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**ARTICLES**

- Globalisation and Ebola disease: Implications for business activities in Nigeria** 47  
Adebanji Ayeni, Oluwole Oladele Iyiola, Ogunnaike Olaleke Oluseye and  
Ibidunni Ayodotun Stephen
- Contribution of Small Scale Irrigation to Households' Income and Food Security:  
Evidence from Ketar Irrigation Scheme, Arsi Zone, Oromiya Region, Ethiopia** 57  
Eshetu Tefera and Young-Bohk Cho

Full Length Research Paper

## Globalisation and Ebola disease: Implications for business activities in Nigeria

Adebanji Ayeni<sup>1\*</sup>, Oluwole Oladele Iyiola<sup>2</sup>, Ogunnaike Olaleke Oluseye<sup>2</sup> and Ibidunni Ayodotun Stephen<sup>2</sup>

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With the Ebola virus outbreak in West Africa, it is expected that whatever the transmitting cause and spread of the virus, it has affected the economic, political and socio- economy activities with an immense strain on the health sector. The scope of this study is the most populous nation in Africa, Nigeria. The quantitative method adopted provided results from questionnaires, which were analysed and resulted in providing the underlined significant role of globalisation in the development of Nigeria business activities and socio-psychological impact of the epidemic virus on globalisation. This is in line with the cross-border spread of the disease in generating bi-lateral strain amongst the affected countries, thus been envisioned from the spread of Ebola Virus. In the course of the paper, epidemics of such degrees in the past were reviewed by looking at how they surfaced, resurfaced and combated. The paper stresses on the role of globalisation in spreading, maintaining and eliminating the virus and its socio-economic implications in Nigeria and her related activities. This paper concludes that Nigerians are aware of the socio-economic benefits and ills of globalisation and they are convinced that the country had been impacted by it. Notably, disasters are proposed to be preventable with adequate systemized agency who will be saddled with epidemic control in Nigeria, resulting in a continuous notable success rather than having a haphazard control mechanism with business activities in negativity aside its disruption.

**Key words:** Globalization, ebola epidemic virus, socio-economic implication, health sector, Nigeria.

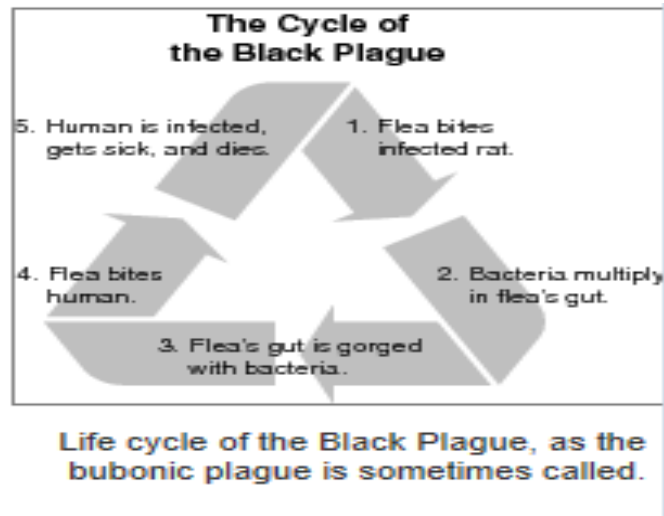
### INTRODUCTION

Humanity has always faced epidemic diseases war and won, though the price is costly unless early averted. The cost is in reference to lives lost, money spent, family displaced and much more that occur (Kothari, 2002). Kothari (2002) posited that when the outbreaks occur, skedaddle for survival among the people causes them to flee the area. In the midst of these, the likelihood of an infected person(s) fleeing to other communities leads to

the continuous spread (Kothari, 2002). Such was the case of the AIDS virus as analysed by the Poundstone et al. (2004).

It is an established fact, that the case of socio-epidemiology can be attributed to virus infection distribution where the epidemiology triangle was formed involving three major players namely the host, the agents and the environment. These three are actively

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**Figure 1.** Cycle of black plague (Perlin and Cohen, 2002).

needed for a virus to break forth from its hiding cocoon (Poundstone et al., 2004). LeDuc and Peters (1999) were of the opinion that the case of the Ebola outbreak in the past years, has being quietly noted to be as a result of human interference in the wildlife scenario which transits to the fact that the reduction of human deeds in the wildlife activities will go a long way in reducing the effect of zoo bacterium or virus transmission as against the currently noted causes (LeDuc and Peters, 1999; Carroll et al., 2015; World Health Organization, 2016).

The paper attempts to trace the trend of the Ebola virus disease and its reaction among the citizens by comparing its movement like the first epidemic in existence using Nigeria as a study. In doing this, the role globalisation played in this blue scenario was not put on the side track but rather in the limelight with effects on business activities.

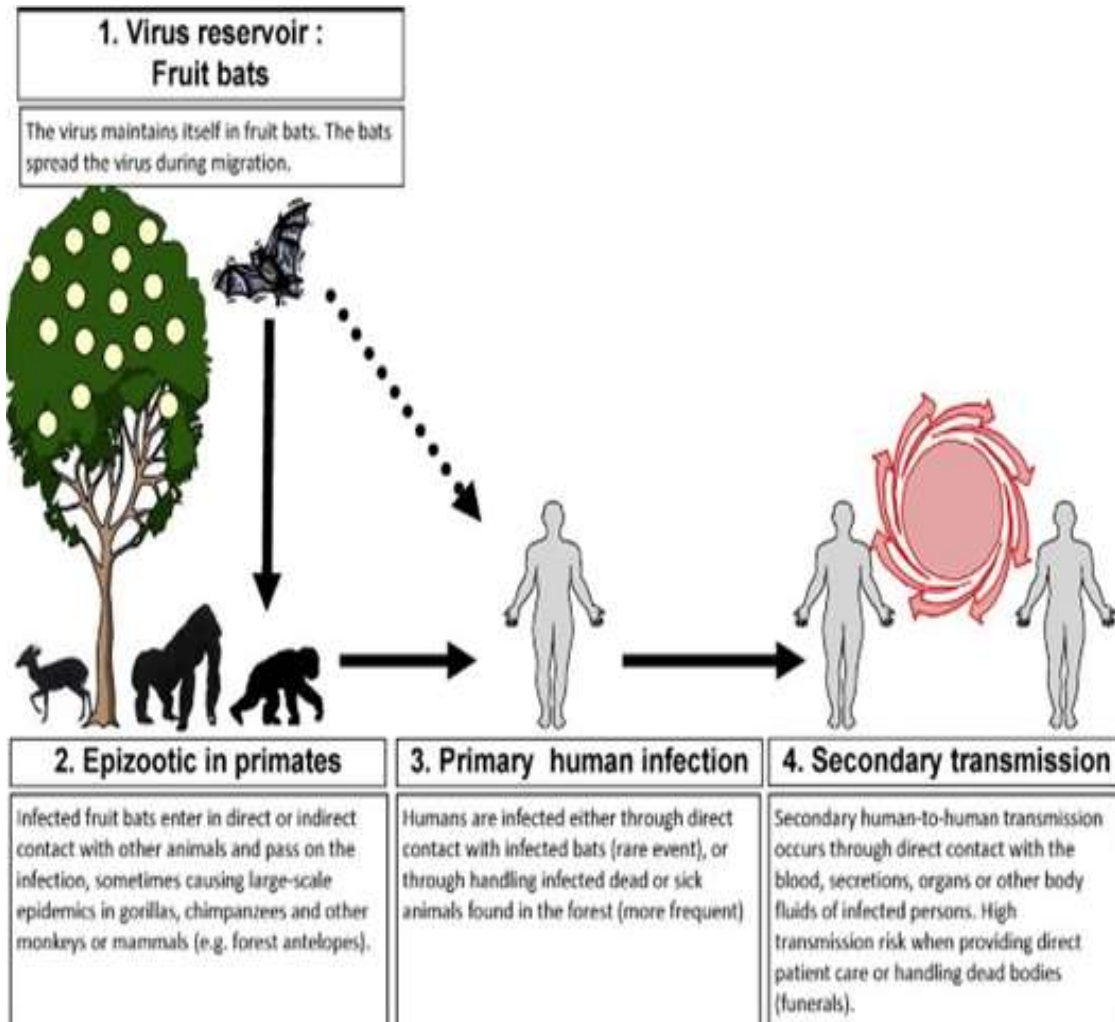
## Background

The epidemic outbreak has its own interesting timeline in the history of mankind. Affirming a case to be the first cause or known outbreak is a herculean task but following the documented history of the ten plagues on the Egyptians according to the biblical records in the book of Exodus in the Bible (Exodus chapter 4-13) will be adopted. In reference to what we term as a disease, the plague of boils on all living things will be the first epidemic disease (Exodus 9 vs 9), using the medieval times as a record timing of epidemic occurrence, we could settle down for Chinese plague which was recorded in 224 B.C (David and Ann, 2002; Infoplease, 2015; Emond et al., 1977; Rodriguez et al., 1995; Rowe et al., 1999; Alexander et al., 2015) though the bubonic plague which is also known as the black death is regarded as one with the most significant outbreak which occurred in the

fourteenth century, precisely 1347 to 1352, with a tag of twenty-five million lives paying for it (Infoplease, 2015). This huge number of casualties must have caused trauma to the European continent during that era as David and Ann (2002) recorded that the plague affected both people and rodents. Rodents was identified as a transmitting line in the spread of the plague with the infection aided by infected human host helping to spread the plague via coughing, sneezing and close talking. This transmitting means mirrors the same way the Ebola virus disease spreads (David and Ann, 2002; Infoplease, 2015).

David and Ann (2002) stated clearly that the Black Death (an alias name that was adopted for the bubonic plague) actually originated from the republic of China. This was caused by the trading silk with the aid of the infested rats on the merchant's ships, recording the spread of a sad historic event. Daniel Defoe gave a graphically written illustration about the reign of the plague between the years 1664 to 1665 (Infoplease, 2015). The black plague disease is in sync with the Ebola Virus Disease in terms of transition, spread and occurrence. While the other was a virus, the latter was designated to be a bacteria, which is inactive until the rightful condition for its nurtured and growth are all in place (David and Ann, 2002; Shears and O'Dempsey, 2015).

Just the way the fleas harbour the bacterium for the black plague (Figure 1), the bats are the main host for the Ebola Virus (Bausch et al., 2007). The epidemic disease is deemed troublesome with the accepted facts that there has not been any globally accepted vaccine or drugs that could tame it, though recorded cases of survival has being noted along the time line (Ross et al., 2014; The Economics, 2014; Yakubu et al., 2016). Next is the adopted diagrams (Figures 1 and 2) shown to illustrate the similarity in the cycle of both diseases.



**Figure 2.** Transmission cycle of the Ebola Virus (Rodriguez et al., 1995).

The spread of the Ebola virus epidemic disease was aided via the tool of globalisation. This paper is designed to answer the length at which globalisation (in lieu with business activities) determines the balance for a nation's economy. The black plague came into Europe via the Chinese route, from China which can be likened to the adopted means Ebola virus disease entered Lagos, via the air route from Liberia. Thus, making it the first time such an epidemic enters Africa's largest populated country (Public Health England, 2014).

The objective of this paper is to access the level of awareness and knowledge of Nigerian regarding the cause, effects and treatments of the disease. However, specific objectives include;

- i) Examine how globalisation facilitates the spread of Ebola virus among Nigerians.
- ii) Investigate the influence of the Ebola Virus disease on Nigerian business activities.

### Significance of study

The occurrence of an epidemic case endanger lives and cease a nation from existing. The paper traces the trend of the Ebola virus disease and reactions among Nigerians via online platform by comparing its growth and movement like the first epidemic that was in existence. In doing this, the role that globalisation played in this blue scenario was not put on the side track but in limelight. The expected role(s) that health workers were expected to play in the epidemic scenario was considered with relevance to the Nigerian government and populace in eradicating the virus with the knowledge of their lives on the line with little or no compensation. In lieu of this, the research is of importance to:

- i) The Government Officials
- ii) Health workers
- iii) Researchers



- iv) The populace
- v) Business owners.

### **Globalisation: Love and Hate**

The need for globalisation cannot be simplified but due to its complexity proving more profitability in analysing when problems such as an epidemic disaster enters a community. Its necessity is being questioned (Troncoso, 2015). Such was the case with the Ebola virus disease with countries restricting flights from affected countries into theirs. Funny, these banned countries served as resource-draining pipes for the same nations who places restriction due to business convenience and good environmental report since internal business regulations are meant to thrive in these nations for foreign investors (World Bank Group, 2014).

During the turbulent times caused by Ebola virus disease, discrimination was believed to be the reasons why developed countries didn't want to give vaccines (though half finished, some school of thoughts believed that they should be sent to the affected countries) (Oleribe et al., 2015; Molokwu, 2015) as the this was not the case as when the reasons for the seclusion of personnel and other human interaction was immensely necessary (Alexander et al., 2015). It could be stated that the survival of the national interest was based on being a paramount issue against all other cases (Public Health England, 2014; Tambo et al., 2016).

### **Intruders: Who are they?**

The Ebola virus disease has put researchers on their toes as to what could have triggered the current silent death giver for years to bear its fangs once more in the world without any restriction. Looking at the stage of transmission of the Ebola virus (reference to Figure 2), it an easy conclusion of who the intruder in the transmission circle was a man. Thus, a case of hygiene and curiosity that brought it out of it pit and transmitted via the four transmission stages namely:

- i) Escape from the host.
- ii) Transport to the new host.
- iii) Entry to the new host.
- iv) Escape from the new host (Society for General Microbiology, 2015).

In comparison with the way the United States political strata's intended to epidemic in lieu of it crossing over was the same view placed with the Nigerian political caucus (Fasina et al., 2015). This synchronizes with ideology that the responsible hand to blame in tackling crisis will be the political party sitting in the corridor of power which becomes the perfect football for the political

elites to use as a distraction for the masses to view their defects (Millman, 2014a,b).

### **Globalisation: Protagonist or antagonist**

It is pertinent to note that Ebola virus entered Nigeria via an equipment called Airplane and its curbing was also ensured via telecommunication devices, thereby concluding both means are products of globalisation (Africa Independent Television, 2014). It is appropriate to state that the tools of globalisation are used to ill and bless nations depending on its utilisation. For days after its appearance, citizens were in doubt about the existence of Ebola Virus. The use of the internet and multimedia devices paid a major role in the circulation of the spread and deadly nature the virus possess (Ogundipe et al., 2014).

A look into the role globalisation plays in the Nigerian economy holistically; it is wrong to state that globalisation has whollistically aided the Ebola virus and not view its help in diminishing the effects sprung forth. Literatures gathered from scholars such as Ronald et al. (2011), Cartalucci (2014), Ezedike (2013), Freeman (2002), Ford (2009) have only aided in stating the double-edged sword possessed by globalization and its role in the government to deal with rewards that spring from it.

### **Punishment for impunity?**

It is possible to attribute the adoption of a particular type of governance in a country to the role or extent that globalisation plays. The role of democracy in countries where practised makes it hard to curb the excesses of globalisation due to the norms that come with it. During the Ebola outbreak in Liberia, some of the populace assumed it was a government scam. This showed the failure of governance (Alexander et al., 2015). Those who survived the deadly epidemic are considered a threat on the confirmation that the male semen could be infectious three months after the being diagnosed with the virus (World Health Organization, 2014; Bausch et al., 2007). Truly, this reflection of the Nigerian health system in being weak and grossly mismanaged was displayed during the crisis but saved by the intrepid nature of the health practitioners, who brought safety and sanity into the country with their lives being the paid as price (Iroezindu et al., 2015).

### **Arising problems, finger pointing, next?**

The human attitude deems it right to direct blame persons or institution when things go wrong and as a result blaming the un-alertness of the security personnel from Liberia for Patrick Sawyer entrance rather than solution providence which should be the next step such

as the occurrence of the Estonia cyber-attack by the Russians (Aborisade et al., 2014). Considering the reaction of the Liberian people to their government as a scam in response to the procurement of western aid it would be easy to see the failure that exists in the nature of governance enhanced by corruption (Jerving, 2014).

With this lack of trust, the capital of Liberia, Monrovia experienced a wildfire of the spread of Ebola virus disease based on the lack of trust leading to its description as the "Worry of the World" by Andrew Hoskins, medical international country director as it was the country with the worst condition in dealing with the virus (Jerving, 2014; Microbiology Online, 2015).

In words of Brecht Bertolt, the worst illiterate is the political illiterate (QwikGist, 2014), which refers to having a knowledge of political occurrence in one's nation is deemed important as it has crippling effects on every aspect of life.

The stated cost by pharmaceutical companies on the development of drugs or vaccines transcends to billions of dollars which should not be a limiting factors for countries such as Nigeria with the financial muscle and entrepreneurs venturing in it but regulation of such monopolized market will definitely have an invisible barrier from allowing competition in the sector (The Economist, 2014; Ogundipe et al., 2014; Gallup World, 2014), with the level of distrust that exist amongst Nigerians and within the levels of government, it is a surprise that the people were swift to react and believe the potency of the virus, thus leading to its curbing (Tomori, 2015). Could this be a light at the tunnel for the country to thrive in actualizing her old savoured moments of being the giant of Africa?

The step to take in an epidemic situation is to search for a cure, possible eradication and future prevention which cannot be attained without the due involvement of the people and government (Formenty, 2014; Iroezindu et al., 2015). Jerving (2014) gave an opinion that Liberians are still being haunted by the failures of their past governance, which also reflects amongst the Nigerians with the only difference of the quick re-spawn of hope amidst a grandeur of failures basked in promises. With the expectation not expiring this hope, a negative response was displayed among the citizens in response to the awareness but sheer determination of the government made 13 infected person which amounts to 61.5% surviving the disease (Ogundipe et al., 2014), thus showing a stronger allegiance amongst the citizens.

### **The Nigerian business environment**

The Nigerian business environment is known to be a lucrative playground as every problem is seen as opportunities for profit realisation. The case of the hand sanitizers which private and established entrepreneurs used to rack in millions within the few months of the Ebola virus disease outbreak is one of these (Dickson,

2009; Akinbogun, 2008). According to C.I.A (2016), Nigerian business environment has major strength amongst others in:

- i) Strong Banking and Financial Sector
- ii) Easy Provision of Medium and Long-Term Loans
- iii) Controlled Money Supply
- iv) Fast Growing Oil and Gas sector
- v) Fast Telecommunication Sector
- vi) Investment Opportunities for the Local Entrepreneurs and Foreign Investors
- vii) Availability of Young, Active and Mobile Labor Force
- viii) Potentials for Future Growth and Investment
- ix) Increased Competitiveness and Profitability in the Petroleum Market Globally.

With the above-stated strengths, her weakness surely exists and act as undermining her great potentials. The weakness as found in Akinbogun (2008) and Ahmed (2015) include:

- i) Lack of power supply, road networks, security setups and other infrastructure.
- ii) Lack of finance and capital resources.
- iii) Lack of information system, new technology, and scientific base.
- iv) Inability to diversify its markets.
- v) Inadequate internal resources.
- vi) Lack of managerial capabilities and leadership skills in its business environment.

It is acceptable to note that there are more risks of doing business in Nigeria and succeeding as an entrepreneur with the country being an unfortunate victim of the mismanagement, corruption, inadequate and dysfunctional infrastructure, weak leadership, and the lack of cohesion (Ahmed, 2015).

### **METHODS**

Primary data was sourced through an online designed questionnaire to get an opinion about the virus in relation to globalisation, thus deriving the respondent's knowledge about the virus. With the use of survey monkey, an electronic tool, questionnaires were distributed to generate an opinion poll among Nigerians on online social platform (Facebook).

### **RESULTS ANALYSIS**

The results established that large number of Nigerians were fully informed about the Ebola Virus with 87.18% and 89.4% showing the population knew what constituted the Ebola transmission. The response rate from the avoidance or reduce rate of prevention was not quite encouraging as it was tagged with 15.38% showing the population were carefree about its transmission and how to avoid it was 41.03% leaving a number with inability

reduce the Ebola case.

Further analysis into the result shows to a large extent that an average Nigerian would not spare his life to help an infected person even when given the right protective gears. This arose from the treatment meted out on the medical professional who laid their lives to curb the virus, thus showing that respect and non-monetary treatment gives the psychological impact (Aborisade et al., 2014).

A response of 76.32 and 89.47%, deems it right to assume the role globalisation played in the Ebola Virus disease (in terms of the transportation of the Virus into the country) which necessitated its being viewed as one of the major ills of globalisation.

A poll of 42.11% shows that the globalization effect is being viewed positively than negative, though 7.89% were indifferent and could possibly mean that they accepted that there exist positive and negative aspects of it.

Opinion that the government did not do enough to implement the right things to curb the Ebola virus was affirmed with the rating of 18.92% showing the government were not being effective. This was in conjunction with the report stated by (Aborisade et al., 2014; The Department of Health, 2014; Aljazeera.com, 2015) as the level of seriousness, thus calling for re-address on the path of the government on how they should respond to issues when they arise.

Different opinions opined that the government was not active in giving a quick and swift response to the Ebola virus epidemic in making its way into the country (Aborisade et al., 2014), the survey shows that the government responded to the situation.

A summary of the analysis shows majority of the respondents were adequately informed about the cause and effect of Ebola Virus even though yet to meet with anyone infected with the disease. On the stages of the virus in an infected person, full information was on the average while majority of respondent will not physically help an infected person even after the protective gears had been given.

Ascertaining that globalisation was responsible for the importation of the disease into the country created a mix feeling on tagging air transportation as an ill of a global economy, though every sector of the economy had benefited immensely from different globalisation policies.

On the non-parametric test, there is significant awareness in Nigeria regarding the cause, effects and treatment of Ebola disease (Appendix 1), while the respondent asserted that spread of the disease was significantly influenced by globalisation (Appendix 2).

## CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE STUDIES

This study revealed that Nigerians are aware of the socio-economic benefits and ills of globalisation but the

ills could be prevented or managed, such as illiteracy level in the country in times of epidemic emergence, the government must employ appropriate medium to provide enlightenment in all strata of the economy in irrespective of political affiliation leading to efficient management of the virus in the country (Palmgreen et al., Shears and O'Dempsey, 2015).

From all ramifications, it could be said that globalisation is not bad but rather a blessing that ought to be controlled. The Chinese ideology says leaving the windows open, be sure the net, thereby preventing the mosquitoes fit well into the Nigeria sceneries. This is because with the aid of corruption, we have allowed all types of mosquitoes have their way into the country.

With this result, it is recommended that medical researchers invest in further research and work on a vaccine to avert another Ebola virus epidemic occurrence and at the completion of this paper, Liberia, one of the countries with the worst outbreak was recovering with three cases per day as against 91 cases (Agency Report, 2014) and having 3400 lives claimed by the virus.

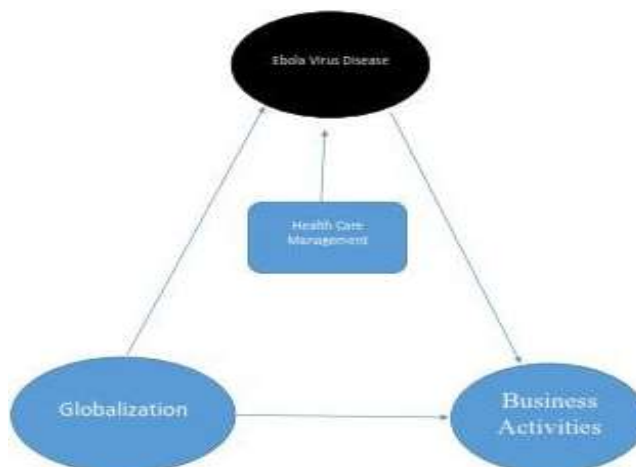
This result was achieved with lives of medical volunteers with no room for complacency as a price and little or no compensation making it a case of true allegiance to one's country as a founding line in a true commitment. Drugs and vaccines, such as the Brincidofovir, Zmapp and the TKM-Ebola injection was made but the confidence on them coupled with the slow response by World Health Organization (2015) was not encouraging or probably due to world politics (Aljazeera.com, 2015; NAN, 2016).

The Redeemers University that kept developing the Ebola test kit during the crisis should be encouraged (Makinde, 2015), as it seems private researchers cannot be funded based on trust or corruption. Institutions should be aided via research funds and grants and not wait for another epidemic to unveil its evil intent again (Erdal and Mahmut, 2008; Burki, 2016).

However, this study recommends that all the health checks in all the entry points of the country should be sustained and residents of the country should maintain high level of hygiene which was practiced during the advent Ebola Virus in Nigeria and the government at all levels should continue to enlighten the citizen on any prevailing health epidemics in the World.

Figure 3 shows the relationship posited by Ebola Virus disease in the course of aspiring positive globalised relations which could be termed a system with and without possibly accruing to a risk of a contagious disease, thus creating mistrust and spread of ill-will amidst neighbouring nations feared to experience the next visible occurrence.

Prevention can be attained via indulging the idea of Tambo et al. (2016), which posits the need for Nigerians and other west African nations to strengthen the healthcare systems which can respond to the high level of responsiveness and capacity. Ayeni et al. (2015)



**Figure 3.** Author's representation of checks on negative globalized issues focusing on health with Ebola as a focus.

welcomes the idea of big data technology in preventing and controlling the Ebola virus disease while using the principles of cloud computing as safety net of operation in the health management system. Also, Owolabi et al. (2015) pinpointed the major problem with Africa as decentralized and uncoordinated data which ends up mystifying our engaged projects. There is a need to welcome the old ways of community participation which when combined with health education and deployment of effective novel diagnostic approaches will aid in early warning and surveillance of threats and emerging diseases (Kinsman, 2012; Tambo et al., 2016). This can be reprogrammed via the development of strategically measures in curbing the viral resurgence, persistence transmission dynamics, spread and accelerating vaccines regimen (immunization) development, which comes with implementation of restructuring plans in achieving sustained control, and eventual elimination in foreseen objective (Tavernise (2014; Fasina et al., 2015; Alexander et al., 2015; Carroll et al., 2015; Jasovský et al., 2016).

Another recommendation of this study is the collaboration of entrepreneurs in the health care system via international African Community. Obviously, the reason why African countries were affected by the epidemic and had to cry out to the developed nation for a solution was based on the reason that the financial muscle for research into the health sector is high with strained ability on any intended person(s) who wants to personally see it through. This suggestion is not in agreement with the view of Folayan et al. (2016) on the position that developed nations were obligated to contribute to strengthening of how health care system but in agreement with Buseh et al. (2015) on the disposition of having a private-public partnership though with reduced involvement of international communities.

The dependency of the African nation on the western continent to deal with issues such as health, war amongst

many others shows the inability to transcend the desired level of independence. We could compare it to a young man asking for freedom and wants recognition but collect daily stipends from his parents. It is in the best interest of all African countries to have a unilateral profit-oriented company that goes into the health-aid business. The organisation should be given the liberty to operate with little interference from any government and have her interest protected by them (all involved nations). This was also suggested by Yakubu et al. (2016) for the provision of institutional health care system as the cases of ethical challenges raise bars to health workers performance in their duties due to compensation being fully amiss when dealing with contagious disease in an apt manner. The suggestion of Iroezindu et al. (2015), also advocated by Oleribe et al. (2015) on the comprehensive strengthening of the Nigerian health system while owning the breeding problems will deviate from its currently weak and grossly mismanaged state and help in winning the war against less virulent infections.

Lastly, an adage says "*Health is wealth*" and thus when there is little or no health pandemonium, business is expected to thrive. In lieu of this, advocating towards preventive methods in epidemic matters is also a profit oriented measure while attaining strategic measures in achieving a sick free society via constant patronization from the governmental agencies and the society at large.

### Conflict of Interests

The authors have not declared any conflict of interests.

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**APPENDIX****Table 1.** Friedman a) non-parametric and b) significance test results for hypothesis one.

<b>Criteria</b>	<b>Mean Rank</b>
<b>Non-parametric test</b>	
Q1	3.79
Q2	3.86
Q3	2.96
Q4	2.75
Q5	1.64
<b>Test statistics</b>	
N	38
Chi-Square	68.628
Df	4
Asymp. Sig.	0.000

Source: Author's computation from SPSS 16.0.

**Table 2.** Friedman a) non-parametric and b) significance test results for hypothesis two.

<b>Criteria</b>	<b>Mean Rank</b>
<b>Non-parametric test</b>	
Q7	2.97
Q8	2.36
Q9	2.71
Q10	1.96
<b>Test statistics</b>	
N	35
Chi-Square	16.177
Df	3
Asymp. Sig.	0.001

Source: Author's computation from SPSS 16.0.

*Full Length Research Paper*

# Contribution of Small Scale Irrigation to Households' Income and Food Security: Evidence from Ketar Irrigation Scheme, Arsi Zone, Oromiya Region, Ethiopia

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Livelihoods of the rural people of Ethiopia depend on agriculture. However, erratic nature of rain and prevalence of drought in the country make agricultural production a challenge. To counter this problem, use of the available water resource for irrigation development is the most promising option. Ketar small scale irrigation scheme is found in Ketar-Genet Peasant association, Tiyo District, Arsi zone, established with the aim of improving level of income and food security of beneficiary households. Nevertheless, no previous study was conducted on the contribution of the scheme to income and food security of households. Thus, this study was conducted with the objective to investigate the contribution of small-scale irrigation to rural household income and food security. The required data set for the study were gathered primarily through survey method from 130 randomly selected sample households both from irrigation users and non-users (65 each). Structured interview was used as data collection method. Both descriptive and inferential statistical methods were used to analyze the required data. Results of the study revealed that, income from irrigated vegetable crops contributed for 21.38% of the total annual crop income for the irrigation users; irrigation users were in better position in terms of livestock (7.58 to 4.38 TLU) and oxen ownership (1.78 to 1.12 TLU); participation in credit (52 to 23%) and the use of extension advisory services. Results of the logit model indicated that age of household head, education level of household head, size of the cultivated land, number of oxen, livestock holding (TLU), income from livestock and irrigation found to be influencing household food security at 1, 5, and 10% significant levels. In general, the empirical analysis confirms that small-scale irrigation development would have positive impact on income and food security of beneficiary households. Thus, the concerned development partners being governmental or non-governmental should join hands to promote the development of such small scale irrigation schemes.

**Key Words:** Small-scale irrigation, food security, agricultural production.

## INTRODUCTION

Ethiopia is the second most populous country in Africa. The incidence of poverty stands at 30% at the national

level. Incidence of poverty is higher for rural areas, than urban areas at 33 and 29%, respectively. Agriculture

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plays an important role in the development of the national economy, contributing about 50% of the gross domestic product (GDP, and employs 85 % of the population (FAO, 2012).

Combinations of natural and manmade factors have resulted in serious and growing food insecurity problem in many parts of the country. Currently, about fifteen million people are facing food insecurity, either chronic or transitory in nature. About five to six million people are chronically food insecure every year. There are people who do not have the capacity to produce or buy enough food to meet their annual food needs even under normal weather and market conditions. The remaining ten million are vulnerable, with a weak resilience to any shock. Under any emergency circumstances, the likelihood of these people falling back into food insecurity is high (FAO, 2012).

In order to address food insecurity of the rapidly growing population in Ethiopia, the current agricultural area assumed to increase by 25%, while average yields are assumed to increase by one-half by 2020 (Ehui et al., 2002). Food insecurity often turns into famine with the slightest adverse climatic incident. The challenge, therefore, is how to meet the increasing demand given the existing but dwindling natural resources and worsening climatic conditions. Hence, there should be ways to use improved technologies of agricultural production to enhance the economic, social, and institutional conditions necessary for increased agricultural production and productivity (Mekuria, 2003).

The challenge posed by recurrent drought, declining agricultural production at household level and ever increasing population pressure necessitated close attention to water resource management and small-scale irrigation development (Hune, 2003). The country may not be able to meet its large food deficit through rain-fed agriculture alone (Desta, 2004). Irrigation development has been given priority in the Agricultural Development Led Industrialization (ADLI) strategy of Ethiopia. Under the program, irrigation is planned to be introduced and implemented in areas where agro-ecological conditions are in harmony with the interventions (GoE, 2001).

On top of this, the Ethiopian Government, in collaboration with its development partners, has developed a Food Security Programme (FSP) within the framework of the Plan for Accelerated and Sustained Development to Eradicate Poverty (PASDEP), which is a guiding strategic framework for the five-year period 2005 to 2010. In the PASDEP and the FSP, due emphasis has been given to developing and using the huge potential of the country for irrigated agriculture to produce food crops as well as raw materials needed for agro-industries (FAO, 2006).

Irrigation development is being promoted by government and non-government organizations as one of the development strategies contributing to the overall agricultural development of the country in general, and to

rural household food security in particular. Though, irrigated agriculture has positive impact on household food security and income (Fuad, 2002; Desta, 2004) there are cases where irrigated agriculture failed to achieve intended impact on household wellbeing (Quasem, 1994).

The contribution of farmer based small-scale irrigation for semi-cash cropping has not been studied, though such schemes cover more than 40% of the irrigated land in the country (Dessalegn, 1999). Seleshi et al. (2005) indicated the need for undertaking impact assessment of small-scale irrigation particularly on production and productivity of rural households.

*Oromia* is one of the nine regional states in the country with its surface area of 359.620 square kilometres, constituting about one third of the total area of the country. The problem of food insecurity has increasingly become worse in the low land areas of the region, which represent about 30 percent of the total land mass. Coping mechanisms of pastoralists and agro-pastoralists in these areas are so fragile that minor change in rainfall distribution often results in famine (OIDA, 2004). The same source indicates that, the region has about 1.7 million hectares of land suitable for irrigation. Because of the growing concern over food security and an increasing trend in the occurrence of drought in the region, the regional government has planned to utilize the exiting irrigation potential.

*Ketar* irrigation scheme is found in *Tiyo* district in *Ketar-Genet* peasant association. Among 305 households in the area, 130 households are members/users of the irrigation scheme. The scheme has been established in order to address household food insecurity and income problems. However, an in-depth analysis of the contribution of the irrigation to this effect has not been studied so far. Therefore, this research was conducted to assess contribution of the small-scale irrigation to the livelihoods of the beneficiary rural households in terms of improving income and food security.

The study also envisaged to generate empirical evidences on the role of small-scale irrigation in enhancing rural household income and food security. At the same time to contribute to the knowledge and understanding of development actors in their future planning and development of small-scale irrigation schemes. Hence, the objectives of this study is to assess households' food security status, to assess the contribution of irrigated agriculture to household's crop income and food security and to identify the major determinants of households' food security in the study area.

## MATERIALS AND METHODS

### Description of the study area

*Tiyo* district is one of the districts in *Arsi* Zone, *Oromia* Regional state. The district is bordered to the south by *Munesa*, to the west

by *Ziway Dugda*, to the northeast by *Hetos*, and to the southeast by *Digeluna Tijo* districts. The zonal capital of the district is *Asella*, which is found 175 km away from the capital *Addis Ababa*. *Mount Chilalo* is the highest point in this district. Major rivers in the district include the *Ketar*, *Kulumsa*, *Gonde*, *Dosha* and *Welkesa*. A survey of the land in this district shows that 40% is arable or cultivable (32% was planted with cereals), 23.1% pasture, 8.7% forest, and the remaining 28.2% is considered swampy, mountainous or otherwise unusable.

The district has a tropical heavy and erosive rainfall as well as cool to moderate climate. The altitude of the area ranges from 2240 to 2740m above sea level, the annual means temperature ranges from 15 to 22°C, and the mean annual rainfall ranges from 900 to 1100mm. The rainfall pattern is bimodal which are short rainy season (*Belg*) and long rainy season (*Meher*).

According to *CSA (2011)*, the total population of the district is 86,727 of which 43,443 are male and 43,284 are female. From the population of the district, about 80,204 or 92.5% lives in rural areas and the remaining proportion lives in urban areas. Farmers in the area practice mixed type of farming. Major crops grown in the district are cereals (barley, wheat, teff, and maize), pulses (bean and pea), oil crops (linseeds and rape seeds) and vegetables (potato, tomato, onion and cabbage). In the district, *Ketar-Genet* Peasant association is known as rain shortage area, by which farmers residing in the water bank of *Ketar* River are benefiting from the irrigation schemes.

*Ketar* River is the major source for *Ketar* irrigation scheme which covers 367 ha of land. The irrigation scheme is located in *Ketar-Genet* Peasant association which is found 39 km away from the zonal capital *Asella*.

**Sampling procedure**

For this study, 130 sample households were used (65 households from users of the irrigation scheme and 65 households from non-users of the irrigation schemes).

**Method of data collection**

Data were collected both from primary and secondary sources.

**Method of data analysis**

**Descriptive statistics**

Mean, standard deviation, frequency distribution and percentage were used to examine and understand the socio economic situations of the sample respondents through comparing irrigation users and non-users. The food items consumed by sample households' calorie content was computed using calorie conversion table of *EHNRI (1968)*, and household members were also converted to their adult equivalent. Then, the amount of total calories consumed by each sample household was computed and divided by 14 days to get per day calorie consumed by household. This figure was divided to the Adult Equivalent (AE) of respective households and which finally gave the amount of calorie available per AE for each sampled household. Thus, those households greater than the minimum amount of calorie required (2100kcal) was put under food secured otherwise not food secured (*Hoddinott, 2001*). The situation of household food security within irrigation users and non-users was also seen independently. In order to calculate rate of return to land management of rain fed and irrigated vegetable crops grown by irrigation users 2012/2013 production season, partial budgeting technique was applied which used plot level input and output data collected for the crops.

**Econometric model**

Logistic model is used to identify the determinants of food security, and to assess their relative importance determining the probability of being in food secure. The functional form of logit model is specified as follows, *Gujarati (1995)*:

$$P_i = E(Y = 1/X_i) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_i)}} \tag{1}$$

For ease of exposition, we write (1) as:

$$P_i = \frac{1}{1 + e^{-Z_i}} \tag{2}$$

The probability that a given household is food secure is expressed by (2) while, the probability for food insecure is:

$$1 - P_i = \frac{1}{1 + e^{Z_i}} \tag{3}$$

Therefore, we can write:

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} = e^{Z_i} \tag{4}$$

Now,  $(P_i/1-P_i)$  is simply the odds ratio in favour of food security. The ratio of the probability that a household will be food secure to the probability that it will be food insecure. Finally, taking the natural log of equation (4) we obtain:

$$L_i = \ln\left[\frac{P_i}{1 - P_i}\right] = Z_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_n X_{in} \tag{5}$$

Where  $P_i$  is a probability of being food secure ranges from 0 to 1.  $Z_i$  is a function of  $n$  explanatory variables ( $x$ ) which is also expressed as:

$$Z_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_n X_{in} \tag{6}$$

$\beta_0$  is an intercept

$\beta_1, \beta_2, \dots, \beta_n$  are slopes of the equation in the model

$L_i$  is log of the odds ratio, which is not only linear in  $X_i$  but also linear in the parameters.

$X_i$  is vector of relevant household characteristics

If the disturbance term ( $U_i$ ) is introduced, the logit model becomes

$$Z_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_n X_{in} + U_i \tag{7}$$

**Hypotheses and definition of variables**

**Household food security (HHFSE)**

This is a dichotomous dependent variable in the model taking value

**Table 1.** Hypothesized independent variables and expected sign.

S/N	Hypothesized independent variable	Expected sign
1	Age of household head (Age)	+
2	Education of HH head (Education)	+
3	Dependency ratio (DEPNDRTO)	-
4	Number of livestock owned (excluding oxen) (livestock)	+
5	Number of oxen owned (Oxen)	+
6	Size of cultivated land (Landcult)	+
7	Labor (Labor)	+
8	Access to credit (Credit)	+
9	Off-farm income (Offinco)	+
10	Income from rain-fed crop produces (Raincrinco)	+
11	Income from irrigated crop production (Irricome)	+
12	Use of fertilizer (Fertilizer)	+
13	Extension Service ( Extention)	+
14	Income from livestock (Livesincome)	+

**Table 2.** Age distribution of sample household heads.

Age (yrs)	Users (n=65)		Non-users (n=65)		Total (n=130)	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
18-25	5	7.7	5	7.7	10	7.7
26-40	29	44.6	32	49.2	61	46.9
41-55	24	36.9	22	33.8	46	35.4
55-65	7	10.8	6	9.2	13	10
Mean		43.65		41.02		42.33
SD		11.4		12.0		11.76
t-Value	1.28NS (Not Significant)					

Source: Computed from the field survey data (2013/14).

of 1 if a household is food secure and 0, otherwise.

### Independent variables

Various socioeconomic and household characteristic variables are expected to affect household food security in the study area. The major explanatory variables hypothesized to influence household food secure situation are presented in Table 1.

## RESULTS AND DISCUSSION

### Descriptive analysis

#### Households characteristics

Age composition of the Household head: Farmers acquire experience and knowledge through devoting their time to farming activities. Therefore, higher age means better farming experience, and accordingly better condition in terms of food security and they become

more risk avert. Table 1 indicates that mean age of the sample household heads was 42.33 with standard deviation of 11.76. The mean age of sample household heads of irrigation users and non-users were 43.65 and 41.02 with standard deviation of 11.43 and 12.0 respectively; this indicated that the older the household head, the more experience he has in farming. Moreover, older persons are more risk averters, and mostly they intensify and diversify their production activities (Abeba, 2003) (Table 2).

**Dependency ratio:** Household with high dependency ratio will face shortage of labour to undertake activities that bring benefit to household. Therefore, economically active members of household have to support themselves and other members of the household. Household members aged below 15 and above 64 are considered as dependents and dividing it by household members whose age is between 15 to 64 resulted in dependency ratio. The distribution of dependency ratio for sample households showed that about 52% of sample

**Table 3.** Dependency ratio of sample households.

Dependency ratio (No)	Users (n=65)		Non-users (n= 65)		Total (n=130)	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
0 – 1.00	34	52.3	33	50.8	67	51.5
1.01 – 2.00	25	38.5	30	46.2	55	42.3
2.01- 4	6	9.2	2	3.0	8	6.2
Mean (No)		1.22		1.25		1.23
SD		0.70		0.55		0.63
t-value				-0.27 NS		

Source: Computed from the field survey data (2013/14).

**Table 4.** Education status of sample household heads.

Education (grad)	Users (n=65 )		Non-users (n= 65 )		Total (n=130 )	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
Illiterate	41	63.1	47	72.3	88	67.6
Read and write	9	13.8	5	7.8	14	10.8
Elementary school	8	12.3	9	13.8	17	13.1
Junior secondary school	7	10.8	4	6.1	11	8.5
Mean (grades)		1.71		1.54		1.62
SD		1.057		0.953		1.006
t-value				0.96 NS		

Source: Computed from the field survey data (2013/14).

households' dependency ratio falls within 0 to 1 (Table 3) indicating that economically active member of a household is expected to support at least one member of the family. The result is almost similar for irrigation users (about 52%) and non-users (about 51%) that is, the dependency ratio range is 0 to 1. The mean dependency ratio for irrigation users and non-users was found to be 1.22 and 1.25 with standard deviation of .70 and .55 respectively. The overall mean of dependency ratio of sample households was 1.23. The t-test result shows that there is no statistically significant difference in mean value dependency ratio between the two groups. A household with more productive labour force compared to the active age shows a high dependency ratio, and it is more likely to be food insecure (Bigsten et al., 2002) (Table 3).

**Education level of household heads:** The average number of years of formal schooling completed by the sample farmers was 1.62 (Table 4). Among the sample farmers, the majority (67 %) were illiterate, while only about 11% could read and write. The rest attended formal elementary or junior secondary school.

None of the household heads had attended school beyond grade 8. Descriptive statistics result revealed that, there is no statistically significant mean difference

between the two groups in their education level (Table 4).

## Household resource endowment

### Labor availability

As shown in Table 5, the mean available labor in man equivalent was 2.14 with the minimum and maximum being 1 and 5.1 respectively. The labor availability between irrigation users and non-users differ in that users had large labor endowment (2.35 Man - Equivalent) than non-users (1.94 Man Equivalent). The result of test statistic is significant at 1%, which indicated that there is significant difference between the two groups in terms of availability of labor. This shows that irrigation user households' have much household labor to undertake their farming activities as compared to non-user households' (Table 5).

### Farm land holdings

Results of Table 6 shows that, nearly 15% of the respondents have farmland size of 1.5 hectare or less while 53% of the respondents own land within 1.51 to 3

**Table 5.** Labor availability of sample households.

Group of households	N	Minimum	Maximum	Mean	Std. Deviation	t-value
User	65	1.00	5.10	2.35	0.75	
Non-users	65	1.00	4.60	1.94	0.75	3.09***
Total	130	1.00	5.10	2.14	0.78	

\*\*\* Significant at 1% level (Source: Computed from the field survey data (2013/14)).

**Table 6.** Cultivated land by sample households.

Land size (ha)	Users (n=65 )		Non-users (n= 65 )		Total (n=130 )	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
<= 1.50	7	10.8	12	18.5	19	14.6
1.51 – 3	32	49.2	37	56.9	69	53.1
3+	26	40.0	16	24.6	42	32.3
Mean (ha)		2.96		2.71		2.83
SD		1.03		1.02		1.03
t-value				1.39 NS		

Source: Computed from the field survey data (2013/14).

**Table 7.** Livestock ownership by sample households (TLU).

Livestock (TLU)	Users (n=65)		Non-users (n= 65)		Total (n=130)	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
<=3	14	21.5	29	44.6	43	33.1
3.01-8	20	30.8	27	41.5	47	36.2
8.01-12	21	32.3	7	10.8	28	21.5
>12	10	15.4	2	3.1	12	9.2
Mean (ha)		7.58		4.38		5.98
SD		4.77		3.67		4.53
t-value				4.28***		

\*\*\* Significant at 1% level (Source: Computed from the field survey data (2013/14)).

hectare limits. Households who own land size of more than 3 hectare accounted for 32.3 %. Irrigation users have mean land size of 2.96 hectare whereas the non-users have 2.71 ha with the mean difference of .25 and standard division of 1.03. The statistical test indicated that there is no statically significant difference between the two groups. However, irrigation user households' are using more chemical fertilizer on their land and continuously using extension advisory services as compared to the non-users.

### **Livestock ownership**

The result on Table 7 shows that mean livestock

ownership by irrigation users is almost double than that of non-users. The number of farmers who own more than 8 TLU was 31 for users and only 9 for non-users. This shows that, irrigation user households have large number of livestock as compared to non-users. A t- test result reveals that, there is a statistically significant difference between users and non-users in the livestock ownership, at a probability level of less that 1%.

### **Oxen ownership**

Table 8 shows that 14.6% of the sample households were without oxen, and about 35% of them owned only 1 ox and 50% owned 2 or more. The mean size of oxen

**Table 8.** Oxen ownership by sample households.

Oxen (No)	Users (n=65)		Non-users (n=65)		Total (n=130)	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
0	2	3.1	17	26.1	19	14.6
1	23	35.4	23	35.4	46	35.4
>=2	40	61.5	25	38.5	65	50.0
Mean		1.78		1.12		1.45
St. deviation		0.96		0.80		0.94
t-value				4.27***		

\*\*\*Significant at 1% level (Source: Computed from the field survey data (2013/14)).

**Table 9.** Use of credit service by sample households.

Credit	User (n=65)		Non-user (n=65)		Total (n=130)	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
Yes	34	52.3	15	23.1	49	37.7
No	31	47.7	50	76.9	81	62.3
$\chi^2$ -value				11.82***		

\*\*\*Significant at 1% (Source: Computed from the field survey data (2013/14)).

ownership between irrigation users is larger (1.78) than that of non-users (1.12) and the overall mean being 1.45. There is a statistically significant difference in oxen ownership between the means of irrigation users and non-users at 1% significant level. Oxen power is the main source of traditional means to cultivate land in Ethiopia. It allows effective utilization of land and labor resources where family labor could be spread over peak and slack periods to carry out both farm and non-farm activities. Households with relatively larger number of oxen can perform better on their farm and achieve sustainable food security.

## Inputs and extension services

### Credit services

The majority of irrigation participants (66.7%) reflected that their participation in credit during the last five years increased. However, in case of non-users this was 44.6%. Table 9 shows the result. Credit serves as a means to boost production and expand income generating activities (DIAGNE, 1998; DEVEREUX, 2001). Thus, a household which has access to credit does initiate investment in farm and non-farm activities and achieve food security.

### Fertilizer use

Use of fertilizer for crop production plays an important

role for production and productivity. In the study area, use of fertilizer is a very important input for the production of crops. Irrigation by its very nature demands high use of improved agricultural inputs like fertilizer in order to produce high value crops like vegetables. In most cases, availability of irrigation encourages farmers to use fertilizer for production of high value crops, which fetches high prices and cover incurred costs (Hazell and Ramasamy, 1991). Analysis of fertilizer use by the two groups indicates that, the mean amount of fertilizer use was almost three fold for users than non-users of the irrigation (Table 10). The mean difference was highly significant at 1% probability level.

### Extension service

Provision of extension service to farmers play important role in terms of creating knowledge and skills in using improved agricultural inputs. The frequency of using an extension service in case of users and non-users of irrigation differs. One of the areas where extension service was given was in area of irrigation development where irrigation users benefit out of it. Frequency of extension service was measured and the results are indicated in Table 11.

### Household income

As shown in Table 12, irrigation users have generated mean income of Ethiopian Birr 2106.66, the maximum

**Table 10.** Fertilizer use by sample households.

Fertilizer(Kg/ha)	Users (n=65 )		Non-users(n= 65 )		Total (n=130 )	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
0-30	13	20	37	56.9	60	46.2
31-60	26	40	11	16.9	37	28.5
>=61	26	40	17	26.2	33	25.3
Mean(Kg/ha)		77.35		27.29		52.32
SD		51.69		18.23		73.30
T-value				4.13***		

\*\*\* Significant at 1% (Source: Computed from the field survey data (2013/14)).

**Table 11.** Extension service by sample household.

Contact	User (n=65)		Non-users (n=65)		Total (n=130)		$\chi^2$ -value
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)	
Once a week	22	33.8	8	12.3	30	23.1	10.78**
Every 15 days	32	49.2	34	52.3	66	50.8	
Once a month	8	12.3	17	26.2	25	19.2	
Once in three months	3	4.6	6	9.2	9	6.9	

\*\*Significant at 5% (Source: Computed from the field survey data (2013/14)).

**Table 12.** Annual income generated by sample households from the irrigated crops.

Income (Birr)/household/year	Irrigation users (n=65)	
	n	Percentage (%)
645-1500	38	58.5
1501-3170	14	21.5
3171- 4840	8	12.3
4840-6510	5	7.7
Mean		2106.66
Std. deviation		1460.24

Note= One Dollar= 20 Ethiopian Birr (Source: Computed from the field survey data (2013/14)).

being Birr 6510.00 and a minimum was Birr 645. The majority of irrigation users' (58.5%) income fall in the first category (Birr 645 to 1500), and it is only 20% of the farmers who managed to generate income with the range of Birr 3171 to 6510. As shown in Table 13, sample households' income from rain fed crop production is indicated.

From the table, it is possible to note that the majority of the sample households' income was found within income range of Birr 235 to 1200. In terms of mean income, irrigation users were in better position, (since they are using chemical fertilizer and properly used extension advisory services), and the test statistic revealed that there is significant difference between the two groups in

their mean income.

Farmers also generate income from livestock in different forms. As shown in Table 14, income from livestock for sampled households differs between irrigation users and non-users. In both cases, the majority of households of users (87.7 %) and non-users (93.8%) fall in the first income range, which is Birr 34 to 1500 /year. The result of test statistic indicated that there is significant difference between the mean incomes of the two groups with irrigation users having higher livestock income than non-users. The difference shows that, irrigation user households' have better access to get feed by planting fodder seeds on the marginal areas of their farm and applying proper livestock husbandry system by following the advice of agricultural extension agents.

### Food security status of sample households

Food security status of sampled households is computed with the conversion of the weekly consumption data into kilocalorie using the nationally standardized food composition table manual (Ehni, 1997). The converted data were divided into household Adult Equivalent (AE).

Following this, the amount of energy in kilocalorie (kcal) available for the household was recorded. Then after, the results obtained were compared with the minimum subsistence requirement per Adult Equivalent (AE) per day (which is 2,100 kcal). Households which consume below this minimum requirement were categorized as

**Table 13.** Income generated by sample households from rain fed crops.

Income from rainfed (Birr)/household/year	Users(n=65)		Non-users (n=65)		Total (n=130)	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
235-1200	37	56.9	51	78.5	88	67.7
1201-2625	17	26.2	12	18.5	29	22.3
2626-5475	11	16.9	2	3	13	10
Total	65	100	65	100	130	100
Mean		1438.47		886.78		1162.62
Std. deviation		1200.27		753.02		1035.73
t-value				3.14***		

\*\*\* Significant at 1% level (Source: Computed from the field survey data (2013/14)).

**Table 14.** Income generated by sample households from livestock.

Income from livestock(Birr)/year	Users (n=65)		Non-users(n=65)		Total (n=130)	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
34-1500	57	87.7	61	93.8	118	90.76
1501-3500	5	7.7	4	6.2	6	4.62
3501-8542	3	4.6	0	0	6	4.42
Mean		999.58		540.98		770.28
Std. deviation		1365.08		543.99		1060.30
t-value				2.51**		

\*\* Significant at 5% level (Source: Computed from the field survey data (2013/14)).

**Table 15.** Food security status of sample households.

Food security status	Users(n=65)		Non- Users(n=65)		Total(n=130)	
	n	Percentage (%)	n	Percentage (%)	n	Percentage (%)
Food secure	42	64.6	19	29.2	61	46.9
Food insecure	23	35.4	46	70.8	69	53.1
Pearson $\chi^2$ -value				16.34***		

\*\*\* Significant at 1% level (Source: Computed from the field survey data (2013/14)).

food insecure and those households which consume above the threshold were considered as food secure.

The food security situation between irrigation users and nonusers was different. The irrigation users were in better position than that of non-users. About 65 % of irrigation users were food secured where this was only 29% for non-users. The statistical test indicates that there is significant difference between users and non-users with regard to food security situation (Table 15).

Further analysis was made to see the position of sample households with regard to calorie consumption. To this effect, the data on household calorie consumption per Adult Equivalent was categorized taking 2100kcl as a cut of point. Those households more than this value are food secured but with different value and less are food

insecure (Table 16). Out of 69 sample households identified as food insecure, kilocalorie (kcal) consumption of 37.7% falls between 287.39 to 1500 Kcal. If we see the two groups separately, 26.2% of irrigation users and 49.2% of non-users were found in this category.

### Contribution of Irrigation to crop Income

From the data collected, it is possible to note that in the study area, sample households were primarily engaged in production of wheat, teff and potato under rain-fed agriculture through allocating large proportion of land for production of these crops.

Therefore, these crops were considered for estimation



**Table 16.** Households' calorie consumption per AE

Kilocalorie Consumption/AE	User(n=65)		Non-users(=65)		Total(n=130)	
	n	%	n	%	n	%
287.39 -1500	17	26.2	32	49.2	49	37.7
1500.01-2100	6	9.2	14	21.5	20	15.4
2100.01-2500	14	21.5	4	6.2	18	13.8
2500.01-3500	22	33.8	12	18.5	34	26.2
>=3500	6	9.2	3	4.6	9	6.9

Source: Computed from the field survey data (2013/14)

**Table 17.** Net return from rain fed and irrigated crops (household average).

Variable	Rain-fed crops(n=65)			Irrigated crops(n=65)	
	Teff	Wheat	Potato	Onion	Tomato
Area (ha)	0.62	1.15	0.28	0.68	0.36
Production (qt)	5.72	17.27	4.19	18.94	9.38
Output price (Birr/qt)	1580.13	523.07	200.05	229.42	323.01
Gross revenue (Birr)	9038.34	9033.42	838.21	4345.21	3029.83
Cost Item(Birr)					
Seed	2149.99	1955.10	74.81	1299.62	1118.87
Fertilizer	368.00	409.64	34.21	238.50	134.07
Chemicals	0.00	11.03	14.02	169.00	92.35
Fuel	-	-	-	46.31	59.00
Labour	309.62	851.00	97.52	383.57	211.29
Oxen (based on daily rental rate of the area that is, 80 birr/day)	189.55	368	99.85	218.46	136.92
Opportunity cost of capital	1.5	2.76	.49	4.9	5.5
<b>Total cost</b>	3018.66	3597.53	320.90	2360.36	1758.00
Net return to land and Management (Birr)	6019.68	5435.89	517.31	1984.85	1271.83

Source: Own computation (2013/14).

of net return. In the same manner, the data collected shows that, vegetables grown during the study period (2013/2014 production season) by the irrigation users were onion and tomato.

Therefore, onion and tomato were the crops grown under irrigation and included in this analysis. Table 17 indicates crop based information on input costs and returns. The figures in the table are mean values. The mean gross revenue generated by the farmers from rain-fed crops was Birr 6303.32, where the gross revenue from teff accounted high (47.80%) followed by wheat (47.77%). Mean gross revenue generated by farmers from irrigated crop was Birr 3687.52; where onion contributed high (58.92%).

### Food security determinants

The logit model result (Table 18) indicated that

coefficients of seven variables were significantly different from zero and found to affect food security status of the households in the study area. However, all variables have showed the expected sign. Age of household head (Age) and income from irrigation (Irrincome) were significant at the 1% level; education of household head (Education) and cultivated land size (Landcult) were significant at the 5% significant level. Oxen ownership (Oxen), livestock ownership (Livestock) and income from livestock (Liveincome) were significant at 10% probability level.

### CONCLUSION

The research was conducted to assess whether the irrigation scheme has had the desirable impact. The empirical analysis used household level data gathered from 130 randomly selected households through survey

**Table 18.** The maximum likelihood estimates of binary logit model (BLM).

Variable	B	S.E.	Wald	Sig.	Exp (B)
Age	0.058	0.022	6.786	0.009***	1.060
Education	1.202	0.592	4.125	0.042**	3.326
Depratio	-0.651	0.407	2.562	0.109	0.521
Labour	0.358	0.389	0.846	0.358	1.430
Landcult	0.765	0.304	6.319	0.012**	2.150
Oxen	0.623	0.349	3.193	0.074*	1.865
Livestock	0.109	0.057	3.628	0.057*	1.116
Credit	0.199	0.508	0.153	0.696	1.220
Extension	0.396	0.562	0.497	0.481	1.487
Irrincome	0.001	0.000	6.602	0.010***	1.001
Liveincom	0.0003	0.000	3.558	0.059*	1.011
Fertilizer	0.006	0.004	1.833	0.176	1.006
Raincroin	0.000	0.000	0.224	0.636	1.000
Constant	-7.518	1.865	16.256	0.000	0.001

-2 log likelihood: 110.96<sup>a</sup>; Prediction success: 85%<sup>b</sup>; \*, \*\*, \*\*\*; Indicate significance at 10, 5 and 1%, level respectively (<sup>a</sup>Based on a 50% probability classification schemes; <sup>b</sup>Correctly predicted food-secure households based on a 50% probability classification).

method. Partial budgeting technique and logistic regression were employed respectively, to income and food security effects of the scheme.

The result of analysis of return to land and management for the rain fed and vegetable crops using Partial Budgeting technique showed that income from irrigated vegetable crops contributed for 21.38% of the total annual crop income for the irrigation users. The results of the study also showed that irrigation users were in better position in terms of livestock (7.58 to 4.38 TLU) and oxen ownership (1.78 to 1.12 TLU); participation in credit (52 to 23%) and the use of extension advisory services.

The result on food security status in the study area shows that, larger proportion (65%) of irrigation users were found to be food secured whereas it was only 29% for non-users. The analysis further indicated that most of food secured irrigation users found to be in a better position in terms of calorie consumption per Adult Equivalent than food secured non-users.

The result of the logit model indicated that age of household head has a positive effect on the probability of household being food secure with 1% significance level. Education of household head was found to influence positively household food security, and found to be significant at 5% level. Moreover, production factors such as cultivated land and oxen number had positive and significant influence on household food security through their role on food production and income generation. Livestock holding (TLU) was also positively and significantly related to the probability of being the households to be food secure (at 10% probability level). Income from livestock and irrigation found to be

influencing household food security at 10 and 1% significant level, respectively.

## IMPLICATIONS AND RECOMMENDATIONS

The study result revealed that access to such small scale irrigation can significantly improve income level and food security status of beneficiary households. Hence, in line with the findings of the study the following recommendations are made:

1. Compared to the non-users, irrigation user households are getting a better income, hence in order to increase the income, saving and investment capacity of the farmers, all responsible development partners including government and non-governmental organizations should focus on promoting small and large scale irrigation schemes across the country.
2. Results of the study clearly indicated that, the promotion of small scale irrigation scheme to ensure food security of the country should be the major focuses of the government short, medium and long term strategic plan.
3. In the study area, non-users of the irrigation scheme households' have no adequate access to credit, extension advisory services and participation in many of the agricultural development activities. Hence, all responsible bodies should empower these group of farmers through the provision of training and facilitating conditions for their full participation in any development agendas.

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## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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