



## Investigating the Effects of Information and Communication Technologies (ICT) on the Sustainable Development in Rural Areas: (A Case Study of Zanjan Province, Iran)

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### ABSTRACT

Information and Communication Technologies have various impacts on sustainable development, particularly rural areas. In this regard, in the present study we try to investigate the effects of information technologies on sustainable development of rural areas in Zanjan Province, Iran. It is an applied study and the methodology is descriptive-analytical. The statistic population of this study includes all the households residing in villages with ICT offices in seven county in Zanjan Province. Accordingly, there have been 226 villages with ICT offices in Zanjan province in 2015. For exact results, 10% of the villages including 22 villages were selected for the study. To select 22 villages among 226 ones with ICT offices, the villages were categorized into 3 groups with regard to the percentage of resident households; then the percentage of each category was determined based on the number of households in it. For data collecting we used library method and field method (questionnaire). Descriptive statistics (mean and standard deviation) and inferential statistics (Wilcoxon signed-rank test) were used for data analysis. The investigation of the effects of information and communication technologies on physical and environmental indicators of sustainable development of rural areas indicates that information and communication technologies have positive impacts only on villagers' access to ICT offices; also, with regard to sociocultural indicators information and communication technologies exhibit positive impacts only on sense of place belonging among young people and reinforcement of existing entities; regarding economic indicators of sustainable development, information and communication technologies show positive impact only on the development of electronic banking, and with regard to other indicators, these technologies don't exhibit any positive effects. The findings also show that the information and communication technologies have mostly influenced the sociocultural aspect of rural sustainable development, while the economic aspect has been influenced less than other aspects.

**Keywords:** sustainable development, information and communication technologies, digital divide

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### INTRODUCTION

Following agricultural era and industrial age, the world society has entered a new age in which any activity and phenomenon has an abstract virtual nature. The world society has evolved in such a way that its hardware aspects have decreased, while its software aspects have increased considerably (Adibi&Khaledi, 2009). During the recent years, information and communication technologies have caused wide rapid changes in different aspects of human life. As a result, information has been raised as the most efficient decision making and planning tool, playing an important role in regular systematic planning to benefit from human and natural resources (Farahani et al, 2012: 12).

The advances in information and communication technologies have raised the matter of globalization and have made the scholars refer to the present era as the age of globalization and space and time compacting, due to the increasing use of information and communication technologies (Avgerou and etal

,2010,11). The increasing development of ICT has made most researchers think of ICT availability as one of the most important prerequisites for achieving development (Jensen, 2006, 3). The role of ICT in improvement of socioeconomic conditions of developing countries has been considered widely by different researchers (Alam, 2015). In some sources the positive effects of ICT on resolving the development problems in rural areas have been referred to (Walsham, 2007 and Doong, 2008). Some researchers believe that the effects of information technology are not positive in every area (Selwyn, 2004 and Qureshi,2012). It has been found that a clear political plan, structural reforms (Thapa,2014), and observation and presence of corruption are some of the main factors of non-effectiveness of information technology in rural areas (Sahay,2008 and Ciborra,2005). Currently, ICT has been approved by the policy makers and academics as a strategy for development of rural communities Fałkowski,2013 and Avgerou, 2003). It is considered as a strategy to improve the social conditions (Derksen, 2008), and help to activate public and private resources (Furmankiewicz, 2010). Global experiences indicate

that with a correct plan, ICT spread can improve access of villagers to health, education, and public services; create new job opportunities; and increase the awareness of people with regard to manufacturing, agriculture and promotion, marketing for agricultural and non-agricultural products ... (Hedayati Moghadam, 2008). A review of the experiences of developed as well as developing countries in using information and communication technologies in rural development indicates that almost all these countries have paid enough attention to the use of ICT. In different countries, there are many examples of macro policies and actions including developing strategies for using ICT (Riahi Vafa & Hedayati, 2005). Various researchers have emphasized on necessity of ICT in the process of rural development (Dlodlo, 2009, 169), such that some researchers believe that inaccessibility of information and communication technologies in rural areas is a main reason for low income and poverty in these areas (Avgerou, 2010, 8). Some successful examples in rural ICT include India, Malaysia, Nepal, and South Korea (Jalali *et al*, 2006, 206). One impact of ICT on rural communities can be acceleration of sustainable development in these areas. During the recent decade many rural areas in Zanjan province have developed regarding ICT. Accordingly in the present study we are going to examine the effects of ICT on sustainable development in rural areas. The main question in this study is: how ICT influences the indicators of rural sustainable development, and which aspect is mostly affected?

Technology is a set of systems, processes, or methods developed in relation with effective activities. Although there is a tendency to consider technology as a modern concept, it dates back at least to the eighteenth century at the beginning of industrial revolution (Peykar, 2004, 61). It is true that technology has a deep root grown with production and spread of machines, but development of information technology and its applied tools is a new concept. During recent decades, with the development of computers in human life and their wide application in different professional aspects, there has been a considerable growth in information technology to enhance optimal methods in using information services in organizations. The information and communication technology of systems includes technology of hardware, software, and communication networks, particularly the advanced technology of these technologies (Momeni, 2001, 534) is the base of information technology, computers, and telecommunications. Basically computers do the task of processing and accumulating data, and telecommunication allows for distributing this data in a wide range. Also, information technology includes studying, designing, developing, implementing, protecting, and managing computer-based information systems, and particularly software and hardware applications of computers. On the other hand, IT supports such activities as creating, saving, using, and relating information, along with associated methods and operating management of such activities (Davaranah, 2002). In addition, we can say that information technology is preparing, collecting, sending, retrieving, saving, accessing, presenting, and changing the information in every type and form such as voice, graphics, text, video, and image. In fact, information technology is defined as a set of instruments, techniques, and storage methods, creating and distributing information, being done based on machine and computer processing. Accordingly, some instances of IT in organizations include: professional software; applications; local, regional, national, and universal information networks data bases, knowledge platforms, internet, professional websites, weblogs, and artificial intelligence.

Information and communication technology is a set of hardware, software, and thinking which allow for circulating and exploiting information (Pahjola, 2002, 21). The concept of ICT is the result of interaction among three concepts computer,

information, and communication (Alexandru, 2006, 2). In 1970s, Daniel Bell defined knowledge as the base for the movement in production from goods to services; at the same time Manuel Castel looked at economic changes and the centers of information flow. Hence, the concept of information service was considered in this decade (Pekari, 2005, 3). During the following years, due to the successful use of information and communication technologies, using ICT to achieve development was emphasized (Tas, 2011, 508).

Since 1970s, at the same time with theoretical criticism and challenges of conventional modernization by dependence, opposition, postmodernism, feminism, and social structuralism schools, the ground for rural development was provided in the form of sustainable development. In addition, another reason for raising rural sustainable development concept instead of the conventional concept of rural development is its historical alignment with general discussions of environmentalism and sustainable development; due to conceptual common points between these two theoretical areas, they combined together and created a paradigm called rural sustainable development emphasizing on an internal local people-oriented mechanism (Vosoghi & Imani, 2010: 24). It can be said that rural sustainability is achieved following a balance between activities and needs of rural people as well as protecting local and environmental systems. Therefore, rural sustainable development can be considered as a process emphasizing on enhancement of all aspects of rural life through encouraging activities consistent with environmental capacities and limitations (Saeidi, 1998: 19). Presently, rural development is based on a generalist and systemic approach containing basic dimensions, forming rural development system, and creating a balanced link among all the aspects (Taherkhani *et al*, 2008: 217).

According to the literature, rural sustainability consists of three bases: 1. Ecological or environmental sustainability, 2. Economic sustainability, 3. Social sustainability (Taherkhani *et al*, 2008: 211). Development thinkers have prioritized these bases in different ways. Here the dimensions of sustainable development are discussed in details.

#### **ECOLOGICAL SUSTAINABILITY**

It refers to the set of elements existing in ecosystem, preparing the ground for activity and production. Ecological sustainability means keeping basic resources in a level in which the future selections are not deprived and the quality and flexibility of ecosystem is maintained through maintaining or enhancing capacities (Asadi & Mahdi 2009: 53). Environment experts emphasize this aspect of development more than other aspects. They are concerned about the restrictions imposed on environment by human activities. They are concerned about what economists call natural capital. They know well that every creature's life depends on primary plant products. They believe that the nature is the most amazing and largest treasure (Kalantari, 2008: 17). Undoubtedly, whatever beneficial and socially accepted are the rural areas, if they are not sustainable environmentally they cannot keep their efficiency over time and inevitably move toward unsustainability.

#### **SOCIAL SUSTAINABILITY**

In defining social sustainability, some researchers have referred to four main determining elements: 1. Social justice, 2. Social solidarity, 3. Participation, 4. Security. In this sense, the bases for measuring social sustainability are such components as equal advancement opportunities for all human beings, living with collaboration, equal opportunities for all people to play social roles, life security and protection against natural threats (DFID, 2002: 2).

In social sustainability, the resources must be exploited in such a way that future generations be able to make decisions for fulfilling their needs in most satisfying level. In this definition the win-win policy is emphasized by decision makers, aiming at achieving socioeconomic and environmental advances (Martin, 2001: 4).

Social sustainability in rural areas means a healthy life through fulfilling the basic needs of people in rural community, considering life quality and maintaining environmental quality in order to achieve the highest level of satisfaction (Badri, 2009: 37). Generally speaking, social sustainability is measured by a main indicator which is life quality. Life quality is defined as providing better conditions for life whose features include balance, coordination, desirability, and fair equity, along with health, security, happiness, creativity, and beauty (Pourtaheri et al, 2010: 6).

**ECONOMIC SUSTAINABILITY**

Economic sustainability means that systems remain competitive and persistent in interaction with economic context. A system which is not persistent economically, whatever accepted it is by the society or supported politically, cannot survive (Zahedi, 2009: 37).

The sustainability of economic activities is described from different points of view:

1. A situation is called sustainable when desirability of society is not decreased with time.
2. A situation is called sustainable if natural resources management is such that the opportunities for production and economic growth remain sustainable for future.
3. A situation is called sustainable when in the process of economic growth and development, the natural resources do not reduce.
4. A situation is called sustainable if the management of natural resources is such that the performance of the resources remains fixed (Khalilian, 2005: 135). Accordingly, economic sustainability in rural areas is reinforcing principles of economy and achieving economic security with regard to access to sustainable livelihood, profitable employment and reliable financial resources, and finally sufficient technology consistent with environment taking advantage of human resources (planning committee of conversional and complementary industries in rural development, 2003: 10).

A review of the main elements of rural development including protection, effective and balanced use of basic resources, increasing selection power of people, and empowering vulnerable rural groups particularly women and young people, developing effective participation of people and local entities in planning and decision making processes, enhancing efficiency in agriculture, developing opportunities, capacities, and diversifying rural economy, developing equal opportunities in access to resources, facilities, and benefits in developing villages and cities, and enhancing life quality in rural communities indicates that these factors are the main functions of ICT offices in rural areas. On the other hand, the actions taken for rural sustainable development, for example decreasing the use of engine vehicles, removing unnecessary trips and replacing them by communication technologies, providing local professions (such that the distance traveled to work and shopping centers is reduced), reducing energy consumption per capita, particularly the energy derived from fossil fuels, protecting regions with particular landscapes and wildlife ecosystems, and emphasizing on participation and extending decision making circles, might be considered as some of the effects of creating ICT offices in

rural areas. Hence, it can be said that establishing rural ICT offices is a main tool for achieving rural sustainable development and comprehensiveness is a main feature of it (MolaeiHashjin et al, 2012: 152). In this regard, the effects if ICT on rural development have been studied and the most important results are shown in the following table.

**Table 1: studies about the effects of ICT**

Author and year	Title	Results
Roberts et al 2016	Investigating the agenda for digital village policy from the point of view of a flexible community	The background required for developing ICT in rural areas specially in third world countries is about preparing the sociocultural backgrounds
Suryawanshia 2016	The role of higher education in developing green ICT for sustainable development	Higher education can play a key role in creating the necessary grounds to achieve ICT fitting with the purposes of sustainable development
Roberts et al 2015	The contribution of creative economy in flexibility of rural communities: investigating cultural and digital capital	Digital development in rural communities is essential with regard to achieving sustainable development and removing poverty as well as correct use of resources
Salemink et al, 2015	Rural development in digital age, a review of systematic studies in rural areas	Increasing the positive effects of ICT depends on the existence of appropriate sociocultural infrastructures in rural areas
Beel et al, 2015	Cultural flexibility: producing the heritage in rural community, the role of volunteers in creating a digital society	The cultural factors are the main factors in forming digital communities
MolaeiHashjin et al 2013	The effects of information technology in sustainable development in rural areas	The rural people have had less use of information services and special services of such offices than basic services
Anabestani and Vaziri 2011	The socioeconomic and physical effects of ICT in developing rural areas	Developing ICT have positive effects in different social, economic, and physical aspects in the studied villages
MotieiLangroudi et al, 2010	The social and economic effects of information and communication technology in rural areas	The groups operating information technology have better conditions than the groups not operating such technology

Yaqoubi, 2010	Investigating the status of rural development based on information technology in Sistan&Balouchestan Province	There is no data available in this area
Eftekhari et al, 2009	Required human structures to exploit IT optimally	There is a significant gap between the present status of villagers regarding tendency and immigrant, and the standards considered by the experts. It means that the villagers' conditions are not desirable
Khalil Moghadam et al 2008	The factors impacting acceptance of information and communication technologies	There is a significant positive relationship between the dependent variable acceptance of ICT and independent variables: age, level of education, gender, marital status, life style, main job, the level of computer skills, and the number of family members familiar with computer

**METHODOLOGY**

The present study is an applied one and its methodology is descriptive-analytical. The statistical population consists of households residing in the villages with ICT offices in seven cities of the Province Zanjan. Accordingly, there were 226 villages having ICT offices in the province Zanjan. At least 10 percent of these villages which equals to 22 villages were selected for the sake of accuracy. In order to select 22 villages from among 226 villages with ICT offices, they were categorized into three groups regarding the number of households. Then, due to the number of households in each group the share of each category was determined. Data collection was performed through library and field (questionnaire) methods. For data analysis we used descriptive statistics (the mean and standard deviation) and inferential statistics (Wilcoxon and paired-samples t-test).

**Table 2: categorization of the villages studied in this research**

City	Number of villages with ICT	Number of households	Below 200 households	201-400 households	Above 400 households
Abhar	34	Frequency	13	11	10
		Percentage	39.23	32.35	29.41
		Share of sample	1	1	1
Zanjan	58	Frequency	17	19	22
		Percentage	29.32	32.75	37.93
		Share of sample	2	2	2
Khodabandeh	59	Frequency	17	31	11
		Percentage	28.81	52.54	18.64
		Share of sample	2	3	1
Khoramdareh	8	Frequency	1	6	1
		Percentage	12.5	75	12.5
		Share of sample	-	1	-
Ijroud	23	Frequency	13	8	2
		Percentage	56.52	34.78	8.69
		Share of sample	1	1	-
Mahnehhan	22	Frequency	13	7	2
		Percentage	59.1	31.80	9.1
		Share of sample	1	1	-
Tarom	22	Frequency	3	18	1
		Percentage	13.63	81.81	4.54
		Share of sample	-	2	-

**Table 3: Selected villages with ICT**

City	Number of villages with ICT	Percentage of sample	Rural district	Village	Number of households	Number of samples
Abhar	34	15.04	SainQaleh	Chargar	237	15
			Darsajin	Darsajin	150	10
			Suburb	Nurin	658	42
Zanjan	58	25.66	Zanjanrud-e-bala	AqBolagh	175	11
			Mojezat	Azhdahatu	453	29
			Upper QarehPoshtelu	Aqkand	30	2
			Central	Qoltuq	226	14
			BughdaKandi	BughdaKandi	328	21
			Chaypareh-ye Pain	Rajin	401	25

Khorramdarreh	59	26.10	KharaRud	Abi-ye Sofla	502	32
			AqBolagh	Aghbolagh h-e Sofla	164	11
			Shivanat	AqchehG onbad	115	7
			KharaRud	GolTappeh	203	13
			Suburb	TupQarah	298	19
			AqBolagh	Zarand	251	16
Khorramdarreh	8	3.53	Khorrמדarreh	Ardajin	308	20
Ijrud	23	10.17	Golaber	Barik Ab	38	3
			Golaber	MollaPiri	298	19
MahNeshan	22	9.73	QalehJuq	Ebrahima bad	85	5
			MahNeshan	Ili Bolaq	256	16
Tarom	22	9.73	Chavarzaq	Astakol	249	16
			Gilavan	Dah Bahar	214	14
total					5639	360

The selected villages have 5639 households. Due to the high amount of households, 260 households were selected as the sample volume through Cochran formula. In the present study, to investigate the effects of information technology on sustainable development in rural areas, the factors are categorized into three dimensions: physical and ecological, social and cultural, and economic. According to table 2 the indicators were designed in the form of questions with Likert scale, and the present status were analyzed using 31 indicators in the form of three main dimensions.

**Table 4: the factors and indicators for investigating the effects of ICT on rural sustainable development**

Factors	Indicators
Physical and ecological	Increasing villagers' awareness of environment, balanced exploitation of environment, decreasing environment destruction, availability of ICT offices for villagers, change in appearance of villages, increasing awareness of the process of receiving credits for strengthening
Social and cultural	Reduction of commuting to cities, extension of people participation, empowering vulnerable groups in community particularly women and young people, creating professions related to ICT, increasing villagers' income through decreasing the role of intermediates, creating new job grounds, reducing immigrants, creating the sense of place belonging among young people, remaining of graduates in villages, reducing the feeling of poverty, reinforcing the existing entities in villages, increasing level of education
Economic	Reducing the costs of service providing, developing opportunities, capacities and diversification of rural economy, marketing, productions appropriate with market needs, improving the affairs related to agricultural activities, creating light thinking activities, establishing local markets, producing handicrafts, extending livestock infrastructures,

extending gardening infrastructures, developing electronic banking, auditing observational organizations
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In order to determine the credit of the indicators of the effects of ICT on rural sustainable development, we used content validity in two forms of CVR and CVI; in order to determine reliability we used Cronbach Alpha.

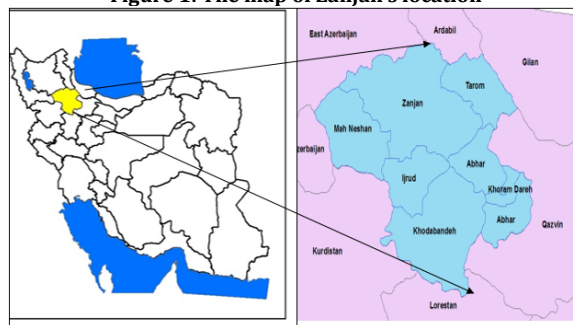
**Table 5: the quantitative results of validity and reliability of the study instrument**

The effects of ICT on rural sustainable development	CVI	CVR	Cronbach Alpha
	0.85	0.83	0.86

**THE STUDY AREA**

The Province Zanjan consists of seven cities namely Zanjan, Abhar, Tarom, Khdabandeh, Khoramdarreh, Ijrud, and MahNeshan; 19 towns, 15 countries, and 46 rural districts. This region is a geographical semi-independent area which has been created around the river QizilUzan. This geographical unit links Azerbaijan Plateau to Qazvin plain with a mild slope. The Province Zanjan is located in North West of Islamic Republic of Iran. Its geographical location is 37°26'N37°15' and 47°10'E49°25'.

**Figure 1: The map of Zanjan's location**



**FINDING OF RESEARCH**

The results of describing individual features of rural households show that the age average of household head is 44 years. 94.6% of the respondents were male, 5.4% were female, and the average size of household equals to 3.9 members. Regarding the education level, 30.4% of household heads were illiterate, 23.8% had primary literacy, 21% had secondary and high school degrees, 14.5% had diploma, and 10% had education above diploma. Investigating the type of professions in the studied villages shows that the most job frequency is related to agriculture with 36.6%, and laboring with 27.6%. The results also indicate that 41% of household heads have secondary jobs. The descriptive findings related to the indicators of rural sustainable development in the villages with ICT offices, indicate that the highest mean value is for the social and cultural dimension and the lowest value is related to the economic dimension.

**Table 6: descriptive findings related to the indicators**

Status	Mean	Standard deviation
Physical and ecological	2.14	0.748
Social and cultural	2.67	0.687
Economic	1.94	0.974
Total dimension	2.25	1.024

Investigating the effects of ICT on physical and environmental indicators of rural sustainable development using Wilcoxon test shows that ICT have positive impact only on the indicator of villagers' access to ICT offices and in other indicators there is no positive impact.

**Table 7: analysis of the effects of ICT on physical and ecological indicators of rural sustainable development**

Indicator	Z	Significance
Increasing villagers' awareness of environment	-1.102	0.189
Villagers' access to ICT offices	-5.47	0.000
Balanced exploitation of environment	-1.074	0.201
Low degree of environment destruction	-0.876	0.438
Increasing the awareness about the process of receiving credit for strengthening	-3.475	0.000
Change in the appearance of village	-1.034	0.264

Investigating the effects of ICT on social and cultural indicators of rural sustainable development using Wilcoxon test shows that ICT have had positive impact on the sense of place belonging among the young people and reinforcement of existing entities in rural areas, while there has been no positive effects on other indicators.

**Table 8: analyzing the effects of ICT on sociocultural indicators of rural sustainable development**

Indicator	Z	Significance
Reduction of commuting to cities	-1.247	0.164
The sense of place belonging among young people	-2.697	0.001
Increasing people participation	-1.451	0.164
Reinforcing existing entities in villages	-2.746	0.000
Increasing villagers' income through reducing the role of intermediates	-1.987	0.089
Empowering vulnerable groups particularly women and young people	-1.217	0.137
Creating new job opportunities	-1.147	0.134
Reducing immigrants	-1.347	0.102
Creating jobs associated with ICT	-1.687	0.054
Remaining graduators in villages	-1.758	0.107
Reducing the feeling of poverty	-1.007	0.194

Increasing the level of education	-1.477	0.088
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Investigating the effects of ICT on the economic indicators of rural sustainable development using Wilcoxon test indicates that ICT has positive impact only on the indicator extension of electronic banking, while there was no positive effects in other indicators.

**Table 9: analyzing the effects of ICT on economic indicators of rural sustainable development**

Indicator	Z	Significance
Reducing the costs of service providing	-1.137	0.209
Developing opportunities, capacities, and diversifying the rural economy	-1.633	0.081
Marketing	-1.451	0.164
Productions appropriate for market needs	-1.746	0.078
Improving the affairs related to agricultural activities	-1.387	0.089
Creating style and thinking activities	-1.017	0.145
Establishing local markets	-1.111	0.168
Producing handicrafts	-1.466	0.102
Extending livestock infrastructures	-1.387	0.098
Extending gardening infrastructures	-1.308	0.140
Extending electronic banking	-3.106	0.000
Auditing observational organizations	-1.177	0.158

We also used paired-sample t-test to investigate the effects of ICT on aspects of rural sustainable development. The results show that ICT has had the highest impact on the sociocultural aspect and the lowest impact on the economic aspect.

**Table 10: examining the impacts of Information and Communication Technology (ICT) on sustainable rural development dimensions**

Indicator	The mean before ICT	The mean after ICT	Standard deviation	t statistic	Significance
Physical and environmental	1.91	2.14	1.87	-1.096	0.236
Sociocultural	2.14	2.67	1.65	-4.096	0.069
Economic	1.84	1.94	1.57	-0.096	0.687
Total	1.96	2.25	1.98	-1.166	0.369

**CONCLUSION**

Today any action to achieve development without using modern technologies particularly information and communication technologies (ICT) is vain. Meanwhile due to remoteness of rural areas from the process of economic and social evolutions, developing ICT seems essential in these areas. The prerequisite for developing ICT in rural areas is the presence of appropriate

individual, economic, social, and structural grounds. Accordingly, in the present study we investigated the effects of information and communication technologies on sustainable development in rural areas of the Province Zanjan. The results of the present investigation using Wilcoxon test show that ICT has positive impacts only on the villagers' access to ICT offices, the sense of place belonging among young people, reinforcement of existing entities, and development of electronic banking, while there was no positive impact on other indicators. The findings also indicate that ICT mostly affects the social and cultural aspect, and its effect on the economic aspect of sustainable development is low.

According to the findings of this study, the following suggestions are presented:

- Make rural people familiar with modern technologies and their operation in rural communities. It must be a main purpose of the programs designed for rural development.
- Information technology is an instrument which can make a lot of information available: however, using information and converting it to knowledge and wealth requires people with necessary capabilities to use IT appropriately. Hence, paying attention to educational infrastructures is an important factor leading to development of ICT.
- Ignoring ICT development in rural areas and its extension in cities will lead to increased gap between city and village with irreparable consequences. Therefore it is necessary to invest on ICT offices in rural areas increasingly.
- Selecting office attendant from the residents of the village.

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