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Digital Marketing Strategies and Profitability in the Agri-Food Industry: Resource Efficiency and Value Chains

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Abstract: Agriculture is essential to any country's economy. Agriculture is crucial not only for feeding a country's population but also for its impact on other businesses. The paradox of agri-food companies generating substantial profits despite seemingly high product prices is explored in this article, focusing on the role of digital marketing within the agri-food industry. Enhanced digital marketing performance leads to efficient advertising campaigns, through reduced advertising costs and increased resource efficiency. To do so, the authors collected web analytical data from five established agri-food firms with the highest market capitalization. Then, linear regression and correlation analyses were used, followed by the utilization of fuzzy cognitive mapping (FCM) modeling. The analysis revealed that increased traffic through search sources is associated with reduced advertising costs. Additionally, enhanced website engagement contributes to lower advertising expenses, emphasizing the optimization of the user experience. However, it has been discovered that allocating funds for social media advertising eventually results in higher expenses with higher website-abandoning rate. Ultimately, successful management of the balance between product costs and profitability in the agri-food sector lies on the increased use of search sources and greatly reducing the use of social media sources.

Keywords: agri-food; digital marketing; profitability; value chains; sufficiency; sustainability; linear regression; FCM; decision support systems (DSSs)

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1. Introduction

In the realm of agri-food enterprises, a perplexing paradox unfolds, captivating the attention of industry observers, researchers, and economists alike. Despite the apparent extravagance of their product pricing, these businesses not only manage to steer clear of financial turmoil but also thrive, showcasing robust profit margins that exceed industry norms. This phenomenon underscores the pivotal role of digital marketing in reshaping consumer perceptions and driving demand within the agri-food sector. Central to their success is the strategic utilization of digital marketing channels to optimize profitability, despite the challenges posed by production costs. According to Järvinen & Karjaluoto [1], an organization's attempts to implement digital marketing metrics systems, as well as the outcomes, cannot be understood without considering the rationale for the parameters chosen, the analysis of metrics data, and the organizational circumstances surrounding the system's use.

Digital marketing is an effective and efficient way to promote companies online, with many strategies and platforms accessible [2]. Vollrath & Villegas [3] suggest preventing digital marketing analytics myopia. Marketing analytics will need to be more adept at

interpreting data from a greater variety of sources as the industry transitions to a more digital one. Even as technology and marketing channels change, practitioners and scholars of digital marketing analytics can still create value for businesses and consumers by using the consumer choice journey as a strategic framework [4]. However, there is a paradox. Several businesses appear to be selling their products at high prices, and they are not bankrupting, but on the contrary, they have high profits.

The scope of this article is to explore this paradoxical phenomenon. Specifically, it aims, on the one hand, to examine specific digital marketing measurement variables and how they affect the reduction in advertising costs and, on the other hand, to propose a digital marketing strategy capable of reducing advertising costs to increase profitability, thus contributing to the efficient use of resources and sustainable development. The significance of this article lies in its potential to offer valuable insights to industry practitioners, guiding them in the development of data-driven marketing strategies that foster sustainable growth and competitive advantage in the dynamic agri-food sector. The findings of this study could contribute to the optimization of resource utilization by reducing advertising costs and increasing business profitability. By elucidating the impact of specific digital marketing measurement variables on cost reduction, this article advances the understanding and application of efficient strategies that promote sustainable development. Such insights are crucial for the survival and evolution of businesses in the rapidly changing agri-food industry, making this research highly relevant and impactful.

Relying entirely on web analytics data may result in unproductive or detrimental marketing decisions. As a result, businesses should only use web analytics data as a part of their performance evaluations. Web analytics may enhance healthcare websites by monitoring engagement, users, acquisition, content, and platforms, thereby improving usability and conversion rates [5]. Improving web analytics systems may increase an organization's profitability by assessing user behavior, performance results, and satisfaction of consumers [6]. Key parameters of digital marketing, extensively researched in this work, include social and search traffic sources, the abandonment rate, the pages per visit, and the time customers spend on their websites, along with the number of returning website customers.

By harnessing the power of digital marketing metrics, agri-food enterprises can effectively reduce advertising costs, achieving profitability even in the face of high production costs. This strategic alignment with digital marketing principles empowers them to not only survive but thrive in today's competitive landscape, forging a path to sustained success in the agri-food industry. Therefore, the following research question is raised:

RQ: "*How are specific digital marketing measurement variables aligned with the reduction in advertising costs?*"

The research question aims to determine what the best channel for digital marketing is in order to minimize the advertising costs and increase the profitability of agri-food businesses. Directing resources to the lowest-cost choice of digital advertising channels has as the result of, in addition to increasing profits, the saving of resources, thus contributing to sustainable development. Our research has analyzed digital marketing variables and focuses on social and search sources variables, suggesting a digital marketing strategy of directing resources to search sources rather than social sources.

The novelty of this study lies in the fact that it attempts to investigate how, through the selection of an appropriate digital marketing strategy, companies can reduce advertising costs and therefore increase their profitability, thus making efficient use of resources and contributing to sustainable development. It was revealed by our bibliographic analysis that there is a dearth of research that is comparable to this one that concurrently looks at sustainable development, business profitability, and digital marketing strategies.

This article makes a significant contribution to understanding how digital marketing strategies can optimize profitability and resource efficiency in the agri-food industry. By exploring the relationship between digital marketing variables and advertising costs, through

robust analytical methods like regression analysis and fuzzy cognitive mapping, this study reveals actionable insights for agricultural enterprises. It underscores the importance of strategic digital investments, particularly in search sources, to reduce advertising costs. Moreover, the findings highlight a shift towards sustainability by minimizing resource waste, thereby setting a precedent for enhancing competitiveness and operational efficiency in the sector.

Digital marketing strategies may include metrics such us website traffic, user engagement, conversion rates, customer demographics, and purchasing behavior. By analyzing these metrics, agri-food companies can gain valuable insights into consumer preferences, market trends, and the efficacy of their marketing campaigns. Ghahremani-Nahr & Nozari [7] claim that key performance indicators are critical and delicate indicators for any firm that can successfully identify and regulate them. Measuring the effectiveness of digital marketing activities and using important indications of digital marketing performance helps boost marketing productivity while also improving the efficacy and optimization of marketing expenditure budgets. There are several measures for measuring digital marketing performance that can help improve the effectiveness of marketing initiatives. Moreover, the concept of "efficient promotions" involves the ability to allocate resources wisely and employ marketing tactics that yield the highest return on investment (ROI). It entails customizing advertising activities to resonate with target audiences, optimizing advertising expenditure, and maximizing conversion rates.

Our research underscores its originality by focusing on the intersection of digital marketing strategies in the agri-food sector, particularly highlighting the innovative use of website customer behavioral data in examining the impact of traffic sources (search and social) and other metrics on their advertising costs. Through the methodology of static FCM simulation, a unique lens is provided for exploring how optimizing digital marketing expenditures, specifically between social media and search engine resources [8], can enhance both profitability and sustainability within agri-food businesses. This work represents a significant contribution to the literature as it highlights the importance and implication of digital marketing strategies in the agri-food sector. It focuses on cost reduction through optimizing advertisements on social media and efficiently using resources for search engine optimization. The reduction in these expenses has substantial implications not only for the profitability of businesses but also for sustainability, ensuring efficient use of limited natural resources and long-term viability of the sector. In this way, this research delves into identifying how website customer behavior can determine beneficial digital marketing strategies in the agri-food sector, and the firms' sustainability and resource efficiency. Therefore, in Table 1 the findings of recent and relevant studies in the field of agri-food and agricultural sectors is laid out to highlight the innovative implications of our research.

Table 1. Relevant literature studies comparison.

Research	Method	Sector/Industry	Findings
Ali & Xia [9]	Implication of AI and big data	Agriculture	Electronic agricultural businesses should adopt digitalization and public–private partnership investments. Agricultural digitalization in achieving sustainable development.
Aparco et al. [10]	Historical–logical, interview, theoretical triangulation, and modeling	Agribusiness	Implementation of e-commerce through digital marketing techniques attracts new commercial allies and potential consumers according to their situation of each productive activity that constitutes rural agribusiness.

Table 1. *Cont.*

Research	Method	Sector/Industry	Findings
Bose & Kiran [4]	Literature review	Agriculture	Digital marketing and technologies in agriculture enhance efficiency, profitability, sustainability, and competitiveness by improving market data processing, communication, funding, distribution, and customer engagement
Caiazza & Bigliardi [11]	Literature review	Agri-food	The digital behavior of agri-food firms, as expressed by web analytics, connects their offline and online consumer activity, and provide a proper digital marketing strategy for expanding their sustainability with lower costs
Gelgile & Shukla [12]	Qualitative study	Agri-food	Digital marketing leads to the desired sustainability outcomes by enabling smooth marketing communication and enhanced mutual understanding for agri-food companies and their partners
Liao & Huang [13]	Systematic review	Agri-food	Digital marketing technologies in the agri-food industry shape consumer perception and acceptability, with social media being a key influencer for unhealthy food intake but less so for pro-environment behavior and attitudes
Apostolopoulos et al. [14]	Structural Equation Model (SEM)	Agri-food	COVID-19 has shifted agri-food entrepreneurship towards digitization, innovative ideas, and new market solutions, posing challenges but also generating opportunities
Vlachopoulou et al. [15]	Business Model Canvas (BMC)	Agri-food	Agri-food digital business models encourage innovation, enhance productivity, and introduce new products and services to the market, enhancing the agribusiness sector

In the following paragraphs of Section 2, a presentation of the literature regarding the peculiarities of the agri-food sector, the economic dimension of production costs in agri-food businesses, and the contribution of digital marketing and big data are provided. Overall, the literature emphasizes the importance of understanding the distinct characteristics of the agri-food sector, effectively managing production costs, and leveraging digital marketing and big data analytics to address the phenomenon, as companies in the sector can oversell their products. The development of research hypotheses then follows, as well as the research methodology. In Section 3, the main findings, from the statistical analysis of the data and the simulation of five basic scenarios of changing the primary parameters as shown by the statistical processing of the data, are presented. In Section 4, a discussion is held where the main findings of the statistical analysis and the results of the scenario simulation are interpreted, highlighting the proposed digital marketing strategy. Finally, Section 5 briefly presents the conclusions of this research.

2. Materials and Methods

2.1. Peculiarities of the Agri-Food Sector

The agri-food sector encompasses a diverse range of activities, including agriculture, food processing, distribution, and retailing. This sector is characterized by unique features such as seasonality, perishability of goods, and dependency on environmental factors. Researchers have extensively studied these peculiarities to understand their implications for market dynamics, supply chain management, and policy development. Shumakova et al. [16] identify the peculiarities of agricultural production including reliance on natural and climatic conditions, low monopolization of food producers, high capital-output ratio in

dairy cattle breeding, low profitability, cost disparities, and inadequate social environments in rural areas. The identification of trends and possibilities for strategic management will aid in promoting the process of improving relationships between various kinds of market interaction and mitigating the impact of risks on the agri-food market. Melikyan [17] concluded that the complex's financial and economic decisions serve the interests of both agrarian and industrial groups, rather than those of just one institution.

Furthermore, corporate profits are consolidated through incomplete compromises based on interest in the food industry rather than market transfer rates. This allows profit generation capabilities to be transmitted between intra-enterprise organizations. To create a favorable investment climate in the food industry, administrative barriers to commercial relations (agricultural, processing, and commerce) should be minimized through corporate governance measures. The global commerce in agri-food items, particularly grains and sunflower oil, is mostly focused in three regions: Europe and North and South America. At the same time, exports from Asia, South and Central America, and Africa are expanding the most rapidly. Considering the development of international economic integration, it should be noted that the main suppliers of agri-food products are mainly the most developed integration groups—the EU, NAFTA, and Southern Common Market (MERCOSUR)—where the largest share belongs to the leading countries. Integration groups have been urged to contribute to the solution of the food security challenge at the regional and international levels [18].

The agri-food sector is crucial to the national economies of European Union (EU) Member States. However, despite support from the first pillar of the CAP (Common Agricultural Policy of the EU), agricultural sectors face long-term challenges such as low food quality, insufficient knowledge of legal documents on environmental, land, and food law, and limited market access for farmers and producers [19]. Busch [20] examines the evolution of the agricultural sector through the sociological lens of neoliberalism's conflict. He argues that the theory of neoliberalism, as applied to the agricultural sector, will face a series of obstacles: climate change, rising energy costs, reduction in biodiversity, environmental degradation due to reckless water and soil usage, and the pursuit of sustainability.

Agri-food value chains play a significant role in shaping the labor dynamics that exist today in the industry, and the sustainability of these value chains is highly dependent on good working conditions [21]. With greater participation in agricultural global value chains leading to increased agricultural employment growth, primarily driven by the processed food sector downstream, and with more pronounced effects in lower-middle-income and high-income countries, the rise of agricultural global value chains (AGVCs) has fundamentally changed the nature of food production worldwide [22]. By integrating sustainability drivers into value-chain governance, smallholders in developing nations can now access higher-value markets through a comprehensive approach that strikes a balance between profit maximization and social and environmental impacts [23,24].

However, as per Meemken et al. [25], sustainability standards can enhance production procedures in certain instances, but they fall short on guaranteeing food system sustainability on a large scale or achieving equity goals in agri-food supply chains. Furthermore, businesses struggle to integrate sustainability in global agri-food supply chains due to a double-company lens and information asymmetry between companies and consumers; rather than focusing on major operations and supply chain improvements, rational businesses instead tend to focus on symbolic actions and communication campaigns using brand-enhancing marketing tools like sustainability reports [26]. According to Struik and Kuyper [27], to make agriculture "green" once more while balancing resource-use efficiency with social, economic, and environmental aspects, sustainable intensification in agriculture requires precise principles, cost–benefit analysis, and common norms. Circular use of biotic resources and avoiding losses are key to enhancing efficiency in agri-food systems, ensuring food security, and the functioning of the Earth's system [28].

2.2. Financial Dimension of the Agri-Food Sector

One of the critical economic dimensions of the agri-food sector is the cost of production. Production costs in agriculture and food processing businesses significantly impact their competitiveness, profitability, and sustainability. Studies have analyzed various factors influencing production costs, including input prices, technology adoption, labor availability, and regulatory compliance. As noted by Reardon [29], the midstream segment has experienced remarkable expansion and transition. This includes both a "modern revolution" with huge multinational firms and a "silent revolution" with a proliferation of small and medium enterprises and significant investment. Revolutions have been fueled by direct government action, followed by liberalization, privatization, urbanization, income growth, and infrastructure improvements. Private-sector investment has been overwhelmingly important compared to direct government investments and for the domestic market, compared to internationally traded sectors. Agri-food policy had a significant part in these processes. Sometimes, the roles have been slowing transforming. Policy and public investment have played a significant role in transforming the food value chain. Investments in production technical modernization have a substantial impact on the competitiveness of the national agri-food system [30]. Enabling conditions, such as roads and electricity, can increase the profitability of private investments by boosting supply from upstream to midstream. By combining technical breakthroughs with sociocultural and policy reforms, agri-food systems can be transformed to meet climate, economic, environmental, health, and social concerns [31].

A point that deserves attention is the financialization of the agri-food sector. Financial investment in the food and agriculture sectors has increased in recent decades, especially in equity-related funds that invest in or follow the performance of a variety of publicly traded international agri-food firms. At their peak in recent years, equity-related investment funds accounted for around one-third of total financial investment in the sector. Large asset management firms have incentives to encourage agribusiness firms in which they own a significant stake to pursue strategies that result in higher returns to shareholders, particularly market strategies that benefit the entire sector rather than individual firms. Such incentives can lead to anti-competitive behavior, mergers and acquisitions, and increased entry barriers into specific industries, resulting in price increases [32].

Thus, examining the extent to which the agricultural sector is integrated into the stock market is important for a comprehensive understanding of the causes and consequences of increasing prices of agricultural products. When there is a financial crisis, managers often turn to the cost-cutting approach, with advertising costs usually affected first. The results of the Markota et al. [33] survey show that firm profitability and advertising expenditures are positively correlated, but firm size and legal structure do not have a statistically significant effect on the level of advertising expenditures. Thus, in agri-food sector businesses, as in all businesses, the reduction in advertising costs is an important factor in the profitability of businesses. Decision makers should evaluate which parameter has the most impact on advertising costs and then compare whether reducing or increasing spending on this parameter ultimately benefits the company's profitability.

According to Coetzee, K. [34], sustainable farming is commonly associated with environmental concerns, but the significance of profitability in achieving sustainability is often overlooked. Profitability is a critical factor that should not be ignored when discussing sustainable farming practices, as it is essential for the long-term success and viability of agricultural operations. Ensuring profitability in sustainable farming practices allows farmers to invest in better technologies and methods that can further enhance both productivity and environmental stewardship. Thus, integrating digital marketing strategies in agriculture can play a pivotal role in promoting both profitability and sustainability, ensuring the sector's growth and resilience in the global market.

2.3. Contribution of Big Data and Digital Marketing

The emergence of digital marketing and big data analytics has transformed the agri-food industry's marketing practices. Digital marketing, big data, and web analytics all play an important role in the growth and longevity of a company's digital brand, as well as profitability [35]. Digital technologies enable businesses to target consumers more effectively, optimize marketing strategies, and enhance customer engagement. Big data analytics offer valuable insights into consumer preferences, market trends, and supply chain efficiency, empowering agri-food businesses to make data-driven decisions. According to Ravi & Rajasekaran [36], the concept of "digitalization" has started taking over the globe, and with it, a wide range of digital marketing innovations and techniques can be applied more efficiently to enhance the conventional marketing approach. Using digital marketing tools is one of the best ways to reach and draw in customers.

Digitalization opens up new opportunities for agriculture and the agro-industrial complex. Digital platforms and big data can be used for several operations in the agro-industrial complex, including planning, production, sales, financial management, personnel, and technical advancements. Digital platforms and big data can enhance national food security by improving management, decision-making, product quality, production costs, marketing, and agricultural raw-material processing precision [37]. According to Tatkari [38], e-commerce in agriculture refers to the purchase and sale of agricultural goods and services via electronic methods. Online marketplaces, mobile apps, and other digital platforms can help expedite transactions between farmers, buyers, and stakeholders in the agriculture value chain. E-commerce in agriculture opens up new markets and clients outside traditional borders. This can help farmers reach a larger client base, boost sales, and minimize reliance on local markets. E-commerce platforms can also give farmers access to real-time market information, allowing them to make better pricing and production decisions. As an illustration, e-commerce adoption has boosted agricultural production efficiency in China, supporting rational labor, land, and capital allocation while also contributing to sustainable growth and a sense of community [39].

Another advantage of e-commerce in agriculture is its capacity to simplify the supply chain and lower transaction costs. Online marketplaces enable farmers to connect with customers directly, eliminating the need for intermediaries and increasing supply chain efficiency. Lower transaction costs benefit both buyers and sellers, making it easier for farmers to sell their products and purchasers to purchase them. As food security is under threat, society must use creative technology solutions to secure a healthy and safe food supply while lowering the negative environmental implications of agricultural production. This can only be accomplished by ensuring that agricultural technologies and products are consistent with societal expectations, needs, and priorities. Digital technology and big data tools can promote agricultural innovation by increasing production efficiency and addressing societal concerns, but their acceptance is dependent on technological and economic variables [40].

While the general notion that consumers are "anti-agri-food technology" is rejected, it is important to co-develop applications of agri-food technologies with stakeholders and other end-users, including consumers [41]. Genetic modification, food fortification, and processing technologies are all gaining popularity as potential solutions to future food security and safety concerns. Consumers and other participants in the food supply chain must accept such technologies to ensure their successful adoption. Basso & Antle [42] claim that the global food system needs to become more sustainable. Thus, digital agriculture, which uses digital and geospatial technology to monitor, assess, and manage soil, climate, and genetic resources, demonstrates how to tackle this issue while balancing the economic, environmental, and social aspects of sustainable food production.

In terms of customer evaluation, major drivers include trust in institutions, information assessment, perceived risks and advantages, attitudes toward the product or technology, perceived behavioral control, product quality perception, and health impact [43]. This is where the role of digital marketing comes into play. Through appropriate strategies,

marketing managers should make consumers aware of technological advancements in the agri-food sector and influence their psychological perspective so that they accept these changes and perceive them as added value to the product they are purchasing.

The use of digital tools such as e-commerce, social networks, search engine optimization (SEO), mobile applications, and others have demonstrated their high performance and leadership role in the rapid processing of market data, building effective communications, lowering costs, and mastering new consumer segments. The world's leading marketers insist on these processes, which are described in modern terms such as "marketing 4.0" and "marketing 5.0" [44]. Farmers can use digital marketing to boost their product's selling price and lower their marketing expenses. Young farmers in particular are prepared to use digital marketing. To build a sustainable digital agriculture market, the federal and state governments can conduct programs to teach farmers about digital marketing [45]. According to Yekimov et al. [46], agricultural businesses can become more competitive by using social networks to promote their products and services.

However, for this process to be successfully organized and carried out, experts with the necessary training and expertise in social media product and service promotion must be used. When utilizing social media for marketing purposes, we should not anticipate immediate results; nevertheless, persistent efforts in this regard can draw in a sizable number of prospective customers. Dollega et al. [47] found that social media can be useful in part because it increases web traffic but only slightly boosts product orders and sales; in contrast, the more extensive social media campaigns produce a significantly greater number of orders on Facebook, the most popular social media platform, surpassing those on less-popular ones like Instagram.

Launching into this exploration of digital marketing tools, it is imperative to address Manko's [48] research; rather than using traditional tactics like printing paper vouchers, cards for punching, and leaflets to promote special bargains, customers may easily access their rewards through a personalized mobile app. This application is a comprehensive solution that facilitates customer recruitment, offer dissemination, communication of promotions, order placement, introduction of new products and services to existing customers, and a variety of other activities. Leveraging app development for digital marketing has the potential to greatly increase sales by better engaging the target audience and providing vital business insights via user analytics.

2.4. Research Hypotheses

After studying the relevant and recent scientific literature, this research intends to answer the following research hypotheses, based on the main research question outlined above.

Hypothesis 1: *The advertising costs of agri-food firms are related to social and search traffic sources*.

This hypothesis suggests that the amount of advertising expenditure undertaken by companies in the agri-food sector is correlated with the traffic originating from social media platforms and internet search sources. This implies that companies investing more in advertisements on these platforms are likely to incur higher advertising costs. Conversely, a decrease in advertising expenditure on these traffic sources could be associated with a reduction in the overall advertising costs of agri-food firms.

Hypothesis 2: *The advertising costs of agri-food firms are related to the abandonment rate of their websites*.

This hypothesis suggests that there exists a relationship between the advertising expenses incurred by agri-food companies and the rate at which visitors abandon their websites without completing desired actions. A higher abandonment rate may indicate inefficiencies or inadequacies in the website design, content, or user experience, which could necessitate increased advertising efforts to attract and retain visitors. Conversely,

lower abandonment rates may correlate with more effective website optimization strategies, potentially resulting in reduced advertising costs for agri-food firms.

Hypothesis 3: *The advertising costs of agri-food firms are related to the pages per visit and time on site customers spend on their websites.*

This hypothesis proposes a connection between the advertising expenses of agri-food firms and two metrics: the average number of pages visited per session and the duration of time customers spend on their websites. A higher number of pages per visit and longer time spent on the site may suggest greater engagement and interest among visitors, potentially leading to increased brand awareness and higher conversion rates. Consequently, agri-food companies may need to allocate more resources to advertising activities to maintain and enhance this level of engagement. Conversely, lower engagement metrics may indicate a need for more targeted advertising efforts or website improvements, which could potentially result in reduced advertising costs.

Hypothesis 4: *The advertising costs of agri-food firms are related to the number of their returning website customers.*

This hypothesis posits a correlation between the advertising expenditures of agri-food companies and the number of customers who revisit their websites. A higher number of returning website customers may indicate stronger brand loyalty and satisfaction with the products or services offered by agri-food firms. Consequently, these companies may need to invest more in advertising activities to maintain and further cultivate customer loyalty. Conversely, a lower number of returning website customers may suggest the need for more targeted advertising efforts or improvements in customer retention strategies, potentially leading to reduced advertising costs.

2.5. Methodological Concept

The primary objective of this study is to determine the relationship between digital marketing metrics and the advertising costs (both organic and paid traffic costs) incurred by agri-food companies, using a three-phase structure. These variables are common digital marketing KPIs [49]. The methodological context refers to discrete stages, such as the collection of big data, statistical analyses, and dynamic modeling.

The first stage of the research context focuses on the extraction of the website analytical data from the selected organizations for this study. These data were extracted from five of the biggest firms in the agri-food sector, by utilizing the Semrush [50] website software. These data were later used as input for the upcoming statistical analysis.

In the second stage, the retrieved data were harvested in the execution of statistical tests, like descriptive statistics, correlation, and linear regression analyses. Through the extracted coefficients, the impact of social and search source traffic, website bounce rate, pages per visit, and time on site, as well as returning customers, on agri-food advertising costs were examined. Moreover, the research hypotheses were verified.

The authors proceeded to the next step of the methodological context after extracting the regression and correlation coefficients, using a fuzzy cognitive map (FCM) model to visualize the relationships between the variables and run simulation scenarios. Fuzzy cognitive maps are popularly used for knowledge representation and reasoning in a wide range of application domains and have attracted a lot of research interest. They are useful for a variety of tasks, including forecasting, analysis, modeling, and decision-making [51]. Fuzzy cognitive maps can be efficiently analyzed and designed for practical uses by breaking them down into fundamental modules and studying their inference patterns hierarchically [52]. The efficacy of digital product and service internet marketing strategies is efficiently assessed by the fuzzy cognitive mapping method [53]. With online direct marketing applications, the fuzzy cognitive mapping method helps to improve the efficacy of these efforts by evaluating negative factors such as viruses and spam [54]. The fuzzy

cognitive map offers a well-informed framework for an objective analysis of the dynamics of digital entrepreneurship by efficiently identifying and analyzing its determinants [55]. By adding time and offering dynamic scenario changes, fuzzy cognitive maps can improve strategy maps and enable hierarchical performance measurement hierarchies [56]. Models created by recurrent artificial neural networks, like fuzzy cognitive maps, are collections of concepts or neurons and the various causal connections that exist between them. Users should select the best kind of FCM based on the following factors: (a) the nature of the problem; (b) the problem's necessary representation capabilities; and (c) the degree of inference required by the case [57].

2.5.1. Sample Description

In this stage of the study, the selection of the sample is presented, based on the selected agri-food companies that were included in this study. These refer to the five biggest agri-food firms for 2023, as they were categorized by Globaldata [58], based on their market capitalization in 2023. Thus, Nestle SA, Mondelez International Inc., The Kraft Heinz Co., Danone SA, and The Hershey Co. make up the sample for the present research. To perform web analytics collection from the corporate websites, the authors utilized the web platform decision support system (DSS) from Semrush [50]. Data gathering involved 180 days of observation and extraction, from July 1st, 2023, to January 31st, 2024. The collected analytic metrics are presented in detail in Table 2 below.

Table 2. Description of collected web analytics.

Analytics/Metrics	Description
Advertising Costs	Advertising costs are all the costs and expenditure associated with marketing and promotion, including, without limitation, advertising, agency fees, materials, medical affairs, meetings, and, when not specifically excluded, allocated sales force costs. In this research, advertising costs consist of organic and paid campaign costs [59].
Direct Sources	Direct sources refer to the traffic or visitors that arrive at a website directly, without the use of intermediary sources such as search engines, links from other websites, or social media. Examples include users typing the URL into their browser, using bookmarks, or access via saved links.
Referral Sources	Referral sources represent the websites or platforms that drive traffic to the site through links, such as articles, blogs, forums, and communities, targeting audiences already interested in related content or services.
Social Sources	Social sources refer to the traffic or visitors generated from social media platforms.
Search Sources	Search sources refer to the traffic sources of a website originating from search engines like Google, Bing, Yahoo, and others. These sources track the traffic generated from search engine results, typically when users are actively seeking specific content or information.
Bounce Rate	The percentage of visitors who navigate away from a website after viewing only one page indicates a lack of engagement.
Pages per Visit	The average number of pages a visitor views during a single session on a website indicates the level of exploration and engagement.
Time on Site	The average amount of time visitors spend on a website during a single session provides insights into user engagement and interest.
New Customers	A new customer refers to a person or organization that was recently acquired via online channels.
Returning Customers	Returning customers are individuals or entities who have previously interacted with a business or brand online and have subsequently returned to engage in further transactions or make additional purchases.

2.5.2. Conceptual Framework

Fuzzy logic is used to represent all variables and metrics in the conceptual model, Cognitive Mapping (FCM) DSS software of MentalModeler [60]. This method shows how changes to one metric may affect others by highlighting the relationships and connections between this study's variables [61] while creating a .mmp file for future analyses and

scenario development. FCM might be able to be arduously employed as a stationary model for simulation. To further tackle the task of changes in a metric, subjective fuzzy cognitive approaches are used for the defuzzification process, converting knowledge from feedback into statistical information [62]. The use of the fuzzy cognitive macro-scale framework in this paper is demonstrated in Figure 1, showing the connections between all the variables and factors that were looked at. The relationships between the variables, as depicted in their affiliation statistics, encompass both direct and inverse correlations, stemming from correlation analyses. A blue line represents a positive relationship, and an orange line represents a negative relationship. Additionally, the line's width intensifies in proportion to the strength of the correlation.

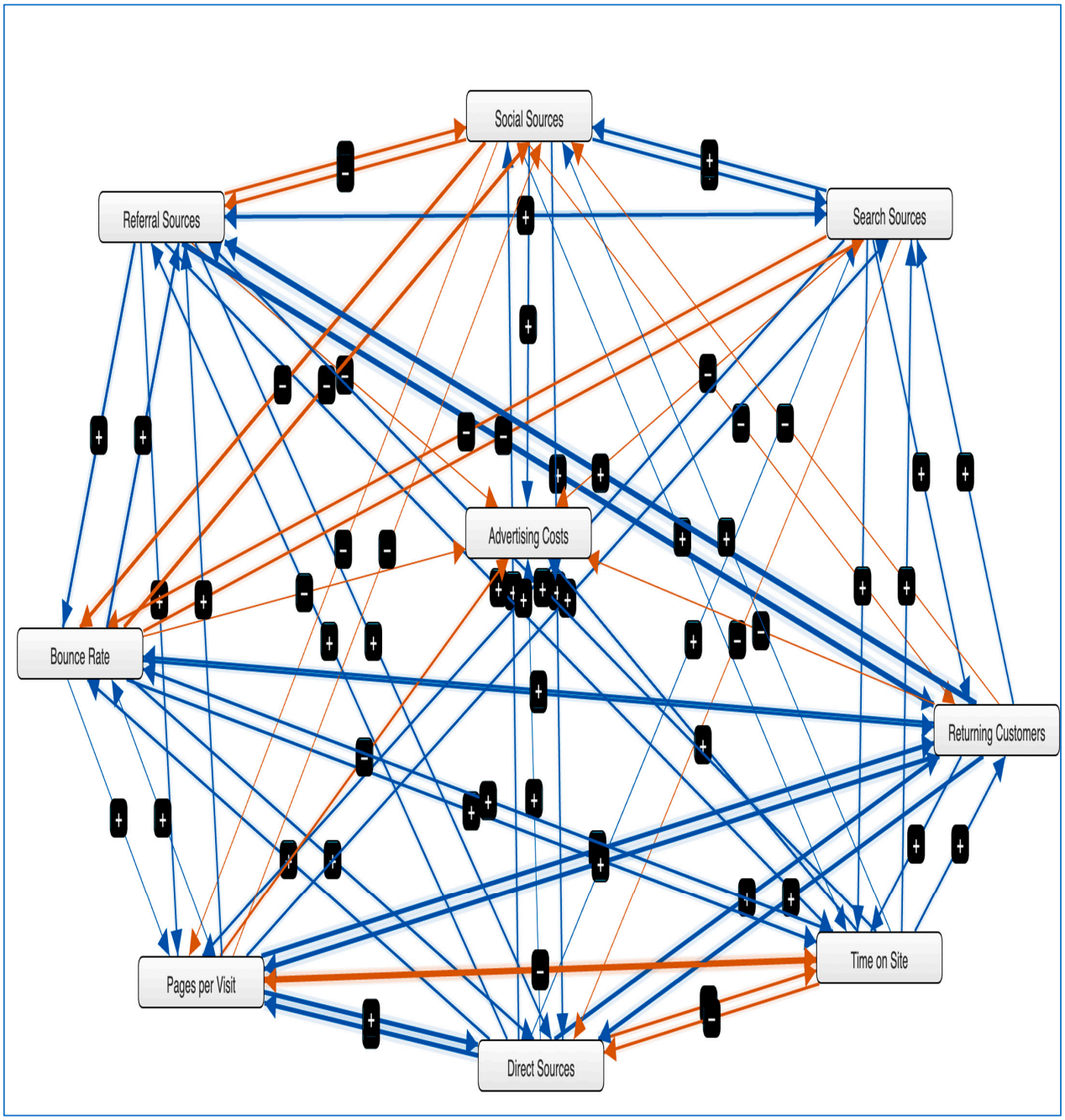


Figure 1. Fuzzy cognitive mapping model. Blue and red arrows signify positive and negative correlations between variables, respectively. The symbols "+" and "–" represent the positive and negative percentage changes, respectively.

3. Results

3.1. Statistical Analysis

After defining this study's sample and research design, the authors carried out the necessary statistical analysis to extract the relevant coefficients from the relationships between the variables. Initially, Table 3 displays the fundamental descriptive statistics of the independent and dependent variables. In Table 4, the correlations of this study's variables are presented. To support the creation of the advertising costs variable (consisting of organic and paid traffic costs), KMO and Cronbach's alpha values were higher than 0.7 [63,64], meaning that the variable is proper for statistical analysis and is cohesive (Table 5).

Table 3. Descriptive statistics.

	Mean	Min	Max	Std. Deviation	Skewness	Kurtosis
Advertising Costs	246,125.66	147,070.00	426,498,00	89,226.31	1.170	0.716
Direct Sources	323,284.57	263,604.00	411,527.00	53,683.07	0.636	−0.663
Referral Sources	373,087.43	265,622.00	552,072.00	88,429.30	1.463	1.911
Social Sources	5985.14	2431.00	10,992.00	2996.30	0.730	−0.193
Search Sources	147,035.29	96,976.00	193,138.00	32,360.16	−0.173	−0.514
Bounce Rate	0.53	0.49	0.57	0.03	0.143	−1.717
Pages per Visit	2.75	2.62	2.85	0.09	−0.246	−1.957
Time on Site	500.14	370.00	691.00	114.01	0.764	−0.253
New Customers	285,612.00	248,488.00	338,317.00	36,169.57	0.613	−1.458
Returning Customers	849,392.71	698,598.00	106,4952.00	130,208.89	0.534	−0.360

Table 4. Correlation analysis.

	Advertising Costs	Direct Sources	Referral Sources	Social Sources	[Search Sources	Bounce Rate	Pages per Visit	Time on Site	New Customers	Old Customers
Advertising Costs	1	0.097	−0.049	0.368	−0.130	−0.149	−0.313	0.328	0.250	−0.017
Direct Sources	0.097	1	0.430	0.223	−0.126	0.292	0.753	−0.225	0.699	0.678
Referral Sources	−0.049	0.430	1	−0.433	0.290	0.615	0.379	0.376	0.758 *	0.919 **
Social Sources	0.368	0.223	−0.433	1	0.255	−0.618	−0.017	0.027	0.239	−0.116
Search Sources	−0.130	−0.126	0.290	0.255	1	−0.487	0.208	0.213	0.364	0.399
Bounce Rate	−0.149	0.292	0.615	−0.618	−0.487	1	0.003	0.223	0.310	0.403
Pages per Visit	−0.313	0.753 *	0.379	−0.017	0.208	0.003	1	−0.565	0.409	0.619
Time on Site	0.328	−0.225	0.376	0.027	0.213	0.223	−0.565	1	0.357	0.216
New Customers	0.250	0.699	0.758 *	0.239	0.364	0.310	0.409	0.357	1	0.899 **
Returning Customers	−0.017	0.678	0.919 **	−0.116	0.399	0.403	0.619	0.216	0.899 **	1

*, ** indicate statistical significance at the 95% and 99% levels, respectively.

Table 5. Consistency of the advertising costs variable.

	Cronbach's Alpha	Kaiser–Meyer–Olkin Factor Adequacy
Advertising Costs (Organic and Paid Traffic Costs)	0.781	0.796

The simple linear regression (SLR) models that were developed aimed to highlight the statistical significance of the study variables' relationships (Table 6). As a dependent variable, the advertising costs of the sample's agri-food firms were selected, and the web analytics of social and search sources, bounce rate, returning customers, pages per visit, and time on site were selected. So, for the first SLR model of advertising costs with the independent variables of social and search sources, the model's variables were overall verified, with p-values < a = 0.05 level of significance and R^2 = 0.689. When social and search sources increase by 1%, agri-food firms' advertising costs variate by 28.8%, and −17.7%, respectively.

Table 6. Impact of social and search sources traffic on agri-food firms' advertising costs.

Variables	Standardized Coefficient	R^2	F	*p*-Value	D-W stat
Social Sources	0.288	0.689	1.983	0.035 *	1.060
Search Sources	−0.177			0.041 *	

* indicates statistical significance at the 95% level.

The examination of agri-food firms' website bounce rate and returning customers on their advertising costs is shown in Table 7. There, the verification of the linear regression model can be discerned, with *p*-values < a = 0.05 level of significance and R^2 = 0.708. For every 1% increase in the bounce rate and returning customers, agri-food firms' advertising costs vary by −255.4% and −376.7%, respectively. As for the linear regression model of the advertising costs with independent variables of the pages per visit and time on site, it is also verified overall, with *p*-values < a = 0.05 level of significance and R^2 = 0.632 (Table 8). By each 1% increase of pages per visit and time on site, agri-food advertising costs variate by −284.8% and −109.7%, respectively.

Table 7. Impact of website bounce rate and returning customers to agri-food firms' advertising costs.

Variables	Standardized Coefficient	R^2	F	*p*-Value	D-W stat
Bounce Rate	−2.554	0.708	2.086	0.049 *	1.128
Returning Customers	−3.767			0.021 *	0.994

* indicates statistical significance at the 95% level.

Table 8. Impact of pages per visit and time on site to agri-food firms' advertising costs.

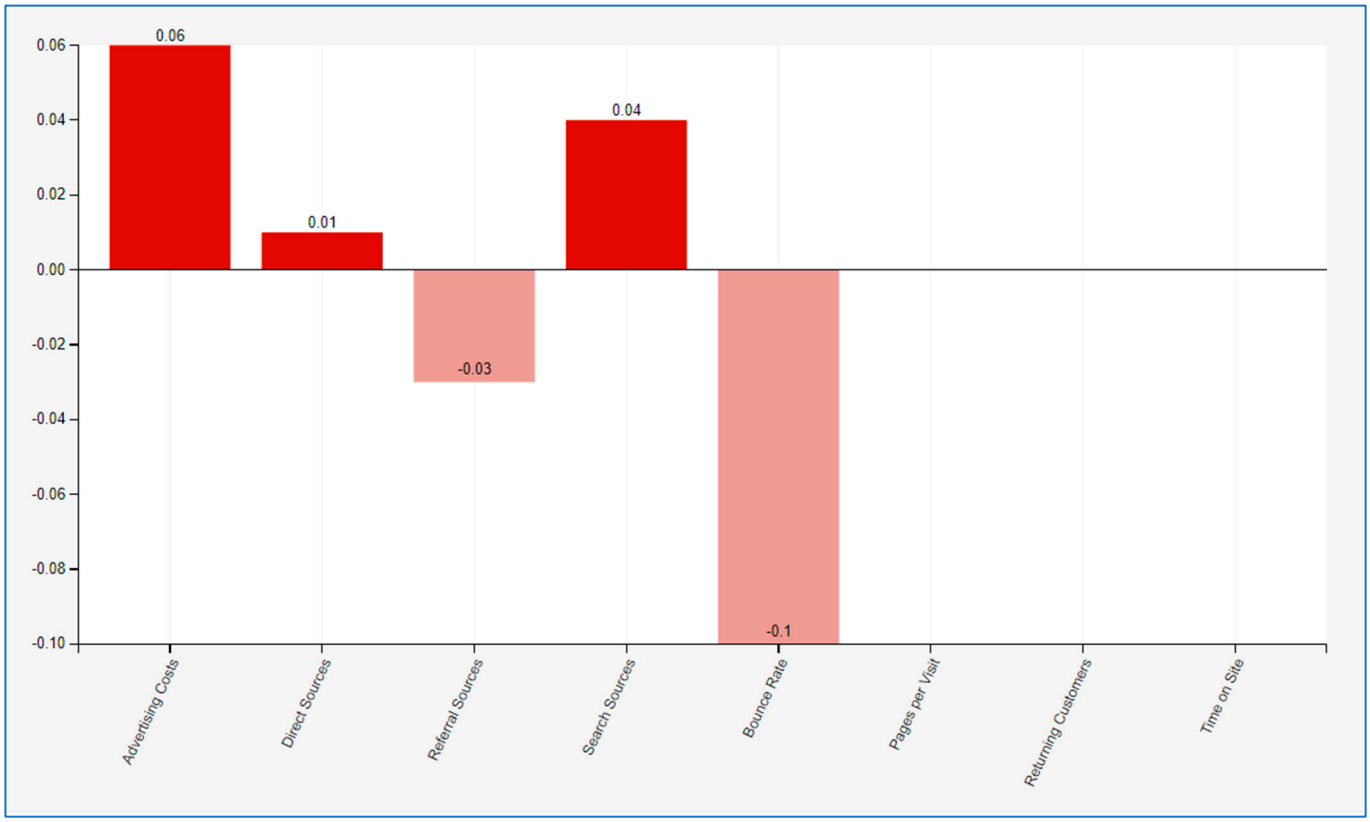
Variables	Standardized Coefficient	R^2	F	*p*-Value	D-W stat
Pages per Visit	−2.848	0.632	1.791	0.025 *	1.262
Time on Site	−1.097			0.047 *	0.989

* indicates statistical significance at the 95% level.

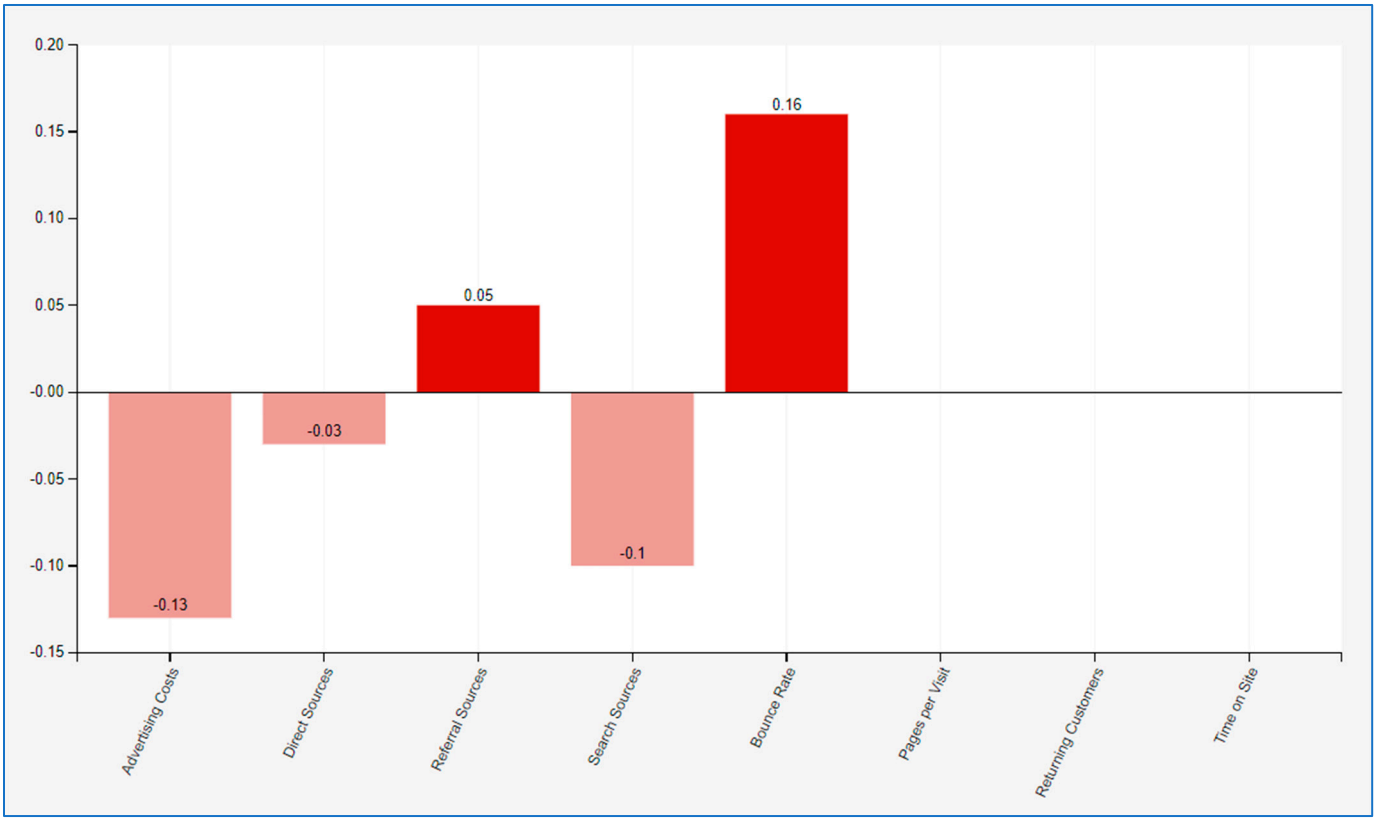
3.2. Fuzzy Cognitive Modeling Scenarios

Fuzzy Cognitive Modeling (FCM) significantly enhances the examination of digital marketing performance in the agri-food sector by handling the complexity and uncertainty inherent in this field. FCM models the intricate interdependencies between various factors such as market trends, consumer behavior, and supply chain logistics, providing dynamic scenario analysis and robust decision support [65]. By integrating both qualitative insights and quantitative data, FCM offers a comprehensive and holistic view of marketing performance [66], identifying key performance indicators and facilitating continuous improvement. Its visual and adaptable nature allows stakeholders to intuitively understand complex interactions and optimize digital marketing strategies effectively, ensuring better resource allocation and strategic planning in a rapidly changing market environment. Regarding the wider food sector, Sarkar et al. [67] utilized a FCM simulation model to analyze the feasibility of food storage, while Emir & Ekici [68] showed that through FCM models, the right polices can be adopted to reduce food waste.

Afterward, a simulation is run, focusing on social and search sources, involving the following five scenarios. The variable "social sources" is increased by 100% in the first scenario. In the second case, there is a 100% decrease in social sources. The third scenario saw a 100% increase in the search sources variable, while the fourth scenario saw a 100% decrease in search sources. In the final scenario, both variables undergo a combination of changes, resulting in a 100% decrease in the social sources and a 100% increase in the search sources variable. The rest of the variables do not change during the process. Figure 2a–e represent the impact of the selected variations of social and search traffic sources to various digital marketing KPIs of agri-food firms.

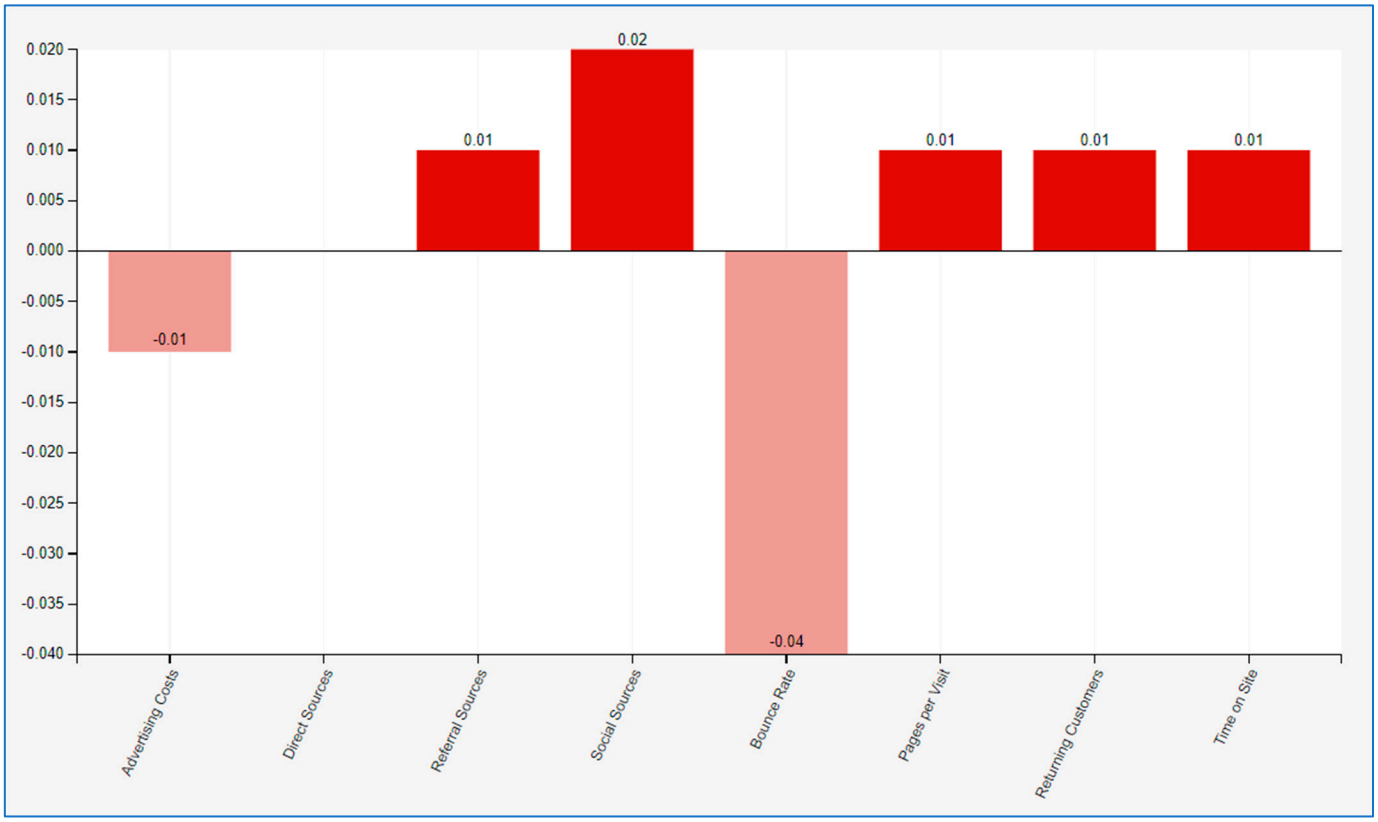


(**a**)

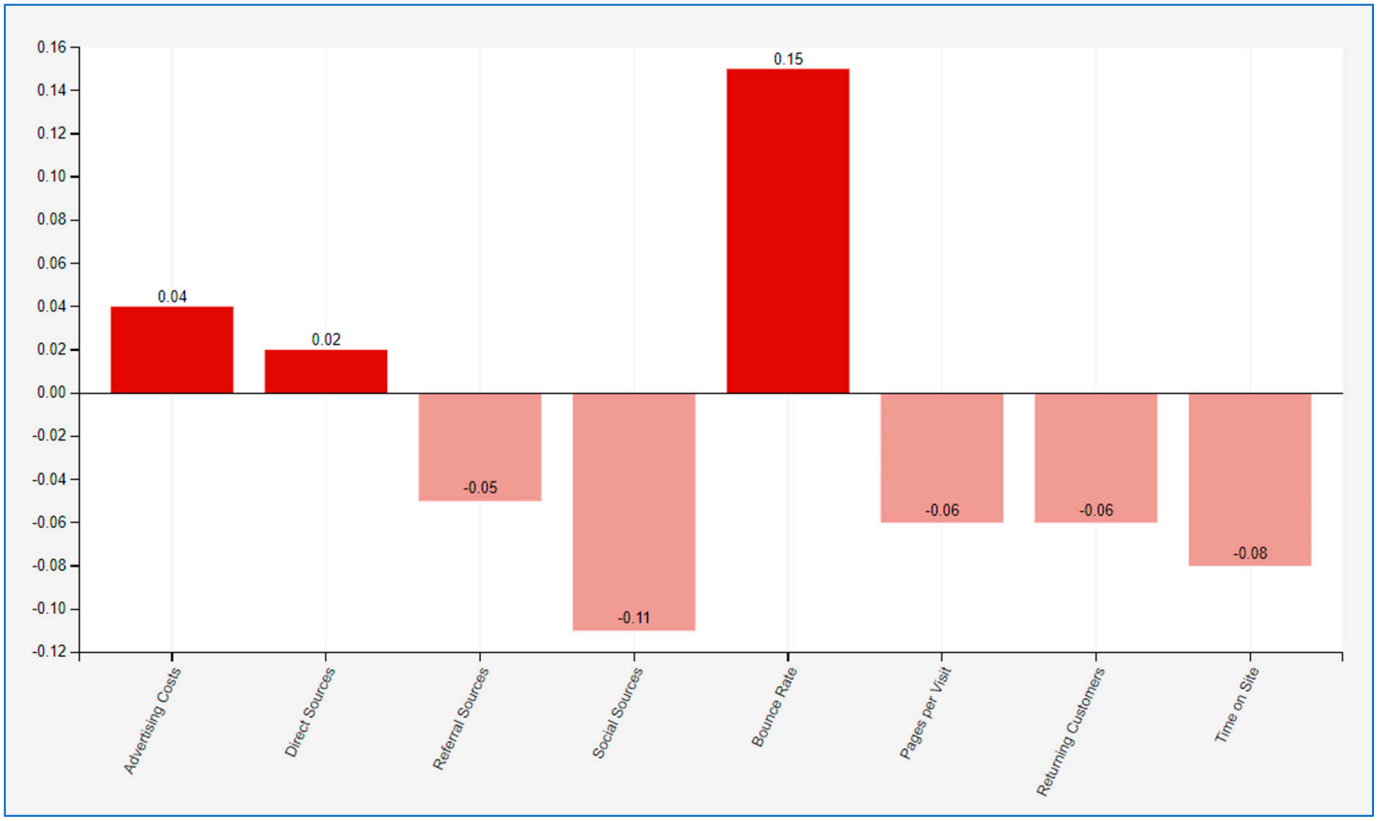


(**b**)

Figure 2. *Cont.*

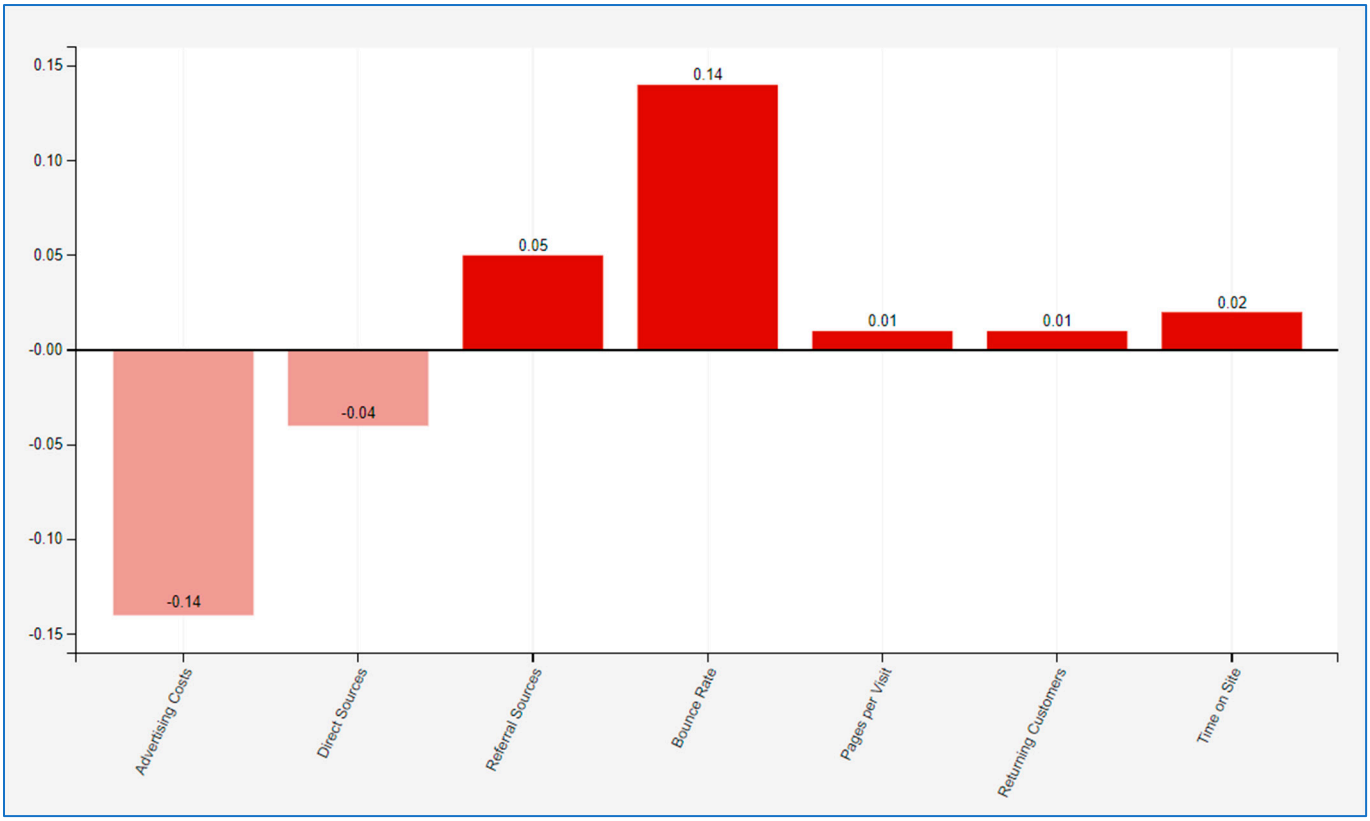


(**c**)



(**d**)

Figure 2. *Cont*.



(**e**)

Figure 2. (**a**) Impact of the increase in the social sources variable by 100%. (**b**) Impact of the decrease in the social sources variable by 100%. (**c**) Impact of the increase in the search sources variable by 100%. (**d**) Impact of the decrease in the search sources variable by 100%. (**e**) Impact of the increase in the search sources variable by 100% and the reduction in the social sources variable by 100%.

3.2.1. First Scenario: Increase the Social Sources Variable by 100%

In the first scenario (Figure 2a), the social resources variable increases steadily by 100%, resulting in the bounce rate variable decreasing by 10% and the referral sources variable decreasing by 3%. Also, the search sources variable increases by 4%, and the direct sources variable increases by 1%, increasing the promotion cost variable by 6%.

3.2.2. Second Scenario: Decrease the Social Sources Variable by 100%

Then, in the second scenario (Figure 2b), the social sources variable is reduced by 100%. The result is that the search sources variable is reduced by 10% and the direct sources variable is reduced by 3%. While the referral sources variable increases by 5%, the bounce rate variable increases spectacularly by 16%. The result of all these changes is that there is a significant reduction in the promotion cost variable by 13%.

3.2.3. Third Scenario: Increase the Search Sources Variable by 100%

Afterwards, the third scenario (Figure 2c) of the simulation is carried out, in which the search sources variable increases by 100%. The result is that the variables referral sources, pages per visit, returning customers, and time on site increase by one percent, respectively, while the social sources variable increases by 2%. Also, the bounce rate variable decreases by 4%, with the result that all these changes lead to a minimum reduction in the advertising cost variable by 1%.

3.2.4. Fourth Scenario: Decrease the Search Sources Variable by 100%

Then, the fourth scenario is run (Figure 2d), which decrements the search sources variable by 100%. It is observed that the referral sources variable decreases by 5%, the social sources variable decreases by 11%, the variables pages per visit and returning customers decreases by 6%, and the time on site variable was reduced by 8%. The bounce rate variable is increases by 15%, and the direct sources variable increases by 2%. The result is that there is an increase in the advertising cost variable by 4%.

3.2.5. Fifth Scenario: Increase the Search Sources Variable by 100% and Decrease the Social Sources Variable by 100%

Finally, the 5th scenario (Figure 2e) is carried out where a simultaneous change in the social sources variable is attempted, a decrease of 100%, and the search sources variable increases by 100%. In this case, it is observed that the referral sources variable increases by 5%, and the bounce rate variable increases by 14%. The pages per visit variable increases by 1% as well as the returning customers variable, and the time on site variable increases by 2%, while the direct sources variable decreases by 4%. The result is that there is a significant reduction in the advertising cost variable by 14%. This reduction in the advertising cost variable is the maximum observed in all scenarios.

4. Discussion

The analysis reveals diverse distribution patterns across the variables (Table 3). Skewness, indicating the asymmetry of the distribution, unveils interesting insights. Variables such as advertising costs, direct sources, referral sources, social sources, new customers, bounce rate, and returning customers exhibit positive skewness, implying a concentration of values towards the higher end. This suggests that certain agri-food firms allocate significantly higher resources to advertising activities, customer acquisition, and engagement. Conversely, pages per visit and search sources display negative skewness, suggesting a preponderance of lower values, possibly indicating areas of improvement or optimization. Furthermore, kurtosis, which characterizes the shape of the distribution, provides additional context. Leptokurtic distributions, observed in advertising costs, referral sources, new customers, and returning customers, suggest peaked distributions with heavier tails, reflecting concentrated expenditure and engagement levels. In contrast, platykurtic distributions, as seen in social sources, search sources, bounce rate, pages per visit, and time on site, indicate flatter distributions with lighter tails, illustrating greater variability in these metrics across agri-food firms. These findings underscore the importance of considering both skewness and kurtosis in understanding the distributional characteristics and potential implications for advertising strategies within the agri-food industry.

The correlation analysis of advertising costs (see Table 3) reveals its relationship with various variables. It is known that although paid ads do not directly affect organic website search results, they indirectly impact other metrics that tend to cause a significant effect on SERP and SEO results [69]. We observe a positive correlation with social sources, direct sources, time on site, and new customers, while it exhibits a negative correlation with referral sources, search sources, bounce rate, returning customers, and pages per visit.

The positive correlation with social sources suggests that allocating more resources to social media for promotion, results in higher overall advertising costs. The positive correlation with new customers implies that acquiring new customers positively relates to overall advertising costs. Moreover, the negative relationship between the number of returning website customers and advertising costs suggests that retaining and reacquiring customers may require less investment in promotion and advertising. Conversely, attracting new customers is positively correlated with higher advertising expenditures. Therefore, agri-food firms should carefully balance their strategies to attract new customers while nurturing existing relationships to maximize the effectiveness of their advertising expenditures. The research by Michel et al. [70] has a conclusion similar to previous findings; in an agro-industrial company, it seems that digital marketing has a moderately significant

relationship with social media marketing and content marketing and a high and significant relationship with customer acquisition.

The negative correlation with search sources suggests that increasing expenditure on search advertising is linked to a decrease in total advertising costs. Enhancing search engine presence is a critical component of digital marketing for agri-food enterprises. By employing SEO strategies, like keyword optimization, businesses can boost their website's visibility and draw organic traffic from potential customers. Improving the overall website experience is vital for retaining visitors and motivating them to explore the offerings further. This involves ensuring easy navigation, providing informative content, fast loading times, and a seamless user interface. Bhatnagar et al. [71] highlight that poor navigation impacts website design by prolonging visits and decreasing the likelihood of a purchase. The negative correlation with bounce rate implies that lower bounce rates are associated with higher total advertising expenses. Furthermore, a rise in website abandonment rate is linked to additional decreases in advertising expenses. Effectively managing and optimizing website engagement to reduce abandonment rate can therefore lead to even greater savings in advertising costs. The negative correlation with pages per visit indicates that an increase in the average number of pages per visit is linked to a decrease in total advertising costs. This highlights the significance of delivering an engaging user experience on the website to boost user interaction and potentially reduce advertising expenditures. Afterward, an examination of the hypotheses, formulated in Section 2.4, is carried out and the results are interpreted.

Based on the standardized coefficients and the *p*-value provided for the variables social sources and search sources (see Table 4), it appears that both variables have a significant impact on advertising costs. Therefore, the results support Hypothesis H1. Specifically, an increase in the social sources variable is associated with an increase in total advertising costs, and an increase in the search sources variable is associated with a decrease in total advertising costs. The model explains approximately 68,9% of the variability in advertising costs, social sources, and the variability in advertising costs, search sources. Note that the *p*-value is statistically significant at the 0.05 level, suggesting that the relationship is likely real and not random. The Durbin–Watson statistic indicates that there is no correlation among the residual deviations, indicating no autocorrelation in the model.

There is a negative correlation between advertising costs and search sources, suggesting that allocating more resources to search engine optimization (SEO) and related strategies may result in lower overall advertising expenses. Conversely, there is a positive correlation with social sources, indicating that increasing investment in social media for promotion typically leads to higher advertising costs. This underscores the importance of balancing SEO efforts, such as keyword optimization and content enhancement, to improve organic visibility without significantly increasing advertising expenditures. Effective SEO can drive organic traffic and reduce reliance on paid advertising channels. On the other hand, enhancing social media presence often involves expenses associated with content creation, paid promotions, and community engagement efforts. Agri-food enterprises should strategically manage both SEO and social media investments to optimize their digital marketing efforts while controlling advertising costs effectively.

The standardized coefficient for bounce rate is −2.554, and the *p*-value associated with this coefficient is 0.049 (see Table 5). This indicates that there is a statistically significant relationship between advertising costs and the abandonment rate of websites. The negative standardized coefficient suggests that an increase in the abandonment rate of websites is associated with a further decrease in advertising costs. Additionally, the model explains approximately 70.8% of the variability in advertising costs. Therefore, based on the provided data, we can support Hypothesis H2, indicating that there is indeed a relationship between the advertising costs of agri-food firms and the abandonment rate of their websites.

The negative standardized coefficient and significant *p*-value indicate a strong relationship where higher abandonment rates on websites are associated with lower advertising costs for agri-food firms, highlighting the critical role of website engagement in marketing

strategies. Higher abandonment rates typically signal that visitors do not find the website engaging or relevant. This underscores the importance for agri-food firms to focus on improving website usability, content relevance, or targeting strategies to decrease bounce rates and potentially enhance advertising effectiveness.

The negative standardized coefficients for both pages per visit and time on site (see Table 6) indicate that an increase in these variables is associated with a decrease in advertising costs. The model explains approximately 63.2% of the variability in advertising costs for pages per visit and for time on site. Both *p*-values are statistically significant at the 0.05 level, indicating that the relationships are likely real and not due to chance. The Durbin–Watson statistics for both variables are close to the ideal value of 2, suggesting no significant autocorrelation in the model residuals. Overall, based on these results, we can conclude that there is a significant relationship between the advertising costs of agri-food firms and both the pages per visit and time spent on site by customers on their websites, supporting Hypothesis H3. The negative standardized coefficients for both pages per visit and time on site indicate that an increase in these variables is associated with a decrease in advertising costs. This suggests that as users engage more deeply with the website (viewing more pages and spending more time), the costs associated with advertising decrease. This could be due to more effective targeting or better quality of user engagement leading to lower necessary advertising expenditure.

According to Table 5, the negative standardized coefficient for returning customers suggests that an increase in the number of returning website customers is associated with a decrease in advertising costs. The model explains approximately 70.8% of the variability in advertising costs. The *p*-value is statistically significant at the 0.05 level, indicating that the relationship is likely real and not due to chance. The Durbin–Watson statistic is close to the ideal value of two, suggesting no significant autocorrelation in the model residuals. Therefore, based on these results, we can conclude that there is indeed a significant relationship between the advertising costs of agri-food firms and the number of their returning website customers, supporting Hypothesis H4.

The negative standardized coefficient and significant *p*-value highlight a robust relationship where a higher proportion of returning customers is associated with lower advertising costs for agri-food firms. This underscores the strategic importance of customer loyalty and retention efforts in optimizing marketing expenditures and maximizing overall profitability in the agri-food sector. Additionally, the highest R^2 value (approximately 70.8%) suggests that returning customers and bounce rate are significant factors influencing advertising costs in these firms. This robust correlation emphasizes the need for strategies that enhance the user experience on the website and improve the overall efficiency of advertising efforts in the agri-food sector.

This article, after examining the relationship between digital marketing metrics and advertising costs, aims to propose a digital marketing strategy. The strategy is intended to result in a reduction in advertising costs. The two variables that were the focus of the simulation are search sources and social sources. The selected pair of variables are crucial components in formulating a comprehensive digital marketing strategy aimed at reducing advertising costs. The statistical significance of the ANOVA analysis being 0.048, indicates that there is a low probability of obtaining these results by chance alone. This suggests that the relationship between the variables (social sources and search sources) as a whole model is statistically significant. In practical terms, this means that the inclusion of these variables in the analysis has a meaningful impact on understanding and predicting outcomes related to digital marketing strategies.

Thus, five possible scenarios emerged, which are shown in Figure 2. These scenarios were chosen strategically to highlight the potential for significant cost reductions, aligning with this study's policy recommendation. Specifically, this study proposes that agri-food businesses should allocate their resources toward search sources rather than social sources to minimize promotional costs. This strategic direction underscores this research's aim

to optimize digital marketing investments for sustainability and profitability in the agri-food sector.

In the first scenario, which is reflected in Figure 2a, an increase of 100% in the social sources variable is carried out, and then, there is an increase in the advertising cost variable by 6%. Then, the second scenario is carried out, which is depicted in Figure 2b. In this case, a reduction in the social sources variable by 100% is carried out. This results in a reduction in the advertising cost variable by 13%. The third scenario is depicted in Figure 2c and concerns the increase in the search source variable to 100%. A slight reduction in advertising costs by 1% is observed. Afterward, in the fourth scenario depicted in Figure 2d, a reduction in the search sources variable is attempted by 100%, which results in an increase in the advertising cost variable by four percent. Ultimately, the fifth scenario is executed, entailing a simultaneous modification of both variables. Consequently, an endeavor is undertaken to augment the search sources variable by 100% and diminish the social sources variable by 100%. It is observed that the concurrent modification of the two upper variables results in a noteworthy decrease of 14% in the advertising cost variable, as depicted in Figure 2e.

The scenarios are designed to demonstrate a marketing strategy that achieves a reduction in advertising costs. After each variable has been examined separately, they are then compared simultaneously. The simulation shows that the fifth scenario offers the best digital marketing strategy for the reduction in advertising costs. The distribution of resources into social media marketing frequently results in cost escalation, as illustrated by the initial simulation scenario. This outcome arises from multiple factors. Firstly, heightened competition within social media platforms drives up advertising expenditures, as businesses compete for visibility and engagement. Secondly, the dynamic nature of social media necessitates ongoing monitoring, analysis, and adjustment of marketing strategies, demanding additional human and financial resources. Platforms such as Facebook prioritize establishing personal connections with users to cultivate customer loyalty [72], intensifying the need for enhanced resource allocation to maintain these relationships. While social media enhances web traffic, it does not necessarily lead to significant increases in product orders and sales revenue [47]. Additionally, targeting specific audience segments on social media platforms often demands investment in advanced tools and technologies, which further drives up costs. Therefore, careful resource allocation is essential in social media marketing to mitigate the risk of excessive spending and ensure efficient use of resources across different marketing channels. This caution is warranted because managerial actions may not always yield the desired effects. For instance, in the fourth scenario analyzed, reducing investment in search sources ultimately resulted in higher advertising costs.

Before utilizing social media for business purposes, it is crucial to develop strategies tailored to the product and target audience. According to Kilgour et al. [73], effective social media marketing requires aligning messages with target audiences and achieving robust customer engagement. This principle holds particular relevance in the agri-food sector, where the target audience may not be highly active on social media platforms. Given the demographic characteristics of agri-food consumers and the diverse nature of agri-food products, conveying specialized knowledge and tailored messaging through social media can be challenging. Therefore, allocating resources to social media marketing for agri-food products without careful consideration of the target audience's online behavior and preferences may lead to inefficient resource allocation and suboptimal results. The simulation indicates that the most effective strategy for reducing advertising costs involves reducing social sources of advertising while increasing investment in search engine marketing. This is the business operation proposal that our research suggests.

This perspective contrasts with that of Inegbedion et al. [74], who argue that leveraging social media platforms like Instagram and WhatsApp significantly reduces costs and enhances marketing efficiency, thereby increasing turnover in agricultural products in South-South Nigeria. As our research revealed, the use of social media should not be preferred as a means of digital marketing; however, it is an excellent tool for communication. Madonna et al. [75] highlight that platforms such as Facebook, WhatsApp,

and Instagram can facilitate community participation in agriculture by promoting social interaction, discussions, and consultation, ultimately enhancing product promotion and marketing through e-commerce to achieve sustainable development goals. Thus, while social media offers valuable opportunities for engagement and community building in agriculture, its role in direct digital marketing strategies should be carefully evaluated based on specific industry dynamics and audience preferences.

The agriculture and agri-food sectors are increasingly emphasizing sustainability and transparency in supply chains, driven by rapid industrialization, growing global food demand, and heightened concerns about food quality and safety. According to Mangla et al. [76], research identifies ten factors that influence sustainable development in the agri-food sector. Two of these factors, which are also pertinent to this study, include understanding customer behavior and effectively managing costs. These factors underscore the importance for companies and the food sector as a whole to comprehend customer behavior thoroughly. This understanding enables the strategic allocation of financial resources towards initiatives that reduce operational costs and ultimately minimize inefficient resource utilization, thereby promoting sustainable development.

As concluded by Hidayati et al. [23], value-chain governance that integrates sustainability drivers provides a holistic approach to balancing social and environmental impacts with profit maximization. This approach opens up higher-value markets for smallholders in developing nations within the agri-food sector. Businesses in this sector can derive substantial benefits from implementing digital marketing strategies that cater to the distinct behaviors of digital consumers. These strategies enable them to reduce operational costs, optimize resource utilization, and customize their offerings, thereby facilitating the sale of products at higher prices.

5. Conclusions

The scope of this article is to explore the paradoxical phenomenon, wherein agri-food businesses sell their products at high prices and show profitability despite production costs. Specifically, it aims to examine how specific digital marketing measurement variables relate to advertising costs. Also, our research tries to propose a digital marketing strategy, capable of reducing advertising costs, thereby increasing profitability and contributing to efficient resource utilization and sustainable development. This research used the linear regression method to extract statistically significant results as well as the correlation between digital marketing metrics and advertising costs. After studying the digital marketing metrics, this research focuses on the variable search sources and social sources to submit a digital marketing strategy proposal. Afterwards, a simulation is carried out using the FCM model, and five possible scenarios are analyzed. The conclusions of our research are as follows:

- Advertising costs of agribusinesses are positively and statistically significantly related to social traffic sources.
- Advertising costs of agribusinesses are negatively and statistically significantly related to search traffic sources, bounce rate, the number of returning website customers, pages per visit, and time on site customers spend on their websites.
- Optimal Resource Allocation: Agri-food businesses can achieve cost efficiencies by prioritizing investments in search sources over social sources in their digital marketing strategies.
- Impact on Sustainability: Effective digital marketing strategies not only enhance profitability but also contribute to sustainable practices by reducing advertising costs and resource wastage.
- Strategic Recommendation: This study suggests that agribusinesses should focus on targeted digital marketing efforts tailored to search engine optimization (SEO) rather than social media platforms.

As the global population increases, it is crucial to develop strategies that enhance food production, minimize resource consumption, and reduce environmental impact, addressing the significant issue of food loss and waste throughout the value chains [77]. Since 1987,

when the definition of sustainable development was given by the Brundtland Report as the development that satisfies current needs without jeopardizing the capacity of future generations to fulfill their own needs [78], the central question remains the same: what can governments, businesses, and consumers do to promote sustainable development? As technology evolves and new methods of production and marketing appear, such as digital marketing, this must be the basic question that is asked. The intertwining effects of climate change and human activities on ecosystems, biodiversity, and the availability of natural resources pose significant obstacles to achieving sustainable agriculture [79]. These factors are outside the sphere of influence of agri-food companies; at least, agri-food companies should try to direct the resources that are for digital marketing to effective uses, as shown by our research: the use of search sources rather than social media, so that they will not waste resources and thus contribute to sustainable development. Businesses can achieve profitability, despite high costs and prices, by allocating resources to the appropriate digital advertising channels in an efficient manner.

This study's limitations include the focus on the five largest agri-food companies based on 2023 market capitalization, potentially limiting the generalizability of findings to smaller firms or different geographic regions. The observation period of 180 days from 1 July 2023 to 31 January 2024 might not capture long-term trends or seasonal variations adequately. Furthermore, reliance on the Semrush [50] decision support system (DSS) for web analytics data collection introduces potential biases or inaccuracies, impacting the reliability of this study's conclusions. Future research could benefit from expanding the sample to include medium-sized and small enterprises, exploring diverse geographic areas, and conducting longitudinal studies to better understand the sustained effects of digital marketing strategies on profitability in the agri-food sector.

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