Farmer's Vulnerability to Climate Hazards in Armenia

Capstone Essay

Submitted to the Political Science and International Affairs Program

College of Humanities and Social Sciences

In partial fulfilment of the requirements for the degree of Master of Arts

American University of Armenia



By Marianna Harutyunyan

Supervisor: Dr Yevgeniya Paturyan

Table of Contents

Acknowledgements					
Abstract					
Abbreviations					
Introduction					
Chapter1: Literature Review					
1.1 The Concepts of Climate Hazards and Vulnerability8					
1.2 Climate Risk Management and Adaptation Practices9					
1.3 Agricultural Insurance as an Effective Way of Overcoming Climate Hazards11					
Chapter 2: Agricultural sector of Armenia15					
2.1. Climate Overview and Climate Change Perspectives in Armenia15					
2.2. Structure and Performance of the Agricultural Sector in Armenia17					
2.3. Major agricultural risks in Armenia					
HAIL18					
DROUGHT					
FROST					
Chapter 3: Methodology					
Chapter 4: Qualitative Data Analysis					
4.1. Climate hazards and its consequences					
4.2 Mitigation of climate risks					
4.3. Agricultural insurance					
4.4. Obstacles on the way of implementation					
Chapter 5: Quantitative Data Analysis					
Conclusion and Recommendations					
List of References					
Appendix A: Interview Questionnaire					
Appendix B: Survey Questionnaire					

Acknowledgements

First of all I would like to express my sincere gratitude to Dr. Yevgeniya Paturyan, my Master's Thesis Advisor for her support and patience during my research. She was of great assistance to me during the whole course of my research, and helped me to overcome all obstacles in order to be write this paper.

Secondly, I am grateful to American University of Armenia for being my second home during these two years. Especially, to all professors of the Political Science and International Affairs Program for providing high quality education and skills.

Finally, I am grateful to my friends and family for their understanding and encouragement.

Abstract

The aim of this paper is to determine the main types of climate hazards in Armenia, to study farmers' vulnerability to unpredictable weather events as well as to examine how Armenian government is planning to respond to these natural disasters. This research paper discusses the major climate events which negatively affect agricultural sector worldwide and elaborates about farmers' vulnerability to those events in Armenia.

The qualitative data (in-depth interviews) were collected and analyzed to determine the steps which the government of Armenia is going to take in order to reduce farmers' vulnerability to climate hazards. Then, the quantitative survey was conducted among the farmers of Armenia to understand their expectations and response to the measures proposed by the government.

All the findings state that climate hazards have a negative impact on agricultural productivity in Armenia. The government of Armenia considers agro-insurance as an effective way of overcoming the climate hazards and begins to take concrete steps towards the implementation of agro-insurance. However, the implementation of agro-insurance and the reduction of farmers' vulnerability to climate hazards is a long process which needs trust towards the government, efforts of the farmers and time.

4

Abbreviations

AMD	Armenian dram (currency)
CBA	Central Bank of Armenia
GDP	Gross Domestic Product
KfW	German Development Bank
MoA	Ministry of Agriculture

Introduction

The importance of managing agricultural risks effectively can hardly be overstated. At the present time agricultural producers in Armenia, particularly the smallholders who comprise a majority of all agricultural enterprises are struggling to manage the risks that affect their livelihoods. Frequent and unpredictable weather events, which impact Armenia often, leave farmers with no recourse but to reduce household consumption or borrow from lenders to make it to the next harvest.

Armenian farmers are highly exposed to agricultural risks, in particular weather risks. These have caused significant losses in recent years. Hail, frost and drought are the events usually causing the most concern for farmers. Commonly applied risk management tools and techniques tend to be least technologically sophisticated ones. They include diversification of income, the use of fertilizer and irrigation. Small farmers do not generally use more advanced risk management systems due to a lack of knowledge about them and their cost. Many farmers appear to be overly reliant on borrowing to cope with difficulties, and they are not saving money in a systematic way. Medium and large sized agricultural enterprises, by contrast, tend to be more sophisticated in terms of their risk management approaches. Although their numbers are low, these farms have an important role not only regarding their share in total output but also in determining the future direction of the sector. Based on the priorities and intentions of the study the following research questions have been raised:

RQ1: Which social policies help decrease farmer's vulnerability to climate hazards?

RQ2: What kind of climate hazards are of primary concern for Armenian farmers?

RQ3: In what stage is the Government of Armenia now in implementing the agricultural insurance policy?

RQ4: What is the farmers' reaction to the agricultural insurance policy in Armenia?

The first chapter of this paper aims to give a deep understanding about ways of managing agricultural risks worldwide. The chapter answers to the first research question and elaborate about types of climate hazards; the vulnerability of farmers to those disasters as well as will determine special policies and other international practices which help farmers to decrease the vulnerability and have fewer loses.

The second chapter of this paper refers to the second research question and determines climate hazards which are of primary concern to farmers in Armenia.

The third chapter presents the methodology of the research and data collection procedures.

The fourth chapter of this study discusses the qualitative data which includes in-depth interviews with the representatives from the Ministry of Agriculture of the Republic of Armenia.

The fifth chapter of the research introduces and analyses the quantitative data which was gathered through the survey conducted in the two marzes of Armenia.

The last chapter of the paper summarizes the findings of the paper and gives recommendations.

Chapter1: Literature Review

1.1 The Concepts of Climate Hazards and Vulnerability

In recent years many scholars refer to climate change and its harmful impacts on agriculture. The authors propose that environmental change will endanger current livelihood options and make them more unpredictable. The variability of climate impacts will cause more problems for farmers and may even bring to hunger and poverty.

In the literature there are different definitions of climate hazards and vulnerability. Climate hazards, according to many scholars, are all the events caused by the nature that have the ability to harm people or the things which are important for their livelihood. Climate hazards can last for a short time and be unexpected such as flooding and hail. Another type of climate hazard is chronic, when immediate impacts of the event are unclear, but it can be harmful in the future (e.g. draught, rise of sea level) (Fellmann 2012).

Vulnerability is the sensitivity of a specific group of people, structure or place to the hazards and disasters, their inability to be ready for the events, to respond effectively and recover from those impacts (Ionescu 2016; Heltberg at al 2009; Füssel 2007). Another group of authors focused on adaptation strategies (Kelly and Adger 2000; Adger 2006; Smit and Wandel 2006; Füssel and Klein 2006; Fellmann 2012; Brooks 2005). Most of the studies are concentrated on the concepts of vulnerability, its relationship with poverty and to climate change.

In many middle- and low-income countries the agriculture sector is essential for national income and employment. Agriculture produces not only food, but also feed (livestock), fuel (transportation) and fiber (clothes). However, in the face of climate change many farmers worldwide become vulnerable to income loss; natural shocks trigger economic loss and increase the poverty. For these reason in many high-income and developed countries special policies are

implemented to reduce climate vulnerability and regulate the connection between climate shocks and outcomes. (Harvey et al. 2014)

In order to survive and prosper, agricultural producers around the world need to cope with a multitude of risks. Producers in emerging markets are facing higher exposure to these risks, as risk management approaches are not well developed. Risks can be characterized by type, frequency and severity (Cervantes-Godoy et al. 2013). The typology also lists level and timing as additional criteria, which are left out from this paper for the sake of simplicity. The production risks are the dominant risk category and it includes natural disasters, weather and disease risks (Wisner et al. 2003; Cervantes-Godoy et al. 2013).

1.2 Climate Risk Management and Adaptation Practices

When households face irregular or frequent climate changes it becomes impossible to respond effectively. These shocks have the worst impacts on the farmer's vulnerability. Evidently, it is impossible to control the risks which are caused by the nature; however the vulnerability of households to climate unpredictability can be reduced through developing human capital, social capital and involvement of institutions. Different scholars argue that vulnerability to climate changes is caused not only from the changes in climate, but also of "sociopolitical and institutional factors". Surely, there are other factors such as age, gender and race which affect vulnerability. Consequently, even though climate change is a "global phenomenon", it is the obligation of the governments to respond adequately and develop adaptive capacity among farmers and households. Although many farmers develop their own adaptive capacity to climate hazards, the role of the institutions is the essential part of reducing the vulnerability effectively (World Bank 2009). Local institutions (civic, public and private) have an important role in managing climate risks and addressing climate adaptation. When coping with the environmental issues these three types of institutions tend to cooperate with each other. As the adaptation to climate hazards is an enduring and complicated procedure, the cooperation between public, private and civic institutions should be beneficial. The partnership between these three layers helps to bring together all the ideas and efforts of diverse decision makers with different skills and capacities. The functions of these institutions in rural areas include the data collection, recruitment and allocation of resources, improving knowledge and capacities of farmers through trainings and other activities, as well as the maintenance of active communication between households and institutions (World Bank 2009).

According to Halstead and O'Shea, the adaptation practices can be divided into five different classifications which are mobility, storage, diversification, communal pooling and market exchange (Halstead and O'Shea 1989). Mobility is the spreading of risk across territory, for example labor migration or involuntary migration (Busby and Purvis 2004). Storage is the spreading of risk through time; water, food or animal storages can improve living conditions of rural households. It is considered as a way of overcoming the scarcity of food or water (Halstead and O'Shea 1989). Diversification of risks across classes includes development of skills, changing of crops and technologies, organizing trainings, etc. Diversification is "reliable to the extent that benefit flows from assets are subject to uncorrelated risks" (World Bank 2009). Communal pooling enables the distribution of risks across households by developing infrastructure, data collection and disaster preparation. (Adger 2006) Market exchange includes improved market access, insurance and sales of new products. It is the buying and selling of risk through contracts, which may "substitute for any of the other four categories when households have access to markets". (World Bank 2009) In many countries for family households,

diversification of income sources is the most common and highly effective approach to reduce risks. Both diversification of agricultural products (e.g. a crop farmer purchasing cattle) as well as diversification into other business sectors are the main strategies to avoid risk in poor economic conditions. (Halstead and O'Shea 1989)

Ceila A. Harvey at al. have done research assessing farmer's vulnerability to agricultural risks, adaptation mechanisms and strategies in Madagascar. They found that farmers face regular agricultural risks caused by climate change, which in its turn led to the loss of crops and income. Farmers outlined that they tried to reduce their vulnerability by changing their farming strategies. The majority changed the planting crops, managed the resources or implemented new practices. However, the scholars come to the conclusion that the effectiveness of these approaches was very low; the majority of farmers pointed out that "their adaptation strategies for drought and flooding were not effective". (Harvey et al. 2014)

In order to increase farmer's agricultural productivity, reduce vulnerability and improve their livelihood options authors of the research propose some recommendations based on their observations and data analysis. They suggest the policymakers to organize trainings and educate farmers regarding the best practices of planting and cropping; provide farmers with feasible and effective adaptation strategies and technical provision. Secondly, they propose to develop insurance market so that farmers rely on formal support system instead of borrowing cash or food from neighbors. (Harvey et al. 2014)

1.3 Agricultural Insurance as an Effective Way of Overcoming Climate Hazards

According to the literature many households prefer to adopt the strategies which are low risky and increase their exposure to extreme climate hazards but also keep the farmers in chronic poverty. For example, in rural areas farmers protect themselves from climate hazards using different mitigation measures such as supplemental irrigation, diversification, producing lower risk products, etc. On the other hand, these strategies are not always effective and feasible. The effective way of coping with climate hazards, according to many scholars, is traditional insurance. Different countries worldwide implement agricultural insurance, some of them are successfully coping with the climate hazards and there are countries which do not.

Larger commercial players (including commercial agribusinesses and a part of the midsized operators) address these risks differently: They increasingly introduce modern production technologies to increase productivity. They also diversify in order to reduce their risk exposures to one single product. As their total risk exposures are naturally growing with their size, risk avoidance strategies are increasingly unfeasible. This generates demand for different means of risk mitigation, specifically for insurance. An affordable and effective agricultural insurance system would motivate agricultural producers to use better seeds and apply better inputs, which increase crop productivity and yields. This has been confirmed as a risk-reduction outcome of insurance, confirmed by top-level experts and international donor organizations providing various examples from different countries worldwide (Liu et al. 2016; Carter et al. 2016; Machinski et al. 2016).

The development of agricultural insurance has generally gone hand in hand with the adoption of modern, normally capital intensive agricultural production technologies. Developing countries have lagged behind in both, mainly for economic and political reasons (Thornton et al. 2017). However, the development of agricultural insurance is even more important for the stability of lower-income countries as poorer populations are less risk tolerant. Due to the prevalence of subsistence farming in the developing world, agricultural insurance plays an

important role as a provider of social stability, as opposed to securing business interests in countries where commercial farming prevails. It is for this reason that the development of viable agricultural insurance schemes for lower-income countries is so important (Klasen and Reimers 2017).

Providing agricultural insurance in lower income countries comes with a set of challenges. Usually farmers in developing countries operate on a small scale in terms of land plot sizes, production volumes and incomes (Klasen and Reimers 2017). This undermines the cost effectiveness of traditional underwriting and loss adjustment practices. Farmers also typically use unsophisticated farming practices and frequently fail to employ basic risk management techniques such as animal vaccination. This too creates difficulties regarding underwriting and loss adjustment (Steinmann 2014). Other systemic issues are typical of lower-income countries. They include land registration problems, the unavailability of historical loss data and a lack of education programs for insurance professionals, which explain the low level of insurance expertise. Limited access to finance further exacerbates these problems (Panda et al. 2013).

First agriculture insurance schemes emerged more than 100 years ago in Europe as Mutual Insurance Societies for Livestock and Hail insurance. Livestock mortality and hail insurance are the oldest agriculture insurance lines and were developed without state involvement (Mohapatra 2010). National scale programs were developed in the USA and Canada in the 1930s as privatepublic partnerships. Israel, Spain and Turkey later made significant technical developments in the area of agricultural underwriting and actuarial work, as well as loss adjustment and claim settlement procedures and standards. The work done in these countries paved the way for the implementation of national agricultural insurance schemes in other countries (Carter et al. 2016). Most agricultural insurance schemes are functioning with the involvement of public and private stakeholders. In some countries, they are led by the private sector (e.g. Switzerland, Austria and Germany), and in other countries the public sector plays the leading role (e.g. USA, Canada, Spain, Turkey and Israel) (Molly 2009).

To sum up, the review of existing literature shows that governments try to develop adaptation practices and implement different policies in order to reduce the negative impact of climate events. Despite of the variety of risk management strategies, according to the literature the effective way of overcoming climate hazards is agricultural insurance. Next chapter will try to find whether or not the agricultural insurance is needed in Armenia.

Chapter 2: Agricultural sector of Armenia

2.1. Climate Overview and Climate Change Perspectives in Armenia

In order to survive and prosper, agricultural producers around the world need to cope with a multitude of risks. Producers in emerging markets such as Armenia are facing higher exposure to these risks, as risk management approaches are not well developed. In Armenia agriculture is practiced on about 2,050 thousand hectares (69% of land area). The table below shows agricultural zones of Armenia to give a deeper understanding about climatic conditions and major crops which are produced in these areas (IFAD 2012).

Table 1: Agricultural Zones

Agricultural Zone	Climatic Conditions	Major Crops and Livestock	
1. Ararat Valley	Arid continental with desert and semi-desert	Wine, vegetables, fruits, dairy, meat,	
	vegetation; irrigated with high productivity	poultry	
2. Ararat Valley	Arid continental with desert and semi-desert	Wine, fruit, dairy, bovine meat,	
foothills	vegetation	poultry, pig-breeding	
3. Mountains	Mountainous	Sheep breeding, serial crops, tobacco	
4. Central Zone	Dry steppe or mountain steppe, rain fed fields	Dairy, beef, sheep breeding	
5. Sevan Basin	1,400–2,500m altitudes, irrigated and rain fed	Stock-breeding, potatoes	
	fields; grazing lands above 2,500m		
6. North-East Zone	Woodless plain above 900m, mountain forest	Tobacco, cattle, fruit, wine, pig-	
	below	breeding	
7. Lori-Pambak	Mountain forest and mountain steppe; rain fed	Dairy, livestock breeding, potatoes	
	farming		
8. Shirak	Irrigated dry-steppe, rain fed mountain steppe	Dairy, beef, sheep breeding grain	
9. Zangezur	Lowland, wooded steppe, mountain steppe	Cattle breeding, sheep breeding,	
		tobacco, wine	

Source: FAO 2001, Country Pasture/Forage Resource Profiles

Armenia features a highland continental climate with cold winters and hot summers. The average annual temperature is 5.5 °C (approximately 16 °C in the summer and -7 °C in winter), while maximum temperatures in the summer can reach to 40 °C. The Ararat Valley, center of agricultural production, generally receives only between 32–36 mm of precipitation in the summer. The most serious climatic challenges for Armenia therefore are: low precipitation, increased evaporation from the soil due to high salinization and dry summers, and soil erosion

(driven by spring floods, droughts and strong winds). These factors define the conditions for agriculture. The most common weather shocks include hail, spring frosts and mud flows. Combined, hail and spring frost are estimated to have caused annual production losses of 10% in recent years for some crops, translating to as much as USD 100–150 million in annual losses nationwide (Ahouissoussi et al. 2014).

Armenia faces four major risks as a result of expected temperature increases, as described in the Table 2. The first three hazards may lead to reduced, less certain, and lower quality crop and livestock yields, while the fourth may result in more severe agricultural shocks and more frequent instances of crop failure. The greatest impact is expected for the Ararat Valley as average temperatures in this region are already high (The World Bank 2012).

Climate change impacts	Estimates
Decreased and more variable	Precipitation decreases of 3% by 2030, 6% by 2070, and 9% by 2100
precipitation	(forecasts can vary substantially by month and by climate model)
Higher temperatures	Average temperature increase of 1 °C by 2030, 2 °C by 2070, and 4 °C
	by 2100. By the middle of the century the expected increase is between
	1.5–3 °C
Reduced river runoff	Snow cover decreases of 7% in 2030, 16–20% in 2070, and 20–40% in
	2100; river flow decreases of 6.7% by 2030, 14.5% by 2070, and
	24.4% by 2100 (compared to the 1961–1990 baseline period)
Increased frequency and severity of	Increased incidence of landslides, mudflows and floods as dry soil and
extreme events	deforestation will coincide with extreme storms

 Table 2: Estimated climate change effects in Armenia

Sources: Reports from the World Bank and UNDP

Altogether, these climate change trends are expected to have a range of social and economic effects, of which the most considerable ones related to agriculture are:

- An overall decrease of efficiency in plant cultivation by 8–14%. The productivity of cereals vegetable cultures, potato and fruits will be reduced.
- The productivity of mountain hayfields will decrease by 7–10 %. Therefore the number of cattle will decrease by 30%, leading to an estimated reduction in cattle breeding between 28–30%.
- Increase in food shortages and food prices as agricultural productivity falters.
- An increased exposure to new pests and diseases for crops and livestock due to temperature increases.
- Lowland regions (up to 1,000 m) are expected to experience the most significant declines in production for both rain fed and irrigated crops. Apricots and grapes are expected to experience the most significant yield losses due to decreased water availability (UNDP and SEI 2009).

2.2. Structure and Performance of the Agricultural Sector in Armenia

Agriculture is Armenia's largest economic sector, comprising about 20% of the economy as of 2016. After Armenia became independent in 1991, agriculture became strategically important in terms of providing food security. As a result, both its share of the economy and of employment increased to over 30% and 40%, respectively. With economic growth resuming, the sector's share of the economy declined, but it continues to employ over a third (36%) of the country's work force (Millns 2013).

The rapid and disorganized process of land privatization following the dissolution of Soviet collective farms caused a series of problems, including uncertainty about the allocation of water rights. More than 150,000 ha of arable land and half of former pasture land remains unused as a consequence of problems resulting from the privatization process. Most farm equipment is outdated and farm productivity is lower than it could be, considering historic performance and known best practices. Most farmers are unable to produce enough volume required for commercial enterprise. About a third of Armenian farmers consume all of their produce, while only a quarter sell or exchange 80–100% of their production (USAID 2014).

2.3. Major agricultural risks in Armenia

This section of the study concentrates on analyzing climate hazards which are related to agricultural productivity particularly in Armenia. Prior reports, findings and research projects, as well as farmer surveys consistently identify three weather hazards of primary concern impacting Armenian agricultural performance: **hail**, **frost**, and **drought**. Other weather-related perils that have the potential to inflict significant damage include **windstorms** (reducing yield and quality of fruit production) and heavy localized **rainfall and flooding** that can stall field work, stress livestock, and wash away seeds, young plants, and valuable fertilizer inputs. The main concerning climate hazards (hail, frost and drought) should be discussed below, to understand the types of climate hazards to which farmers are mostly vulnerable.

HAIL

Hail is defined as precipitation of either transparent or partly or completely opaque particles of ice (hailstones), usually spheroid, conical or irregular in form and of diameter very generally between 5 and 50 mm, which falls from a cloud either separately or agglomerated into irregular lumps. The extent of the damage to crops, vegetation, buildings, vehicles, etc., which is a result of contact with hail is usually directly related to the size of the hailstones. Hail forms when moist air is rapidly up-drafted into cooler air layers during summer thunderstorm processes (Meteoterm 2017).

Hail is one of the most costly and frequent agricultural risks in Armenia, inflicting damage multiple times every year. Hail maps, such as the one from Hydromet (Figure 1) also indicate the general occurrence of intense thunderstorm activity that arise out of local topographic conditions and seasonal atmospheric circulations, helping to explain why some areas are subject to hail hazard more frequently than others.





Source: Armenian Hydromet

However, while recorded historic data suggests a greater hail occurrence in regions north of Yerevan, it is important to note that the Ararat Valley to the south is much more sensitive to it given the high concentration of agriculture here. In 2013, a hailstorm lasting 43 minutes destroyed up to 100% of crops on some farms, overall causing damages estimated at USD 60

million (AMD 25 billion)(Eurasianet.org 2013). This and a 2011 hail event are the most severe cases in recorded history. Average annual losses related to hail were estimated at USD 30–40 million in 2005. Other sources also indicate that 368 villages are located in zones with higher risk of hail occurrence—representing 15–17% of the agricultural area (The World Bank 2009).

Major hail damage is affecting both fruits and plants vegetation. Major losses are observed for vegetables, orchards and vineyards. Intense hail can drop fruit and cause heavy bruising, resulting in both loss of quality and yield. Soft fruits such as apricots and grapes are particularly susceptible to hail damage. Primary hail damage often leads to secondary damage by diseases. Losses from disease caused by hail damage are often much higher than the actual primary hail damage. There are several hail mitigation activities available for extensive crop growing, of which hail-protection nets prove to be the most effective hail protection technology. Hail-protection nets could be applied for orchards and vineyards, while serving also as a deterrent to bird predation. Available data estimate the cost of installing hail nets at AMD 8–10 million per hectare for imported nets and at AMD 4–5 million for locally produced ones. Such hail nets have an estimated lifespan of 15–20 years (Meteoterm 2017). Other interventions, such as hail cannons, are not shown to be effective means of hail protection.

DROUGHT

Drought is generally characterized by a moisture deficit or deviation below an anticipated mean value for the time frame in question. The manifestation of drought on production outcomes varies widely depending on the onset and duration of the shortfall relevant for a particular crop. Drought is usually referenced with respect to the timing and quantity of rainfall. Drought conditions can also be exacerbated by interactions between atmospheric temperature, wind extremes and soil types (considering their different moisture retention capacity (Meteoterm 2017).

Severe region-wide drought can have long-term production, livelihood and social consequences, as observed following the 2000–2001 droughts that caused direct losses of about USD 110 million (AMD 38 billion). Upon examining the inter-annual variability of precipitation it may be concluded that such catastrophic droughts have a probability of occurring once in 15 years (UNDP 2013). Localized drought can also be considered a systemic type of event as it impacts many producers across the area and across their different farming activities and thus greatly reduces the benefit of crop diversification. Drought risk has greater implications for livestock and household level dairy production than hail or frost. Excessive heat, which often accompanies drought, stresses animals, substantially reducing weight gain and milk production. Extensive pasture grazing can become much more limited while at the same time supplemental fodder costs can increase.

FROST

Frost or cold wave (semi-systemic / semi-idiosyncratic) is defined as damage to vegetation occurring when the water that is part of the cell structure of the plant solidifies, bursting cells walls and deteriorating the plant materials. The risk of damage by frost may be expressed as the probability or frequency of killing frost on different dates during the growing season, or as the distribution of dates of the last killing frost of spring or the first of autumn (Meteoterm 2017).

Frost is recognized as an often-rapid decline in nighttime or early morning air temperature to below freezing levels during the growing season, after the usual last "frost free day" or before the usual onset of fall/winter frost. Late spring frost damages or destroys vegetative and reproductive growth with the potential to reduce yields to zero. Early fall frost can affect yields and quality. Countrywide frost data between 1975 and 2006 indicates that the number of days experiencing frost varies between 32 and 118 (UNDP 2013). While demonstrating a modestly increasing trend in terms of total frost days, the variance of frost days has noticeably increased beginning in the early 1990s.

Tolerance to frost varies among agricultural crops, with wheat and apples being the most tolerant, while potatoes are most susceptible, incurring damage at temperatures only slightly below freezing. Apricot trees, which blossom earliest among fruit trees in the spring, are the most vulnerable to strong early spring frost effects, which frequently result in substantial yield loss for Armenian growers. Some areas of Ararat and Armavir marzes have been exposed to late spring frosts. They rarely occur, but cause significant damage to apricots, peaches and potato crops.

From the review of the secondary data it become obvious that climate change will bring to higher temperature and less precipitation in the future, however it does not mean that there will be less extreme weather events such as hail and frost. The climate change (even if it is global warming) will lead to more unpredictable weather events which gradually harm agricultural sector not only in Armenia but worldwide.

Chapter 3: Methodology

To answer to the first research question and understand policies and practices which help to reduce farmers' vulnerability to climate hazards the review of existing literature was conducted. The literature shows that one of the best policies which helps farmers to overcome weather hazards and to increase agricultural productivity is agricultural insurance policy. Then, the review of various reports and statistics of whether events helps to answer the second research question of this study.

In order to understand in what stage is the Government of Armenia now (RQ3) in implementing the agricultural policy and what would be farmers' reaction (RQ4) **mixed methodology** of the research is used.

The qualitative data analysis - tree in-depth face-to-face interviews were conducted with the experts from the Ministry of Agriculture to understand to what extent agricultural insurance will increase agricultural productivity in Armenia, what are the possible obstacles in implementing that policy and do they think that agricultural insurance will be well received by the farmers.

The quantitative data analysis- surveys with the farmers (N=112) were conducted in Armavir and Ararat marzes. Sampling strategy is **purposive**; these two marzes were chosen because they are mostly exposed to harmful weather events. The analysis of the quantitative part shows the degree of vulnerability of Armenian farmers to climate hazards and their attitude towards the upcoming policy.

Chapter 4: Qualitative Data Analysis

4.1. Climate hazards and its consequences

The aim of the first group of questions were to determine the major types of climate hazards and understand the interviewees perceptions of coping mechanisms with climate hazards. To the first question regarding the decline in agricultural productivity, all the interviewees answered that there was a loss of income due to damaging weather events and the consequences were terrible. One interview stated, that "The agricultural sector is one of the most significant economic sectors in Armenia. However, despite its significant role for the country, agricultural productivity remains below its potential". They mentioned that in recent years the damage caused by drought, hail, floods and frost amounts to approximately \$15-30 billion per year.

When responding to the second and third questions "What are the types of climate hazards in Armenia?" and "What are the consequences of these climate hazards for farmers?" all the interviews emphasized that most of the damage was caused by hailstorm. However, drought, floods, frost and windstorms are also a significant threat to the agriculture in Armenia. One of the experts explained that climate change may bring to increase of thunderstorms and hailstorms during spring and summer seasons which will endanger agricultural sector significantly. Droughts and late spring frosts are frequently harming Armavir and Ararat provinces. Hail is more dangerous for Shirak, Aragatsotn and Armavir. As a result of climate change we recently observed mid- June droughts, which had a negative impact on agriculture. Each year, 10-15% of the cultivation areas are damaged by the hail causing in some cases from 80 to 100% of damage.

Overall, the interviewees concluded that Armenia's agriculture will become increasingly vulnerable because of the effects of climate change. They all mentioned that the important reason

of the decrease of agricultural productivity is a lack of effective risk management systems, which could shield farmers from local weather perils.

4.2 Mitigation of climate risks

This section will elaborate the ways of coping with the unpredictable weather events. To the question "What policies should be implemented in order to reduce farmer's vulnerability against climate hazards?" all the experts provided a detailed overview of ways to overcome abrupt weather changes that cause damages and loss.

"Nowadays about 8% of cultivated areas of Armenia are protected with anti-hail stations. Around 60-70 ha of the territory of Armenia are protected by anti-hail net, which are efficient by 100%." Another expert explained that anti-hail nets are reliable way to protect the yield vineyards and fruit trees.

All the experts provided that a number of programs were implemented by the Government of Armenia during recent years to reduce the impact of damaging weather events. One interviewee described a program that provided an opportunity to expand the scope of use of highly productive seeds. The program was aimed to prevent the use of low quality seeds and to expand the varieties of new plants accommodated to climate change.

Another program implemented by the Government of Armenia is "Plant Protection Program" which aims to reduce plant deceases and fight against plant pests. One of the interviewees stated that there was a project named "Rural Advisory Service" which provided professional consulting services about disaster risk management. Based on the analysis of the losses due to weather events, there is an urgent need of new policy which will enable the reduction of the climate hazards' consequences".

4.3. Agricultural insurance

Third set of questions was about agricultural insurance and its future implementation in Armenia. To the question "The Government of Armenia more than once mentioned about a gradual implementation of agricultural insurance. Can you please elaborate a little about this?" one of the interviewees mentioned that the Government of Armenia recognized the issues and intended to establish agricultural insurance system starting with a pilot project. He stated that climate change risk was another major factor influencing the urgency for introducing a viable agricultural insurance system.

The Government of Armenia is just beginning to take the first step towards the development of the program aimed to support agro-insurance. It recognizes the importance of this topic and is committed to create a program that will eventually lead to the introduction of agro-insurance. Several initiatives are underway in such areas as food safety, irrigation and agro-tourism.

The objective of the Programme is to reduce the vulnerability of Armenian farmers towards production risks and losses related to extreme weather events. This includes all farmer categories: micro, small, medium, and large. To this end, one of the experts explains that, a viable agricultural insurance system in Armenia shall be set up for the following:

- Contribute to the mitigation of farmers' weather-related production risks;
- Reduce the financial losses associated with weather-related perils;
- Improve commercial viability of agricultural investments.

As per the next question "Should it be a mandatory insurance?" the experts responded that at the beginning it will not be a mandatory and they would be unable to give more detailed information about the future structure of agro-insurance. "...Within upcoming two years the pilot program

should be implemented. If the results are positive, there will be large-scale investments in agricultural insurance..."

They mentioned only that the involvement of multiple public and private stakeholders was guaranteed. To be specific, agro-insurance should be implemented with the support of Ministry of Agriculture which will support piloting and rollout of agricultural insurance operations. Potential partner to the program will be insurance companies, whereas as the Central Bank of Armenia and the German Development Bank (KfW) are expected to take the role of facilitators. They will also monitor the implementation of the project according to best international standards. "...Within the context of a consistent long-term agricultural development strategy, the proposed insurance system will eventually help to promote a gradual shift from subsistence farming to commercial agriculture".

4.4. Obstacles on the way of implementation

Last set of questions were designed to understand if there were any obstacles in implementing agro-insurance policy. Is it considered that agricultural insurance will be well received or there will be problems with implementing?

Armenian insurance companies have no experience with agro-insurance other than implementing a few very small-scale, temporary projects in the past. Currently, there are eight insurance companies that are active in the market and the main barrier preventing insurance companies from entering the agro-insurance market is their own lack of knowledge of the sector, their perception that affordability of insurance will be problematic, and the lack of data that can be used for pricing and actuarial calculations. Most of the large Armenian insurance companies are interested in the possibility of offering agro-insurance. However, they view their potential future participation in the context of a government-supported program, given their lack of knowledge to start without external support. None of them indicated that they would be able or willing to approach the sector on their own. Extensive technical assistance is needed for insurance companies to offer agro-insurance products successfully.

According to the interviewees regardless of enterprise size, the introduction of agro-insurance presents an opportunity to mitigate risks and contribute to the economic stability of agricultural producers and farmers. Most are aware of what agro-insurance is, in principle, although they do require some education regarding the specifics of contractual conditions and pricing.

Chapter 5: Quantitative Data Analysis

The survey conducted in Armavir and Ararat marzes discovered interesting data for discussion. The questions were designed to get information about weather hazards which mostly bothers farmers, as well as to determine the attitude of farmers towards implementation of agricultural insurance policy.

The primary data received from the surveys was analyzed with using SPSS statistical software. The descriptive statistics shows that from the total 112 respondents, about 53 % were from Armavir marz and the remaining 47% were from the Ararat marz. The majority of the respondents (81 farmers) stated that they have a loss of income due to weather hazards, whereas the 31 farmers have not.



The Chart 1 below shows that Hail (41%) is a most damaging weather event in these two marzes. In the second place is frost (21%), snow (34 %) and drought is only 4 %.



The majority of the respondents 40% face with damaging weather events at least twice a year, 23% once a year, 25% more than twice a year and only 24% meet harmful weather events less than once a year (Chart 2).

From the crosstab (Table 3) it is obvious that the damage occurs from the events which they encounter most. Those who meet hail frequently, their agricultural products are damaged by hail.

		0	Worst damage		
			snow	hail	strong wind
What type of climate hazard encounter more	snow	Count	33	4	1
		% within What type of climate hazard encounter more	86.8%	10.5%	2.6%
		% within Worst damage	84.6%	8.3%	25.0%
	hail	Count	4	42	
		% within What type of climate hazard encounter more	8.7%	91.3%	
		% within Worst damage	10.3%	87.5%	aa
	strong wind	Count	1		3
		% within What type of climate hazard encounter more	25.0%		75.0%
		% within Worst damage	2.6%		75.0%
	drought	Count	1	2	
		% within What type of climate hazard encounter more	4.2%	8.3%	
		% within Worst damage	2.6%	4.2%	
Total		Count	39	48	4
		% within What type of climate hazard encounter more	34.8%	42.9%	3.6%
		% within Worst damage	100.0%	100.0%	100.0%

Table 3: Crosstab: What type of climate hazard encounter more/Worst damage

From 112 respondents the majority (66 people) mentioned that they want to insure their agricultural products against weather events, 32 of them don't want the agricultural insurance and 14 of them "don't know".

The t-test shows that there is a statistically significant difference at .000 level of significance between those who are for or against insuring. Those who are willing to insure their crops report more frequent damaging weather events.

The 3 chart depict the reasons why 28, 6 % of the respondents are against agriculture insurance.



Another T-test at the .000 level of significance shows that those who encounter climate hazards more frequently are for insuring their crops, and those who don't want to insure their products encounter climate disasters rarely.

To wrap it up, the results of the survey shows that there is climate hazards can be considered as a real treat to agricultural productivity. Hail, snow and frost are weather events that mostly harms agricultural sector in Ararat and Armavir. The majority of the respondents want to insure their crops.

Conclusion and Recommendations

The issue of climate change and its impact on agricultural now requires great attention of scholars and scientists. The climate hazards decrease agricultural productivity. Unpredictable weather conditions cause loss of income and lead to a poverty among farmers. Different countries worldwide are now trying to cope with climate changes and developing policies or mitigation strategies to reduce the impact of weather conditions on their agricultural sector.

The review of the relevant literature emphasized different ways to reduce farmers' vulnerability to terrible weather changes. Governments enable involvement of local institutions and improve their infrastructure to be able to respond effectively, change farming strategies and implement new practices of plant cultivation and adaptation to new climate conditions. Finally, they train and educate farmers to reduce their vulnerability to climate shocks. There are also other mitigation measures such as supplemental irrigation, diversification, producing lower risk products, etc. which helps farmers to reduce the damage. However according to different sources, these strategies are not always effective. Agricultural insurance is considered to be the most feasible way of preventing income loss and reduction of negative climate impacts on production.

The research shows that in Armenia there is a significant income loss due to damaging weather conditions. Findings from the survey and in-depth interviews show that farmers face damaging climate hazards quite often. The majority of farmers who face damaging climate events and have loss of income want to insure their crops against weather events.

According to results of in-depth interviews with the experts from the Ministry of Agriculture, the implementation of agro-insurance policy is now in process. The experts stated

that the pilot program should be implemented in two years and various stakeholders should be involved. Thus, agriculture of Armenia would greatly benefit from the introduction of insurance policy covering production risks.

Hopefully, the agro-insurance will improve Armenia's agricultural risk management environment, contribute to stability of farmers' income, and increase the creditworthiness of agricultural borrowers. The proposed insurance system may also provide an effective alternative to current governmental ad hoc relief payments used in the event of natural disasters.

Armenian farmers have no experience with agro-insurance, since no products have been introduced as of yet. Nevertheless, surveyed farmers seemed to have a general understanding of agro-insurance and how it works in principle. However, they lack specific insights into types of policies, pricing and coverage options that could be available. Based on these facts the first recommendation to the government of Armenia can be done to organize awareness building campaigns among farmers before the implementation of the program.

Secondly, several farmers stated that they would only use insurance if there is a close involvement of the government, since they have greater trust in the government than into insurance companies. Trust is the most critical driver of successful insurance scheme and needs to be built and protected. All stakeholders need to participate in building this trust, while one is enough to destroy it. The main reason for a lack of farmers' trust towards insurance companies is the perception that insurance companies unfairly refuse to pay claims, or they only pay a portion of loss, or significantly delay the repayment process.

34

List of References

- Adger, W. Neil. 2006. "Vulnerability." *Global Environmental Change*, Resilience, Vulnerability, and Adaptation: A Cross-Cutting Theme of the International Human Dimensions Programme on Global Environmental ChangeResilience, Vulnerability, and Adaptation: A Cross-Cutting Theme of the International Human Dimensions Programme on Global Environmental Change, 16 (3): 268–81. doi:10.1016/j.gloenvcha.2006.02.006.
- Brooks, et al. 2017. "Vulnerability, Risk and Adaptation: A Conceptual Framework." *GSDRC*. Accessed March 17. http://www.gsdrc.org/document-library/vulnerability-risk-and-adaptation-a-conceptual-framework/.
- Busby, Joshua, and Nigel Purvis. 2004. "The Security Implications of Climate Change for the UN System." *Woodrow Wilson International Center for Scholars*. http://www.belfercenter.org/node/89594.
- Carter, Michael R., Lan Cheng, and Alexandros Sarris. 2016. "Where and How Index Insurance Can Boost the Adoption of Improved Agricultural Technologies." *Journal of Development Economics* 118 (January): 59–71. doi:10.1016/j.jdeveco.2015.08.008.
- Cervantes-Godoy, Dalila, Shingo Kimura, and Jesús Antón. 2013. "Smallholder Risk Management in Developing Countries." OECD Food, Agriculture and Fisheries Papers. Paris: Organisation for Economic Co-operation and Development. http://www.oecdilibrary.org/content/workingpaper/5k452k28wljl-en.
- Eurasianet. 2013. "Armenia: Could Fed-Up Farmers Foster Unrest?"
- Fellmann, Thomas. 2012. "The Assessment of Climate Change-Related Vulnerability in the Agricultural Sector: Reviewing Coceptual Frameworks." *Pablo de Olavide University*.
- Füssel, Hans-Martin, and Richard J. T. Klein. 2006. "Climate Change Vulnerability Assessments: An Evolution of Conceptual Thinking." *Climatic Change* 75 (3): 301–29. doi:10.1007/s10584-006-0329-3.
- Halstead, Paul, and John O'Shea. 1989. "Bad Year Economics: Cultural Responses to Risk and Uncertainty." *Cambridge University Press*.
- Harvey, Celia A., Zo Lalaina Rakotobe, Nalini S. Rao, Radhika Dave, Hery Razafimahatratra, Rivo Hasinandrianina Rabarijohn, Haingo Rajaofara, and James L. MacKinnon. 2014. "Extreme Vulnerability of Smallholder Farmers to Agricultural Risks and Climate Change in Madagascar." *Philosophical Transactions of the Royal Society B: Biological Sciences* 369 (1639). doi:10.1098/rstb.2013.0089.
- IFAD. 2012. "Rural Areas Economic Development Programme: Republic of Armenia."
- Kelly, P. M., and W. N. Adger. 2000. "Theory and Practice in Assessing Vulnerability to Climate Change andFacilitating Adaptation." *Climatic Change* 47 (4): 325–52. doi:10.1023/A:1005627828199.
- Klasen, Stephan, and Malte Reimers. 2017. "Looking at Pro-Poor Growth from an Agricultural Perspective." *World Development* 90 (February): 147–68. doi:10.1016/j.worlddev.2016.09.003.
- Liu, Fei, Charles P. Corcoran, Jianping Tao, and Jing Cheng. 2016. "Risk Perception, Insurance Recognition and Agricultural Insurance behavior—An Empirical Based on Dynamic Panel Data in 31 Provinces of China." *International Journal of Disaster Risk Reduction* 20 (December): 19–25. doi:10.1016/j.ijdrr.2016.10.005.
- Machinski, Paulo Alberto, Mauro Cézar de Faria, Vilmar Rodrigues Moreira, and Alex Antonio Ferraresi. 2016. "Agricultural Insurance Mechanisms through Mutualism: The Case of an Agricultural Cooperative." *Revista de Administração* 51 (3): 266–75. doi:10.1016/j.rausp.2016.06.004.
- Meteoterm. 2017. "METEOTERM WMO." World Meteological Organization. https://www.wmo.int/pages/prog/lsp/meteoterm_wmo_en.html.
- Millns, John. 2013. "Agriculture and Rural Cooperation Examples from Armenia, Georgia and Moldova." No. 2013-2.
- Mohapatra, Sanket. 2010. "Mobile Money Platforms for Agricultural Micro-Insurance." Text. *People Move*. March 11. http://blogs.worldbank.org/peoplemove/mobile-money-platforms-for-agricultural-micro-insurance.

- Molly, E. 2009. "Index Insurance and Climate Risk: Prospects for Development and Disaster Management." *GSDRC*. http://www.gsdrc.org/document-library/index-insurance-and-climate-risk-prospects-for-development-and-disaster-management/.
- Panda, Architesh, Upasna Sharma, K. N. Ninan, and Anthony Patt. 2013. "Adaptive Capacity Contributing to Improved Agricultural Productivity at the Household Level: Empirical Findings Highlighting the Importance of Crop Insurance." *Global Environmental Change* 23 (4): 782–90. doi:10.1016/j.gloenvcha.2013.03.002.
- Smit, B., and J. Wandel. 2006. "Adaptation, Adaptive Capacity and Vulnerability." *Global Environmental Change* 16: 282–92.
- Steinmann, Roland. 2014. "Some Reflections on Smallholder Agriculture, Microinsurance, and Rural Development." *Enterprise Development and Microfinance* 25 (4): 311–26. doi:10.3362/1755-1986.2014.029.
- The World Bank, The World. 2012. "Armenia Climate Change and Agriculture Country Note." 73332. The World Bank. http://documents.worldbank.org/curated/en/750371468208161919/Armenia-Climate-change-and-agriculture-country-note.
- Thornton, PK, T Schuetz, W Förch, L Cramer, D Abreu, S Vermeulen, and BM Campbell. 2017. "Responding to Global Change: A Theory of Change Approach to Making Agricultural Research for Development Outcome-Based." *Agricultural Systems* 152 (March): 145–53. doi:10.1016/j.agsy.2017.01.005.
- UNDP. 2013. "Climate Risk Management in Armenia: Country Report."
- UNDP and SEI. 2009. "The Socio-Economic Impact of Climate Change in Armenia." http://www.am.undp.org/content/armenia/en/home/library/environment_energy/the-socioeconomic-impact-of-climate-change-in-armenia.html.
- USAID. 2014. "Awareness, Literacy, Access and Usage of Financial Services by MSMEs in Regions of Armenia." http://www.edrc.am/news-events/events-news/288-presentation-of-baseline-assessment-report-awareness,-literacy,-access-and-usage-of-financial-services-by-msmes-in-regions-of-armenia%E2%80%9D.
- Wisner, Ben, Piers Blaikie, Terry Cannon, and Ian Davis. 2003. At Risk: Natural Hazards, People's Vulnerability and Disasters. 2nd edition. London; New York: Routledge.
- World Bank. 2009. *The Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World*. Edited by Robin Mearns and Andrew Norton. The World Bank. http://elibrary.worldbank.org/doi/book/10.1596/978-0-8213-7887-8.

Appendix A: Interview Questionnaire

Interview questions with the experts from the Ministry of Agriculture

- 1. What are the main reasons which decrease agricultural productivity in Armenia?
- 2. What are the types of climate hazards in Armenia?
- 3. What are the consequences of these climate hazards for farmers?
- 4. How farmers can cope with climate hazards?
- 5. What policies should be implemented in order to reduce farmer's vulnerability against climate hazards?
- 6. The government of Armenia more than once mentioned about the gradually implementation of agricultural insurance. Can you please elaborate a little about this?
- 7. Should it be a mandatory insurance?
- 8. To what extent agricultural insurance will increase agricultural productivity in Armenia?
- 9. What are the possible obstacles in implementing this policy?
- 10. Do you think that agricultural insurance will be well received or there will be problems with implementing?
- 11. Will farmers agree to have agricultural insurance?
- 12. Do you think they need to be convinced or are they eager to see this new policy implemented?

Appendix B: Survey Questionnaire

1. Have you ever had a loss of income due to bad weather events which caused the loss of crops?

- o Yes
- o No
- 2. What type of climate hazard are you encounter more?
- o Rain
- o Snow
- o Hail
- Strong wind
- o Drought
- Not meeting
- \circ Other
- 3. Please mention the climate hazard which caused the worst damage to your agricultural products?
- o Rain
- o Snow
- o Hail
- \circ Strong wind
- o Drought
- No one has brought disaster
- \circ other
- 4. If you have suffered a damage then please mention how often you met these hazards.
- Less than once per year
- Once a year
- Twice a year
- \circ more than twice a year
- 5. Would you like to ensure agricultural products against weather conditions?
- o Yes
- o No
- o Don't know

- 6. In case of negative response please state the reasons.
- o Don't trust
- No necessity
- Lack of finances
- Small household
- Law number of damages
- 7. Which crop would you like to ensure?
- o Vegetables
- o Grapes
- o Grain
- o Fruits
- Other
- 8. If yes, then please state how much are you ready to pay for insurance per month?
- o 5000 AMD
- o 10.000 AMD
- o 15.000 AMD
- o 20.000 AMD
- o 30.000 AMD
- More than 30000 AMD