cues in digital marketing model: Special considerations of social media, gaming, and livestreaming environments for food marketing and eating behavior research. **Frontiers in Nutrition**, 10.
- Ministry of Planning. (2021). **Statistical yearbook of Cambodia 2021**. Ministry of Planning, Phnom Penh, Cambodia.
- Naylor, R. L., Kishore, A., Sumaila, U. R., Issifu, I., Hunter, B. P., Belton, B., Bush, S. R., Cao, L., Gelcich, S., Gephart, J. A., Golden, C. D., Jonell, M., Koehn, J. Z., Little, D. C., Thilsted, S. H., Tigchelaar, M., and Crona, B. (2021). Blue food demands across geographic and temporal scales. **Nature Communications**, 12(1), 5413.
- Olney, D. K., Talukder, A., Iannotti, L. L., Ruel, M. T., and Quinn, V. (2009). Assessing impact and impact pathways of a homestead food production program on household and child nutrition in Cambodia. **Food and Nutrition Bulletin**, 30(4), 355-369.
- Osterwalder, A., Papadakos, T., Pigneur, Y., Bernarda, G., Smith, A., and Papadakos, T. (2014). **Value proposition design: How to create products and services customers want**. Wiley, New Jersey.
- Peulić, T., Marić, A., Maravić, N., Novaković, A., Kalenjuck Pivarski, B., Čabarkapa, I., Lazarević, J., Šmugović, S., and Ikonić, P. (2023). Consumer attitudes and preferences towards traditional food products in Vojvodina. **Sustainability**, 15(16), 12420.
- Steger, M. B. and Roy, R. K. (2010). **Neoliberalism: A very short introduction**. Oxford University Press.
- Teh, L. S. L., Bond, N., KC, K., Fraser, E., Seng, R., and Sumaila, U. R. (2019). The economic impact of global change on fishing and non-fishing households in the Tonle Sap ecosystem, Pursat, Cambodia. **Fisheries Research**, 210, 71-80.

- Trichopoulou, A., Soukara, S., and Vasilopoulou, E. (2007). Traditional foods: A science and society perspective. **Trends in Food Science & Technology**, **18**(8), 420-427.
- United Nations Conference on Trade and Development. (2017). **Fishery exports and the economic development of LDCs: Bangladesh, Cambodia, the Comoros, Mozambique, Myanmar and Uganda**. UNCATD, Geneva, Switzerland.
- United Nations Industrial Development Organization. (2022). **Field mission report on the development of official control protocol for the control of safety and quality of fish and fishery products in Cambodia**. UNIDO, Phnom Penh, Cambodia.
- United Nations Industrial Development Organization. (2024). **Annual project report of CAPFISH-Capture postharvest fisheries development project**. UNIDO, Phnom Penh, Cambodia.
- Wang, W., Mensah, I. A., Atingabili, S., Omari-Sasu, A. Y., Nouwati, E., Kunkuaboor, C. Y., and Qiao, M. (2025). The nexus between food security, health outcomes, and climate change: A multisectoral approach to sustainable development in Africa. **BMC Public Health**, **25**(1), 2319.
- WorldFish Center. (2010). **The contribution of fish intake, aquaculture, and small-scale fisheries to improving nutrition security: A literature review**. WorldFish Center Working Paper, Phnom Penh, Cambodia.