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Consumer Behavior and Food Insecurity of Urban Residents: Dynamic Analysis of its Controlling Factors

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ABSTRACT

Careful and focused decision-making in the food sector reduces the challenges threatening food systems' stability. Besides, it can optimally control any changes that result in food shortages. The present study aimed to identify identifiable factors' effects on food insecurity using a dynamic system with an emphasis on consumption behaviors. A dynamic model was developed to understand the long-term interaction between individual characteristics, average cost, average income, and hygiene status, and a dynamic model was then validated and operationalized among 1,000 Alborz Province's households randomly using a questionnaire. The base scenario for predicting food insecurity changes revealed that food insecurity had increased over ten years, resulting in changes in social and economic status and vulnerability of urban society. Four additional scenarios indicated that the average cost and income could directly affect the food insecurity status in Iran by indirectly influencing policies to increase food security, health, and hygiene. Individual characteristics and food security also influence food insecurity and reinforce the relationship between these variables. The study revealed that dynamic systems modeling could be a valuable tool for assessing food insecurity policies and their factors in developing countries.

Keywords: Alborz Province, Food problems, Food security, Urban consumption behavior.

INTRODUCTION

An increase in the world's population and migration from rural to urban areas on a large scale, while increasing the urban population, has eliminated biodiversity, increased pressure on food, water, and energy resources (de Amorim *et al*., 2019). Thus, the urban population will reach 68%, or about 6 billion, by 2050, and this very high concentration in urban areas and a prediction of population growth for large cities create a severe challenge (Berchin *et al*., 2019). In this regard, food security is one of the main challenges of the 21st century for the future of cities as vital geographical units with the function of maintaining economic growth and development, especially in developing countries (Papakonstantinou, 2019). Concerns about this challenge in cities due to changing climate conditions (Lal, 2016), unpredictable political instability, and increased resource consumption have increased (Namany *et al*., 2019). Food problems in cities have intensified in recent years, and it is impossible to ignore the role that food plays in urban centers (Maye, 2018). In addition, social movements and measures of authorities have increasingly involved cities in food and agriculture (Derkzen and Morgan, 2012). However, using resources to supply food puts pressure on infrastructure in cities (Satterthwaite, 2009). In contrast, factors such as livelihood complexity, employment, high market dependence on food purchases, and lack of

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urban infrastructure have led to unequal access and consumption of foods in urban areas (Garrett and Ruel, 1999; Maxwell *et al*., 1999; Zhou and Staatz, 2016). Food insecurity is defined as lack of physical, social, or economic access to healthy food or the inability to access such foods through socially acceptable ways (Szabo, 2016), limited or uncertain availability of appropriate and healthy foods, or limited or uncertain ability to achieve proper foods (Drennen *et al*., 2019). Currently, Iran ranks 76th in the world in terms of food security, but according to the results of the studies conducted in Iran, the prevalence of food insecurity in the whole country is (2.23%) and Alborz Province is higher than the country's average (31.3%) (Honarvar *et al*., 2023). Moving towards creating solutions and opportunities to address this challenge and ensuring food availability is crucial to food security (Namany *et al*., 2020). Sustainable food security has been defined as food availability or sufficient food production, food access or the purchase of food ability, sufficiency in terms of nutrition including energy, proteins, and micronutrients as well as safety, and finally, the stability and foreseeability of these conditions (Vågsholm *et al*., 2020). In this regard, de Amorim *et al*. (2019) and Namany *et al*. (2020) emphasize the achievement of sustainable food security by creating social change through knowledge, attitude, and behavior.

Hence, paying attention to social issues and approaches, especially rapid change that occurs in urban areas, is crucial. System dynamics is an appropriate simulation tool for analyzing and understanding the behaviors of complex systems over time (Azar, 2014). Considering the complexity of the concept of food insecurity, this tool predicts the practical and occurred food insecurity situations (Azar and Vaidyanathan, 2015). It seems the food insecurity simulation model develops and examines deeper social/economic issues that cause management concerns and different current scenarios with other structures and policies is a research gap that opens the main issue by reviewing the existing literature on the subject.

Metropolitan Nourishment Insecurity

Because of irregular and uncontrolled urbanization and also low absorption capacity by cities, urban poverty is rising (Anand *et al*., 2019; Jonah and May, 2020). Although the majority of poor people continue to live in rural areas, the rate of urban poverty is increasing with urbanization and the migration from rural to the cities' outskirts, especially in developing countries (Hong *et al*., 2021; Kuddus *et al*., 2020; Pilehvar, 2021; Vilar-Compte *et al*., 2021). This phenomenon causes food insecurity to grow among both mentioned poor people in rural areas and cities (Orsini *et al*., 2013; Oyeleye *et al*., 2013). It can also be noted that, unfortunately, the expected urban economic growth has been associated with the rapid expansion of unplanned neighborhoods and the high density of poor urban populations without skills and education (Tacoli, 2017). As expected, people living in poor urban neighborhoods will reach 2 billion in developing countries by 2030 (Habitat, 2014; Un-Habitat, 2010). Since most food purchasers are urban residents, food prices and incomes directly reduce their purchasing power and increase food insecurity. Their food security largely depends on the family's economic conditions in these purchasing conditions (Cohen and Garrett, 2010). Wertheim-Heck *et al*. (2019) state that this rate is 40% of the total household expenditure of low-income groups in Vietnam. Thus, urban residents are at higher risk of food insecurity than villagers. Results of research conducted in poor urban communities in Cambodia and Nepal showed that this rate could be much higher for poorer households and residents of smaller cities (Boonyabancha *et al*., 2019). Low and irregular incomes intensify food insecurity, and usually informal employment, disease, or recurring events affect one's primary income, meaning that food will not be on the table that day. Food security will also change as income

fluctuates from one day to another day (Tacoli, 2019). Also, it is associated with homeownership and the level of housing assets (St-Germain and Tarasuk, 2020). By strengthening and completing services in areas with low resource consumption and informing the families better about the techniques of production, crop, land management methods, and issues related to climate change, it is possible to accelerate the adoption of crucial adaptation strategies (Alam *et al*., 2019). Still, households in cities, especially immigrants to suburbs, don't have access to local welfare systems supporting them. In addition, the expected increase in urbanization and population growth can increase the vulnerability of city residents to sudden shocks in agricultural markets. In this situation, policymakers must respond to these risks by recognizing the overall factors and developing strategies that address urban food security.

Reviewing the above references shows the different effective factors of food insecurity separately, and this study wants to clear the complexity and describe the dynamic model of food insecurity by focusing on combining all known effective factors in other studies. The model's study, designed by the food insecurity dynamic system, includes (a) Mechanisms of household income and costs, (b) The effect of food insecurity among vulnerable populations, sick populations, and urban migrants, (c) Consumption characteristics studies in urban areas, and (d) Investigates food insecurity indexes with a comprehensive and dynamic look at all dimensions of food consumption and food insecurity behaviors this research tries to explain the research goals by focusing on the final extracted research model.

MATERIALS AND METHODS

The present study aimed to provide a model for analyzing the factors affecting food insecurity among 1,000 households of Alborz Province in Iran to estimate the level of food insecurity over a 10-year outlook by interview, using a questionnaire. the data were extracted from two provincial household-based surveys containing information on food insecurity including continuous assessment of individuals' food consumption in the form of the Household Food Insecurity Index (HFIS), Coping Strategy Index (CSI), and Household Hunger Scale (HHS) food insecurity indices checklists, which were divided into four categories including food secure (0-2), mildly insecure (3-12), moderately insecure (13-40), and severely insecure (> 40) (Maxwell *et al*., 2008). In the next step, socioeconomic and health characteristics, income and expenditure mechanisms of the households, demographic features, and consumption attributes in urban areas were investigated in the form of a researcher-made questionnaire.

The present study aimed at exploring "Food Consumption Behaviors" that determine the level of food insecurity in urban areas through dynamic modeling, which is a valuable tool in conceptualizing food insecurity. The main concepts of system dynamics are feedback and causal loop diagrams. Feedback loops and structures are necessary because systems rarely exhibit linear behavior due to interactions between the systems. The feedback structure is fundamental since it reflects the patterns or behavior of designs to evolve dynamically over time. In a causal relationship, the arrow of each describes the causal effects among the system variables. The opposite hand represents the relationship between the dependent and independent variables. A positive pole (+) indicates that the effect changes in the same direction. A negative bar (-) indicates the difference is in the opposite direction of the cause. We conduct research consisting of two powerful research methods, including case study (qualitative) and dynamic system methods (quantitative), which is a combination of two simulations to provide valuable solutions to problems (Sooka and Rwashana-Semwanga, 2011).

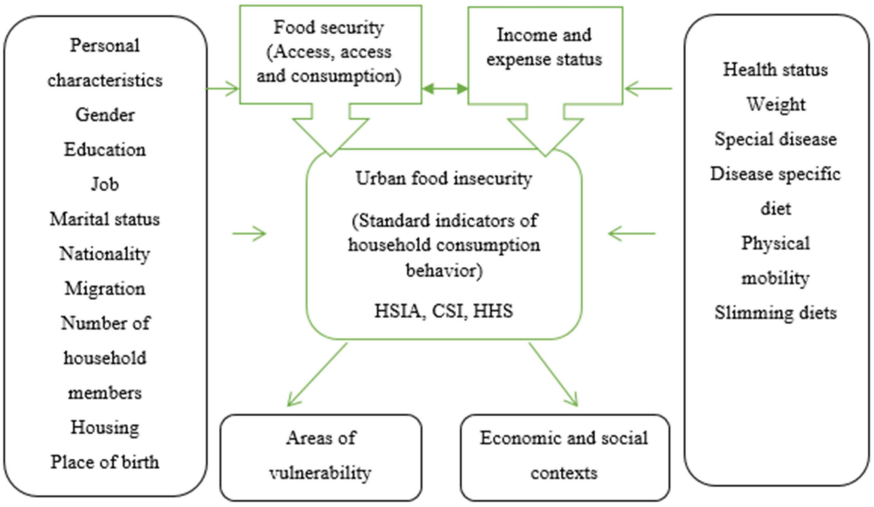

Figure 1. Block model of the dynamic system of urban food insecurity.

Figure 1 represents a general view of the model and shows a broad view of the main blocks considered in the theoretical framework of the research. Based on the objectives of this study, the following endogenous blocks were considered:

- Urban food insecurity status,
- Income and cost status,
- Health and hygiene status,
- Individual characteristics,
- Vulnerability areas.

The main loop is the urban food insecurity situation. Flow variables such as standard Food Consumption Behavior indexes determine the state variable of urban food insecurity. Other blocks with defined subsets affect the state and quality and show exogenous variables affecting the model. The dynamic system simulation model has been developed here. It consists of diagrams of state and flow variables and an information network. Relationships between variables are shown with mathematical functions (Morecroft, 2015; Sterman, 2000). State variables are represented by rectangles that store information. The status and level of the state variable are adjusted by input and output and can only be modified by input and output. Other elements are auxiliary parameters or variables that are used for calculations and kept by the information network.

Model simulation has been developed in Vensim PLE 8.0.8. This model has been developed based on food insecurity and food security models (Engdaw and Kebede, 2018; Kharisma and Abe, 2020; Muetzelfeldt, 2010; Sjaifuddin *et al*., 2019; Stave and Kopainsky, 2015). The extracted model has four state variables: individual characteristics, health and hygiene status, income and cost status, and food security status. This model has been enriched by adding the following elements needed for the model:

a) Changes in 9 characteristics of individual characteristics in households,
b) Average income and average cost status in 18 household consumption sectors,
c) Indexes of access, achievement, and everyday consumption of food security,
d) Changes in 8 characteristics of the health and hygiene status characteristics of households,
e) Changes in HFIS (Masa and Sharma, 2021), HHS (Andriamparany *et al*., 2021), and CSI (Maxwell *et al*., 2008) indications of food insecurity.

Limitations of this include the coincidence of data collection with the start of the Corona pandemic, low access to funding, and participants, difficulty in accessing confidential information (income, disease, etc.) of the studied community, as well as the newness of the process of information analysis and data processing. Also, due to the complexity of these studies and the use of different scenarios, data collection and analysis requires high inference and accuracy.

RESULTS

Characteristics Changes in Households

Changes in individual characteristics are according to the distribution of gender, age, education, occupation, marital status, ethnicity, migration (number of years of migration), number of family members, residence status, and place of birth of respondents as statistical samples. Accordingly, under the research model subsystem, household characteristics and their impact are divided into two subgroups of quantitative and qualitative ones. We performed the quantitative (numerical) coding in the class of qualitative characteristics such as gender, ethnicity, marital status, place of birth, and residence status. Individual characteristics status depends on changes in gender and age composition, marital status, and other variables. The research model in this subsystem integrates these characteristics. There are three variables in this subsystem, including Variation of Characteristics (VCh), Individual Characteristics status (ICh), and Effectiveness of Characteristics (ECh). The model has one input (change in them) and one output (development), while other variables cause delays. For example, to assess the level of effect of migration, the duration of migration is needed. In the case of this variable, the impact of the migration variable increases as the duration of migration increases.

Auxiliary variables form the information network. In this case, the information network to affect the individual characteristics shows the extent of changes in the different households' characteristics. Figure 2 illustrates the effect of these characteristics as a result of their differences. Differential equations represent

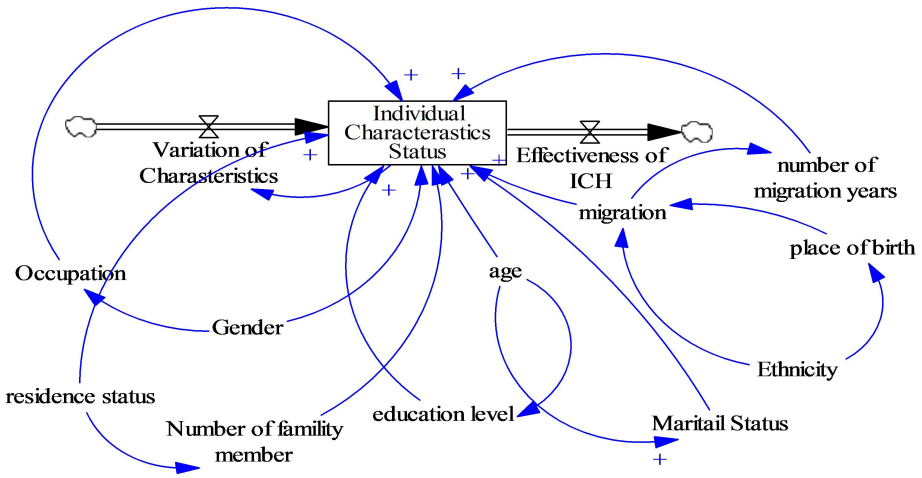

Figure 2. State and flow diagram of individual characteristics. Source: Extracted from Vensim's finding.

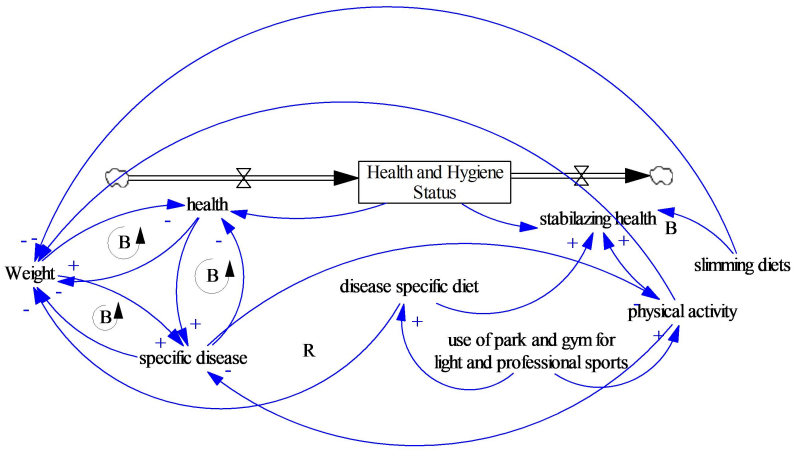

Figure 3. State and flow diagram of health status. Source: Extracted from Vensim's finding.

flow and state dynamics. For example, Equation (1) shows the relationship between ICH and its flows:

$$\frac{d(ICH)}{dt} = VCH - ECH \qquad (1)$$

Where Individual characteristics (ICH), Variation Characteristics (VCH), and Effectiveness of ICH (ECH).

Health and hygiene status has six sub-classes: weight, specific disease, disease-specific diet, physical activity (use of park and gym for light and professional sports), and slimming diets. This state is divided into two classes of health (weight, specific disease) and maintaining health and hygiene (typical disease diet, physical activity, slimming diets). A change in this state depends on two classes of health and its maintenance and continuity. We considered two categories of health and its care and continuity for this subsystem.

Figure 3 shows the flow and state diagram of this subsystem. Both flow variables have the same structure. Both change the Food Consumption Behavior type of households and change the style of food consumption. This structure will have a material delay until reaching the conclusion stage of this behavior. The health and hygiene status improves or declines with changes in the health class, and its condition is stabilized with maintenance and continuity. In this regard, auxiliary variables of weight and specific diseases form a corrective feedback loop (corrective or negative feedback means that with increasing one, the other decreases). In addition, all auxiliary variables are in the class of maintaining health; there is a strengthening and positive relationship. In some cases, these additional variables have negative and positive effects (diets, weight loss, and physical activity for weight loss and reduce diseases). Both instances are complications of urbanism that are exacerbated.

Equation (2) shows an example of quantifying the health status model. This equation describes the dynamics of the state variable. The dynamics of Health and Hygiene Status (HHS) depend on Health (H) and Stabilizing Health (SH).

$$\frac{d(HHS)}{dt} = H - SH \qquad (2)$$

Income and Cost Status

This subsystem has two flows of income and cost. These two flows show the status of expectations and the ability to stabilize the income and cost status. These flows directly represent the values of the Food Consumption Behavior curve (Kharisma and Abe, 2020). For example, Equation (3 and 4) shows modeling average cost as a consumption curve. It starts with the initial cost of foods (13 different sections), education, and health.

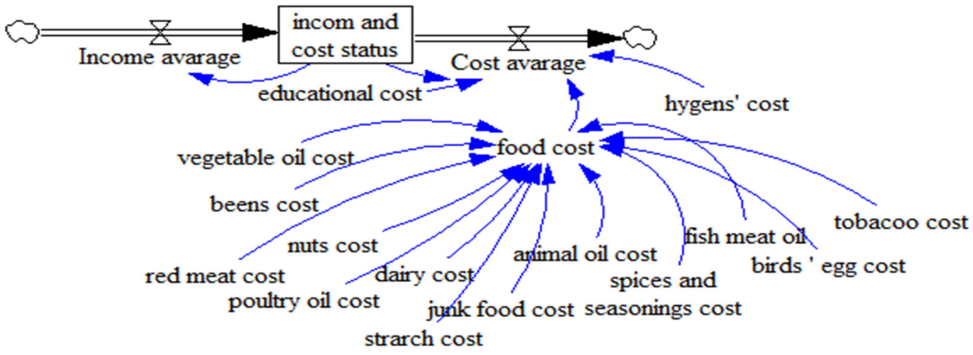

Figure 4. State and flow diagram of income and cost status (Source: Extracted from Vensim's finding).

Their total consumption costs were calculated using the average cost (with cost curve function) (Figure 4).

$$\frac{d(ICS)}{dt} = CA - IA \quad (3)$$

$$IF: CA \leq EC + FC + HC \quad (4)$$

Where Income and Cost Status (ICS), Incom Avarage (IA), Cost Average (CA), Educational Cost (EC), Food Cost (FC), Hygiene Cost (HC).

Food Security Status (Accessibility, Affordability, Consumption)

In this subsystem, we developed state and flow variables similar to the food security system (Muetzelfeldt, 2010) and eliminated only auxiliary variables. This subsystem has three indexes to create food security, including accessibility, affordability, and consumption. Figure 5 shows the main structure of food security. As an example of a state variable, Equation (5) describes the relationship between the fulfillment of each index for Food Security (FS) and its flows.

The income and average cost diagrams also influenced the path of fulfillment of household food security indexes.

$$\frac{d(FS)}{dt} = FC - EC \quad (5)$$

Where Fulfilment of Criteria (FC) and Effectiveness of Criteria (EC).

The two variables of economic and social contexts and vulnerability contexts in food insecurity (Figure 6) are also affected by food insecurity in the final model.

Validation

Evaluation is essential for potential users of a model. The user needs information about the quality of the model to decide how much credence to give to model results. Evaluation is a significant activity in all

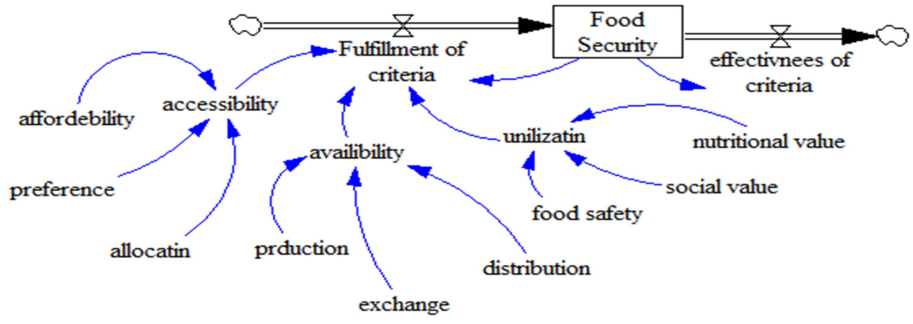

Figure 5. State and flow diagram of food security.

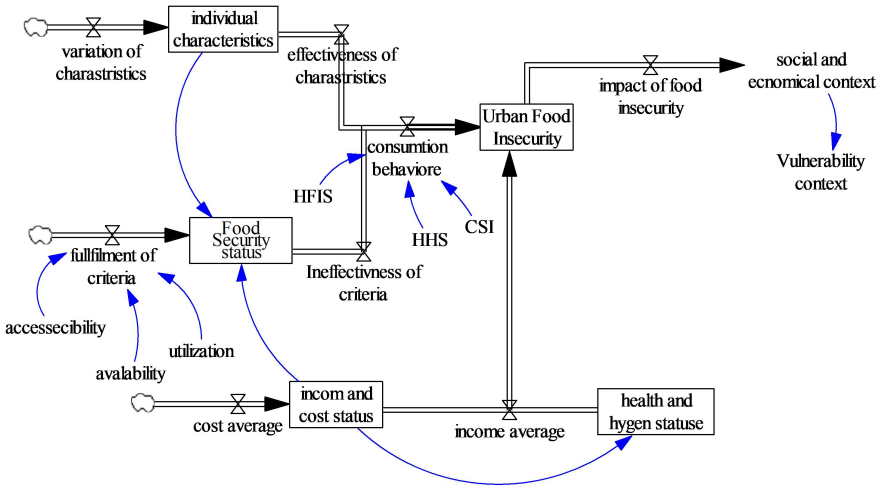

Figure 6. State and flow diagram of food insecurity (Source: Extracted from Vensim's finding).

modeling work, but it is particularly important for system modeling in complex food systems; consequently, model errors can be significant. It is essential then to give some quantitative measure of how significant those errors are (Wallach *et al*., 2018). If by "valid" we mean that the processes described in a system model have behavior identical to the processes in the real world, then, we can never conclude that a model is valid. The usefulness of models for drawing conclusions about real-world behavior is probably limited to very simple models (Wallach *et al*., 2018). We performed a validation process according to the standards used (Barlas, 1996; Sterman, 2001) to validate the model and simulation results. Experimental results were performed to analyze structural compatibility (subsequent compatibility tests and parameter verification) for structural validation. To confirm the parameter, we analyzed the initial dataset to provide reliable information for the development of the model (Table 1). In the research literature, to confirm the relationships as stated in the model presentation, the knowledge obtained from references (Wallach *et al*., 2018; Portela-Parra and Leung 2019; Kharisma and Abe, 2020;Sjaifuddin *et al*., 2019) was used.

Moreover, structuralism behavioral tests (Extreme Condition test) (Barlas, 1996) were used, and no structural defect was observed.

Also, researchers tested the model's ability to repeat past behaviors, for example, behavior validation (Jacobi *et al*., 2003). Thus, past data were compared with simulation results, and the model was calibrated for unknown parameters by Minimizing the Error (MSE) (Table 2). The income and average cost parameters, food security status, health and hygiene status, and individual characteristics were selected using the previously mentioned models. After achieving the structural and behavioral validity of the model, this model was used for practical testing.

Simulation and Analysis of Results

This section presents a set of simulation experiments with different urban food insecurity scenarios. The main scenario refers to the introduction of individual characteristics and the effect of urban food

Table 1. Limits and equations for each evaluation criteria.[a]

Criteria	Limits	Equation
Reduction in the objective function	Percentage between -100 and 100%	$\frac{\text{MSE after calibration} - \text{PMSE before calibration}}{\text{PMSE before calibration}}$
Maximum difference reached in the period t of simulation	Dimensional without limits	$\text{Max} = \frac{(\text{Xij} - \text{Y ij})}{\text{Yij}}$
Error distribution	Percentage between 0 and 100%	$\frac{\text{PMSEi}}{\text{PMSE}}$
Theil's coefficients	Percentage between 0 and 100% Um+Uv+Uc= 1	$\text{UM} = \frac{(\text{Xji} - \text{Y ji})^2}{\text{MSE}}$ $\text{Uv} = \frac{(\text{Sd. X} - \text{Sd. Y})^2}{\text{MS}}$ $\text{EUc} = \frac{((1 - \text{r})(\text{Sd. X})(\text{Sd. Y}))^2}{\text{MSE}}$
R^2 coefficient	Percentage between 0% and 100%	$\sum \frac{(\text{Xij} - \text{Xij})(\text{Yij} - \text{Y ij})}{\sqrt{\sum \text{Xij} - \text{Xij})^2 \sum (\text{Yij} - \text{Yij})^2}}$

[a] *X: Represents the simulated data, *Y: The Historical data, *Um: Average error, *Uv: Variance error, *Uc: Correlation error, *Sd: Is the Standard deviation and *R: Is the correlation coefficient.

Table 2. Behavior validation results.

Variables	Theil				
	R (dmnl)	MSE[a]	U_m (dmnl)	U_v (dmnl)	U_c (dmnl)
The income and average cost	0. 989	4,236,919	0.487	0.001	0.533
food security status	0.982	60	0.368	0.006	0.651
health and hygiene status	0.979	41,315	0.658	0.127	0.276
individual characteristics	0.975	20,728	0.009	0.095	0.956

[a] MSE (Mean Squared Error): $\frac{1}{n}\sum_{i=1}^{n}(y1 - yh)^2$ Source: Extracted from Vensim's finding.

insecurity. The fundamental changes for the analysis are:

a) Changes in individual characteristics in terms of basic food needs,

b) The effect of these changes on urban food insecurity, which is considered a common approach in urban life.

Accordingly, the parameters considered in the Individual Characteristic (ICh) status are the current state, as we discussed in the previous section. This scenario is directly related to the current system. It means that this scenario includes the same set of parameters used to validate the model, as it is directly related to policies at the beginning of the simulation. Figure 7 shows the dynamics of using the individual characteristic's status after indicating the studied characteristics' effectiveness.

Their effectiveness increases by improving attention to individual characteristics in urban environments (this situation can be strengthened for the next ten years, probably). The intensity of migration and the age of the study group, the degree of impact, and the power of decision making increase them. Also, quantified characteristics such as gender or place of birth affect their level of effect and their decision-making for the choices ahead (within the studied time limit). Thus, there is sufficient evidence to conclude that the average decrease and increase of the studied characteristics increase the effectiveness of these characteristics over time.

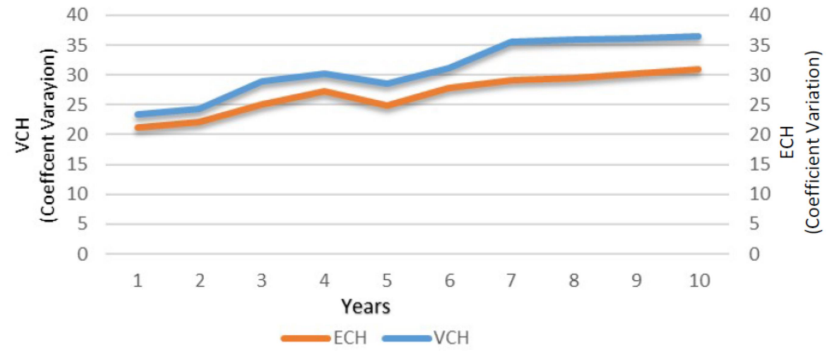

Figure 7. Changes in the Variation Characteristics (VCh) and Effectiveness of Characteristics (ECh) (Source: Extracted from Vensim's finding).

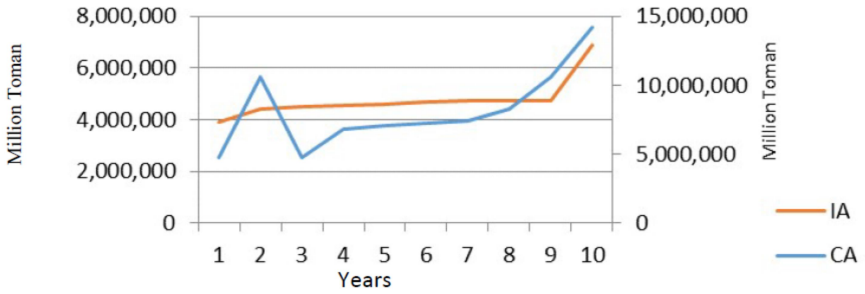

Figure 8. Changes in Income Average (IA) and Cost Average (CA) status on urban food insecurity (Source: Extracted from Vensim's finding).

Figure 8 shows the continuous increase in food prices [Rials (Iranian National Currency) was considered the measurement unit of average cost and average income]. This increase results from monetary and financial policies and inflationary stagnation, and the overseas economy caused by sanctions imposed on Iran. This figure also shows how the shortage of city household needs' sufficient supply that is caused by the Disproportionate ratio of the average cost and income has led to food insecurity and a vulnerable population over the years.

According to extracted results, in Figure 9 we can show the comparison among individual characteristics, health and hygiene, and food security scenarios. The results showed that food insecurity has increased due to the change in consumption behavior.

The simulation results show that individual characteristics, food security, and health characteristics decreased slightly in the prediction range. The average income and cost have high and low states due to the effect and strengthening of food security indexes and health and hygiene status (Figure 10).

To quantify the effect of these characteristics, by comparing the results of all models, the impact of individual characteristics increased by 10.3% and food prices and average cost increased by 13.7%. Average income increased by 9.6%, given food insecurity scenarios and the results of the models proposed in the cited studies, which were the basis of this study. The fulfillment rate of food safety indexes decreased by 4.2%, increasing the proportion of vulnerable urban populations with inadequate basic food. Although the results show that the increase in food

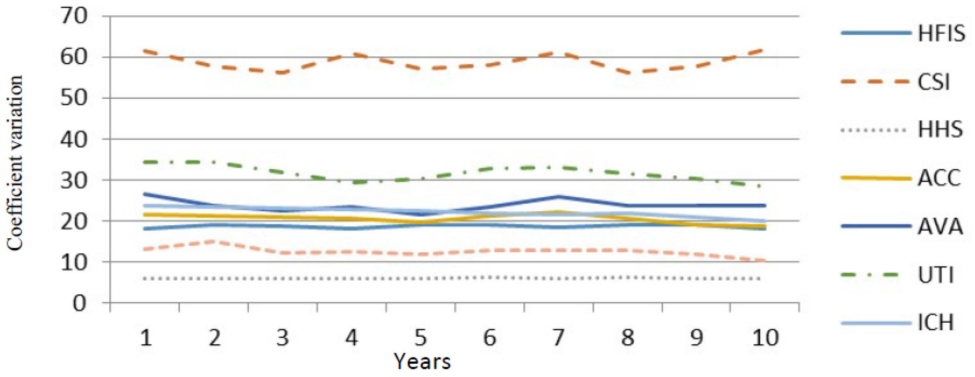

Figure 9. Comparison among individual characteristics, health and hygiene, and food security scenarios (Source: Extracted from Vensim's finding).

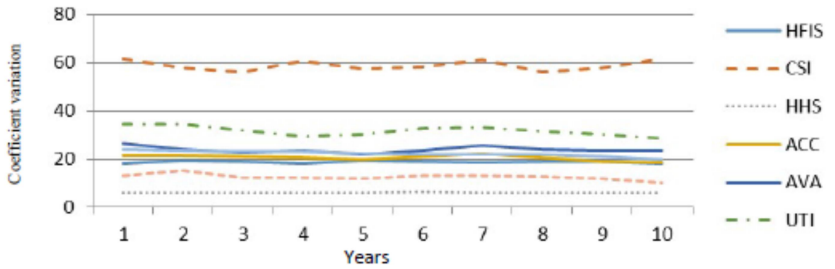

Figure 10. Average cost and average income scenario (Source: Extracted from Vensim's finding). (HFIS) Household Food Insecurity Access Scale; (CSI) Coping Strategies Index; (HHS) Household Hunger Scale; (Ava) Availability; (Acc) Accessbility; (Uti) Utilization; (ICH) Income /Cost Characteristic.

insecurity due to the rise in food prices and average cost has been affected by increasing fuel prices over the past two years, individual characteristics were affected less by this change. It was higher only in migration from rural to urban areas and job changes due to uneconomical agricultural jobs.

DISCUSSION

One scenario focused on individual characteristics with particular emphasis on migration and job changes. The other scenarios concentrated on changes in food security indexes, changes in costs, and average income, and one scenario on health and hygiene status.

In the first scenario, cities' situation and attraction in fulfillment of the growing needs of people and lack of comprehensive growth of small towns and villages inherently change immigration behavior and job change among citizens. However, other individual characteristics (such as age changes) also occur directly and over time, non-significantly, with changes in education level and marital status. The above scenario assumes that personal characteristics enhance the extent to which food insecurity indexes are fulfilled.

In contrast, the scenario proposed by Brown *et al*. (2019) was consistent with this model. Accordingly, these individual characteristics now enhance the negative effect of food insecurity, which is also compatible with Muetzelfeldt (2010) model. In addition, the scenario of changes in food security indexes focuses on the performance

of the food system (accessibility, affordability, and consumption).

Concerning individual characteristics, this scenario creates and enhances food insecurity by reducing its own effects.

The scenario of cost and income changes also indicates a decrease in income and an increase in expenses, enhancing the effect on food insecurity. This scenario focuses on increasing production and changing the government's monetary and financial policy to control inflationary stagnation, as Kharisma and Abe (2020) emphasizes changes in income and cost on food insecurity and security.

In this regard, the research analysis began with assessing the baseline scenario by determining the FIS indicators, which considered the urban household's consumption behavior. This consumer behavior is influenced by the average cost and income, the health status and the health variables of urban households, and the stability and continuity of these variables, the quality of individual characteristics and the influence of these variables, and finally, the degree of fulfillment and importance to food security indicators have decreased.

Also, since health status and fulfilling food safety indexes are affected by average income and average cost, they will experience positive gains and expenses over time. Changes in the middle income and average expenditure indirectly affect, and are affected by, society's social and economic conditions.

CONCLUSIONS

This study used a dynamic system-based model and evaluated the possible consequences of changes in individual characteristics, income, and cost, food security indexes, and health and hygiene status for food insecurity of urban households using Food Consumption Behavior indexes. The primary case simulation showed how individual characteristics could exacerbate urban food insecurity. Papers' scenarios showed the correlation between food insecurity indexes and effectiveness. Competition for food security indexes, considering individual characteristics, reduces the effectiveness and fulfillment of negative Food Consumption Behaviors in food insecurity indexes, reducing the population's vulnerability to basic food needs. In addition, average income and average cost scenarios, and changes in health and hygiene were very effective in creating different Food Consumption Behaviors. Costs in the health and education sectors improved the health status and continued these changes. This path also is predictable for the next ten years. People are highly vulnerable to food insecurity when they face multiple shocks when their income is low and uncertain (Maliro, 2011). These interventions require parts of scenarios that aim to improve individuals, communities, or systems affected by crises to withstand damage and achieve rapid recovery (Fao, 2008). A wide range of models based on different methods (such as non-linear linear programming methods (Darmon et al., 2002; Parlesak et al., 2016), Multi-Criteria Decision-Making (MCDM) types (Radmehr et al., 2021), and types of decision support systems (Blackmon et al., 2021) seek to detect and integrate other scales' indicators that have not been identified but they have imperceptible changes in the food insecurity phenomenon over time and with use of several dynamic variables. This research confirms that the modeling process can be valuable for evaluating consumer behavior policies and their factors in developing countries. This analytical framework is essential for governments to assess the real potential of their citizens' characteristics.

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رفتار مصرف کننده و ناامنی غذایی ساکنان شهری: تحلیل دینامیکی عوامل کنترل کننده آن

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چکیده

تصمیم گیری دقیق و متمرکز در بخش مواد غذایی چالش های تهدید کننده ثبات سیستم های غذایی را کاهش می دهد. علاوه بر این، می تواند هر گونه تغییری که منجر به کمبود مواد غذایی شود را به طور بهینه کنترل کند .پژوهش حاضر با هدف شناسایی اثرات عوامل قابل شناسایی بر ناامنی غذایی با استفاده از یک سیستم پویا با تاکید بر رفتارهای مصرفی انجام شده است. یک مدل پویا برای درک تعامل بلندمدت بین ویژگی‌های فردی، میانگین هزینه، متوسط درآمد و وضعیت بهداشتی تهیه شد و سپس یک مدل پویا با استفاده از پرسشنامه در بین خانوارهای استان البرز اعتبارسنجی و عملیاتی شد .سناریوی پایه برای پیش‌بینی تغییرات ناامنی غذایی نشان داد که ناامنی غذایی طی ده سال افزایش یافته و منجر به تغییر وضعیت اجتماعی، اقتصادی و آسیب‌پذیری جامعه شهری شده است. چهار سناریوی دیگر نشان می‌دهد که میانگین هزینه و درآمد می‌تواند مستقیماً با تأثیر غیرمستقیم بر سیاست‌های افزایش امنیت غذایی، سلامت و بهداشت بر وضعیت ناامنی غذایی در ایران تأثیر بگذارد. ویژگی های فردی و امنیت غذایی نیز بر ناامنی غذایی تأثیر می گذارد و رابطه بین این متغیرها را تقویت می کند .این مطالعه نشان داد که مدل‌سازی سیستم‌های پویا می‌تواند ابزار ارزشمندی برای ارزیابی سیاست‌های ناامنی غذایی و عوامل آن در کشورهای در حال توسعه باشد.