Factors Affecting Adoption of Solar Lightning Products in Rural Villages of Ethiopia: The Case of Oromia Special Zone Surrounding Addis Ababa

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Factors Affecting Adoption of Solar Lighting Products in Rural Villages of Ethiopia: The Case of Oromia Special Zone Surrounding Addis Ababa

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Statement of Certification

This is to certify that the thesis entitled, “Factors Affecting Adoption of Solar Lighting Products in Rural Villages of Ethiopia: The Case of Oromia Special Zone Surrounding Addis Ababa” was carried out by Habtamu Tesfaye Eticha under the supervision of Hailemariam Kebede (Phd), submitted in partial fulfillment of the requirements for the degree of Master of Arts in Marketing Management complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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LETTER OF DECLARATION

I hereby declare that the research entitled “Factors Affecting Adoption of Solar Lighting Products in Rural Villages of Ethiopia: The Case of Oromia Special Zone Surrounding Addis Ababa” is my original work done under the guidance of my advisor Dr. Hailemariam Kebede. It has never been presented in Addis Ababa University or any other university for any purpose. All sources of the materials used for writing the research report have been acknowledged.

Habtamu Tesfaye

Signature: _____

Date: _____

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ABSTRACT

Understanding factors influencing the adoption and subsequent diffusion of solar lighting products at the household level is crucial to creating access to sustainable renewable energy sources for rural communities. This study therefore is conducted with the main objective of identifying factors that affect solar lighting products adoption in rural villages of Ethiopia particularly in Oromia Special Zone Surrounding Addis Ababa. The study is tuned to Rogers' perceived attributes of innovation constructs, namely relative advantage, compatibility with needs, compatibility with values and experiences, complexity, observability, and trialability in determining their effect on intention to adopt solar lighting products. A cross-sectional survey design was employed. Respondents were selected using cluster sampling method from each weredas of the special zone and a convenient sample of 384 off-grid household heads were selected for the study. The data were analyzed using descriptive and inferential statistics. The finding revealed that there are positive and significant relationships between the predictor variables: relative advantage, compatibility with values & experiences, complexity and observability; and the dependent variable adoption intention; whereas, negative and significant relationship observed between the rest two predictor variables: compatibility with needs and Trialability; and the dependent variable: adoption intention. Therefore, the study forwarded valuable recommendations for governmental organizations, solar lighting products' promoters, traders, and other stakeholders to take appropriate actions in the aim of uplifting the adoption and diffusion rates of solar lighting products in rural villages of Ethiopia.

Key Words: Solar Lighting Products, Relative Advantage, Compatibility with Needs, Compatibility with Values & Experiences, Complexity, Observability, and Trialability.

ACRONYMS

ASD	African Solar Designs Ltd
CSA	Central Statistics Agency
DFID	UK Department for International Development
GOGLA	Global Off-Grid Lighting Association
GTP	Growth and Transformation Plan
GWh	Gigawatt hour
IRENA	International Renewable Energy Agency
kWh	Kilowatt-hours, amount of electricity used over time
MoWE	Ministry of Water & Energy
MW	Megawatt
NBE	National Bank of Ethiopia
NEP-IRM	Ethiopia's National Electricity Program-Implementation Roadmap
ODI	Overseas Development Institute
OIES	Oxford Institute for Energy Studies
PJ	Petajoules
REF	Rural Electrification Fund
SEDA-E	Solar Energy Development Association of Ethiopia
SEforALL	Sustainable Energy for All
SNV	Netherlands Development Organization

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Africa's economy is growing at unprecedented speed. One of the core challenges as African countries continue to grow and develop is energy (ispy, 2018). According to the International Renewable Energy Agency, the continent's biomass, geothermal, hydropower, solar and wind energy resources are among the best in the world. However, a continued reliance on oil and gas along with traditional biomass for energy will bring considerable social, economic and environmental constraints. Tackling today's energy challenge on the continent requires a firm commitment to accelerate the use of modern renewable energy sources (IRENA, 2015).

Ethiopia is the second most populous country in Sub-Saharan Africa with an estimated total population of around 100 million, out of which 80 percent are rural dwellers (CSA, 2018). The country is gifted with significant renewable energy resources, with massive potential for hydro, solar, wind, bio-energy and geothermal power. Ethiopia is one of the few countries in Sub-Saharan Africa, which generates all its electricity from renewable resources (MoWE, 2012 and World Bank 119032-ET, 2018).

The hydro-energy potential of Ethiopia is estimated around 650,000 GWh per annum whereas bio-energy potential estimated to 750 PJ per year (46.5% forest residue, 34% crops residue, 18.8% livestock waste, and 0.05% municipal solid waste). The country also has enormous wind and geothermal energy resource potential estimated about 1,035 Giga watts and more than 7,000 MW respectively. Regarding solar energy, the national average radiation received at ground level is estimated at 5.2 kWh/m2 per day. This potential however varies from season to season, with lowest potential being 4.55 kWh/m2 per day, and the highest potential recorded about 6.25 kWh/m2 per day (MoWE, 2013; Sebsibie, W., 2017; and E.W. Gabisa & S.H. Gheewala, 2018).

Ethiopia's energy needs are mostly met from traditional biomass fuels which account for 92.4% followed by oil 6.7% and hydro power 0.9 per cent. Within the traditional biomass

fuels fire wood and charcoal contribute for about 87% while agricultural residues such as dung and crop residues constitute about 11% (Gebreegziabher and van Kooten, 2013). Energy scarcity in the country is quite severe because of the limited ability to access adequate, affordable, reliable, quality, safe, and environmentally sound energy services to support human and economic development (Ecofys and SNV Ethiopia, 2016). In Ethiopian only 27.7% of the population have access to electricity. In urban areas 92% had access, compared with 12.2% in rural areas (Lighting Africa, 2016).

The national energy policy of the country is aim to ensure and encourage a gradual shift from traditional energy sources use to modern energy sources. Generating power using renewable energy sources provides significant benefits for the country by reducing deforestation and forest degradation in areas where non-renewable biomass is used as a source of fuel; reducing the use of diesel or gasoline powered lighting equipment which leading to emissions of air pollutants & greenhouse gases (GHG); and develop public goods benefits, such as increased security and lower environmental contamination (World Bank 116753 REV, 2018).

In the second GTP from the period 2016-2020, the government has been planning to generate electricity from diversified electric sources. While before all focus was on grid extension and large scale grid connected projects, now the government's strategy includes stand-alone alternatives like mini-grids or household energy systems based on renewable energy resources (Ecofys and SNV Ethiopia, 2016). Accordingly, the government has been planned to increase the power generating capacity of the country from 4,180MW in 2014/15 to 17,208MW by 2019/20; of which, 13,817MW is planned to be generated from hydro-power, 1224MW from wind power, 300MW from solar power, 577MW from geothermal power, 50MW from wastes, 474MW from sugar and 257MW from biomass (GTP II, 2016).

The government recently also launched National Electrification Program envisions that by 2025, 65% of the population will be connected to the grid as they place a strong emphasis on scaling up connections in areas within short-term reach of the grid. The other 35% or around 7.7 million households will need an interim off-grid solution while waiting for grid expansion, or even a permanent one where appropriate, such as in very

remote rural areas where grid access will remain too costly and logistically challenging even in the long term. Without access to quality-verified off-grid lighting and energy products, these unconnected families are likely to continue to rely on hazardous lighting options such as kerosene lamps, firewood, and candles (NEP-IRM, 2017; Lighting Africa, 2016; World Bank, 2017; OIES, 2018; and World Bank 119032-ET, 2018). Therefore, diffusion of renewable energy technologies like off-grid solar lighting devices (solar lantern and solar home system) has been identified as a priority for Ethiopia for creating access to better energy services for households live in rural areas outside of grid coverage (GTP II, 2016; Ashira, 2018; World Bank 116753 REV, 2018; SEforALL and Power for All, 2017; and World Bank 119032-ET, 2018).

The term diffusion refers to the process whereby a new product, service or idea spreads through a population, whereas adoption reflects the purchase of an innovation by an individual consumer or household (Solomon et al., 2006; Hoyer and MacInnis, 2010). A consumer's decision to adopt a new item like solar lighting product depends on his or her personal characteristics (if he or she is inclined to try new things) and on the characteristics of the item. Products sometimes stand a better chance of being adopted if they demand relatively little change in behavior from consumers and are compatible with current practices. They are also more likely to diffuse if they can be tested prior to purchase, if they are not complex, if their use is visible to others, and, most importantly, if they provide a relative advantage vis-à-vis existing products (Solomon et al., 2006).

Understanding the factors influencing the adoption and subsequent diffusion of solar lighting product at the household level is crucial to creating access to sustainable renewable energy sources for rural communities. This study therefore is conducted with the main objective of identifying factors that affect solar lighting products adoption in rural villages of Ethiopia particularly in Oromia Special Zone Surrounding Addis Ababa.

1.2 STATEMENT OF THE PROBLEM

Ethiopia is identified as one of the huge potential sources of solar energy in Africa because of its geographical location near the equator (NBE, 2017). Nearly 22 percent of the Ethiopian households adopt and use off-grid solar products (solar lantern or solar home system) as their main light source. Whereas, about 80 percent of rural households still rely on fuel-based light sources, predominantly kerosene used with wick lamps or hurricane lamps which can cause serious health problems and damage to the environment (World Bank 119032-ET, 2018).

The government has a plan to disseminate 3.6 million solar lanterns and 400,000 solar home systems by 2020 for significant number of rural households under its second Growth and Transformation Plan (GTP II, 2016, and ODI & GOGLA, 2016). However, data collected from Ministry of Water, Irrigation and Electricity indicated that only 1,638,906 (45%) solar lanterns and 107,633 (27%) solar home systems were disseminated within the first three years (2015/16 – 2017/18) of the GTP II period. During the year 2017/18, 579,882 solar lanterns (against the year's target of 700,000) and 63,080 solar home systems (against the year's target of 100,000) were distributed, which puts into question the achievement of the strategic plan within the remaining two years period. In addition a survey conducted by World Bank in 2017 showed that, the rate of adoption for off-grid solar lighting products for subsequent years (2017 and 2018) does not change because of the increases in off-grid solutions are not greater than population growth (World Bank 119032-ET, 2018).

According to IFC (2018) data collected from the year 2014 – 2017, Ethiopia's off-grid solar devices market is still under-penetrated that showed miniature sales growth as shown in the following figure. Where;

1. *Harvest*: markets where sales continue to rise despite relatively high penetration, suggesting that suppliers can continue to harvest revenues.
2. *Upgrade*: highly penetrated maturing markets, where suppliers may consider upgrading existing customers to higher quality technologies and service levels.

3. *Accelerate*: up-and-coming markets which show promising growth and where suppliers can continue to scale operations to take advantage of large un-penetrated populations.
4. *Resolve*: under-penetrated markets which have seen sales fall, & which would need concentrated supplier investment to resolve context-specific issues.

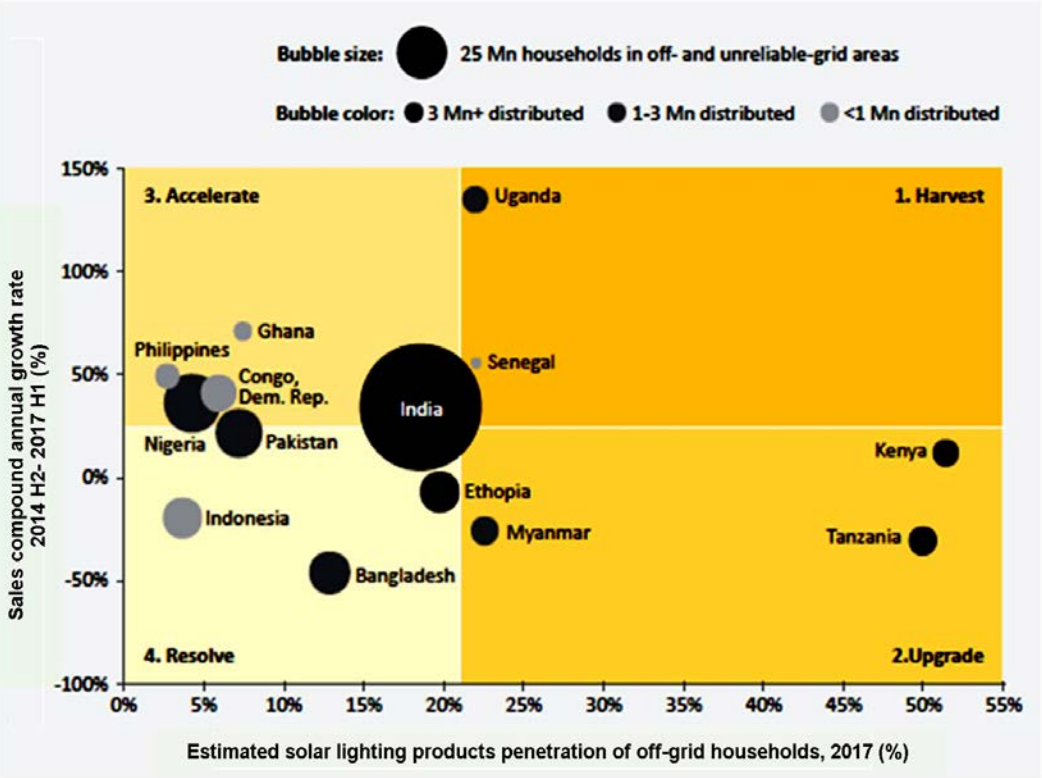

Figure 1: estimated sales and penetration of off-grid solar devices in selected markets (2014 – 2017)
Source: IFC, 2018

The dissemination of these lighting products to rural villages is very essential at least for lighting, running a radio/cassette player and mobile charging (Sebsibie W., 2017). However, the marketing and promotion of solar lighting products to rural consumers is a difficult, time and resource consuming task (ODI & GOGLA, 2016) because of the existence of a number of challenges related to consumers awareness, price, quality, distribution channel, after sales service (warranty & maintenance) and other factors that have a potential to limit the adoption of the products and successful implementation of the strategic plan (IPSOS and IFC, 2016 and ASD, Evidence on Demand and DFID, 2016).

This study therefore seeks to find out the major factors that affect the adoption of solar lighting products (solar lantern and solar home system) in rural villages of Oromia Special Zone Surrounding Addis Ababa using the widely accepted Rogers' (2003) innovation diffusion theoretical framework since the special zone is significantly inhabited by non- electrified rural households. According to recent data collected from Zone's Water Resource and Energy Bureau, 49.2% (372,735) of the population have access to electricity from the national grid, whereas the rest 382,278 peoples (76,456 households) are not connected to the grid. The proportion of Kebeles without electricity access reached 57.62% (87 Kebeles) in 2018 out of the total 151 Kebeles constitute in the special zone.

Solar lighting product importers and distributers have little information regarding consumers' preferences (Lighting Africa, 2016), plus government agencies, NGOs, financial institutions, multi-national organizations and other stockholders require pertinent market information. Therefore, the finding of the study is relevant to different stockholders who are engaged in solar lighting products trading and promotion.

In addition, the findings of this study may develop the knowledge base of innovation adoption particularly off-grid solar technology by providing empirical evidences from Ethiopian contexts.

1.3 RESEARCH QUESTIONS

The following identified research questions are answered at the end of the investigation.

Main Research Question

- Which perceived attributes of innovation are affecting the adoption intention of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa?

Sub-research Questions

- What is the effect of perceived relative advantage in the adoption intention of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa?
- What is the relationship between perceived compatibility with needs and solar lighting products adoption intention in rural villages of Oromia Special Zone Surrounding Addis Ababa?
- What is the effect of perceived compatibility with values & experiences in the adoption intention of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa?
- How does perceived complexity affect the adoption intention of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa?
- What is the role of perceived observability in the adoption intention of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa?
- What is the effect of perceived trialability in the adoption intention of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa?

1.4 OBJECTIVES OF THE STUDY

1.4.1 General Objective of the Study

The general objective of the study is to identify factors that affect the adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.

1.4.2 Specific Objectives of the Study

The specific objective of the study includes the following:

- To examine the effect of perceived relative advantage in the adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.
- To measure the influence of perceived compatibility with needs in solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.
- To examine the effect of perceived compatibility with values & experiences in the adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.
- To evaluate the effect of perceived complexity in the adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.
- To measure the Influence of perceived observability in the adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.
- To assess the effect of perceived trialability in the adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.

1.5 SIGNIFICANCE OF THE STUDY

The study provides an insight to know the major factors that affect the adoption of solar lighting products in rural villages in Ethiopia particularly in Oromia Special Zone Surrounding Addis Ababa based on Rogers' innovation diffusion theory. Specifically, this study is believed to have the following importance:

- The finding of the study will have importance for government bodies such as federal and regional energy bureaus, environment protection offices, policy makers, and others who are directly or indirectly engaged in policy making, strategy formulation, planning and project management in relation to rural electrification and off-grid solar lighting products dissemination.
- Findings of the study have a significant role for off-grid solar technology producers & traders on marketing and sales strategy development and execution.
- The study helps off-grid solar technology promoters & supporters like international organizations (UNDP, AU, EU, World Bank, IFC etc), NGOs (GIZ, USAID, Lightening Africa, REF, DFID etc), consultants, financial institutions, Ethio-telecom, and others in there awareness creation, financing, technical support, capacity building, and project management works by providing valuable information.
- In addition, the study also use as a base for further investigation and develop the knowledge base of innovation adoption particularly off-grid solar technology by providing empirical evidences from Ethiopian contexts.

1.6 SCOPE OF THE STUDY

The focus of this research is limited to investigate key factors that have an effect on the adoption of solar lighting products in rural villages of Ethiopian, specifically Oromia Special Zone Surrounding Addis Ababa mainly due to its low level of electricity penetration and proximity of the area to conduct the study.

There are several well-known theoretical models existed in the study of technology products' adoption and diffusion, such as: Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Technological Acceptance Model (TAM), Innovation Diffusion Theory (IDT), Unified Theory of Acceptance and Use of Technology (UTAUT), and others. However, this study is theoretically limited to the widely accepted Rogers' Innovation Diffusion Theory in the identification of factors affecting the adoption of solar lighting products in rural villages of Ethiopian.

To meet purpose of the study, the research is employed explanatory research design and data was collected quantitatively from rural household heads using structured survey questionnaires and analyzed statistically to explain causal relationships between variables.

1.7 LIMITATION OF THE STUDY

The study is only deal with understanding factors that affect the adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa. As most studies, this research contains limitations which should be acknowledged. Accordingly, the major limitations of the study are;

- The study is employed non-probability sampling technique specifically convenience sampling method to collect data, thus the sample may not be representative of the actual population which may hinders the generalization of the study to whole rural households.
- The study focuses only on behavioral factors of solar lighting products usage status of the samples rather than other demographic, behavioral and psychographic heterogeneity factors in the sampling technique. Hence, the demographic, behavioral and psychographic characteristics of the respondents were not tested under the construct and its effect remains unclear.
- The sample size of the study was limited to a total of 384 rural households which is 0.5% of the population. Thus, it may hinder the study to get more profound information from the target population.

- There is limited empirical literatures on solar technology products adoption from Ethiopian perspective thereby it may limiting the amount of information available on the study.
- The validity of certain data collected may not be such completely perfect as a result of bias and hesitation of the respondents, which might affect the conclusions.
- Furthermore, the outcome of the survey is limited to the time, budget and resource used by the researcher.

1.8 DEFINITION OF TERMS

Diffusion: is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 2003 pp. 5).

Rate of adoption: is the relative speed with which an innovation is adopted by members of a social system (Rogers, 2003 pp. 23).

Potential market: the overall market of households (or people) that either lack access to an electricity connection (off-grid) or have a poor-quality electricity connection (unreliable-grid), forming the total potential customer base for solar lighting devices (IFC, 2017 pp. lx).

Off-grid population: are households (or people) that lack access to an electricity connection to the national grid (IFC, 2017 pp. lx).

Access to Electricity: access to electricity has been measured on the basis of household connections to the national electric grid of their respective country (IFC, 2017 pp. lx).

The confidence level or reliability: is the expected percentage of times that the actual value will fall within the stated precision limits (Kothari, 2004 pp. 155)

Diffusion process: is the manner in which innovations spread throughout the market (khan, 2006 pp. 80).

Household: is a broader term that includes a single person living alone or a group of individuals who live together in a common dwelling, regardless of whether they are related (Hoyer and MacInnis, 2010 pp.344).

1.9 ORGANIZATION OF THE STUDY

The entire structure of the study is containing five chapters with different sections and sub-sections. The first chapter deals with the introduction of the study. Chapter two reflects pertinent findings on the theoretical and empirical aspect of factors affecting the adoption of solar lighting products. The third chapter addresses the research methodology. Chapter four deals with results and discussion; and the last chapter is about the summery of findings, conclusion and recommendation.

CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

The purpose of this part is to set the study subject in a broader context through investigation of the relevant literature. The chapter looks at the theoretical literature review focusing on innovation adoption. In addition, the review discusses empirical literature focusing on the determinants of adoption of solar lighting products. Finally, the chapter is concluded the review by drawing a conceptual framework for the study.

2.2 THEORETICAL REVIEW

2.2.1 Adoption and Diffusion of Innovation

- *Innovation*

An *innovation* is an idea, practice, attribute, product, or service perceived to be new by an individual or a group and that has an effect on existing consumption patterns (Khan, 2006; Hoyer and MacInnis, 2010). Whether or not a given offering is an innovation is determined by the perceptions of the potential market, not by an objective measure of technological change (Hawkins and Mothersbaugh, 2010). The "newness" aspect of an innovation may be expressed in terms of knowledge, persuasion, or a decision to adopt (Rogers, 1983). If an innovation is successful, it spreads through the population. First it is bought and/or used by only a few people, and then more and more consumers decide to adopt it, until, in some cases, it seems that almost everyone has bought or tried the innovation (Solomon et al., 2006).

Marketers classify innovations in three main ways: in terms of the innovation's type, the type of benefits it offers, and its breadth (Hoyer and MacInnis, 2010). Based on innovation's type, it is farther classified into continuous innovations, dynamically continuous innovations and discontinuous innovations. Continuous innovations, which simply involve the modification of existing products and lead to few, if any, changes in consumer behavior. Dynamically continuous innovations while more disruptive than the previous category, which has a pronounced effect on consumption practices and often

involves a new technology whereas discontinuous innovations are dramatically new and lead to significant changes in patterns of behavior and usage (Wilson and Gilligan, 2005).

According to (Hoyer and MacInnis, 2010) based on the types of benefits innovation offers, it is also classified into functional innovation: is a new product, service, attribute, or idea that has utilitarian benefits that are different from or better than those of alternatives; Aesthetic or hedonic innovation: is also an innovation that appeals to our aesthetic, pleasure-seeking, and/or sensory needs; and symbolic innovation in the other way is a product, service, attribute, or idea that has new social meaning. In addition, according to its breadth consumers can consider the adoption of an innovation or they would choose to resist buying it.

- *Innovation Adoption*

Innovation adoption is a purchase decision made by an individual consumer or household to become a regular user of the innovation (Kotler and Armstrong, 2012; Hoyer and MacInnis, 2010). Consumers go through five stages in the decision-making sequence to adopt an innovation starting from the stages of awareness, interest, evaluation, trial and adoption, although the relative importance of each stage may differ depending on how much is already known about a product, as well as on cultural factors that may affect people's willingness to try new things (Solomon et al., 2006).

Consumers differ on the basis of their adoption of innovation. A variety of categorization systems and titles for adopters have been used in different research studies. According to the most widely followed adopters' categorization, there are five adopter groups based on the timing of their adoption decisions (Rogers, 2003). As (Hoyer and MacInnis, 2010) stated that, the first 2.5 percent of the market to adopt the innovation are described as innovators. The next 13.5 percent are called early adopters. The next 34 percent are called the early majority. The late majority represent the next 34 percent of adopters. The last 16 percent of the market to purchase the product are called laggards as shown in figure 2.

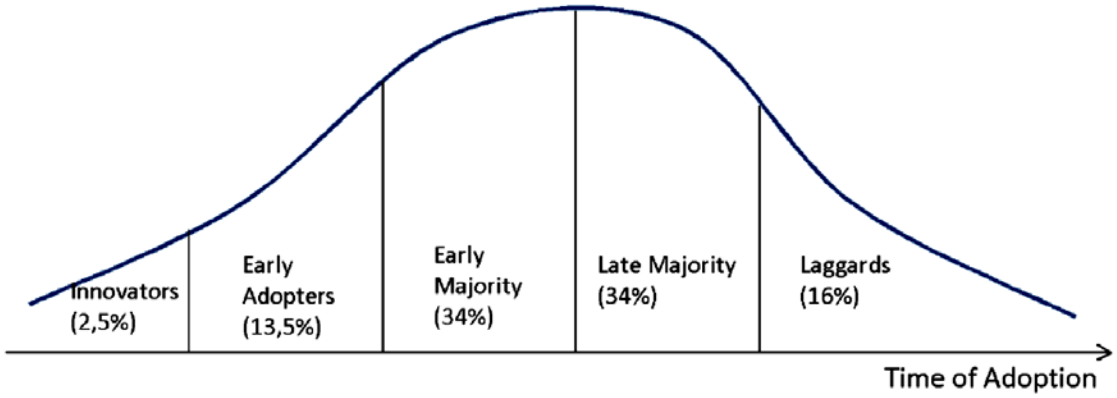

Figure 2: adopter categories on the basis of innovativeness

According to Kotler and Armstrong (2012), the five adopter groups have different values. Accordingly, Innovators are venturesome; they try new ideas at some risk. Early adopters are guided by respect; they are opinion leaders in their communities and adopt new ideas early but carefully. The early majority is deliberate; although they rarely are leaders, they adopt new ideas before the average person. The late majority is skeptical; they adopt an innovation only after a majority of people have tried it. Finally, laggards are tradition bound; they are suspicious of changes and adopt the innovation only when it has become something of a tradition itself.

- *Innovation Diffusion*

Diffusion of innovations is a process by which the acceptance of an innovation/new product, a new idea, a new service, is spread by communication to members of a social system over a period of time (Rogers, 2003; Kotler and Armstrong, 2012). Products sometimes stand a better chance of being adopted and diffused if they demand relatively little change in behavior from consumers and are compatible with current practices. They are also more likely to diffuse if they can be tested prior to purchase, if they are not complex, if their use is visible to others, and, most importantly, if they provide a relative advantage vis-à-vis existing products (Solomon et al., 2006).

All innovations that are new to the market do not have equal potential for consumer acceptance. Some products seem to catch on almost short time while others take a very long time to gain acceptance (Rogers, 2003). The rate of diffusion can be fast, typical

and slow. The typical diffusion process shows a slow growth or adoption. It later rises rapidly, and then a period of slow growth is noticed. In fast diffusion process, the product clicks immediately. The spread of innovation is very quick. People patronize the product immediately and later on there is again slow diffusion. In slow diffusion process, the product takes a lot of time to diffuse or spread, and the consumer follows a pattern of adoption slowly by getting acquainted with the product (Khan, 2006; Hawkins and Mothersbaugh, 2010).

The rate at which an innovation is diffused from innovators to laggards is a function of (1) nature of the group involved, (2) type of innovation decision required, (3) extent of marketing effort, (4) strength of felt need, (5) compatibility of the innovation with existing values, (6) relative advantage, (7) complexity of the innovation, (8) ease in observing usage of the innovation, (9) ease in trying the innovation, and (10) perceived risk in trying the innovation (Hawkins and Mothersbaugh, 2010).

2.2.2 Review of Theories of Innovation Adoption

There are several theories that deal with prediction and modeling of the behavior of users that make the decision to adopt the innovation or reject it. These include Innovation Diffusion Theory, Theory of Reasoned action, Technology Acceptance Model, Theory of Planned Behavior, and Unified Theory of Acceptance and Use of Technology. In line with objectives of the study each theory is discussed as follows;

2.2.2.1 Innovation Diffusion Theory (IDT)

Everett M. Rogers in 1962 pioneered the effort to understand diffusion of innovations in his influential book. Subsequently, hundreds of scholars have applied and expanded Rogers' principles of early adopters, early majority, laggards, and others whose labels have become standard terminology. Scholars in a variety of fields - including organizational theory (Damanpour, 1992; Van de Ven et al., 1999; Wejnert, 2002), education (Napierkowski and Parsons, 1995), business and management (Burns and Wholey, 1993; O'Neill et al., 2002; Ravichandra, 2000) - have contributed to the understanding of this phenomenon called diffusion of innovation.

For Rogers (2003), adoption is a decision of "full use of an innovation as the best course of action available" and rejection is a decision "not to adopt an innovation". Rogers defines diffusion as "the process in which an innovation is communicated thorough certain channels over time among the members of a social system". As expressed in this definition, innovation, communication channels, time, and social system are the four key components of the diffusion of innovations.

I. Innovation

Rogers offered the following description of an innovation: "An innovation is an idea, practice, or project that is perceived as new by an individual or other unit of adoption" (Rogers, 2003). An innovation may have been invented a long time ago, but if individuals perceive it as new, then it may still be an innovation for them. The newness characteristic of an adoption is more related to the three steps (knowledge, persuasion, and decision) of the innovation-decision process.

Rogers' (2003) diffusion of innovation model contends that, the five perceived attributes of an innovation namely relative advantage, compatibility, complexity, observability, and trialability are significant predictors of the innovation adoption process. Empirical and non-empirical studies have used successfully the five attributes in predicting innovation diffusion and adoption. Rogers reported that 49-87% of the variance in the rate of adoption of innovations is explained by these five attributes.

- *Relative Advantage*

Rogers (2003) defined relative advantage as "the degree to which an innovation is perceived as being better than the idea it supersedes". The cost and social status motivation aspects of innovations are elements of relative advantage. For instance, while innovators, early adopters, and early majority are more status-motivated for adopting innovations, the late majority and laggards perceive status as less significant. Moreover, Rogers categorized innovations into two types: preventive and incremental (non-preventive) innovations. "A preventive innovation is a new idea that an individual adopts now in order to lower the probability of some unwanted future event" (Rogers, 2003). Preventive innovations usually have a slow rate of adoption so their relative

advantage is highly uncertain. However, incremental innovations provide beneficial outcomes in a short period.

To increase the rate of adopting innovations and to make relative advantage more effective, direct or indirect financial payment incentives may be used to support the individuals of a social system in adopting an innovation. Incentives are part of support and motivation factors. Another motivation factor in the diffusion process is the compatibility attribute (Rogers, 2003).

- *Compatibility*

In some diffusion research, relative advantage and compatibility were viewed as similar, although they are conceptually different. Rogers (2003) stated that "compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters". If an innovation is compatible with an individual's needs, then uncertainty will decrease and the rate of adoption of the innovation will increase. Thus, even naming the innovation is an important part of compatibility. What the innovation is called should be meaningful to the potential adopter. What the innovation means also should be clear.

- *Complexity*

Rogers (2003) defined complexity as "the degree to which an innovation is perceived as relatively difficult to understand and use". As Rogers stated, opposite to the other attributes, complexity is negatively correlated with the rate of adoption. Thus, excessive complexity of an innovation is an important obstacle in its adoption.

- *Trialability*

According to Rogers (2003), "trialability is the degree to which an innovation may be experimented with on a limited basis". Also, trialability is positively correlated with the rate of adoption. The more an innovation is tried, the faster its adoption and reinvention may occur during the trial of the innovation. Then, the innovation may be changed or modified by the potential adopter. Increased reinvention may create faster adoption of the innovation. For the adoption of an innovation, another important factor is the vicarious trial, which is especially helpful for later adopters. However, Rogers stated that

earlier adopters see the trialability attribute of innovations as more important than later adopters.

- *Observability*

The last characteristic of innovations is observability. Rogers (2003) defined observability as "the degree to which the results of an innovation are visible to others". Role modeling (or peer observation) is the key motivational factor in the adoption and diffusion of technology (Parisot, 1997). Similar to relative advantage, compatibility, and trialability, observability also is positively correlated with the rate of adoption of an innovation.

In summary, Rogers (2003) argued that innovations offering more relative advantage, compatibility, simplicity, trialability, and observability will be adopted faster than other innovations. So the availability of all of these variables of innovation speeds up the innovation-diffusion process.

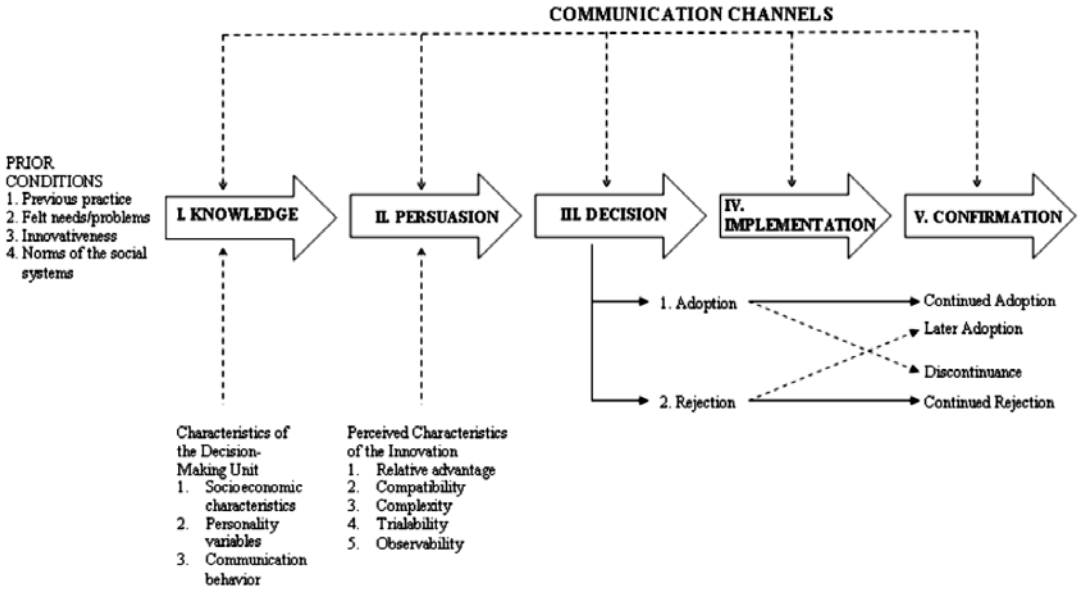

Figure 3: The innovation-decision process stages in diffusion of innovations (source: Rogers, 2003)

II. Communication Channels

The second element of the diffusion of innovations process is communication channels. For Rogers (2003), communication is "a process in which participants create and share

information with one another in order to reach a mutual understanding". This communication occurs through channels between sources. Rogers states that "a source is an individual or an institution that originates a message. A channel is the means by which a message gets from the source to the receiver".

Rogers states that diffusion is a specific kind of communication and includes these communication elements: an innovation, two individuals or other units of adoption, and a communication channel. Mass media and interpersonal communication are two communication channels. While mass media channels include a mass medium such as TV, radio, or newspaper, interpersonal channels consist of a two-way communication between two or more individuals. On the other hand, "diffusion is a very social process that involves interpersonal communication relationships" (Rogers, 2003). Thus, interpersonal channels are more powerful to create or change strong attitudes held by an individual.

In interpersonal channels, the communication may have a characteristic of homophily, that is, "the degree to which two or more individuals who interact are similar in certain attributes, such as beliefs, education, socioeconomic status, and the like," but the diffusion of innovations requires at least some degree of heterophily, which is "the degree to which two or more individuals who interact are different in certain attributes." In fact, "one of the most distinctive problems in the diffusion of innovations is that the participants are usually quite heterophilous" (Rogers, 2003).

Communication channels also can be categorized as localite channels and cosmopolite channels that communicate between an individual of the social system and outside sources. While interpersonal channels can be local or cosmopolite, almost all mass media channels are cosmopolite. Because of these communication channels' characteristics, mass media channels and cosmopolite channels are more significant at the knowledge stage and localite channels and interpersonal channels are more important at the persuasion stage of the innovation-decision process (Rogers, 2003).

III. Time

According to Rogers (2003), the time aspect is ignored in most behavioral research. He argues that including the time dimension in diffusion research illustrates one of its strengths. The innovation-diffusion process, adopter categorization, and rate of adoptions all include a time dimension. The innovation decision process is the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. It is possible to conceptualize five steps in this process: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. An individual seeks information at various stages in the innovation-decision process in order to decrease uncertainty about an innovation's expected consequences. The decision stage leads to adoption, a decision to make full use of an innovation as the best course of action available, or to rejection, a decision not to adopt an innovation.

IV. Social System

The social system is the last element in the diffusion process. Rogers (2003) defined the social system as “a set of interrelated units engaged in joint problem solving to accomplish a common goal”. Since diffusion of innovations takes place in the social system, it is influenced by the social structure of the social system. For Rogers (2003), structure is “the patterned arrangements of the units in a system”. He further claimed that the nature of the social system affects individuals’ innovativeness, which is the main criterion for categorizing adopters.

Key criticisms of Diffusion of Innovations Theory

Botha and Atkins (2005) summarise many of the key criticisms of the model. They note that the theory has a pro-innovation bias, in that it assumes change to be a good thing and reflects this position in the value laden classification of later adopters as “laggards” (see also Smith et al. 2008). They also note that the model emphasises “individual blame” at the expense of a more nuanced understanding of the impact of social structures on the decision to adopt an innovation (Botha and Atkins 2005). This criticism

speaks directly to observations made by Shove (1998) in relation to the utility of the technology transfer framework for understanding what an inherently social process is

2.2.2.2 Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM) was introduced by Fred Davis in 1986. An adaptation of Theory of Reasonable Action, TAM is specifically tailored for modeling users' acceptance of information systems or technologies. In 1989, Davis used TAM to explain computer usage behavior as shown in Figure 4. The goal of Davis' (1989) TAM is to explain the general determinants of computer acceptance that lead to explaining users' behavior across a broad range of end-user computing technologies and user populations.

The basic TAM model included and tested two specific beliefs: Perceived Usefulness (PU) and Perceived Ease of Use (PEU). Perceived Usefulness is defined as the potential user's subjective likelihood that the use of a certain system (e.g: single platform E-payment System) will improve his/her action and Perceived Ease of Use refers to the degree to which the potential user expects the target system to be effortless (Davis, 1989). The belief of the person towards a system may be influenced by other factors referred to as external variables in TAM.

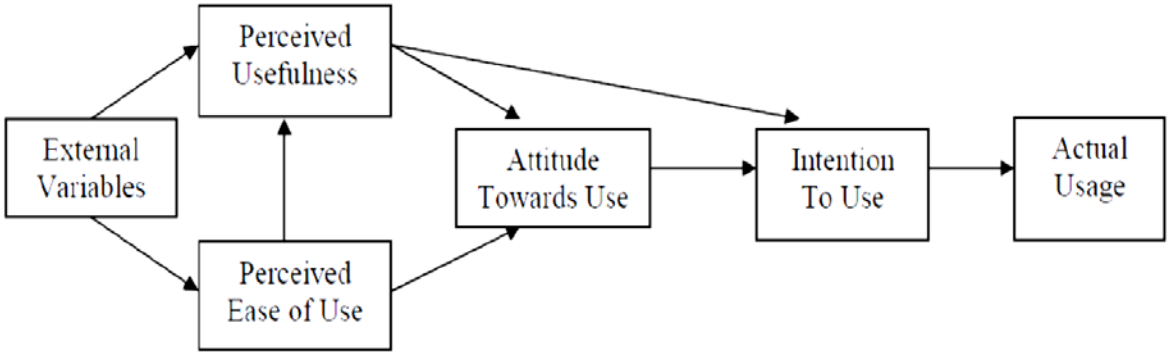

Figure 4: final version of Technology Acceptance Model (source: Venkatesh and Davis,1996)

The final version of Technology Acceptance Model was formed by Venkatesh and Davis (1996) as shown in the following figure after the main finding of both perceived

usefulness and perceived ease of use were found to have a direct influence on behavior intention, thus eliminating the need for the attitude construct.

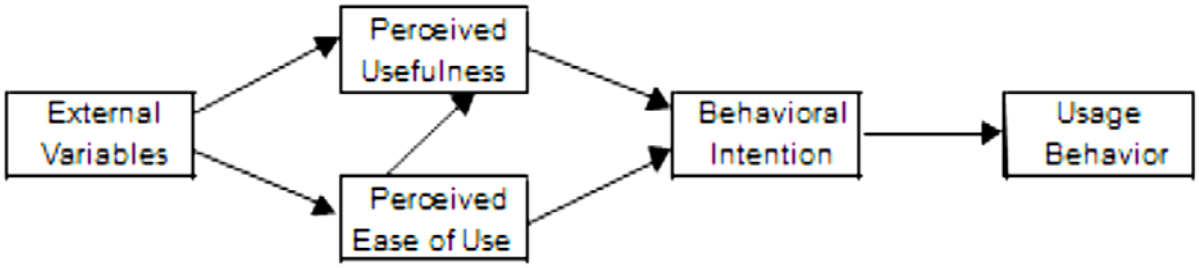

Figure 5: first modified version of Technology Acceptance Model (source: Davis, Bogazzi and Warshaw, 1989)

Key criticisms of Technology Acceptance Model

The criticism which is advanced by Zahid et al. (2013) suggests that the TAM does not consider factors such as age and education as external variables which could influence acceptance of and willingness to use technology. Conversely, it could be contended that it is extremely problematic to measure behavior, as hidden personality traits often motivate behavior. Accordingly, potential users of technology may not necessarily base their acceptance of and willingness to use new technology on their perceptions of the usefulness of IT and how easy it is to use, although the model does suggest that there may be other external factors which could be responsible for their acceptance of the technology.

2.2.2.3 Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980) originated in the field of social psychology and explains how and why attitudes affect behavior. TRA asserts that an individual's behavior is determined by his attitude toward the outcome of that behavior and by the opinions of others within his social environment. Ajzen and Fishbein (1980) proposed that an individual's intention to perform leads to a specific behavior. Behavior is the transition of intention into action. Intention to behave is a function of an individual's attitude toward the behavior and his subjective norms. TRA is designed to enable generalizations regarding behavior, since

individuals make conscious choices based on: (1) How strongly they perceive the benefits leading to a positive outcome; and, (2) the social norms, risks, and rewards they associate with that choice.

Based on the TRA, a person's intention is a function of two basic determinants, one "personal" in nature and the other reflecting "social influence." The personal factor is the individual's positive or negative evaluation of performing the behavior, which is called "attitude toward the behavior" and refers to attitudinal factors. The second determinant of intention is the person's perception of the social pressure put on him/her to perform or not to perform the behavior in question. This factor is termed "subjective norm" which deals with perceived prescriptions and relates to the normative considerations (Ajzen & Fishbein, 1980).

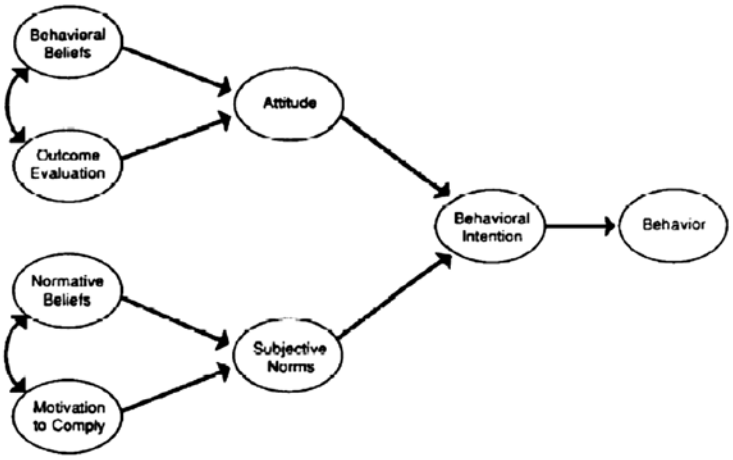

Figure 6: the Theory of Reasonable Action (source: Fishbein and Ajzen, 1975)

Key criticisms of Theory of Reasoned Action

The main disadvantages of TRA are the lack of addressing the role of habit, the cognitive deliberation, misunderstanding through a survey (attitudes, subjective norms, and intention of the respondents) and the moral factors. In addition, usage voluntariness is a crucial issue for validation of TRA (Taherdoost, 2018). The criticism faced by TRA that it is based on relatively static construct of attitude and thus cannot be used for prediction of behavioral outcome.

2.2.2.4 Theory of Planned Behavior (TPB)

Ajzen (1991) developed Theory of Planned Behavior which is about one factor that determines behavioral intention of the person's attitudes toward that behavior. The first two factors are the same as Theory of Reasonable Action (Fishbein and Ajzen, 1975). The third factor that is known as the perceived control behavior is the control which users perceive that may limit their behavior.

Decomposed Theory of Planned Behavior (Decomposed TPB) was introduced by Taylor and Todd (1995). The Decomposed TPB consists of three main factors influencing behavior intention and actual behavior adoption which are attitude, subjective norms and perceived behavior control. Shih and Fang (2004) examined the adoption of internet banking by means of the TPB as well as Decomposed TPB. There has been a great deal of research on the Theory of Reasoned Action (Ajzen & Fishbein, 1980; Sheppard et al., 1998), Theory of Planned Behavior (Ajzen, 1991) and Decomposed Theory of Planned Behavior (Taylor and Todd, 1995) but mostly used for products already in the marketplace and included the view of society (Subjective norm).

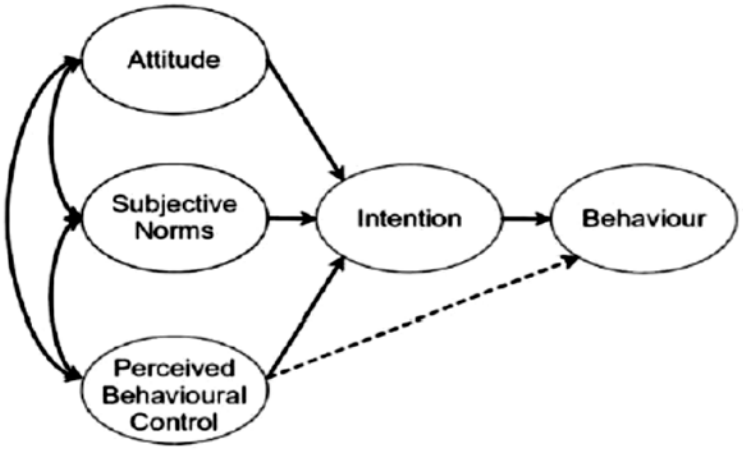

Figure 7: the Theory of Planned Behavior (source: Ajzen, 1991)

Key criticisms of Theory of Planned Behavior

A frequently voiced criticism of the TPB and other reasoned action models is that they are too 'rational,' not taking sufficient account of cognitive and affective processes that are known to bias human judgments and behavior. It is true, of course, that the TPB

emphasizes the controlled aspects of human information processing and decision making. Its concern is primarily with behaviors that are goal-directed and steered by conscious self-regulatory processes. This focus has often been misinterpreted to mean that the theory posits an impassionate, rational actor who reviews all available information in an unbiased fashion to arrive at a behavioral decision. In reality, the theory draws a much more complex and nuanced picture. Importantly, there is no assumption in the TPB that behavioral, normative and control beliefs are formed in a rational, unbiased fashion or that they accurately represent reality (Ajzen, 2011).

2.2.2.5 Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh et al., (2003) studied from the previous models/theories and formed Unified Theory of Acceptance and Use of Technology (UTAUT). These models are Technology Acceptance Model, Theory of Reasoned Action, combined TAM and TPB, Theory of Planned Behavior, Model of PC Utilization, Diffusion of Innovation, Motivational Model and Social Cognitive Theory.

The UTAUT has four predictors of users' behavioral intention and there are performance expectancy, effort expectancy, social influence and facilitating conditions. The five similar constructs including perceived usefulness, extrinsic motivation, job-fit, relative advantage and outcome expectations form the performance expectancy in the UTAUT model while effort expectancy captures the notions of perceived ease of use and complexity (Venkatesh et al, 2003). As for the social context, Venkatesh et al. (2003) validation tests found that social influence was not significant in voluntary contexts.

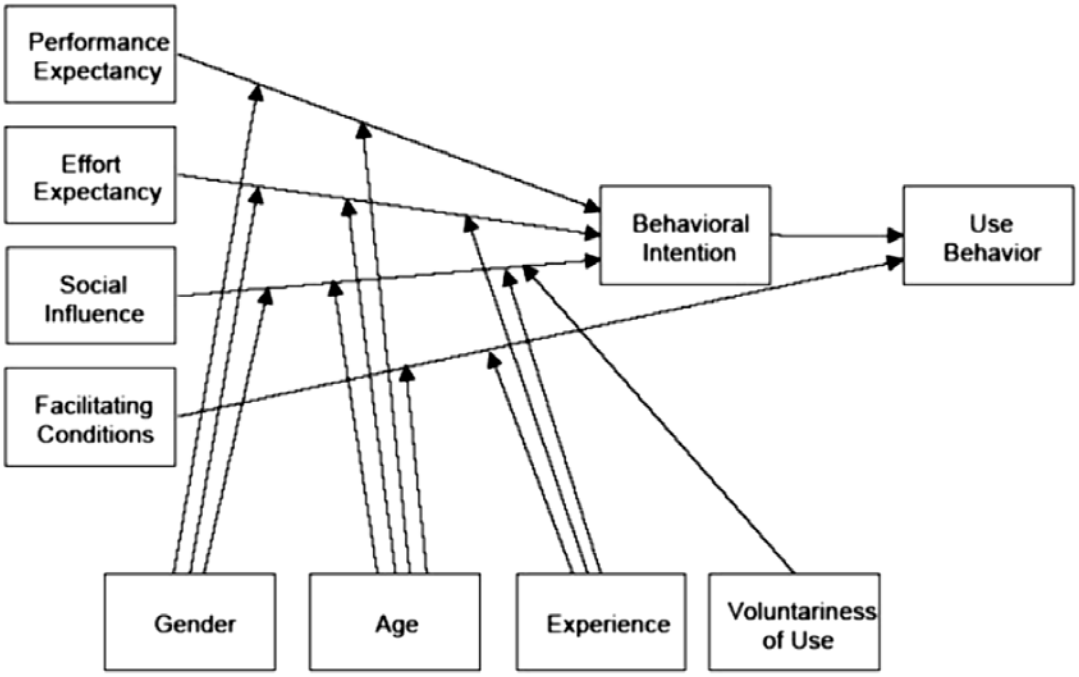

Figure 8: Unified Theory of Acceptance and Use of Technology (source: Venkatesh, Morris & Davis 2003)

Key criticisms of UTAUT

As sited by Sharma and Mishra (2014), the unified theory is proposed to be superior as it is able to explain 70% of the variance while the earlier theories were explaining only 30-40% variance in the adoption behavior (Venkatesh et al. 2003). However, it is criticized on the grounds of being overly complex, not being parsimonious in its approach and its inability to explain individual behaviour (Casey & Wilson-Evered 2012; Van Raaij & Schapers 2008).

2.3 EMPIRICAL REVIEW

Innovation diffusion theory is selected to conduct this study because it is more capable to explain consumers' behavior especially in rural context than other models discussed above, and it is able to explain 49-87% of the variance in the rate of adoption of innovations.

The model's perceived attributes of innovation components: relative advantage, compatibility, complexity, observability, and triability are significant predictors of

innovation's rate of adoption (Kotler & Armstrong, 2012; Hawkins and Mothersbaugh, 2010; Qureshi et al, 2017; Vasseur and Kemp, 2015). Accordingly, several studies have been conducted by researchers to identify factors that affect adoption of solar lighting products in rural areas using Rogers' perceived attributes of innovation. Even if a range of related studies are conducted in different parts of the world, only limited numbers of solar technology adoption studies are identified from Ethiopian context. Accordingly, the study reviewed few pertinent research findings both from international and local context in line with objective of the study as follows.

2.3.1 Relative Advantage and Solar Lighting Products Adoption intention

Rogers (2003) theorizes that people are more likely to adopt an innovation when it has a relative advantage over alternatives. He explained that the relative advantage of an innovation, as perceived by members of a social system, is positively related to its rate of adoption. The consumer's perceptions of the relative advantage of solar technology is based on consideration of the technologies upfront costs, fuel cost reduction, savings from incentives or tax credits, provisions of warranty, maintenance package, customer service, environmental action, and social acceptance (Macal et al., 2014).

Relative advantage is one of the strongest predictors of adoption rates to addresses the reduction of uncertainty. Rogers (2003) argues that levels of uncertainty decrease when participants weight the benefits of a technology against the costs of adoption and perceive a low risk and high benefit. Similar findings are reported by Labay and Kinnear (1981), in their solar technology research relative advantage is indicated as an important characteristic (both economic and noneconomic considerations), the greater this characteristic is, the faster the rate of adoption will be.

A study on adoption and non-adoption of solar PV in the Netherlands found that the perceived relative advantage of the technology and the complexity of the innovation are a critical driver for the adoption of solar home systems (Vasseur and Kemp, 2015). A study conducted on the adoption of solar energy technology in Lebanon by Caird et al. (2008) and Caird and Roy (2010) also found that the main drivers for adopting micro generation solar technologies were perceived relative advantage of the technology in

energy savings and lowering of fuel bills. The main barriers were uncertainty about reliability of the technology and performance, long payback periods, high system costs and limited roof space in multi-story buildings. Thus, this study hypothesizes that there is a significant positive relationship between perceived relative advantage and solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.

Hypothesis 1: Relative advantage has a positive and significant influence on solar lighting products adoption intention in rural villages of Oromia Special Zone Surrounding Addis Ababa.

2.3.2 Compatibility and Solar Lighting Products Adoption intention

Compatibility is the degree to which an innovation is perceived as being consistent with the existing values (e.g. socio-cultural values and beliefs), past experiences (e.g. previously introduced ideas), and the needs of potential adopters (Rogers, 2003). Rogers generalized that the compatibility of an innovation, as perceived by members of a social system, is positively related to its rate of adoption. However, compatibility has been criticized as lacking a clear definition and operational clarity, as it refers to three different dimensions: values, needs and past experiences (Claudy et al., 2011).

Even Rogers meanwhile asserted that, because the classical diffusion model was formulated under quite different socioeconomic conditions it is difficult to generalize the existence of positive relationship between compatibility of an innovation and rate of adoption with developing countries reality. As such compatibility can be described as an attribute that evolves according to an adopter's socio-economic status. Farmers with more land, more money, and more knowledge can more easily obtain credit, further information, and other inputs to adopt technical innovations. Since they adopt innovations relatively earlier, they gain more of the benefits of innovations. The majority of poorer farmers in developing nations lack resources and either cannot adopt innovations or else must adopt relatively later (Rogers, 2003).

As sited in Faiers and Neame (2006), issues such as long simple payback periods, high capital costs and a lack of confidence in the long-term performance of the systems

are limiting widespread adoption of solar systems (ETSU, 2001; Timilsina et al., 2000). A study conducted in Lahore, Pakistan also reveals that the high initial cost and inability to finance the solar PV system is the most significant barrier identified by all respondents regardless of their solar PV usage status (Qureshi et al., 2017). According to Silk (2014); palm (2017); Suppanich and Wangjiraniran (2015) finding, the rejecters think that installation cost is too high and inconsistence with their needs.

Feng (2011) finding indicated that compatibility of solar PV with the existing values, past experiences and needs of potential adopters. Sefordzi et al. (2018) also indicated in their review that, in terms of compatibility with values, beliefs, past experiences, if a renewable energy technology causes less disruption it is adopted faster. According to a finding in Sabsay (2013) study indicate that value compatibility for PV-systems in terms of environmental friendliness is positive.

Consequently, the study hypothesizes that perceived compatibility by dividing the construct into two parts since compatibility of solar lighting products' have both positive and negative effect in the adoption of the innovation in developing countries perspective. It is considered as a significant predictor that positively affects the adoption of solar lighting products against values & experience; and negatively affects the adopter against his/her needs in rural villages of Oromia Special Zone Surrounding Addis Ababa. Therefore the following two hypotheses are drown;

Hypothesis 2: Compatibility with needs has a negative and significant influence on solar lighting products adoption intention in rural villages of Oromia Special Zone Surrounding Addis Ababa.

Hypothesis 3: Compatibility with values & experiences has a positive and significant influence on solar lighting products adoption intention in rural villages of Oromia Special Zone Surrounding Addis Ababa.

2.3.3 Perceived Complexity and Solar Lighting Products Adoption intention

Complexity is the degree of which an innovation is perceived as being relatively difficult to use and understand (Rogers, 2003). Rogers (2003) suggests that the complexity of

an innovation, as perceived by members of a social system, is negatively related to its rate of adoption. A study conducted on the diffusion or adoption of solar PV system in Lahore, Pakistan revealed that perceived complexity usage and installation of solar PV system is not a complicated process rather a simple practice inadequate financial support from government is one of the significant factors in the slow diffusion of solar PV system among households in Lahore (Qureshi et al., 2017). Whereas, the Vasseur and RenéKemp (2014) finding also shows that technical complexity of solar PV does not appear to be an important threshold.

A finding in Silk (2014); Sabsay (2013) study is that PV-systems are seen as being very easy to use, which indicates a positive view of the characteristic of complexity. Some of the respondents however, but notably not all, thought that the actual installation could be complicated, which for these respondents would have a negative impact on both the complexity as well as compatibility with infrastructure aspect (Sabsay, 2013).

As a result, this study hypothesizes that perceived complexity is a significant predictor that affect the adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.

Hypothesis 4: Complexity has a negative and significant influence on solar lighting products adoption intention in rural villages of Oromia Special Zone Surrounding Addis Ababa.

2.3.4 Observability and Solar Lighting Products Adoption intention

Observability is the degree to which the results of an innovation are visible to others (Rogers, 2003). Rogers (2003) asserted that the observability of an innovation as perceived by members of a social system is positively related to its rate of adoption. According to Silk (2014) and Tidd (2009) the rate of adoption of an innovation increases when it is easier to see the benefits of this innovation. A study on Lahore, Pakistan showed that the friends, family members and pears' opinions that may have influence on their final decision of adopting solar PV system. In response, almost all of the interviewee has mentioned that everyone is in the favor and recommends installing it if there are no financial constraints (Qureshi et al, 2017). The case study made in

Germany also reveals that local solar companies may also influence the adoption rate via the neighborhood effect on potential adopters due to image motivation (Karakaya et al., 2015).

Sabsay (2011) on his research on perceptions of domestic solar systems suggested that the observability for PV solar systems could have a positive impact as an attribute transmitting green values even though the respondents does not by themselves fraise it or think of it that way. Another aspect is that it helps the actual diffusion since an observable technology becomes more familiar to the ones who can view it. PV solar systems are perceived by the respondents as a visible technology, which means that the respondents think that PV-systems have a high level of observability (Sabsay, 2013). As a result, this study hypothesizes that perceived observability is a significant predictor that affect the adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.

Hypothesis 5: Observability has a positive and significant influence on solar lighting products adoption intention in rural villages of Oromia Special Zone Surrounding Addis Ababa.

2.3.5 Trialability and Solar Lighting Products Adoption intention

Trialability is the degree with which an innovation may be experimented on a limited basis (Rogers, 2003). Rogers (2003) generalized that the trailability of an innovation as perceived by the members of a social system is positively related to its rate of adoption. Some innovations like solar lighting products can however by its nature not tried out before the decision of adoption has to be made. However, the trial and demonstration by peers, “trail by others”, can to a certain extent substitute this (Sabsay, 2013). Similar with Sabsay, Faiers and Neame (2006) also found out that a domestic solar power is not generally considered to be ‘trialable’ due to its nature.

According to Qureshi et al. (2017) in the study of factors responsible for solar PV adoption at household level showed that the provision of trial performance warranty by installer resulted in minimize the uncertainties of solar PV system in household's mind. A study by Khalil et al. (2017) in Pakistan shows that, several activities organized by the

local entrepreneur, e.g., solar walks and open door days, have also increased perceived trialability. Thus, this study hypothesizes that there is a significant positive relationship between perceived trialability and solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.

Hypothesis 6: Trialability has a positive and significant influence on solar lighting products adoption intention in rural villages of Oromia Special Zone Surrounding Addis Ababa.

2.4 CONCEPTUAL FRAMEWORK

The aim of this research is to identify factors that affect the adoption of solar lighting products in rural villages of Ethiopia. Hence, based on the literature review the conceptual framework of the study is developed using Rogers's innovation diffusion theory to identify the factors. Accordingly, Rogers' perceived attributes of innovation: relative advantage; compatibility with needs; compatibility with values & experiences; complexity; trialability; and observability are identified as independent variables that are believed to have effect on the dependent variable: solar lighting products adoption intention as illustrated in the following figure.

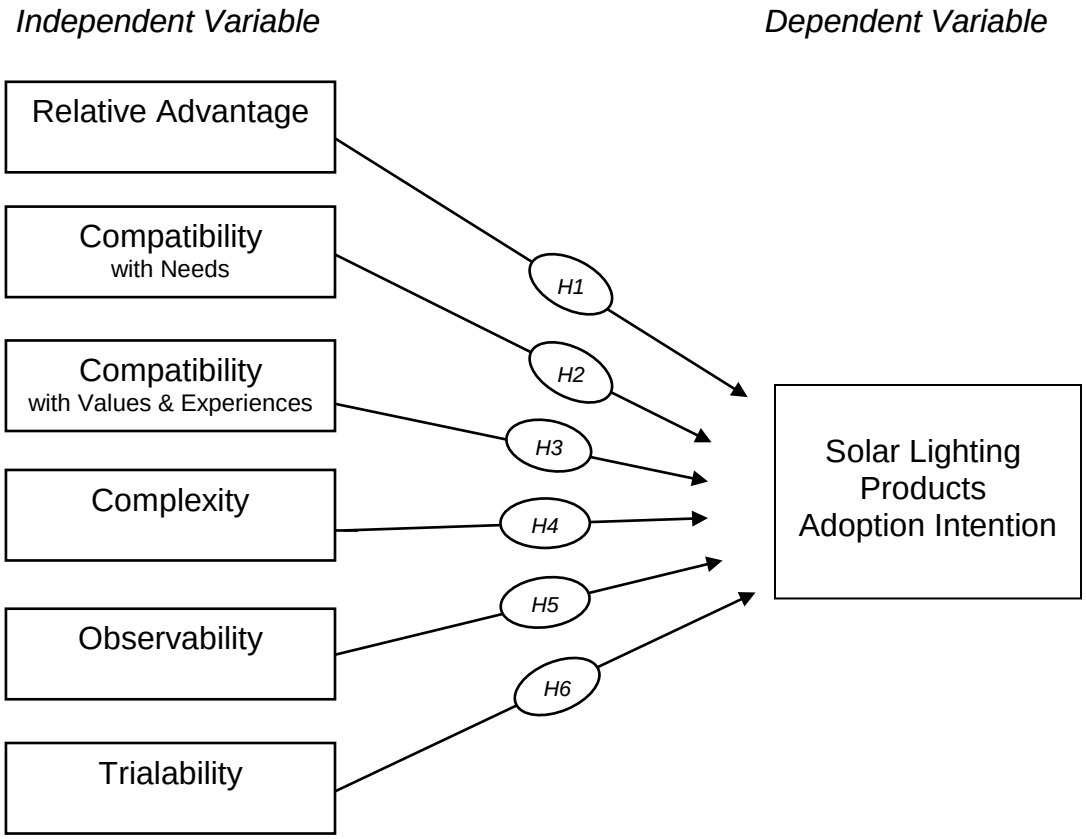

Figure 9: conceptual framework of the study based on Rogers' (2003) diffusion of innovation theory

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 INTRODUCTION

The review of different literatures revealed that access to electric energy is still a luxury to peoples living in rural Ethiopia even though it is a basic necessity for sustainable development. To address this problem, the country gives a priority for the development and use of off-grid solar technologies with other alternative renewable energy resources. However, the rate of adoption of off-grid solar lighting products in rural villages is still exceptionally slow. It is for this distinct reason that the study is conducted to identify the major factors that affect the adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.

Accordingly, this part of the study provides operational framework within which data was collected and analyzed. It describes the research approach and design; the study population, sample size and technique; the research instruments used; method of data collection and analysis. It is also focused on validity and reliability of instruments and ethical issues.

3.2 RESEARCH APPROACH

Research approaches are plans and procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation (Creswell, 2014). There are two main research approaches: deduction and induction. Deductive research aimed at testing existing theories and hypotheses through empirical observation. Whereas, inductive research aimed at developing theories and explanations based on observations from the empirical world (Saunders et al., 2007; Lancaster, 2005).

On the other hand, there are two basic approaches to research, namely: quantitative approach and the qualitative approach (Kothari, 2004). As (Greener, 2008 and Creswell, 2014) states, a quantitative approach to research is likely to be associated with a deductive approach to testing theory by examining the relationship among

variables, often using number or fact in an objectivist view of the objective studied. While, a qualitative approach to research is likely to be associated with an inductive approach to generating theory, often using an interpretivist model allowing the existence of multiple subjective perspectives and constructing knowledge using in depth interviews for the purpose.

According to (Marczyk et al., 2005) the choice of which research approaches to use largely depends on the types of questions being asked in the research study, and different fields of research typically rely on different categories of research to achieve their goals. This study also aims to answer the research question by the means of hypotheses, which can be derived from the propositions of the theory. Therefore, the researcher is used a deductive research approach to know the causal relationship between the anticipated factors and solar lighting products adoption in rural villages of Ethiopia by developing and testing a hypothesis based on Rogers' innovation diffusion theory.

The study was examined large number of rural household heads quantitatively by employing Rogers' theory to identify the causal relationships between perceived attributes of innovation and solar lighting products adoption. Accordingly, a quantitative research approach was employed to test the relationship between the dependent variable (solar lighting products adoption intention) and the independent variables (the six perceived attributes of Innovation).

3.3 RESEARCH DESIGN

Research design is the plan and structure of the investigation used to collect and analyze the relevant information to answer research questions or problems with minimal expenditure of effort, time and money (Kothari, 2004). The objectives of the research, the available data sources, the urgency of the decision, and the cost of obtaining the data will determine the type of research design employed (Saunders et al., 2009). According to the authors, based on the purpose of the study there are different research design approaches, such as; exploratory, descriptive and explanatory.

Exploratory research studies termed as formulative research studies. The main purpose of such studies is that of formulating a problem for more precise investigation or of developing the working hypotheses from an operational point of view. The major emphasis in such studies is on the discovery of new ideas and insights. As such, the research design appropriate for such studies must be flexible enough to provide opportunity for considering different aspects of a problem under study (Kothari, 2004).

Descriptive research studies are those studies which are concerned with describing the characteristics of a particular individual, or of a group. According to Robson (2002) as cited by (Saunders et al., 2007), the objective of descriptive research is to portray an accurate profile of persons, events or situations. Whereas, studies that establish causal relationships between variables may be termed explanatory studies. The main tasks in explanatory research are to isolate causes, and tell whether and to what extent causes results in effects (Ghauri and Gronhaug, 2005).

To provide a brief explanation of factors presumed to affect the adoption of solar lighting products in rural villages of Ethiopia, the most verified Rogers' (2003) perceived attributes of innovation model was examined in the study to understand causal links between the explanatory variables: relative advantage, compatibility with needs, Compatibility with Values & Experiences, complexity, observability & trialability, and the explained variable: solar lighting products adoption intention.

Hence, to answer why and to what extent these explanatory variables influence large number of rural household heads in their solar lighting products adoption, the study was employed explanatory type of research method. This method is very convenient to survey large number of rural household heads in order to know the root causes of the problem and answer the research questions in line with its objective as per the existing reputable conceptual framework.

3.4 DATA TYPES AND DATA SOURCES

There are two data sources in research: primary data and secondary data (Smith and Albaum, 2012). The primary data are those which are collected afresh and for the first time, and thus happen to be original in character. Primary data will often be collected

through techniques such as experimentation, interviewing, observation and surveys (Lancaster, 2005; Kothari, 2004). Experimentation is a research method where there is researcher intervention and control over the factors affecting the response variable of interest, thus allowing for the establishment of causal relationships (Smith and Albaum, 2012), whereas the interviewing method of data collection involves presentation of oral-verbal stimuli and reply in terms of oral-verbal responses. This method can be used through personal interviews and, if possible, through telephone interviews (Kothari, 2004).

Observation is another versatile approach to data collection. This approach relies on the direct observation of the construct of interest without asking from the respondent. The use of observational methods usually produces frequency counts of a particular behavior or behaviors (Marczyk et al., 2005). While, the survey strategy is usually associated with the deductive approach, It is a popular strategy in business and management research and it is most frequently used to answer who, what, where, how much and how many questions.

The survey strategy allows the researcher to collect quantitative data using questionnaires or structured interviews to analyze quantitatively in descriptive and inferential statistics. In addition, the data collected using a survey strategy can be used to suggest possible reasons for particular relationships between non-manipulated variables and to produce models of these relationships (Saunders et al., 2007).

The secondary data on the other hand are those which have already been collected by someone else and which have already been passed through the statistical process (Kothari, 2004). According to (Saunders et al., 2009), there are three main sub-groups of secondary data: documentary data, survey-based data, and those compiled from multiple sources.

Documentary secondary data include written materials such as books, journal and magazine articles, newspapers notices, correspondence, minutes of meetings, reports, diaries, transcripts of speeches and administrative and public records. While, Survey-based secondary data refers to data collected using a survey strategy, usually by

questionnaires that have already been analyzed for their original purpose. They are made available as compiled data tables of raw data for secondary analysis. Multiple-source secondary data can be based entirely on documentary or on survey secondary data, or can be an amalgamation of the two.

Most research projects require some combination of secondary and primary data to answer the research questions and to meet the research objectives (Saunders et al., 2007). Accordingly, in order to meet purpose of the study, different data collection tools were employed from primary and secondary data sources in this study. In the primary method, to identify factors affecting the adoption of solar lighting products in rural villages, quantitative data was collected using a structured survey questionnaire that captured information relating to variables under the study since the method allows collecting large amount of data from sizeable rural households within short time economically than other methods.

Preliminary data was also collected and organized through a review of multiple secondary data source such as, previous research works, articles, journals, books, reports, administrative & public records, survey-based compiled data tables and online information in order to obtain reliable theoretical literatures and empirical findings that can be applied in order to have a better understanding of factors affecting the adoption intention of innovation specifically solar lighting products and how the diffusion of innovation model can be used to investigate it.

3.5 POPULATION OF THE STUDY

Population is the full set of people or organization or any other entity under investigation that the researcher is attempting to make a valid inference and generalization (Saunders et al., 2009). The population is usually defined by the purpose of the research and the research question itself (Marczyk et al., 2005). Accordingly, the target population of this study consists of off-grid household heads reside in rural villages of Oromia Special Zone Surrounding Addis Ababa.

Oromia Special Zone Surrounding Addis Ababa is one of the 12 administrative zones of the Oromia Region in Ethiopia. This zone is surrounding the capital of Ethiopia, Addis

Abeba, which is called Finfinne in the Oromo language. The Zone incorporated six Weredas namely: Sebeta Hawaas, Akaki, Sululta, Berek, Mulo and Welmera which holds a total of 151 rural Kebeles and few small towns.

No	Weredas	Non Electrified		Electrified		Both Electrified and Non-Electrified		% of Electrified	
		Kebeles	Population	Kebeles	Population	Kebeles	Population	with respect to population	with respect to Kebele
1	Sebeta Hawaas	23	79,973	17	62,118	40	142,091	43.7	42.50
2	Akaki	21	49,288	7	32,862	28	82,150	40.0	25.00
3	Sululta	13	89,396	13	74,595	26	163,991	45.5	50.00
4	Berek	16	56,891	9	75,848	25	132,739	57.1	36.00
5	Mulo	4	25,540	4	21,428	8	46,968	45.6	50.00
6	Welmera	10	84,534	14	105,884	24	190,418	55.6	58.33
Total		**87**	**385,622**	**64**	**372,735**	**151**	**758,357**	***49.2***	***42.38***

Table 1: Electricity coverage of Oromia Special Zone Surrounding Addis Ababa as of march 2018
Source: Oromia Special Zone Surrounding Addis Ababa's Water Resource and Energy Bureau

As the special zone was created after the census of 2007, it's hard to find correct data about the population of zone. According to data gathered from Zone's administrative office, the total estimated population size is 758,357, of which 386,782 or 51% are males and the rest 371,575 are females. As shown in table 1, out of the total population of the zone, 382,278 peoples (76,456 households) do not have access to electricity from the national grid.

3.6 SAMPLING PROCEDURE

The study adopted a non-probability research method to select the sample respondent conveniently. The sample size of the study was 384 based on the formula developed by Kohtari (2004).

3.6.1 Sample Size

The size of sample should neither be excessively large, nor too small. It should be optimum. An optimum sample is one which fulfills the requirements of efficiency, representativeness, reliability and flexibility. While deciding the size of sample,

researcher must determine the desired precision as also an acceptable confidence level for the estimate (Kothari, 2004). Saunders et al., (2009) summarized that there are four strategies to decide sample size including (1) census for small populations, (2) imitating a sample size of similar studies, (3) applying formulas to calculate a sample size, and (4) using published tables.

Currently, the total numbers of households dwelled in Oromia Special Zone Surrounding Addis Ababa without access to electricity from the national grid is estimated around 76,456. However, the number of target households for the study does not exactly known and there is no sample frame, thus this study was used the following formula developed by Kothari (2004) to determine infinite/unknown sample size.

$$n = \frac{z^2 \,.\, p.q}{e^2}$$

Where; n = sample size

z = standard variant

p = proportion of success

q = proportion of failure

e = the level of precision or sampling error

Accordingly, the sample size for the study with a 95% confidence level and ±5% precision is calculated based on the above formula as follows;

$$n = \frac{1.96^2 \,.\, (0.5).(1-0.5)}{(0.05)^2}$$

$$n = 384.16 \approx 384$$

Based on the above calculation, the sample size for the study is 384; however, by considering defected/missing questioners, a total of 396 questionnaires were collected from sampled respondents, which was more than sufficient to proceed with the data

analysis. The higher response rate is attributed because of the researcher personally administered the questionnaires to the respondents with the help of trained data collectors.

3.6.2 Sampling Technique

Sampling technique provide a range of methods that enable researchers to reduce the amount of data needed to collect by considering only data from a sub-group rather than all possible elements (Saunders et al., 2009). There are two major sampling techniques available to select a sample from a population: probability or representative sampling; and non-probability or judgmental sampling (Smith and Albaum, 2012; Saunders et al., 2009).

In probability sampling, the elements in the population are finite (possible to enumerate) and have some known (non-zero) chance or probability of being selected as sample subjects (Sekaran and Bougie, 2009; Saunders et al., 2009). Under this technique it is possible to generalize the results obtained from the sample to the population at large. The common probability sampling techniques are simple random sampling, systematic sampling, stratified random sampling, cluster sampling and multistage sampling (Saunders et al., 2009).

In non-probability sampling, the elements are infinite (impossible to enumerate) and do not have a known or predetermined chance of being selected as subjects (Sekaran and Bougie, 2009; Saunders et al., 2007). Hence, the findings from the study of the sample cannot be confidently generalized to the population. A range of non-probability sampling techniques is available to select sample cases such as purposive sampling, shopping mall intercept sampling, sequential sampling, quota sampling, snowball sampling, panel samples and convenience sampling (Saunders et al., 2009). Some of non-probability sampling plans such as convenience sampling and purposive sampling are more dependable than others and could offer some important leads to potentially useful information with regard to the population (Sekaran and Bougie, 2009).

Accordingly, the study was adopt non-probability sampling techniques since the objective of the study is not generalizing the finding to the population, and it is

impossible & difficult to create a formal sampling frame of the entire non-electrified target households in the special zone with a small budget and time constraints. To select the sample cases a convenience sampling technique was employed because there is only little variation in the population and the sample selected is not very small.

The study was conducted in the entire six weredas of the special zone namely: Sebeta Hawaas, Akaki, Sululta, Berek, Mulo and Welmera to obtain a representative sample. Accordingly, based on weredas' population and household size the sample respondents (household heads) were allocated proportionally using cluster sampling method as shown in table 2.

No	Weredas	Wereda's Population Size	Wereda's Household Size	Household Proportion in %	Proportional household sample size
1	Sebeta Hawaas	76,629	15,326	20%	77
2	Akaki	49,288	9,858	13%	50
3	Sululta	89,396	17,879	23%	88
4	Berek	56,891	11,378	15%	58
5	Mulo	25,540	5,108	7%	27
6	Welmera	84,534	16,907	22%	84
Total		**382,278**	**76,456**	**100%**	**384**

Table 2: Proportional household heads sample size determination per each stratum Weredas
Source: Oromia Special Zone Surrounding Addis Ababa office and own computation

Subsequently, by the assumption of taking 10% of the total 87 non-electrified Kebeles as a sample is representative; nine sample rural kebeles was selected using simple random sampling method from each Wereda of the special zone as shown in table 3. Thus, Mogile Kebele & Buro Finchea Kebeles from Sebeta Hawaas Wereda; Oda Nabe & Gelan Arabsa Kebeles from Akaki Wereda; Boku Golba from Sululta Wereda; Bura Berek and Ripha Dembel Kebeles from Berek Wereda; Mulo Kersa Kebele from Mulo Wereda; and Haro Boki Kebele from Welmera Wereda were taken as a sample on the principle that they can be representative of the whole non-electrified rural kebeles since they have almost similar socio-economic characteristics.

Finally, to select household heads from each selected rural kebeles, convenience sampling method was used. Accordingly, both adopters and non-adopters of solar lighting products were nominated as sample respondents conveniently to describe and explain the key themes that can be observed.

No.	Weredas	No. of Kebeles	Kebeles Proportion in %	Proportional Kebeles sample size	Name of selected Sample Kebeles	Proportional household sample size
1	Sebeta Hawaas	23	26%	2	Mogile	39
					Buro Finchea	38
2	Akaki	21	24%	2	Oda Nabe	25
					Gelan Arabsa	25
3	Sululta	13	15%	1	Boku Golba	88
4	Berek	16	18%	2	Bura Berek	29
					Ripha Dembel	29
5	Mulo	4	5%	1	Mulo Kersa	27
6	Welmera	10	12%	1	Haro Boki	84
Total		**87**	**100%**	**9**	**-**	**384**
For contingency (2 from each Wereda)						**12**
Over all Total					**-**	**396**

Table 3: Proportional sample Kebeles and their respective household heads size determination
Source: Oromia Special Zone Surrounding Addis Ababa office and own computation

3.7 DATA GATHERING INSTRUMENTS

Creswell (2014) states that survey research provide qualitative or numeric description of trends, attitudes or opinion of a population by studying a sample of that population. It includes cross-sectional and longitudinal studies using questionnaires or structured interviews for data collection. Longitudinal research refers to the study of individuals several points in time, often using repeated data collection instrument. While, cross-sectional is the study of groups one point in time in order to answer a research question (Beins and McCarthy, 2012; Sekaran and Bougie, 2009).

Thus, the study was used cross-sectional method to collect primary data using a structured survey questionnaire that captured information relating to the variables under study. The items in the questionnaire were adopted from popular book and journal studies like (Rogers, 2003; Qureshi et al., 2017; Vasseur and Kemp, 2015) with some modification by the researcher as shown in table 4. After originally developing the questionnaires in English language it is translated into Amharic version for easily comprehension by respondents.

The data collection instrument had three sections that hold a total of 30 questions. Section A contains six general information questions about the respondents' age, gender, education level, marital status, occupation and solar lighting product usage status. In Section B, to measure the effects of Rogers' perceived attributes of innovation on the adoption intention of solar lighting products, respondents were asked twenty-one questions to show their agreement or disagreement with five-point Likert scale (1 = don't know; 2 = strongly disagree; 3 = disagree; 4 = agree; and 5 = strongly agree). In Section C, three dependent variable's questions were asked to point out the respondents' intention of adoption for solar lighting products using five-point Likert scale.

Finally, in selected rural villages of Oromia Special Zone Surrounding Addis Ababa, the required information was collected by asking rural household heads orally since they have difficulty of filling the questionnaires by themselves.

Perceived Attributes of innovation	Determinants Categorizations
Relative advantage	Financial viability
	Environmental friendliness
	Decrease in discomfort
	Energy security
	Multi-functionality
	Social acceptable
Compatibility with needs	Initial cost
	Loan/grant
	Product quality
	Product information
Compatibility with values & experiences	Social norms
	Habits and routine
	Household residence
Complexity	Simplicity to understand
	Simplicity to operate
	Technical support availability
	Availability of spare parts
	Unforeseen troubles
Observability	People opinion & experience
Trialability	Return or replace warranty

Table 4: Categorization of perceived attributes of innovation and factors
Source: Rogers (2003); Qureshi et al. (2017); Vasseur and Kemp (2015)

3.8 VALIDITY AND RELIABILITY

Validity is the extent to which differences found with a measuring instrument reflect true differences among those being tested, (Kothari, 2004). In other words, Validity is the most critical criterion that indicates the degree to which a measure what it is supposed to measure. Accordingly, to assure validity, questionnaires were designed on the basis of previous studies' data collection instruments and review of related literatures. The researcher selected multiple sources of evidence including documentation and personal observation. Finally, the researcher used well-established literature to construct the frame of references.

Reliability is the extent to which measurements are repeatable – when different persons perform the measurements, on different occasions, under different conditions, with supposedly alternative instruments which measure the same thing. In sum, reliability is consistency of measurement or stability of measurement over a variety of conditions in which basically the same results should be obtained (Drost, 2007). To assess the internal consistency of variables in the research, Cronbachs alpha reliability test technique was applied. According to Field (2006), Cronbachs alpha coefficient greater than 0.7 indicate the reliability of the instrument used. As shown in table 5, the results of Cronbach's alpha are higher than 0.7 thus this indicates the questioner result is reliable.

Variables	Cronbach's Alpha	Number of Items
Relative Advantage	0.799	5
Compatibility with needs	0.705	4
Compatibility with Values & experiences	0.839	3
Complexity	0.726	5
Observability	0.748	2
Trialability	0.715	2
Adoption Intention	0.834	3
Over all Reliability	0.860	24

Table 5: reliability test
Source: own survey (2019)

3.9 METHODS OF DATA ANALYSIS

The data analysis method needed cumulative activities which include presentation, analysis and interpretation. Accordingly, the data collected through questionnaires is analyzed and interpreted using descriptive and inferential statistical techniques. The study adopted frequencies and percentages to determine the demographic composition of the respondents. The dependent and independent variables of the study also described using mean and standard deviation. To examine the correlation between Rogers' perceived attributes of innovation and adoption intention of solar lighting products, Pearson Correlation coefficient is employed and the effects between the variables analyzed through multiple linear regression method. The Statistical Package for Social Sciences (SPSS) 20.0 is used to analyze the data collected.

3.10 ETHICAL CONSIDERATION

The study considers certain ethical issues like consent and confidentiality. Accordingly, in order to keep the confidentiality of the respondents, they were not asked to give their name and assured the anonymity and confidentiality of their response. The data were collected from willing household heads. The purpose of data collection was clearly indicated on the questionnaire and announced orally for the respondents. The response of the respondents are highly honored and kept confidential. In the final result of the research paper, personal information are not included and only the summery of relevant data that helps in answering the research questions are incorporated. The conclusions reached and the recommendations given are also based on the data collected only and only.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 INTRODUCTION

This chapter contained data presentation, analysis and interpretation parts of the study in accordance to the research objective and hypothesis. The primary objective of the study is identifying factors that affect the adoption intention of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa. Accordingly, the primary data that was collected through structured survey questionnaires from non-electrified rural household heads of the special zone are summarized and analyzed in order to realize the ultimate objective of the study. The general background information of the respondents is summarized using percentile and frequency distribution. The scale typed questions are also analyzed by employing descriptive and inferential statistical techniques to test the research hypotheses and answering the research questions.

4.2 DATA EDITING AND CLEANING

Before data is processed for statistical analysis and interpretation, data cleaning and editing must be done to ensure missing responses are treated carefully to minimize their adverse effects on the result of the study. Thus, the researcher has undertaken data cleaning and editing process before running overall statistical analysis to ensure that the data was properly entered into SPSS and maximum and minimum values are within the range of the values on the survey.

4.3 BACKGROUND OF THE RESPONDENTS

The respondents were asked to indicate their age group, gender, educational level, marital status, occupation and solar lighting products usage status, if they were the household head and reside in one of the selected non-electrified rural kebeles of Oromia Special Zone Surrounding Addis Ababa. As shown in the following table, the gender composition is dominated by male household heads which counted 77.6% (298) of the respondents while 22.4% (86) of the respondents were female household heads. Regarding age of the respondents, 45.8% (176) of the respondents were from the age

group of 36 - 50 which constituting the largest percentage. The age group between 18 - 35 years holds 29.9% (115) of the respondents. The rest 24.2% (93) of the respondents were aged above 50 years old. This shows that the respondents' set was highly dominated by male and adult household heads.

No	Attributes	Characteristics	Frequency	Percent
1	Age	18 – 35	115	29.9
		36 – 50	176	45.8
		above 50	93	24.2
		Total	384	100.0
2	Gender	Male	298	77.6
		Female	86	22.4
		Total	384	100.0
3	Educational Level	None	198	51.6
		1 – 6	124	32.3
		7 - 12/TVET	58	15.1
		Diploma & above	4	1.0
		Total	384	100.0
4	Marital Status	Married	367	95.6
		Single	13	3.4
		Divorced	2	.5
		Widower	2	.5
		Total	384	100.0
5	Occupation	Farmer	377	98.2
		Employee	6	1.6
		Merchant	1	.3
		Total	384	100.0
6	Do you use a solar lighting product in your home?	Yes	120	31.3
		No	264	68.8
		Total	384	100.0

Table 6: Descriptive Statistics of Background of the Respondents
Source: own survey, 2019

As table 6 indicated that, 95.6% (367) of the household heads were married, 3.4% (13) of the household heads were single, and the other 1% of the household heads were divorced or widower. The educational level shows that large numbers of the

respondents i.e. 51.6% (198) do not have a formal education except informal short term educational and training programs like “Meserete Timhrt”. Whereas, 32.3% (124) of the respondents were educated in between grade 1 - 6 and the others 15.1% (58) educated in between grade 7 - 12/TVET. The rest of the respondents were hold Diploma and above. Regarding the respondents’ occupation, 98.2% (377) of the household heads were primarily engaged in farming and the remaining were employees or merchants. This implies that most of those who responded were married farmers that do not have advanced educational background.

To know the households’ major energy source of lighting, the respondents were asked question regarding to their solar lighting product usage status. Accordingly, 68.8% (264) of the households do not adopt one of off-grid solar lighting products (solar lantern or solar home system) rather they were mainly used wick lamps or hurricane lamps, firewood, dry cells and other traditional lighting sources. The remaining 31.3% rural households used solar lighting products as their major lighting energy source.

4.4 DESCRIPTIVE ANALYSIS OF VARIABLES

The summary of descriptive statistics that is intended to give general descriptions about the overall data collected from non-electrified rural household heads is presented in the following tables organized into two categories: perceived attributes of innovation and adoption intention. In the analysis, percentile, mean and standard deviation values of the variables are used so as to show the overall trends of the data.

4.4.1 Descriptive Statistics of Perceived Attributes of Innovation

Illustration of the descriptive statistics for each main constructs of perceived attributes of innovation and its dimensions is given on this part. The responses were on the extent to which the rural household heads strongly disagreed (SD), disagreed (D), did not know (DK), agreed (A) or strongly agreed (SA) on the effect of perceived attributes of solar lighting products in their adoption intention. Accordingly, the descriptive statistics outcome of relative advantage, perceived compatibility with needs, compatibility with existing values & past experiences, complexity, observability, and trialability is discussed in the subsequent six tables as follows.

I. Descriptive Statistics of Relative Advantage

The researcher required to address the first objective by examining the perception of household heads towards relative advantage of solar lighting products. Accordingly, as shown in the following table, all the five relative advantage attributes scored average mean value of 4.06 (out of 5) and average standard deviation of 0.505 which indicates the existence of significant agreement and lower dispersion in all the statements. Specifically the attribute 'provides better lighting energy than lamp, dry-cell, firewood & candle' had a mean score of 4.18, with 99.7% agreement. The attribute 'providing electrical energy for other devices such as radio and mobile besides lighting' scored a mean of 3.92 which is the lowest of others with 90% agreement and 7.6% disagreement on the statement. The statements 'reduce household's expenses' and 'reduce environmental pollution' recorded a mean value of 4.03 and 4.11 with 94.2% and 98.5% agreement respectively. The attribute 'advances the social prestige' also attain a mean value 4.07 with 95.5% agreement on the statement.

Table 7: Descriptive Statistics of Relative Advantage

Relative Advantage Variables	SD in %	D in %	N in %	A in %	SA in %	Mean	Std. Dev.
Solar lighting products provide better lighting energy than lamp, dry-cell, firewood & candle.	0	0	0.3	81	18.7	4.18	.395
Solar lighting products help daily life by providing electrical energy for radio, mobile & other devices besides lighting.	0.8	6.8	2.3	79.9	10.2	3.92	.679
Solar lighting products reduce household's gas and battery expenses spend to get lighting energy.	0	3.6	2.1	82	12.2	4.03	.538
Using solar lighting products help to reduce home and environmental pollution.	0	0.3	1.3	85.2	13.3	4.11	.379
Being seen as a user of solar lighting product advances the social prestige.	0.3	2.6	1.6	80.7	14.8	4.07	.536
Average						**4.06**	**0.505**

Note: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree
Number of observation = 384
Source: own survey, 2019

In general it can be observed from the result, household heads considered solar lighting products relatively very advantageous than traditional energy sources even if they are

not fully satisfied with the products' multi-functional benefit in energizing other electronic devices such as radio & mobile phone, and inability of the product to reduce household expenses by providing sufficient light.

II. Descriptive Statistics of Compatibility with Needs

The investigation followed by looking the extent to which solar lighting product is compatible with perceived needs of off-grid rural households of Oromia Special Zone Surrounding Addis Ababa. The survey result indicated that, the attributes of the construct recorded an average mean and standard deviation value of 2.49 and 1.054 respectively. This showed the respondents were given variety of opinions on the issue and most of them didn't perceive the product as computable with their needs.

As shown in table 8, the initial purchasing cost of quality solar lighting products was reasonable only for 30% of the respondents, whereas the rest 63% of the respondents believes as it was unaffordable. Most of the household heads also stressed the unavailability of adequate information, consumers' education, quality solar lighting product and loan facility which are compatible with their needs and capacity by showing their disagreement ranging from 70% to 76% in the rest three attributes of the construct.

Table 8: Descriptive Statistics of Compatibility with Needs

Compatibility with Need Variables	SD in %	D in %	N in %	A in %	SA in %	Mean	Std. Dev.
I get enough Information and education about solar lighting products. ***	9.6	66.7	2.3	13.3	8.1	2.43	1.092
Quality solar lighting products that meet my need are sufficiently available in the market.	4.4	65.1	10.9	14.8	4.7	2.50	.959
The initial purchasing cost of solar lighting product is affordable.	10.2	53.1	6.5	25.5	4.7	2.61	1.111
The loan facility available for the purchase of solar lighting product is compatible with my need.	12	59.9	8.9	13.3	6	2.41	1.054
Average						**2.49**	**1.054**

Note: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree
Number of observation = 384

*** The questioner statement and the value are transformed for analysis purpose

Source: own survey, 2019

In general, rural household heads considered solar lighting products as an incompatible product with their needs considering the unavailability of sufficient product information related to product types, quality, futures, pricing, suppliers etc to make informed decision; unavailability of sufficient quality products that meets their long term energy needs even if the market packed with confusing low-quality imported & smuggled products; the expensiveness of quality products; and the difficulty and inability to access loan facility with affordable interest rate & payback period from financial intermediaries.

III. Descriptive Statistics of Compatibility with Values & Past Experiences

The study also examined the compatibility of solar lighting products with rural households' existing values and past experiences in Oromia Special Zone Surrounding Addis Ababa. Accordingly as shown in table 9, all of the dimensions have recorded highest average mean value of 4.24 with average standard deviation score of 0.465 which shows the highly concentrated agree and strongly agree opinions of the respondent ranging from 98.7% - 99.5% together in all attributes of the construct.

Table 9: Descriptive Statistics of Compatibility with Values & Past Experiences

Compatibility with Values & Past Experiences Variables	SD in %	D in %	N in %	A in %	SA in %	Mean	Std. Dev.
Using solar lighting products would not go against our society's culture and belief.	0	0.5	0.3	62.5	36.7	4.35	0.516
Solar lighting products are compatible with my habits and routine.	0	0	0.5	75.8	23.7	4.23	0.435
My home & living area are suitable for using solar lighting products.	0	1	0.3	81	17.7	4.15	0.445
Average						**4.24**	**0.465**

Note: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree
Number of observation = 384
Source: own survey, 2019

In general, the finding revealed that most respondents perceived solar lighting products as compatible innovation with their beliefs, cultural practices, habits and daily routines. In addition the outcome showed the suitability of the respondents' home and village to access enough direct sun light and installs solar lighting products.

IV. Descriptive Statistics of Complexity

Complexity is one of the core dimensions of perceived attributes of innovation which expected to limits the rate of adoption of an innovation. To test the complexity nature of solar lighting products, the respondents were asked to give their opinions on five complexity attributes. Consequently, the result showed that the three attributes 'not complicated to understand', 'not difficult to operate' and 'not frustrating to use' had a mean scores ranging from 3.93 - 4.01 with above 90% agree and strongly agree cumulative ratings as shown in table 10. Whereas, the other two attributes 'technician /maintenance support is easily available' and 'spare part is easily available' had a mean value of 2.4 and 2.32 with 77.6 and 81.3 strongly disagree and disagree ratings respectively.

Table 10: Descriptive Statistics of Complexity***

Complexity Variables	SD in %	D in %	N in %	A in %	SA in %	Mean	Std. Dev.
Solar lighting product is not complicated to understand.	0	5.2	1	89.1	4.7	3.93	0.512
Solar lighting product is not difficult to operate.	0	5.7	0.5	81	12.8	4.01	0.602
Technician/maintenance support is easily available for solar lighting product.	2.3	75.3	6	13	3.4	2.4	0.867
Spare parts for solar lighting product are easily available.	2.1	79.2	5.2	11.5	2.1	2.32	0.785
It is not frustrating to use a solar lighting product.	1.3	6.8	0.8	76.8	14.3	3.96	0.734
Average						**3.32**	**0.700**

Note: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree
Number of observation = 384
*** The questioner statements and the values are transformed for analysis purpose
Source: own survey, 2019

Generally, on average the five attributes of complexity construct recorded 3.32 mean and 0.7 standard deviation values that showed an inclination to agree on simplicity of the product rather than its complexity even if the responses moderately dispersed. However, issues related to unavailability of technicians and spare parts may hinder the rate of adoption and usage of solar lighting products.

V. Descriptive Statistics of Observability

The outcome of the investigation related to observability of solar lighting product showed that among the surveyed off-grid rural household heads in Oromia Special Zone Surrounding Addis Ababa, 95% of them are seen the products' users in their village and the benefit they gained using the innovation. Although they had few disagreement on the benefit of the innovation related with poor quality products as they observed in their villages. In general, the average mean score of 4.02 showed the observability of the product in off-grid rural villages of the special zone.

Table 11: Descriptive Statistics of Observability

Observability Variables	SD in %	D in %	N in %	A in %	SA in %	Mean	Std. Dev.
I have seen solar lighting product users in my village.	0	4.7	0.5	84.4	10.4	4.01	0.546
I have seen what other people benefited using solar lighting product.	0	3.9	0.8	83.9	11.5	4.03	0.528
Average						**4.02**	**0.537**

Note: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree
Number of observation = 384
Source: own survey, 2019

VI. Descriptive Statistics of Trialability

Trialability is the degree to which an innovation can be tested on a limited scale (Rogers, 2003). Therefore, the research tried to assess the trialability of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa by raising two questions. Accordingly, the finding showed that 85% and 62% of the respondents disagree on the statement 'I can return/replace defected product after purchase' and 'I can get warranty' respectively as shown in table 12. The average mean (2.31) and standard deviation (0.908) values of the construct indicated that a solar lighting product is not trialable even if the rural households need sustainable warranty for the products they purchased.

Table 12: Descriptive Statistics of Trialability

Trialability Variables	SD in %	D in %	N in %	A in %	SA in %	Mean	Std. Dev.
I can easily return/replace defected solar lighting products after purchase.	17.4	67.2	6.5	7.3	1.6	2.08	0.816
I can get sustainable warranty for solar lighting products I purchased.	10.2	51.3	14.3	22.7	1.6	2.54	1.000
Average						**2.31**	**0.908**

Note: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree
Number of observation = 384
Source: own survey, 2019

4.4.2 Descriptive Statistics of Adoption Intention

To see off-grid rural household heads' adoption intention towards solar lighting products, three questions were forwarded. Accordingly, the attribute 'I buy and use' scored a mean of 4.20, with 99.7% agreement and the attribute 'I use continuously in the future' scored a mean of 4.12, with 99.7% agreement. In addition, 'I strongly recommend to others' attribute scored a mean of 4.08 with 99.2% agreement.

Table 13: Descriptive Statistics of Adoption Intention

Adoption Intention Variables	SD in %	D in %	N in %	A in %	SA in %	Mean	Std. Dev.
I buy and use solar lighting products.	0	0	0.3	79.3	20.6	4.20	0.409
I intend to use solar lighting product continuously in the future.	0	0	0.3	87.5	12.2	4.12	0.333
I strongly recommend others to adopt solar lighting products.	0	0	0.8	90.9	8.3	4.08	0.293
Average						**4.13**	**0.345**

Note: SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree
Number of observation = 384
Source: own survey, 2019

Generally, the mean score (4.13) of the adoption intention showed the willingness of off-grid rural households of Oromia Special Zone Surrounding Addis Ababa to adopt, continuously use and recommend solar lighting products.

4.5 CORRELATION ANALYSIS

Correlation is used to measure the strength of association between two variables. To measure the strength of association between variables, Spearman's rank correlation coefficient (Spearman's rho) and Kendall's rank correlation coefficient (Kendall's tau) are most widely used in business and management research (Saunders, et al., 2009). Accordingly, the study employed Spearman's rank correlation to test whether there is association between independent and dependent variables of the study.

Spearman's coefficient of correlation is the technique of determining the degree of correlation between two variables. The main objective of this coefficient is to determine the extent to which the two sets of ranking are similar or dissimilar. The coefficient value of 'r' lies between ± 1. Positive values of r indicate positive correlation between the two variables (i.e., changes in both variables take place in the statement direction), whereas negative values of 'r' indicate negative correlation i.e., changes in the two variables taking place in the opposite directions. A zero value of 'r' indicates that there is no association between the two variables (Kothari, 2004).

To interpret the strength of relationships between variables, the guideline suggested by Field (2005) is followed. Field's classification of the correlation efficient (r) is as follows: 0.1 – 0.29 is weak; 0.3 – 0.49 is moderate; and > 0.5 is strong.

Correlations

		Relative Advantage	Compatibility with Needs	Compatibility with Values & Experiences	Complexity	Observability	Trialability	Adoption Intention
Relative Advantage	Pearson Correlation	1	.280**	.492**	.344**	.454**	.069	.804**
	Sig. (2-tailed)		.000	.000	.000	.000	.176	.000
	N	384	384	384	384	384	384	384
Compatibility with Needs	Pearson Correlation	.280**	1	.487**	.352**	.285**	.413**	.252**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
	N	384	384	384	384	384	384	384
Compatibility with Values & Experiences	Pearson Correlation	.492**	.487**	1	.333**	.423**	.122*	.570**
	Sig. (2-tailed)	.000	.000		.000	.000	.017	.000
	N	384	384	384	384	384	384	384
Complexity	Pearson Correlation	.344**	.352**	.333**	1	.303**	.241**	.469**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
	N	384	384	384	384	384	384	384
Observability	Pearson Correlation	.454**	.285**	.423**	.303**	1	.001	.513**
	Sig. (2-tailed)	.000	.000	.000	.000		.977	.000
	N	384	384	384	384	384	384	384
Trialability	Pearson Correlation	.069	.413**	.122*	.241**	.001	1	.004
	Sig. (2-tailed)	.176	.000	.017	.000	.977		.934
	N	384	384	384	384	384	384	384
Adoption Intention	Pearson Correlation	**.804****	**.252****	**.570****	**.469****	**.513****	**.004**	**1**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.934	
	N	384	384	384	384	384	384	384

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 14: Correlations between Perceived Attributes of Innovation and Adoption Intention

Accordingly, a Pearson correlation test was conducted to know the degree of relationship between the independent variables: relative advantage; compatibility with needs; compatibility with values & experiences; complexity; observability & trialability; and the dependent variable: adoption intention. The results of correlation analysis between these variables indicates that, there is significantly very strong and positive correlation between relative advantage and adoption intention where ($r = 0.804$, $p < 0.01$). While, the correlation output between compatibility with needs and adoption intention showed relatively near to moderate correlation with ($r = 0.252$, $p < 0.01$). The value ($r = 0.570$, $p < 0.01$) of adoption intention and compatibility with values & experiences suggest the existence of a strong and positive relationship between the two variables. On the other hand, the correlation test between complexity with adoption intention and observability with adoption intention showed correlation coefficients of

($r = 0.469$, $p < 0.01$) and ($r = 0.513$, $p < 0.01$) respectively, that confirmed the existence of relatively near to strong and positive relationship between the variables. In contrast to others, correlation coefficient ($r = 0.004$, $p > 0.05$) of trialability and adoption intention showed a very week and statistically insignificant correlation between the two variables.

Generally, a conclusion derived from the analysis indicated that all the independent variables except trialability have a relation with adoption intention of solar lighting products even if their degree of relation varies.

4.6 REGRESSION ANALYSIS

Linear regression estimates the coefficient of the linear equation, involving one or more independent variables that best predict the value of the dependent variable (Robert, 2006). Before regression analysis is conducted different regression test is conducted. Then the variables under perceived attributes of innovation are entered into regression analysis to examine their effect on adoption intention of solar lighting products.

4.6.1 Testing Regression Analysis Assumptions

Multiple regression analysis relies on some assumptions related to the variables used in the analysis. Study results may not be dependable when the assumptions are not met, so it is important to test these assumptions. Accordingly, normality, multicollinearity, linearity, Durbin-watson and curve estimation tests were done in the study to satisfy the common regression analysis assumptions.

4.6.1.1 Normality test

A normal distribution is one of the importantly assumed statistical procedures. Normality of a data should be test before running the regression analysis because multiple regressions require that the independent variables in the analysis be normally distributed. A common test for normality is to run descriptive statistics to get skewness and kurtosis. Skewness represents the symmetry of the data. A positive skewness indicates that more of the data appears to the high end, or the right, on the graph. A negative value indicates a skew to the lower values. Kurtosis has to do with the flatness of the curve. If the data implies a curve flatter than the bell curve, the kurtosis value is

negative. If, on the other hand, the data inscribes a curve that is more pointed on top than the bell curve, the kurtosis value is positive.

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
Relative Advantage	384	.722	.125	1.681	.248
Compatibility with Needs	384	.789	.125	1.312	.248
Compatibility with Values & Experiences	384	.701	.125	-.072	.248
Complexity	384	.509	.125	3.215	.248
Observability	384	-1.352	.125	6.304	.248
Trialability	384	.839	.125	1.139	.248
Adoption Intention	384	1.991	.125	2.832	.248
Valid N (listwise)	384				

Table 15: normality test of Skewness and Kurtosis

According to Robert (2006), interpretation of normality is based on the absolute value of skewness and kurtosis and substantial non-normality is referred for absolute value of skewness larger than 2 and absolute value of kurtosis larger than 7. Thus, based on the above table the normality of the distribution is satisfied for this data.

4.6.1.2 Multicollinearity

Multicollinearity is a condition that exists when the independent variables are correlated with one another. The adverse effect of multicollinearity is that the estimated regression coefficients of the independent variables that are correlated tend to have large sampling errors (keller, 2014). According to Field (2005) as sited in Saunders et al. (2009), perfect collinearity exists when at least one predictor variable is a perfect linear combination of the other. If there is perfect collinearity between predictors, it becomes impossible to obtain unique estimate of the regression coefficients because there are an infinite number of combination of coefficients that would work equally well.

Therefore, multicollinearity causes wrong signs and magnitudes of regression coefficient estimates and a lack of statistical significance of individual independent variables. While the overall model may be strongly significant, incorrect conclusions are drawn about relationships between independent and dependent variables. The common measures used to test multicollinearity are tolerance value and variance inflation factor

(VIF). Hair et al. (2006) recommend that a very small tolerance value (0.10 or below) or a large VIF value (10 or above) indicates the possibility of multicollinearity.

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	Relative Advantage	.664	1.506
	Compatibility with Needs	.613	1.631
	Compatibility with Values & Experiences	.594	1.684
	Complexity	.774	1.292
	Observability	.715	1.399
	Trialability	.792	1.262

a. Dependent Variable: Adoption Intention
Table 16: multicollinearity test

As table 16 displays, the results of these examinations revealed the tolerance value for all independent variables is greater than 0.1 and independent variables VIF value is less than 10. Therefore, multicollinearity is not a problem for the study.

4.6.1.3 Autocorrelation Test

Autocorrelation occurs when the residuals are not independent from each other. In other words when the value of y(x+1) is not independent from the value of y(x) there certainly is autocorrelation. In most cases Durbin-Watson test is applied to observe whether or not auto correlation among the variables. Durbin-Watson‘s tests the null hypothesis that the residuals are not linearly auto-correlated. The Durbin-Watson statistic ranges in value from 0 to 4. A value near 2 indicates non-autocorrelation; a value toward 0 indicates positive autocorrelation; a value toward 4 indicates negative autocorrelation (Field, 2005). Garson (2012) indicated that values of Durbin- Watson test need to be in the limits between 1.5 and 2.5 for independent observations. The result of Durbin-Watson test of variables of this study is 1.692, which implies that there is no auto correlate between the variables as shown in table 17.

4.6.1.4 Linearity Test

Testing for non-linearity is necessary because correlation, regression and other elements of general linear model (GLM) assume linearity (Garson G.David, 2012).There are different methods for example, ANOVA test of linearity. The author stated that, one can compute an ANOVA table for linear and nonlinear component, if the F significance for nonlinear component is the critical value <0.05, then there is significant non linearity. Thus, from the ANOVA tables in appendix 1, all variables are non-linear since the significance values are less than the cutting point (sig. = <0.05).

4.6.1.5 Curve Estimation

Since the linearity of the analysis is not confirmed, before a nonlinear regression analysis is made, curve estimation is tested to determine which best fitting regression model to use. Accordingly, a linear and the most frequently used curvilinear regressions models of power and compound regressions are tested as shown in annex 2. Consequently, the findings of the test revealed that the ANOVA significance value of all the three models (linear, power & compound) are lower than 0.05, which sowed all the models are well-fitted, whereas R square value of linear model is higher than power and compound modes. Therefore the study decided to use the simplest and most fitted linear regression model than the non-linear regression since the higher is the R square; the better is the model fitting on the data.

4.6.2 Multiple Regression Analysis

Multiple regression analysis is the process of calculating a coefficient of multiple determination and regression equation using two or more independent variables and one dependent variable (Saunders et al., 2009). The analysis shows how a set of independent variables explains a proportion of the variance in a dependent variable at a significant level. Accordingly, a multiple linear regression analysis is performed to test the hypothesis and know how much the independent variable explains the dependent variable in the study. The following tables are the results of the regression analysis, using the constructs relative advantage, compatibility with needs, compatibility with

values & experiences, complexity, observability, and trialability as the independent variables and adoption intention as the dependent variable.

The model summary table shown below includes information about the quantity of variance that is explained by independent variables of the study. The first statistic R is the correlation coefficient between all of the independent variables and the dependent variable. In this model, the value is 0.861, which indicates that there is a great deal of variance shared by the independent variables and the dependent variables. The next value, R Square, is simply the squared value of R. This is frequently used to describe the goodness-of-fit or the amount of variance explained by a given set of independent variables. The R square value in this case is 0.741, which implies that about 74.1% of the dependent variable (adoption intention) can be explained by the independent variables (relative advantage, compatibility with needs, compatibility with values & experiences, complexity, observability, and trialability) leaving about 25.9% to be explained by otherfactors. The Adjusted R Square value 0.737 corrects R2 to more closely reflect the goodness-of-fit of the model in the population.

Table 17: Model Summary Showing Prediction Level of the Constructs.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.861a	.741	.737	.15482	1.692

a. Predictors: (Constant), Trialability, Observability, Complexity, Compatibility with Values & Experiences, Relative Advantage, Compatibility with Needs

b. Dependent Variable: Adoption Intention

The ANOVA result describes the general significance of the model. If the F-value is large and significance level is close to zero (lower than 0.05), the regression is significant and the results probably are not due to random chance. Therefore, since the significance result on the ANOVA is 0.000 which is $p< 0.05$ and the regression mean square is greater than residual mean square with F value 179.78, the regression model fit to a good degree of prediction. Thus, the combination of relative advantage, compatibility with needs, compatibility with values & experiences, complexity,

observability and trialability significantly predict the dependent variable (adoption intention).

Table 18: Analysis of Variance (ANOVA) Results

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	25.856	6	4.309	179.780	.000[b]
	Residual	9.037	377	.024		
	Total	34.893	383			

a. Dependent Variable: Adoption Intention

b. Predictors: (Constant), Trialability, Observability, Complexity, Compatibility with Values & Experiences, Relative Advantage, Compatibility with Needs

The next standard regression output provides information about the effects of individual predictor variables. Generally, there are two types of information in the Coefficients table: coefficients (β) and significance tests. The β values indicate the relationship between the dependent and each independent variable. If the value is positive; it shows that there is positive relationship between predictor and the outcome; whereas a negative coefficient represents negative relationship. Highest β value mean the independent variable has highest influence or effect on dependent variable. Accordingly, as shown in table 19, four of the independent variables (relative advantage, compatibility with values & experiences, complexity and observability) have positive and significant relationship with adoption intention. Compatibility with needs and Trialability showed a significant negative relationship with adoption intention of solar lighting products.

Among the independent variables, relative advantage has the highest positive influence on solar lighting products adoption intention of rural household heads followed by compatibility with values & experiences, complexity and observability respectively.

Table 19: Beta Coefficients Showing Contributions of Variables to the Model.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.978	.105		9.309	.000
	Relative Advantage	.479	.025	.611	19.012	.000
	Compatibility with Needs	-.037	.013	-.095	-2.839	.005
	Compatibility with Values & Experience	.155	.025	.208	6.119	.000
	Complexity	.127	.018	.207	6.950	.000
	Observability	.071	.020	.112	3.624	.000
	Trialability	-.028	.011	-.074	-2.516	.012

a. Dependent Variable: Adoption Intention

The established multiple linear regression equation becomes;

$$\mathbf{Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6}$$

AI = 0.978 + 0.479(RA) - 0.037(CwN) + 0.155(CwVE) + 0.127(CLX) + 0.071(OBS) - 0.028(TRB)

Where: 0.978 = Constant

AI = Adoption Intention

RA = Relative Advantage

CwN = Compatibility with Needs

CwVE = Compatibility with Values & Experience

CLX = Complexity

OBS = Observability

TRB = Trialability

4.7 HYPOTHESIS TESTING

The researcher initially asserted six hypotheses to be tested on this research. Accordingly, based on the above multiple regression result, each proposed hypothesis is tested as follows.

Hypothesis 1: Relative advantage has a positive and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.

According to the above regression result, there is a positive and significant relationship between relative advantage and adoption intention with a β value of 0.479, at 95% confidence level. From this the researcher concluded that the alternative hypothesis is supported by the result and the null hypothesis is rejected.

Hypothesis 2: Compatibility with needs has a negative and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.

According to the above regression output, there is a negative and significant relationship between compatibility with needs and adoption intention with a β value of -0.037, at 95% confidence level. From this it is possible to conclude that, the alternative hypothesis is supported by the result and the null hypothesis is rejected.

Hypothesis 3: Compatibility with values & experiences has a positive and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.

According to the above regression result, there is a positive and significant relationship between compatibility with values & experiences, and adoption intention with a β value of 0.155, at 95% confidence level. From this the researcher concluded that the alternative hypothesis is supported by the result and the null hypothesis is rejected.

Hypothesis 4: Complexity has a negative and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.

According to the above regression result, there is a positive and significant relationship between complexity and adoption intention with a β value of 0.127, at 95% confidence level. Therefore, the alternative hypothesis is rejected by the result and the null hypothesis is failed to reject.

Hypothesis 5: Observability has a positive and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.

According to the above regression result, there is a positive and significant relationship between observability and adoption intention with a β value of 0.071, at 95% confidence level. Therefore, the alternative hypothesis is supported by the result and the null hypothesis is rejected.

Hypothesis 6: Trialability has a positive and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.

According to the above regression result, there is a negative and significant relationship between trialability and adoption intention with a β value of -0.028, at 95% confidence level. Therefore, the alternative hypothesis is rejected by the result and the null hypothesis is failed to reject.

Summary of Hypothesis Testing

Hypothesis	Results	Reasons
Hypothesis 1: Relative advantage has a positive and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.	Supported	β = 0.479, p<0.05
Hypothesis 2: Compatibility with needs has a negative and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.	Supported	β = -0.037, p<0.05
Hypothesis 3: Compatibility with values & experiences has a positive and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.	Supported	β = 0.155, p<0.05
Hypothesis 4: Complexity has a negative and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.	Rejected	β = 0.127, p<0.05
Hypothesis 5: Observability has a positive and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.	Supported	β = 0.071, p<0.05
Hypothesis 6: Trialability has a positive and significant influence on solar lighting products adoption in rural villages of Oromia Special Zone Surrounding Addis Ababa.	Rejected	β = -0.028, p<0.05

Table 20: Summary of hypothesis test

4.8 DISCUSSION OF FINDING

This paper has particularly tried to see the effects of perceived attributes of innovation in rural households' solar lighting products adoption intention as proposed by Rogers with little modification. Accordingly, the constructs relative advantage, compatibility with needs, compatibility with values & experiences, complexity, observability, and trialability are taken as independent variables and adoption intention as the dependent variable.

As the regression result depicted, the most significant predictor of adoption intention of solar lighting products is relative advantage with (β = 0.479, Sig. = 0.000) value. This indicates that one unit change in relative advantage results in 0.479 unit increase in solar lighting products adoption holding other variables constant. Such finding of positive and significant relationship between relative advantage and adoption intention solar lighting products is also reported by a number of researches such as Labay and Kinnear (1981); Vasseur and Kemp, 2015; et al. (2008); Claudy et al. (2011) and Caird and Roy (2010).

The finding also confirmed the existence of inversely related significant relation between compatibility with needs and adoption intention with β value of -0.037, at 95% confidence level. This signify, one unit change in compatibility with needs results in -0.037 unit reduction in solar lighting products adoption holding other variables constant. This is also in line with Silk (2014); palm (2017); Suppanich and Wangjiraniran (2015); ETSU (2001); and Timilsina et al., (2000) findings. This implies, the more unaffordable & inferiority is the product, adoption intention will be worse. Whereas, compatibility with values and past experiences' β value of 0.155 at $p<0.05$ significant level indicates that a one unit change in compatibility with values and experiences consequences in 0.155 unit increase in adoption intention of the households. This finds also supported by Qureshi et al., (2017); Sabsay (2013); Feng (2011); Sefordzi et al. (2018); Sabsay (2013); and other studies.

The construct complexity recorded significant and positive β value of 0.127 at $p<0.05$ significant level. This indicates the simplicity of the product rather than its complexity and a one unit change in its simplicity results in 0.127 unit increase in solar lighting

product adoption intention of the households. This finding is against Qureshi et al., (2017); Silk (2014); & Sabsay (2013) result and in line with Vasseur and RenéKemp (2014); and Feng (2011) findings.

Concerning observability of solar lighting products, β value of 0.071 at $p<0.05$ significant level indicated that a one unit change in observability results in 0.071 unit increases in solar lighting products adoption holding other variables constant. This indicate the more the visibility of solar lighting products in rural villages, the more the adoption intention of the households will be. The outcome is similar with Silk (2014); Tidd (2009); Sabsay (2011); Qureshi et al, (2017); and Karakaya et al. (2015) findings. Trialability's β value of -0.028 at $p< 0.05$ also revealed the lack of full and/or partial product trial (warranty & replace/return) service for sold solar lighting products. This signify, one unit change in trialability results in -0.028 unit reduction in solar lighting products adoption holding other variables constant. This is in line with Khalil et al. (2017) and Qureshi et al. (2017) findings even if it contrasts with Faiers and Neame (2006); and Sabsay (2013) findings.

CHAPTER FIVE

RESEARCH FINDING, CONCLUSION AND RECOMMENDATION

5.1 INTERODUCTION

The primary objective of the study is identifying factors that affect the adoption intention of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa. Accordingly, this chapter presents summary of the major findings, conclusions and recommendations that is drawn from the previous chapters of this study in line with this research objective.

5.2 SUMMERY OF MAJOR FINDINGS

This study aimed to identify factors that affect households' adoption intention of solar lighting products in non-electrified rural villages of Oromia Special Zone Surrounding Addis Ababa. Therefore, the study employed Rogers' perceived attributes of an innovation namely relative advantage, compatibility with needs, compatibility with values & past experiences, complexity, observability, and trialability to identify the factors.

The study was adopted cluster sampling method to obtain a representative sample from entire six weredas of the special zone namely: Sebeta Hawaas, Akaki, Sululta, Berek, Mulo and Welmera. Whereby a sample of nine kebles and 384 household heads selected using simple random sampling and convenience sampling methods respectively.

Generally, based on the analysis made by descriptive and inferential statistics, the researcher outlined the following findings of the study;

- The survey revealed that 69% of the household heads were not adopted any of off-grid solar lighting products.

- The constructs and instrument used in the study that records overall reliability value of 0.860 provide both theoretical and practical implication to predict factors affecting adoption intention of solar lighting products especially in rural context.
- The results of correlation analysis between the predictor and outcome variables indicates that, there is significant and positive correlation between relative advantage, compatibility with needs, compatibility with values & experiences, complexity and observability attributes of the independent variable; and the dependent variable: adoption intention. Whereas in contrast to others, trialability and adoption intention showed a very week and statistically insignificant correlation.
- The perceived relative advantage attributes of solar lighting products is scored average mean value of 4.06 (out of 5) in the descriptive analysis and the highest significant β value of 0.479 at $p<0.05$ significant level among the predictor variables in the regression analysis. This indicates the perceived relative advantages acquired from solar lighting products than the traditional energy sources have a highest significant influence on off-grid households' solar lighting products adoption intention.
- The descriptive and regression analysis results indicated that, the attributes of compatibility with adopters' need recorded an average mean value of 2.49 and inversely related β value of -0.037 at $p<0.05$ significant level among the predictor variables in the regression analysis. This indicates the existence of unmet needs that restrain adoption intention of the households as a result of the inconsistence of solar lighting products' direct & indirect characteristic with adopters' needs and expectations at hand.
- The attributes of perceived compatibility of solar lighting products with values and past experiences of the adopter are scored average mean value of 4.25 and the positively correlated significant β value of 0.155 at $p<0.05$ significant level. This revealed the compatible of solar lighting products with rural households' cultural practices, beliefs, habits and routines. Besides it showed the suitability of their village & home to access enough direct sun light and installs solar lighting

products. As a result, this construct positively and significantly contributed in the adoption intention of the households.

- The find of the analysis revealed that, complexity attributes recorded 3.32 average mean values and positively associated significant β value of 0.127 at $p<0.05$ significant level that showed an inclination to agree on simplicity of solar lighting products to understand & operate rather than its complexity which facilitates the rate of adoption of the product even if issues related to availability of technicians and spare parts stile in question.
- The outcome of the investigation also indicated that observability of solar lighting products' adopters and the benefit gained in rural villages of Oromia Special Zone Surrounding Addis Ababa, have significant constructive effect on adoption intention of other non-adopter households. This premise is supported by the investigation results of average mean value 4.02 and β value of 0.071 at $p<0.05$ significant level. Although the respondents had few disagreement on the benefit of the innovation related to poor quality products as they observed in their villages.
- Regarding trialability of solar lighting products, average mean score (2.31) and β value of -0.028 at $p<0.05$ significant level revealed the existence of inversely related significant relationship between trialability and adoption intention of solar lighting product. That indicates the lack of sustainable warranty for sold solar lighting product.
- Generally, the R square value of the study revealed that about 74% of the dependent variable (solar lighting products adoption intention) can be explained by the independent variables (relative advantage, compatibility with needs, compatibility with values & experiences, complexity, observability, and trialability) leaving about 26% to be explained by other unidentified factors.

5.3 CONCLUSION

Based on the findings made from both descriptive and inferential analysis of the study, the researcher derived the following conclusions that identifies the major factors that influences households' adoption intention of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.

According to the survey, 69% of the household heads were not adopt any of off-grid solar lighting products (solar lantern or solar home system) rather they were mainly used wick lamps or hurricane lamps, firewood, dry cells and other traditional lighting sources. This may possibly shows the low level adoption of solar lighting products in rural villages of Oromia Special Zone Surrounding Addis Ababa.

The main factor that contributes to the adoption of solar lighting product is the aspirations of the rural households to get modern electrical energy. The rural households perceives solar lighting products as a useful innovation that enable them to have enough and clean lighting power at night; reduce household expenses spend for the purchase of gas/dry-cell; and gain additional electrical energy to power radio and mobile devices. In addition, the simplicity of the product to understand & operate; the compatibility of the product with their values (culture, beliefs, norms & routines) & past experiences; and the observability of early adopters & the benefits they obtained in their village plays a significant role in the favorable adoption intention of off-grid rural households.

Whereas, the confusing market which packed with low-quality imported & smuggled solar lighting products; unavailability of adequate quality solar lighting products that meets their long term energy needs in the market; and the incompatibility of solar lighting products' purchasing cost with their pocket potentially limits the adoption intention of the households. Besides, inaccessibility of loan facility with affordable interest rate & payback period from financial intermediaries; lack of well trained technicians & genuine spare parts; unavailability of sustainable product warranty; and insufficient product information related to product types, quality, pricing, suppliers etc to

make informed decision hold back off-grid rural households' intention to adopt the products.

Generally, it is possible to conclude that the independent variables: perceived relative advantages acquired from solar lighting products; simplicity (non-complexity) of the products to understand & operate; the compatible of solar lighting products with rural households' values & experiences; and the observability of the product in rural villages are the major stimulating factors that affect the adoption intention of sampled off-grid rural household heads in the purchase of solar lighting products.

The rest two independent variables (compatibility with needs and trialability) do not have positive effect in the adoption intention of solar lighting products. Rather the incompatibility of solar lighting products with off-grid rural households' needs related to quality, affordability& relevant product information is significantly hold-down the momentum of the diffusion rate of the products in Oromia Special Zone Surrounding Addis Ababa, plus the trialability variable negatively affected the adoption intention of the households.

The finding summarized that about 74% of the dependent variable (solar lighting products adoption intention) can be explained by the independent variables: relative advantage; compatibility with needs; compatibility with values & experiences; complexity; observability; and trialability.

5.4 RECOMMENDATION

Based on the findings and conclusions of the study the following recommendations are forwarded aiming to enhance the adoption and diffusion of solar lighting products in rural villages of Ethiopia.

Government

- The government needs to provide foreign currency, loan access and tax reduction privileges for solar lighting products importers and wholesalers as priority sector to facilitate the smooth importation and lower the initial purchasing costs of the product.
- The government needs to attract foreign and local investors to manufacture quality solar lighting products within the country.
- The government needs to devise strong quality control mechanisms specifically for solar lighting products and reduce the smuggling and importation of low quality products.
- The regional governments need to encourage quality solar lighting product traders by providing different privileges.
- The lower level government bodies especially kebele level energy offices need to inform and educate the rural communities about solar lighting products in collaboration with other stakeholders.

Supporters

- International organizations and NGOs need to support the government' standard and quality assurance activities with knowledge and finance.
- International organizations and NGOs need to enhance the awareness level of rural households by implementing intensive road show campaign in local market days and broadcast media campaign especially using radio by their own language.

- Financial institutions need to devise tailored and affordable solar lighting products' loan facility for rural consumers with reasonable interest rate and payback period.
- Financial institutions need to enhance the time taking and restrictive third-party credit guarantee scheme into simple and flexible scheme that allows the consumers to easily access the credit facility for the purchase of solar lighting products.

Traders

- Besides the selling activities, traders need to inform and educate potential rural consumers about solar lighting products futures and possibilities.
- Big traders need to have at least one permanent distribution outlets in wereda level to promote, sell and provide after sales service.
- Solar lighting product importers and suppliers need to work with microfinance institutions, farmers' cooperatives and kebele energy offices to disseminate quality and affordable solar lighting products.
- Importers/wholesalers should provide sustainable and effective product warranty services directly by themselves and/or through channel of distribution networks to off-grid rural consumers.

5.5 RECOMMENDATIONS FOR FUTURE RESEARCH

Future research will be mainly based on the current limitations. Since this study focuses on only specific areas of rural villages of Oromia Special Zone Surrounding Addis Ababa, such concentration could limit generalization of the findings to the entire rural villages of Ethiopia. This limitation creates an opportunity for future researcher in this area. The future researches may replicate this study in other geographical areas of the country especially vary remote rural areas.

This study includes only the perceived attribute of innovation dimensions to conduct the study. However, there could be some other relevant factors that may be perceived as important by rural household heads. Thus, future research can incorporate diversified dimensions such as the effects of communication channels, social systems and perceived characteristics of the adopter.

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APPENDIX 1: TEST FOR LINEARITY

Adoption Intention * Relative Advantage

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Adoption Intention * Relative Advantage	Between Groups	(Combined)	29.249	10	2.925	193.306	.000
		Linearity	22.570	1	22.570	1491.611	.000
		Deviation from Linearity	6.680	9	.742	49.049	.000
	Within Groups		5.644	373	.015		
	Total		34.893	383			

Adoption Intention * Compatibility with Needs

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Adoption Intention * Compatibility with Needs	Between Groups	(Combined)	5.749	14	.411	5.199	.000
		Linearity	2.208	1	2.208	27.961	.000
		Deviation from Linearity	3.541	13	.272	3.448	.000
	Within Groups		29.144	369	.079		
	Total		34.893	383			

Adoption Intention * Compatibility with Values & Experiences

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Adoption Intention * Compatibility with Values & Experiences	Between Groups	(Combined)	12.706	5	2.541	43.294	.000
		Linearity	11.348	1	11.348	193.331	.000
		Deviation from Linearity	1.358	4	.340	5.785	.000
	Within Groups		22.187	378	.059		
	Total		34.893	383			

Adoption Intention * Complexity

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Adoption Intention * Complexity	Between Groups	(Combined)	13.644	17	.803	13.824	.000
		Linearity	7.680	1	7.680	132.278	.000
		Deviation from Linearity	5.964	16	.373	6.420	.000
	Within Groups		21.249	366	.058		
	Total		34.893	383			

Adoption Intention * Observability

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Adoption Intention * Observability	Between Groups	(Combined)	18.521	5	3.704	85.518	.000
		Linearity	9.196	1	9.196	212.313	.000
		Deviation from Linearity	9.324	4	2.331	53.819	.000
	Within Groups		16.373	378	.043		
	Total		34.893	383			

Adoption Intention * Trialability

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Adoption Intention * Trialability	Between Groups	(Combined)	1.385	7	.198	2.220	.032
		Linearity	.001	1	.001	.007	.933
		Deviation from Linearity	1.384	6	.231	2.589	.018
	Within Groups		33.508	376	.089		
	Total		34.893	383			

APPENDIX 2: CURVE ESTIMATION

Model Summary and Parameter Estimates

Dependent Variable: Adoption Intention

Equation	Model Summary					Parameter Estimates
	R Square	F	df1	df2	Sig.	b1
Linear	.997	121443.325	1	383	.000	1.013
Compound	.996	97564.186	1	383	.000	1.414
Power	.998	209852.644	1	383	.000	1.011

The independent variable is Relative Advantage.

Model Summary and Parameter Estimates

Dependent Variable: Adoption Intention

Equation	Model Summary					Parameter Estimates
	R Square	F	df1	df2	Sig.	b1
Linear	.919	4334.448	1	383	.000	1.524
Compound	.918	4284.036	1	383	.000	1.684
Power	.888	3028.340	1	383	.000	1.451

The independent variable is Compatibility with Needs.

Model Summary and Parameter Estimates

Dependent Variable: Adoption Intention

Equation	Model Summary					Parameter Estimates
	R Square	F	df1	df2	Sig.	b1
Linear	.994	59169.750	1	383	.000	.968
Compound	.994	61770.148	1	383	.000	1.393
Power	.997	125746.440	1	383	.000	.980

The independent variable is Compatibility with Values & Experiences.

Model Summary and Parameter Estimates

Dependent Variable: Adoption Intention

Equation	Model Summary					Parameter Estimates
	R Square	F	df1	df2	Sig.	b1
Linear	.983	22623.979	1	383	.000	1.223
Compound	.983	21990.990	1	383	.000	1.520
Power	.987	28592.881	1	383	.000	1.174

The independent variable is Complexity.

Model Summary and Parameter Estimates

Dependent Variable: Adoption Intention

Equation	Model Summary					Parameter Estimates
	R Square	F	df1	df2	Sig.	b1
Linear	.990	36220.112	1	383	.000	1.019
Compound	.989	35979.809	1	383	.000	1.417
Power	.992	46233.855	1	383	.000	1.017

The independent variable is Observability.

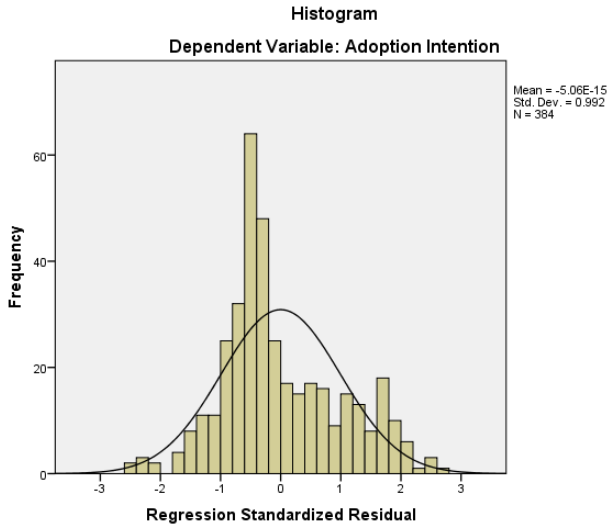
Model Summary and Parameter Estimates

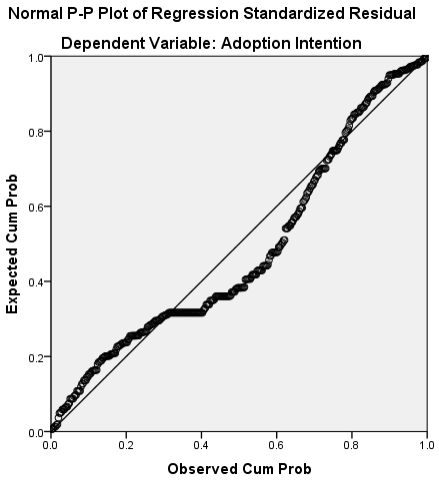
Dependent Variable: Adoption Intention

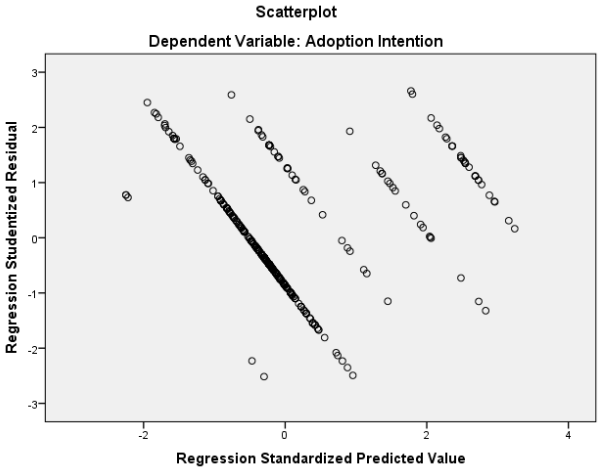
Equation	Model Summary					Parameter Estimates
	R Square	F	df1	df2	Sig.	b1
Linear	.888	3022.084	1	383	.000	1.594
Compound	.890	3101.069	1	383	.000	1.727
Power	.824	1793.712	1	383	.000	1.506

The independent variable is Trialability.

APPENDIX 3: LINEAR REGRESSION OUTPUTS







APPENDIX 4: DATA COLLECTION INSTRUMENT

Addis Ababa University School of Commerce

Marketing Management Graduate Program

A Survey for the Purpose of Writing Thesis in Solar Lighting Products Adoption

This survey deals with your opinions of the factors that affect the adoption of solar lighting products and how this factors influence your decision to accept the products. Please provide answers to the following questions by putting a tick (✓) in the provided box.

Part One: List of General Questions

1. Age Group ☐ 18 - 35 ☐ 36 - 50 ☐ above 50

2. Gender ☐ Male ☐ Female

3. Educational Level ☐ none ☐ 1 - 6 ☐ 7 – 12/TVET ☐ Diploma & above

4. Marital Status ☐ Married ☐ Single ☐ Divorced ☐ Widower

5. Occupation ☐ Farmer ☐ Employee ☐ Merchant ☐ Daily Laborer

6. Do you use a solar lighting product in your home? ☐ Yes ☐ No

Part Two: Perceived Attributes of Innovation/Solar Lighting Product Questions

Please, indicate your opinion by marking (✓) in the appropriate box on the five point scale where: 1 = Strongly Disagree; 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

No	Description	1	2	3	4	5
1	**Relative Advantage**					
1.1	Solar lighting products provide better lighting energy than lamp, dry-cell, firewood & candle.					
1.2	Solar lighting products help daily life by providing electrical energy for radio, mobile & other devices besides lighting.					
1.3	Solar lighting products reduce household's gas and battery expense used to get energy.					
1.4	Using solar lighting products help to reduce home and outdoor environmental pollution.					
1.5	Being seen as a user of solar lighting product is advances the social prestige.					
2	**Compatibility with needs**					
2.1	I don't get enough Information and education about solar lighting products.					
2.2	Quality solar lighting products that meet my need are sufficiently available in the market.					
2.3	The initial purchasing cost of solar lighting product is affordable.					
2.4	The loan facility available for the purchase of solar lighting product is compatible with my need.					

3	**Compatibility with values and experiences**					
3.1	Using solar lighting products would not go against our society's culture and belief.					
3.2	Solar lighting products are compatible with my habits and routine.					
3.3	My home & living area are suitable for using solar lighting products.					
4	**Complexity**					
4.1	Solar lighting product is complicated to understand.					
4.2	Solar lighting product is difficult to operate.					
4.3	Technician/maintenance support for solar lighting product is not easily available.					
4.4	Spare parts for solar lighting product are not easily available.					
4.5	It is frustrating to use a solar lighting product.					
5	**Observability**					
5.1	I have seen solar lighting product users in my village.					
5.2	I have seen what other people benefited using solar lighting product.					
6	**Triability**					
6.1	I can easily return/replace defected solar lighting products after purchase.					
6.2	I can get sustainable warranty for solar lighting products I purchased.					

Part Three: List of Solar Lighting Product Adoption Questions

Please, indicate your opinion by marking (✓) in the appropriate box on the five point scale where: 1 = Strongly Disagree; 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

No	Description	1	2	3	4	5
1	I buy and use solar lighting products.					
2	I intend to use solar lighting product continuously in the future.					
3	I strongly recommend others to adopt solar lighting products.					

አዲስ አበባ ዩኒቨርስቲ ንግድ ስራ ኮሌጅ
የማርኬቲንግ ማኔጅመንት ድህረ ምረቃ ፕሮግራም

ውድ ምላሽ ሰጪ! ይህ መጠይቅ የሶላር ብርሃን ምርት (solar lighting product) በአዲስ አበባ ዙሪያ የኦሮሚያ ልዩ ዞን ገጠራማ አካባቢዎች ያለው ተቀባይነት ላይ ተፅዕኖ የሚፈጥሩ ምክኒያቶችን ለመለየት የተዘጋጀ ነው። በመሆኑም መጠይቁ ለትምህርት አላማ ብቻ የሚውል መሆኑን በመገንዘብ በጥንቃቄ (✓) ምልክት በማድረግ እንዲሞሉልኝ በትህትና እየጠየኩኝ ስለትብብሮ በቅድሚያ ከልብ አመሠግናለሁ።

ክፍል አንድ፡ አጠቃላይ መረጃ

1. እድሜ ☐ 18 - 35 ☐ 36 - 50 ☐ ከ50 በላይ
2. ፆታ ☐ ወንድ ☐ ሴት
3. የትምህርት ደረጃ ☐ ምንም ☐ 1 - 6 ☐ 7 - 12/ቴክኒክና ሞያ ☐ ዲፕሎማና ከዚያ በላይ
4. የጋብቻ ሁኔት ☐ ያገባ/ች ☐ ያላገባ/ች ☐ ፈት ☐ የትዳር አጋር በሞት ያጣ/ያጣች
5. የስራ መስክ ☐ ገበሬ ☐ ተቀጣሪ ☐ ነጋዴ ☐ የቀን ጉልበት ሰራተኛ
6. የሶላር ብርሃን ምርት በቤትዎ ይጠቀማሉ? ☐ እጠቀማለሁ ☐ አልጠቀምም

ክፍል ሁለት፡ ስለሶላር ብርሃን ምርት ባህሪያት ያለ እይታ መጠይቅ

1 = በፍፁም አልስማማም፤ 2 = አልስማማም፤ 3 = ገለልተኛ፤ 4 = እስማማለሁ፤ 5 = በጣም እስማማለሁ

ተ.ቁ	የመለኪያ መስፈርት አርፍተ ነገሮች	1	2	3	4	5
1	**የምርቱ ልዩ ጥቅም /Relative Advantage/**					
1.1	የሶላር ብርሃን ምርት በቂ ብርሃን ለረጅም ሰዓታት ከላምባ/ኩራዝ/ባትሪ/ማገዶ በተሻለ ይሰጣል።					
1.2	የሶላር ብርሃን ምርት ከብርሃን በተጨማሪ ለሞባይል፣ ራዲዮን እና ለመሳሰሉት የኤሌክትሪክ ሀይል በመስጠት ያገለግላል::					
1.3	የሶላር ብርሃን ምርት ብርሃን ለማግኘት በየጊዜው ለጋዝና ለባትሪ የሚወጣውን ወጪ ይቀንሳል።					
1.4	የሶላር ብርሃን ምርትን መጠቀም የቤትና የአካባቢ ብክለትን ለመቀነስ ይረዳል።					
1.5	የሶላር ብርሃን ምርት ተጠቃሚ ሆኖ መታየት ክብርን ይጨምራል።					
2	**የምርቱ ተዛማጅነት /Compatibility with needs/**	**1**	**2**	**3**	**4**	**5**
2.1	ስለሶላር ብርሃን ምርት በቂ መረጃና ትምህርት አላገኝም:: **					
2.2	ጥራት ያላቸው የሶላር ብርሃን ምርቶች በበቂ ሁኔታ በገቢያ ውስጥ ይገኛሉ።					
2.3	የሶላር ብርሃን ምርት የመሸጫ ዋጋ ተመጣጣኝ ነው።					
2.4	ለሶላር ብርሃን ምርት መግዢያ የብድር አገልግሎት እንደፍላጎቴ አገኛለው::					
3	**የምርቱ ተዛማጅነት /Compatibility values and experiences**					
3.1	የሶላር ብርሃን ምርቶችን መጠቀም የማህበረሰባችንን ባህልና ዕምነት አይፃረርም።					

3.2	የሶላር ብርሃን ምርት ከቀን ተቀን የቤተሰቤ ተግባርና ልማድ ጋር ይጣጣማል፡፡					
3.3	የመኖሪያ ቤቴና አካባቢዬ የሶላር ብርሃን ምርቶችን ለመጠቀም ምቹ ነው፡፡					
4	**የምርቱ ውስብስብነት /Complexity/**	**1**	**2**	**3**	**4**	**5**
4.1	የሶላር ብርሃን ምርት ለመረዳት ያስቸግራል:: **					
4.2	የሶላር ብርሃን ምርት ለመጠቀም ያስቸግራል:: **					
4.3	የሶላር ብርሃን ምርት የጥገና አገልግሎት/ጠጋኝ በቀላሉ አይገኝም፡፡ **					
4.4	የሶላር ብርሃን ምርት መለዋወጫ በቀላሉ አይገኝም፡፡ **					
4.5	የሶላር ብርሃን ምርትን ለመጠቀም ያስፈራኛል፡፡ **					
5	**የምርቱ ታይነት /Observability/**	**1**	**2**	**3**	**4**	**5**
5.1	በአካባቢዬ የሶላር ብርሃን ምርት ተጠቃሚ ሰዎችን አስተውላለሁ፡፡					
5.2	ሌሎች ሰዎች በሶላር ብርሃን ምርት በመገልገላቸው ያገኙትን ጥቅም አስተውያለሁ፡፡					
6	**የምርቱ ተሞካሪነት /Triability/**	**1**	**2**	**3**	**4**	**5**
6.1	የሶላር ብርሃን ምርት ከገዛሁኝ በውኃላ ባይሰራ በቀላሉ መመለስ/ማስቀየር እችላለሁ፡፡					
6.2	ለምገዛው የሶላር ብርሃን ምርት ዘላቂ ዋስትና አገኛለሁ፡፡					

ክፍል ሦስት፡ የሶላር ብርሃን ምርት ተጠቃሚነት/Adoption ጥያቄዎች

1 = በፍፁም አልስማማም፤ 2 = አልስማማም፤ 3 = ገለልተኛ፤ 4 = እስማማለሁ፤ 5 = በጣም እስማማለሁ

ተ.ቁ	የመለኪያ መስፈርት አርፍተ ነገሮች	1	2	3	4	5
1	የሶላር ብርሃን ምርትን ገዝቼ እጠቀማለሁ፡፡					
2	ወደፊትም የሶላር ብርሃን ምርቶችን በቀጣይነት ለመጠቀም እፈልጋለሁ፡፡					
3	የሶላር ብርሃን ምርትን ሌሎች እንዲጠቀሙ በደንብ እመክራለሁ፡፡					

ለትብብሮ አመሰግናለሁ!

APPENDIX 2: LIST OF NONE ELECTRIFIED KEBELES

I. None Electrified Kebeles of Sebeta Hawas Wereda

No	Wereda	Name of Kebele	Villages
1	Sebeta Hawas	Mogile	Turbo Bala
2	Sebeta Hawas	Sego Kabi	Guta
3	Sebeta Hawas	Gelan Guda	Genda Tina
4	Sebeta Hawas	Geja Koye	Sulula
5	Sebeta Hawas	Oda Guda	Oda Guda
6	Sebeta Hawas	Debel Yohannis	Cheri Agemsa
7	Sebeta Hawas	Wele&Eka	Golole
8	Sebeta Hawas	Temse & roban jirecha	Lemefu
9	Sebeta Hawas	Boro &Hiro	Batu
10	Sebeta Hawas	Buro Finchea	Buro Asgori
11	Sebeta Hawas	Gora Harkiso	Wedesa
12	Sebeta Hawas	Kelecha Kela	Ejecho
13	Sebeta Hawas	Dima Magno	Magno Gora
14	Sebeta Hawas	Akale	Akale
15	Sebeta Hawas	Geja Migira	Weran Gerba
16	Sebeta Hawas	Kontoma	Mitros
17	Sebeta Hawas	Koche	Medane &Desta
18	Sebeta Hawas	Atebela Gudisa	Tiro
19	Sebeta Hawas	Dima Guranda	Belfe
20	Sebeta Hawas	Belche	Ilamu 3ffa
21	Sebeta Hawas	Korke	Mogoro
22	Sebeta Hawas	Haro Jila	Ejersa
23	Sebeta Hawas	Bonde	Moje & Yaya
24	Sebeta Hawas	Gedemba	Teno
25	Sebeta Hawas	Berga Goro	Sefera & Kombore

II. None Electrified Kebeles of Mulo Wereda

No	Wereda	Name of Kebeles	Villages
1	Mulo	Eka Jarso Gebeta	Adado
2	Mulo	Mulo Tita	Chebeka
3	Mulo	Kura Kemole	Geba kamise
4	Mulo	Mulo Kersa	Kersa

Source: Office of Oromia Special Zone Surrounding Addis Ababa

III. None Electrified Kebeles of Akaki Wereda

No	Wereda	Name of Kebeles	Villages
1	Akaki	Dodota and Chiri	Dodota
2	Akaki	Abu Kombolcha	Meko
3	Akaki	Oda Nabe	Susuki
4	Akaki	Abu Haro	Haro
5	Akaki	Abu Loya	Furda
6	Akaki	Gelan Arabsa	Gobore
7	Akaki	Hechu	Andode
8	Akaki	Gale koticha	Gale
9	Akaki	Dhera fi Edero	Adecha
10	Akaki	Bilbilo	Dhenku
11	Akaki	Abu Serkema	Serkema
12	Akaki	Abu Gerbi	Keyo
13	Akaki	Yerer Abeyi	Gerbi
14	Akaki	Dufa	Dufa
15	Akaki	Gimashe	Gara Duba
16	Akaki	Ensilale	Ensilale
17	Akaki	Abu Lugna	Gerbi
18	Akaki	Abay Silto	Abay
19	Akaki	Borata and Guji	Migire
20	Akaki	Koftu	Bashasfa
21	Akaki	Abu Kombolcha	Giche
22	Akaki	Yere Necho	Chafe Buki
23	Akaki	Dhengego	Giche

IV. None Electrified Kebeles of Welmera Wereda

No	Wereda	Name of Kebeles	Villages
1	Welmera	Ula Silase	Fo'ata, Harbu
2	Welmera	Dufa	Bome
3	Welmera	Tulu Wato Dalecha	Wato Dalecha
4	Welmera	Sokoru Hawaso	Sokoru
5	Welmera	Haro Boki	Kore
6	Welmera	Wetebecha Minjaro	Haro, Bilbile
7	Welmera	Gerersu Sida	Bite
8	Welmera	Fale Tulu Rada	Lafto Waji
9	Welmera	Dhoa and Lafto	Dhewa
10	Welmera	Wechecha	Serategna

Source: Office of Oromia Special Zone Surrounding Addis Ababa

V. None Electrified Kebeles of Berek Wereda

No	Wereda	Name of Kebeles	Villages
1	Berek	Lencha	Lencha
2	Berek	Girar Berek	Berek
3	Berek	Bura Berek	Heto Beshe
4	Berek	Bura Dibdabe	Berek
5	Berek	Mugaro Harbu Aba Mela	Magaro
6	Berek	Chaffe Kullo	Kessamba
7	Berek	Dabe Godo Muda	Sendefa
8	Berek	Roge Abu	Bille
9	Berek	Kura Jidda	Gelmo
10	Berek	Kontoba wedecha	Kontoba
11	Berek	Ripha Dembel	Ripha
12	Berek	Acheni Kelatte	Shanno
13	Berek	Bura jate Mogno	Argisa
14	Berek	Chabbi	Bufeta 02&03
15	Berek	Warabi Tonkole	Werbi
16	Berek	Ch ebbi Sire Goyo	Sire Goyo

VI. None Electrified Kebeles of Sululta Wereda

No	Wereda	Name of Kebeles	Villages
1	Sululta	wajitu Dalota	Amato
2	Sululta	Kata walale	Keta
3	Sululta	Gulale Gebriel	Gulale Deneba
4	Sululta	Gnea (Nya'a) Dheka Bora	Sekala
5	Sululta	Guto Elamu	Sedan Gute
6	Sululta	Boku Golba	Haro
7	Sululta	Wererso Galeyi mena Abichu	Mesalemiya
8	Sululta	Nannoo Seyo Gara Alge	Seyo
9	Sululta	Becho	Tadusi
10	Sululta	Dhaka Bora	Gelano
11	Sululta	Gelano	Kasami
12	Sululta	Alem Tena kara dire	Maderiya
13	Sululta	Burkisami Geba Robi	Kusami

Source: Office of Oromia Special Zone Surrounding Addis Ababa