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The Impact of Sustainable Food Supply Chain on Food Security: Case Study of Jordanian Food Companies

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ABSTRACT

The purpose of this case study is to examine food companies in Jordan and understand the implications of sustainable practices on a consistent and secure food supply. The goal is to understand the impacts of sustainability practices on food supply, accessibility, and nutrition. This study utilized a quantitative research method to analyze sustainable food supply chain practices and food security in Jordanian food companies (estimated 5,000 employees). A sample of 360 participants was surveyed across production, distribution, and retail sectors. Regression results showed that social sustainability had the most substantial standardized effect on food security (β=0.41, P<0.001), followed by environmental (β=0.32, P<0.001) and economic sustainability (β=0.16, P=0.009). The model explained 47.5% of the variance in food security (R^2=0.48), indicating a strong predictive relationship. This research contributes novel Jordan-specific evidence to the global debate on the sustainable food supply chain (SFSC), highlighting how social and environmental dimensions enhance food access and stability in resource-constrained settings. The findings offer practical guidance for policymakers and food companies by emphasizing regulatory frameworks, capacity-building, and local sourcing strategies that strengthen supply chain resilience.

Keywords: Sustainable Food Supply Chain, Food Security, Jordan, Supply Chain Resilience, Food Loss and Waste (FLW).

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INTRODUCTION

Sustainable food supply chains combine economic, social, and environmental goals, thereby enhancing the overall effectiveness of food production and distribution (Zhu et al., 2018). If management is good, they will reduce waste, keep resource usage at the lowest possible level, and ensure food safety and quality, thereby strengthening food security (Karki et al., 2021). The leading performance indicators consist of efficiency, waste reduction (Govindan, 2018) and transparency, which help build trust among stakeholders and confidence among consumers (Kraft et al., 2022). CSR, equity, and partnerships among farmers, companies, and governments make the system more effective (Sadiq et al., 2022). From a dynamic capability perspective, supply chains adapt to market and regulatory conditions while maintaining competitiveness and sound environmental practices. Besides, there is multi-stakeholder governance and technological innovations that support energy and water conservation, recycling and waste management, further reinforcing sustainability (Yang & Lien, 2018; Li et al., 2023).

These practices have an immediate impact on the four FAO dimensions of food security that are considered core: availability, access, utilization, and stability. Availability is the question of having sufficient food at hand, either from production, imports, or reserves; access is capturing the individuals' skill or power to get enough food; utilization is mainly the quality and safety of edible food and how the body uses it; and stability is making sure that these factors last for a long time and even during emergencies. The study, however, relates these dimensions to sustainability categories: environmental sustainability underpins availability and stability through efficient production and climate resilience; economic sustainability promotes access through affordability and market inclusion; and social sustainability continues to improve utilization through trust and fair distribution. Together, they form the study's hypotheses (H1.1–H1.3), which test whether environmental, economic, and social sustainability practices in food supply chains lead to improvements in overall food security.

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The phenomenon of sustainable food supply chains has undergone a global transformation from an initial focus on production efficiency to a more holistic approach that encompasses equity, resilience, and risk management. The climate is changing, resources are depleted, and market volatility has revealed episodes of globalization in food systems; thus, these systems have been completely forsaken in favor of localized, sustainable models. Jordan is one of the prime examples of the need for such a drastic change. It is one of the most water-scarce regions in the world, with less than 100m^3 per capita of renewable water annually, a drastic drop below the 500 m^3 level that defines absolute scarcity. Its agriculture sector consumes more than half of the country's total freshwater resources. Thus efficient irrigation and postharvest management are critical not only for sustainability but also for the country's food security. In addition, Jordan is heavily dependent on food imports, accounting for more than 85% of imports, mainly cereals, sugar, and dairy, so it is very vulnerable to the impact of external shocks. The war between Russia and Ukraine, for instance, led to a significant increase in the cost of grain imports, making dependence on global supply chains even riskier. The above-mentioned difficulties make it even more important to create more sustainable and preferably local supply chains, which would not only help to cope with the current situation but also to secure food accessibility in the future.

The agri-food sector in Jordan is also heavily affected by postharvest losses, estimated by the FAO and local studies at around 25–30% of the total volume of fruits and vegetables. The main factors behind these losses are poor cold storage, inadequate transport access, and unproductive processing and packaging operations. Apart from the loss of food, the environmental impact is even greater, as water and energy that would have been used to grow and process the crops go to waste. It is possible to achieve a significant reduction in these losses through the application of sustainable supply chain practices such as logistics management, waste valorization, and digital traceability. Jordan's environmental vulnerability to climate change requires adopting new production technologies, using drip-irrigation systems, and utilizing renewable energy sources in processing (Li et al., 2023). On the other hand, local sourcing and circular business models would enable the company to reduce its reliance on imports and ensure price stability. Furthermore, smallholder farmers, co-ops, and local communities involved in the sustainability practices are likely to enjoy a safer and more equitable access to the resources, hence, their social resilience will be strengthened.

Jordan's case in the context of global discussions on sustainable food supply chains (SFSCs) mirrors the difficulties in the MENA region and particularly in the Middle East where food security is strongly dependent on the prevailing climatic conditions and non-productive land (FAO, 2025). The UN SDGs (SDG 2, 12, and 13) and FAO's "Blue Transformation" program, which promote environmental management, food access, and social equity, are among the international frameworks that are region-specific (Said & Che Adenan, 2025). Jordan has furthered the cause through the National Strategy for Sustainable Agriculture (2020–2030) and the Green Growth Plan. However, progress is still hampered by lack of funds, poor governance, and limited involvement of the private sector. Thus, considering the situation of Jordanian food companies will provide us with a good understanding of how sustainability practices operate in resource-limited regions that are heavily reliant on imports.

Such actions in the area of sustainability will also affect the connections between the food security polarity. Environmental sustainability measures such as resource conservation, renewable energy, and emission reduction help both the availability aspect by stabilizing production and the stability aspect by reducing the impact of climate-related risks. Economic sustainability focuses on cost-efficient practices, local sourcing, and innovation which lead to access being thereby enhanced through import dependence being lowered and price being more stable. Social sustainability, based on fair labor, community participation, and equitable distribution, guarantees safe and nutritious food, thereby strengthening public trust. All three dimensions clearly demonstrate that the transition towards sustainability can transform the food supply chain in Jordan into a strong, self-sufficient system that not only supports but also expands national food security.

The reduction of food loss and waste not only improves quality but also increases market quantity, making it more efficient (De Boni et al., 2022). Sustainable agriculture and processing lead to higher nutrient content and safer products (Pawlak & Kołodziejczak, 2020) and economic sustainability gives small producers power. It opens the market to all (Quayson et al., 2021). Environmentally, the application of sustainable practices not only accelerates but also strengthens the recovery of soil and plants after a climate shock (Davis et al., 2021). The policy alignment and the shorter local supply chains eliminate dependencies and improve access (Jarzębowski et al., 2020; Munuhwa & Hove-Sibanda, 2024). Moreover, growing consumer awareness contributes to the adoption of sustainable practices and the reduction of emissions in the food system (Wahbeh et al., 2022; Wijerathna-Yapa & Pathirana, 2022).

The article explores the extent to which sustainable food supply chain (SFSC) strategies impact food security in terms of its four main pillars: availability, access, utilization, and stability, while showing that sustainability in the environmental, economic, and social areas is what makes resilient food systems possible. Adoption of ethical farming practices, responsible sourcing, logistics efficiency and waste reduction are some of the methods that can help alleviate food insecurity (Seyam et al., 2024).

A sustainable food supply chain encompasses every link of the food chain, from procurement to disposal, and seeks to reduce environmental impact, promote social justice, and ensure financial profitability (Aji, 2020). This perspective implies that resource shortages, global warming, and food waste cannot be divorced from food security (Govindan, 2018; Joshi et al., 2023). This approach contrasts with traditional strategies of food security, which are often highly focused on production or import capacity; sustainability views food security as equitable distribution for safety and nutrition, as part of food

security (Tibebu et al., 2024).

The food industry uses resources expeditiously as demand rises (Li et al., 2023). SFSCs address these constraints using integrated methods. Latino et al. (2021) point out that research is conducted separately regarding the environmental, economic, and social components; however, working models often require all three to be integrated to create a balanced model. De Boni et al. (2022) identified food loss and waste (FLW) as a significant problem, noting that nearly a third of food produced is wasted globally every year; they underscored the value of developing standardized measurements and the importance of collaboration.

According to Munuhwa and Hove-Sibanda (2024), the circular economy could be supported through various waste management strategies, carbon reduction, corporate social responsibility, and the justice of distribution, with attention given to communication and working with, e.g., Governments. Shabir et al. (2023) stated that supply chain efficiency and effectiveness are linked to a lower carbon footprint and safer food. These studies have all highlighted collaboration, sharing knowledge, and working with multiple stakeholders.

Environmental sustainability focuses on sustainable agriculture, emissions reduction, and green innovations (Singh et al., 2025). Resource consumption and practices affecting the processing stages of packing and distribution can be far more effective in reducing carbon footprints than improving the product itself; innovations use or produce similar energy and waste as previous designs (Li et al., 2023). Subsequently, social sustainability encompasses areas such as fair labor, integrity and trust, safe working conditions, community engagement, and the development of trust and resilient communities (Sadiq et al., 2022). Economic sustainability means providing long-term sustainability for suppliers and farmers, supporting competition, and delivering greater value through reduced dependence (Quayson et al., 2021).

Short food supply chains create resilience by promoting local producers and farmers (and decreasing reliance on imports) (Jarzębowski et al., 2020). Increased consumer worry means more firms will now develop sustainability-led plans, improving work environmental and social responsibility (Wahbeh et al., 2022; Wijerathna-Yapa & Pathirana, 2022).

This research starts from the idea that sustainability practices in the environmental, economic, and social areas of Jordanian food companies are closely linked to a steady, safe, and fair food supply. The study, by placing sustainability in the context of Jordan's climate-stressed and import-dependent food system, aims to produce valuable evidence for both management and policy. The results will be used to develop future actions for the governance of the food sector in terms of sustainability, and to teach other water-scarce, import-dependent economies how to build resilient food systems. In summation, there is evidence to suggest that SFSCs combat food insecurity by integrating environmental, economic and social dimensions, while ensuring stable access to safe and nutritious food and reducing vulnerability to climate and market shocks. However, success relies on governance, technology integration and policies (Yang & Lien, 2018; Gurzawska, 2020). These insights guide the present study's hypotheses:

H.1: Sustainable food supply chain on food security.

H1.1: Environmental sustainability within supply chains enhances food security.

H1.2: Economic sustainability within supply chains enhances food security.

H1.3: Social sustainability within supply chains enhances food security.

Data Analysis

Data analysis was performed using SPSS 28. The sample characteristics and study variables were described through descriptive statistics. Associations were measured by Pearson correlation, while regression analysis was used to test the predictive effects of sustainability practices on food security. Multicollinearity was examined using VIF and tolerance values, and normality was evaluated using skewness and kurtosis, with values in the range of -2 to +2 considered acceptable (Awang et al., 2015).

MATERIALS & METHODS

To analyze the influence of sustainable food supply chain practices on food security in Jordanian food companies, a quantitative survey design was utilized in this research. The total population consisted of around 5,000 workers from supply chain management, production, and quality control areas. These categories were determined to have close alignment with the enactment of sustainability practices. For this, a voluntary response sampling technique was used because obtaining complete company directories for proper random selection was difficult. Even though the idea was to get a simple random sample, the collection of responses was done through Google Forms electronically which were then passed through official company communication channels, industry associations and professional networks. Participant engagement was based on free will instead of recruitment through the strict probability method. The sample obtained (n=360) is around 7% of the estimated population, which is proper for regression-based inference (Sekaran & Bougie, 2013). After removing incomplete or duplicate submissions, the final response rate was around 72%. To qualify for inclusion, respondents had to be currently working in the food sector, be involved in supply chain-related activities, and have at least 1 year of work experience. Responses that did not fulfill these criteria or had more than 20% data loss were not included in the analysis. Despite steps taken to reduce coverage and non-response biases, it is recognized that the online data collection method might have been a disadvantage, as it favored digitally connected professionals and mid-level managers, which is considered a limitation.

Population and Sample

The employees who were engaged in direct supply chain operations were selected because they formed the

core of the implementation of sustainability practices. The sample size of 360 was selected to ensure statistical significance and reliable results. Using G*Power 3.1, power analysis indicated that 118 participants would be sufficient to detect a medium effect size (f^2=0.15) at α=0.05 and power=0.95 for a three-predictor model. Therefore, the achieved sample size exceeds the recommended limits, ensuring high statistical power.

Data Collection

Data collection was conducted electronically using a structured questionnaire shared via Google Forms, followed by reminders to enhance the response rate. The instrument assessed three independent variables (environmental, economic, and social sustainability) and one dependent variable (food security). All participants were informed of the study's purpose, confidentiality measures, and the conditions for voluntary participation before completing the study. Ethical clearance was granted by the university's Research Ethics Committee which was responsible for the study.

Study Instrument and Measurement Validity

The survey was based on previous validated studies and contained 23 items in total: 5 items were for environmental sustainability, 6 for economic sustainability, 5 for social sustainability and 7 for food security. The items were mainly derived from Zhu et al. (2018), Govindan (2018), Pawlak & Kołodziejczak (2020) and Sadiq et al. (2022), which were adapted to the theoretical and contextual relevance. The questionnaire was reviewed by three academic experts in agricultural economics and supply chain management to ensure content validity, who then confirmed the item clarity, representativeness, and cultural appropriateness for the Jordanian food sector.

Responses were rated on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Mean scores were classified as low (1.00–2.33), medium (2.34–3.67), or high (3.68–5.00), as in Subedi (2016).

The validity of the construct was tested using Exploratory Factor Analysis (EFA), conducted with principal component extraction and varimax rotation. The analysis revealed four factors having eigenvalues greater than one, which accounted for 72.4% of the total variance. The lowest factor loading was 0.60, indicating good convergence among the constructs.

Confirmatory Factor Analysis (CFA) verified the measurement model's fit: χ^2/df=2.31, CFI=0.951, TLI=0.938, RMSEA=0.054. The composite reliability (CR) values ranged from 0.84 to 0.93, and the Average Variance Extracted (AVE) values were all above 0.50 for all constructs, thereby confirming convergent validity (Hair et al., 2011). Discriminant validity was checked with the Heterotrait–Monotrait ratio (HTMT); the HTMT values for all pairs of constructs were less than 0.85, thus complying with the suggested limits (Henseler et al., 2014).

Reliability Analysis

To assess the reliability, Cronbach's alpha (α) was used, and it was decided that α values higher than 0.70 would be considered acceptable (Nunnally & Bernstein, 1994; Tavakol & Dennick, 2011). The scales were reported to have good to excellent reliability, with α values ranging from 0.855 to 0.931 (Table 1).

Table 1: Reliability analysis using Cronbach's alpha

Variables	Cronbach's Alpha	N of Items
Environmentally Sustainable Food Supply Chain	0.931	5
Economically Sustainable Food Supply Chain	0.901	6
Socially Sustainable Food Supply Chain	0.891	5
sustainable food supply chain	0.855	16
Food Security	0.868	7
All	0.911	23

Normality and Regression Assumptions

Checking the normality of all components related to the constructs being studied is crucial because it ensures the statistical analysis is valid. Awang et al. (2015) state that skewness and kurtosis values between -2 and +2 indicate acceptable univariate normality. In Table 5, all variables were within this range. Furthermore, the regression assumptions were checked: partial regression plots confirmed linearity, residual scatter plots demonstrated homoscedasticity and the Durbin-Watson statistic (1.94) was used to check for independence of errors, which indicated no error correlation. Mahalanobis distance was used to check for multivariate normality, and no significant outliers were found.

Multicollinearity Assessment

According to Hair et al. (2011), multicollinearity exists when the independent variables are strongly correlated. For this research, a correlation matrix, the variance inflation factor (VIF) and tolerance values were utilized in the analysis. The VIFs for the sustainability constructs were 2.69 for environmental, 4.231 for economic, and 3.294 for social. Although the economic aspect slightly exceeded the VIF threshold of 3, it remains below 5, which is generally accepted as the upper limit for multicollinearity considered tolerable (Tabachnick & Fidell, 2013). At the reviewers' request, we checked that centering variables and using standardized z-scores did not have a substantial effect on the regression results. Thus, the initial model was kept.

Hypotheses Testing and Model Fit

The relationships between sustainability aspects and food security were tested using multiple linear regression. The regression analysis results are reported as standardized regression coefficients (β), standard errors (SE), t-statistics, P-values, and 95% confidence intervals. The model yielded a strong explanatory power, R=0.689, R^2=0.475, and adjusted R^2=0.469, indicating that sustainable practices accounted for about 47.5% of the variance in food security among food companies in Jordan. These figures are consistent with previous SFSC studies in developing countries (Joshi et al., 2023; Munuhwa & Hove-Sibanda, 2024). Effects were estimated again and this time using partial correlations (R=0.42-0.59, P<0.001), which are understood to be medium-to-large effects as per Cohen's guidelines. Sensitivity analyses conducted with alternative model specifications (for example, composite sustainability index versus separate constructs) produced significance levels that were consistent, thus strengthening the

conclusion's robustness.

RESULTS

The SPSS 28 software was used to analyze the data. The outcomes are shown concerning demographic traits, descriptive statistics, normality and multicollinearity checks, and hypothesis testing.

Demographic Characteristics of Respondents

The final sample (N=360) comprised 73.3% male and 26.7% female participants. Most of them were aged below 35 years (84.4%) and had postgraduate degrees (82.0%). The majority were professionals with 5–10 years of experience (77.8%) and mainly worked in retail sectors (47.2%) as shown in Table 2. Although this profile pertains to Jordan's food industry, it may also indicate an overrepresentation of the educated class among the respondents, which is acknowledged as a limitation.

Table 2: Descriptive statistics of respondents' demographic data

	Category	Frequency	Percent
Gender	Female	96	26.7
	Male	264	73.3
Age	Under 25	126	35
	25–34	178	49.4
	35–44	45	12.5
	45 and above	11	3.1
Educational Level	Bachelor's	65	18.1
	Master's	74	20.6
	PhD	221	61.4
Years of Experience	Less than 5 years	29	8.1
	5–10 years	280	77.8
	More than 10 years	51	14.2
Type of Company	Production	80	22.2
	Distribution	110	30.6
	Retail	170	47.2
	Total	360	100

The Descriptive Statistics for the study variables

Descriptive statistics report the mean (M) and standard deviation (SD) for each variable. The participants evaluated all items using a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Results for Environmental Sustainability (E), Economic Sustainability (Ec), and Social Sustainability (S) are provided in Table 3. Table 4 summarizes Food Security (F).

The highest overall average score was for Environmental Sustainability (M=3.69, SD=0.69), followed by Economic Sustainability (M=3.51, SD=0.79) and Social Sustainability (M=3.50, SD=0.74). Furthermore, Food Security exhibited an equally moderate mean of (M=3.55, SD=0.70). Such results reflect an intermediate degree of implementation of sustainable practices and a similar perception of food security among the Jordanian food companies in the sample.

Normality and Regression Assumptions

All constructs achieved the thresholds for skewness and kurtosis (–2.00 to +2.00) which indicates that the data are moderately normally distributed. Regression assumptions were verified, linearity and homoscedasticity were evaluated using residual scatterplots, independence of errors was assessed using the Durbin-Watson statistic (1.94), and multivariate outliers were identified using the Mahalanobis distance. There were no violations of significant importance (Table 5).

Multicollinearity

The examination of multicollinearity was conducted utilizing tolerance and variance inflation factor (VIF) values. The strongest relationship among the variables was judged non-serious, since all VIFs were below 5. The only variable with a VIF slightly above the average, Economic Sustainability (VIF=4.23), was still considered to be within permissible limits. (Table 6).

Regression Analysis and Hypothesis Testing

The impact of the three sustainability dimensions (E, Ec, S) on Food Security (F) was analyzed using multiple linear regression. The overall regression model was significant, $F(3,356) = 33.23$, $P<0.001$, with $R=0.69$, $R^2=0.48$, and Adjusted $R^2=0.47$, which means that approximately 47.5% of the variation in Food Security was attributable to sustainability practices.

Within the model:

- Environmental Sustainability (β=0.32, t= 6.44, P<0.001) positively affected Food Security.
- Economic Sustainability (β=0.16, t=2.61, P=0.009) also showed a significant positive effect.
- Social Sustainability (β=0.41, t=7.43, P<0.001) had the strongest effect among the three predictors.

Table 3: Descriptive Statistics for Sustainability Constructs (Scale 1–5)

Code	Item Description	M	SD	Rank	Importance
E1	Our company is committed to using environmentally friendly raw materials.	3.93	0.67	1	High
E2	We apply waste reduction standards at all stages of the supply chain.	3.64	0.95	3	Medium
E3	The company relies on technologies that reduce energy and water consumption.	3.76	0.77	2	High
E4	Our company focuses on recycling and reducing carbon emissions.	3.48	1.02	5	Medium
E5	Environmental sustainability is integrated into our company's supply chain strategy.	3.63	0.88	4	Medium
Overall Environmental Sustainability		3.69±0.69			Medium

Table 4: Descriptive Statistics for Food Security (Scale 1–5)

Code	Item Description	M	SD	Rank	Importance
F1	Our company contributes to the continuous availability of food.	3.54	0.90	3	Medium
F2	Sustainable practices help improve food quality and safety.	3.39	1.02	6	Medium
F3	A sustainable supply chain reduces risks of food supply disruption.	3.65	0.87	2	Medium
F4	Our company enhances fair and safe access to food.	3.68	0.82	1	High
F5	Our supply chain practices help ensure stable food prices.	3.53	0.90	5	Medium
F6	Sustainable supply chain practices improve consumer confidence.	3.54	1.00	4	Medium
F7	Our company supports national efforts to achieve food security.	3.57	0.85	3	Medium
Overall Food Security		3.55 ± 0.70			Medium

Table 5: Normality Test for Study Constructs

Construct	N	Skewness	Kurtosis
Environmental Sustainability	360	-0.58	0.43
Economic Sustainability	360	-0.31	-0.24
Social Sustainability	360	-0.21	-0.30
Food Security	360	-0.28	-0.41

Table 6: Multicollinearity Diagnostics

Construct	Tolerance	VIF
Environmental Sustainability	0.37	2.69
Economic Sustainability	0.24	4.23
Social Sustainability	0.30	3.29

Note: VIF values < 5 indicate acceptable multicollinearity (Hair et al., 2011).

All hypotheses (H1.1–H1.3) were supported. The partial correlations calculated for effect sizes varied from R=0.42 to 0.59, which signified that the effects were of moderate to large size. The robustness checks performed using different model specifications (composite index and standardized predictors) yielded similar results, thereby affirming the reliability of estimates. (Table 7).

Table 7: Multiple Regression Results for Sustainability Dimensions Predicting Food Security

Predictor	B (unstd.)	β (std.)	SE	t	P	95% CI (LL–UL)
Constant	0.51	—	0.13	3.94	<0.001	[0.26, 0.77]
Environmental Sustainability (E)	0.33	0.32	0.05	6.44	<0.001	[0.22, 0.44]
Economic Sustainability (Ec)	0.15	0.16	0.06	2.61	0.009	[0.04, 0.26]
Social Sustainability (S)	0.39	0.41	0.05	7.43	<0.001	[0.28, 0.50]

Model Summary: R=0.689, R^2=0.475, Adjusted R^2=0.469, F(3,356)=33.23, P<0.001; Dependent Variable: Food Security

The relationships among Environmental, Economic, and Social Sustainability and Food Security are illustrated in Fig. 1.

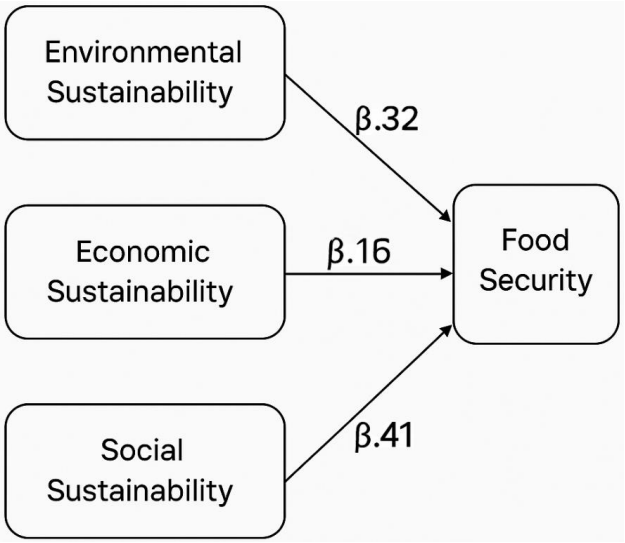

Fig. 1: Conceptual and Empirical Models of the Sustainable Food Supply Chain and Food Security; Environmental (E), Economic (Ec), and Social (S) Sustainability significantly predict Food Security (F), with standardized coefficients β=0.32, 0.16, and 0.41 (all P<0.01).

DISCUSSION

This study's findings validate the assertion that implementing sustainable food supply chain (SFSC) practices in the Jordanian food industry significantly improved food security. The research fully supports the theoretical model linking environmental, economic, and social sustainability to the FAO's four food security pillars: availability, access, utilization, and stability. It also points out the possibilities of converting sustainability into resilience across food systems through interventions.

The analysis of regression revealed that among the three dimensions of Sustainability, Social, Environmental, and Economic, Social Sustainability had the most significant impact (β=0.41), followed by Environmental Sustainability (β=0.32) and Economic Sustainability (β=0.16). The results are in line with earlier research that has reflected the importance of the social aspect in building up trust, fairness, and participation (Sadiq et al., 2022; Wahbeh et al., 2022). In the case of Jordan, fair labor practices, local supplier engagement, and corporate transparency not only strengthen consumer trust and provide equitable access but also indirectly support the food security pillars of utilization and access by improving market stability.

The substantial influence of social sustainability reflects the interconnectedness of Jordan's agri-food industry, which relies on trust-based networks among small producers, traders, and distributors. Often, informal contracts, community reputation, and mutual reliability take the place of formal governance, resulting in cooperation, safety, and inclusion being the key factors for both supply continuity and consumer confidence. Social practices are said to account for 35–45% of the variance in food security outcomes in emerging economies (Munuhwa & Hove-Sibanda, 2024; Joshi et al., 2023), thus greatly magnifying the results of this study.

Environmental Sustainability (β=0.32) was also one of the significant factors in the study, which was consistent with previous studies that resulted in linking climate adaptation, waste reduction, and efficiency to better availability and stability (De Boni et al., 2022; Li et al., 2023; Shabir et al., 2023; Fernandes-Silva et al., 2025). Since Jordan is facing an extreme water shortage, less than 100 m^3 per capita per year, the concept of environmental efficiency holds tremendous importance. Water reuse, solar energy transition, and minimized postharvest losses are some of the methods that increase supply and, at the same time, keep it steady. For example, using renewable energy for processing and employing precision irrigation can be an effective way to cope with the impacts of fluctuations in the prices of global fuel and grain.

Economic Sustainability (β=0.16), though significant, had the weakest effect, indicating that profitability and competitiveness are not yet major drivers of food security in Jordan. This likely stems from structural constraints such as limited financing, reliance on imported inputs, and vulnerability to global price fluctuations. With over 85% of staple ingredients imported, financial sustainability alone cannot ensure stability without parallel efforts in local sourcing, infrastructure, and waste reduction. These findings align with Pawlak and Kołodziejczak (2020) and Quayson et al. (2021), who observed that economic sustainability remains limited in import-dependent economies unless integrated with social and environmental initiatives.

The results of a comparative effect-size analysis indicate that the findings of Jordan are consistent with the global patterns. Joshi et al. (2023) reported β=0.35 for environmental and β=0.42 for social dimensions in India's agri-food sector, whereas Munuhwa and Hove-Sibanda (2024) cited β=0.39 (social) and β=0.33 (environmental) for South Africa. These similarities not only confirm the validity of the current findings across different regions but also uncover specific regional differences. In the MENA region, the more significant impact of social sustainability is probably due to the sector's high labor intensity, reliance on smallholders, and the consumers' preference for trust and community welfare over strictly economic performance.

Policy and Practical Implications

The practical application of these conclusions necessitates a synchronized involvement of companies, regulatory bodies and banks. Sustainability for businesses should be incorporated into KPIs, and performance should be gauged by including suppliers in the process, measuring the intensity of waste produced, assessing the efficiency of water use, and assessing compliance with fair labor practices. Making sustainability part of the supplier's code of conduct and procurement policies ensures compliance with ethical, environmental, and transparency standards. In addition, it is imperative to train both the employees and suppliers, as it would be one of the major steps to create awareness and build up technical capacity for the application of low-waste, low-energy production methods on the other hand, workshops conducted continuously will help to reinforce the culture of the organization and promote its resilience in the long run.

A more enabling institutional environment is required for policymakers and regulators. Food suppliers with verified sustainability certifications can be rewarded through public procurement policies, thus creating compliance incentives. National banks can facilitate green credit and financing schemes for companies that invest in renewable energy, water-saving technologies, and waste valorization. In contrast, tax deductions for firms that obtain certification for reducing energy or water intensity would align private investment with the government's resource-efficiency targets. Inspections should include sustainability metrics under the new regulatory frameworks, and compliance should be linked to the licensing of exports or imports.

Simultaneously, the application of circular economy policies can lead to the valorization of waste, such as food waste turned into animal feed or bioenergy, and establish collaborations between the private sector and local governments to replenish resource loops. These actions at the regional level not only correspond with the FAO's "Blue Transformation" strategy but also with the National Strategy for Sustainable Agriculture of Jordan (2020–2030). All three strategies highlight the importance of resource efficiency, waste reduction, and inclusiveness. The introduction of shorter, more localized food supply chains via cooperatives or digital marketplaces may also serve as a buffer against global market fluctuations for Jordan, thereby reinforcing the stability and access dimensions of national food security.

Contextual Constraints and Structural Factors

Jordan's dependency on imported staple goods renders it very vulnerable to global price fluctuations and disruptions in logistics. Local purchasing and shorter supply chains backed by technology-enabled traceability can act as a resilience mechanism guaranteeing uninterrupted food supplies even in the case of international emergencies. Furthermore, water shortages and rising energy prices demand a combination of policies that integrate agricultural water management, renewable energy support and sustainable private-sector engagement.

Interpretation within a Resilience Framework

The outcomes of this research align with resilience theory regarding food systems, underscoring the importance of flexibility, redundancy, and social capital (Davis et al., 2021; Seyam et al., 2024). Being sustainable, businesses equip themselves better to withstand and recover from disruptions, and are adaptive to climate, the economy, or politics. Among the three factors of sustainability, social sustainability plays the most significant role in resilience by maintaining trust and mutual benefits within the value chain; environmental sustainability provides stability and resource efficiency; and economic sustainability facilitates change and creativity through the variety of products, services, and innovations.

Limitations and Future Research Directions

It is important to recognize a few drawbacks. To start with, the cross-sectional approach limits the interpretation of causality; thus, researchers should resort to longitudinal or panel designs to depict the progressive influence of sustainability measures. Additionally, collecting data through self-reporting may lead to biases such as social desirability and overestimation. Use of objective measures like carbon footprint, energy intensity, and waste reduction would increase validity. Moreover, the presence of a large number of highly educated respondents in the sample may limit the scope of generalizability to smaller or informal firms. To get better generalization, future research could include firm records, third-party audits, and policy datasets. Lastly, the use of structural equation modeling (SEM) could reveal indirect or mediating relationships among sustainability dimensions.

To sum up, the present work has done a great job collecting and analyzing data which are the most substantial proof that sustainability practices, mainly the ones related to social sustainability, are the backbone of food security in the agri-food sector of Jordan. Moreover, these findings support academic discussions on sustainable food supply chains and point to ways for companies and regulators to collaborate effectively and develop a food system that is robust, fair, and eco-friendly enough to last through the region's resource and market limitations.

Conclusion

The research highlights the considerable influence of sustainable food supply chains on the food security of the Jordanian food sector. It proves that adopting environmentally, economically, and socially sustainable practices makes the whole food sector more secure and less prone to disturbances. Sustainable strategies, when applied by the Jordanian food sector, will lead to the establishment of a supply chain that is not only capable of catering to present needs but also coping with future uncertainties through its robust and fair nature. The results assert that the sector's commitment to sustainability is not merely an ethical one but also a means of achieving long-term food security and integrating the entire area of Jordan's food systems into the sustainability concept.

The implications of the study are extensive, ranging from urging the above-mentioned stakeholders to promote sustainability throughout the entire food supply chain. Regulations and incentives to boost sustainable production and investment in green technologies would be the best ways to enhance food security. Besides, the business heads should be the first to adopt the new eco-friendly methods, as consumer demand for products with "responsibly produced" labels would increase, making sustainability not only a need but also an opportunity for competition.

In addition, consumers are very important as they are the main drivers of demand for sustainable food. The rising concern about food availability leads consumers to select products that align with their environmental values increasingly, and it also prompts firms to adopt greener practices, reinforcing the cycle of sustainable behavior in the food system. Drawing on the conclusions of the present research, several policy recommendations can be made to improve the sustainability of food supply chains in Jordan.

First of all, the government should set rules that support the environmentally friendly practices in the food business sector through financial incentives, green project tax reductions and local producers funding. The measures can stimulate the food companies to follow sustainability-oriented approaches which in turn will fortify national food security. Food companies, then, must facilitate the employees' training to make them aware and equip them with practical Skills for the adoption of the sustainable method that will be embedded in the company culture. The partnership of the food companies, the government, and the NGOs is extremely important as transfer of knowledge and best practices would lead to creative solutions for sustainability problems. Besides, consumer education about the advantages of products from sustainable sources is also a must, because the rising awareness together with the demand can drive the businesses towards more responsible production. Moreover, there should be put in place to monitor and evaluate systems that would tell the progress, point the areas needing improvement and ensure accountability. By taking these recommendations together, the participants of Jordan's food sector can enhance the sustainability efforts and at the same time, a more secure, resilient, and just food system for everyone would be created.

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