



Future Research of Sustainable Rural Planning based on Information and Communication Technology in East Azerbaijan Province

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Abstract

Purpose- Rapid advancements in Information and Communication Technology (ICT) present complex uncertainties for rural planning, with traditional methods often insufficient for navigating these ambiguities. This study aims to identify key drivers and plausible future scenarios for sustainable rural development based on ICT in East Azerbaijan Province, a region currently seeking to optimize its developmental position.

Design/methodology/approach- This applied research utilizes a descriptive-analytical method based on a future study approach. Data were collected through citation review and a researcher-made questionnaire completed by a panel of 31 experts. Structural analysis was performed using a 23×23 cross-impact matrix (MICMAC software) to identify key drivers, followed by scenario analysis (Scenario Wizard) to determine consistent future situations for a 10-year horizon (2033).

Finding- The analysis of the dispersion plane indicates that the system is unstable. Out of 23 initial variables, 7 key drivers were identified as the most critical factors affecting the system. The variable "execution of intra-village research with the cooperation of village residents to adapt ICT-based development principles to regional conditions" ranked first in terms of direct and indirect influence. Based on these drivers, 21 possible situations were designed. Ultimately, 8 scenarios with high consistency were extracted. The results suggest that the most consistent and favorable scenarios for the horizon of 2033 rely on "Creating sites related to villagers' affairs with content adapted to local culture" and "Directing extension programs to explain the necessity of ICT development." These findings provide a strategic roadmap for policymakers to transition from static planning to dynamic, future-oriented rural development.

Research limitations/implications- The study is limited to East Azerbaijan Province and relies on expert panel judgments, which may introduce subjective bias. Future research could expand the geographical scope and incorporate quantitative indicators for validation.

Originality/value- This study contributes to the literature by applying a foresight approach to ICT-based rural planning in Iran, providing a strategic roadmap for policymakers to transition from static planning to dynamic, future-oriented rural development.

Key words: Future Study, Rural Planning, Sustainable Development, ICT, East Azerbaijan.

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1. Introduction

We live in the era of communications and information, or, the revolution of communications or the revolution of information. (Ghorbani et al., 2019). Information and communication technology (ICT) as a new paradigm governing development, has become the main focus of all aspects of development and progress by influencing the way of thinking and acting and changing work and life patterns, and is considered both the cause and sign of development (Zarrabi et al., 2016). The appropriate recognition and the use of the new opportunities that this paradigm governing development presents, as the most powerful instrument of empowerment and equalization in the field of sustainable development, in order to advance economic, social, political goals, etc., to form the future era, requires awareness and adjustment with the revolutionary wave because with little negligence, we will lose the opportunities (Zarrabi et al., 2014). With the development of the Third Wave Theory by Toffler that outlined technological revolution (Jain, 2014), global communities started to learn, develop the transfer of experiences and information and zone their communication so that they can play a role and make changes for their own benefits in macro, economic, social, political and cultural fields that are directly related to the globalization process (Heddeghem et al., 2014). The use of information and communication technology can motivate the empowerment and conscious influence of this forgotten group in the process sustainability of the rural environment of Iran, and considering the ICT (FAVA) education can be effective in sustainable rural development from different dimensions (Mousazadeh et al., 2021). However, ICT (FAVA) is known as a tool for sustainable rural development in order to mitigate poverty, close the digital gap and prevent the indiscriminate migration of villagers to cities, and it is a complex issue and its development requires simultaneous interaction (Razavi Mashauf et al., 2018). ICT (FAVA) has brought social, environmental and economic development worldwide, as the availability of the market and market information has made it possible among the rural residents to enhance their income (Khodapanah, 2021). Today, the debate of ICT (FAVA) has become a necessity

for policy makers, planners and actors of rural development, and the important issue is that the proper utilization of this technology brings important achievements to promote the development of rural communities (Sorani et al., 2012). Indeed, as sustainable development in the current world is based on knowledge, the management of sustainable rural development in Iran should also emphasize on knowledge (Hajinejad et al., 2011). ICT (FAVA) centers increase productivity and mitigate living costs for villagers by providing access to the required services (Farahani et al., 2012). By using these technologies, it is possible to provide knowledge related to rural communities and enhance and increase the employment and income of villagers in structural frameworks, and strengthen the creation of new economic knowledge by villagers (Zahrani et al., 2021). It is worth to mention that despite the introduction of ICT (FAVA) in many villages of Iran, many of the capabilities of this technology in the rural sector have not received much attention due to the lack of adequate knowledge about promoting and inhibiting factors, and it has also not been properly employed (Sorani et al., 2014). It should be mentioned that access to information and communication technology will lead to the economic, social and cultural development of rural areas. Information and communication technology presents the access to the benefits and infrastructure of development for people, and to the same extent, the lack of access to information and communication technology makes a challenge in achieving the goals of sustainable development for the rural community (Movahedi et al., 2017). On the other hand, it should be stated that the investigation of many developments in today's villages and planning for their future is not imagined without considering the role and importance of ICT development. For this reason, today, the regulation of ICT development policies and strategies has become an important issue for many countries, especially third world countries (Seidiy and Hedayati Moghadam, 2012). In examining the effects of foresight in policymaking, future study is regarded as an intelligent strategic tool. This name indicates the necessity of evaluating the position of foresight in the policy system and the methods to improve its effects. Also, the requirement for the successful

design of foresight activities is a clear perception of the effect of foresight on policy-making (Namdarian, 2017) and it can play a crucial role in the development and application of proper policies in the planning structure of the region. In order to achieve sustainable rural development based on information and communication technology, different strategies should be taken: understanding the internal relations between the economic, social, environmental and political sectors, find solutions about the dangers we encounter, good and continuous control of the stakeholders and, finally, future study for designing policies and effective programming and create an understanding of the future in case of multiple and unstable developments in rural communities (Khaleghi, 2024).

Some studies have been performed by various researchers such as Grimes (1992), Ajani (2014), Krishna et al. (2015), Alam and Wagner (2016), El Bilali (2017), Kusakina et al. (2018), Aldosari (2019), Zhu et al. (2021) on IT. A review of the literature reveals that while the role of ICT in rural development has been discussed, the application of a foresight approach to identify future scenarios in this field has received less attention. The results of various researches show that neglecting the role and importance of foresight and the process of future developments of information and communication technology and the path in which villages will be positioned will lead to encountering serious barriers, imposing pressure on future generations and ultimately strategic neglect. Under such conditions, the importance and role of foresight approach in sustainable rural development is evident based on information and communication technology. Using this approach, it is possible to know the future developments of sustainable rural development and strive for improvement, stability, reconstruction and modernization of rural society based on new ideas and beliefs, as well as creating healthy communities, considering the advantages of modern information and communication technologies.

2. Research Theoretical Literature

The latest ranking status of Iran in terms of the ICT (FAVA) development index, which was published by the World Telecommunication Union by 2017, indicates that Iran assigns the 81st place among

167 countries around the world, and based on this report, Iran is lower than the global average in the sub-index of the use of ICT. However, according to official statistics by the 2015, Iran was ranked 15th in the region and 89th in the world in terms of development of communication and information technology. Despite its improvement among the countries of the region and the world, Iran has not reached an acceptable rank among the countries of the region and the world, and there is a big gap between Iran and the global average in this field (Zeinalzadeh et al., 2021). Despite its historical and cultural significance in the field of communication and the extensive measures taken in the field of infrastructure, East Azerbaijan still has not found its real position in the country and is on the path of progress. With the new measures of institutions related to communication and with the development of the province's planning and development document, it is hoped that East Azerbaijan will become the leading and prominent province of Iran in terms of employment and internet business and production support in the future. The implementation of communication and information projects of the province has made good progress compared to other aspects of the planning and development document, so that the Internet coverage has been predicted in one thousand and 122 villages, all of which have been realized and more than this number have been covered. The rural communication development plan of optical fiber has been announced with the aim of developing broadband in rural areas and strengthening the broadband core of the rural communication network. In this regard and considering the necessity of the research problem, the present study attempts to analyze and evaluate the process of prioritization and the importance of ICT influence indicators and the process of the effect of economic and social components from these areas and the components of this approach using structural effects analysis in East Azerbaijan province as a study field. The conceptual model of this research is based on the structural analysis of cross-impacts (MICMAC). In this model, the primary factors (23 variables) are ultimately reduced to 7 key factors (main drivers), and their relationships are examined within the framework of an unstable system.

Table 1. Conceptual Model Elements and Key Drivers

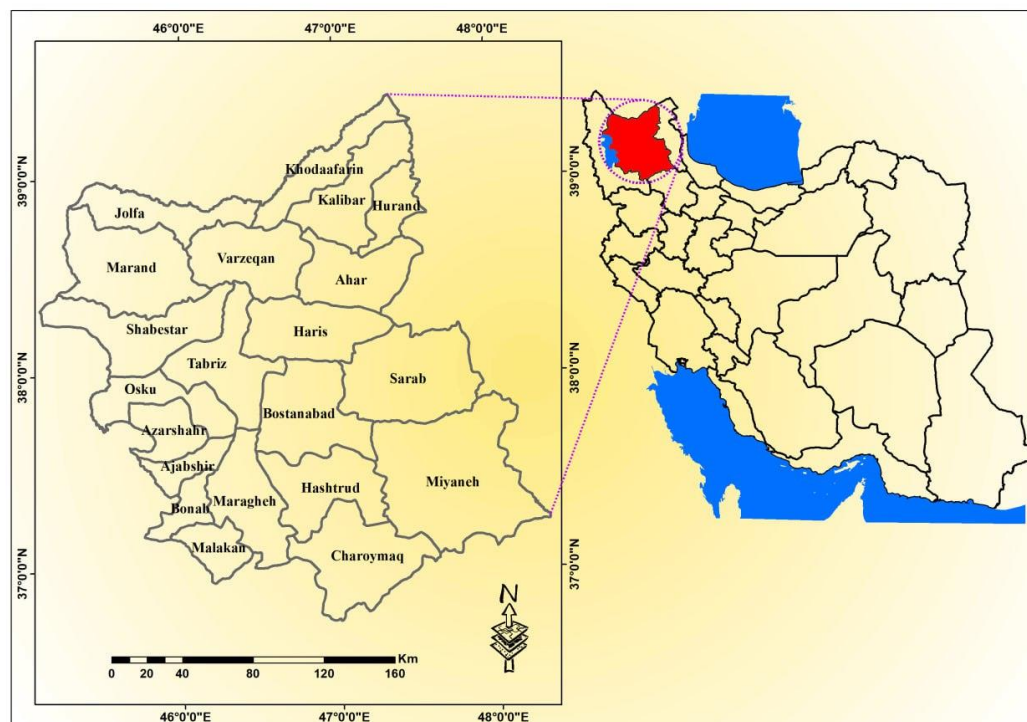
Main Elements of the Model	Definition Based on Research	Key Variables (Future Drivers)
Input (Drivers)	Influential and Strategic Factors for the future of ICT-based rural development in East Azerbaijan province.	Execute intra-village research, Increase the interaction of ICT development research system, create sites related to the affairs of villagers, strengthen feedback loops, Hold specialized ICT training courses, Use the experience and innovations of rural communities in different countries, <u>Direct extension programs</u> .
Process (Structural Analysis)	The complex, bidirectional, and unstable relationship among the key factors	Analysis of direct/indirect effects (23x23 matrix) and determination of plausible scenarios (8 scenarios with high consistency).
Output (Ultimate Goal)	Achieving Sustainable Rural Development through the use of ICT.	Advancing economic, social, and political goals, etc., in the rural areas of East Azerbaijan.

3. Research Methodology

3.1 Geographical Scope of the Research

The geographical area of the research is East Azerbaijan province. East Azerbaijan with an area of 45,490.89 square kilometers occupies 2.76 % of the country's area. According to the latest political divisions in 2017, East Azerbaijan province has 21 cities, 46 districts, 63 cities and 144 villages. Also, out of 3077 villages of East Azerbaijan province,

88.04 % (2079 villages) have inhabitants. According to the results of the census of 2016, the population of East Azerbaijan Province has reached 3,909,652 people with an average annual growth of 0.97 compared to 2011, of which 1,989,400 are men and 1,920,252 are women. Accordingly, the gender ratio of the province's population is 104 (Figure 1).


Figure 1. Map of the study area

3.2. Methodology

The present research is applied based on the purpose and descriptive-analytical type in terms of

nature and method and it is based on the future study approach from the time dimension. The reason for grouping forecasting tools is that all of these tools, regardless of whether they are quantitative or qualitative, have some inherent and inevitable ontological and epistemological assumptions. These assumptions indicate how we view the future as imaginary or objective and at the same time as something that reveals or constructs the future. The results of the citation survey to identify the key factors effective in the future of rural communication and improvement technology in East Azerbaijan province in the form of a mutual effects analysis matrix (influence rate from 0 to 3) have been provided to the respondents for

analysis in MICMAC software as a researcher-made questionnaire. At this stage, 31 experts have been identified. The participants include expert university professors, experts in the governorate, cooperative, agricultural jihad, governorate, district administration, and researchers in the field of rural and regional planning and agricultural development and extension. Figure 2 demonstrates the characteristics of the respondents.

To calculate the validity, content and face validity methods and techniques have been employed. Cronbach's alpha method was also used to measure the reliability of the research questionnaire. Cronbach's alpha coefficient for structural effects analysis is 0.83.

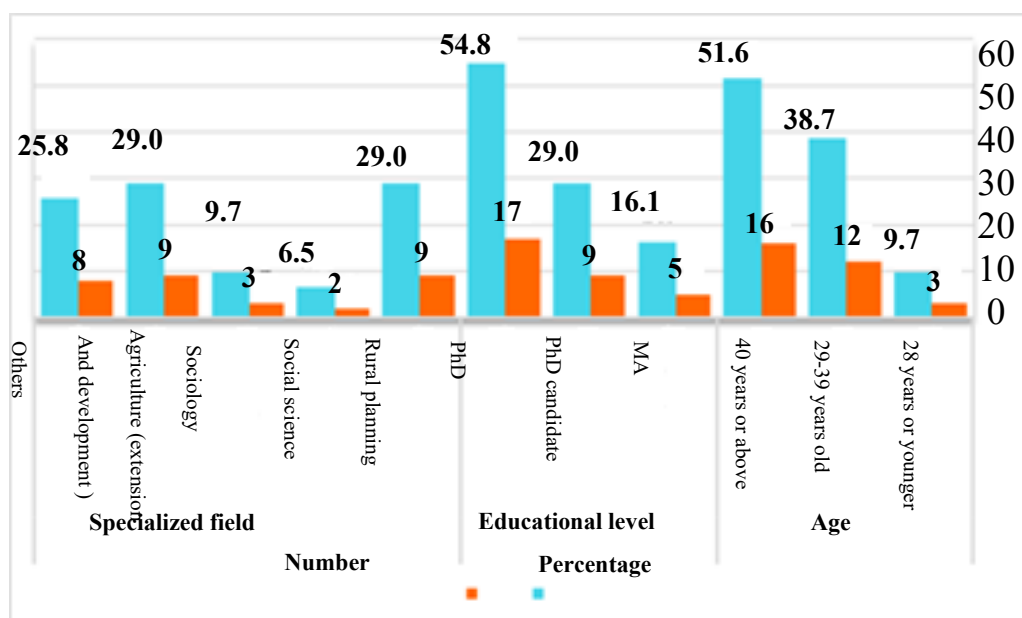


Figure 2. Specifications of respondents

4. Research Findings

The MICMAC software method is such that first, important variables and components are identified in the desired field, then they are entered in the influence analysis matrix, and the degree of connection between these variables and the relevant field is determined by experts. The variables in the rows influence the variables in the columns; thus, the variables in the rows are influential and the variables in the columns are dependent (Godet, 2006; Godet & Durance, 2011). This matrix is known as MDI or matrix of direct influence, and each MDI_{ij} represents the influence of each variable *i* on variable *j*, which can be expressed as quantitative numbers from zero to 3

(Godet, 2006). Zero indicates the absence of relationship between the variables, 1 indicates weak relationship, two is an average relationship and three indicates a strong relationship, so if the number of identified variables is *n*, an *n***n* matrix is obtained in which the influences of the variables on each other are determined. In general, the present study identified 22 variables as primary factors and analyzed with MICMAC software. In the cross matrix, the sum of the row numbers of each factor, the amount of influence and the column sum of each factor demonstrates its influence from other factors. 23 primary key factors to form the matrix of cross effects in order to identify the future of sustainable rural planning based on information and communication

technology (ICT) in the form of hardware and software dimensions are displayed in Table 3.

Table 3- Foresight of sustainable rural development based on information and communication technology

Dimension	Variable	Code
Hardware	Execution of intra-village research with the cooperation of villagers in order to adapt ICT-based development principles to the conditions of the region	Hard01
	Increase the interaction of ICT development research system with rural development researchers	Hard02
	ICT network security	Hard03
	Create sites related to the affairs of villagers and coordinating the content of the sites to the culture of villagers	Hard04
	Localize and produce software and applications in accordance with the conditions of rural areas	Hard05
	Supply equipment according to the needs of villagers	Hard06
	Strengthen feedback loops between researchers and with other stakeholders to identify technologies required by villagers	Hard07
	Strengthen information and communication infrastructures to transfer ICT knowledge to villagers	Hard08
	Wider access of rural residents to information and communication tools	Hard09
Software	Adopt appropriate policies to strengthen the physical, information and communication infrastructure	Soft01
	Adopt policies to provide human resources and training of ICT experts	Soft02
	Use the capacity of the private sector and public institutions in the development of ICT in rural areas	Soft03
	Increase villagers' trust and use of ICT in agricultural businesses	Soft04
	Making local managers, experts and rural extension authorities familiar with the concepts, principles and benefits of using ICT	Soft05
Software	Revise and reform laws related to ICT development with the approach of sustainable rural development	Soft06
	Hold specialized ICT training courses for rural experts and extension authorities	Soft07
	Use the experience and innovations of rural communities in different countries in the field of ICT	Soft08
	Allocate the credit budget for the implementation of development programs based on ICT	Soft09
	Develop a strategic and operational plan for the development of ICT in the rural areas	Soft10
	Direct extension programs in order to explain the necessity of ICT development among the villagers	Soft11
	Perceive the economic, social and environmental advantages of ICT by policy makers	Soft12
	Identify the information needs of villagers regarding each of the principles of information and communication technologies	Soft13
	Coordinate between programs of government and non-government institutions and organizations related to ICT	Soft14

Source: (Research findings, 2022) using the theoretical basics of research

23 factors were extracted in two hardware and software dimensions. In the second stage, the factors entered into the cross-impact matrix to determine the level and amount of their influence on each other and on the future process of sustainable rural development planning based on information and communication technology. The number of identified variables N should form an N×N matrix. The degree of this influence is from 0

to 3. Zero indicates no effect, 1 indicates weak effect, number 2 indicates moderate effect, and 3 indicates high effect. After determining the degree of influence of the factors, the matrix was entered into the MICMAC software to extract the key factors. The dimensions of the matrix are 23 x 23, and the degree of saturation of the matrix is 93.194, which shows that the factors have influenced each other in more than 93%. Out of the total 493 possible relationships in this matrix, 36

relations indicate zero, 86 relations show 1, 230 relations indicate 2 and 177 relations show 3.

Table 4. Direct and indirect influence of variables on each other

N	Variable	Influence	Dependence	N	Variable
1	Execute intra-village research with the cooperation of villagers in order to adapt ICT-based development principles to the conditions of the region	55	56	120795	123030
2	Increase the interaction of ICT development research system with rural development researchers	54	51	118338	112275
3	ICT Network Security	36	46	81052	101321
4	Create sites related to the affairs of villagers and coordinating the content of the sites to the culture of villagers	55	52	120631	113750
5	Localize and produce software and applications in accordance with the conditions of rural areas	43	48	96068	105701
6	Supply equipment according to the needs of villagers	39	46	86401	101580
7	Strengthen feedback loops between researchers and with other stakeholders to identify technologies required by villagers	50	53	110100	116060
8	Strengthen information and communication infrastructures to transfer ICT knowledge to villagers	48	37	106346	82903
9	Wider access of rural residents to information and communication tools	37	45	80798	99152
10	Adopt appropriate policies to strengthen the physical, information and communication infrastructure	40	48	89496	106717
11	Adopt policies to provide human resources and training of ICT experts	39	54	88015	118691
12	Use the capacity of the private sector and public institutions in the development of ICT in rural areas	39	39	85791	87089
13	Increase villagers' trust and use of ICT in agricultural businesses	43	43	94011	94130
14	Making local managers, experts and rural extension authorities familiar with the concepts, principles and benefits of using ICT	41	49	92098	108533
15	Revise and reform laws related to ICT development with the approach of sustainable rural development	59	46	128477	101904
16	Hold specialized ICT training courses for rural experts and extension authorities	50	48	109104	106358
17	Use the experience and innovations of rural communities in different countries in the field	53	53	116526	116613

N	Variable	Influence	Dependence	N	Variable
	of ICT				
18	Allocate the credit budget for the implementation of development programs based on ICT	45	49	101591	108824
19	Develop a strategic and operational plan for the development of ICT in the rural areas	50	38	110455	85118
20	Direct extension programs in order to explain the necessity of ICT development among the villagers	53	41	115501	90054
21	Perceive the economic, social and environmental advantages of ICT by policy makers	57	51	124313	113289
22	Identify the information needs of villagers regarding each of the principles of information and communication technologies	43	41	97003	90739
23	Coordinate between programs of government and non-government institutions and organizations related to ICT	48	43	107785	96864

It should be mentioned that the changes in the results of the analysis of direct and indirect effects are little, and based on the results of the first ranks, both in direct and indirect effects, there is not much difference from each other, and the

variables with a high effect are repeated in the same way with a few rows of displacement. Thus, the number of the first 7 indicators of both groups is almost the same (Figure 3)

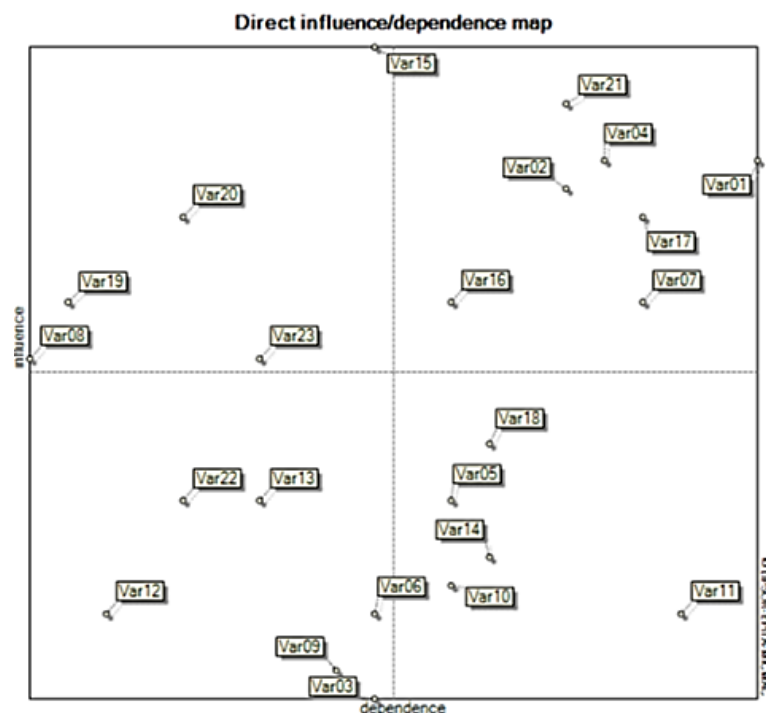


Figure 3. Dispersion of variables based on direct effects in terms of influence and dependence

The method of the dispersion of the factors on this graph shows the state of the system. Whether it is stable or unstable? This basic understanding of the state of the system affects how to analyze the factors. In stable systems, the dispersion of factors is L-shaped, which means that some factors are highly influential and some are highly dependent. Therefore, in stable systems, there are three categories of influencing factors, dependent and independent factors. On the other hand, in unstable systems, the situation is more complicated than in stable systems. In these systems, the factors are

scattered around the diagonal axis of the plane, and the factors are in an intermediate state most of the time (Godet, 2006). Based on the state of the dispersion plane of the effective variables, we can understand about the state of instability of the system. Most of the variables are dispersed around the diagonal axis of the plane. Except for a few limited factors that show that they have a high influence in the system, the rest of the variables have a similar status to each other. Therefore, the variables in Table 6 can be identified according to the instability of the system.

Table 6. Different types of identified variables

Variable type	Distribution method
Variables of district 1 (Bidirectional, strategic or surprising)	Implementation of intra-village research with the cooperation of villagers for the adaptation with the ICT-based development principles to regional conditions
	Increase the interaction of ICT development research system with rural development researchers
	Create sites related to the affairs of villagers and adjust the content of the sites to the culture of the villagers
	Strengthen feedback loops between researchers and with other stakeholders to identify technologies required by villagers
	Hold specialized ICT training courses for rural experts and extension authorities
	Take advantage of the experience and innovations of rural communities in different countries in the field of ICT
	Direct extension programs in order to explain the necessity of ICT development among the villagers

Bidirectional variables have two common characteristics of high influence and highly dependent, any change in these variables will cause changes in other variables. The drivers of district 1 are the most influential indicators. Influence graph variables indicate the relationships between variables and how they influence each other. This

graph is shown with red and blue lines; the end of each line is indicated by an arrow and shows the direction of the variable effect. The red lines indicate the strong influence of the factors on each other, and the blue lines, with differences in thickness, indicate moderate to weak relationships (Figure 4).

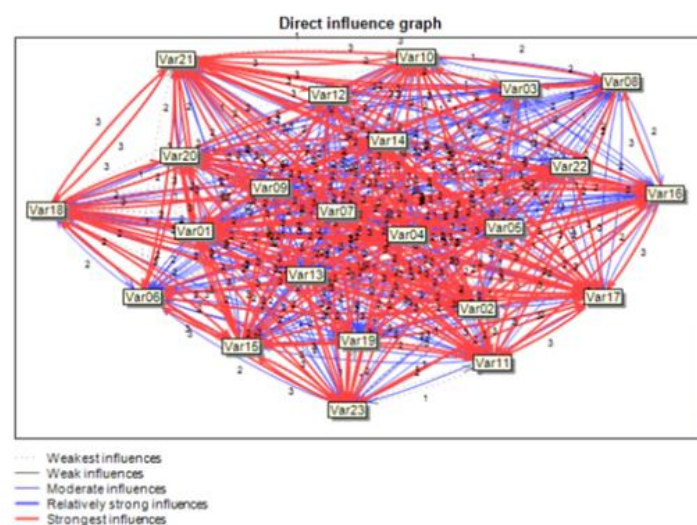


Figure 4. Direct effect cycle graph

All the factors have double effects and the dependent factors on the other hand have high influence. For this reason, the same 7 influential factors in direct and indirect influence have been

repeated in the same way (Figure 5). This indicates the validity, accuracy of calculations and its reliability.

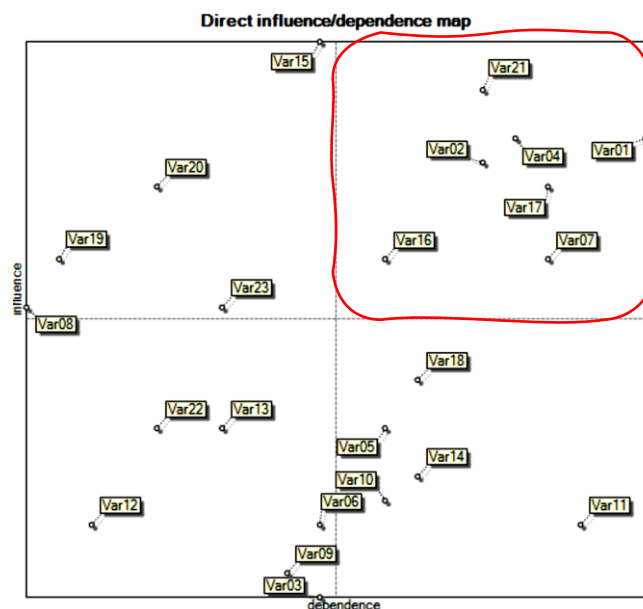


Figure 5. Direct influence-dependence map

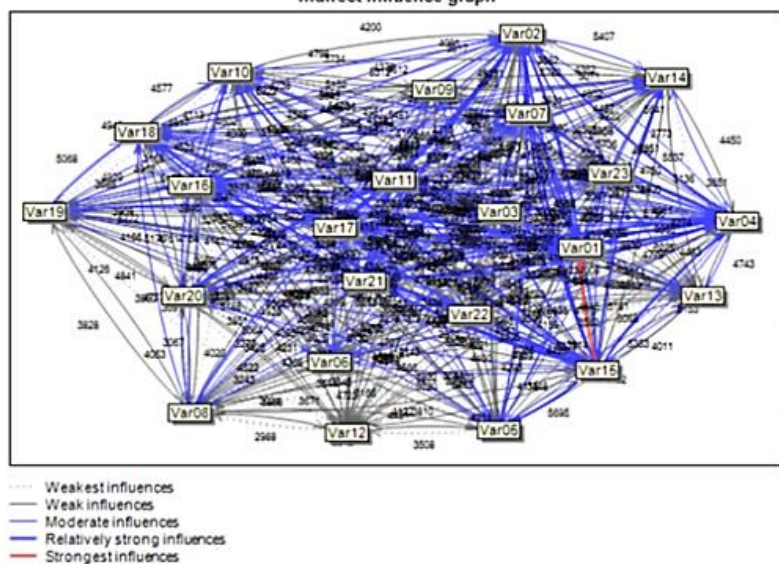


Figure 6. Indirect influence cycle graph

To make a final conclusion to determine the effective key drivers on the local planning approach of rural settlements, based on the results of two methods, including "the rank of variables in each of the states" and "the total effect of variables in all states", the key and effective factors have

been selected as described in Figure 7. Therefore, the key and effective drivers that can be considered in this research for the future approach of sustainable rural planning based on information and communication technology



Figure 7. Final ranking of key factors affecting the system

The process of structural analysis of cross effects of factors on each other was formed with a matrix that their dimensions (23 x 23) were obtained via interviews with the panel. The results indicated that the matrix based on statistical indicators with two data rotations has a 99% desirability, which demonstrates the high validity of the responses. Examining the state of the dispersion plane of the effective variables showed the instability state of the system. Most of the variables were dispersed around the diagonal axis of the plane, except for a few limited factors that show that they have a high

influence in the system, the rest of the variables had almost the same status to each other. Totally, 7 key drivers for the future approach of sustainable rural planning based on information and communication technology (ICT) were determined and identified.

Based on possible future situations, in total, 21 different situations have been designed for 7 key factors, which include a range of favorable to unfavorable conditions, and the number of conditions for each factor is composed of three possible situations (Table 7).

Table 7. Key factors and possible future scenarios for ICT-based sustainable rural planning

Key factors		Desirability degree	Uncertainties	Code
A	Implementation of intra-village research with the cooperation of villagers to adapt ICT (FAVA)-based development principles to the conditions of the desired region.	Good	Coherent and efficient planning to implement intra-rural research with the cooperation of villagers to adapt ICT (Fava)-based development principles to the conditions of the region	A1
		Intermediate and static	Inadequate attention to the implementation of intra-village research with the cooperation of villagers in order to adapt ICT-based development principles to the conditions of the region	A2
		Undesirable	Not considering intra-village research with the cooperation of villagers in order to adapt ICT-based development principles to the conditions of the region	A3
B	Increase the interaction of ICT development research system with rural development	Desirable	Increase the interaction of ICT development research system with rural development researchers	B1

Key factors		Desirability degree	Uncertainties	Code
	researchers	Intermediate and static	Relative increase in the interaction of the ICT development research system with rural development researchers	B2
		Undesirable	Reduce interaction of FAVA development research system with the rural development researchers	B3
C	Create sites related to the affairs of villagers and adjust the content of the sites to the culture of the villagers	Desirable	Investment and planning to create the relevant sites with the affairs of villagers and coordinating the content of sites with the culture of villagers	C1
		Intermediate and static	Inadequate attention in identifying information and communication needs in creating sites related to the affairs of villagers and adjusting the content of the sites to the culture of villagers	C2
		Undesirable	Lack of a specific program to create sites related to the affairs of villagers and coordinating the content of the sites to the culture of the villagers	C3
D	Strengthen feedback loops between researchers and with other stakeholders to identify technologies required by villagers	Desirable	Coherent and efficient planning to strengthen the feedback loops between researchers and other stakeholders to identify the technologies required by the villagers	D1
		Intermediate and static	Relative strengthening of feedback loops between researchers and other stakeholders to identify technologies needed by villagers	D2
		Undesirable	Lack of specific planning to strengthen feedback loops between researchers and other stakeholders to identify technologies needed by villagers	D3
E	Hold specialized ICT training courses for rural experts and extension authorities	Desirable	Planning and efficient management for the organization of FAVA specialized training courses for rural experts and extension authorities	E1
		Intermediate and static	Limited cooperation to hold specialized ICT training courses for rural experts and extension authorities	E2
		Undesirable	Lack of coordination and cooperation to hold specialized FAVA training courses for rural experts and extension developers	E3
F	Use the experience and innovations of rural communities of different countries in FAV	Desirable	The use of experience and innovations of rural communities in different countries in the field of Fava	F1
		Intermediate and static	Restricted use of the experience and innovations of rural communities in different countries in the field of FAVA	F2
		Undesirable	Intermediate and static use of the experience and innovations of rural communities in different countries in the field of FAVA	F3
G	Direct the extension programs	Desirable	Not using the experience and innovations	G1

Key factors		Desirability degree	Uncertainties	Code
	to explain the necessary of FAVA development among the villagers		of rural communities in different countries in the field of FAVA	
		Intermediate and static	Directing extension programs in order to explain the necessity of Fava development among the villagers	G2
		Undesirable	Directing extension programs in order to explain the necessity of Fava development among villagers	G3

Based on the obtained results, 1 scenario has high probability. Weak scenarios include 1536 scenarios and the scenarios with high consistency include 8 scenarios. As a result, based on the results of the scenario wizard method, 8 scenarios with high

consistency have been selected and considering that each of the key factors has 3 possible situations, each of the scenarios is divided into 3 categories, desirable, static and critical. Table 8 discusses the scenarios in details.

Table 8. State of plausible scenarios

Scenario 8	Scenario 7	Scenario 6	Scenario 5	Scenario 4	Scenario 3	Scenario 2	Scenario 1
Inadequate attention to the implementation of intra-village research with the cooperation of villagers in order to adapt ICT-based development principles to the conditions of the region	Coherent and efficient planning to implement intra-rural research with the cooperation of villagers to adapt ICT (Fava)-based development principles to the conditions of the region	Inadequate attention to the implementation of intra-village research with the cooperation of villagers in order to adapt ICT-based development principles to the conditions of the region	Coherent and efficient planning to implement intra-rural research with the cooperation of villagers to adapt ICT (Fava)-based development principles to the conditions of the region	Inadequate attention to the implementation of intra-village research with the cooperation of villagers to adapt ICT (Fava)-based development principles to the conditions of the region	Inadequate attention to the implementation of intra-village research with the cooperation of villagers in order to adapt ICT-based development principles to the conditions of the region		
Increase the interaction of ICT development research system with rural development researchers						Relative increase in the interaction of the ICT development research system with rural development researchers	Increase the interaction of ICT development research system with rural development researchers
Investment and planning to create the relevant sites with the affairs of villagers and coordinating the content of sites with the culture of villagers	Inadequate attention in identifying information and communication needs in creating sites related to the affairs of villagers and adjusting the content of the sites to the culture of villagers	Investment and planning to create the relevant sites with the affairs of villagers and coordinating the content of sites with the culture of villagers	Inadequate attention in identifying information and communication needs in creating sites related to the affairs of villagers and adjusting the	Investment and planning to create the relevant sites with the affairs of villagers and coordinating the content of sites with the culture of villagers	Investment and planning to create the relevant sites with the affairs of villagers and coordinating the content of sites with the culture of villagers		

Scenario 8	Scenario 7	Scenario 6	Scenario 5	Scenario 4	Scenario 3	Scenario 2	Scenario 1
				content of the sites to the culture of villagers			
Coherent and efficient planning to strengthen the feedback loops between researchers and other stakeholders		Relative strengthening of feedback loops between researchers and other stakeholders				Coherent and efficient planning to strengthen the feedback loops between researchers and other stakeholders	
Lack of coordination and cooperation to hold specialized training FAVA courses	Planning and efficient management to organize holding specialized training courses of FAVA	lack of coordination and cooperation to hold specialized training courses of FAVA					
Not using the experience and innovations of rural communities of different countries		Restricted use of experience and innovations of rural communities of different countries		Suitable use of experience and innovations of rural communities of different countries			
Directing the extension programs to explain the necessity of developing FAVA among villagers							

In the following sections, descriptors are discussed based on cross impact judgments. In other words, two scenarios "Investment and planning to create sites related to the affairs of villagers and adjusting the content of the sites to the culture of the villagers" and "Directing extension programs in order to explain the necessity of Fava development among the villagers" are reported as consistent scenarios.

About the descriptor "creating sites related to villagers' affairs and adjusting the content of the

sites to the culture of the villagers", the hypothesis "investment and planning in order to create sites related to the affairs of the villagers and adjusting the content of the sites to the culture of the villagers" has been selected. None of the other elements of the scenario contradict this assumption. Briefly, this hypothesis shows an impact score of +13 (Figure 8). Therefore, the selected hypothesis can be evaluated as consistent.

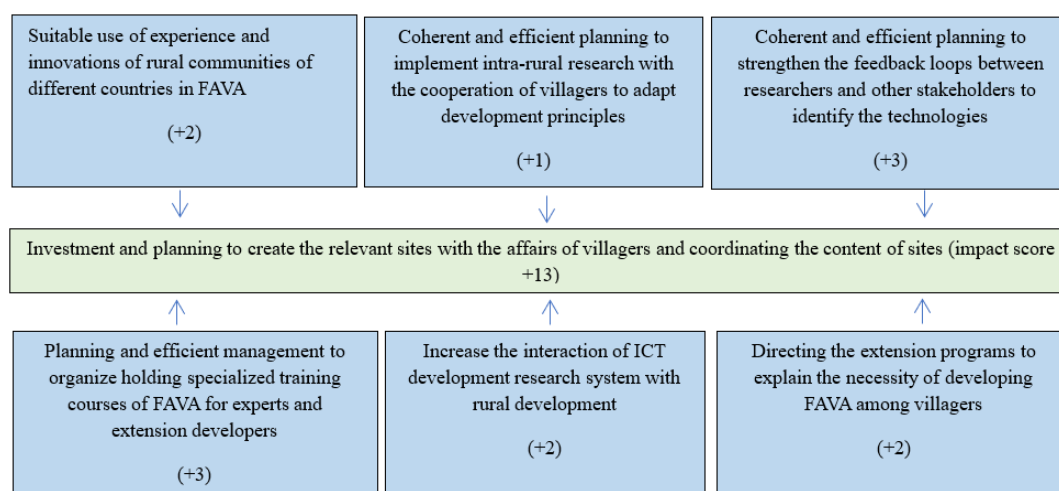


Figure 8. Implementation of intra-village research with the cooperation of villagers to adjust Fava-based development principles to the region conditions

None of the other possible assumptions shows a better balance between the followers and opponents. Briefly, none of the alternative hypotheses is more acceptable than the selected hypothesis "investment and planning to create sites related to the affairs of the villagers and the adaptation of the construction of the sites with the culture of the villagers". Regarding the descriptor "Directing extension programs in order to explain

the necessity of Fava development among villagers" the assumption "Directing extension programs in order to explain the necessity of Fava development among villagers" has been selected. None of the other elements of the scenario contradict this assumption. Briefly, this hypothesis indicates an impact score of +13 (Figure 9). Thus, the selected hypothesis can be evaluated as consistent.

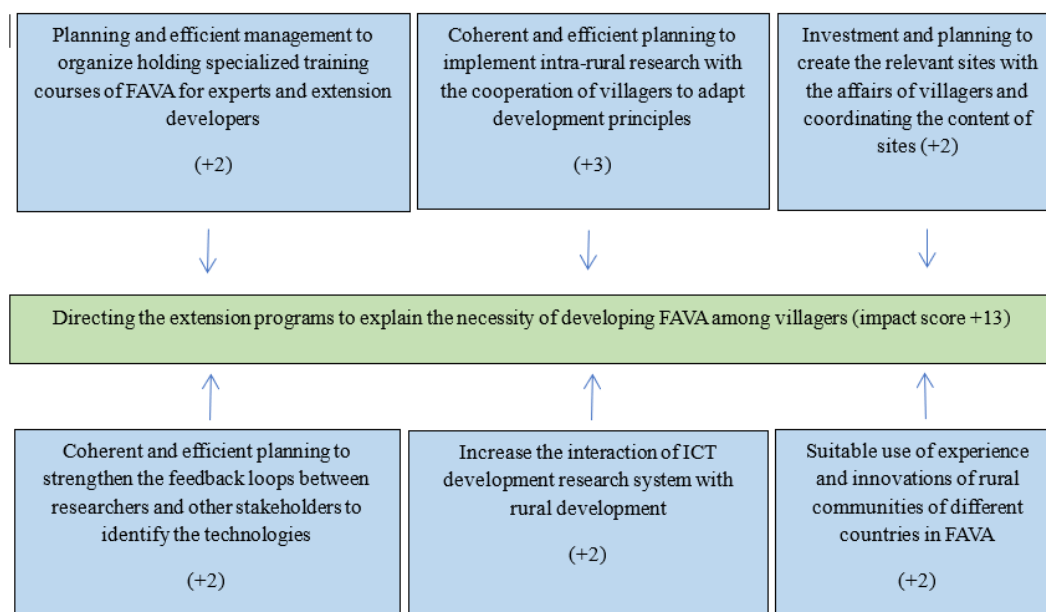


Figure 9. Directing extension programs in order to explain the necessity of Fava development among the villagers

This scenario consists of weak impact assumptions. Thus, the construction of the scenario should be described as internally inconsistent.

5. Discussion and Conclusion

This research attempts to conduct a foresight analysis of the identification of future scenarios of sustainable rural planning based on information and communication technology (ICT) in East Azerbaijan province for a 10-year horizon (2033) via the construction of different scenarios with foresight analysis. According to the future study approach, the data analysis in this research was a multi-stage process; thus, the "structural-cross impacts on the ICT-based sustainable rural planning process" were analyzed.

In this section, it was attempted to extract the key factors influencing the future trend of the system by identifying the primary factors influencing the future trend of ICT-based sustainable rural

planning in East Azerbaijan province with the generalizability approach. Theoretical citation was used to identify the primary effective factors. 23 factors were extracted in two dimensions, hardware and software. In the second stage, the factors were entered into the cross-matrix to determine the level and amount of their influence on each other and on the process of the subject. The dimensions of the matrix were 23 x 23, and the saturation degree of the matrix was 93.194, which indicated that the factors influenced each other in more than 93%.

Out of the total of 493 possible relations in this matrix, 36 were zero relationships, 86 relations showed 1, 230 relations indicated two and 177 relations indicated 3. It was found that the matrix based on statistical indicators with the two data rotations has a 99% desirability, which indicates the high validity of the answers. By examining the state of the dispersion plane of the effective

variables, the system is unstable. In total, 7 key drivers for the future approach of sustainable rural planning based on information and communication technology (ICT) were determined and identified.

Comparison with Previous Studies In order to validate and position the findings of this research within the existing literature, the results were compared with similar studies. The identification of "Holding specialized ICT training courses" and "Directing extension programs" as key drivers in this study aligns with the findings of [Mousazadeh et al. \(2021\)](#) and [Sorani et al. \(2014\)](#). They emphasized that without education and addressing inhibiting factors, the mere existence of technology cannot lead to sustainable development. Furthermore, the emphasis of the present study on "Creating sites related to villagers' affairs and adapting content to culture" confirms the results obtained by [Movahedi et al. \(2017\)](#) and [Alam and Wagner \(2016\)](#), who argued that access to ICT must be accompanied by culturally and economically relevant content to bridge the digital gap effectively. Additionally, the necessity of a "Foresight approach" to avoid strategic neglect, which was a core premise of this research, is consistent with the work of [Talabi Fard \(2020\)](#), who utilized a similar methodological framework for Jiroft city. Finally, while some previous studies focused heavily on infrastructure, the identification of "Feedback loops" and "Interaction of research systems" as key drivers in this research highlights the importance of the co-evolution of technology and social systems, a concept also supported by [Zhu et al. \(2021\)](#) in the context of Taobao villages.

Scenarios and Recommendations According to the obtained results, 1 scenario with a high probability of occurrence is not considered among the best and desirable scenarios because it is not operational and the results are far from expected, and it cannot be used as the best scenario. Therefore, the scenario with high consistency is considered, which is 8 based on the obtained results. As a result, according to the results of the scenario wizard method, 8 scenarios with high consistency have been selected. The descriptor "Creation of sites related to the affairs of villagers and adjusting the content of the sites to the culture of the villagers" and "directing extension programs in

order to explain the necessity of FAVA development among the villagers" were introduced as two selected hypotheses as consistent scenarios. According to the research and applied goals of the research and the proposed scenarios, the following recommendations (stable and consistent research scenarios) are presented for use in the future planning of rural sustainable development planning based on information and communication technology at the macro level:

- Invest and plan in order to create sites related to villagers' affairs and adapting the content of the sites to the villagers' culture.
- Direct the extension programs in order to explain the necessity of FAVA development among the villagers.
- Coherent and efficient planning to implement intra-village research with the cooperation of villagers in order to adapt the development principles based on FAVA to the conditions of the region.
- Increase the interaction of the FAVA development research system with rural development researchers.
- Coherent and efficient planning to strengthen feedback loops between researchers and other stakeholders to identify technologies needed by villagers.
- Efficient planning and management to organize FAVA specialized training courses for rural experts and extension developers.
- Appropriate use of the experience and innovations of rural communities in different countries in the field of FAVA.

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Authors' contributions

The authors equally contributed to the preparation of this article.

Conflict of interest

The authors declare no conflict of interest.

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آینده پژوهی برنامه ریزی روستایی پایدار مبتنی بر فناوری اطلاعات و ارتباطات در استان آذربایجان شرقی

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چکیده مبسوط

۱. مقدمه

ما در عصری زندگی می کنیم که به عصر ارتباطات و اطلاعات و یا به تعبیر بهتر انقلاب ارتباطات و یا انقلاب اطلاعات مشهور است. فناوری اطلاعات و ارتباطات (فاوا) به عنوان پارادایم جدید حاکم بر توسعه، با اثرگذاری بر نحوه تفکر و عمل و تغییر الگوهای کار و زندگی، محوریت تمامی جنبه های تحول و پیشرفت قرار گرفته و درواقع هم علت توسعه و هم نشان توسعه یافتگی محسوب می شود. شناخت و بهره گیری صحیح از فرصت های جدیدی که این پارادایم حاکم بر توسعه، به عنوان نیرومندترین ابزار توانمندسازی و برابر سازی در زمینه توسعه پایدار، جهت پیشبرد اهداف اقتصادی، اجتماعی، سیاسی و... برای شکل بخشیدن به عصر آینده ارائه می دهد مستلزم آگاهی و همراهی با این موج انقلابی است چراکه اندکی غفلت فرصت ها را به دیگران خواهد سپرد. با مطرح شدن نظریه موج سوم توسط تافلر با عنوان انقلاب فناوری مجامع جهانی اقدام به یادگیری، بسط انتقال تجارب و اطلاعات و حوزه بندی ارتباطات خود نموده تا از این طریق بتوانند در حوزه های کلان، اقتصادی، اجتماعی، سیاسی و فرهنگی که به صورت مستقیم با فرایند جهانی شدن در ارتباط می باشد نقش آفرینی کرده و تحولات را به نفع خود رقم بزنند. بهره گیری از فناوری اطلاعات و ارتباطات می تواند سبب توانمندسازی و تأثیرگذاری آگاهانه این قشر فراموش شده در روند پایداری محیط روستاهای کشور گردد و توجه به آموزش های فاوا می تواند از ابعاد مختلف در توسعه پایدار روستایی مؤثر واقع شود؛ و این در حالی است که فاوا، به عنوان یک ابزار توسعه پایدار روستاها در راستای کاهش فقر، کاهش شکاف دیجیتالی و جلوگیری از مهاجرت بی رویه ی روستاییان به شهرها شناخته شده است و مقوله ای پیچیده بوده و توسعه آن، مستلزم تعامل همزمان است.

۲. مبانی نظری تحقیق

برای دستیابی به توسعه پایدار روستایی مبتنی بر فناوری اطلاعات و ارتباطات ضروری است راه های مختلفی چون درک ارتباطات درونی بین بخش های اقتصادی، اجتماعی، زیست محیطی و سیاسی؛ چاره اندیشیدن در مورد خطراتی که با آن ها مواجه هستیم؛ نظارت خوب و مستمر ذینفعان و در نهایت آینده نگاری جهت طراحی سیاست ها و برنامه ریزی مؤثر و ایجاد درکی از آینده در مقابل تحولات متعدد و ناپایدار در جوامع روستایی مورد توجه قرار گیرد.

آخرین وضعیت رتبه بندی ایران از نظر شاخص توسعه فاوا که تا پایان سال ۲۰۱۷ از سوی اتحادیه جهانی مخابرات منتشر شده است، نشان می دهد ایران در میان ۱۶۷ کشور دنیا جایگاه ۸۱ را به خود اختصاص داده و بر اساس این گزارش ایران در زمینه زیرشاخص استفاده و کاربری از فاوا از متوسط جهانی پایین تر است. درحالی که بر اساس آمارهای رسمی تا پایان سال ۲۰۱۵ ایران در زمینه توسعه ارتباطات و فناوری اطلاعات از رتبه ۱۵ منطقه و ۸۹ جهان برخوردار بوده است. علیرغم ارتقای جایگاه کشور در میان کشورهای منطقه و جهان، ولی به نقطه قابل قبولی در میان کشورهای منطقه و جهان نرسیده است و شکاف زیادی بین ایران و متوسط جهانی در این زمینه وجود دارد. آذربایجان شرقی باوجود صبغه تاریخی و فرهنگی در عرصه ارتباطات و به رغم اقدامات وسیع انجام شده در حوزه زیرساخت ها، هنوز جایگاه واقعی خود را در کشور نیافته و در میانه های راه است. با اقدامات جدید نهادهای مرتبط با ارتباطات و با تدوین سند تدبیر و توسعه استان امید می رود در سال های آینده، آذربایجان شرقی تبدیل به استان پیشتاز و مطرح کشور از جهت اشتغال و کسب و کار اینترنتی و پشتیبان تولید شود. اجرای طرح های ارتباطات و اطلاعات استان نسبت به دیگر هسته های سند تدبیر و

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در سیستم هستند، بقیه متغیرها از وضعیت تقریباً مشابهی نسبت به یکدیگر برخوردار بودند. در مجموع تعداد ۷ پیشران کلیدی برای رهیافت آینده برنامه‌ریزی روستایی پایدار مبتنی بر فناوری اطلاعات و ارتباطات (ICT) تعیین و شناسایی شد.

۴. بحث و نتیجه‌گیری

با توجه به اهداف پژوهشی و کاربردی تحقیق و سناریوهای مطرح، پیشنهادات ذیل (سناریوهای استوار و سازگار پژوهش) جهت استفاده در برنامه‌ریزی آتی برنامه‌ریزی توسعه پایدار روستایی روستایی مبتنی بر فناوری اطلاعات و ارتباطات در سطح کلان ارائه می‌گردد:

❖ سرمایه‌گذاری و برنامه‌ریزی در جهت ایجاد سایت‌های مرتبط با امور روستاییان و تناسب سازی محتوای سایت‌ها با فرهنگ روستاییان؛

❖ جهت‌دهی برنامه‌های ترویجی در راستای تبیین ضرورت توسعه فاوا در بین روستاییان؛

❖ برنامه‌ریزی منسجم و کارآمد جهت اجرای تحقیقات درون روستایی با همکاری روستاییان جهت سازگاری اصول توسعه مبتنی بر فاوا با شرایط منطقه؛

❖ افزایش تعامل نظام تحقیقات توسعه فاوا با محققان توسعه روستایی؛

❖ برنامه‌ریزی منسجم و کارآمد برای تقویت حلقه‌های بازخوردی بین محققان و با سایر ذینفعان جهت شناسایی فناوری‌های موردنیاز روستاییان؛

❖ برنامه‌ریزی و مدیریت کارآمد جهت سازمان‌دهی برگزاری دوره‌های آموزشی تخصصی فاوا برای کارشناسان و مروجان روستایی؛ و

❖ بهره‌گیری مناسب از تجربه و نوآوری‌های جوامع روستایی کشورهای مختلف در زمینه فاوا.

کلیدواژه‌ها: آینده‌پژوهی، برنامه‌ریزی روستایی، توسعه پایدار، فناوری اطلاعات و ارتباطات، آذربایجان شرقی.

تشکر و قدردانی

مطالعه حاضر حامی مالی نداشته و حاصل فعالیت علمی نویسنده (گان) است.

توسعه پیشرفت خوبی داشته‌طور که پوشش اینترنت در یک هزار و ۱۲۲ روستا پیش‌بینی شده که همگی محقق شده و بیش از این تعداد نیز زیر پوشش قرار گرفتند. طرح توسعه ارتباطات روستایی (تار) فیبر نوری با هدف توسعه پهن باند در مناطق روستایی و تقویت هسته پهن باند شبکه ارتباطات روستایی ابلاغ شده است. در این راستا و با توجه به ضرورت مسأله پژوهش؛ در مطالعه حاضر سعی گردیده در استان آذربایجان شرقی به‌عنوان بستر مورد مطالعه فرایند اولویت‌پذیری و اهمیت شاخص‌های تأثیرگذاری ICT و فرایند تأثیرپذیری مؤلفه‌های اقتصادی و اجتماعی از این حوزه‌ها و مؤلفه‌های این رویکرد با استفاده از تحلیل اثرات ساختاری مورد تحلیل و ارزیابی قرار گیرد.

۳. روش تحقیق

با توجه به رویکرد آینده‌نگاری، تجزیه و تحلیل داده‌ها در این تحقیق فرایندی چندمرحله‌ای بود، بنابراین به تجزیه و تحلیل «تحلیل اثرات متقابل - ساختاری بر روند برنامه‌ریزی روستایی پایدار مبتنی بر (ICT)» پرداخته شد. در این بخش سعی شد تا با شناسایی عوامل اولیه تأثیرگذار بر روند آینده برنامه‌ریزی روستایی پایدار مبتنی بر (ICT) در استان آذربایجان شرقی با رویکرد قابلیت تعمیم، فاکتورهای کلیدی تأثیرگذار بر روند آینده سیستم را استخراج شود. برای شناسایی فاکتورهای اولیه مؤثر از استناد نظری استفاده شد. تعداد ۲۳ عامل در دو بعد سخت افزاری و نرم افزاری استخراج شدند. در مرحله دوم، عوامل وارد ماتریس متقابل شده تا سطح و مقدار تأثیرگذاری آن‌ها بر یکدیگر و بر روند موضوع مشخص شود. ابعاد ماتریس ۲۳×۲۳ بوده و درجه پرشدگی ماتریس نیز ۹۳/۱۹۴ بود که نشان داد عوامل در بیش از ۹۳ درصد بر یکدیگر تأثیرگذار بوده‌اند. از مجموع ۴۹۳ رابطه ممکن در این ماتریس، ۳۶ رابطه عدد صفر، ۸۶ رابطه عدد یک، ۲۳۰ رابطه عدد دو و ۱۷۷ رابطه عدد سه می‌باشند. نتایج نشان داد ماتریس بر اساس شاخص‌های آماری با تعداد دو بار چرخش داده‌ای از مطلوبیت ۹۹ درصدی برخوردار است که نشان از روایی بالای پاسخ‌هاست. آنچه از بررسی وضعیت صفحه پراکندگی متغیرهای مؤثر حاصل شد، وضعیت ناپایداری سیستم است. بیشتر متغیرها در اطراف محور قطری صفحه پراکنده بودند. به غیر از چند عامل محدود که نشان می‌دهند دارای تأثیرگذاری بالایی



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