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Prioritizing Farm-to-Fork Systems through Analytical Hierarchy Process - A Customer Perspective

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Abstract: ***This research utilizes the Analytic Hierarchy Process (AHP) to prioritize farm-to-fork systems, including Licious, TenderCuts, ZappFresh, Meatigo, and Fresh to Home. The AHP method helped determine the weights and decisions for each relevant factor. Data was collected through Google Forms and survey questionnaires in Hyderabad, India. Based on the weighted alternatives, Licious ranked highest, followed by Fresh to Home, then TenderCuts, ZappFresh, and finally Meatigo.***

Keywords: Farm-to-Fork systems (FFS), online food delivery systems (OFS), Analytical hierarchy process (AHP)**.**

1. Introduction

India's e-commerce industry has revolutionized the manner in which business is conducted in India, creating diverse segments of commerce that include business-to-business (B2B), direct-to-consumer (D2C), consumer-to-consumer (C2C), and consumer-to-business (C2B). Significant segments like D2C and B2B have witnessed substantial growth in recent years. Farm-to-fork systems (FFS) are like D2C model, whereas online food delivery system (OFS) is B2C and D2c also; however, they differ in their primary offerings and the customers they target. In this study, we define farm-to-fork systems (FFS) as mobile applications, websites, and various other online platforms. While online food delivery systems (OFS) provide meals prepared by restaurants and eateries, farm-to-fork systems focus on delivering fresh, raw food products such as meat, poultry, and seafood, emphasizing quality and freshness. OFS focus on speed of delivery and usually less than one hour, whereas FFS focus on quality, freshness and direct sourcing from suppliers and targeted audience are individuals and families who want to prepare fresh meal at home.

Online food delivery systems have witnessed remarkable expansion since the mid-2000s, propelled by advancements in internet technology, a widespread shift towards e-commerce, increasing urbanization, and evolving social dynamics. Food delivery has become a vital component of urban life, enabling customers to effortlessly order from a wide array of restaurants and have their meals delivered to their homes with a simple tap on their mobile devices. Online food delivery platforms offer a multitude of choices, convenience, cashback rewards, incentives, appealing offers, and discounts.

Throughout the years, it has evolved to a point where once unimaginable innovations, including robots, electric vehicles, 3D printing, e-cigarettes, gene editing, and digital assistants, have come to fruition. In the early days, technology was mainly employed for communication, data recording and retrieval, cloud computing, internet access, analytics, immersive and augmented reality, and automation. Today, it has become so engaging that individuals can order their preferred food items without stepping outside, thanks to online delivery services that provide a variety of menu options available in their vicinity.

2. Objective of the study

As the demand for fresh items delivery services increases, numerous online delivery companies are expanding their offerings. While these companies provide similar advantages in fulfilling customer orders through online platforms, their delivery fees, cashback options, promotional offers, and additional customer benefits vary significantly. Consequently, it is essential for customers to make well-informed choices regarding which online delivery services will most effectively meet their requirements. This evaluation represents a multifaceted decision-making process aimed at identifying the most sustainable services within the FFS.

This study aims to identify the primary factors influencing consumer choices and satisfaction regarding applications, including aspects such as Economy, Service Quality, Technology, Privacy and security, availability of menu options. These criteria will be elaborated upon in the methods section. In view of consumer perspective, the farm-to-fork systems are same as online food delivery systems only, so we considered the criteria which are used by customers to evaluate online food delivery systems. The study helps the customer to choose best OFS for their requirements.

3. Literature Review

The Internet has evolved from a simple communication tool into a vast and interactive marketplace for products and services. According to source [1], India's e-commerce industry is expected to reach a valuation of US$ 325 billion by 2030, bolstered by 500 million consumers and enhanced internet access, especially in rural areas. By 2026, it is projected that over 1.18 billion people will own smartphones, enabling digital transactions. Indian e-commerce market is forecasted to expand at a compound annual growth rate (CAGR) of 27%, reaching US$ 163 billion by 2026. The online food service industry [2] has experienced exponential growth in India, with revenue in the Online Food Delivery market anticipated to reach US$54.97 billion by 2025, and revenue is projected to exhibit an annual growth rate (CAGR 2025-2030) of 13.26%, leading to an estimated market volume of US$102.43 billion by 2030. The above numbers show the growth of the e-commerce and online food delivery systems in India.

AHP is a method for organizing and analysing complex decisions based on math and psychology [3]. Previous literature [4] shows that many researchers have adopted AHP and fuzzy AHP methodology in various fields such as, security systems in social media platforms [5] selecting facility location [6], safety management system [7], project selection [8].

AHP is widely used in evaluation of online food delivery such as, AHP to compare food delivery systems [9], comparison of different factors in online food delivery [10], quantifying decision factors in selection of online food [11], AHP-TOPSIS for evaluating online food delivery [12], evaluation and selection of online food delivery through FUZZY-TOPSIS [13].

4. Methodology

The Analytical Hierarchy Process (AHP) is one of the multi-criteria-decision methods (MCDM) and the decision-support framework developed by Saaty.TL [14]. Its main aim is to assess the relative importance of a defined set of alternatives using a ratio scale, which is based on the decision-maker's judgment. This methodology highlights the importance of the intuitive assessments made by the decision-maker and the need for consistency when comparing alternatives during the decision-making process. Since decision-makers depend on their expertise and experience to make judgments and ultimately decisions, the AHP framework is well-suited to their behavioural tendencies. A significant benefit of this method is its capacity to systematically arrange both measurable and non-measurable factors, providing a structured yet relatively simple approach to addressing decision-making issues. Additionally, by logically breaking down a problem from a broader viewpoint to more specific details, one can create links between the smaller components and the larger context through straightforward paired comparison judgments. Saaty.TL [15-17] outlined the following steps for implementing the AHP:

1) Define the problem and determine its goal.
2) Structure the hierarchy from the top (the objectives from a decision-maker's viewpoint) through the intermediate levels (criteria on which sub- sequent levels depend) to the lowest level which usually contains the list of alternatives.
3) Construct a set of pair-wise comparison matrices (size n×n) for each of the lower levels with one matrix for each element in the level immediately above by using the relative scale measurement shown in Table 1. The pair-wise comparisons are done in terms of which element dominates the other.
4) There are n(n-1)/ 2 judgments required to develop the set of matrices in step 3. Reciprocals are automatically assigned in each pair-wise comparison.
5) Hierarchical synthesis is now used to weight the eigenvectors by the weights of the criteria and the sum is taken over all weighted eigenvector entries corresponding to those in the next lower level of the hierarchy.
6) Having made all the pair-wise comparisons, the consistency is determined by using the eigenvalue, λ_{max}, to calculate the consistency index, CI as follows: $CI=(\lambda_{max}-n)/(n-1)$, where n is the matrix size. Judgment consistency can be checked by taking the consistency ratio (CR) of CI with the appropriate value in Table 2. The CR is acceptable, if it does not exceed 0.10. If it is more, the judgment matrix is inconsistent. To obtain a consistent matrix, judgments should be reviewed and improved.
7) Steps 3-6 are performed for all levels in the hierarchy.

Table 1: The saaty's scale of relative importance

Relative importance	Definition	Description
1	Equally importance	Two factors equally influence the objective
3	Moderate importance	Experience and judgement slightly favour one factor over another
5	Strong importance	Experience and judgement strongly favour one factor over another
7	Very strong importance	One decision factor is strongly favoured over another, and its supremacy is established in practice
9	Extreme importance	The evidence favouring one decision factor over another is of the highest possible orders of validity
2,4,6 and 8	Intermediate values between adjacent values	When compromise is required

Fortunately, there is no need to implement the steps manually. Professional commercial software, **Expert Choice**, developed by Expert Choice, Inc. [18], is available in the market which simplifies the implementation of the AHP's steps and automates many of its computations.

Table 2: Average random consistency (RI)

Size of matrix	1	2	3	4	5	6	7	8	9	10
Random consistency	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

In this research, primary data were collected through questionnaires distributed to online consumers. A structured questionnaire was utilized to aid in the data collection process for the study. The design of the questionnaires was meticulously developed to guarantee the utmost accuracy in the information gathered and to improve the understanding of the respondents. Following this, the Analytic Hierarchy Process (AHP) was implemented on the collected data to achieve the goals of the present research. Numerous researchers have assessed online food delivery using various criteria such as delivery speed, service quality, online tracking customer service, dish variety, and privacy and security [19-22]. The criteria to prioritize for FFS is also same as OFS. In this study, we identified five critical criteria for evaluation, which were considered essential for the assessment. The chosen criteria are elaborated upon below.

1) **Economy:** This includes the charge by the company which include transportation, labour and administration costs, discounts and offers, cash back offers, reward points, minimum order amount, membership offers and delivery fee.
2) **Service Quality:** This includes time saving of ordering, pick-up, and cleanliness of the food, eco-friendly packaging, carbon footprint and the quality of the item
3) **Technology:** This includes a calling feature for placing phone calls, Time taken for online tracking, Timeliness of order arrival, Timeliness of SMS, WhatsApp alert, order accuracy, response of customer service, user interface, accessibility of the system, flexibility of payment system like debit card, credit card payments, UPI payment system, wallet facility, internet banking facility and cash on delivery facility.
4) **Privacy and security:** The key factors to consider during online transactions and order placements are privacy and security. This encompasses the customer's title, phone number, mailing address, bank statement, email address, password, and various other personal details that constitute personal information. As a consequence of numerous high-profile news reports regarding data breaches involving prominent companies, consumers are increasingly worried about the usage and handling of their sensitive information during online transactions. Therefore, online food delivery applications must provide assurances regarding their privacy and security measures.
5) **Availibility of menu options:**
Another important criterion is menu which contains availability of menu options, credibility of the FFS refers to the level of trust worthiness of information, as well as the reliability and accuracy of the platform.

Subsequently, five leading farm-to-fork systems (FFS) **Licious, TenderCuts, ZappFresh, Meatigo and Fresh** to Home in Hyderabad, India are compared based on the chosen criteria by organizing the decision-making process into a three-tier hierarchy consisting of Goal, Criteria, and Alternatives. Overview of this process is shown in the following **figure**-1 and after structuring the goal in hierarchy AHP process is applied to find the priority ranking of FFS

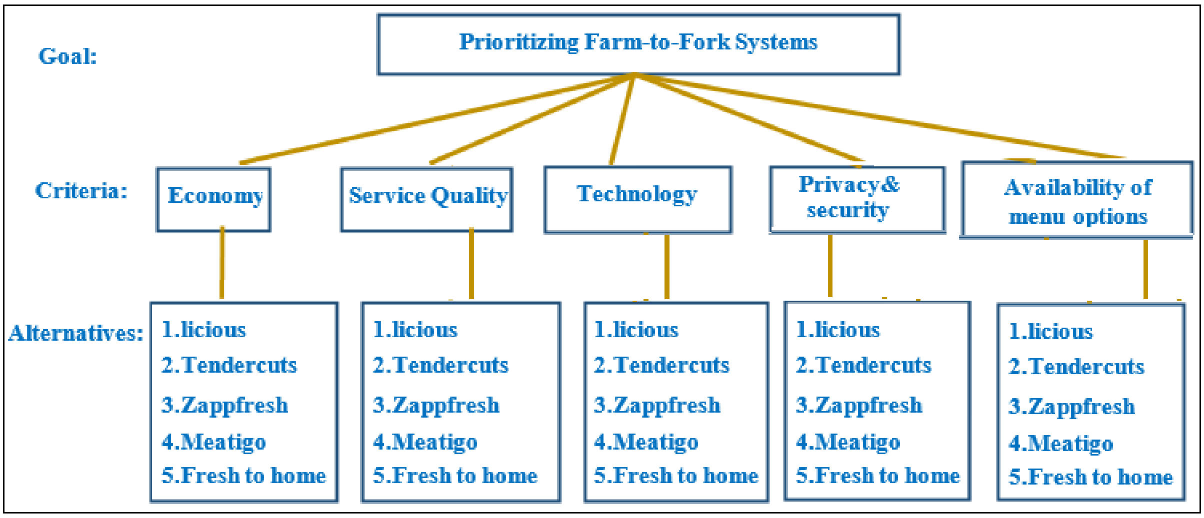

Figure 1: Proposed Model

The AHP calculations are given in table 3 to 9

Table 3: Pair-wise comparison matrix for all criteria

	Economy	Service quality	Technology	Privacy and security	Availability of menu options	Priority vector
Economy	1	1/5	1/3	2	2	0.111
Service quality	5	1	5	6	7	0.565
Technology	3	1/5	1	2	2	0.175
Privacy & security	1/2	1/6	1/2	1	2	0.086
Availability of menu options	1/2	1/7	1/2	1/2	1	0.063
λ_{max} = 5.232, CR = 0.051 < 0.1						

Table 4: Pairwise comparison matrix for "*Economy* "

	Licious	Fresh to Home	Tendercuts	Zappfresh	Meatigo	Priority vector
Licious	1	1/5	1/6	3	2	0.089
Fresh to Home	5	1	1/4	5	7	0.259
Tendrcuts	6	4	1	9	9	0.555
Zappfresh	1/3	1/5	1/9	1	3	0.058
Meatigo	1/2	1/7	1/9	1/3	1	0.037
λ_{max} = 5.385, CR = 0.008 < 0.1						

Table 5: Pairwise comparison for "Service Quality"

	Licious	Fresh to Home	Tendercuts	Zappfresh	Meatigo	Priority vector
Licious	1	2	2	4	4	0.384
Freshto Home	1/2	1	3	3	2	0.247
Tendrcuts	1/2	1/3	1	2	3	0.168
Zappfresh	1/4	1/3	1/2	1	3	0.121
Meatigo	1/4	1/2	1/3	1/3	1	0.080
λ_{max} = 5.245, CR=0.054<0.1						

Table- 6: Pair-wise comparison matrix for "*Technology*"

	Licious	Fresh to Home	Tendercuts	Zappfresh	Meatigo	Priority vector
Licious	1	2	3	2	1	0.024
Freshto Home	1/2	1	3	2	1/2	0.197
Tendrcuts	1/3	13	1	1/2	1/3	0.081
Zappfresh	1/2	1/2	2	1	1/2	0.135
Meatigo	1	2	3	2	1	0.294
λ_{max} = 5.088, CR = 0.020 < 0.1						

Table 7: Pair-wise comparison matrix for "*Privacy and security*"

	Licious	Fresh to Home	Tendercuts	Zappfresh	Meatigo	Priority vector
Licious	1	1/5	1/4	2	3	0.116
Freshto Home	5	1	4	5	5	0.509
Tendrcuts	4	1/4	1	3	3	0.233
Zappfresh	1/2	1/5	1/3	1	2	0.082
Meatigo	1/3	1/5	1/3	1/2	1	0.059
λ_{max} = 5.351, CR = 0.07 < 0.1						

Table 8: Pair-wise comparison matrix for "*Availability of menu options*"

	Licious	Fresh to Home	Tendercuts	Zappfresh	Meatigo	Priority vector
Licious	1	7	3	2	7	0.438
Freshto Home	1/7	1	1/4	1/2	3	0.082
Tendrcuts	1/3	4	1	1/3	5	0.173
Zappfresh	1/2	2	3	1	7	0.269
Meatigo	1/7	1/3	1/5	1/7	1	0.038
λ_{max} = 5.328, CR = 0.07< 0.1						

Table- 9: Final priority table

	Economy	Service quality	Technology	Privacy and security	Availability of menu options	Final priority vector	Rank
	0.111	0.565	0.175	0.086	0.063		
Licious	0.089	0.384	0.024	0.116	0.438	0.269	1
Freshto Home	0.259	0.247	0.197	0.509	0.082	0.252	2
Tendrcuts	0.555	0.168	0.081	0.233	0.173	0.202	3
Zappfresh	0.058	0.121	0.135	0.082	0.269	0.122	4
Meatigo	0.037	0.080	0.294	0.059	0.038	0.108	5

5. Results

The present study focuses on the comparative assessment of five farm-to-fork systems in Hyderabad based on various factors, including Economy, Service Quality, Technology, Privacy and security and availability of menu options. The findings indicate that **Licious** (0.269) ranks highest in terms of overall suitability among all evaluated systems, following **Fesh to Home** (0.252), emerges as the second most popular one, with **Tendercuts** (0.202) in third place, **Zappfresh** (0.122) in fourth, and **Meatigo** (0.108) in last position. The results highlight that **Licious and Fresh to Home** are the two leading online farm-to-fork systems.

6. Conclusion

The aim of this research is to assess and rank five prominent farm-to-fork systems (FFS) in Hyderabad, specifically **Licious, TenderCuts, ZappFresh, Meatigo** and **Fresh to Home,** based on specific criteria. The criteria evaluated include Economy, service quality, privacy & security, technology and availability of menu options. The research engaged participants from Hyderabad, aged 26 to 55, who have utilized FFS services at least twice weekly and possess experience with all five companies. The findings indicate that the primary element influencing customers' choice of FFS is service quality, while technology ranks as the second most important factor. In summary, the Analytic Hierarchy Process (AHP) model aids individuals in making informed decisions in intricate scenarios. Subsequent studies could incorporate additional criteria and sub-criteria for a more comprehensive evaluation. For upcoming research, multi-criteria decision-making (MCDM) techniques such as PROMETHEE, Fuzzy PROMETHEE, AHP-ANP, VIKOR, TOPSIS, Fuzzy AHP, and Fuzzy TOPSIS may be utilized.

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