Journal of Sustainability Science and Management
Volume 18 Number 4, April 2023: 152-165

eISSN: 2672-7226

MODELLING FACTORS THAT INFLUENCE FOOD SECURITY AMONG WHEAT FARMERS

FARZANEH NORUZI-AJABSHIR, FARHAD LASHGARARA*, SEYED-MEHDI MIRDAMADI AND MARYAM OMIDI-NAJAFABADI

Department of Agricultural Extension and Education, Science and Research Branch, Islamic Azad University, Tehran, Iran.

**Corresponding author: flashkarara@gmail.com*
Submitted final draft: 21 January 2023 *Accepted: 7 March 2023* http://doi.org/10.46754/jssm.2023.04.011

Abstract: Given the environmental challenges and an urgent need for food security, it is essential to focus on wheat technologies to achieve a better state of food security for wheat farmers. This study aims to develop a model that identifies factors, particularly those involving technology, that influence food security among wheat farmers in East Azerbaijan province in Iran. This study involves the participation of 110 wheat growers in the province. A questionnaire was used to gather data, and expert opinion confirmed its validity. The questionnaire's reliability was also confirmed by the Cronbach's alpha coefficient (0.724–0.949). The results indicated that most wheat farmers viewed the level of food security as low (57.5%). Goodness-of-fit indexes [e.g., chi-square ($P > 0.05$), RMSEA < 0.024, and GFI = 0.816] showed that the model had an excellent fit for the data. Regression analysis revealed that the most significant factors were related to the profitability of adopting wheat technology (0.621), its impact on improving food security, and the concept of capacity building (0.491).

Keywords: Sustainability, food security, technology acceptance, East Azerbaijan.

Introduction

Food security is one of the key contributors to individual and social health and is instrumental in the development of society. Its importance have led the World Bank and the Food and Agriculture Organisation to identify food security as one of the Millennium Development Goals (Campi *et al.*, 2021). Food security is one of the leading challenges in the world in the 21st century (Lestari, 2021). Highlighting the importance of food security and recognising it as a critical global issue require a concerted effort to tackle this crisis. In response, several developed and developing countries have encouraged the adoption of organic farming, driven by growing public concern over food quality, individual health, and the depletion of natural resources (Ingram, 2020).

Agricultural production in Iran has an unsteady pattern of fluctuation. This unreliability needs to be addressed given the domestic conditions and the international situation that imposes strict export conditions for agricultural products, especially in the context of food security. Therefore, there is an urgent need for serious consideration of this issue. The concept of food security is refers to a situation where all individuals have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and preferences, thereby enabling them to maintain a healthy life (Herforth *et al.*, 2020). Food insecurity is not necessarily the result of material and economic poverty, as most families with favourable economic conditions may face food insecurity due to a lack of information and awareness, resulting in poor nutritional outcomes. In other words, low nutrition literacy can lead poor nutritional status (Michou *et al.*, 2019).

According to research, agricultural technologies play a special role in developing countries due to increased agricultural performance and overall growth (Dagne & Oguamanam, 2018). Agricultural technologies directly help reduce food insecurity by improving seeds and fertilisers to increase agricultural productivity. This can ultimately lead to higher consumption, greater levels of household income, and lower amounts of irrigation at the risk of crop failure at times of drought (Dube *et al.*, 2018). Therefore, when it comes to food insecurity, it is necessary to focus on the adoption of new technologies to improve the agricultural situation. When new technologies are introduced in a developing country like Iran, the process of adaptation usually requires the acceptance of target groups. These groups need to recognise new innovation and decide on whether to accept it. That is, they make the necessary assessments of its benefits and disadvantages, while learning how it is applied and weighing the merits or disadvantages of the technology in general. Then, necessary steps can be taken by the target population of the importer to use the technology in accordance with customised criteria; otherwise, absorbing the technology would be unlikely to happen in an appropriate manner and time (Cafer & Rikoon, 2018).

The profitability of most technical innovations requires a minimum level of production by farmers. Larger farmers, therefore, appear to be in a better position to adopt new technologies. Technical innovations reduce the expected cost of each unit of product, thereby shifting the final cost function to lower levels and providing incentive for technology adoption on the condition of expected price stability of a product. Early adopters usually make a head start in profits from their early tech-based products due to the advertisement stage being at the early stage. Along with the expectation of innovation in the agricultural sector, new technology is being developed and the total output is rising in Iran and product prices decreasing. Meanwhile, most agricultural products have low fluctuations in the demand price, whereas the decline in revenue can force other farmers to adopt new technologies or exit the sector. Conservative adopters are those who adopt technology to prevent harm, but there is still debate as to how the acceptance of technology has remained largely unsuccessful in changing the situation of Iranian farmers, even though farmers have incentives to adopt new technologies (Bagherpour & Mohamadi, 2016).

In equating technology with economic and social prosperity, there is much evidence that small-scale farmers in developing countries are aspiring to higher standards of living. This can be seen as an incentive among small-scale farmers to use technology. However, the main issue at hand is to investigate why technology has not been as widely adopted as originally anticipated at the beginning of the 21st century. Several hypotheses can be outlined as answers; that the technology is not user-friendly, the farmers are not aware of better ways to use the technology, and farmers lack the motivation to use them. Also, educated groups are supposed to assist in teaching technological applications to farmers, but may find it difficult and inefficient to arrive at a substantial outcome. Farmers are usually unwilling to take risks by adopting new devices that have not been locally used before, and the market may not have an availability of accessories for devices in need of repair (Masere, 2016).

Despite the debate over the benefits of technological advancements, there is no doubt that all groups and societies generally benefit from technological advancements due to the constraints of some agricultural resources, especially land and spatial availability, imposed on the growth of agricultural production. This is especially highlighted in the context of technological progress. In addition, the vital role of agriculture accelerates economic development and a sufficient rate of technological advancement in agriculture can benefit sectors that encompass the entire economy. Resource constraints in the agricultural sector highlight the importance of selecting appropriate technologies to make an efficient use of scarce resources in the production of sufficient food (Salehi *et al.*, 2019). Figure 1 shows the conceptual model of research based on the unified theory of acceptance and use of technology (UTAUT2) model.

The overall objective of this study was to develop a model that identifies factors influencing food security among wheat growers in East Azerbaijan province. The aim of this study was to investigate the impact of the

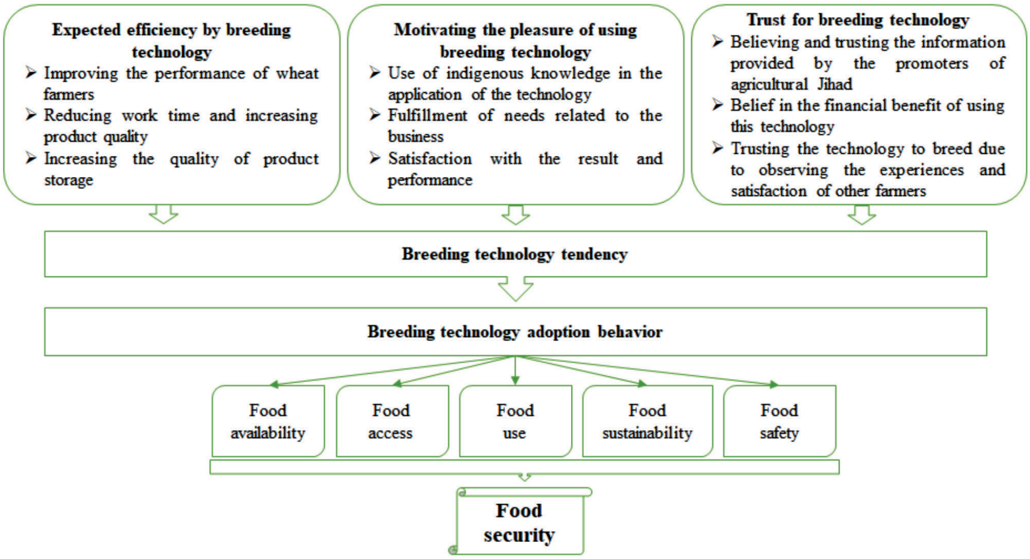

Figure 1: The conceptual model of research based on the UTAUT2 model

social dimension, including capacity building and employment, on the adoption of wheat production and its potential to improve food security, as perceived by experts overseeing agricultural practices in the province. The main question of this study is to identify the factors that influence the food security of wheat farmers in the country. To answer this question, East Azerbaijan, which is one of the most important provinces in the production of this strategic product in the country, was selected as the study location. In this study, the current food security situation was examined based of four components: Recognising the effects of the social dimension (capacity building and employment) in adopting wheat technologies and improving food security, and recognizing the impact of the economic dimension. The main objective of this study was to develop a model that identifies factors influencing food security among wheat farmers in East Azerbaijan province, Iran, with a particular emphasis on technology.

Materials and Methods

This study is an applied research study and was non-experimental (descriptive) in its data collection, and was based on the correlation method. The statistical population of the study consisted of 110 agricultural experts in the cities of East Azerbaijan, who were surveyed in a collective census involving a questionnaire and an interview. Based on the collected data, in the age range of the statistical population was between 27 and 52 years old. A total number of 83 individuals (75.5%) were male and 27 (24.5%) were female. Further information is available in Table 1.

Table 1: Frequency distribution of respondents' individual characteristics

Features	Average	Minimum	Max
Age (year)	45	27	52
Grade	**Frequency (s)**	**Percentage**	**Cumulative (%)**
Bachelor	70	63/6	63/6
MSc	35	31/8	95/5
Ph.D	5	4/5	100

Food security was measured using a Likert scale with 28 items. These items were then combined and coded. Given the 28 items and the Likert scale for measuring food security (very low: 1, low: 2, medium: 3, high: 4 and very high: 5), the lowest and highest scores for a respondent were 28 = (28 * 1) and 140 = (28 * 5) (Joshi *et al*., 2015). Then, after recoding of the status, scores were categorised into five levels: Very low (28-49), low (50-72), moderate (73-95), high (96- 118) and very high (119-141). In order to evaluate its validity, the questionnaire was reviewed by experts, who provided necessary feedback and corrections. Also, the Cronbach's alpha coefficient (0.724–0.949) was used in measuring the reliability of the questionnaire. The dependent variable in this study was assessed using 28 items in four sections: Availability (10 items), reachability (5 items), use (7 items) and sustainability (6 items) at a quasi-interval level.

The independent variables in this study were social dimensions in two parts, i.e. capacity building (5 items) and increasing employment (5 items), as well as economic aspects in three segments, i.e. production optimisation (6 items), economic advantage (8 items), enhancement of livelihood (9 items). After collecting and categorising the data, their analysis occurred in two parts: Descriptive statistics and inferential statistics. In the inferential statistics section, structural equation modelling was used for the classical approach and, finally, the research model was designed. Data processing and all statistical analyses were performed using the SPSSV16 and AmosV23 software.

Results and Discussion

The results of present study indicated that from the viewpoint of experts, 81% of the farmers have a low or very low level of food security. None of the experts gave high or very high scores to the farmers' level of food security in the province (Table 2), which can be due to insufficient land in the province, the instability of annual rainfall and the absence of the government's timely payment to farmers after buying their harvest of wheat.

A previous study on food security and wheat indicated that the increase in production costs and inflation are essential causes of economic instability among farmers (Curtis & Halford, 2016). The role of inflation in Iran and its effects on agricultural activity have been outlined from as early as 1978, despite high revenues of crude oil that benefited the Iranian economy extensively (Katouzian, 1978), to more recent research on the effects of economic uncertainty that affects the private sector and its decision to invest in Iranian agriculture, as a result of which the willingness to invest in agriculture decreases significantly because of inflation (Baboly & Lashkarizadeh, 2018).

Climate change has had mixed effects on Iran, from an increase in the likelihood of floods (Kaboli *et al*., 2021; Ramezanpour and Farajpour, 2022) to an increase in the spatial variability of rainfall trends (Javari, 2017), unprecedented drought in the Northwest of Iran (SafarianZengir *et al.*, 2020), where the province of this study is located, and the erosion of soil as caused by changes in rainfall erosivity, which affects the ultimate yield of wheat fields (Azari *et al.*, 2021). While wheat is mostly cultivated

Table 2: Frequency distribution of expert opinions on farmers' food security

Food security	Frequency (s)	Percentage	Cumulative (%)
Very low (49-28)	18	16.4	16.4
Low (72-50)	72	65.5	81.9
Medium (95-73)	20	18.1	100
Total	110	100	-

in the province during autumn, variations in the climate of spring are largely influential in the wheat yield observed in the province (Kheiri *et al.*, 2017). Groundwater resources are gradually decreasing and, as a matter of the pressure that wheat cultivation has on the water resources of the province, the water footprint of wheat is not a promising issue in irrigated farming (Mojtahedi *et al.*, 2021).

A pertinent case in Tunisia cited the case of drought-triggered, high wheat price, which started as a political event and led to a national initiative of introducing drought-tolerant genes into wheat cultivars (Sadok *et al.*, 2019). The occurrence of drought elicits various responses from farmers and people in the agricultural industry in general, depending on the mood, perseverance and aspiration of those involved in agricultural activities (Aseeri *et al.*, 2017). Resilience and apt responses to drought-triggered conditions require indigenous populations to gradually manage landscape dynamics, crop diversity, and a correct selection of season-specific crops in relation to land suitability in regional ecosystems (Choudhury & Sindhi, 2017).

Meanwhile, the feasibility of drought-index crop insurance in Iran is unlikely to offer large-scale breakthroughs regarding the drought dilemma because of the extensive amounts of wheat-cultivated lands across the country, which undermines the government's support for agricultural insurance. Nonetheless, countries such as Ethiopia (Eze *et al.*, 2020) and Ghana (Abugri *et al.*, 2017) have covered some levels of success in shielding farmers from the impact of drought by establishing insurance-related initiatives. In order to prioritise the tendency of a population in accepting technology, path coefficient estimation statistics were used. Any item that has a higher estimate value has a higher priority. Based on the coefficients, valuing indigenous knowledge and respect for local culture with coefficients of 0.85 and 0.83, respectively, had the highest priority among other items in the course of achieving food security among farmers (Table 3). The case of indigenous knowledge in Iran is very much respected because of the strong weight of experience and practical knowledge among older age groups.

In this respect, indigenous knowledge comes into contrast with academic knowledge, especially in Iran, where the history of Westernised universities in their academic sense rarely exceeds 100 years. One of the most famous Iranian universities, the University of Tehran, for instance, was founded in 1934, as a result of which academic studies on agricultural practice were introduced to the nation. But since the Iranian population was mostly skeptical about new knowledge being introduced to them, they generally felt safer relying on knowledge they developed indigenously. Even nowadays, after nearly 100 years of having academic establishments in the country, less-educated people in rural areas tend to view academic knowledge as inferior to indigenous knowledge. Some of these people consider academic knowledge as young and theoretical, suggesting that it has a limited capacity to generate palpable results of a substantial difference, compared with the rich history of indigenous knowledge they have already put into practice in agricultural practices.

The intersection between indigenous and academic knowledge can benefit from capacity-building efforts. Evidence-based programmes and policies can be employed to work towards a balance between indigenous expectations of academic knowledge and academic expectations of indigenous knowledge. Technical challenges can be best addressed through interdisciplinary approaches, a prerequisite of which is to render specialist knowledge, foster community-based initiatives and facilitate partnerships (Hwalla *et al.*, 2016).

The ultimate aim of a balance between knowledge-based expectations is to generate new space for experiences in decision-making and to enable meaningful participation in agricultural practices to improve livelihoods and bring populations closer to food security (Bresney *et al.*, 2019).

Table 3: Prioritising organic farming factors for improving food security by estimating path coefficients

Priority	Capacity Building	Estimate
1	Valuing indigenous knowledge and traditional farming systems	0.85
2	Respect for local culture	0.83
3	Creating self-reliance in the production of products	0.77
4	Empowering rural communities through partnerships with other farmers and group formation (providing participatory guarantee system and strengthening social organisation)	0.76
Priority	Employment	Estimate
1	Increase in agricultural employment	0.98
2	Attracting new entrepreneurs and creating more work	0.90
3	Improving employment opportunities, especially in rural areas	0.89
4	Increase in non-farm employment	0.60
5	Involvement of new and different groups of society in production	0.59
Priority	Production optimisation	Estimate
1	Increasing yields in areas with low input (pesticides, herbicides, etc.)	0.86
2	Optimising production	0.78
3	Finding capacity to provide sustainable food to the market	0.77
4	Reducing spoilage of agricultural commodities	0.76
5	Reducing risks of production	0.74
6	Maintaining an optimum amount of yield in dry years	0.64
Priority	Economic advantage	Estimate
1	An increase in long-term productivity (optimising agricultural productivity)	0.82
2	Value-added products through marketing and processing activities	0.80
3	Making more efficient use of resources (minimise the use of non-renewable resources)	0.79
4	Cost-effectiveness in comparison with traditional farming (due to lower input variable costs, uniform fixed costs, and higher crop yields	0.78
5	An increase in marketing opportunities for producers	0.76
6	More crop production (per unit of energy and other resources consumed) in agriculture	0.73
7	Increase in overall farm performance per unit area	0.72
Priority	Creating income	Estimate
1	Increase farmers' income in the long run	0.92
2	Improving the livelihood of producers (in selling crops and enabling them to provide better clothing, education and training opportunities for their children)	0.83
3	Increasing the welfare of producers' households	0.82
4	Setting better prices for the products	0.76
5	Reducing cash investment (e.g. reducing import requirements)	0.69

6	Meeting the basic needs of a quality life (e.g. self-sufficiency and job satisfaction)	0.68
7	Saving cash by reducing costs of crop production	0.67
8	Reducing the need for facilities and credit dependency (loans, etc.) as a result of reduced imports	0.56
9	Reducing the cost of purchasing foreign inputs and imports (e.g. chemical pesticides, pesticides, etc.)	0.50

The least valued item in prioritising farming capacity was "dependence on locally available production assets", which means that local populations in rural areas cannot rely totally on their local products to achieve food security. In other words, from the viewpoint of experts answering the questionnaire, relying solely on locally available production assets for achieving food security may not be sufficient, and capacity-building efforts in this area may have limited impact. In a similar study on such dependence, rural populations in Mongolia were reportedly capable of locally producing the necessary amounts of food they needed, although they increasingly showed a desire to consume imported food as a manifestation of aspirations for diversified development in food consumption (Yang *et al.*, 2020).

In order to prioritise the applicability of technology to wheat, path coefficient estimation statistics were used. According to the results of the questionnaire obtained from experts, and as a result of the need for more work, it was observed that increasing agricultural employment and attracting new entrepreneurs had the highest priority with coefficients of 0.98 and 0.90, respectively, among other items for improving food security among farmers (Table 3). The increase in agricultural employment in East Azerbaijan province in Iran is usually based on two types of opportunity. Landlords either lease land to individuals or agree to receive half of the annual profit from selling the product instead of receiving rent money. Private lands are abundant and vast in the province, and it often happens that some patches of land remain idle for some years. One reason is that landlords usually do not like to lease land to people they do not know, and they prefer not to work with individuals they have not worked with before.

This tends to reduce employment flexibility in the agricultural sector. Ironically but realistically, a landlord may prefer to leave a piece of land idle and uncultivated, instead of agreeing to requests of rent from unknown individuals. The same can be said in the case of new entrepreneurs who could be seen as strangers from the perspective of the landlords. Though the highest priority was attributed to an increase in employment and the need to attract new entrepreneurs to this realm, it is unfortunate that these interests appear effective in theory most of the time. Since these questionnaires were answered by specialists who thought and spoke in a mode of perfection and theory, the reality of agricultural employment could be marred in the face of unreal quotes.

Agriculture is more rigid than flexible and, as such, food security cannot be helped with simple, straight-forward items like the ones in Table 3. Better outcomes can be expected when the items are integrated and used together. An example of this regard can be seen in a study conducted in India, which suggested that poverty can be reduced by raising the level of education and the quality of employment, as well as encouraging rural individuals to become involved in non-agricultural activities (Mahendra Dev, 2017). These findings include and confirm some of the items in the present study.

A study in Ukraine showed that the demand for labour force is not merely substantial in its own and that labour productivity in agriculture is as important as labour availability (Patyka *et al.*, 2021). In Kenya, teaching agriculture to the youth in secondary schools correlated positively with the creation of employment out of school (Seraphine *et al.*, 2018). Relevant policies, such as the presentation of realistic scopes and opportunities for the actualisation of employment, were outlined to further harmonise teaching agriculture and job creation (Seraphine *et al.*, 2018).

From the experts' point of view, increasing yields in areas with low input (pesticides, herbicides, etc.) (0.86) and optimising production (0.78) had the highest priority among other items in improving farmers' food security (Table 3). Inclination towards technology adoption by rural populations are based on agricultural expectations that reflect the need to answer high-priority demands. According to the results, farmers expect technology to maintain or even increase agricultural yield in conditions when there is a shortage in facilities, equipment and input in general. Ultimately, the aim is to optimise production. A study in Punjab revealed that the adoption of technology by farmers led to an increase in several measurable traits of agricultural output (Singh *et al.*, 2017).

One of the benefits of technology adoption in agriculture is the provision of precision in using resources and in reducing the rate of agricultural loss. For instance, smart farming technologies can facilitate descriptions of the economic impact of precision tools for optimised agriculture, and herbicide applications can be programmed at variable doses (Pedersen & Lind, 2017). These are examples by which farmers can actualise their expectations if technological tools are diversified and made accessible within the national context. The least estimated value of path coefficient (0.64) was attributed to the maintenance of yield in dry years. The probable reason is that farmers are unlikely to believe that technology is capable of alleviating the effects of drought to significant extents.

Regarding the economic advantage of technology adoption, from the experts' point of view, increasing long-term productivity (0.82) and bringing added value to the products (0.80) were the two items of highest priority in improving food security. It can be assumed that farmers are primarily concerned with the time span of agricultural productivity and that the seasonal nature of agriculture is a strong determinant of food security in terms of economic advantage. In other words, extending the span of productivity beyond a seasonal reach can be a substantial achievement if technology adoption is endorsed. Since this research focused on wheat farmers, it would be appropriate to consider value-added products that can be derived from wheat.

In Iran, one such value-added product is samanoo, which is known for its rich nutritional content (Nemati *et al.*, 2006; Mirmajidi *et al.*, 2019). The role of scientific research in technology adoption by producers of wheat and developers of samanoo has also been valuable in determining the types of wheat cultivar that can render the samanoo tastier, more storable and marketable (Mirmajidi & Abbasi, 2017). Another value-added product is spaghetti, which derives from durum wheat. A relevant research in this regard compared the quality of durum wheat among Iranian landraces and Mexican cultivars, suggesting that the quality of Iranian durum grain is comparable to that of Mexican lines and that a good potential exists for breeding programmes (Hernandez-Espinosa *et al.*, 2020).

It can be said that a vital move in furthering the outcomes of value-added products in wheat is to observe an increase in the knowledge of rural populations about such products and to encourage their improvements through breeding programmes, while highlighting the advantage of native, Iranian landraces over imported cultivars to maintain genetic diversity and prevent Iranian landraces from extinction, even if the imported landraces exhibit better performance in some measures (Etminan *et al.*, 2018; Desiderio *et al.*, 2019; Fayaz *et al.*, 2019). These arguments can also be used in furtherance of several other items (Table 3), such as "more crop production", "increase in overall farm performance" and "economic profitability using domestic input", which scored 0.73, 0.72 and 0.71 in estimations of path coefficient, respectively.

Estimates were further used in prioritising items that increased the capability of creating income. According to the experts, increasing farmers' income (0.92) and improving the livelihoods of producers (0.83) had the highest priority among the items of income in improving farmers' food security (Table 3). There is usually a strong premise in the connection between income and food security. In this regard, Anderzén *et al.* (2020) emphasised that rural development substantially benefits from diversification as an agro-strategy. Strengthening rural infrastructural development is another approach to the aim of increasing farmers' income in the long run (Mengistu *et al.*, 2021).

Nonetheless, the concept of "climate-sensitive sources of income", which derives from climate change (Ali & Erenstein, 2017), applies to Iran as a semi-arid country, thereby requiring technological adoptions that can mitigate the effects of climate change. While farmers are required to comprehend the long-term threats of climate change to their income, the proper selection and use of suitable wheat varieties is systematically considered as a way of increasing crop productivity and, thus, income, which can be achieved through participatory development plans via access to crop genetic resources (Gotor *et al.*, 2021).

In selling wheat, transportation costs and unofficial payments to mass buyers by farmers can undermine the scope of the farmers' income in wheat marketing. Reducing the costs of trade can involve investments in the grain market infrastructure and the elimination of unofficial payments in the wheat trade (Svanidze *et al.*, 2019). A model of applying technology adoption for wheat was also analysed from the perspective of experts. Fitness statistics, such as P-value > 0.05 and RMSEA < 0.024, confirmed the fitness of the obtained model (Figure 2; Table 4).

Also, other criteria values were used to fit this model, including the approximate high value of goodness of fit index (GFI) (0.816) and modified fit goodness index (AGFI) (0.759).

Their closeness to 0.95 was another confirmation for the proper fit of the model. Meanwhile, the parameters related to the path coefficients, along with the level of significance (Table 5), showed that all path coefficients for food security are significant ($P \leq 0.01$), including the creation of income, capacity building, entrepreneurship, optimisation of production, and economic advantage.

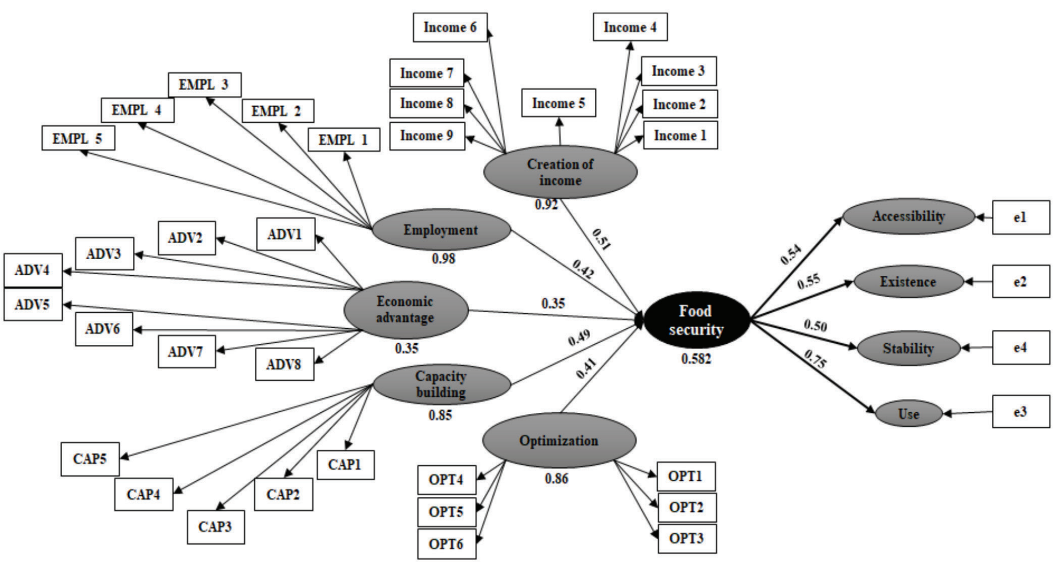

Figure 2: The obtained model of technology adoption for wheat to enhance food security (EMPL: Employment; ADV: Advantage; CAP: Capacity; OPT: Optimisation)

Table 4: Goodness-of-fit indexes for the present model

Index	Value	Standard
Chi-square	14.03	----
P-value	0.60	Over .05
RMSEA	0.017	Less than .024
P-close	0.63	Higher than .05
SRMR	0.069	Less than .08
NFI	0.92	Close to .95
AGFI	0.759	-
GFI	0.816	-

Note: RMSEA: Root Mean Square Error of Approximation; SRMR: Standardised Root Mean Square Residual; NFI: Normed Fit Index; AGFI: Modified Fit goodness Index; GFI: Goodness-of-Fit Index.

Table 5: The results of regression analysis

Variable	Estimated Parameter	Standard Deviation	Critical Ratio	Significance	Standardized Regression Coefficients
Creation of income	0.402	0.099	4.077	***	0.51
Capacity building	0.439	0.098	4.504	***	0.49
Employment	0.368	0.094	3.916	***	0.42
Optimization	0.291	0.080	3.625	***	0.41
Economic advantage	0.447	0.156	2.868	**	0.35

Estimation of standardised regression coefficients of paths showed that the greatest impact on improving food security was related to the effect of income-creating ability with a value of 0.507, capacity-building ability with a value of 0.491 and entrepreneurship ability (employability) with a value of 0.423.

Conclusion

This study suggests that prioritising technology adoption and financial incentives for farmers through government initiatives could encourage farmers to increase their income and employment rates if technology adoption is encouraged. Technology adoption creates jobs as a result of the need for more work and attracting entrepreneurs, while leading to increased income and food security. The tendency and orientation of government agricultural policies towards environmental and social goals can provide a great opportunity to expand technology adoption. Successful projects are often those that combine new approaches, academic outputs, common practices, indigenous knowledge, and local information. The integrative role of scientific and academic achievements in generating problem-solving thoughts can make elaborative combinations with executive experience in an ultimate picture, where technology adoption and food security draw closer to their deserved positions.

Acknowledgements

We would like to thank Islamic Azad University for its financial support.

References

Abugri, S. A., Amikuzuno, J., & Daadi, E. B. (2017). Looking out for a better mitigation strategy: Smallholder farmers' willingness to pay for drought-index crop insurance premium in the Northern Region of Ghana. *Agriculture and Food Security*, *6*, 1-9. https://doi.org/10.1186/s40066-017-0152-2

Ali, A., & Erenstein, O. (2017). Assessing farmer use of climate change adaptation practices and impacts on food security and poverty in Pakistan. *Climate Risk Management*, *16*, 183-194. https://doi.org/10.1016/j.crm.2016.12.001

Anderzén, J., Guzmán Luna, A., Luna-González, D. V, Merrill, S. C., Caswell, M., Méndez, V. E., Hernández Jonapá, R., & Mier y Terán Giménez Cacho, M. (2020). Effects of on-farm diversification strategies on smallholder coffee farmer food security and income sufficiency in Chiapas, Mexico. *Journal of Rural Studies*, *77*, 33-46. https://doi.org/10.1016/j.jrurstud.2020.04.001

Aseeri, S., Klein, M., Condiff, K., & Unver, B. (2017). Freedge: Fighting food insecurity with connected infrastructure. In *Conference on Human Factors in Computing Systems - Proceedings*, pp. 33-38.

Azari, M., Oliaye, A., & Nearing, M. A. (2021). Expected climate change impacts on rainfall erosivity over Iran based on CMIP5 climate models. *Journal of Hydrology*, *593*, 125826. https://doi.org/10.1016/j.jhydrol.2020.125826

Baboly, E., & Lashkarizadeh, M. (2018). Effect of different levels of inflation uncertainty on private investment in agriculture sector of Iran. *Agricultural Economics and Development*, *25*, 95-117.

Bagherpour, H., & Mohamadi, H. (2016). Challenges and prospects of precision agriculture in Iran. *International Journal for Science and Emerging Technologies*, *17*, 1-8.

Bresney, S., Forni, L., Huber-Lee, A., Shrestha, M., & Piman, T. (2019). Participation and capacity building for equity, food security, effective governance and informed decision making in the Stung Chinit Basin, Cambodia. In *AGU Fall Meeting Abstracts*, pp. H21O-1977.

Cafer, A. M., & Rikoon, J. S. (2018). Adoption of new technologies by smallholder farmers: The contributions of extension, research institutes, cooperatives, and access to cash for improving tef production in Ethiopia. *Agriculture and Human Values*, *35*, 685-699.

Campi, M., Dueñas, M., & Fagiolo, G. (2021). Specialization in food production affects global food security and food systems sustainability. *World Development*, *141*, 105411.

Choudhury, P. R., & Sindhi, S. (2017). Improving the drought resilience of the small farmer Agroecosystem. *Economic and Political Weekly*, *52*, 41-46.

Curtis, T., & Halford, N. G. (2016) Food security: The challenge of increasing wheat yield and the importance of not compromising food safety. *Annals of Applied Biology*, *164*, 354-372.

Dagne, T. W., & Oguamanam, C. (2018). ICTs in agricultural production and potential deployment in operationalising geographical indications in Uganda. *Ottawa Faculty of Law Working Paper*, *24*, 1-27.

Desiderio, F., Zarei, L., Licciardello, S., Cheghamirza, K., Farshadfar, E., Virzi, N., Sciacca, F., Bagnaresi, P., Battaglia, R., Guerra, D., Palumbo, M., Cattivelli, L., & Mazzucotelli, E. (2019). Genomic regions from an iranian landrace increase kernel size in durum wheat. *Frontiers in Plant Science*, *10*, 448. https://doi.org/10.3389/fpls.2019.00448

Dube, A. K., Haji, J., & Zemedu, L. (2018). Determinants of food insecurity and coping strategies of rural households: The case of

Shalla District, West Arsi Zone, Oromia Region, Ethiopia. *Journal of Development and Agricultural Economics*, *10*, 200-212.

Etminan, A., Pour-Aboughadareh, A., Mohammadi, R., Noori, A., & Ahmadi-Rad, A. (2018). Applicability of CAAT box-derived polymorphism (CBDP) markers for analysis of genetic diversity in durum wheat. *Cereal Research Communications*, *46*, 1-9. https://doi.org/10.1556/0806.45.2017.054

Eze, E., Girma, A., Zenebe, A. A., & Zenebe, G. (2020). Feasible crop insurance indexes for drought risk management in Northern Ethiopia. *International Journal of Disaster Risk Reduction*, *47*, 101544. https://doi.org/10.1016/j.ijdrr.2020.101544

Fayaz, F., Aghaee Sarbarzeh, M., Talebi, R., & Azadi, A. (2019). Genetic diversity and molecular characterization of Iranian Durum Wheat Landraces (Triticum turgidum durum (Desf.) Husn.) Using DArT Markers. *Biochemical Genetics*, *57*, 98-116. https://doi.org/10.1007/s10528-018-9877-2

Gotor, E., Usman, M. A., Occelli, M., Fantahun, B., Fadda, C., Kidane, Y. G., Mengistu, D., Kiros, A. Y., Mohammed, J. N., Assefa, M., Woldesemayate, T., & Caracciolo, F. (2021). Wheat varietal diversification increases ethiopian smallholders' food security: Evidence from a participatory development initiative. *Sustainability (Switzerland)*, *13*, 1-17. https://doi.org/10.3390/su13031029

Herforth, A., Bai, Y., Venkat, A., Mahrt, K., Ebel, A., & Masters, W. A. (2020). *Cost and Affordability of Healthy Diets across and within Countries: Background Paper for The State of Food Security and Nutrition in the World 2020. FAO Agricultural Development Economics Technical Study No. 9*. Food & Agriculture Org.

Hernandez-Espinosa, N., Laddomada, B., Payne, T., Huerta-Espino, J., Govindan, V., Ammar, K., Ibba, M. I., Pasqualone, A., & Guzman, C. (2020). Nutritional quality characterization of a set of durum wheat landraces from Iran and Mexico. *LWT*, *124*, 109198. https://doi.org/10.1016/j.lwt.2020.109198

Hwalla, N., El Labban, S., & Bahn, R. A. (2016). Nutrition security is an integral component of food security. *Frontiers in Life Science*, *9*, 167-172. https://doi.org/10.1080/21553769.2016.1209133

Ingram, J. (2020). Nutrition security is more than food security. *Nature Food*, *1*, 2.

Javari, M. (2017). Spatial variability of rainfall trends in Iran. *Arabian Journal of Geosciences*, *10*, 78. https://doi.org/10.1007/s12517-017-2857-8

Kaboli, S., Hekmatzadeh, A. A., Darabi, H., & Haghighi, A. T. (2021). Variation in physical characteristics of rainfall in Iran, determined using daily rainfall concentration index and monthly rainfall percentage index. *Theoretical and Applied Climatology*, *144*, 507-520. https://doi.org/10.1007/s00704-021-03553-9

Katouzian, M. A. (1978). Oil versus agriculture a case of dual resource depletion in Iran. *The Journal of Peasant Studies*, *5*, 347-369. https://doi.org/10.1080/03066157808438052

Kheiri, M., Soufizadeh, S., Ghaffari, A., AghaAlikhani, M., & Eskandari, A. (2017). Association between temperature and precipitation with dryland wheat yield in northwest of Iran. *Climatic Change*, *141*, 703-717. https://doi.org/10.1007/s10584-017-1904-5

Lestari, R. S. D. (2021). Fertilizer encapsulation to support food security. *City*, *96*, 41-75.

Mahendra Dev, S. (2017). Poverty and employment: Roles of agriculture. *Indian Journal of Labour Economics*, *60*, 57-80. https://doi.org/10.1007/s41027-017-0091-2

Masere, T. P. (2016). An evaluation of the role of extension in adoption of new technology by small-scale resource-constrained farmers: A case of Lower Gweru Communal area, Zimbabwe.

Mengistu, D. D., Degaga, D. T., & Tsehay, A. S. (2021). Analyzing the contribution of crop diversification in improving household food security among wheat dominated rural households in Sinana District, Bale Zone, Ethiopia. *Agriculture and Food Security*, *10*, 1-15. https://doi.org/10.1186/s40066-020-00280-8

Michou, M., Panagiotakos, D. B., & Costarelli, V. (2019). Development & validation of the Greek version of the nutrition literacy scale. *Mediterranean Journal of Nutrition and Metabolism*, *12*, 61-67.

Mirmajidi, A., & Abbasi, S. (2017). Effect of wheat cultivar and wheat flour ratio on physicochemical properties of samanoo. *Journal of Agricultural Engineering Research (Iran)*, *13*, 45-56.

Mirmajidi, A., Fatemian, H., Behmadi, H., Hosseini, G., & Keshavarz, N. (2019). Determination of the standard method for malt wheat (samanoo) preparation from wheat cultivars and evaluation of some physicochemical properties of Samanoo.

Mojtahedi, M., Kalantari, K., Asadi, A., Varmazyari, H., & Hosseinzad, J. (2021). Investigating the water footprint components of wheat and barley in East Azerbaijan Province. *Iranian Journal of Soil and Water Research*.

Nemati, M., Razavieh, S. V., & Zandieh, E. (2006). Comparison between iron, copper, zinc and phytate contents of wheat malt extracts (samanoo) prepared from normal and fortified wheat.

Patyka, N., Gryschenko, O., Kucher, A., Hełdak, M., & Raszka, B. (2021). Assessment of the degree of factors impact on employment in Ukraine's agriculture. *Sustainability (Switzerland)*, *13*, 1-19. https://doi.org/10.3390/su13020564

Pedersen, S. M., & Lind, K. M. (2017). *Precision agriculture: Technology and economic perspectives*. Springer.

Ramezanpour, M. R., & Farajpour, M. (2022). Application of artificial neural networks and genetic algorithm to predict and optimize greenhouse banana fruit yield through nitrogen, potassium and magnesium. *Plos One*, *17*, e0264040.

Sadok, W., Schoppach, R., Ghanem, M. E., Zucca, C., & Sinclair, T. R. (2019). Wheat drought-tolerance to enhance food security in Tunisia, birthplace of the Arab Spring. *European Journal of Agronomy*, *107*, 1-9. https://doi.org/10.1016/j.eja.2019.03.009

SafarianZengir, V., Sobhani, B., & Asghari, S. (2020). Modeling and monitoring of drought for forecasting it, to reduce natural hazards atmosphere in western and north western part of Iran, Iran. *Air Quality, Atmosphere and Health*, *13*, 119-130. https://doi.org/10.1007/s11869-019-00776-8

Salehi, S., Hayati, D., Karbalaee, F., & Chin, W. W. (2019). Factors affecting intention to use variable rate technology-tillage by structural equation modeling. *International Journal of AgriScience*, *2*, 860-874.

Seraphine, S. A., Jacob, J. J. O. K., & Joash, K. K. (2018). Influence of instructional resources in learning agriculture in secondary school on employment creation in Vihiga County, Kenya. *International Journal of Educational Administration and Policy Studies*, *10*, 1-9. https://doi.org/10.5897/ijeaps2017.0535

Singh, G., Singh, P., & Sodhi, G. P. S. (2017). Assessment and analysis of agriculture technology adoption and yield gaps in wheat production in sub-tropical Punjab. *Indian Journal of Extension Education*, *53*, 70-77.

Svanidze, M., Götz, L., Djuric, I., & Glauben, T. (2019). Food security and the functioning of wheat markets in Eurasia: A comparative price transmission analysis for the countries of Central Asia and the South Caucasus. *Food Security*, *11*, 733-752. https://doi.org/10.1007/s12571-019-00933-y

Yang, W., Zhen, L., & Wei, Y. (2020). Food consumption and its local dependence: A case study in the Xilin Gol Grassland, China. *Environmental Development*, *34*, 100470. https://doi.org/10.1016/j.envdev.2019.100470