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ACCESSIBILITY OF RURAL PUBLIC INFRASTRUCTURES AND FOOD SECURITY AMONG RURAL HOUSEHOLDS IN KERSA DISTRICT, SOUTH WESTERN ETHIOPIA

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ABSTRACT:
PUBLIC INFRASTRUCTURES SUCH AS ROADS, AGRICULTURAL EXTENSION SERVICES, ELECTRICITY, ICT, PROTECTED WATER SOURCES, IRRIGATION, EDUCATION CENTERS, AND HEALTH CENTERS ARE ESSENTIAL FOR ECONOMY AND SOCIETY TO OPERATE PROPERLY. THE OBJECTIVE OF STUDY WAS TO EXAMINE THE ACCESSIBILITY OF THESE RURAL PUBLIC INFRASTRUCTURES IN RURAL AREAS AND THEIR POSITIVE INFLUENCE ON RURAL PEOPLE'S FOOD SECURITY. THIS STUDY BORROWED THE PRAGMATIST RESEARCH PHILOSOPHY THAT ADVOCATES ONTOLOGICAL AND EPISTEMOLOGICAL MIXES IN AN EFFORT TO MINIMIZE THE GAPS NOTED ON THE EMPIRICAL KNOWLEDGE. ACCORDINGLY, QUANTITATIVE AND QUALITATIVE APPROACHES WERE EMPLOYED. DATA ANALYSIS HAS FOLLOWED A CONVERGENT DESIGN THAT COMBINED DESCRIPTIVE AND INFERENTIAL TECHNIQUES WITH THE THEMES EMERGING THROUGH QUALITATIVE DATA. CONSEQUENTLY, THE FINDINGS OF THE RESEARCH REVEALED THAT PUBLIC INFRASTRUCTURES HAVE A SIGNIFICANT ASSOCIATION RURAL PEOPLE FOOD SECURITY. SPECIFICALLY, THERE WERE SIGNIFICANT ASSOCIATIONS WHEREBY HOUSEHOLDS WHO HAVE AN ACCESS TO AN ASSUMED INFRASTRUCTURE MORE LIKELY IMPROVE THEIR FOOD SECURITY THAN HOUSEHOLDS WHO HADN'T ACCESS TO RESPECTIVE RURAL PUBLIC INFRASTRUCTURES. THUS GOVERNMENT AND OTHERS RESPONSIBLE BODIES ARE NEEDED TO INVEST MORE ON PUBLIC INFRASTRUCTURES TO REACH OUT TO RURAL PEOPLE TO IMPROVE THEIR FOOD SECURITY.

KEY WORDS: PUBLIC INFRASTRUCTURE, FOOD SECURITY, ACCESSIBILITY TO PUBLIC INFRASTRUCTURE, HOUSEHOLD

1. INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The beginnings of construction public infrastructures can be traced as far back as the Roman Empire two thousand years ago. The industrialization in Europe of the 19 century brought rapid urbanization and expansion of public infrastructures such as transport (railways,

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tramways, metropolitan), water supply and sewerage and energy. Nowadays cross the globe, infrastructure is the life blood of prosperity and economic confidence. Public infrastructures includes irrigation and public water facilities; transport facilities; storage facilities; marketing and export facilities; processing facilities; utilities; agricultural research and extension services; communication and information services; soil conservation schemes; credit and financial institutions; and education and health facilities[4].

Public infrastructure is decisive means for agriculture, agro-industries and overall socio-economic and political development. It also, incidentally, provides basic amenities that improve the quality of life which is most of the time manifested in enlightening food security. It plays a key role in reaching the large mass of poor people particularly in rural areas where food insecurity is pervasively experienced. When public infrastructure has deteriorated or is non-existent, the poor live a worsened life. Poor public infrastructure also limits the ability of the traders to travel to and communicate with remote farming areas, limiting market access from these areas and eliminating competition for their produce[5].

Because of well documented importance of rural public infrastructures to promote the above listed and other advantages for rural people, either national governments or international aid agencies seem to prioritize investments in the construction of new public infrastructures and maintenance of existing infrastructures[6]. The UN Millennium Project (2005) has re-emphasized the need for a 'big push' strategy in public investment to help poor countries and groups of people break out of their poverty trap and meet the MDG goals. Besides it was believed in improving the food security of households so as to achieve expected social development[7].

While the state of public infrastructure varies widely among developing countries, most lower-income developing countries suffer severe public infrastructure deficiencies. Africa's infrastructure networks increasingly lag behind those of other developing countries and are characterized by missing regional links and stagnant household access. Deficiencies in transportation, energy, telecommunication, and related infrastructure translate into poorly functioning community which would have adverse impacts on the food security of households particularly in rural areas in developing countries[8].

A large share of Africa's infrastructure is domestically financed, with the central government budget being the main driver of infrastructure investment[9]. Thus, African governments need further scientific researches for the purpose of bringing a food security in selection, funding, implementing, monitoring and evaluating the projects of rural public infrastructural development[10].

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Improved rural public infrastructure leads improvement of food security, social participation, female participation, and job opportunities[11]. We have selected only eight public infrastructures (all-weather roads, health centers, education centers, protected water sources, irrigation, ICT, electricity and agricultural extension infrastructures), for the purpose of this study, on which government of Ethiopia has been spending huge budget with huge objectives of which improving the food security is the leading.

1.2. PROBLEM STATEMENT

Ethiopia is the second-most populous country in Africa with a population of more than 100 million. According to CSA[12] it has lowest level of public infrastructure particularly in rural areas of which an estimated 80 percent of the country's population lives. She is one of the most food-insecure and famine affected countries. A large portion of the country's population has been affected by chronic and transitory food insecurity. The food security situation in Ethiopia deteriorated sharply in 2017. The estimated food insecure population increased from 5.6 million in 2016 to 8.5 million in 2017[13]. Nowadays, insufficient and unequal access and protection of public infrastructure in rural areas is deemed as the foremost causes of food insecurity in Ethiopia[14]. As a result international community in general and Ethiopia government in particular are promoting basic services program at a national and local levels to improve access to and quality of public infrastructures such as education, health, water supply, rural roads, agricultural extension services, and electricity[15].

Researchers such as Dubale[16]; Tirkaso[17]; and Kedanemariam and Sanjay[18] studied the role of a given specific infrastructures in improving the life of rural people in socio-economic and political aspects. They all come up with the findings that improvement in a given public infrastructure improves the livelihood outcomes in general and food security in particular among rural households.

Dubale[19] stated that telecommunication has an indispensable role in increasing productivity for the rural people. Tirkaso[20] conducted on the impact of ICT on the poverty reduction in Hossana district, southern parts of Ethiopia and argued that ICT plays a significant

[11] Fosu, K. Yerfi, et al. Public goods and services and food security: theory and modelling approaches. Unknown Publisher, 1995.
[12] CSA. Population B- Projection, 2015
[13] Mohamed, Abduselam Abdulahi. "Food security situation in Ethiopia: a review study." International Journal of Health Economics and Policy, 2017.
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role in poverty reduction of rural people. Kedanemariam and Sanjay[21] studied an impact of hydroelectric project on community development and concluded that hydroelectric project development is positively correlated with the improvement of rural households' food security. Demenge et al.[22] based on fieldwork conducted in 2014 in the semi-arid region of Tigray, Ethiopia, explores the opportunities and potential for multifunctional roads and argued that improving road connectivity could result in improving the livelihood of rural people.

Although many studies were done so far on the impacts of public infrastructure on the livelihood outcomes, there are still gaps that this study anticipated to fill. We also endeavored to show the association between food security among rural households and accessibility of selected public infrastructures. Finally, this research employed triangulation (both qualitative and quantitative) in understanding the issue under study unlike some of the researchers we had reviewed.

1.3. OBJECTIVES OF THE STUDY

The specific objectives of the study are the following:

- To assess accessibility of selected rural public infrastructures
- To describe the situations of selected rural public infrastructures
- To examine an association between selected rural public infrastructures and rural households food security

2. RESEARCH METHODS

2.1 Study Setting and Population

The study area is in the Oromia National Regional State (ONRS) of Ethiopia, Jimma Zone administrative area. According to the CSA[23] census, the Oromia regional state has a population of 33, 692,000 of which 4,880,000 is urban dwellers and 28, 812,000 is rural dwellers. Jimma Zone is purposively selected from the zones of Oromia region. The total population of Jimma zone is 2,986,957 of which 1,498,021 are male and 1,488,936 are female. Kersa is one of the woredas in the Jimma Zone of the Oromia Region of Ethiopia. It is bordered in South by Dedo, Southwest by seka chekorsa, West by Mana, North by Limmu kosa, Northeast by Tiro Afata and Southeast by Omo Nada. The altitude of this woreda ranges from 1740 to 2660 meters above sea level, and it encompasses mountains like Sume, Gora, Kero, Folla and Jiren.

2.2 Research Design

The study deployed a mix of both quantitative and qualitative approach. The philosophical foundation of the study is pragmatism. The reasons for the selection of pragmatic approach are: to use variety of data sources, to use multiple methods in the study at the same time or one after the other and to use multiple perspectives to interpret the results. Approximating longitudinal survey with cross-sectional design was employed. The researchers selected this study design because there were no baseline data in the study area and to get the advantages of both cross-sectional and longitudinal survey design.

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[21] Kedanemariam, Aklilu Kahssay, and Sanjay Mishra. "Community Development through Hydroelectric Project: A Case Study of Gilgel Gibe III Hydroelectric Power Project in Ethiopia." International Journal of Community Development, 2013.

[22] Demenge, Jonathan, Rossella Alba, Katharina Welle, Kebede Manjur, Alemu Addisu, Lyla Mehta, and Kifle Woldearegay. "Multifunctional roads: the potential effects of combined roads and water harvesting infrastructure on livelihoods and poverty in Ethiopia." Journal of Infrastructure Development, 2015.

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2.3 Methods and Instruments of Data Collection

Household survey, in-depth interview, key informant interview and observation were used to collect data. The collected data were about accessibility to a given infrastructures, contexts of rural public infrastructures, and food security. In-depth interview was employed in collecting detailed information to substantiate quantitative data and to offer a complete picture. In the opinion of Bernard (2006), key informants are groups of people with whom the researcher talks and communicates extensively over a lengthy of duration. The key informant interview method was held with key individuals on all selected sectors of public infrastructures. The main data-generation instruments were structured questionnaires and semi-structured checklists.

2.4 Sampling Methods and Sample Size

Simple random sampling technique was used, since it was possible to access the lists of the residents from the respective study *kebeles*. From thirty one rural Kebeles, four kebeles (Tolikarso, Bulbuli, Babo and kallacha) were randomly selected. Thereby 255 households were selected through lottery method of sampling and proportionally to the selected kebeles. The sample size was determined depending on the formula of Yamane (1967:886) because it's the simplified in the case of finite population. The formula considers 95% of confidence and 5% margin of error. The formula is $n = N / [1 + N (e)^{2}]$; where n is the sample size, N is the population size, and e is the level of precision.

Furthermore, *kebeles*' elders – 16 individuals (four from each *kebele*) were purposively selected and deeply interviewed assuming that they have experience on issues under study and can provide profound on the issues under study. Finally, the head of all respective infrastructures (sectors) bureaus at district level – 16 individuals (two each) from office of health, education, water, electricity (power), irrigation, transportation, agricultural, and ICT were interviewed.

2.5 Reliability and Validity

The aspects of inter-rater technique of reliability proved its usefulness in the context of the pilot testing. It assessed the reliability of research instruments by utilizing four interviewers per site (Tolikarso, Bulbuli, Babo and kallacha). Internal consistency of instruments was assured by the split-half correlation. The two halves of an instruments provided similar result of ($r = .88$). Subsequently, instruments had strong internal consistency. The researchers believed that the items on the instrument captured the concepts that are essential in the research.

2.6 Methods of Data Analysis

The analysis applied a mixed design. Quantitative analysis uses the numeric data gathered through the sample households applying both the techniques of descriptive and inferential statistics. The descriptive analysis follows and emphasizes on percentages, central tendencies and graphic presentations. Consequently, the interpretations follow presentations made through these techniques. The results confer the prevailing relationships among the variables compared through column percentages. In addition, binary logistic regression was used to explain the strength and direction of association wherever the data appeared apparent. The qualitative data were transcribed, categorized, interpreted and schematized based on their respective contents and themes. The meanings, words, symbols and argumentative texts have formed basic premises in the structures of reporting the sub-titles and sections.

2.7 Ethical Considerations

In conducting this study all expected research ethics were considered. Before going to the field the letter from Ethical review board of the college of Social Sciences and Humanities was taken and given and/or shown to all responsible bodies. After we went to the field and contacted with respondents, the purposes and importance of the study were explained for the participants of the study and informed consent was obtained. Participants were given full right to withdraw at any time. Generally, confidentiality and anonymity of information were strongly maintained.

3. RESULTS AND DISCUSSION

This section deals with data analyses and presentation of the objectives of the study. Specifically, it includes about the presentation of: (a) socio-demographic background of respondents; (b) assessment of selected public infrastructures accessibility*;* (c) description about the situations of selected public infrastructures (all season road, formal health centers, formal education centers, ICT, protected water sources, agricultural extension services, electricity, and irrigation); and (d) rural public infrastructures linkages with food security among rural households.

3.1. Socio-demographic Background of Respondents

This sub-section presents socio-demographic backgrounds of respondents like sex, age, religion, educational status, and marital status.

Table 1: Sex, age, religion, educational status, and marital status of respondents

Variables	Category	Frequency	Percent
Sex	Male	218	85.5
	Female	37	14.5
Age	<30	3	1.2
	31-40	20	7.8
	41-50	99	38.8
	51-60	33	12.9
	61-65	80	31.4
	>65	20	7.8
Religion	orthodox	31	12.2
	Islam	199	78.0
	Protestant	17	6.7
	Other	8	3.1
Educational status	Can't read and write	99	38.8
	Grade 1-8	96	37.6
	Grade 9- 10	45	17.6
	Grade 11 - 12	9	3.5
	Diploma holder	3	1.2
	Degree and above holder	3	1.2
Marital status	Married	192	75.3

	Divorced	16	6.3
	Widowed[24]	47	18.4

Source: Household Survey 2016

Table 4.1 shows that the majority of the respondents were male (85.5 percent) and the rest were female. Concerning age, majority of respondents were fall under a category of 41-50 (38.8 percent) and followed by 61-65 (31.4 percent), 51-60 (12.9 percent), 30-40 (7.8 percent), > 65 (7.8) and <30 (1.2 percent) respectively.

Regarding religion of respondents the majority of respondents were Muslims (78.2 percent), followed by Orthodox (12.2 percent), Protestant (6.7 percent), and other[25] (3.1 percent) respectively. On the subject of educational status of the survey respondents, the majority of the respondents 99 (38.8 percent) were those who can't read and write. The second largest were those between grade one to eight 96 (37.6 percent). An accumulation of respondents below grade eight were 76.4%. The smallest were those who hold diploma and who hold degree and above each of 3 (1.2 percent). To conclude, the mainstream of the sample households 192 (75.3 percent) were married; followed by widowed 47 (18.4 percent) and divorced 16 (6.3 percent) respectively.

3.2 Accessibility of Public Infrastructures in Rural Areas and Its Situations

This sub-section assesses and describes accessibility and situations of selected public infrastructures in Kersa *woreda*. Accordingly, description about all-weather roads, any formal health centers, any formal education centers, protected water sources, electricity, ICT, irrigation and agricultural extension infrastructures were discussed below.

A district has a total coverage of 481 kilometers of which 50 kilometers is asphalt, 181.5 kilometers is all-weather road and 249.5 kilometers is only winter road. Among 31 rural *kebeles* of a district, only eleven *kebeles* have all-weather roads with averagely 14.5 kilometers. Likely, Foster and Morella (2010) argue that rural road accessibility is very low in Ethiopia. According to a GIS-based analysis, only 10 percent of Ethiopia's rural population lives within two kilometers of an all-weather road. This is only half of the benchmark level for low-income countries in Sub-Saharan Africa.

Nevertheless, to improve the situations of lack of accessibility to all weather roads government at different levels have been working on it. One expert from transportation office claimed that, "we are working to enhance all-weather road within five kilometers to connect all *kebeles* of a district." The transportation officer also said "We are enlightening all-weather road by pressing all-weather road for all rural people as slogan, because we believe that households' access to all-weather roads improve food security."

Health centers are another pivotal public infrastructure. Officer from health office confirmed that 'district has thirty four health posts with maximum distance of five kilometers among them and seven are health center catchment. All rural *kebeles* have at least one health post. It is assumed as five thousand people to one health extension worker ratio." One of 55 health extension workers also said that "there is substantially improvement of health centers and services in our district. However, there are also people out of five kilometers' coverage of health posts."

[24] Majority of widowed respondents (84.8 percent) were female; it needs further research to answer the Question; 'why?'
[25] Waaqeffannaa and Catholics constitute this category

Regarding education centers, Kersa district has 73 primary schools of which 71 are found in rural *kebeles* with a minimum of three kilometers among them. There are also three secondary schools of which two are in rural *kebeles* with a minimum of seven kilometers among them and one preparatory school in Serbo town (Education office of Kersa district 2016). As one education expert stated standard of three kilometers was adopted from federal education ministers. The intension was that children should not go more than it since it decreases dropouts and school age children out of school. However, all respondents believe that there are high dropouts and school age children out of schools because of others related public infrastructures like all-weather road and electricity.

The other central infrastructure, on which a district's responsible bodies are effectively and efficiently have been working, is protected water sources. Consequently, 60% of a district is getting protected water sources. District has 193 protected spring sources and 129 pump water. In other words more than half of the rural people in the study area are believed to have an access to protected water sources with time for collecting and waiting at the point was $\leq$15 and $\leq$ five minutes respectively. These guidelines value have been recommended by WHO in 1983. Inconsistently with this finding, Kedanemariam and Sanjay [26] stated as the majority of Ethiopia's population relies on unimproved water and sanitation; 68 percent use surface water and 62 percent practice open defecation. Officer from water, energy and mineral office described:

Rural water supply projects take different forms ranging from simple protected springs to surface water systems with piped distribution of treated water system. The design and implementation of the simple schemes such as hand-dug wells, protected spring on spot, and spring with rural pipe scheme are being conducted. Simple schemes designed and implemented by the Woreda are known as Woreda Managed Projects (WMPs) and that of by the community are known as Community Managed Projects (CMPs).

Regarding irrigation data from district irrigation office indicates that sixty seven percent (18,540) of households are using irrigation on 0.5 hectare for each household. However, they weren't allowed to irrigate on more than 0.5 hectare unless with certain conditions. Generally, about 9,945 hectares were irrigated last year of which 7,226 hectares through traditional irrigation, 140 hectares through modern irrigation, 445 hectares through underground water irrigation, and 2134 hectares through pump irrigation. Of 18,540 (67%) of households who use irrigation: 13,630 use traditional irrigation, 253 use modern irrigation, 1,580 use underground water irrigation, and 3140 use pump irrigation. Another expert from irrigation office also added "nowadays, modernized irrigation systems are mostly used which works based on the pressurized energy system. The sprinkler and drip irrigation systems are of this type of water application systems." Finally, head of the office assured that government has been effectively and efficiently working on this sector so as to increase production and bring sustainable productivity.

Another selected public infrastructure is agricultural extension services. Kersa district has sixty four agricultural extension workers of 2-3 workers for each *kebele*. It has three groups: (plant extension workers - 36, animal extension workers – 17 workers, and cooperative workers- 11 workers). According to the sector officer, these groups (groups of agricultural extension services) have their own respective duties though they might work cooperatively with each other. Always they should be in rural areas. They give services through various

[26] Kedanemariam, Aklilu Kahssay, and Sanjay Mishra. "Community Development through Hydroelectric Project: A Case Study of Gilgel Gibe III Hydroelectric Power Project in Ethiopia." International Journal of Community Development, 2013.

mechanisms. Among those going house to house and giving training through organized zones of each kebele twice per month are the most invaluable mechanisms. There are households who frequently contact and consult agricultural extension workers while there are also others who participate once per month or twice per month or never attend the trainings.

Regarding ICT and electricity, availability and accessibility is very low. Data from survey indicated that 51% and 78.4 hadn't access to them respectively which is consistent with the finding of Demenge et al.[27] which indicates as Coverage of ICT services in Ethiopia is the lowest in Africa. GSM signals cover barely 10 percent of the population, compared with 48 percent for the low-income country benchmark; and the GSM subscription rate is only 1.6 percent of the population in Ethiopia, compared with 15.1 for the low-income country benchmark.

Depending on the standardized criteria of each sector, we summarized the respondents' response about their access to selected public infrastructures in the following table. For the purpose of this research, the researchers have used the following criteria (demarcation line) as households might have access to selected public infrastructures or not respectively. Those are: (a) five kilometers between household's house and all-weather road – for road infrastructure, (b) five kilometers between health posts or health centers catchment and home of households – for health centers, (c) three kilometers between (formal) education centers and household's house – for education infrastructure, (d) Fifteen and five minutes for collecting and waiting at the point respectively – for water infrastructure, (e) having modern and pump irrigation – for irrigation, and (f) participating on training and contacting with extension workers twice or more than it per month. Generally, the described demarcation line in this section were used in the following section where binary logistic regression model was employed to analyze association between selected public infrastructures and rural people food security status.

Table 2: Respondents Response about Accessibility of Selected Public Infrastructures

Variables	Category	Frequency	Percent
Sex	Male	218	55.5
	Female	37	14.5
Age	<30	3	1.2
	31-40	20	7.8
	41-50	99	38.8
	51-60	33	12.9
	61-65	80	31.4
	>65	20	7.8
Religion	orthodox	31	12.2
	Islam	199	78.0
	Protestant	17	6.7
	Other	8	3.1
	Can't read and write	99	38.8

[27] Demenge, Jonathan, Rossella Alba, Katharina Welle, Kebede Manjur, Alemu Addisu, Lyla Mehta, and Kifle Woldearegay. "Multifunctional roads: the potential effects of combined roads and water harvesting infrastructure on livelihoods and poverty in Ethiopia." Journal of Infrastructure Development, 2015.

Educational status	Grade 1-8	96	37.6
	Grade 9- 10	45	17.6
	Grade 11 - 12	9	3.5
	Diploma holder	3	1.2
	Degree and above holder	3	1.2
Marital status	Married	192	75.3
	Divorced	16	6.3
	Widowed[28]	47	18.4

Source: Household survey 2016

Depending on the standards given in the section before table, the respondents who have not or limited access to all-weather roads were 55.7 percent, electricity were 78.4 percent, protected water sources were 51.8 percent, ICT were 51 percent, health centers were 56.5 percent, education centers were 46.3 percent, irrigation were 91.8 percent, and agricultural extension services were 37.6 percent. Except an access to education centers and agricultural extension services more than half of respondents have not accessibility to public infrastructures. This implies that the level of public infrastructures in rural areas is at infant stage. The interviewed respondents from all sectors also witnessed as coverage of respective public infrastructures is at low rate in a district. They also argued as responsible bodies need to be increase proportionally high infrastructures funding and careful handling of public investments so as to reach infrastructures' targets within a reasonable time.

3.3 Public Infrastructures in Rural Areas and Food Security

The focuses in food security by measuring the protein, micronutrients, food quality and safety have to be treated as value judgments[29]. Thus for the purpose of this study, the researcher asked respondents almost subjective responses depending on the indicators of food security explained - the physical availability of food, the ability of household to access the available food and the ability of individuals (particularly those susceptible to food deficits such as women, infants and children) to secure entitlement to it throughout a year. If household head responded as these three elements are satisfactory; it has been considered as household has food security. Consequently, food security as a dependent variable, assumes the value of Y= 1 if a household is food secure, 0 otherwise.

Accordingly, majority of respondents (64.3 percent) were food insecure while only 35.7 percent were food secure. Majority of those who have access to a given public infrastructures have food security and vice versa. The result of survey shows that 70.8 percent of 113 households who have access to all-weather roads; 45.1 percent of 111 households who access to any formal health centers; 51.1 percent of 137 households who have access to any formal education centers; 52.8 percent of 123 households who have access to protected water sources ; 60 percent of 125 households who access to ICT; 54.08 percent of 159 households who have access to agricultural extension services; 90.9 percent of 55 households who have access to electricity ; and 95.2 percent of 21 households who have access to irrigation had food security throughout a year respectively.

[28] Majority of widowed respondents (84.8 percent) were female; it needs further research to answer the Question; 'why?'

[29] Maxwell, Simon, and Marisol Smith. "Household food security: a conceptual review." Household food security: Concepts, indicators, measurements, 1992.

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Contrastingly, 99.1 percent of those who have no access to all-weathers roads, 78.5 percent of those who have no access to any formal health centers , 88.1 percent of those who have no access to any formal education centers, 98.4 percent of those who have no access to protected water sources , 88.8 percent of those who have no access to ICT, 92.5 percent of those who have no access to agricultural extension services, 88.8 percent of those who have no access to electricity, and 67.1 percent of those who have no access to irrigation were food insecure throughout a year.

The following (figure 1) shows the feeling of households that either an intervention (accessibility) of respective infrastructures could improve their food security or not. Middle-of-the-road of respondents who have access to all-weather roads (73.4 percent), irrigation (96 percent) and agricultural extension services (98.1 percent) responded that accessibility to these respective infrastructures could improve their food security status. Unswervingly, Hussein[30], Bedeke[31], Mitiku, Fufa, and Tadesse[32], Kidane, Zerihun, and Godfrey[33], and Fekedu[34] strongly argue that an accessibility to one or more of public infrastructures can be a mechanism of improving rural households food security in one or another way. Rural households' food security is intractably linked with an advancement of rural public infrastructures[35]. Consequently, they recommend investment in public infrastructures particularly on road and agricultural extension services for better improvement of rural households' livelihood.

[30] Hussein, B. "Major causes of household food insecurity in Wuchale-Jidda Woreda, Oromiya national regional state." PhD diss., MA Thesis, Addis Ababa University, 2006.
[31] Bedeke, Sisay Belay. "Food insecurity and copping strategies: a perspective from Kersa district, East Hararghe Ethiopia." Food Science and Quality Management, 2012.
[32] Mitiku, Amsalu, Bekabil Fufa, and Beyene Tadese. "Emperical analysis of the determinants of rural households food security in Southern Ethiopia: The case of Shashemene District." Basic Res J Agric Sci Rev, 2012.
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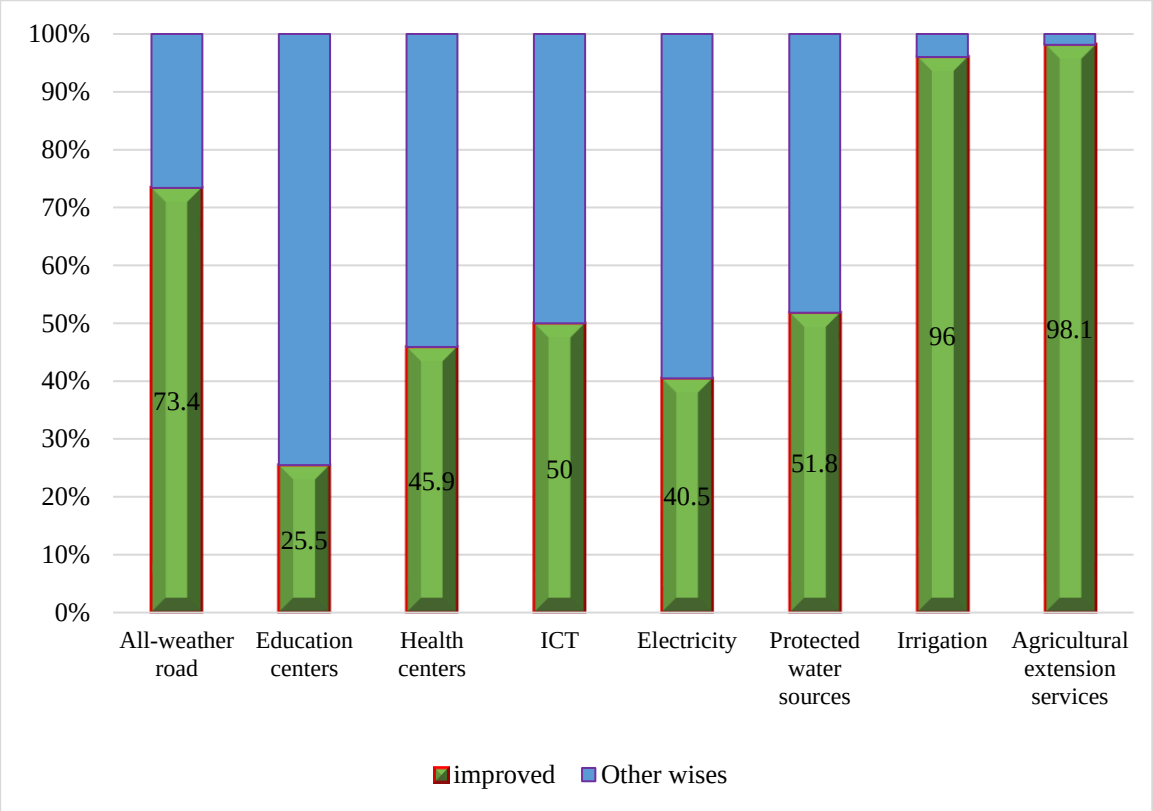

Figure 1: Households' feeling about food security and public infrastructures
Source: Household survey, 2016

Data from the qualitative methods also consistently supports the findings from quantitative data. For example, if they have access to all weather roads they save their time for engaging production and productivity which would have direct and indirect associations with rural households' food security. Access to ICT also helps rural households to get information which they utilize in improving their food security status and decreasing risks. Getting health centers and education centers improves the quality of human capital which explicitly triggers in diversifying livelihood strategies and leads to food security. The same is true for all selected public infrastructures. Generally, data from interview, FGD, and key informant interview indicates that rural public infrastructures have both direct and indirect associations with food security among rural households. Besides to the above descriptive finding, binary logistic regression was computed and the result was put as the follows.

Table 3: Binary logistic regression output about an accessibility of public infrastructures and households feeling about food security

Public Infrastructures	**Categories**	**Frequency**	**Percent**
All season road	Accessible at ≤5km	113	44.3
	Lak of access	142	55.7
Electricity	yes	55	21.6
	No	200	78.4
Protected water sources	Accessible at ≤ 1km	123	48.2
	Lak of access	132	51.8
ICT	Accessible	125	49
	Lak of access	130	51
Health centers	Accessible at ≤5km	111	43.5

	Lak of access	144	56.5
Education centers	Accessible at ≤3km	137	53.7
	Lak of access	118	46.3
Irrigation	Yes	21	8.2
	No	234	91.8
Agricultural extension	Yes	159	62.4
	No	96	37.6

Source: Household Survey, 2016

The above (table 3) shows access among other selected public infrastructures to all-weathers roads and agricultural extension services have significant and positive possible effects on the food security of households at $p < 0.01$. Consequently, the odds ratio tells us that the households who have an access to all-weathers roads were 25 times and who have access agricultural extension services were 43 times more likely responded that they have food security throughout a year than households who have not an access to these infrastructures respectively. Majority of respondents who have an access to all-weather roads and agricultural extension services were very happy. One respondent from interview stated that after they got all-weather road and agricultural extension services they have hardly facing the problems of food insecurity.

In addition an expert from transport office detailed the relationship between all-weather roads and food security as enhancing road has its own role in increasing food security of rural households. *Woreda's* agricultural office officer also added that rural people food security status is increasing satisfactorily as a result of getting an agricultural extension services. An expert from water office also witnessed that as it is usual without water everything is impossible. Protected water sources played a great role in ensuring food security of rural households. It helps them in producing quality food and increasing their production and productivity. To sum up, almost all of interviewed and key informants from all selected sectors believe that improvement in a given public infrastructure could directly or indirectly play a great role in the improvement of rural people food security.

4. CONCLUSION AND RECOMMENDATION

Conclusions entail empirical knowledge generated on the two inter-related key components of the study: an accessibility of public infrastructures and households' feeling of food security. Public infrastructures coverage in rural parts of Ethiopia is at infant stage though a large number of people live in rural areas. The demand of rural people about public infrastructures couldn't be answered. As a result a large number of rural households are food insecure in Ethiopia. An accessibility of public infrastructures and food security are directly related with each other. As there is low level of access to public infrastructures, there is food insecurity. Studying one of them separately from another is problematic. Therefore, studying instantaneously about the possible effects of public infrastructures on the complex and changing food security have a decisive role. Finally, we recommend government and others responsible bodies to upsurge their engagement in advancing pillar public infrastructures to reach out to where majority of Ethiopian people live (rural area) without having access to all those an indispensable public infrastructures.

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COMPETING INTEREST

The authors declare that there is no competing interest among authors. This manuscript has not been published and is not under consideration for publication elsewhere.

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