Determining the Causal Model Role of ICT in Improving Food Availability of Iranian Rural Households

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Abstract

Access to desirable, sufficient, safe and nutritious food is one of the basic components of the development and health of a society. Information and communications technologies (ICTs) represent an important strategy that can be used in attaining food security. The main purpose of this research, performed in 2006-2007, was to identify the effectiveness of ICTs in improving the food availability of rural Iranian households. A descriptive methodology was applied in this research, through questionnaires. The results showed that, according to the experts' point of view, the situation of food security in rural Iranian households was medium, but that ICTs could play an important role in improving the situation. The results of stepwise regressions showed that increasing food production, transferring of new methods and technologies, improving interactions and communications, providing information about cultivation and harvest, facilitators and content of old technologies were determined to account for 71% of the variance of the food availability of rural Iranian households. Moreover, the path analysis technique demonstrated that the improvement of interactions and communications had the greatest influence on determining the casual model of improving the food availability of rural Iranian households (β = 0.992).

Key words: *Information and communications technologies, food availability, rural households*

1. Introduction

Access to desirable, sufficient, safe and nutritious food is a basic component of development and health of a society. Thus, when developing country goals and priorities, food security is of utmost importance. Most observers of rural development believe that, currently, the necessary condition for obtaining food security is information. Knowledge and information are important factors to ensure food security, and ICTs have the ability to present the information required for improving food security. According to the definition determined by the World Food Summit (1996), Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food security for a household means access by all members at all times to enough food for an active, healthy life (CTA 2005). In other words, food security is the guarantee of the physical availability of and economical accessibility to sufficient food (produced with bioenvironmental and sustainable social methods) in terms of quantity (amount, distribution, calories) and quality (safe, nutritious, balanced), while cultural admittance for all people at all times means having healthy and active lives to preserve human places and degrees (Temu and Msuya 2004).

Food security can be summarized according to three factors: food availability, food accessibility and food utilization. Food availability is achieved when a sufficient amount of food is constantly available for all members of society. This kind of food can be obtained through household production, local production, imports or food aids. Food accessibility is obtained when households and individuals have sufficient sources to consume a suitable diet. In other words, food accessibility is possible if the household income allows for the preparation and purchase of enough food (Bakhtiari and Haghi 2003). Food utilization refers to suitable biological uses of food that depend on a household knowledge of techniques for storing and processing food and basic principles of nutrition and caring for children (Sustainable Development Department 2006).

Different strategies exist for obtaining food security; the use of information and communications technology is one of these strategies. ICTs consist of various collections of resources and technical tools that are used for connecting, spreading, storing and managing information (Pigato 2004). In other words, ICT represents the collection of hardware and software that is used for producing, preparing, transferring and storing data via devices such as computers, radios, televisions, etc., and it includes an extensive scope of traditional and modern media (Norad 2002). In general, ICTs can be classified into three groups:

1. New ICTs: This group consists of computers, satellites, one-on-one connections, wireless phones (mobile), the internet, e-mail, the web, internet services, video conferences, CD-ROMs, personal computers (PC), distance control systems, informational-geographical systems, global positioning systems (GPS), electronic cameras, databases, etc. The hidden concept behind these technologies is that they are not automatically considered to be new, but their common and inexpensive availability has resulted in them being regarded as new.
2. Old ICTs: This group consists of radios, televisions, telephones, telegraphs, audio and video cassettes, films and slides. This group of technologies has been used for several decades.
3. Very Old ICTs: This group of technologies has been used for several centuries and includes newspapers, books, photo albums, posters, theater, human interactions, markets and plays (Obayelu and Oyunlade 2006).

Information and communications technologies have an important role in different aims, such as those of increasing rural decision power, extending rural markets, preserving the environment, increasing life quality and empowering the rural poor. It is also important in several domains including social development, research, education, extension, the management and control of organization, gender equality, hygiene, the environment, agriculture and nutrition.

According to Chowdhury (2001), ICTs play an important role in food security through facilitating accessibility to related policies and information for market communication, improving market profitability, helping farmers to make decisions, increasing diversity in rural economies and reducing the cost of living. In general, some of the important capacities of ICTs in food security are related to improving communications between research systems, farmers and extension, improving accessibility to information regarding inputs, introducing technologies, providing more rapid accessibility to high quality information, ensuring information about the appropriate times and places for

optimized sales of agricultural products, increasing agricultural products and decreasing agricultural waste products (Balakrishna, 2003, Maoz, 2004, Temu and Msya 2004).

Many studies have been carried out in relation to the role of ICTs in improving the food security of rural households. The main result of the FAO research (1998) focused on creating an agricultural communication network project in Italy has helped to ensure agricultural inputs and product marketing. The results of Indonesia's participatory video project (1998) have been considered to help with clientele needs. The findings from the research of Fortier and Van Crowder (2000) about the electronic diffusion of agricultural information projects in rural communities of Kenya can improve the ability for individuals to acquire information, increase food production and develop the local capacity of rural community building. The research of Gerster and Zimmermann (2003) focused on a radio program project aimed at improving financial decisions and increasing food production. The findings of Uganda's knowledge system and agricultural information project are related to improving the power of acquiring individual information and attending to clientele needs (2000). The results of PCARRD (2003) research regarding the Philippines' information services and agricultural technology were used to improve the marketing of agricultural products and to increase production. The findings of Bangladesh's rural ICT project (2001) resulted in better marketing of agricultural products, decreased costs of accessing information and the creation of jobs. The main results of Malaysia's E-bario project pertained to the improvement of interactions and communications and responses to clientele needs.

In development fourth program of Iran, 10000 ICT rural offices have been predicated, but 2500 ICT office has been mobilized at the present. There was no ICT rural office in Iran in 2000, but the quantity of ICT office in 2005 was 963, in 2006, 2287 and in 2007, 2446 (information technology company 2007).

The results of FAO research in relation to situation of food security in Iran showed that food security indicator in rural households has been decreased during 1985-2005. Therefore, in recent years for ensuring food security in Iran, different programs have been carried out, including increasing food production in 1945-1948, ensuring rate of strategic products in 1973-1981 and investing in agricultural sector in 1983-1987 (ministry of hygiene, remedy & medical education 2004).

In addition, above mentioned solutions, using ICT for improvement food security of rural households can be an important option, because the key element in rural development in general and food security in particular, is information.

The main purpose of this research was the identification of the effective capabilities of information and communications technologies for improving the food availability of rural Iranian households. With this purpose in mind, the following objectives were compiled:

1. The study of the personal and professional characteristics of extension experts.
2. The study of the situation of food availability in rural Iranian households, from the extension experts' point of view.
3. The examination of the role of information and communications technologies in improving the food availability of Iranian rural households.
4. The determination of the casual model role of information and communications technologies in improving the food availability of Iranian rural households

2. Material and methods

The methodology of this research was descriptive, and it was carried out as a survey. The instrument that was used for data collection was a questionnaire. The research independent variables consisted of: (A) ICT capability in improving food availability (B) ICT tools(C) implications of the use of ICTs for improving food security (as you see in figure 1) and (D) personal characteristics of extension experts: gender, age, job record, level of education, major and workplace. The dependent variable was the experts' point of view about food availability; to assess it, forty-four statements were used in the form of a five-point Likert scale (from very unsuitable to very suitable), and the mean score of the answered questions was identified as the respondent's attitude. After computing the statements, they were examined on an interval scale. Some of these statements were related to the rate of food production by rural households, the rate of government investments in agricultural sectors, the amount of farming lands, the yield per hectare of agricultural products, government policies regarding the avoidance of changes in farm operations, government functions related to land consolidation , government policies related to the guaranteed sales of agricultural products, the rate of the application of scientific principles in agricultural production, the amount of foreign food imports, the volume of agricultural waste products, etc.

The statistical research personnel consisted of 253 extension experts from agricultural organizations in eight provinces of Iran: Qom, Ilam, Kerman, Semnan, Qazvin, Kordistan, Tehran and Lorestan. The required research sample size was also calculated to be 170 people by using the Cockran formula. Thus, in a pre-test, 30 questionnaires were distributed, and the variance of the dependent variable (food availability) was calculated as $S^2 = 0.26$. Using N = 253, d = 0.05 and t = 1.96, the required sample size was determined to be 155 persons; to increase certainty; it was increased to 170 persons.

$$n = \frac{N^2 t s^2}{N^2 d + t^2 s^2} \quad , \quad n = 170$$

The research sampling method was stratified. Thus, initially, among the 30 provinces of Iran, the 8 provinces listed above were chosen randomly (Table 1).

Table 1. Divisiveness of provinces of Iran according to influence coefficient of rural ICTs

Rank	Province	coefficient of rural ICTs	Range
1	**Qom**	96	
2	Mazandaran	78.49	75-100%
3	Golestan	75.09	
4	Kermanshah	63.59	
5	Chaharmahal	61.15	
6	**Ilam**	59.26	50-75%
7	Southern Khorasan	53.65	
8	Isfehan	48.14	
9	**Kerman**	43.37	
10	Northern Khorasan	42.40	
11	Fars	38.60	
12	Boshehr	37.38	

13	**Semnan**	37.19	
14	Sistan	36.78	
15	Kohkiloye	36.51	25-50%
16	**Qazvin**	36.19	
17	Khozestan	35.43	
18	Western Azerbaijan	34.44	
19	**Kordestan**	34.21	
20	Khorasan	29.21	
21	Eastern Azerbaijan	28.72	
22	Yazd	28.44	
23	Ardebil	26.00	
24	**Tehran**	24.46	
25	Hormozgan	22.85	
26	Zanjan	21.67	
27	Markazi	20.66	Lower 25%
28	Hamedan	19.46	
29	**Lorestan**	7.34	
30	Gilan	5.25	

To maintain the proportion between research personnel size N = 253 and sample size N = 170 in each province, the necessary sample size was chosen randomly, according to the number of experts in those provinces (Table 2).

Table 2. Number of chosen agricultural extension experts on selected provinces

Province	Total number of experts	Number of chosen experts
Qom	21	14
Ilam	24	16
Kerman	32	21
Semnan	33	22
Qazvin	18	12
Kordestan	32	21
Tehran	67	47
Lorestan	26	17
Total	253	170

To analyze the collective data, the software SPSS 13 was used. For descriptive statistics, mean, median, mode and coefficient of variation and inferential statistics methods such as correlation, regression and path analysis were used.

3. Results and Discussion

First purpose: The study of the personal and technical characteristics of extension experts

The results of this research showed that 131 of the experts were men (77.1%) and 39 persons were women (22.9%). The major of most respondents was agricultural extension

(36%). Most of the experts were working in Tehran (27.67%). Of all the experts, 116 experts (68.2%) had a Bachelor's degree, and 53 persons (31.2%) had Master's degrees. Most respondents (41.8%) had 12 – 17 years of job experience; the mean was 12 years, and the values ranged from 1 to 29 years.

Second purpose: The study situation of food availability of Iranian rural households according to agricultural extension experts' point of view

In order to assess the current food availability situation of rural Iranian households, 21 statements were used. The scores for these statements were added together and then recoded. According to the number of statements and the Likert scale for examining food security (1- very unsuitable, 2- unsuitable, 3- medium, 4- suitable, 5- very suitable), the lowest and the highest scores for one respondent were 21 = (21x1) and 105 = (21x5). After recoding, the score of a very unsuitable situation was (1- 21), the score of an unsuitable was (22- 43), the medium was (44- 65), suitable was (66- 87) and very suitable was (88- 109). The results of the research indicated that most of the respondents (77.6%) assessed the food availability situation of rural Iranian households as medium (Table 3).

Table 3-Agricultural expert's point of view about food availability situation of Iranian rural households (n=170)

Situation	Frequency	Percent	Cumulative percent
Unsuitable(22 – 43)	16	9/4	9/4
Medium (44 – 65)	132	77/6	87/1
Suitable (66 – 87)	21	12/4	99/4
very suitable(88 – 109)	1	0/6	100
Mean: 54	Median: 53	Mode: 56	

The priority settings of food availability statements were determined using coefficient variation statistics. In this way, each statement that had a lower coefficient variation was related to a more important situation. According to the results shown in Table 4, in the experts' point of view, the conditions of rural Iranian households were favorable with regard to the rate of food production (0.2517), the amount of farming lands (0.2752) and the amount of applying scientific methods in producing of agricultural production by farmers (0.296). However, when considering the quality of natural resources and environment (0.3818), government policies regarding the avoidance of changes in farm operations (0.3822) and the high volume of agricultural waste products (0.5161), the food security of these households faced serious problems.

Table 4- Priority setting of food availability situation of Iranian rural households in agricultural expert's point of view

Priority	Statements	Coefficient of variation
1	Amount of food producing by rural households	0.2517
2	Amount of farming lands	0.2752
3	rate of applying scientific methods in agricultural production by farmers	0.296
4	Situation of diversity in rural economic	0.297
5	Situation of production resources in agriculture section (water & soil)	0.3029
6	Situation of human resources management in agricultural section	0.3082
7	Variation situation in rural economic	0.297
8	Situation of human resources management in agricultural sector	0.3029
9	the rate of government investments in agricultural sector	0.3107
10–18	-	-
19	the quality of natural resources and environment	0.3818
20	government policies regarding the avoidance of changes in farm operations	0.3822
21	Volume of agricultural waste products	0.5161

Third purpose: The examination of the role of ICTs in improving the food availability of rural Iranian households

To determine the role of ICTs in improving the food availability of rural Iranian households, a total of 48 statements were used. These statements were computed and then recoded. According to 48 effective ICT capabilities and the Likert scale for testing the role of ICTs in improving food availability (1- very little, 2- little, 3- medium, 4- much/ many, 5- very much / many), the lowest and the highest scores for each respondent were 48 (48x1) and 240 (48x5). After recoding, the very little score was (1- 48), little (49- 97), medium (98 – 145), much/ many (146- 194) and very much / many (195 – 243). The results shown in Table 5 indicate that most respondents (36.5%) assigned an important role to ICT capabilities in improving the food availability of rural Iranian households.

Table 5- The role of ICTs in improving food availability situation of Iranian rural households

Role	Frequency	Percent	Cumulative percent
Little	15	8.8	8.8
Medium	60	35.3	44.1
Much	62	36.5	80.6
Very much	33	19.4	100

On the other hand, the food availability of rural Iranian households was examined with 21 statements and the 5-point Likert scale that, after being computed, became a quantitative variable.

According to the results shown in Table 6, considering clientele needs, transferring technologies and new methods, increasing food production, accessing content of old technologies, improving interactions and communications and facilitators had a positive and significant relationship at the 99% level with improving the food availability of rural households and informing farmers about cultivation and harvesting of agricultural products, helping to ensure agricultural inputs, improving individual abilities to acquire knowledge and improving individual power and the presentation of appropriate information had a positive and significant relationship at the 95% level with improving the food availability of rural households. The other variables did not have any significant relationships with the improvement of food availability of rural households. Both the food availability and the independent variables shown in Table 6 were measured in intervals, thus the Pearson correlation coefficient was used.

Table 6- Pearson correlation coefficient between research variables & improving food availability

Variables	r	p
considering clientele needs	0/211**	0/000
transferring technologies and new methods	0/211**	0/000
increasing food production	0/227**	0/000
accessing content of old technologies	0/142**	0/001
improving interactions and communications	0/196**	0/001
facilitators	0/169**	0/004
informing farmers about cultivation and harvesting of agricultural products	0/037*	0/03
helping to ensure agricultural inputs	0/067*	0/02
improving the management power of rural people and farmers	0/074*	0/01
the presentation of appropriate information	0/056*	0/02

* = P<0.05, ** = P<0.01

In order to determine the improvement of food availability of rural Iranian households, all of the variables shown in Table 6 were entered into a stepwise regression analysis. The analysis results are shown in Tables 7 and 8. According to Table 7, increasing food production, transferring new methods and technologies, improving interactions and communications, informing farmers about cultivation and harvesting of agricultural products, facilitators and content of old technologies were entered as stepwise regressions. In the first step, increasing food production was entered in the regression equation and it was determined that 33% of the variance of the dependent variable (food availability). In the second step, transferring new methods and technologies and the previous variable represented 39% of the changes. In the third step, the improving interactions and communications and the two previous variables were determined to represent 47% of the changes. In the fourth step, informing farmers about cultivation and harvesting of agricultural products and the three previous variables were determined as 55%, in the fifth step, the variable related to facilitators and the previous variables were determined as 64%; and in the sixth step, content of old technologies were determined 71% of the food availability. In total, when entering all of these variables, the result was $R^2 = 0.714$. This coefficient shows that 71.4% of the food availability of rural households' variance was related to these six variables.

Table 7- Stepwise regression analysis in improving food availability of Iranian rural households

Steps	R	R Square	Adjusted R Square	Std Error of the Estimate
1	0.63	0.396	0.331	3.32
2	0.67	0.447	0.396	3.02
3	0.72	0.523	0.473	2.64
4	0.78	0.603	0.552	2.27
5	0.83	0.688	0.643	2.04
6	0.89	0.785	0.714	1.74

The regression significance was also calculated by the F-test; it was significant at the 99% level (sig = 0.000). This research confirmed the results of Fortier (2000), Zimmermann and Gerster (2003), PCARRD (2003), rural ICT of Bangladesh (2001) and E-bario Malaysia (2003).

The variables that were entered in the regression equation were the main part of the regression analysis and are shown in Table 8. The related T-test of regression coefficient showed that these coefficients were significant and in estimate is Y.

Table 8- Standardized & unstandardized coefficients of improving food availability

Variables	Unstandardized Coefficients B	Std.Error	Standardized Coefficients Beta	t	Sig
Constant	50/263	3/459	----------	19/157	0.000
Increasing food producing (X_1)	0/243	0/255	0/616	2/802	0.000
Transferring new methods and technologies (X2)	0/296	0/278	0/509	3/463	0.002
Improving interactions and communications (X_3)	0/311	0/283	0/423	2/129	0.002
Informing farmers about cultivation and harvesting of agricultural products (X_4)	0/ 421	0/34	0/383	3/142	0.003
Facilitators (X_5)	0/483	0/371	0/296	4/042	0.002
Content of old technologies (X6)	0/527	0/416	0.201	3.418	0.003

According to the results shown in Table 8, the regression equation according to B and β quantities were, respectively:

$Y= 50.263 + 0.243x_1 + 0.269x_2 + 0.311x_3 + 0.421x_4 + 0.483x_5 + 0.527x_6$
$Y= 0.6161x_1 + 0.509x_2 + 0.423x_3 + 0.383x_4 + 0.296x_5 + 0.201x_6$

Figure 1 shows collections of determining and effective factors in improving the food security of rural Iranian households.

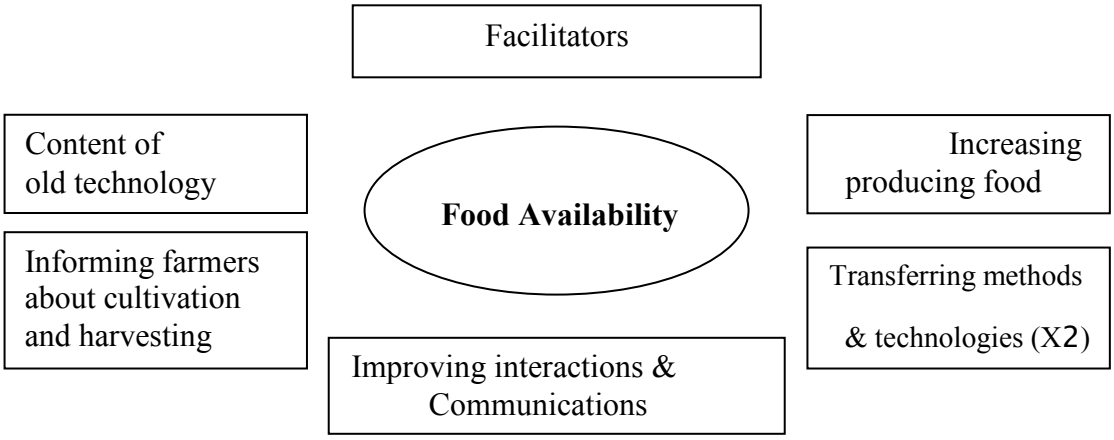


Figure 1- The determining factors of food availability of Iranian rural households

Fourth purpose: The determination casual model role of ICTs in improving food availability of Iranian rural households

To determine the casual model of effective capabilities of ICTs in improving the food availability of rural households, a path analysis technique was used. To determine the path coefficients and calculate the direct and indirect influences of the variables, a regression technique was used. In each step, one variable is the dependent variable, and the other variables of the regression analysis are independent variables, thus allowing for the calculation of the direct and indirect influences.

In the first step, food availability (X7) was the dependent variable and the other variables were independent variables. According to the quantities shown in the coefficient table (Table 8), the direct influences of increasing food production (X□), transferring new methods and technologies (X2),, improving interactions and communications (X3), informing farmers about cultivation and harvesting of agricultural products (X4), facilitators (X5) and content of old technologies (X6) on food availability were 0.616, 0.509, 0.423, 0.383, 0.296 and 0.201, respectively.

In the second step, increasing food production (X1) was the dependent variable, and other variables were considered as independent variables. The direct influences of facilitators (X5), content of old technologies (X6), transferring new methods and technologies (X2), improving interactions and communications (X3) and informing farmers about cultivation and harvesting (X4) on food availability were 0.248, 0.421, 0.311, 0.423, 0.283 respectively.

In the third step, the direct influences of facilitators (X5), content of old technologies (X6), transferring new methods and technologies (X2), improving interactions and communications

(X3) on informing farmers about cultivation and harvesting (X4) were calculated to be 0.311, 0.317, 0.428 and 0.104 respectively.

In the fourth step, , the direct influences of facilitators (X5) and improving interactions and communications (X3) on transferring new methods and technologies (X2) were determined to be 0.191 and 0.285 and respectively.

Finally, In the fifth step, the direct influences of improving interactions and communications (X3) on content of old technologies (X6) was 0.286.

Then, after obtaining the β coefficients, the indirect influences of each independent variable on the dependent variable can be calculated. To calculate the indirect influences, the β coefficients of each path were multiplied by each other until reaching the dependent variable. Each variable had both direct and indirect influences such that casual influences were obtained from all of them.

After calculating of direct & indirect influences of all variables, all of these influences are summarized in table 9.

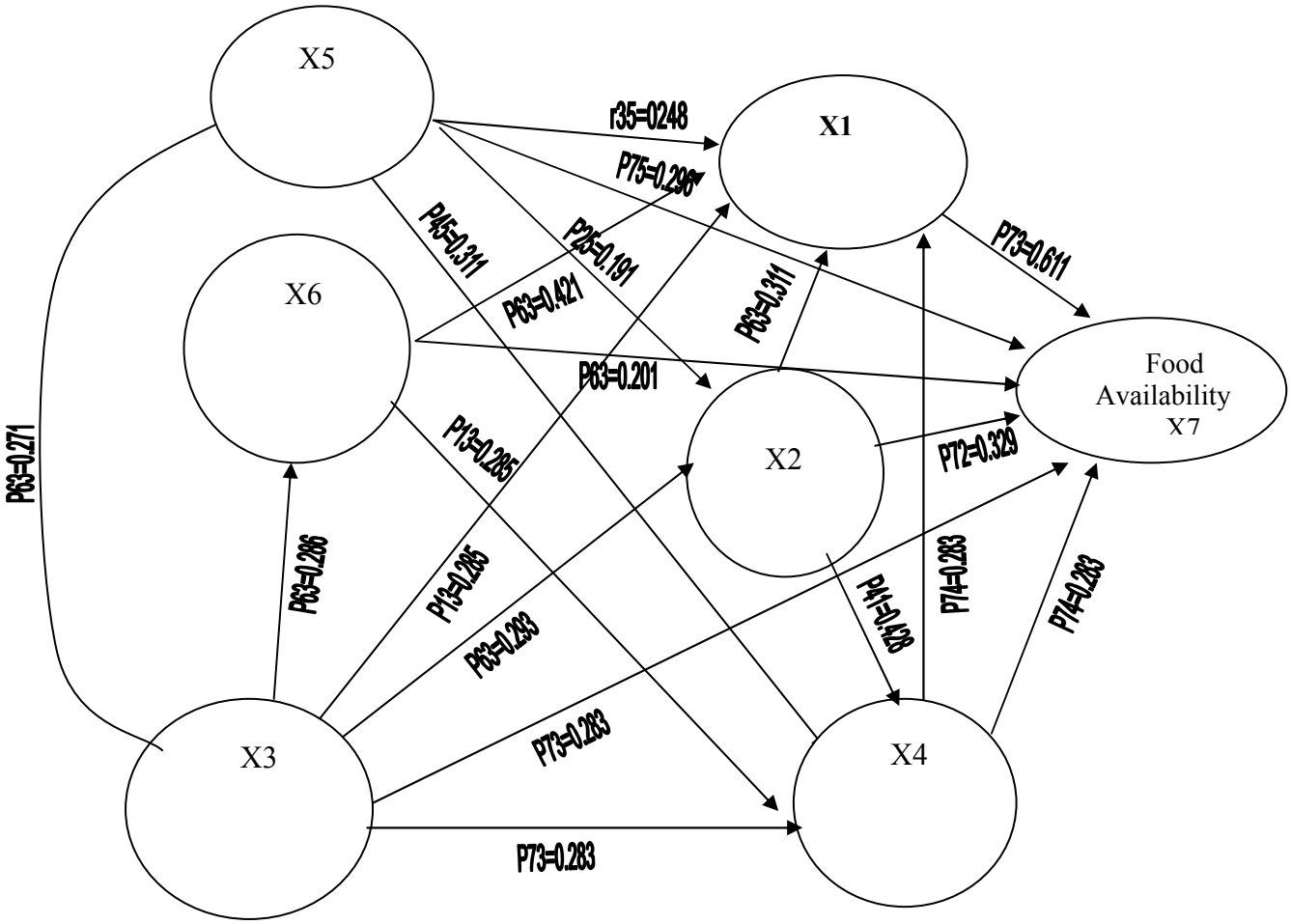
Table 9- Direct & indirect influences of independent variables on food availability

Independent variables	Indirect influences	Direct influences	Total direct & indirect influences
Increasing food producing (X_1)	----	0/611	0/611
Transferring new methods and technologies (X_2)	0/423	0/329	0/752
Improving interactions and communications (X_3)	0/569	0/423	0/992
Informing farmers about cultivation and harvesting of agricultural products (X_4)	0/078	0/283	0/361
Facilitators (X_5)	0/391	0/296	0/687
Content of old technologies (X_6)	0/371	0/201	0/572

According to Table 9, Increasing food producing (X□) had the most direct influence (0.611), improving interactions and communications (X3) had the most indirect influence (0.561), and overall, improving interactions and communications (X3) had the most influence on determining the casual model of improving rural household food availability (0.992).

The results obtained here are consistent with the results of the VERCON project in Egypt (2000), the Indian global center of agricultural information (2000), research regarding the Philippines' information services and agricultural technology (2003) and E-bario in Malaysia.

The diagram of the path analysis of the casual model of food availability is shown in Figure 2.



(X□) Increasing food producing, (X□) Transferring new methods and technologies, (X□) Improving interactions and communications, (X□) Informing farmers about cultivation and harvesting of agricultural products, (X□) Facilitators and (X□) Content of old technologies ICTs

Figure 2. Diagram of the path analysis of the improvement in rural Iranian household food availability with β coefficients

4. Conclusion and recommendations

This research, carried out to study the role of information and communications technologies in improving the food availability of rural Iranian households, has shown that the food availability situation of rural households is medium. This means that factors such as the quality of natural resources and environment, government policies regarding the avoidance of changes in farm operations and the high volume of agricultural waste products not only problematic but that they also threaten the food availability situation of rural Iranian

households. In the experts' view, information and communications technologies can have an important role in improving the food availability of rural households.

increasing food production, transferring new methods and technologies, improving interactions and communications, informing farmers about cultivation and harvesting of agricultural products, facilitators and content of old technologies could play an important role in improving the food availability of rural households. Information about food related to the manner of storing food processing food, optimizing food consumption, improving food distribution, supplying food and providing food safety played a direct and important role. On the other hand, the improvement of the food availability of rural households was strongly influenced by the improvement of interactions and communications; this rural means that practices such as increasing the quality of studies in the agricultural section, improving interactions and communications among various production factors, improving presentations of extension services, improving communications among researchers, extension personnel and farmers, and decreasing the gap between rural people and researchers can increase and improve the food availability of rural Iranian households. It can be concluded that:

- To achieve improvements in the food availability of rural households, more consideration should be paid to improving of users awareness in relation to protection of natural resource, the avoidance of changes in farm operations and also to managing the agricultural waste products.
- According to most of the experts' point of view, much more precise considerations regarding the use of information and communications technologies in improving the food availability of rural households are completely necessary and logical. Actions such as identifying and assessing appropriate ICTs for fulfilling participatory needs, ensuring appropriate ICTs for improving food security, ensuring appropriate software and hardware, providing equal access to ICTs for all people, considering clientele needs in presenting programs and information, investing in ICTs and promoting technical-information infrastructures for this purpose are essential.
- To improve the role of information and communications technologies in increasing the food availability of rural households, solutions such as the use of appropriate content from old technologies, for example, radios and televisions, for increasing food production, introducing new methods and technologies, preparing the necessity condition for applying scientific principles in producing agricultural production, improving interactions and communication, improving extension services, improving interactions among researcher, extensionist and farmers and providing information about the planting and harvesting of agricultural products are highly recommended. In addition to, being of experienced facilitators for vulgarization and preparing condition for using ICTs among rural households is important.

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