

# **Economic Consequences of Natural Disasters: Floods and Droughts in Argentina**

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<b>Contents</b>	<b>3</b>
<b>1. Introduction</b>	<b>5</b>
<b>1.1 Motivation</b>	
<b>1.2 Statement of Research Subject</b>	
<b>2. Macroeconomic Impacts of Natural Disasters</b>	<b>9</b>
<b>3. Theoretical framework: Microeconomic approach</b>	<b>14</b>
<b>3.1 Introduction</b>	
<b>3.2 Microeconomic theories</b>	
<b>3.3 Risk</b>	
<b>4. Floods and Droughts in Argentina</b>	<b>20</b>
<b>4.1 Río Salado Basin in Buenos Aires Province</b>	
<b>4.2 San Roque Lake in Córdoba Province</b>	
<b>5. Conclusion and Recommendations</b>	<b>27</b>
<b>References</b>	<b>30</b>



## **1. Introduction**

### **1.1 Motivation**

For my bachelor thesis research I wanted to combine my personal background and interests with the scientific knowledge I obtained during the three years of my bachelor International Development Studies at Wageningen University and Research centre. For several years I have been involved in a local small-scaled development project in Mar del Plata, Argentina, initiated by a local Argentine NGO and funded by a Dutch foundation. In the last three years, I visited Argentina six times, and during a journey in 2009 through some northern provinces, my attention was attracted by droughts as well as floods. At that moment I had no possibility or time to study this phenomena more deeply, but my curiosity and attention were aroused immediately.

These events raised several questions: Were my observations really as severe as they seemed to be? Was it something ‘normal’ and regular that was going on, or was it a recent development? How did the Argentine government deal with these phenomena? How did it affect the livelihoods of local people? Did it increase the chance of falling into poverty? To what extent were economic influences affecting these local people? And to what extent the country in general?

Thinking about these questions, I thought it might be interesting to look into this field for my bachelor thesis. As I became more and more interested in the field of natural disasters and conflicts, I combined my specialization in development economics with following a minor in disaster studies and participating in the courses *Natural hazards and Disasters*, given by dr J. Warner and prof. dr. ir. J.W.M. van Dijk and *Conflict, Development and Disaster*, given by prof. dr. ir. G.E. Frerks.

For me it was extremely interesting to first see and observe possible problematic natural circumstances in real during a journey, then wondering and thinking about it for quite a time, then following two interesting courses on the topic, and finally using and studying it for my Bachelor thesis.

## **1.2 Statement of Research Subject**

From the early history, disasters, caused or worsened by natural factors, have led to immense human and material costs. Some major recent natural disasters, such as the heavy flooding in Pakistan and the tremendous earthquake in Haiti, have brought catastrophic events at the top of the world's agenda. These emergency situations can usually count on much publicity in newspapers, TV programs, etc., as well as in the academic field of disaster studies.

A report from the Integrated Regional Information Network of the United Nations stated in June 2005: 'Natural disasters are happening more often, and having an ever more dramatic impact on the world in terms of both their human and economic costs. While the number of lives lost has declined in the past 20 years - 800,000 people died from natural disasters in the 1990s, compared with 2 million in the 1970s - the number of people affected has risen. Over the past decade, the total affected by natural disasters has tripled to 2 billion. According to the UN's Bureau for Crisis Prevention and Recovery, some 75 percent of the world's population live in areas that have been affected at least once by either an earthquake, a tropical cyclone, flooding or drought between 1980 and 2000'(IRIN, 2005). With regard to this increasing number of affected people, the field of the impacts and consequences of natural disasters is becoming more important. Therefore, it is highly important to do reduce in this field.

When you focus on Latin America, climatic risks play an important role in the current debate on the effects of natural disasters. According to The British Department for International Development (DFID) Latin America, in terms of the effects of climate change, is very much at risk. DFID states in their report: 'The poor in Latin America are already vulnerable to the climate, including hurricanes and the effects of El Niño. Climate change will worsen this picture, with changes in temperatures and rainfall, and an increasing frequency and severity of El Niño, storms and hurricanes.' And: 'Even without future climate change, Latin American countries face regular climate risks including variable rainfall, droughts, floods, and windstorms. In a region where agriculture remains one of the main sectors (employing 30 to 40% of the economically active population) changes in the timing and intensity of rainfall have serious consequences. If the effects of the climate on poverty are not recognized and managed, then gains in development made over decades will remain at risk to a few days of adverse weather. Latin America cannot afford to ignore climate risks' (DFID, 2004).

When we focus on Argentina, this second largest country in South America, is well-known for its agricultural production, i.e. production of beef, corn, wheat and soybeans. According to the CIA Factbook (2010), Argentina benefits a lot from a high amount of natural resources and has an export-oriented agricultural sector. Although nowadays it is hard to imagine, 100 years ago, Argentina was one of the wealthiest countries in the world. Argentina had a great trading position and Buenos Aires was one of the most important cities in the world.

However, in the 20<sup>th</sup> century, Argentina has faced recurring economic crises, high inflation, increasing debts and high political instability. The best known is the recent economic crisis in 2001/2002, when the entire Argentine economy collapsed, which led to almost 60% of the Argentine population under the poverty line (CIA Factbook, 2010). In this sense, the modern history of Argentina can be considered as a turbulent one. There has been written a lot in recent literature about this history, since, in terms of shocks and crises, Argentina has much experience and expertise.

However, in recent years natural factors have become more relevant. Traditionally, political instability, corruption, and high inflation were seen as the main reasons of Argentine crises. Natural factors were seen as less important in explaining Argentine problems. Despite the unmistakable importance of these factors, natural factors have become more relevant in recent years, i.e. with the occurrence of floods and droughts in several regions. Both heavy floods and historically long and severe droughts in certain areas have had a tremendous impact on society. Although these natural disasters are widely recognized, this is not very much seen as a factor in explaining broad economic and social development.

In this context and to address these factors, I will look into the field of the impact of natural disasters in terms of economic consequences. I have formulated a main research enquiry that I hope to answer when processing and analyzing the studied literature. This question is as follows: What are the economic effects of floods in Buenos Aires province and droughts in Córdoba province in Argentina? The chapters that follow contribute to the main query in order to reach possible answers. Chapter 2 is about the macroeconomic impacts of natural disasters. By analyzing several articles on this topic, the impacts of natural disasters in a macroeconomic perspective are elaborated. Chapter 3 contains a theoretical framework on the microeconomic side of the impact of natural disasters. This theoretical framework,

about the role of vulnerability, risk and poverty among other factors, will determine the borders around the concepts which are addressed in this thesis. In Chapter 4 this is applied to a rural area in the Buenos Aires province, which suffers from the risk of floods and an area in the province of Córdoba, which suffers from the risk of droughts. In Chapter 5 the main conclusions are described.



## 2. Macroeconomic Impacts of Natural Disasters

As pointed out in the introduction, no other conclusion can be made than that it's important to do research in the field of natural hazards and disasters. It is important to endeavor to improve the ability to predict disasters, to prepare for them and to study the ways the resilience of groups can be increased and harm can be mitigated. In the literature, several scholars write about these topics and try to obtain better insights regarding impacts of natural disasters. This thesis will focus on the micro- and macroeconomic effects of natural disasters. Economist Ilan Noy, recently studied the economic consequences on a macroeconomic level, by using a multi-country and multi-event framework. In his article, called *The macroeconomic consequences of disasters*, he focuses on the natural disasters' *ex post* impact on the macroeconomy by measuring and estimating the costs of these crises in terms of forgone production, and using an international macroeconomic panel dataset, to be able to look at the determinants of those costs critically (Noy, 2009).

Another article on this topic was published in 1993 by J.M. Albala-Bertrand, which was called *Natural Disaster Situations and Growth: A Macroeconomic Model for Sudden Disaster Impacts*. In this study, the relation between a natural disaster and its potential effects on the growth rate of output is examined. This has been done by building a simple macroeconomic model with data based on a limited set of disaster events and accomplished with a statistical before-after analysis. First, to bolster this analysis, some definitions and assumptions are made. A disaster situation is analytically divided into three different components: the impact, the response and the incidental interference of a disaster. To separate a disaster situation this way, a more accurate approach is formulated to examine the actual effects of the growth rate. Second, the effects of a disaster are linked with the loss-to-GDP ratio, a direct relationship between the magnitude and the consequences of a disaster, which means that a larger natural disaster causes larger damage in terms of GDP. However, an important note that has to be made is that this relationship cannot be interpreted as a synonym of the strength of the disaster. Hence, a smaller ratio can have worse economic effects if the event hits a particular highly valuable economic activity, i.e. when droughts or floods take away the region's most important source of income (Albala-Bertrand, 1993).

The main findings of this study can be stated as follows. It likely that GDP increases in the periods immediately following a natural disaster, since most of the damage caused by disasters is reflected in the loss of capital and durable goods. Because stocks of capital are not measured in GDP and replacing these stocks is, GDP increases after a natural disaster (Skidmore and Toya, 2002). Furthermore, a fall in the growth rate of output caused by capital loss due to a disaster represents only a small fraction of the ratio disaster loss-to-output. Another conclusion based on the outcomes of the model is that the total compensatory expenditure (the investments that have to be done to reconstruct after a disaster to keep the level of output as if there were no disaster) is a smaller fraction of the disaster loss ratio than the fall in growth rate. This implies that the required reconstruction expenditures rarely need to be large, even in large natural disaster situations. Another outcome is that the reconstruction effort can be both moderate and spread over several years without affecting the output negatively. These findings all support the general conclusion of this article that external responses would be better aimed at directly helping the actual victims of disasters than working under the assumption that every economy will be affected heavily by any disaster (Albala-Bertrand, 1993).

Another – more recent – paper is a study by Toya and Skidmore (2006), called *Economic development and the impacts of natural disasters*. In this study, the relationship between economic development and natural disasters is examined. Disaster impact data has been analyzed in order to be able to say something about the relationship between social/economic development and natural disasters. The starting point is the reasoning that ‘as a country develops, it devotes greater resources to safety, including implementing precautionary measures designed to reduce the impacts of natural disasters’, and economic development in reducing vulnerability is considered to be important (Toya and Skidmore, 2006). Furthermore, they build upon the ideas of previous researches, like Horwich, who argues in his article about the response to the Kobe earthquake in 1995, that an important factor in the economy’s response to a natural disaster is its level of wealth (Horwich, 2000). Also, the reasoning that the people most affected by disaster impacts are those who have weaker economic and political bases, is seen as a basic principle.

Toya and Skidmore’s work extends this principles by focusing more on the disaster-safety-development relationship, and the relationship between development and economic

damages/GDP. Using two sets of regressions, Toya and Skidmore hypothesize that countries with a higher level of educational attainment, greater openness, and a more highly developed financial sector will experience fewer deaths. Several assumptions are tested, like if a higher level of education enables people to make better choices with regard to locations and construction methods of settlements, and if greater openness provides advantages in the form of more competition and access to technological knowledge from abroad which may reduce risk. The role of the financial system is also investigated by questioning if a more highly developed system has more access to information, and is therefore more efficient and less likely to finance risky projects.

The results of the regressions show that per capita income is inversely correlated with both disaster deaths and damages/GDP. The results also show that a higher level of education, greater openness, and a stronger financial sector are associated with fewer deaths. Moreover, higher income levels have led to significant improvements in safety over time. The study has two main conclusions: 1) when an economy develops there are fewer disaster-related deaths and damages/GDP, 2) human and/or economic losses are less in countries with higher levels of education, more open economies, more complete financial systems, and smaller governments. With these conclusions, Toya and Skidmore, plead for more attention on non-income factors in reducing disaster deaths and damage, like education, the openness of the economy and the financial system.

The article of Noy is the most recent study on the topic of macroeconomic consequences of natural disasters. The article by Noy is also the most relevant one, since the majority of the articles are specific case studies, whereas Noy's based on the EM-DAT database with a worldwide coverage. For these two reasons I will go deeper into this study. Noy uses the Centre for Research on the Epidemiology of Disasters (CRED) for a definition of a disaster. CRED collects data on natural disasters and their human impact, which they document in the EM-DAT database. They define a disaster as follows: 'a natural situation or event which overwhelms local capacity, necessitating a request for external assistance' (CRED). An important assumption is that, according to Noy, the impact of a specific natural disaster on the macro-economy depends on the magnitude of the disaster relative to the size of the economy. In other words, the more severe the event in relation with the size of the economy, the more severe its impact on the macro-economy. Noy chooses to describe the short-run dynamics of the macro-economy following disasters.

Noy assumes that natural disasters have a statistically observable adverse impact on the macro-economy in the short-run. He also assumes that costlier events lead to more slowdowns in production. The underlying mechanism behind this correlation is that the capital that is affected by a natural disaster loses productivity and slows down production. Noy starts by questioning why developing countries and smaller economies face much larger output declines due a disaster than developed countries or bigger economies do. Then, he continues with the idea of studying ‘the determinants of the adverse macroeconomic output costs’. The results of his study are interesting and noteworthy. As said before, Noy aims at describing the short-run dynamics of the macro-economy with relation to the occurrence of a natural disaster. An advantage of doing so is that it avoids possible problems with endogeneity, because in the long-run the disaster impact may be influenced by endogenous factors. There are several relevant results, which give a good view of the general macroeconomic impact of disaster situation. The most important findings are stressed out below.

First, the role of the level of human capital in a financial crisis is examined. It is found to be likely that with a higher level of human capital, the impact of physical capital loss will be lower. This statement is corroborated by the findings of an analysis of the role of illiteracy, which shows it is plausible that countries with higher level of illiteracy will experience a more adverse effect on output growth as a result of a natural disaster. Despite this conducive point, the credibility of this point decreases, since the measure of illiteracy is the only proxy of human capital that was available considering the needed sample size (Noy, 2009).

Second, the importance of governing institutions has been measured. The result is that institutional capacity is positively correlated with macroeconomic costs. Presumably, this is based on the reasoning of an more efficient government, which is better able to recover from the circumstances in the private sector, as well as a more efficient and powerful way of public intervention. Also, the income level per capita is positively correlated with the costs of a disaster at a macroeconomic level, which is possibly due to a higher ability to counter exogenous shocks with counter-cyclical fiscal policy, i.e. decreasing taxes in times of a low aggregate demand in order to stimulate consumers in their consumption and firms in their investments.

Third, more structural aspects are analyzed, like the size of the government (measured in a ratio of government consumption and GDP) and the size of the exports (measured in percentage of GDP). Both analyses give a negative relationship to disaster impact, which are considered as plausible since a country with a larger government is supposed to be able to mobilize more resources more rapidly for reconstruction and recovery, and a country which is more open to trade faces less problems in the demand for products, since they can obtain products more easily abroad. This means they are less dependent on domestic production and more open to foreign markets, so it will be easier to rely on foreign products and services in the post-disaster phase of recovery and reconstruction.

Next, the role of the geographical location is discussed. It is often assumed that tropical countries are more exposed to disaster impact, i.e. in terms of public health due to possibly more rapidly spreading of infectious diseases after a natural disaster. This notion has been hypothesized and analyzed by Noy. The results turn out rather remarkable, since according to the analysis more tropical regions are likely to experience higher growth rates than non-tropic regions. Noy argues that a possible explanation might be the greater ability of agriculture to recover in these regions, since in tropical climates some crops can be harvested more frequently in a year due to faster growing conditions.

Finally, Noy examines the financial market conditions, whether this matters for the consequences of disaster events. Two components are measured: the size of the domestic stock market and the level of domestic credit. There is no evidence of assuming that stock markets play a significant role in keeping an economy away from natural disaster impacts. Regarding the level of domestic credit, in terms of foregone output growth, more domestic credit appears to decrease the costs of disaster events. Finally, for several analysis no evidence has been found, regarding the possible correlation between the relative size of the agricultural or mining sectors and the impact of disaster, nor the possible correlation between a higher vulnerability and island economies.

### **3. Theoretical framework: microeconomic approach**

#### **3.1 Introduction**

As addressed in chapter 2, natural disasters may have many influential consequences at a macroeconomic level. But what about the microeconomic level? It is very likely that natural disasters and shocks may result in tremendous effects on the livelihoods and economic possibilities of the affected people. The direct impact of shocks and disasters can be enormous, immediately resulting in a high level of possible income uncertainty, losses of important assets, capital and resources, and higher possibilities of personal damage like diseases, traumatized experiences, family losses, and so forth. This has very much to do with the vulnerability of people and their livelihoods. In the short-run this may be visible, but what about the long-run? How are people able to cope with natural shocks? Or in other words: to what extent are people able to rely on their resilience in a longer period of time? And especially for this long-run, what about the so-called ‘poverty trap’? In this chapter the microeconomic side of the impact of natural disasters is considered.

#### **3.2 Microeconomic theories**

To address the questions raised above, some definitions need to be made. In an article by Dercon (2005), some relevant definitions of the concept of vulnerability are reviewed. In this article the central argument is that ‘risk is not just another expression or dimension of poverty, but it is also an important cause of persistent poverty and poverty traps’ (Dercon, 2005). A definition of vulnerability by Chambers (1989) is that vulnerability “refers to exposure to contingencies and stress, [...] which is defencelessness, meaning a lack of means to cope without damaging loss”. The World Development Report 2000/2001 by the World Bank provides, among others, this definition: “vulnerability measures [...] - the likelihood that a shock will result in a decline in well-being”. Finally, the most relevant definition for this thesis – and the one which is handled in the article by Dercon – relates vulnerability to a sense of insecurity, of potential harm people must feel wary of – something bad may happen and ‘spell ruin’. Or in other words: ‘vulnerability as the existence and the extent of a threat of poverty and destitution; the danger that a socially unacceptable level of wellbeing may materialise’ (Dercon, 2005). This last definition builds upon the idea of the linkage between

the occurrence of a random event (a shock or disaster) and permanent effects, and can best be understood with the concept of a poverty trap, which I will consider later in this chapter (Carter, et. al., 2007).

Another important concept which plays an important role in a microeconomic approach to coping with shocks and disasters is the concept of risk. In many economies in developing countries, high income-risk is part of daily life. All different types of risks emerge when living conditions become unstable. There can be thought of climatic risks, production risks, a variety of abrupt economic fluctuations, and also a lot of personal, individual and more specific uncertainties people are confronted to. Many studies in the past have related all kind of different shocks to income variability. In an article by the British micro-development economist Stefan Dercon (2002) some examples from recent literature are mentioned. For instance, in a study by Bliss and Stern in 1982 in an Indian region, the relationship between a two-week delay in the onset of production is associated with a 20 percent decline in yields (Bliss and Stern, 1982).

**Table 1: Main sources of risk**

Type of risk	At the household or individual level (idiosyncratic)	At the community level (covariate)	At the nationwide level (covariate)
Natural	Rainfall	Earthquakes Landslides Volcanic eruption	Floods Drought High winds
Health	Illness Injury Disability Old age Death	Epidemic	
Social	Crime Domestic violence	Terrorism Gangs	Civil strife War Social upheaval
Economic	Frictional unemployment	Resettlement Harvest failure	Growth collapse Balance-of-payments, financial, or currency crisis Technology- or trade-induced terms-of-trade shocks
Political		Riots	Political default on social programs Coup d'état
Environmental	Pollution	Pollution Deforestation Nuclear disaster	

Source: Lustig, 2001

In an article by Lustig (2001) the main causes and characteristics of different kind of risks are addressed and enumerated in the figure above (Table 1). Lustig uses the distinction between so-called *idiosyncratic* and *covariate* types of risk. The difference can be explained with the notion of what Dercon calls *common* and *idiosyncratic* risks. He states: ‘Common risks are aggregate, economy-wide, covariate risks that affect all members of a community or region. Individual or idiosyncratic risks affect only a particular individual.’(Dercon, 2002). In terms of shocks, a natural disaster can be seen as a very heavy, infrequent covariate shock. While making this distinction, at the same time Lustig (2001) admits in her article that the distinguished types of shocks and risks can be highly correlated to each other. For instance, a covariate risk like a natural disaster can cause major idiosyncratic risks, like the death of the breadwinner, which directly worsens the initial impact. Dercon (2002): ‘‘In practice, even within well-defined rural communities, few risks are purely common or idiosyncratic’’.

Considering these sources of risk, it’s interesting to take a look at the strategies of how to deal with these risks. According to Dercon (2002), in order to deal with the consequences of risks it helps to identify the nature of shocks. In contrast with idiosyncratic shocks, Dercon argues that common, covariate shocks cannot be insured within a community, since if everyone is affected, the risk cannot be shared. This has not to be confused with the effects of the risk, which of course can be shared commonly. As said, natural disasters can be seen as heavy, infrequent covariate shocks, with a great impact. In terms of natural disasters, it is therefore important to ensure access to formal and informal insurance transfers, i.e. credit and insurances, from outside the community, in order to deal with common shocks properly (Dercon, 2002).

Considering the strategies of dealing with risks more studies are relevant. According to Alderman and Paxson (1994) risk-management can be distinguished from risk-coping strategies. Strategies concerning risk-management endeavor to reduce the riskiness *ex ante*, for instance by income diversification. Risk-coping strategies are strategies that smooth consumption over time or between households. Risk-coping strategies include saving behavior, self-insurance and risk-sharing. The latter is, in many parts of the world, a very important way of mitigating the impact of shocks. Most of the time, informal arrangements are made among members of a social group, for instance a family, tribe, neighborhood, work alliance, etc. According to this group-based strategy, households are able to spread the risks and smooth the impact among a bigger group. Another method of self-insurance is building



up reserves in good times, which can be drawn upon in bad years. According to Dercon (2002), risk-coping strategies may also involve temporary earning of extra income when a shock has occurred. He observes this in, among others, Ethiopia and Sudan, where families tried to earn extra income by migrating or collecting wild foods or firewood during famines.

In addition to this, Lustig (2001) elaborates a theory on how adverse shocks can be managed. The theory is based on a classification of three types of strategies: *nonmarket*, *market-based* and *publically provided*. Self-insurance and risk-sharing can be ranged under nonmarket arrangements, and market-based arrangements are more based on the financial aspect, such as insurances by insurance companies. Publically provided strategies include rules and regulations in order to provide insurance for unemployment, disability, retirement and sickness. In the figure below (table 2) this theory has been visualized.

**Table 2: Mechanisms for managing risk**

	Informal mechanisms		Formal mechanisms	
	Individual and household	Group based	Market-based	Publicly provided
Risk reduction	Preventive health practices Migration Less risky income sources	Collective action for infrastructure, dikes, terraces Common property resource management		Sound macro-economic policy Environmental policy Education and training policy Public health policy Infrastructure (dams, roads) Labor market policies
Risk mitigation				
Portfolio diversification	Crop and plot diversification Income source diversification Investment in physical and human capital	Occupational associations Rotating savings and credit associations	Savings accounts in financial institutions <i>Microfinance</i>	Agricultural extension Open up trade opportunities Protection of property rights
Insurance	Marriage and extended family Sharecrop tenancy Buffer stocks	Investment in social capital (networks, associations, rituals, reciprocal gift giving)	Old age annuities Accident and disability insurance	<i>Pension systems</i> <i>Unemployment insurance</i> Health and disability insurance
Risk coping	Sale of assets Loans from moneylenders Child labor Reduced food consumption	Transfers from networks of mutual support	Sale of financial assets Loans from financial institutions	<i>Social assistance</i> <i>Workfare</i> Subsidies <i>Social funds</i> Cash transfers

Source: Lustig, 2001

Despite the availability of formal mechanisms for managing risk, as stressed out in the figure above, according to Lustig (2001) poor people in developing countries are more attracted to informal mechanisms, like safety nets provided by social networks. Several reasons can be given for this, but that falls outside the aim of this thesis. Access to these mechanisms can be denied or insufficient. The fact is that in many circumstances the efficacy of informal mechanisms is limited. Therefore, it can be argued that an approach based on more public intervention would be desirable. This becomes even more desirable when, in the case of idiosyncratic shocks with an appeal on social relations, the impact turns out more negative than in a situation without these informal mechanisms. In the words of Lustig (2001): ‘Informal or self-insurance arrangements may be suboptimal even in the case of idiosyncratic shocks because they could result in lower potential incomes [...]. In all such cases public intervention is warranted to improve the access of the poor to market-based arrangements and to reduce the use of self-destructive informal and self-insurance schemes to cope with adverse shocks’.

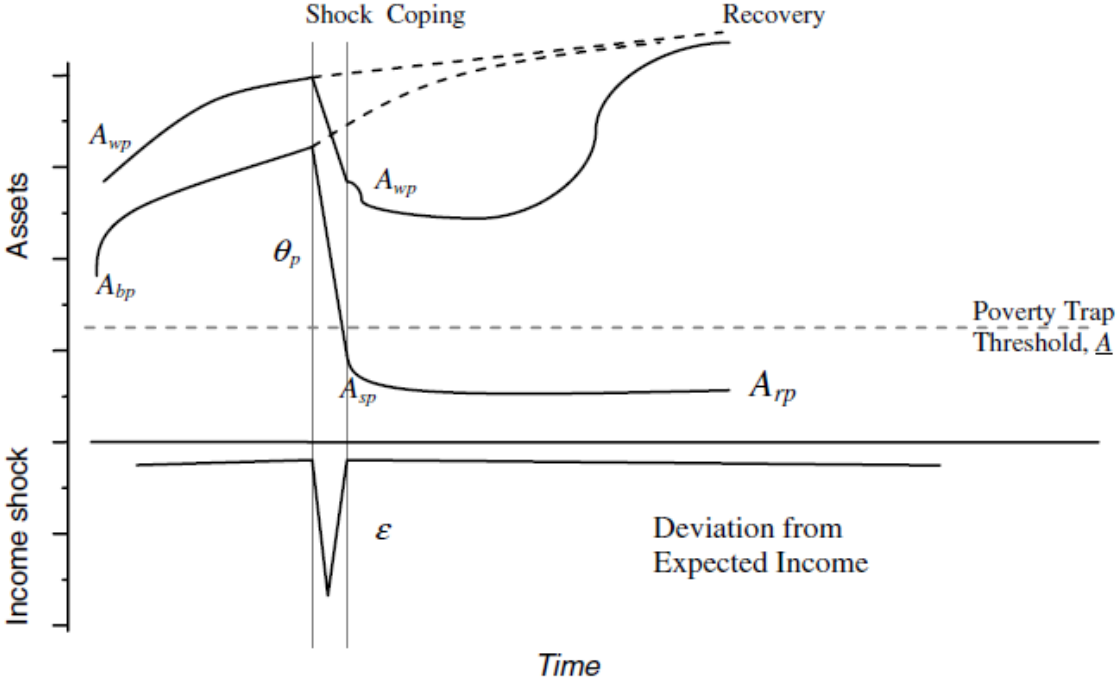
### **3.3 Poverty trap**

As stressed out above, coping and managing strategies of risk and vulnerability are limited and can cause poverty (Dercon, 2005). When people are directly being trapped into poverty, this can result in the occurrence of a poverty trap. A poverty trap can be understood as ‘a minimum asset threshold, below which accumulation and livelihood growth are not feasible’ (Carter et. al., 2007). This means that, for example, due to a drought or flood people can get below the threshold, which consequently will prevent them from recovering from the event or moving ahead economically over time. Those above the line after a shock can be expected to recover, productively invest and accumulate new assets.

The working of a poverty trap in relation to a short-term shock (e.g. a hurricane or heavy rainfall) is shown in the figure below (Carter et. al., 2007). The y-axis measures the level of assets and the impact on the income, while the x-axis measures the time. Two lines are drawn; one represents a wealthier household ( $A_{wp}$ ) and the other represents a relatively poorer household ( $A_{bp}$ ). The difference in welfare is related to the level of assets. The dashed lines illustrate the asset development without the occurrence of a shock. When the shock occurs, in both cases assets are reduced and both lines fall significantly, but  $A_{wp}$

succeeds in staying above the threshold, and is even able to recover lost assets over time. This is in contrast with  $A_{bp}$ , which comes below the threshold and ends in a poverty trap, and is not able to recover.

**Figure 1: Working of a poverty trap**



In order to come back at the notion of vulnerability, it is useful to link the strategies detailed earlier with the concept of a poverty trap. In the context of such a poverty trap, an accessible credit system (ex post) and insurance market (ex ante) is of great importance. When one is exposed to a natural disaster or an abrupt shock, access to credit is very valuable in the recovery stage. Insuring assets may help even more to recover to the initial status. However, in many developing parts of the world, the formal credit system or the insurance market are inaccessible for the majority of the population. People cannot afford insurance, and, due to their weak economic position, loans are not supplied, which keeps local people out of credit. Microfinance programs or informal/traditional credit are increasingly appearing, especially in times of high risks (Dercon, 2002).

## **4. Floods and droughts in Argentina**

### **4.1 Río Salado Basin in province of Buenos Aires**

#### **4.1.1 Introduction**

A case study of Hilda Herzer about flooding in the Pampean Region in the province of Buenos Aires was published in 2003. Herzer is a professor at the University of Buenos Aires and author of several articles on the impact of disasters. For the analyses shown in the case study, three important municipalities were chosen in the *Río Salado*. A disaster is perceived as a process: ‘its understandings derives from the creation of risk conditions in the course of time, as a result of the interaction between certain unchaining events (hazards) and society’s vulnerability.’ Herzer describes a flooding situation in terms of: ‘[an] expression of relations and conflicts among different areas and diverse socioeconomic groups over time, within the context of natural, economic, social, and political processes’ (Herzer, 2003).

#### **4.1.2 Characteristics and importance of the region**

In agricultural terms, the Pampean region in the province of Buenos Aires is considered as an important area. The Río Salado basin has a surface of 186.000 square kilometers, similar to the surface of Uruguay. The surface covers more than half of the province of Buenos Aires. Before 1990 the land was mainly used for cattle breeding, followed by agriculture and also milk production (which is in fact an activity within cattle breeding, but is seen as a regionally important secondary activity). After 1990, several technical improvements (like artificial irrigation systems and new kinds of seeds, fertilizers, herbicides and pesticides) changed the type of land use. A lot of land which was used for cattle breeding was transferred into agricultural land and the production cycle was intensified (Herzer, 2003).

At the moment, both land use types are used: there is a mix of cereal production and cattle breeding. Areas with no agricultural use, mostly due to their low sea level, are regularly used for cattle breeding. The agricultural and cattle breeding sector fulfills a strategic role in the provincial and national economies, due to factors like: large-scale production, mechanized farmland, generally adequate rainfall, a well-articulated road network, proximity to agro-manufacturing, and proximity to consumer and export centers. For instance, to the country’s farming and cattle-breeding production, the basin has a significant contribution, including

from 1994-1997, when the production of corn, wheat, sunflowers and soybeans represented 25 percent of the national level (Herzer, 2003).

**4.1.3 Floods**

Historically speaking, the Río Salado Basin is prone to flooding. From the beginning of the measurements the area has faced very wet periods, like at the end of the 19<sup>th</sup> century, when more and more floods occurred: 1854, 1857,1857,1874,1877,1883,1886 and 1900. This period has to be considered as a wet one in the history of the region and it continued until the beginning of the 20<sup>th</sup> century. However, the area knows periods of drought as well, as the period 1930-1957 was seen as a very dry phase and was dominated by dried up reservoirs and empty rivers. Since 1970, a new damp phase has begun, with an amount of annual average rainfall that was increasing from 600-700 millimeters to 1000-1100 millimeters, according to Herzer (2003). In the next table, enumerated below, the increase of rainfall during the last decades has been distinguished by region. The table shows that in the last 25 years the average rainfall in every region has increased considerably.

**Table 3. Average rainfall for each region**

<i>Region</i>	<i>1920–1985</i>	<i>Average from 1986 to 2001</i>
Salado Vallimanca Norte and Sur	800 to 900 millimeters	1000 to 1100 millimeters
Noroeste	750 millimeters	More than 1100 millimeters
Lagunas Encadenadas del Oeste	700 to 900 millimeters	1100 millimeters

**Source: Herzer, 2003**

There are several explanations why the Río Salado Basin is an area prone to flooding. An important recent reason of more vulnerability to floods in the region is based on the changes in production and land use in the 1990s. As said before, technical improvements changed the type of land use and land which was used for cattle breeding was transferred into arable land. This was caused by several economic deregulation policies, which had their impact on

farming and cattle-breeding practices. The policies favored large firms and affected medium and small producers negatively. For instance, road and railway networks and port activities were deregulated and privatized. Also, export taxes were decreased and international repayments were made tax-exempt, which made the economy more open to foreign markets. As described in chapter 2, Noy (2009) concludes in his article that this openness of an economy on the macro level may have positive effects, but on a microeconomic level, in this case, it did decrease people's response capacity. It increased their vulnerability to flood consequences, with an increasing risk of floods. This was worsened by the absence of any integral basin management, which became more visible when intense rain cycles occurred (Herzer, 2003).

Besides the economic deregulation policies, the region is also more prone to floods due to its natural characteristics. Among other factors, the type of the soil, the slope, and the shallowness of the river and its streams are responsible for difficulties in water drainage during rainy weather. These characteristics of the natural system have been negatively influenced by human-induced factors, such as the construction of roads, railways, and especially the building of canals. The construction of a series of canals and artificial dikes around these canals seriously hinders the water drainage. The three main regions that the basin contains, are interconnected by a large plain where drainage conditions are insufficient or not present at all (Herzer, 2003).

Several municipalities in the region have faced migration flows due to changing flood and drought cycles. The changes in these cycles affect the economic possibilities of many farmers, as they cannot ensure their income and face uncertainty and risk in their annual production expectations. This also affects other economic sectors, like public services, industry, etc., as it becomes harder to generate stable labor sources. (Herzer, 2003).

In the context of the Pampean region and in terms of the theory elaborated by Lustig (2001), floods can be considered as a covariate type of risk, since the floods are infrequent and the effects are experienced by the community and region as a whole, instead of an idiosyncratic type of risk, where the damage is experienced mainly individually. Mechanisms for coping with risk, which according to the theory by Alderman and Paxson (1994) endeavor to share or mitigate risk by for instance adapted saving behavior or risk-sharing, are widely used in the

affected region. Herzer states that: 'In all cases, it is important to stress the assistance provided by neighbors and their organizations during floods, even if it only means providing shelter in neighborhood associations and participating in the building and vigilance of defenses. Often, neighbors themselves build provisional defenses to protect their homes.' These community based strategies of coping with risk are highly important, since the influence and the capability of the local governments is considered to be weak. Herzer: 'Local governments have little capacity to solve problems caused by flooding, and their actions are mainly confined to emergency situations through relief distribution, building defenses and pumping posts, and assisting evacuees.'

In the conclusions of the case study, Herzer points out several issues that, in her opinion, are causing huge problems in the region. Her main argument is that due to the incapability of the municipalities and the local governments, there is a huge lack of coordination and cooperation. The municipalities do not have the financial resources to face disasters and they are in this context highly dependent on provincial and national governments. Civil society organizations are considered weak, and the local governments do not have any true autonomy when facing a natural disaster. When an emergency situation occurs, a lack of experience in cooperating with other political actors leads to inefficiency and a limited reaction to the problems. A permanent risk-manage policy is also missing, since the process of flooding repeats itself and has produced mistrust and uncertainty of the local people. Another issue is the urban expansion patterns that contribute to an increase in the vulnerability of the local population. There is also a lack of attention to prevention activities. Actions are only taken during floods, which does not change the vulnerability that existed prior to the emergency situation (Herzer, 2003).

## 4.2 San Roque Lake in Córdoba province

### 4.2.1 Introduction

When I visited Argentina in December 2009, I travelled through an area at the west side of Argentine's second largest city: Córdoba, in the eponymous province. With a lot of dusty roads and extremely dry meadows, immediately the area seemed to be a dry one. There were cars of governmental institutions driving around with the message to minimize the water consumption and please not to waste any water. I came in contact with a small-scale Dutch-Argentine travel organization, who are currently operating in the area, near to the city of Villa Carlos Paz. They told me the area depends very much on touristic activities. It is also a region prone to droughts, which has been visible in recent history. According to the directors of the travel organization, the tourist sector can be considered as both the victim and perpetrator of the recurring droughts. As a victim, since due to the droughts the lakes and rivers run dry, which has dramatic effects on the large variety of water sports and the popular bathing sites in the area. The tourist sector is at the same time a perpetrator, since tourists drive up the demand of potable water and use a lot of water in their hotels, tourist resorts and *cabañas* (wooden cottages) with swimming pools and luxurious bathrooms.

In an article in the well-known Argentine newspaper La Nacion, published the 29<sup>th</sup> of October 2009, the 'red alert' stage in the water crisis was launched by the authorities of the city of Villa Carlos Paz, located in de Punilla Valley in the Córdoba Province. Villa Carlos Paz is located next to the San Roque Lake, an important tourist attraction in the region. The water crisis was caused by severe droughts worsened by hardly any precipitation. Despite the earlier warnings by the authorities, the people did not reduce their water consumption, and the government did not succeed in developing effective preventive mechanisms. It was announced that 150 inspectors were going to give sanctions to people who were wasting water, i.e. by cleaning sidewalks and cars or filling their swimming pools, which is all strictly forbidden. The local government tried to decrease water use by trying to increase awareness and other types of preventive measures.



#### **4.2.2 San Roque Lake Watershed**

In 2007, a case study on the San Roque Lake Watershed was published in The World Lake Vision Action Report, which is published by the International Lake Environment Committee (ILEC). ILEC is an International Non-Governmental Organization on the management and conservation of lakes. The case study was written by Teresa Moncarz, a watershed program coordinator, working for the local civil association *Los Algarrobos* (ACLA) in Córdoba, Argentina. According to this study the San Roque lake has a surface of approximately 17 square kilometers. It lays 600 meters above sea level, and was created by the construction of dams. The region is considered to be rich in natural resources, and of great environmental value. Furthermore, the region is the second most important tourist resort of the country, so economically speaking, the increasing tourism industry is of high importance for regional development. In this sense, the San Roque Reservoir plays an important role as the source of water for domestic uses in Córdoba city as well as for industries and irrigation. It has encouraged the development of recreational activities in the territory's central area, e.g. sport-fishing, various water sports, motor boat races, cruising, etc. More than 50% of facilities for tourist reception in Córdoba Province are concentrated in the Valley of Punilla (Moncarz, 2007).

According to Moncarz (2007) the region is facing several problems: ‘The region faces serious and complex inter-related environmental, economic and social problems, [...]. Not only the population of the vally – 264.000 people – is affected by these problems, but also the densely populated area of the capital city of Córdoba, whose 1.8 million inhabitants downstream the lake, depend on the SRL for drinking water’. The overuse of water and the severe droughts are considered as two of the main problems of the San Roque Lake watershed. In the region water is seen as ‘very clearly a finite resource, especially in semi-arid regions; demand for water continues to grow with population, therefore creating conflict between various waters users and communities’(Moncarz, 2007).

Prolonged dry periods cause a lot of risk among the members of the community, and, due to the droughts, income uncertainty has increased considerably. The theory of Lustig (2001) about the sources of risk, considers drought as a covariate type of risk, because, according to Dercon (2002), drought can be seen as an aggregate economy-wide risk, that affects all members of a region or community. Because of the limited precipitation, the local labour force depending on the recreation and tourist business is becoming more uncertain and their

vulnerability increases. The droughts and the drying up of the lake and rivers are causing a lot of riskiness and the local population has a lack of means to cope with that risk without damaging loss, which according to the definition of Chambers (1989) makes them more vulnerable.

When talking about the strategies of dealing with risks, the local government clearly uses an *ex ante* method of risk-management. By organizing community based preventive activities and by trying to increase the awareness of the local people, the government endeavours to decrease the overuse of water and thereby reducing the chance of a water crisis. In the theory of Lustig (2001) about how adverse shocks can be managed, different types of mechanisms for managing risk are distinguished. The strategy used by the local government in Argentina can be considered as a formal, publically provided 'education and training' policy.

Furthermore, possibly, the droughts can also lead to the occurrence of a poverty trap, as described in section 3.3. Because due to the dried up San Roque lake, which happened in December 2009 and January 2010, fishing boats and yachts are damaged, which leads to the loss of capital. Eventually this can lead to falling into a 'poverty trap', since small fishermen and small boat rentals may be unable to invest in new boats and accumulate new assets. This may make them unable to recover from the consequences of the droughts over time. However, the role of the credit market and insurance also need to be taken into account, since access to credit (*ex post*) or insurance (*ex ante*) can mitigate the effects of a disaster and help to recover from the initial situation more effectively. In both the case study and literature studied, as well as according to the information provided by the local people I have spoken to, no information about the credit system was revealed.

According to the case study of Moncarz (2007), the droughts and the problems with access to water should be addressed with more attention to a collaboration between the community and the government. Moncarz argues: 'The community must be well informed, participate fully, and take responsibility for making and implementing decisions. Therefore, solutions can be found through collaboration between government and the community. Only then can a system be developed that supports a healthy environment.'

## 5. Conclusion

In order to obtain a clear view of the impacts and consequences of natural disasters, the aim of this thesis is to examine these consequences and impacts in an economic perspective, and to apply that to two cases in Argentina

Chapter 2 points out the macroeconomic impacts of natural disasters. On the basis of a recent article by the economist Noy the following impacts are mentioned. First, it is likely that with a higher level of human capital, the impact of physical capital loss will be lower. Second, institutional capacity is positively correlated with macroeconomic costs. Also, the income level per capita is positively correlated with the costs of a disaster. Third, the size of the government and the size of the exports have a negative relationship to disaster impact. Thereby, it is found that the openness of the economy leads to less disaster impact. Fourth, it is likely that tropical regions experience higher growth rates than non-tropic regions after a disaster. Finally, no evidence is found of assuming that stock markets play a significant role in keeping an economy away from natural disaster impacts, and more domestic credit appears to decrease the costs of disaster events.

In Chapter 3 the microeconomic consequences are elaborated. According to an article by Dercon, some definitions of vulnerability are mentioned. This is done in order to be able to say something about a natural disaster in the context of a ‘sense of insecurity, of potential harm people must feel wary of’ and ‘as the existence and the extent of a threat of poverty and destitution; the danger that a socially unacceptable level of wellbeing may materialise’. The concept of risk is pointed out as well, and according to a study of Lustig, different sources of risk are examined. The types of risks are distinguished by *idiosyncratic* and *covariate* types of risk. According to Dercon, this distinction is important to take into account when dealing with risk. A natural disaster is considered as a heavy, infrequent covariate shock, with a great impact. According to Alderman and Paxson, risk-management can be distinguished from risk-coping strategies. Strategies concerning risk-management endeavor to reduce the riskiness *ex ante*, while risk-coping strategies smooth consumption between households and over time. According to a study by Lustig, different mechanisms of managing risk are elaborated. Access to formal mechanisms can be denied, which makes safety nets provided by social networks more important. According to Dercon, coping and managing strategies of risk and vulnerability are limited and can cause poverty. A poverty trap can occur, which will prevent

one from recovering or moving ahead economically over time. When one is exposed to a natural disaster or an abrupt shock, access to credit is highly valuable in the recovery stage. Insuring assets may help even more to recover to the initial status. The great importance of an accessible credit system (*ex post*) and insurance market (*ex ante*) is emphasized.

In section 4.1, according to a case study of Herzer, an area in the Buenos Aires Province prone to flooding is studied. Since 1970, a new damp phase has begun, with an increasing amount of annual rainfall. An important recent reason of more vulnerability to floods in the region is based on the changes in production and land use in the 1990s. Due to technical improvements, land which was used for cattle breeding was transferred into arable land. This was caused by several economic deregulation policies, which made the economy more open to external influences. According to one of the conclusions of Noy, this should decrease the disaster impact, but in this case, it decreased people's response capacity and it increased their vulnerability to flood consequences. This was worsened by the absence of any integral basin management. Other factors, like the type of the soil, the slope, and the shallowness of the river and its streams are also responsible for more riskiness to flooding. These characteristics of the natural system have been negatively influenced by human-induced factors, like the construction of a series of canals and artificial dikes, which hinders the water drainage. Consequences are: migration flows, less economic possibilities, increasing income- and production uncertainty, and a weaker labor force which affects also other sectors. In terms of the theory by Lustig, floods can be considered as a covariate type of risk. Mechanisms for coping with risk, for instance risk-sharing, are widely used in the region. These community based strategies of coping with risk are highly important, since the capability of the local governments is considered to be weak. The main conclusion of this case study is in order to mitigate the risk and impacts of floods, the capacity of the provincial and local government should be improved and the collaboration with the national government should be enhanced.

In section 4.2 an area prone to droughts in the Córdoba Province is studied. In a case study by Moncarz about a lake in the region, the area is considered to be rich in natural resources and the lake is seen as the second most important tourist resort of the country. The overuse of water and the severe droughts are mentioned as two of the main problems of the region. According to the theory of Lustig drought can be stated as a covariate type of risk. Because of the limited precipitation, the local labour force depending on the recreation and tourist business is becoming more uncertain and their vulnerability increases. Droughts and drying

up of the lake and rivers are causing a lot of risk to the local population, who are not able to cope with these risks without damaging loss, which makes them more vulnerable. By organizing community based preventive activities and by trying to increase the awareness of the local people, the government clearly uses *ex ante* ways of risk-management. The strategy used by the local government in Argentina can be considered as a formal, publically provided 'education and training' policy. Droughts may cause a poverty trap, since, due to the dried up lake, fishing boats and yachts are damaged, which leads to the loss of capital. Eventually this can lead a 'poverty trap'. However, the role of the credit and insurance market also need to be taken into account, since access to credit (ex post) or insurance (ex ante) can mitigate the effects of an disaster. In a conclusion, Moncarz argues for more attention to the communication with and participation of the community, and more cooperation between the government and the community, as well as more cooperation between different government bodies.

Given these economic consequences, both on a macro and micro level, and applied on two practical cases in Argentina, this provides a clear view on the impacts and consequences of natural disasters.

## References

- Alderman, H., and C. Paxson, 1994. Do the Poor insure? A synthesis of the Literature on Risk and Consumption in Developing Countries. In D. Bacha, ed., *Economics in a Changing World*. Vol. 4: *Development, Trade and the Environment*. London
- Carter, M. R., Little, P. D., Mogue, T., & Negatu, W., 2007. Poverty Traps and Natural Disasters in Ethiopia and Honduras, *Elsevier, World Development*, Vol. 35, No. 5, pp. 835-856.
- Chambers, R., 1989. Editorial Introduction: vulnerability, coping and policy, *IDS Bulletin*, vol. 2, pp.1-7.
- CIA Factbook, 2010. The World Factbook. <https://www.cia.gov/library/publications/the-world-factbook/geos/ar.html>
- Dercon, S., 2002. Income Risk, Coping Strategies, and Safety Nets, *The World Bank Research Observer*, Vol. 17, no. 2, pp. 141-166
- Dercon, S., 2005. Vulnerability: a micro perspective, *working paper*, Oxford University
- DFID, 2004. Climate Change in Latin America. The British Department for International Development, Policy division, access via <http://www.bvsde.paho.org/bvsacd/cd16/12latinamerica.pdf>
- Herzer, H., 2003. Flooding in the Pampean Region of Argentina: The Salado Basin. *Building Safer Cities; The Future of Disaster Risk*, Disaster Risk Management Series, World Bank, no. 3, pp. 137-147
- IRIN, 2005. Integrated Regional Information Networks, humanitarian news and analysis service of the UN Office for the Coordination of Humanitarian Affairs. Article: Disaster reduction and the human cost of disaster, June 2005, access via <http://www.irinnews.org/InDepthMain.aspx?reportid=62446&indepthid=14>
- Lustig, N., 2001. *Shielding the Poor. Social Protection in the Developing World*. Washington, D.C.: Brookings Institution Press
- Moncarz, T., 2007. Support Programme for the Environmental Recovery of the San Roque Lake Watershed, *World Lake Vision Action Report*, World Lake Vision Action Report Committee, International Lake Environment Committee, pp. 335-343, access via [http://www.ilec.or.jp/eg/wlv/World\\_Lake\\_Vision\\_Action\\_Report.pdf](http://www.ilec.or.jp/eg/wlv/World_Lake_Vision_Action_Report.pdf)
- Noy, I., 2009. The macroeconomic consequences of disasters, *Journal of Development Economics*, Elsevier, Vol. 88, pp. 221-231
- Quiros, R., 1998. Classification and State of the Environment of the Argentinean Lakes, *Facultad de Agronomía*, Universidad de Buenos Aires
- Skidmore, M., and H. Toya, 2002. Do Natural Disasters promote long-run growth? *Economic Inquiry*, Vol. 40, No. 4, pp. 664-687, Western Economic Association International
- Skidmore, M., and H. Toya, 2006. Economic development and the impacts of natural disasters, *Economic Letters 94*, pp. 20-25, Elsevier
- World Bank, 2001. *World Development Report 2000/2001. Attacking Poverty*, New York, Oxford University Press.