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**Environmental Shocks and
Household Welfare in Rwanda
Evidence from EICV4**

Master Thesis is submitted to the School of Economics in partial fulfillment of the Requirements for the Award of Master Degree in Economics

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DECLARATION

This Thesis is my original work and has not been presented for a degree in any other University.

Signature

Date.....

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This Thesis has been submitted for examination with my approval as University Supervisor

Signature

Date.....

.....

DEDICATION

I dedicate this work to my family, my and to all the lectures during my Master studies.

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ABBREVIATIONS AND ACRONYMS (In Ascending Order)

DHS: Demographic and Health Surveys

EICV: Integrated Household Living Conditions Survey

GDP: Gross Domestic Product

IFRC: International Federation of Red Cross and Red Crescent Societies

MICS: Multiple Indicator Cluster Surveys

MIDMAR: Ministry of Disaster Management and Refugees

MINECOFIN: Ministry of Finance and Economic Planning

NGO: Non-Government Organization

NISR: National Institute of Statistics of Rwanda

OECD: Organization for Economic Co-Operation and Development

REMA: Rwanda Environment Management Authority

UNDP: United Nations Development Programme

WHO: World Health Organization

HH: Household

ABSTRACT

The objective of the dissertation was to evaluate the impact of environmental shocks on household incomes. Rwanda, like many countries, is affected by changes in climate, these effects permeate through to incomes of households in the country considering the extent to which households in Rwanda depend on the environment. The study attempts to assess the effect of environmental shocks on household welfare represented by household consumption in Rwanda. Using regression analysis with data from EICV4, this study reveals a negative and significant impact of environmental shocks on household welfare in the country whereby the environmental shocks reduces the overall household welfare by 4 percent. The findings also show that there are other factors which significantly affect household welfare such as savings, education levels and health status of household members. The results suggest what common sense does: “Since the environmental shocks that often result in disasters such as extinction of species, depletion of resource stocks, or destruction of ecosystems, the government of Rwanda in collaboration with other countries should devise policies that are environmentally-friendly and more specifically that aims at protecting the environmental and mitigate the risks in case of environmental shocks. Although some of these policies exist already, they could be enhanced by national awareness as well as promoting selective investments that are not disastrous to the environment.”

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Environmental degradation from households' works is projected to significantly rise up by 2030 (OECD, 2008a). Issues related to the environmental impacts on production and consumption of goods and services, like loss of climate change, environmental damage, and natural resources caused by waste and emissions, have been tackled worldwide by the United Nations since the 1992 Earth Summit, in Rio de Janeiro (OECD Report, 2008), but the tendency of effects resulting from the climate change is still evolving, which show the need to invest more on studies that talk about environmental degradation and come up with concrete resolution to this scary problem the world is experiencing now a days.

Environmental shocks like natural threats such as landslides, mass wasting, droughts, and floods lead to main disasters which hinder the development of the countries and shake many areas in the World. Many nations in the world, particularly African and Asian nations, don't have a suitable and trustworthy methodology to estimate damages due to the existence of natural calamities. The evidence about the loss estimation triggered by overflows of different levels and the loss return period are critical to the development of policies for rational landslide, floods and droughts mitigation, based on cost effective methods (IFRC, 2017).

Rwanda is exposed to climate change as it strongly depends on agriculture both for urban settings and rural areas where the country experiences emergencies from landslides, floods and draughts calamities. Rwanda faces issues linked to lack of data to provide strong climate forecasts. Temperature increase is inexact while prospect rainfall patterns are even more inexact, which makes more difficult to make good plans. This is mostly important for agriculture works, where

harvest revenues depend on rainfall and temperature, and planning for forthcoming water supply to support the national economy.

More to this, the environment shocks our lives in a various manners. The association between person's wellbeing and the environment is widely investigated and environmental consequences were proven to affect meaningfully the human wellbeing, direct by putting people to destructive mediators, or incidentally by disturbing lives nourishing environments. The WHO report predicts that 23 percent of all deaths and 24 percent of the world disease weight are linked to environmental influences, this environmental weights is 15 times advanced in developing nations than in western nations, based on the dissimilarities in discloser to risks related to environment and right to use health care this hinders significantly national economic and households' welfare in many ways for example households assets loss, household production loss, fluctuation in households health expenditure among others (Remoundou & Koundouri 2009), this study tries to investigate the environmental shocks on household welfare by taking evidence from the EICV 4 and compare with other factors that have influence in households welfare.

1.2 Statement of the problem

Though it is known that developing countries such as Rwanda experience massive environmental degradation, (Winters and et all, 1998), unlimited researches assessed the impact of such environmental shocks to the economic welfare of the countries.

The relationships between environmental degradation and household welfare have been, nevertheless, analyzed and highlighted to scarcity of food, grass, and water which consequently result in low agricultural production and reduced ability to consume domestically-made meals (Dimoso, 2009). According to the study by Dimoso (2009), this ultimately results in low

disposable income for households. A reduction of household's disposable income reduces how much money is available for children school fees, good food, health care to mention but a few.

The major problem that this study attempts to investigate and find a solution for is the impact of environmental shocks on household consumption/welfare in Rwanda. Like mentioned above, there are studies that have attempted to unpack the impact of environmental degradation on different economies but few, have attempted to investigate similar impacts to households in Rwanda. This study, therefore, intends to investigate the effects of environmental shocks on household welfare in Rwanda using data from EICV4.

This thesis is going to discover the various aspects that can be linked to the improvement of household welfare, explore effects of environmental shocks to the household welfare and investigate how the resilience factor which savings do rectify the effect of environmental shocks on household welfare.

1.3 Research Objectives

1.3.1 Main Objective

The major objective of this research is to assess the effect of environmental shocks on household welfare in Rwanda. The study attempts to answer the aforementioned objective by mining and applying evidence of EICV4.

1.3.2 Explicit Objectives

To support the main objective, stated below are the specific objectives that was investigated to provide more details to the main objective:

1. To assess the effect of environmental shocks on household welfare in Rwanda.

2. To assess the effect of saving as a factor of resilience in addressing crisis in case of Environmental shocks

1.4 Research Questions

This study tries unpack particular seemingly coded topics for the country. The area for which the study can be defined by the question as demonstrated below:

1. What is the consequence of environmental shocks on household welfare/consumption in Rwanda?
2. Can saving be a rectifying factor of crisis in case of environmental shocks?

1.5 Justification

This research on the association between environmental shocks and household welfare/consumption is important for purposes of unfolding household poverty, economic policy, sustainable development and environmental policy for the following reasons:

1. It would stress more clarification to the understanding of the effects of environmental degradation not only in Rwanda but everywhere in the world;
2. It would highlight the correlation between some or all of the above effects to an average household's welfare in Rwanda;
3. It would provide empirical evidence for the implementation and development of environmental program related to undesirable impacts of environmental shocks on household welfare in Rwanda;
4. It would also ignite an inquisitive research paradigm of economic policy on how households could be saved from the dangers of environment and its degradation.

This research will investigate the impact of environmental change in household welfare/consumption using data from EICV 4. This study's results will be serve as a foundation of numerous policies in Rwanda and other nations, most especially in African countries.

1.6 Scope

This research covers Rwanda as its geographical coverage. Although results of this study may be applied in devising policy in other countries; the data used to draw conclusions and informing recommendations is collected in Rwanda which is the EICV4 which was conducted in 2014. The selection to reach to Rwanda for this thesis was based on the author's sole discretion.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Literature review under this study focused on doing a deep research on what other authors wrote on environment in two dimensions. Firstly, on the evolution of environmental change in the world in general and in Rwanda in particular, this will be coupled with the effect this change had on humanity and the world surrounding humans. Secondly, this study reviews intends to backflip literature that explored the effect of environmental shocks on human welfare. This could be through various angles mostly covering the social and economic stances of those affected by such environmental shocks such as health, income, nutrition, agriculture production, education level, employment, etc. This section would also investigate how other researchers relate environmental shocks and household welfare. This review would, however, try to investigate other studies' work on determinants of developing countries such as Rwanda.

2.2 Global Image of Environmental situation

2.2.1 Environmental Degradation

Degradation of our environment is the first cause of the environmental shocks that the planet earth is facing today, and it is as a result of human actions.

The degradation of environment is the collapse of the earth and environmental deterioration through excess consumption of earth's natural resources, for instance air, soil and water, there has been destruction of the environment and wildlife eradication (Stem. et Al., 1996). This is categorized as exacerbation or any evolution to natural pasture seen to be malicious or unwanted

The creation of degradation of ecology is as a result of merging of an effectually substantial and human population increase, financial development, per capita wealth is constantly expanding and the solicitation of asset draining and knowledge pollution. It happens once earth's natural assets

are exhausted and environment is conceded in the form of destruction of water, species, soil pollution and air, including fast growth in Population (Panayotou, 1993).

Environmental deprivation has been sometimes considered as the major pressures being focused globally today. The International Strategy for Disaster Reduction of the United Nations, in its findings, shows environmental dilapidation as the diminishing of the earth's frontier to meet social and environmental purposes, and needs (Uduorji, 2013). Environmental deprivation can occur in different methods. When the environment is exhausted or ordinary resources are worn-out, the environment is measured harmed and corrupt. There are many different systems used to preserve this, e.g. environmental resource protection and general protection efforts. (Zhang, 2008).

According to Parmesan, & Yohe, (2003), environmental related matters could be considered as long term ecological effects, some of those can trounce the entire environment. The environment is the only unit and it integrates all the non-living and living of components that are found in it as their home. Beings and plants are obvious portions of the atmosphere, it as well comprise the things on which they hang on such as streams soils and lakes.

Environments get to be alienated during technological progression splits up to areas of terrestrial. Instances can include roads at times may cut through woods or even traces the wind over prairies. As it sound terrifying on the superficial, there are unscrupulous results. Animal and plants sets felt more this in particular, the big majority of specific bio region need a huge space so as to create that the genomic shapes are retained integral (Liu et al., 2007).

2.2.2 Effect of Environmental Deprivation

Other environmental lifecycle classes need ample parts to help them get living space, food and diverse resources to survive. These beings are called particular spaces. Once biomes are separated, the huge coverings of living universe don't persist anymore. It becomes worse and more worrying

for the wild life to obtain resources they need for their survival. The environment continues, although plant life and animal do not help stand for it appropriately. According to Brander, & Taylor, (1998), the following are possible causes of environmental degradation:

1. Land Disturbance: According to Liu, & Diamond, (2005), Land damage is another major cause of environmental degradation. Their study reveals that frequent weedy plant classes, for instance, garlic mustard, are both far-off and unmistakable in the nature. The break apart in environmental backgrounds delivers a casual to start increasing and scattering in other regions. Florae of this kind can undertake control over wildlife; eliminate the local vegetation, which results into ground with a solitary principal plant that doesn't offer acceptable food monies to all the environmental life. The whole environment can result into a total destruction because of these aggressive types.

2. Pollution: Contamination, in whatsoever form, whether it is water, noise, land or air is destructive for the environment. Air pollution pollutes the air that we breathe which causes health issues. Water pollution degrades the quality of water that we use for drinking purposes. Land pollution results in degradation of earth's surface as a result of human activities. A study by Francis, et al (2009) suggests that noise pollution can cause irreparable damage to our ears when exposed to continuous large sounds like honking of vehicles on a busy road or machines producing large noise in a factory or a mill.

3. Overpopulation: Fast population evolution puts draining on natural resources which causes the deprivation of our environment. Death rate has decreased as a result of better medical services which has ensued the augmented lifespan. The more the population the more the demand for food will be, shelter and clothes. There will be need of more land to produce food and offer homes to masses of people. This will accelerate the deforestation which is another influence of environmental dilapidation.

4. Landfills: contaminate the environment and abolish the beauty of the country. Landfills originate within the city due the big amount of waste that are generated by industries, households, hospitals and factories. Landfills pose a great risk to the health of the environment and the people who live there. Landfills give bad smell when scorched and give a huge environmental deprivation.

5. Deforestation: Deforestation is the censoring of trees to create a way for additional homes and industries. Fast growth in population and urban extension are two of the main reasons of deforestation. More to this, animal grazing, harvest for fuel wood, usage of forestry land for agriculture, and charting are some of the other sources of deforestation. Deforestation leads directly to global warming as decreased forest size puts carbon back into the environment.

6: Natural Causes: Stuffs like quakes, storms, tidal waves, avalanches and wildfires can entirely press nearby plant groups and animals to the level where they will be no survival in those areas. This can either originate to completion through physical destruction as the consequence of a specific catastrophe, or by the long-term deprivation of resources by the demonstration of a flagrant external species to the surroundings. The latter often happens after tidal waves, when reptiles and bugs are splashed onto land.

Obviously, persons are not completely to be guilt of this entire thing. Globe itself affect the issues of ecology. Whereas environmental deprivation is most generally linked to the stuffs that people make, the fact of the matter is that the environment is always varying. Without or with the effect of human maneuvers, some systems of biology destroy to the level where they cannot support the life that is fictional that lives there.

2.2.3 Consequences of Environmental Degradation

A huge number of researchers have tried to investigate the effect of environmental degradation. Many of them tend to agree on the majority of the effects especially on health, environment, space,

and economies among others. The following few pages try to summarize these effects based on a book by Rajakumar, & Selvaraj (2017), which the author believes contains a more comprehensive analysis and list of the effects.

1. Human Health Impact: As a result human health is likely to be at risk of environmental degradation due to exposed areas to toxic and air pollution substances that might cause respiratory diseases, like asthma and pneumonia. The world has experience unexpected number of deaths in millions as result of indirect effects of air pollutants.

2. Biodiversity Disappearance: Clearly the importance of biodiversity to maintaining balance in the ecosystem by reducing pollution, nutrients restoration, safeguarding water sources and putting in place a stable climate, caused by global warming, deforestation due to biodiversity loss.

3. Weakening of the Ozone layer: This layer protects the earth from strong rays sent by the sun, these rays are blocked by the presence of mixture of gases that form the ozone, once the ozone is depleted by emitting of harmful radiations back to earth due to chlorofluorocarbons and hydro chlorofluorocarbons in the atmosphere.

4. Failure of Tourism Industry: The worsening of environment can be a vast hindrance for tourism industry that depend on tourists for their everyday living. Environmental destruction in the form of damage of green cover, huge landfills, damage of biodiversity, water pollution and increased air can be a big minor road for utmost of the tourists.

5. Impact of Economy: The enormous cost that a nation may have to stood due to environmental deprivation can lead to a huge impact economically in terms of renovation of cleaning up of landfills, green cover and protection of vanishing species. The impact of economy might again be in terms of revenue reduction in the industry of tourism

Obviously, there are many things that can have consequence on the environment. If we are not cautious, we can accelerate the environmental deprivation that is happening all over the globe. However, it is possible to care about the environment by taking actions or caring our world by educating environmental caring lessons to the people to élite acquaintance with their surroundings that will allow to take care of environmental worries so as to make it more valuable and safe for our progenies and other future cohorts.

2.2.4 Global environmental change: impacts, inequalities, and development sector

The United Nations in 2000 have set out eight development goals to advance the life of the world's destitute populations (UN, 2015). The goals pursue the reductions in illiteracy, sex inequality, malnutrition, poverty, maternal mortality, child deaths and major infections as well formation of environmental solidity and a global corporation for development. One problem of this breakdown of goals is that it divides environmental considerations from health attentions. Poverty can't be eradicated while environmental degradation aggravates malnutrition, injury and diseases. Food supplies need continuing soil fertility, climatic stability, freshwater supplies, and ecological support (such as pollination). Infectious diseases can't be alleviated in circumstances of climatic volatility, migrant flows, and disadvantage.

The seventh millennium development goal also receipts a partial view of environmental sustainability, focusing mainly on traditional localized physical, microbial and chemical threats. Those threats, which are linked to urbanization, agriculture and industrialization in inferior income countries, endure important as they impose most on poor and weak populations. Experience to interior air pollution, for instance, fluctuates substantially between poor and rich in rural and urban inhabitants. The World Health Organization forecasts that a quarter of the global burden of disease, including over one third of childhood problem, is due to adaptable factors in water, air, food and

soil. This projected environment related problem is much superior in inferior income than superior income nations in general (25 percent versus 17 percent of deaths—and spreading further to a double difference in percentages between the uppermost and lowermost risk nations). Substantial metals and chemical deposits pollute local foods, urban air pollution leads to early deaths, and aquatic enteric pathogens destroy two million children yearly.

These moderately restricted environmental health dangers, though, are mostly remediable. In the meantime, a greater scale, less remediable, and theoretically permanent category of environmental health danger is emerging. Human burdens on the natural environment, replicating global population growth and deepened economic activities, are now so countless that many of the biophysical of the world and ecological systems are being reduced. Models of these global environmental variations embrace climate change, loss of biodiversity, freshwater shortages (with consequential changes to operations of ecosystems), and enervation of fisheries. These changes are unparalleled in scale, and the subsequent risks to population health need urgent reply by health specialists and the health sector at large.

2.2.5 Environmental Degradation and Economic Welfare: Household Effect

Persons made global climate change is now a recognized reality. This has been regarded by many studies as a major result of environmental degradation. A number of studies have attempted to investigate the correlation between environmental degradation and economic welfare. (Dimoso 2009) studied how degradation of the environmental resources affected household welfare in certain parts of Tanzania. In doing so, they attempted to apply many of the determinants of welfare and well-being discussed in prior sub-sections as functions of environmental degradation. They find that ‘deteriorating environmental resources increase the costs of collecting environmental products, which in many aspects have no feasible close substitutes (Cavendish 1999 & Dasgupta,

2001)'. In these studies the increased costs referred to are usually the increased labor time allocated by household members to gathering environmental products, grazing activities, and other household activities. Dimoso (2009) further suggests that the deterioration of environmental resources often affects woman and children as members of the household more than it does to men. They argue that this is because they are the ones largely charged with the aforementioned activities. This is more applicable to less developed countries such as the one in which the study was conducted than it is in developed countries where ownership of property tends to be even and the style of living is quite different.

In addition, Dimoso (2009) suggest that not only does deterioration of environmental resources increase costs as discussed above, they also argue that it drains children's time to go to school, hence, impeding their performance and the country's human capital development in the long-run. The discussion of Damiso et al in their studies show clearly how environmental deterioration fluctuate the well-being of the family by increasing the cost of some aspects that contribute to directly on the household welfare, which explain the need to dig deeper to what extent do really environmental shocks affect the household level of consumption.

Although many studies have attempted to investigate the impact of environmental shocks in household welfare, few (if any) have studied this impact in Rwanda. This study therefore presents an empirical analysis of these effects Rwanda, thus complementing other studies.

2.2.6 Climate Change in Africa

Africa is very weak to climate modification because of social and other environmental stresses. The economy rely unfavorably on agriculture, where around two thirds of the workforce and up to half of household incomes and food comes from (van der Linden & Hanson, 2007).

- Change in climate forecast regional increases in mean temperatures of several degrees centigrade by 2100, a decline in summer rainfall in southern and northern Africa and some increase in west and east Africa. Drying, plus the demands of population growth and economic development, will exacerbate regional water scarcity
- Reduction in crop yields due to 1-2°C warming by 2050 would add a projection of 12 million extra Africans to the 200 million presently malnourished.
- Dangerous events such as flooding change will affect food availability by damaging roads, storage, and market floods in 2000 in Mozambique damaged about 10 percent of farm-land and 90 percent of displaced two million people, irrigation and affected up to 1.5 million livings (mostly in poor rural zones)
- Cattle viral diseases like east coast fever, mouth and foot sickness, blue tongue virus, Rift valley fever are climate delicate. Regional increases in temperature and rainfall could affect tsetse fly habitation and henceforth trypanosomiasis in livestock
- Change in climate and agricultural recession in Africa might lead inhabitants to move, producing conflicts over region. Pastoralists enforced to search for grazing land because of wells drying up may partially elucidate the Darfur crisis in Sudan.
- Some association between human health and change in change in climate are compound. For instance, the forecasted drying in sub-Saharan Africa could rise the incidence of HIV infection, as disadvantaged rural farming families move to cities where conditions adopt unsafe sex and sex work (Hargreaves, 2008)

The current report of the Human Health project and Global Environmental Change stretches a good swift of the main groups of current and forecasted health consequences of world environmental changes other than change in climate.

2.2.7 Climate Change Effects in Rwanda

Main Climate Change associated impacts already detected comprise the dropping of lakes' and rivers' water levels, disappearance of connected biodiversity (REMA, 2005). A study by Mutabazi reveals that an important reduction in agricultural productivity triggered by changing climatic situations is prominent to poor performance of crops. This has triggered a worsening food security situation, malnutrition and poor health throughout the country. Especially the southern part of the country is already rainfall constrained, and prone to aggravating dry spells and prolonged droughts. In the past five years alone, crop failures and poor performance of traditionally cultivated species were observed.

A study by UNDP (2012) on how to reduce vulnerability to climatic change suggests that Extreme floods in western Rwanda have led to the death of dozens of people and have destroyed roads and other infrastructure, as well as significant amounts of agricultural production and houses, leaving many people homeless. Auto-adaptation is already ongoing, with people flood proofing their homes through stone walls, and road construction companies investing into stronger canalization and run-off management, established river channels are being strengthened and partially reinforced through cementation and local authorities invest in drainage systems.

The spreading of diseases, esp. of malaria and waterborne threats have been observed. The worsening food security situation has negative impacts on health esp. of already vulnerable groups such as children, pregnant women, elderly people and the poor. Linkages to the effects of HIV/AIDS have not been formally established, however may be significant.

In terms of water availability (drinking water, production incl. irrigation, hydro-electricity), overall Rwanda is believed to have sufficient water resources, characterized by a good hydrological network (with the sources of the Nile originating in Rwanda's highlands), and 101 lakes and 860 wetlands covering 16% of the surface area of Rwanda. However, a lowering of water tables as well as impacts of reduced water flows have been observed especially, but not only, in eastern Rwanda. These impacts are at least partially attributed to climate change stresses (other drivers are related to non-climatic causes such as sub-optimal water resource and watershed management), which limit water availability. Rainfall variability is related to overall impacts on hydrological flow, water storage and availability, leading to more floods and dry spells while ground water recharge diminishes.

In other extreme climate related incidences following torrential rainfall events, flash floods occur and flood water accumulates in low laying valleys and forms ponds, which impede on settlements and production land. Mostly negative impacts are observed on (i) irrigation potential for agricultural production, (ii) availability of good drinking water, and (iii) feasibility of hydro-electrical schemes in place/planned in Rwanda. For example, lower water flows or more extreme flash floods often carrying high sedimentation loads, lead to increasingly high levels of siltation, worsened by the severe erosion problem. These may adversely impact on micro-hydropower schemes, which will have to deal with more erratic water supplies, as well as higher maintenance costs, which need to be factored into designs Allan & Castillo, (2007).

2.2.8 Impacts of Change in Climate in Rwanda

The research of Stockholm Environment Institute entitled “**Economics of Climate Change in Rwanda**” (2009) examined the effects of climate change events and found that they are economically significant. The most austere of the recent events was the 2007 flood. The study has

estimated that the direct measurable economic costs of this event were \$4 to \$22 million (equivalent to around 0.1 – 0.6% of GDP) for two districts alone. Though, this only contains the straight economic costs of household harm, agricultural damages and fatalities. It does not comprise the broader economic charges from infrastructure damage (including loss of transport infrastructure), water system destruction and contamination, soil erosion and direct and indirect impacts to individuals. The total economic costs of the 2007 floods are therefore much larger and would increase further when other national level effects are deliberated (REMA, 2017). It is clear that these actions have economic overheads that played a very substantial role in terms of national GDP. The continuous annual problem of these events leads to decreases in evolution over time.

The study estimated also the costs of adaptation in Rwanda and found that this cost will increase in future centuries. The accumulated estimates deliver a possible variety, with allegations for the source and level of finance prerequisite. Approximations of medium-term costs to discourse future climate change are naturally of the order of \$50 and \$300 million per year in Rwanda by 2030, concentrated on improving climate resilience. Note that the stock in 2030 builds resilience for future years when possibly more unadorned climate signals happen. Nonetheless, advanced values in excess of \$600 million per year are conceivable if continual social protection and faster development are encompassed, noticing that these are predominantly expansion activities (REMA, 2007).

2.2.9 Coping with Economic and Environmental shocks

Shocks resulted from environment, mainly earthquakes, droughts, floods and natural damages, examine the limits of vulnerability and social resilience and vulnerability. Based on (EM-DAT) the international, disaster database between 1975 and 2011 the numeral natural damages that

occurred in the world together with the households impacted progressively augmented during this era [natural disaster trends, center for research on the epidemiology of disasters (CRED)].

The country's status in economy did not forecast the number or damages a nation confronted. Conversely, discoveries show that nations having inferior revenues and countries having superior revenues inequalities encounter more casualties and greater economic damage (Anbarci et al. (2005) & (Khan, 2005; keefer et al.; 2011;Stromberg, 2007). This is consequently key to comprehend how societies in inferior income nations can manage better the environmental shocks.

The study of shocks in economics is an ongoing and ever-growing area of research. The types of shocks researchers have studied include financial, environmental, price, trade, political, and others. While shocks can be seen as a tool to introduce randomness, economists are particularly interested in how people respond to these shocks and the consequences of shocks causing a variety of responses. Some of the consequences of these shocks can leave vulnerable households in long-term devastation. But even if households are not left in long-term devastation shocks can still affect welfare negatively. Households are usually risk averse and shocks increase the exposure to risk resulting in welfare loss.

Households in developed countries often account for the risk associated with shocks with formal insurance (Glauber et al., 2002). Evidence shows that insured households are less vulnerable to becoming impoverished than uninsured households (Janzen and Carter, 2013; Janzen et al., 2013). Unfortunately, households in developing countries do not have the economic infrastructure to support formal insurance. Households in evolving nations also sometimes do not have access to formal insurance because they do not have the ability to pay for insurance with their income (Jalan and Ravallion, 1999). As a result, these households must find other methods of dealing with risk.

Households in developing countries use many different methods of managing shocks to their income when they do not have access to insurance. Such households must decide between selling assets, decreasing investment in human capital, diversifying labor patterns, or partaking in risk sharing networks to account for lost income (Dercon, 1998, 2002). Unfortunately, findings indicate that some households using the aforementioned informal coping mechanisms in developing countries may be vulnerable to long-term negative consequences (Hoddinott, 2006; Carter and Maluccio, 2003; Rose, 1999). In many instances such households are left in a chronic state of poverty (Carter et al., 2007; Rodr'iguez-Meza and Gonz'alezVega, 2004). This chronic poverty perpetuates the households' inability to satisfy their basic needs, in turn affecting the human capital of household members, causing them to be further impoverished (Banerjee and Duflo, 2011). Such negative consequences from decisions made by households indicates the importance of studying households when they are confronted with unexpected shocks. Governments, NGOs, and researchers can better act in a way that will ultimately help households better cope in risky environments when they have a clear understanding of the decisions households make.

2.3 Household welfare and well-being measurements

2.3.1 Factors of well-being and Welfare

It would not seem prudent if you assess the effect of anything on well-being and welfare without understanding what these two terms mean. Mainly welfare refers to the slight theory of being satisfied resulting from money or income while wellbeing is wider whereby it stands for being satisfied by the life in general.

The two concepts, namely *welfare* and *well-being*, need to be considered in detail. *Welfare* stands for the narrow concept of satisfaction derived from income or *monetary* welfare. *Well-being* is rather a much wider concept; it stands for satisfaction with life as a whole.

The author intends to examine empirical research findings around determinants to intuitively select those that would be applicable to Rwanda. Research tends to suggest that welfare and well-being are closely related to income and employment (Dimoso, 2009). In a study by Dimoso, (2009) that examines environmental resources and their impacts in certain areas of Tanzania, two major determinants of well-being and welfare which was identified was explicitly objective variables (for example age and income), which are often referred to as *external factors* and subjective variables (e.g., financial satisfaction), often referred to as *internal factors* (Diener and Lucas, 1999).

Although it has been hotly debated by researchers, income and welfare and have been found to be highly correlated up to a given level after which their correlation shrinks at the expense of other human needs (Boulding, 1949). Other studies tend to suggest that people often do compare their incomes others' which determines their happiness as well (Stutzer, 2004). These studies tend to suggest that people who perceive their incomes to be higher than those for whom they compare tend to feel happier than those who believe they own less incomes. A more fascinating revelation by economists suggests that human satisfaction is also related to one's past financial situation as opposed to today's. They argue that a current income raise would slightly increase one's welfare and well-being for a particular period after which they would feel the same (Brickman et al., 1978). They, additionally, suggest that an income reduction certainly significantly slashes one's happiness.

Other studies have tried to investigate the relationship between other variables such as employment, economic, social, and demographic variables. Clark and Oswald (1994) study the relationship between employment and satisfaction. They find that unemployment is one of the

leading causes of depression ranking higher than unfortunate events in human life such as divorce and losing a partner.

2.3.2 Measurement of Welfare: Asset Guides

The Welfare is typically the proxy variable of income or consumption. Though, recently measuring welfare by using assets as a substitute measurement has been progressively noticeable. Actually, wealth guides symbolize the one method to examine distributional aspects in exclusively comprehensive big scale studies like multiple indicator cluster studies and demographic and health studies that absence of evidence on consumption and or income (Howe et al., 2008).

The wealth measure has often been theoretically and specifically a major marginal measure of economic status to consumption and income (Johnson and Rutstein, 2004): wealth mirrors better the welfare in long-term because it is less unstable than both income and consumption; it is considerably more appropriate to examine multi-dimensional poverty and lastly data concentrated and hence easy to compute (Pritchett and Filmer, 1999) & Azzaarri et al., 2006; Sahn and stifle 2000; 2003)

2.4 Summary

This chapter has inspected literature surrounding the effect of environmental shocks on household welfare. It has been found that a number of studies have been conducted on the topic with various orientation. However, it has been revealed that no study has been conducted on the subject in Rwanda. This makes geographical coverage one of the major difference between this study and other studies. Many researchers tend to agree on the principle that environmental shocks affect household welfare. However, what tends to be hotly debated upon is to what extent and what form does this impact take. A section of researchers argue that this impact tends to escalate as an economy tends to be underdeveloped and largely depends on environmental products for their day-

to-day survival. Another section of researchers suggest that the impact should rather be viewed from the comparative point of view. There seems to be general consensus on the impact of environmental shocks in form of reduced time for household members, increased costs of living, reduced disposable income to spend on life-improving items such as education.

It has been discussed that a number of research studies have tapped into investigating how environmental shocks affect household welfare. A notable one is the one conducted in Tanzania by Dimoso (2009) among others. However, there seems to be need to dive deeper into the topic by researchers to assess how specific environmental shocks affect household welfare as there is not enough similar studies in Rwanda. For instance: who is affected in the household? What affects household welfare more between landslides, soil erosion etc? Is there a casual effect? All these questions fall behind the jurisdiction of this study. Some of them have been narrowly investigated and others remain scantily examined. There is, therefore, need for broad research on these topics to intuitively inform policy and prepare households for the future likely effects.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

The major source of data for this research is EICV 4 which was conducted by the NISR between 2013 and 2014, more to this a deep analysis on different reports saying about environmental effects on economic welfare will be explored. As this study used the secondary data this means directly that the study adhered to the same methodology used by NISR to reach to the final dataset.

3.2. Hypothesis:

“Environmental shocks reduce household welfare.”

The data in question would be analyzed using STATA and would be arranged into independent and dependent variables as follows:

3.3 Economic Model

As has been described in prior sections, this study’s research findings and conclusions will be drawn with help of an econometric regression analysis of the variables explained in this chapter.

The regression model to be analyzed is as follows:

The economic model:

$$\begin{aligned} \text{LogConsumption} = & \beta_0 + \beta_1 \text{Environmental Shocks} + \beta_2 \text{Education} + \beta_3 \text{Health problem} + \\ & \beta_4 \text{hhlocation} + \beta_5 \text{Sex} + \beta_6 \text{Poverty} + \beta_7 \text{Ubudehe Category One} + \beta_8 \text{Marital Status} + \\ & \beta_9 \text{Having Health Insurance} + \beta_{10} \text{Owing Mobile Phone} \quad (\text{Eq1}) \end{aligned}$$

$$\text{LogConsumption} = \alpha_0 + \alpha_1 \text{Environmental Shocks} + \alpha_2 \text{Saving} \quad (\text{Eq2})$$

3.3.1 Dependent Variables:

Consumption: The household welfare for this study is measured as consumption, by assumption the higher the household consumption the higher the level of household welfare. It has been realized that without the environment and natural resources, no economic development would be possible (NISR & MINECOFIN, 2016). Further, conventional economics suggests the higher is the economic consumption the higher the welfare will be (Jackson and Marks 1999). This, therefore, makes consumption an important proxy for household welfare. For the purposes of this study, consumption quintiles are applied as a proxy to welfare. As discussed in NISR & MINECOFIN (2016),

3.3.2 Independent Variable:

Environmental shocks: Aligning to the overall objective of this study, environmental shocks represent an impact on the dependent variable as a result of environmental disturbances. Since a significant number of Rwandans depend on the environment for survival, it is apparent that environmental shocks are likely to have an impact on their welfare as investigated in multiple studies (Sallis et al., 2009). This study specifically utilizes “households affected by environmental shocks in less than a year as a proxy for measuring environmental shocks to households. The types of environmental shocks presented in EICV4 are floods (8.8%), mountain slides (2.9%), destructive rains (52.8%) and others (15.4%).

Education: A review of literature in this study reveals that education is one of the determinants of welfare. As revealed in multiple studies such as that of Noble et al. (2015), education materially affects household welfare. This study deploys general education, literacy/learning/training, education expenses as proxies for education.

Health problem: It has been discussed in this study that health is one of the determinants of welfare. It has been found that health is significantly correlated with household welfare (Shibuya et al., 2002). This study uses disability and health problems, health insurance, consultations as proxies for health.

Household location: It has been researched as to whether one's geographical location, in terms of rural and urban address, and welfare are related. Kapoor et al. (1996) reveal that one's geographical location has an impact on how they perceive the state of their welfare. This study deploys household members' location in terms of urban and rural as a proxy for region.

Sex: This variable represents the distribution of Gender among respondents of the EICV4, it was included in the model based on some discussion that male are more likely to be better off compared to female.

Marital Status: This represents the status of respondents whether married or not, it was included in the model just because of the ideas that people who married are more likely to have better life compared to unmarried people

Poverty: This variable represent the level of poverty of the respondents in three categories which are extreme poverty who are people consuming less than 64,000 RWF per month, poor who consume between 64,000 RWF to 108,000RWF and none poor who consume more than 108,000 RWF per month, this variable have very significant role in the model as it is the key variable to measure the household welfare, and the dummy variable consist of 1 which represent category two and three and 0 which represents poor category

Ubudehe Category one: This variable represents the social classification of Rwandans, here in EIC4 was ranked from category 1 to category 6. This variable also has a key role in the model as it shows the household wealth categories.

Having health insurance: This variable represents the ways respondents of EICV4 get health care to insure the household welfare

Owning a Mobile phone: the household owing a mobile phone are more likely to have more consumption than those who do not have it, this variable was included in the model to investigate if that idea is really factual.

3.4 Data Processing and analysis

Data exploration and regression analysis of variables of interest under this study were done to draw inference about the effect of environment shocks on Households economic welfare.

CHAPTER FOUR: FINDINGS AND DISCUSSION

This chapter is aimed at investigating environmental shocks in Rwanda, empirically examining the relationship between environmental shocks and household welfare in Rwanda. As discussed earlier, this objective would be reached by running a regression analysis of the economic model demonstrated in the previous chapter. In this section, regression analysis was presented and discussed to present experimental indication of the environmental shocks and household welfare in Rwanda and explain the major goal of this study generally.

4.1 Descriptive analysis of the variables included in the model

Before analyzing regression results, here are summary statistics of the variable of interest in the economic model explained above to show a clear picture of those variables and the implication they have in the inference made. Observations are not converted in natural logarithm in order to be economically meaningful.

4.1.1 Distribution of households shocked by environmental issues, by main type of destruction, according to urban/rural, province and sex of head of household (EICV4)

EICV4	% with dwelling affected by environmental destruction	Total number of households (in 1000s)
All Rwanda	20.1	2,493
Urban/rural		
Urban	11.7	426
Rural	21.9	2,067
Province		
Kigali City	9.8	295
Southern Province	22.3	597
Western Province	27.4	559
Northern Province	23.1	394
Eastern Province	14.7	647

Table 1: Percentage (%) of households with dwelling affected by environmental destruction, (EICV4)

The table 1 above shows the proportion of dwellings that have been shocked by environmental devastation in Rwanda and the different kinds of shocks that affected them; 20.1 percent of the household interviewed reported that they have experienced environmental destruction,. When comparing the issue in urban vs rural settings, the problem is more serious in rural in general whereas 21.9 percent of household interviewed were affected by environmental destruction against 11.7 percent in urban.

4.1.2 Main types of devastation desegregated by urban/ rural, province (EICV4)

EICV4	Main environmental destruction affecting dwelling					Households facing environmental destruction (000s)
	floods	Hills slides	Rain destructions	Other environmental devastation	Totals	
All Rwanda	8.5	21.6	53	16.9	100	502
Urban/rural						
Urban	9.1	13.2	61.5	16.2	100	50
Rural	8.4	22.5	52.1	16.9	100	452
Province						
Kigali City	2.5	6.1	75.3	16	100	29
Southern Province	8.4	10.8	74.4	6.5	100	133
Western Province	11.6	37.1	31.8	19.5	100	153
Northern Province	9.2	34.4	37.3	19.2	100	91
Eastern Province	4.8	4.3	65.6	25.2	100	95

Table 2: Main types of devastation desegregated by urban/ rural, province (EICV4)

The table 2 represents the main type of destructive rains with 53 percent of the affected household seem to be the scariest disaster, followed by mountain slides with 21.6 percent of the affected households, floods represents 8.5 percent of the affected households and 16.9 percent were shocked with other environmental shocks.

Destructive rain is more a problem in urban settings with 61.5 percent of case among the affected households against 52.1 percent in rural areas, mountain slides is more an issue in rural areas with 22.5 percent of cases among the affected households against 13.2 percent in urban areas, floods is more a problem in urban than in rural areas with respectively 9.1 percent and 8.4 percent. The table also break down the issue across the province of Rwanda to show how environmental shocks behave in different corners of the country.

4.1.3 Proportion of people ever been to school and those never been to school, by urban/rural and Province

EICV4	Proportion of people ever been to school	
	Yes	No
All Rwanda	75%	25%
Urban/Rural		
Urban	14%	2%
Rural	61%	23%
Province		
Kigali City	9%	1%
Southern Province	20%	7%
Western Province	17%	6%
Northern Province	12%	5%
Eastern Province	18%	6%

Table 3: Proportion of people ever been to school and those never been to school, by urban/rural and Province

The table 3 above shows that 75 percent of Rwandan population have ever been to school, 25 percent have never been to school, in rural areas 61 percent reported that they have ever been to school whereas 23 percent never attended school, it also shows how people ever been to school across all the province of Rwanda. This variable was included in the model solely based on its role in household welfare whereby there is much assumptions that household headed by educated person is much likely to better off compared to the one headed by a person who does not know what is school is.

4.1.4 Proportion of people who suffered from health problem in the last 4 weeks by urban/Rural and across provinces

EICV4	Proportion of people who Suffered from health problem in the last 4 weeks	
	Yes	No
All Rwanda	32%	68%
Urban/Rural		
Urban	4%	12%
Rural	28%	56%
Province		
Kigali City	2%	7%
Southern Province	10%	17%
Western Province	8%	15%
Northern Province	4%	12%
Eastern Province	7%	16%

Table 4: Proportion of people who suffered from health problem in the last 4 weeks by urban/Rural and across provinces

The table 4 above shows the proportion of people who have suffered from a health problem, 32 percent reported that they have suffered from the health problem; those who suffered from health problem are more in rural areas with 28 percent and 4 percent in urban areas, and it also shows how suffering from a health problem is spread across province. This variable have been included in the model because it has much implication on how income is generated in the household which will determine their level of consumption and the well-being of the household in general.

4.1.5 Distribution of the population by household location

EICV4	Distribution of population by household location
Urban/Rural	
Urban	16%
Rural	84%

Table 5: Distribution of the population by household location

The table 5 above shows that 84 percent of Rwandan population live in rural areas this have much of implication on how exposed to environmental shocks as presented in the table one where we have seen that mountain slides is much higher in rural settings than in urban areas, and

4.2: Empirical Results

4.2.1 Regression Analysis of the Equation one

The Stata software package was used to create the regression for the equation one as presented in the economic model presented in section three of this dissertation;

logConsumption	Coefficient	Standard Errors	t	P value	[95% of Conf . Interval]	
Environmental Shocks	-0.0441987	0.0110438	-4	0.00	-0.06585	-0.02255
Education	0.0991449	0.011031	8.99	0.00	0.077522	0.120767
HH Location	0.5023834	0.0150348	33.41	0.00	0.472913	0.531854
Ubudehe One	0.3460661	0.0175869	19.68	0.00	0.311593	0.380539
No Poverty	0.9729275	0.0133724	72.76	0.00	0.946716	0.99914
Sex	0.1236519	0.0164587	7.51	0.00	0.09139	0.155914
Owning a Mobile Phone	0.1969231	0.0101204	19.46	0.00	0.177086	0.216761
Marital Status	-0.2072923	0.0150617	-13.76	0.00	-0.23682	-0.17777
Health Problem	0.0274965	0.0098701	2.79	0.005	0.008149	0.046844
Having Health Insurance	0.1353323	0.0103743	13.04	0.00	0.114997	0.155668
Constant	11.07266	0.0169176	654.5	0.00	11.0395	11.10582

Table 6: Regression analysis Results (EICV4 Data)

The table above shows the regression model of consumption on household that faced environmental shocks, having a health problem, educated or not, the household location (Rural or Urban), the household poverty levels, being in ubudehe category one or not, the sex of respondents,

the marital status, owning a mobile phone and having health insurance; the regressions shows that variables of interest in the model are significant at 5% as their P-Value are less than 5%. R² (0.474) looks acceptable for the model fit. The constant of the model also is significant at 5% level of significance statistically. It should be noted all variables are statistically significant as their p-values are all less than 5% at 5% level of significance.

Environmental Shocks

As expected, the estimated coefficient for Environmental Shocks (-0.0441) has an expected sign (negative) and acceptable at 5% statistically significant, it implies that the environmental shocks negatively impact the household welfare in Rwanda. The model shows that the consumption of the household that faced the environmental shocks decreased by 4% *ceteris paribus*. This suggests that Environmental shocks has a negative impact household consumption, this can be explained by various mechanism when a household experience environmental destruction this will have serious implication on the household income flow and the expenses is likely to raise to copy with the consequences of that shocks which will have a negative effect on the household welfare in general. Dimoso (2009) also finds similar results in a study conducted in a more neighboring country Tanzania. He finds that environmental shocks negatively affect family's time and energy allocated on other tasks and hence minimize their available income for consumption.

Education

Education materially impacts household consumption levels. As presented from table 6, when the household head accessed education here it is in terms of literacy, learning or training; being educated will result in an increase of 9%, keeping other factors constant. Many research have found the same results in other studies. For instance, Noble et al. (2015), education materially affects household welfare. Swaan, (1988) also uses similar approaches and studies how education

affects welfare in Europe and USA and finds a positive correlation between the two variables in question.

Health Problem

Results in this study as reflected in table 6 suggest that when the household head suffers from a health problem the consumption will increase slightly by 2%, *ceteris paribus* keeping other factors constant. The same findings were also found by Shibuya et al., (2002) and Finkelstein, et al. (2013) who argues that wealth is literally of little use if there is no good health.

Household Location

As can be evidenced in table 6 when the household is located in an urban setting the consumption of the household will increase by 50% *ceteris paribus* keeping other factors constant.. These results are very well consistent with others such as Kapoor et al. (1996) who reveal that people located in urban centers have better opportunities for employment and when aggregated with other factors such as better education and training, multiplier effect among others, this eventually affects results into an increase in their consumption and welfare.

Poverty:

The findings from table 6 shows that when people are not in poor category, when a household belong in none poor category there is a likelihood of 97% of being better off compared to poor category.

Ubudehe Category One:

Ubudehe category are the social classification of Rwandans, in their stands of livings which 4 categories by now; the findings from table 6 reveals belonging in ubudehe category one will result in an increase of 34 percent on the consumption as well as welfare which means the fact of

belonging in other categories may result to an increase of the household consumption more than 34 percent.

Sex of Respondents:

The sex of the people says much about how better off s/she will be as there is a saying that women needs to empowered and be at the same level as men, it is claimed that they were a bit underestimated; the study reveals that being a female there will be a likelihood of increasing the household welfare by 12 % which means being a male will increase the household welfare by 88 percent.

Marital Status:

The marital status of individuals reveals too much about their welfare, married people are more likely to prosper than unmarried man because of different factors like the difference in how the manage the income, how the aspire the future in terms of saving and investment and more; the findings from table 6 show that when you are unmarried there will be a likelihood of decreasing the consumption or welfare by 20 percent.

Having Health Insurance:

Having a health insurance is very key for welfare and have a better life. The study shows that having health insurance will lead to an increase of welfare or consumption level by 13 percent.

Mobile telephone:

The table 6 shows that household that when a household owns a mobile phone they will be likely to increase by 19 percent the household welfare.

4.2.2 Regression Analysis of Equation two: Saving

In trying to investigate the impact of savings on household consumption, savings as a variable was regressed against environmental shocks to investigate how a resilience factor would rectify the welfare in case of environmental shocks. Results are presented in table 4.3.

Log Consumption	Coefficient	Std. Err.	t	P>t	[95% Conf. Interval]	
Savings & Environmental shocks	0.1544834	0.0087105	17.74	0.00	0.137397	0.17157
Constant	11.0043	0.0764757	143.89	0.00	10.85428	11.15431

Table 7: Regression of Consumption on Savings and Environmental Shocks

The table above explore the role of resilience factors to rectify the household welfare when experiencing the environmental shock; when regressed the joint interaction of environmental shocks and savings which is one of the resilience factor, the regression shows that household welfare will increase by 15 percent even though the environmental shock was found to have a negative sing on household welfare. All the variables are significant in the model to take inference from them as their P-Value is less than 5%. This is consistent with Danziger et al. (1981) who also suggests that an increase in household savings increases their consumption.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Research

This last chapter summarizes the main findings and discussions under this study. It outlines the main findings and interpretations made in the above chapters of this research. This chapter also suggests the major recommendations to policy makers. It should be remembered that this study aimed at achieving the following objectives to investigate environmental shocks in Rwanda and to assess the relationship between environmental shocks and household welfare in Rwanda.

To investigate how environmental shocks affect household welfare, the regression equation contained environmental shocks as well as consumption as a proxy for welfare. The results reveal that that environmental shocks negatively impacts households' welfare in Rwanda by 4 percent. Additionally, it is vital to note that this impact is quite significant. Similar results were found by Bovenberg & Smulders (1995) and Kochar (1999) for India. Dimoso (2009) in several Sub-Saharan Africa including Tanzania.

The study results clearly reveal an important conclusion for policy makers, which is the level at which education affects welfare in households in Rwanda. Results suggest that education materially impacts household consumption levels. However, this might not be a surprising result as many other researchers have found the similar results. These include (Noble et al. 2015) & Swaan, (1988).

To study the relationship between household welfare and health status, an interaction between the two variables was run in the model. Results in this study reveal that when members of the households are faced with health challenges, their welfare is impacted as there will contribute to consumption very little. Similar results was found by (shibuya et al., 2002) & (Finkelstein et al., 2013).

The results of this study emphasize that geographical location of households in Rwanda is a strong and significant determinant of welfare in households. When the HOUSEHOLD is located in an urban setting the consumption of the HOUSEHOLD will increase by a strong margin. This probably explains why the number of town and city dwellers significantly increases every year. These results are very well consistent with others such as Kapoor et al. (1996).

To investigate how savings impact household welfare, savings as a variable was regressed against environmental shocks. Results reveal that saving will increase the HOUSEHOLD consumption level by nearly a third while the environmental shocks will decrease the HOUSEHOLD welfare. This is consistent with those results by Danziger et al. (1981)

5.2 Recommendations

Since the environmental shocks that often result in disasters such as disappearance of classes, diminution of natural resource stocks, or the damage of the ecology, the government of Rwanda in collaboration with other countries should devise policies that are environmentally-friendly and more specifically that aims at protecting the environmental and mitigate the risks in case of environmental shocks. Although some of these policies exist already, they could be enhanced by national awareness as well as promoting selective investments that are not disastrous to the environment (Bretschger & Vinogradova, 2017).

On education; the government of Rwanda has tremendously continuously improved the literacy rate in the country, this has been through implementation of policies that make it easy for all Rwandans to afford school. The findings of this dissertation proposes that this is a rewarding road the country has taken of positive implication on household welfare. Since Rwanda is already among the best performing countries, it is recommended that the country divert efforts to the

quality of education. This would ensure that productivity is raised hence increasing households' incomes and hence welfare.

On health; as the saying goes that "life first, everything else follows". This study's results suggest what common sense does: "Policies that lead to the improvement of health standards are likely to improve households' welfare." It is, therefore, recommended that government should devise policies that improve households' welfare as well as awareness towards the environmental protection mechanisms. Climate information of Rwanda have to adhere to universal climate models so that it can generate reliable data which will inform Rwandan planning but also the regional planning to alleviate the environmental shocks effects on country's welfare (MIDIMAR, 2012).

It has been reiterated by numerous economists that savings induce investment and hence accumulation of wealth. This wealth increase consequently allows people to afford their needs, which improves their welfare. Results of this study are in agreement with these researchers. If there is any recommendation that should be grasped by policy-makers, it is that they should devise policies that increase savings in the country. This has already been initiated by several stakeholders such as NBR and Ministry of Finance. The National Savings Mobilization Strategy is an example of similar mechanisms to raise awareness and as well as increase savings at national level. Such policies are more likely to improve households' standards.

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