

**The Role of Policy in the Fight Against Desertification in the Middle Atlas Mountains**

by

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By all observable accounts, desertification is exacting a toll on the rural populations of Morocco, potentially leading to social and economic instability. With almost all of Morocco and the majority of the African continent characterized by high vulnerability, it is incumbent upon policy makers and program developers to understand the full parameters of the threat to humanity security. Through process tracing, this paper examines the issue of desertification as a function of the macro-level policies that have been implemented, environmental indicators, and the knowledge, behavior and beliefs of rural villagers in one particular targeted location. Without generalizing to the larger population, findings identify the lack of empowerment as a key factor inhibiting progress in the fight against desertification. This includes the failure to include women in promoting lifestyle changes and the lack of community and social tools necessary to trigger mobilization amongst individual villagers. Government expenditures are not likely to be able to address these issues through macro-level policies due to the localized nature of the problem. As such, developing a system that effectively transfers knowledge and resources from external entities (government and NGOs) to local actors that can facilitate local empowerment is essential in bringing about the needed action to fight desertification.

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## 1.0 INTRODUCTION

When examining desertification policy, Morocco is an interesting case study because roughly half of the country's population lives in the rural areas.<sup>12</sup> Simultaneously, the causes and effects of desertification are played out in the countryside. Because their livelihoods tend to depend on the natural elements, rural inhabitants are the first ones to be affected by desertification. Similarly, their lifestyles are a main contributor to the causes of desertification. Poor farming practices lead to land degradation, soil erosion and subsequent desertification. Compounding the problem even further, rural populations tend not to have the same access to resources as those in the cities. They experience a lower standard of living and have fewer opportunities for development.

The Moroccan government is, therefore, left with the burden of determining how to implement the needed development and anti-desertification measures for these rural areas when the populations are spread throughout small villages across the mountains and the desert. The more remote or sparsely populated an area is, the less cost-effective project implementation becomes. It is also increasingly difficult to administer public policy the more disconnected a village may be. Therefore, from the policy perspective, we are presented with two conflicting problems: Half the country is, by and large, inaccessible by government administrators, yet it is this very half of the country where the battle against desertification is waged.

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<sup>1</sup> According to Arabic German consulting, the rural population in 1996 was 51%. A low rural population growth implies that this figure is likely to have decreased since then.

<sup>2</sup> Arabic German Consulting, <http://www.arab.de/arabinfo/morocco.htm>, (1998 – 1999) (accessed 1/10/2010).

This paper focuses on one subgroup that lives on the periphery of a desert where an increase in temperature is marked by a rapid reduction in conditions conducive to survival. I examined the role of policy in the fight against desertification and the response mechanisms in the Middle Atlas Mountains of Morocco. In the process, I scrutinized the Moroccan policy that addresses desertification. I also looked at the real conditions of what environmental indicators are telling us and, finally, through the use of focus groups, I asked the rural inhabitants from the village of El Mers about the roles these issues play in their lives. Through process tracing, my findings will determine how public policy has affected one particular village.

Thus, the proposed research will be a case study carried out in three key components:

- 1) Policy analysis of actions taken place by the various agents involved
- 2) An investigation of environmental indicators
- 3) Qualitative research on the experiences of the villagers

Through these three components, the research aims to pinpoint the weaknesses in the response mechanisms to the threat of desertification and shed light on the following questions: Is the Moroccan government responding effectively with sufficient policies and programs to protect the environment? Are villagers informed of the causes and effects of desertification particularly in matters that concern their lifestyles? How are problems perceived? What are the roles of external actors? Ultimately, by locating the weakest links in the system, policy recommendations will be made in order to reduce the future consequences of desertification. Comparing macro-level policies with the perceptions and experiences of affected populations will assist in determining whether or not the policy is appropriate.

This research is intended to serve an exploratory function. Because focus groups do not yield statistically-generalizable data, empirical data to support this research will likely follow in the years to come. A framework of constructs for future policy analyses and program evaluations

will be provided through this research. Future research may take place in the form of surveys, interviews or repertory grid methodology, all of which require a pre-existing understanding of the reality and perceptions of the target population. The necessary items to be researched will be identified throughout the duration of this paper.

In the end, my findings will shed light onto public policy addressing environmental issues occurring on the fringes of society when poverty is a key player. I will accomplish this task by closely examining how one community is affected by both public policy and environmental degradation. In doing so, hidden resources and constraints that exist within the population itself will be identified.

## **2.0 BACKGROUND**

### **2.1 DESERTIFICATION**

As defined by the United Nations Convention to Combat Desertification (UNCCD), desertification is “the degradation of land in arid, semi-arid and dry sub-humid areas... caused primarily by human activities and climatic variations.” (UNCCD 2005) Fragile topsoil in dry climates makes an environment vulnerable. As human activity puts pressure on the ground, the soil chemistry changes, making it susceptible to run-off from wind and rainfall. Once wind and rain sweep away the topsoil in a process known as erosion, the land can no longer sustain agricultural production. Human survival depends on the existence of topsoil; hence, its depletion is a threat to human security.

The causes of desertification are a mixture of natural events and man-made practices leading to land degradation. Over-exploitation of pastures and land, particularly through the raising of livestock, changes the composition of topsoil, rendering it loose and without the proper nutrients to sustain cultivation. Deforestation has a similar effect of not only increasing the amount of CO<sub>2</sub> and temperatures, but also reducing the ground’s ability to absorb water and destabilizing the topsoil. Fires may also become more frequent as the environment becomes drier, causing further deforestation and release of CO<sub>2</sub>. Ultimately, it is a complex, self-reinforcing cycle that results in a human security disaster.

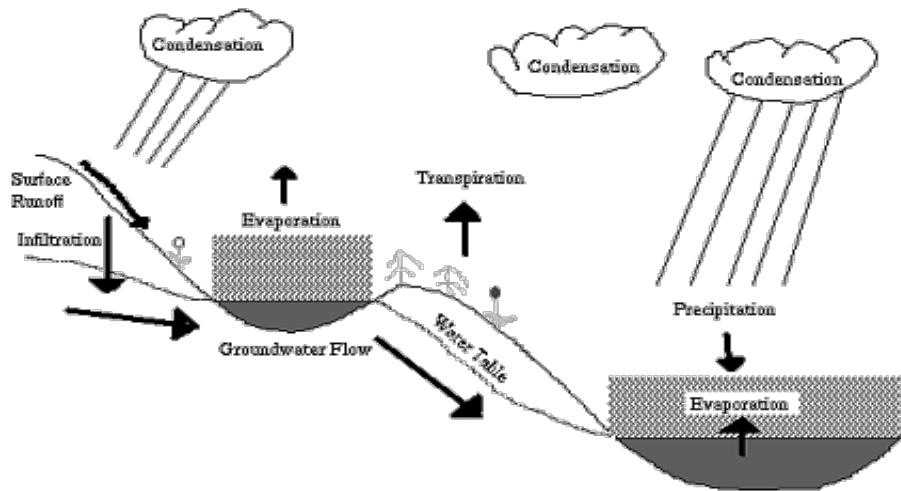
The threat of desertification manifests in multiple ways. Sustainability --meaning the ability of future generations to access the resources that present generations have access to-- is seriously undermined by desertification. The reduction of forest area reduces the amount of fuel-wood and vegetation for future generations. But even worse, it exacerbates the conditions of desertification making it impossible to engage in agricultural production. Further still, the lack of trees and vegetation alters the hydrologic cycle. Groundwater recharge is reduced due to rapid run-off. The reduction in the amount of transpiration from trees and evaporation from vegetation ultimately brings about a reduction in rainfall and surface water. As surface water is depleted, more and more individuals resort to the pumping of groundwater of which only 2.5% is renewable.<sup>3</sup> An imbalance between the supply and demand of water brings about a positive feedback cycle<sup>4</sup> whereby, as water becomes scarce, competition over the resource is elevated, resulting in more rapid extraction. Pumping water at a rate that is higher than the rate of recharge implies that eventually the resource will run dry or it will simply be too expensive to extract anymore. With the depletion of natural resources, the model of sustainability is not upheld and the lifestyle of future generations is threatened.

Figure 1 demonstrates the hydrologic cycle that is in jeopardy in the instance of desertification. Instead of seeping into the ground, water runs off to a downstream location which then leads to a reduction in the water table, evaporation and transpiration. Ultimately, there is a reduction in precipitation, plants begin to die, and the cycle is perpetuated as a decrease in groundcover facilitates further run-off.

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<sup>3</sup> Tom Teitenberg and Lynne Lewis, *Environmental Economics & Policy* (Boston: Addison-Wesley, 2010), 175.

<sup>4</sup> A positive feedback cycles refer to trends that are self-reinforcing and that ultimately expand the problem. For more information, review *Environmental Economics & Policy* by Tom Teitenberg and Lynne Lewis, p. 5.



**Figure 1: The Hydrologic Cycle**

Source: National Weather Service River Forecast Center, 2009. <http://www.srh.noaa.gov/abr/c/?n=fcmstmethods>  
 © National Weather Service. Work is not subject to copyright protection.

There are many secondary social effects of desertification. In the instance of scarcity, women are often the most negatively affected. In poverty stricken areas, women have minimal access to assets, making them less capable of adapting to environmental changes and leaving them at a disadvantage.<sup>5</sup> Desertification is also directly and indirectly associated with migration patterns. Once the conditions are no longer conducive to survival, the only options are to migrate or to remain in extreme poverty. Migration puts a strain on other sectors of the economy, mainly the urban sector. For example, increased migration from country to city puts economic pressures on low-income neighborhoods.<sup>6</sup>

<sup>5</sup> UNCCD, thematic fact sheet series No. 4, "Gender and desertification," UNCCD. <http://www.unccd.int/knowledge/docs/Desertificationandgender.pdf> (Accessed November 30, 2009).

<sup>6</sup> UNCCD, thematic fact sheet series, no. 3, "Migration and Desertification," UNCCD. <http://www.unccd.int/documents/Desertificationandmigration.pdf> (Accessed October, 24 2009).

Desertification is also an inherent threat to global food security. Rural areas are the agricultural engine of a society. Anytime there is a drought or yields get smaller, the country is vulnerable to food shortages and civil unrest. Finally, a decrease in the availability of scarce natural resources inevitably leads to rising tensions between competitors international or domestic. Such pressures increase the likelihood of instability.<sup>7</sup>

## 2.2 GLOBAL IMPLICATIONS OF DESERTIFICATION

Worldwide, desertification directly affects over 250 million people and approximately one billion people are at risk. Over one hundred countries, many inhabited by some of the world's poorest people, are at risk of desertification.<sup>8</sup> Roughly 41 % of the earth's surface is classified as dry-lands. If nothing is done, over the next 10 years 50 million people are at risk of displacement.<sup>9</sup> By 2030, almost 50% of the world's population is going to live in areas of high water stress.<sup>10</sup>

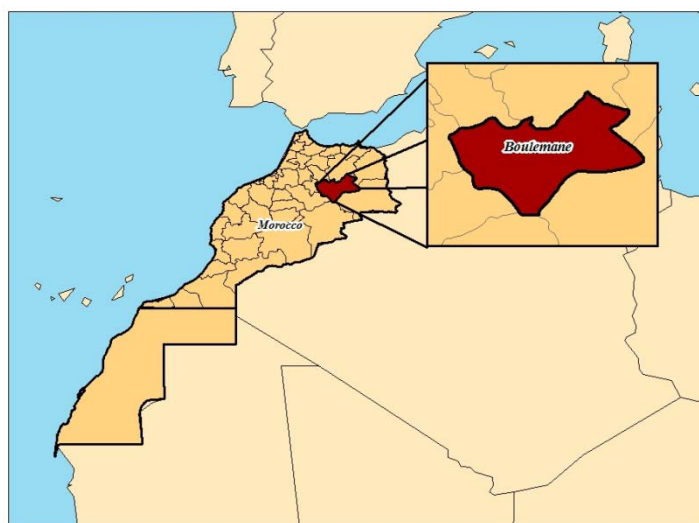
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<sup>7</sup> Securitizing the ground, grounding security, *UNCCD*, Brauch, Hans Gunter and Ursula Oswald Spring, Issue Paper No. 2, 2009, [http://www.unccd.int/knowledge/docs/dldd\\_eng.pdf](http://www.unccd.int/knowledge/docs/dldd_eng.pdf).

<sup>8</sup> UNCCD "The United Nations Convention to Combat Desertification," <http://www.unccd.int/convention/text/leaflet.php> Accessed October 24, 2009.

<sup>9</sup> UNCCD, thematic fact sheet series, no. 3, "Migration and Desertification," UNCCD. <http://www.unccd.int/documents/Desertificationandmigration.pdf> (Accessed October, 24 2009).

<sup>10</sup> UNCCD, thematic fact sheet series No.2, "Water Security and Desertification," <http://www.unccd.int/documents/Desertificationandwater.pdf>, (Accessed October 24, 2009).



**Figure 2: Morocco and the Target Region**

According to the United Nations Convention to Combat Desertification (UNCCD), two-thirds of the continent of Africa is at high risk of desertification.<sup>11</sup> In 2001, P.F. Reich, S.T. Numben, R.A. Almaraz and H. Eswaran conducted a study using GIS software to pinpoint the areas in Africa that are most vulnerable to land degradation based on soil composition and levels of rainfall. The regions that were found to be the most vulnerable were the areas located around the margins of the deserts where approximately 22 million people currently live. As a caveat, the authors state that high soil quality does not necessarily translate to low risk of desertification. On the contrary, mismanagement of soils through improper farming techniques can subject any high quality land area to desertification. A special emphasis in this study was put on the fact that population growth renders land more susceptible to desertification. Morocco was singled out as an area where this is particularly evident.

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<sup>11</sup> UNCCD, Fact sheet 11, "Combating desertification in Africa," <http://www.unccd.int/publicinfo/factsheets/showFS.php?number=11> (Accessed 11/08/09).



## 2.3 MOROCCO

Morocco is situated in the northwest corner of Africa.<sup>12</sup> The climate is quite varied by region. It is considered temperate in some regions, desert in the south, Mediterranean in the north, oceanic in the west and continental in the interior. Situated on the west coast of the continent, in many ways the geography resembles that of California in shape, size and climate. Like California, Morocco has a mountainous interior and a desert southern-most area. Approximately 93% of the country is arid to semi-arid.<sup>13</sup> Currently only 9.78% of Morocco is forested (Mongabay 2005). This area provides 30% of the country's needs for wood, 30% of the national energy, and 17% of livestock food (Maghreb Arab Presse 2007).

On the socio-political front, Morocco is a constitutional monarchy that has engaged in many reforms over the last ten years. The current king Mohammad VI declared himself a democrat when he took the throne in 1999,<sup>14</sup> but he has faced many setbacks in his efforts to liberalize a country that has long been accustomed to authoritarian rule. It is considered a moderate Muslim country. There are currently 34,859,364 (2009 estimate) Moroccans of whom nearly 100% are Arab-Berber Muslims.<sup>15</sup> They have a population growth rate of 1.19,<sup>16</sup> which is one of the lowest of the Arab countries but is still considered to be relatively high.

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<sup>12</sup> Western Sahara, the area located to the Southwest of Morocco is a disputed territory. This thesis makes no claims whatsoever regarding the status of this territory.

<sup>13</sup> Kingdom of Morocco, Ministère de l'Agriculture, Du Développement Rural et Des Eaux et Forêts, « Plan D'action... », June 2001, 16.

<sup>14</sup> "King Mohammed VI Speaks Out On Democracy," Panafrican News Agency, 6 August 2000. <http://www.hartford-hwp.com/archives/27a/087.html> (Accessed 11/08/09).

<sup>15</sup> CIA Factbook, "Morocco," <https://www.cia.gov/library/publications/the-world-factbook/geos/mo.html>, (Accessed October 24, 2009).

<sup>16</sup> World Bank Quick Query, <http://ddp-ext.worldbank.org/ext/DDPQQ/member.do?method=getMembers&userid=1&queryId=135>.

Morocco is a medium development country with a human development index of 0.654, ranking 130. This value is based on the following breakdown:

- GDP per capita (PPP US\$) = 4,108, ranking 118 out of 182 countries
- Life expectancy = 71, ranking 98
- Adult literacy rate = 55.6% (ages 15 and above) ranking 132
- Combined gross enrolment ratio = 61.0 ranking 135.<sup>17</sup>

These figures indicate that Morocco struggles from a lack of education which ends up dragging down its overall HDI value. In implementing policy, it is important to consider that nearly half the country's population is illiterate, most of which is concentrated in the rural areas. One must also take into account the rural to urban discrepancies. Rural inhabitants live a much starker life than inhabitants of the city, a distinction that is concealed by the aggregate figures of the Middle East North Africa (MENA) region, Morocco stands apart as having a large rural population. Yemen is the only other country in the MENA region that has a higher rural population. This discrepancy is a rather large consideration when evaluating a centralized approach to problem-solving.

The last telling feature of Morocco's socioeconomic position as a whole is the migration situation. Based on UNDP 2000-2002 figures, Morocco has an emigration rate of 8.1, the vast majority (74.5%) ending up in Europe. This has implications on Morocco due to the loss of human capital, known as "the brain drain." It also has implications on European countries as they encounter problems of cross-cultural integration and illegal immigration. Rural to urban migration also poses problems for the aggregate social welfare of the cities, increasing poverty and unemployment. In 2003,<sup>18</sup> Morocco experienced a terrorist attack in Casablanca of which

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<sup>17</sup>UNDP Statistics [http://hdrstats.undp.org/en/countries/country\\_fact\\_sheets/cty\\_fs\\_MAR.html#](http://hdrstats.undp.org/en/countries/country_fact_sheets/cty_fs_MAR.html#) (Accessed October 24, 2009).

<sup>18</sup> Elliot, Andrea, "Where Boys Grow Up To Be Jihadis," New York Times, November 25, 2007, Magazine section.

the bombers were said to have come from the slums, manipulated by extremist elements from the Middle East. Because the environment impacts all of these issues directly and indirectly, it can be argued that environmental degradation is a security issue, not only for Morocco, but for the rest of the world, especially Europe.

## **2.4 TARGET REGION**

The targeted population of this study is in the commune of El Mers. El Mers is situated in the province of Boulemane in the Middle Atlas Mountains. Boulemane is one of the poorest provinces of Morocco, ranking 43 out of 57. It has a headcount poverty rate of 27.9% with a 59% vulnerability rate.<sup>19</sup> The commune of El Mers has a population of 6,050, of whom 1,300 are farmers.<sup>20</sup>

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<sup>19</sup> World Bank, "Morocco Poverty Report, strengthening policy..." Report No. 28223 - Morocco, 2004.

<sup>20</sup> Ministry of Agriculture, Boulemane, Morocco 2009



**Figure 3: Satellite Image of El Mers**

There are a variety of different property regimes in Morocco. The vast majority in El Mers fall under the category of “melk,” or private property. This property regime is viewed most favorably by the authorities as it promotes security and stability which are crucial to conservation. However, the registration of private property has not been sufficient nor has the funding for the administration in charge of registration.<sup>21</sup> Therefore, it is possible that not all of the expected benefits that come from private property regimes, such as security and exclusivity, may be maximized.

The environment of El Mers is very dry and windy, characterized by cold winters and hot summers. Rainfall has had a tendency to come in downpours during the rainy season and does not come at all during the dry season. The village of El Mers, located at the center of the

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<sup>21</sup> Kingdom of Morocco, Ministère de l’Agriculture, Du Développement Rural et Des Eaux et Forêts, « Plan D’action... », June 2001, 36.

commune of El Mers, exists on what looks like the edge of a desert. Its surrounding area is traditionally forested but currently marked by an increasing amount of open, barren land. Just over a few hills, however, less than a kilometer away, the terrain is a vast open space with hardly a tree in sight. During a discussion I had in 2007 with the Minister of Agriculture, he explained that lone trees standing in an open stretch of land indicate that the entire area was once forested. Another villager explained in the summer of 2009 that the area just over the hill was southern-facing and therefore most exposed to the Sahara.

Another factor to take into account when examining this region is its ethnic history. The region is populated by the *Amazigh*,--popularly known as the Berbers-- who are the original inhabitants of North Africa. Their presence in the Middle Atlas Mountains has existed since before recorded history. Because the area has experienced minimal development until recent years, there are traces of 3,000 years of history still present in the culture. For example, the word for foreigner in the Berber language is *aromi* which comes from the word “roman.” Arabs came to Morocco in the late seventh century and brought Islam with them.<sup>22</sup> Berbers accepted Islam but resisted a process of arabization and maintained their ethnic identity which has at times throughout history erupted into tensions with the Arabs. During the colonial period, the French often tried to exploit these tensions with their “divide and rule” policy. Today Arabs and Berbers are relatively mixed with most Moroccans claiming some amount of Berber ancestry. This identity sets Morocco apart from the rest of the Arab world. While the country is technically classified as Arab, many of the customs and even the Moroccan Arabic dialect are quite foreign to the rest of the Arab world.

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<sup>22</sup> Blanchard, Ian, *Mining, Metallurgy and Minting in the Middle Ages: Asiatic supremacy, 425 – 1125*, (Franz Steiner Verlag Stuttgart, 2001), 128.

The tribes in the commune of El Mers trace their ancestry back to a single Arab immigrant that was accepted as a leader in the Berber community. The offspring of this ancestor created the branches of the different tribes that exist today. The culture is deeply entrenched in local folklore which is at times at odds with the religious teachings of Islam. Since independence from French rule, however, there has been more influence from the cities as many have been educated in urban settings and then returned. Amongst the young, the Berber language is not as widely spoken. Some traditions have also been shunned because of Islamic religious prohibition.

## **2.5 STAKEHOLDER ANALYSIS**

The following stakeholder analysis provides a framework from which this study has commenced. The table details those that contribute to and are affected by the mitigation of desertification. The stakeholder is listed in the first column. Under the second column called, “interests,” what is at stake is listed. The contributions refer to what kind of investment or input is required on the part of the stakeholder. How this contribution will have an impact is then detailed in addition to the overall goal or outcome.

Although this thesis focuses on only two of the listed stakeholders--the state government and the rural inhabitants--this chart demonstrates the far-reaching consequences of the effects of desertification and the potential for productive collaborations between interest groups. For example, an international organization initiative, such as one sponsored by the United Nations, or a smaller grassroots initiative can be supported by the government or the rural inhabitants as a potential policy. In terms of resources and contributions, however, the state government appears to be in the position with the highest level of capacity for bringing about change.

**Table 1: Stakeholder Analysis**

Stakeholder	Interests	Contributions	Impacts	Total Outcomes
Rural inhabitants	<ul style="list-style-type: none"> <li>• Income</li> <li>• Water accessibility</li> <li>• Fuel resources</li> <li>• Grazing areas</li> </ul>	<ul style="list-style-type: none"> <li>• Time</li> <li>• Labor</li> <li>• Long-term investments</li> </ul>	<ul style="list-style-type: none"> <li>• Increase in agricultural yields</li> <li>• Preservation of water resources</li> </ul>	<ul style="list-style-type: none"> <li>• Increase in human development indicators</li> <li>• Decrease in migration</li> <li>• Decrease in poverty</li> </ul>
State Government	<ul style="list-style-type: none"> <li>• Income stability</li> <li>• Environmental sustainability</li> <li>• Social stability</li> <li>• Political stability</li> <li>• Economic growth</li> </ul>	<ul style="list-style-type: none"> <li>• Financial investment</li> <li>• Bureaucracy</li> <li>• Political clout</li> <li>• Time</li> <li>• Resources</li> <li>• Enforcement capabilities</li> </ul>	<ul style="list-style-type: none"> <li>• Government</li> <li>• Protected areas</li> <li>• Irrigation</li> <li>• Resources</li> <li>• Subsidies</li> <li>• Policy</li> <li>• Infrastructure</li> <li>• Awareness</li> </ul>	<ul style="list-style-type: none"> <li>• Preservation of biodiversity</li> <li>• Universal access to potable water and education</li> </ul>
Domestic NGOs	<ul style="list-style-type: none"> <li>• Income stability</li> <li>• Environmental sustainability</li> <li>• Social stability</li> </ul>	<ul style="list-style-type: none"> <li>• Time</li> <li>• Money</li> <li>• Resources</li> <li>• Outside funding</li> <li>• Volunteer hours</li> </ul>	<ul style="list-style-type: none"> <li>• Social services</li> <li>• Micro-level interventions</li> <li>• Research</li> </ul>	<ul style="list-style-type: none"> <li>• Poverty alleviation</li> </ul>
Foreign NGOs	<ul style="list-style-type: none"> <li>• Income stability</li> <li>• Environmental sustainability</li> <li>• Social stability</li> </ul>	<ul style="list-style-type: none"> <li>• Time</li> <li>• Money</li> <li>• Resources</li> <li>• Outside funding</li> <li>• Volunteer hours</li> </ul>	<ul style="list-style-type: none"> <li>• Social services</li> <li>• Micro-level interventions</li> <li>• Research</li> </ul>	<ul style="list-style-type: none"> <li>• Poverty alleviation</li> </ul>
Urban inhabitants	<ul style="list-style-type: none"> <li>• Food supply</li> <li>• Reduced urban poverty</li> <li>• Environmental sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Market demand</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain or increase the demand of agricultural goods</li> </ul>	<ul style="list-style-type: none"> <li>• Social stability in urban slums</li> <li>• Decrease in rural poverty</li> </ul>
Foreign countries	<ul style="list-style-type: none"> <li>• Food supply</li> <li>• Reduced social concerns regarding immigrants</li> <li>• Trade</li> </ul>	<ul style="list-style-type: none"> <li>• Market demand</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain or increase the demand of agricultural goods</li> </ul>	<ul style="list-style-type: none"> <li>• Social instability in urban slums</li> <li>• Decrease in rural poverty</li> </ul>
Academic community	<ul style="list-style-type: none"> <li>• Information dissemination</li> <li>• Problem solving</li> </ul>	<ul style="list-style-type: none"> <li>• Time</li> <li>• Funding</li> <li>• Expertise</li> </ul>	<ul style="list-style-type: none"> <li>• Data</li> <li>• Research</li> </ul>	<ul style="list-style-type: none"> <li>• General understanding of the problems</li> </ul>
Local government	<ul style="list-style-type: none"> <li>• Income stability</li> <li>• Environmental sustainability</li> <li>• Social stability</li> <li>• Economic growth</li> <li>• Reduced conflict over resources</li> <li>• Reduced tribal tensions</li> </ul>	<ul style="list-style-type: none"> <li>• Time</li> <li>• Capacity</li> <li>• Resources</li> <li>• Money</li> </ul>	<ul style="list-style-type: none"> <li>• Legislation and regulations</li> <li>• Enforcement</li> </ul>	<ul style="list-style-type: none"> <li>• Stability</li> <li>• Conservation-inducing</li> </ul>

## 2.6 PURPOSE OF THE STUDY

The objectives of this study are to examine the discrepancies between the Moroccan policy, expert research, and villager opinions. This examination is primarily focused on the micro level and the impact that government policy is capable of having on the rural situation. Rather than draw widespread conclusions about the situation in Morocco, this study is looking at how this particular area of El Mers is affected by desertification and government-led efforts to mitigate its effects. It is important to identify the possibilities for impacting positive environmental change in a difficult policy setting.

Despite the difficulties, however, desertification has proven to be a manageable threat. Israel and China are two instances where the desert is actually getting smaller every year due to a multitude of environmental initiatives.<sup>23</sup> While the situations in Israel and China are not the same as the situation in Morocco, their success stories provide a direction to initiatives being waged elsewhere.

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<sup>23</sup> Hein, Avi, "International scientists learn how Israel combats desertification with forestry," The Israel Export & International Cooperation Institute, November, 2007.  
<http://www.export.gov.il/Eng/Articles/Article.asp?ArticleID=6920&CategoryID=646> (Accessed November 8, 2009).



### **3.0 THEORETICAL FRAMEWORK**

The theoretical framework examines the market determinants of environmental degradation and the determinants of effective program or policy implementation. Because poverty has been highlighted as playing an important role in the perpetuation of desertification, it is crucial to look closely at the economic reality affecting the environment. Fully understanding this relationship allows us to use poverty alleviation as a tool to combat environmental degradation. For these reasons, the theoretical framework of this thesis focuses on the following fields of study: 1) the economics of deforestation and desertification and 2) the diffusion of innovations.

#### **3.1 THE ECONOMICS OF DEFORESTATION AND DESERTIFICATION**

Environmental degradation constitutes a market failure. The law of supply and demand is based on rational choices regarding individual welfare. These do not always result in the optimal outcome for natural resource preservation, thereby incurring a social cost or a negative externality.<sup>24</sup> In the case of desertification, the market incentivizes unsustainable practices such as deforestation, poor farming practices and the raising of livestock. To not engage in these activities puts an individual at a competitive disadvantage. In the absence of political oversight, there are currently no mechanisms to internalize the negative externalities of poor lifestyle practices. Theoretically, a feasible policy option would be to subsidize the transition into more

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<sup>24</sup> Gudger, W.M. and D.C. Barker, *Banking for the Environment*, Food and Agriculture Organization of the United Nations, 1993. Ch. III.

sustainable farming practices such as more efficient equipment, water catchment facilities and alternatives to raising livestock. Because the environmental consequences of daily activity generally exist in the long-run, short-run decision-making does not address needed problems.<sup>25</sup>

For example, Morocco has a large cedar industry. Cedar takes many years to grow and the forests in which they exist involve a significant amount of biodiversity. A tree can require two generations to mature to the optimal harvesting period. This implies that there is no immediate economic benefit to individuals who replant trees that have been cut down. On the contrary, replanting incurs a cost, thus reducing the incentives to replant.<sup>26</sup> Poverty worsens this scenario by increasing the urgency and the value of immediate economic benefit. The harvest of cedar reduces biodiversity in the forest and eliminates the resource for future generations.

In the case of Morocco, nearly half the population lives in the poverty-stricken, rural areas.<sup>27</sup> The financial and political investment required to address poverty and environmental degradation in such a dispersed population is beyond the capabilities of the Moroccan government.

Common environmental management tools include the implementation of property regimes. The appropriateness of a property regime can make or break an environmental catastrophe. Strengthening private property rights is generally thought to be essential for conservation.<sup>28</sup> However, this is not always the case. Implementing private property initiatives for the purposes of environmental sustainability assumes that long-term environmental benefits

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<sup>25</sup> IBID

<sup>26</sup> Teitenberg, Tom and Lynne Lewis, *Environmental Economic & Policy*, sixth edition, (Boston: Addison-Wesley, 2010), 254 – 255.

<sup>27</sup> “Morocco: Global Rural Electrification Programme – PERG,” Agence Française de Développement, <http://www.afd.fr/jahia/Jahia/site/afd/lang/en/pid/1346>, (Accessed November 11, 2009).

<sup>28</sup> Dr. Iliia Murtazashvili, Class notes, September 15, 2009.

are perceived to be in the best interest of the owner. However, environmental conditions are such that the consequences of our actions today, for better or for worse, will not be felt until several years down the road, at which point it may be too late to create needed change. For example, cutting down trees slowly alters the hydrologic cycle so that one day in the future the local ecosystem has changed, but the immediate impact is generally not felt. Additionally, in the instance of poverty, effective management of the initiative on the part of the owner is not likely to be an option.

Under a state-owned property regime, enforcement is not feasible considering the expansiveness of the rural population and the minimal amount of control the state government has over rural areas. Common property, on the other hand, which is held either collectively or by a local authority, may be a viable option, particularly considering the degree to which rural populations adhere to traditional customs. Success of effective collective management requires that knowledge, leadership and organizational capacity be sufficient.

There are numerous examples of effective forest management when the state government undergoes a process of decentralization.<sup>29</sup> The decentralized approach in forest management involves transferring control over forests to local authorities. The utility of the mechanism is based on the fact that natural resources are too vast for a state government to be able to manage effectively. Additionally, conservation of natural resources is tied to the relationship that occupiers of the land have with the resource. The needs and uses of the specific forests for individual communities are rarely understood on the state-wide level. Nurturing an environment of collective responsibility among rural inhabitants can be an effective way to facilitate

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<sup>29</sup> Agrawal, Arun and Elinor Ostrom, "Collective Action, Property Rights and Decentralization in Resource Use in India and Nepal," *Politics Society* (2001): 29;485 - 514.

appropriate lifestyle changes that uphold the model of sustainability. The process provides local actors with more control and decision-making with their local environment. It can involve any combination of stakeholders, local inhabitants, local authorities, NGOs and state government representatives. The degree of control can also vary according to the policy upon which it is decided. It can entail forests being entirely governed by local authorities or by a coalition of local authorities and local inhabitants.

Elinor Ostrom and Arun Agrawal wrote a paper examining the decentralized approach in Southeast Asia. They looked at case studies in India and Nepal and determined that, in order for the decentralized process to be effective, local users need to have the degree of control of “claimants and proprietors,” meaning that individuals need to have control over decision-making, exclusivity, withdraw, operational rights and resource harvesting.<sup>30</sup> A Synergos Institute study of participatory management approaches to fighting desertification similarly showed the importance of local knowledge. Case studies from Burkina Faso, Ghana, Kenya and Zimbabwe were used to highlight the various factors that can facilitate the fight against desertification. Among their findings were the following:

- 1) Substantial knowledge exists at the local level.*
- 2) Participatory approaches to combating desertification can mobilize significant community resources and produce self-sustaining results.*
- 3) Traditional social, religious and economic institutions often play an important role in protection of the natural environment.*
- 4) Desertification should not be viewed as solely an environmental problem, but rather as both a symptom and cause of broader rural problems.*

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<sup>30</sup> Agrawal, Arun and Elinor Ostrom, “Collective Action, Property Rights and Decentralization in Resource Use in India and Nepal,” *Politics Society* (2001): 29;485 - 514..

5) *Local government can be a key official actor in supporting community-based efforts to combat desertification.*

6) *Participatory and conventional approaches to combating desertification differ significantly.*<sup>31</sup>

There is, however, an innate flaw to the collective management system; an individual acting in his own self-interest determines that his welfare is improved if he lets the rest of the community engage in collective action while he reaps the benefits. Ultimately, all community participants come to this same conclusion and the needed collective action fails to take place. This concept is illustrated in game theory by “the prisoner’s dilemma” and also by Hardin’s (1968) “The Tragedy of the Commons.” In the prisoner’s dilemma, individual actors opt to betray their counterpart even though non-betrayal would lead to a greater outcome for everyone. Ostrom (2009) argues this point by stating that when trust and reciprocity are present, individuals are fully capable of collaborating in the interest of the community, particularly when there is a shared history and future.

Similarly, common property can lead to an open-access situation which is a *defacto* free-for-all, causing individuals to compete over scarce resources. In the case of water management, streams may be diverted for personal use until there is nothing left in the original stream. In the case of deforestation, a shortage of fuel during a cold winter in an area with few trees will cause people to rush to the remaining trees, taking as many as they can in order to secure their own supply.

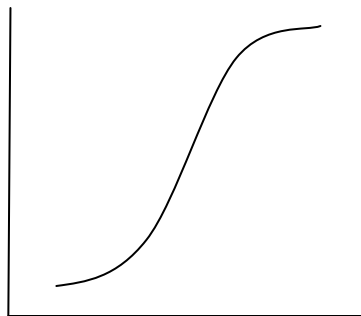
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<sup>31</sup> Annorbah-Sarpei, A. James, Norbert Dube, Edward Rugumayo, S. Bruce Schearer, John Tomlison, “The Importance of Participatory Approaches For Dry Land Management and Anti-Desertification Programs,” The Synergos Institute, November 1993.

### 3.2 DIFFUSION OF INNOVATIONS

The study of the “diffusion of innovations” provides a framework for the most effective ways of implementing change. As a concept, the diffusion of innovations has been around for as long as innovation itself. As a field of study the topic has been of interest since the early part of the 20<sup>th</sup> century.<sup>32</sup> Everett Rogers was able to consolidate the findings of multiple studies across several disciplines in order to trigger a so-called “diffusion of the diffusion of innovations.”

In our context, the diffusion of innovations assists in connecting truths established in academic policy environment to a practical context by examining the conditions under which innovations are adopted. In order for a new practice to be adopted that may conserve natural resources, it will have to undergo such a diffusion process. To some extent, the diffusion of innovations can be a function of the market as it was with the invention of the cotton gin and the ensuing industrial revolution. Technological breakthroughs driven by the motivation for profit change the way a society operates through a series of stages until the innovation becomes the standard practice. According to Everett Rogers (1962), innovations have taken up to 50 years



**Figure 4: Everett Rogers' S-Curve**

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<sup>32</sup> Rogers, Everett, “Diffusion of Innovations,” The Free Press, New York, 1962.

from the moment they are discovered to full adoption<sup>33</sup>. The process of change follows an S-curve, starting with a few early adopters, then leading to a larger movement to adopt the innovation, and finally leveling off with fewer and fewer late adopters. This process can be observed in all domains, as evidenced by a massive body of research in healthcare, education, agriculture and many more sectors of society.

Rogers lists the step-by-step process through which the adoption of an innovation occurs:

- 1) Awareness
- 2) Interest
- 3) Evaluation
- 4) Trial
- 5) Adoption<sup>34</sup>

Each individual participating in the innovation falls under one of five of the following categories:

- 1) Innovators
- 2) Early adopters
- 3) Early majority
- 4) Late majority
- 5) Laggards<sup>35</sup>

According to Rogers, these elements and categories are consistent with what research has shown throughout the various fields.

Applying the study of the diffusion of innovations to agroforestry, Evans (1988) presented a case study of the diffusion process in Paraguay. A United Nations funded forest extension program was started in the early 1980's. In developing the program, a literature review of the diffusion of innovations led program designers to focus on the following characteristics: target population and environment, the nature of the innovation, the complex process of selling

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<sup>33</sup> Rogers, Everett, "Diffusion of Innovations," The Free Press, New York, 1962. 2.

<sup>34</sup> Rogers, Everett, "Diffusion of Innovations," The Free Press, New York, 1962, 81.

<sup>35</sup> Rogers, Everett, "Diffusion of Innovations," The Free Press, New York, 1962, 19.

the idea and the client and institutional capacity. After having successfully implemented an innovation that maintained forest levels and provided a source of income, Evans concluded that the most important factors of the diffusion process were the ‘observability’ of the innovation and the potential for economic gain. The ‘observability’ was achieved by creating an example of the innovation that was easily visible to the public. The economic gain was based in the marketability of the trees that were chosen for the innovation.<sup>36</sup>

In the study of rural sociology, Ryan and Gross (1943) conducted research on the use of hybrid seed corn in Iowa that was perhaps the most notable of early diffusion researchers in the field of rural sociology. One of the major findings relevant to this study is that farmers were typically more influenced by other neighbors, even though the initial introduction to the innovation was presented by salesmen. This finding is similar to the conclusion that multiple scholars have come to regarding the change agent. Radhudkar (1959) found, even when their education was lower, that change agents were more effective when their level of education matched that of the project constituents. This is attributed to being better able to relate to the individuals being served.

In more recent times, a similar quest has been undertaken by Malcolm Gladwell in his book, “The Tipping Point” (2002). In his research, Gladwell attempts to pinpoint the elements that create a movement or a sudden change in the status quo, whether it is a new fashion trend, crime waves or an epidemic. He calls the moment where the change takes off the “tipping point.” In the context of the “diffusion of innovations” on Rogers S-curve, this point would be where the

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<sup>36</sup> Evans, Patrick T., “Designing Agroforestry Innovations to Increase Their Adoptability: A Case Study from Paraguay,” *Journal of Rural Studies*, Vol. 4, No. 1, pp. 45-55, 1988.



slope makes its first sharp turn upwards. Regarding the above discussion on the implications of scarcity, Gladwell's tipping point would be the point at which the rate of depletion of a natural resource begins to increase as people are faced with scarcity.

Gladwell breaks the process down to three essential components: 1) the Law of the Few, 2) the Stickiness Factor, and 3) the Power of Context. The Law of the Few refers to the particular characteristics of what Rogers would call the "change agent." "Connectors, Mavens and Salesmen" are all initiators of change, according to Gladwell, in making a message heard. Connectors create the relationship between the people and the innovation. Mavens are those that find the innovations. Salesmen play the role of convincing individuals of the innovation or change. The Stickiness Factor can be a marketing tool that creates a situation where the individuals somehow relate to the change or innovation in a way that registers. The Power of Context refers to the placement of all other factors in a situation. For instance, in two different eras, while the innovation may be just as beneficial to both, it may only have success in one simply due to its current social, political, economic or environmental climate.

The conclusions of the preceding researchers can be useful in seeking the determinants of a successful policy. Applying these lessons to fighting desertification in Morocco brings to light the many shortcomings that a policy may have. As we will see in the subsequent policy evaluation, the Moroccan government came to similar conclusions based on previous experience.

## **4.0 METHODOLOGY**

Through the use of qualitative and quantitative methods, I examined the conditions that led to desertification in the commune of El Mers. The conditions, or the independent variables, were examined on the macro and on the micro scale in order to determine how macro level policy affects local, rural communities.

Dependent variable = Desertification

Independent variables =

- 1) Macro - State level policy addressing issues of desertification
- 2) Micro - Knowledge, behaviors and beliefs of the local inhabitants

Government policies were evaluated through an analysis of their written word in addition to the perspectives presented by particular agents that interact with the policies. The micro level evaluation was done through focus groups conducted in the village of El Mers.

### **4.1 POLICY ANALYSIS**

A policy analysis was conducted based on a review of the National Action Program (PAN-LCD) of Morocco, the progress reports that have been published since the PAN-LCD was adopted, and interviews with various actors within the community. My analysis is dependent on base line indicators, the prescription outlined in the National Action Plan, and an assessment of whether or not the policy was implemented. The final result is a comprehensive review of the National

Action Plan for the Fight Against Desertification of Morocco, how it was administered, and whether or not it has been effective.

## **4.2 DATA ANALYSIS**

Data was collected on the following indicators of desertification:

- 1) Forest Area change since 1990
- 2) Temperature changes since 1990
- 3) Precipitation changes since 1990
- 4) Land Degradation changes since 2002

The objective was to determine what the environmental trends have been in the period since Morocco became a signatory to the Convention to Combat Desertification. I sought to evaluate whether or not the areas of focus of the policy are consistent with what environmental indicators are telling us in addition to whether or not the perspectives delivered in the focus groups are consistent with overall picture of the environment.

Limitations to this type of analysis are that environmental impacts tend to occur in the long-run. Therefore, these indicators are not intended to evaluate the success or failure of the policy, but rather to identify what the overall trends are.

## **4.3 FOCUS GROUPS**

Three focus groups were conducted in order to understand the knowledge, behaviors and beliefs of the local inhabitants regarding issues of desertification. The strength of focus groups as a methodology is based on the fact that the discussion is not dictated by the interviewer, but rather the interviewer takes a passive role, letting the constructs reveal themselves through a group

discussion. While focus groups do not readily translate to statistical analyses, they provide in-depth explanations behind the thoughts and experiences of the participants. The theory behind the effectiveness of focus groups over interviews can be summed up by Stuart A. Rice:

*A defect of the interview for the purposes of fact-finding in scientific research, then, is that the questioner takes the lead. That is, the subject plays a more or less passive role. Information or points of view of the highest value may not be disclosed because the direction given the interview by the questioner leads away from them. In short, data obtained from an interview are as likely to embody the preconceived ideas of the interviewer as the attitudes of the subjects interviewed (Kreuger, p. 2).*

### 4.3.1 Sampling Scheme

In deference to local customs, the groups were separated by gender. Two groups involved only men and one involved only women. While this is the standard custom in this region and should be respected, we also aim to make the women as comfortable to speak up as possible to get the most accurate representation of their thoughts and feelings.

Chosen participants represented a variety of lifestyle circumstances, as shown in the following table.

**Table 2: Sampling Scheme**

	Farmer	Merchant	Homemaker	Student	Livestock owning	Retiree	Civil servant	Unemployed
Female			X	X				X
Male	X	X			X	X	X	X

### **4.3.2 Recruiting Strategy**

Recruiting was done by a point person from the village who knows most of the village inhabitants. He recruited according to the above sampling scheme. In order to avoid having isolates or non-responsive participants, the recruiter was careful to choose people that are known to engage. This strategy inevitably encounters a sampling bias that over-represents the type of person who is engaged and has a lot to say on these issues; therefore, we attempted to keep the bias as small as possible by involving a variety of backgrounds.

### **4.3.3 Location**

All focus groups were held in the living room of one of the village residents. The women's group was held in the living room of one of the female participants. Tea and a meal were provided.

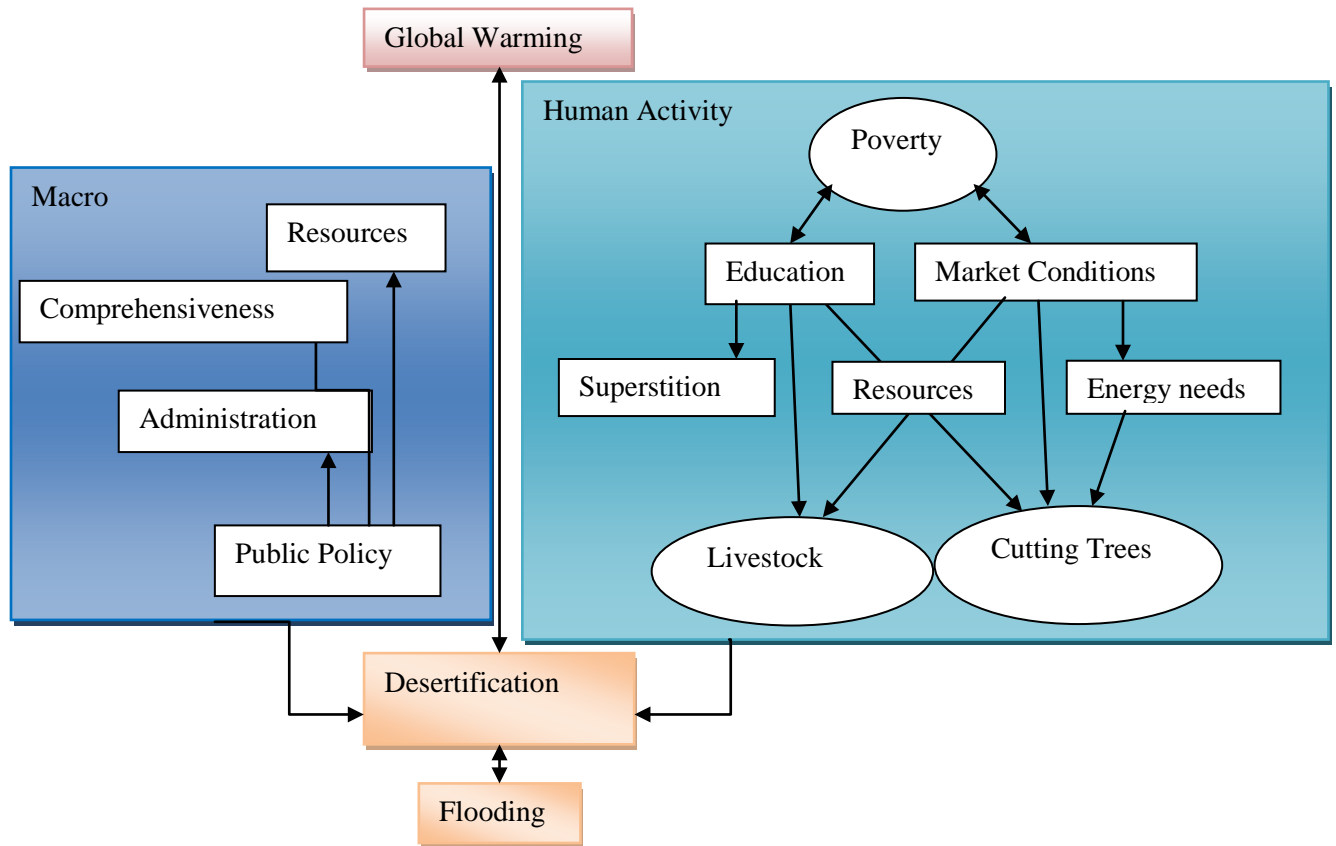
### **4.3.4 Questions**

- 1) Tell us a little about yourself.
- 2) How have you experienced first-hand the effects of desertification?
- 3) Tell us what you know about the causes and effects of desertification.
- 4) What do you know about the causes of flooding?
- 5) What are the obstacles to fighting desertification?
- 6) What are the ways that we can empower this region economically to be able to more effectively fight desertification?

### **4.3.5 Map of Constructs**

The following is a map of the relationships established before performing the research in order to illustrate what the focus group discussion sought to understand. The three branches of the causal network were perceived to be: natural causes and global warming, human activity and the macro-level policies and inputs. The focus groups attempted to define the key components of human

activity that lead to desertification. The highlighted concepts were: poverty, education, market conditions, superstition, resources and energy needs, all of which lead to or are related to deforestation and the raising of livestock. The linear relationships are important in order to understand the chain of events that connect root causes to a final outcome. In this research, the relative weight or importance of the different concepts is being measured. Exploratory research is also being conducted in order to determine other factors that may contribute to desertification via human activity and public policy.



**Figure 5: The Conditions Leading to Desertification**

#### 4.3.6 Analysis

First and foremost, a native speaker of Arabic and Berber transcribed and translated the discussion of each group into English from the recorder mp3 player. Upon reviewing the transcripts, I coded the responses according to the following categories:

1. Identification of potential hindrances on enacting lifestyle change in the community.
2. Personal experiences with the effects of desertification.
3. The knowledge and or beliefs about the causes and effects of desertification.
4. Behavior that in some way impacts desertification.
5. Attitudes around lifestyle practices that exacerbate desertification.

After reading through the comments pertaining to the above constructs, the responses were categorized again according to the following elements:

1. Local government
2. State government
3. First person – Statements that were made in the first person or referring to personal beliefs, experiences, knowledge or attitudes.
4. Third person - Statements that were made in the third person referring to personal beliefs, experiences, knowledge or attitudes of others.
5. NGO or charitable actors

Finally, a matrix was created with the categories for constructs and elements on separate axes. Responses were summarized in list form and characterized with a quote for each of the boxes within the matrix. This matrix can be reviewed in appendix A. Each box within the matrix represents a component of the problem of the solution as perceived by villagers of this region. A subsequent survey would be needed to establish the frequency of the stated concepts in order to determine how much of an impact each component has on desertification and, therefore, how much a policy or program should focus on the stated component.

## **5.0 National Action Plan to Fight Against Desertification (PAN-LCD)**

The National Action Plan to Fight Against Desertification (PAN-LCD) was passed in Morocco in 2001 as part of the signatory process to the United Nations Convention to Combat Desertification (UNCCD). The objective of the plan was to mitigate the effects of drought and to promote the protection of nature and the environment with a particular priority on socioeconomic development. The Moroccan government has in recent years taken a more active role in the development of Morocco in the rural areas. While massive improvements have been made, enormous disparities between the lifestyles of rural areas to that of urban areas are still seen as an embarrassment and a liability to Moroccan stability. The PAN-LCD is a segmented strategy based on the problem definition and the causal components. It is an agreement facilitating past, present, and future initiatives, taking into consideration learned lessons from previous efforts.

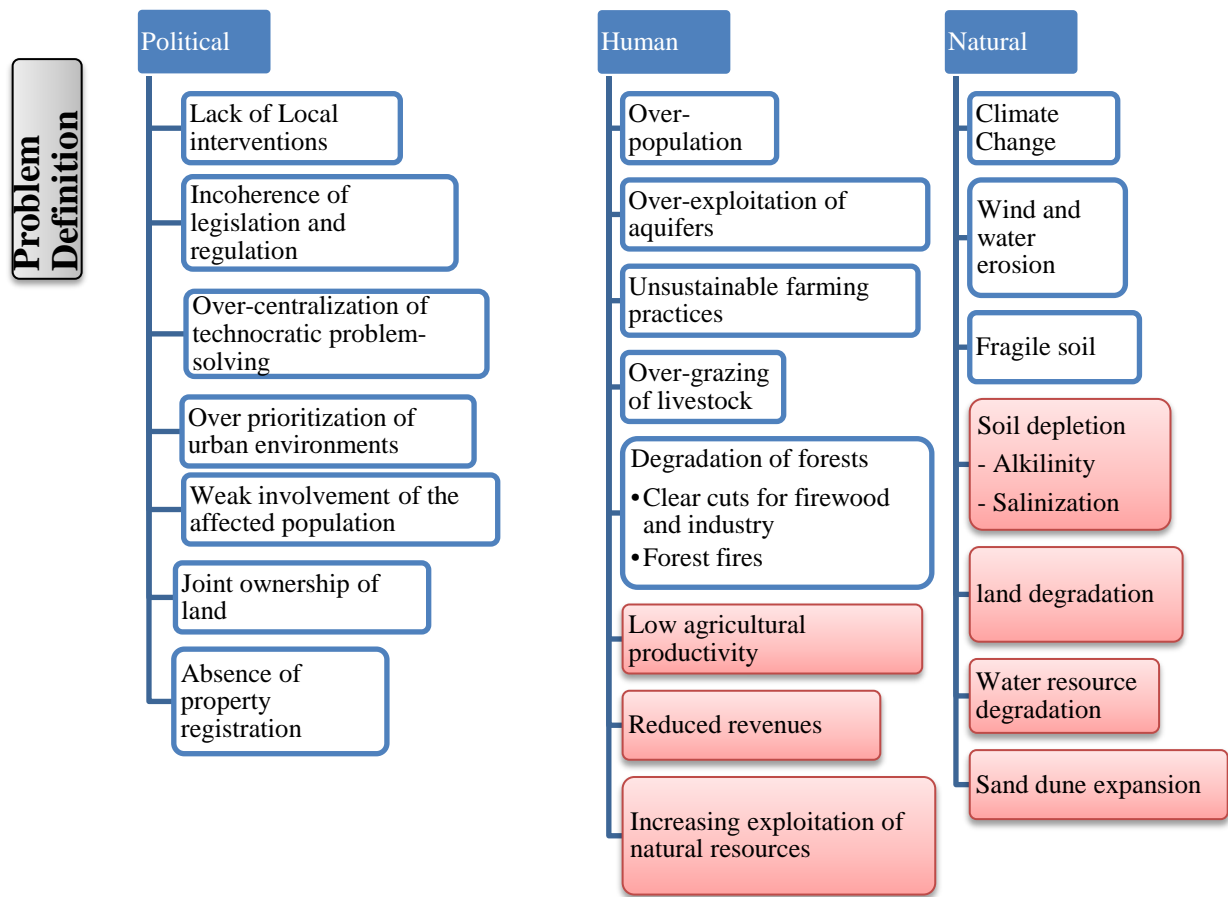
Within the policy, action programs were designed and implemented through a collaboration of the relevant ministries, NGOs, the press, and field experts addressing each of the problem areas. Among these problems are the following causal components as stated in the policy itself:

- 1) Political and institutional shortcomings - Ineffective and incoherent legislation has reduced its efficacy. The lack of involvement and attention given to rural inhabitants has given way to the stark differences in quality of life between the rural and urban populations. Land ownership has been marked by inefficient systems such as joint



- ownership and the absence of formal property registration leading to poor enforcement of property rights.
- 2) Human causes - The lack of capital to invest in sustainable change has prolonged poverty in the rural areas while the rest of the country enjoys a high economic growth rate. Correspondingly, the population growth has increased pressures on the environment and its productive capacity. Livestock degrade the earth by pounding the ground with their hooves. Deforestation for fuel, fences or for agricultural clearings limits the ability of the earth to absorb water. Lastly, irrigation is generally pulled from dwindling underground aquifers.
  - 3) The natural process constitutes factors over which Moroccan inhabitants have no control. There are inherent characteristics of the environment that make it susceptible to desertification. As already stated, the climate is arid to semi-arid, the soil is fragile and the terrain is marked by high wind exposure. Natural shifts in the environment can bring about periods of drought and periods of heavy rains. Global warming inevitably has an impact on incidence of drought.

The following figure represents the segmentation of the PAN-LCD approach, based on the problem definition. The red squares represent the consequences and the white squares represent the causes.

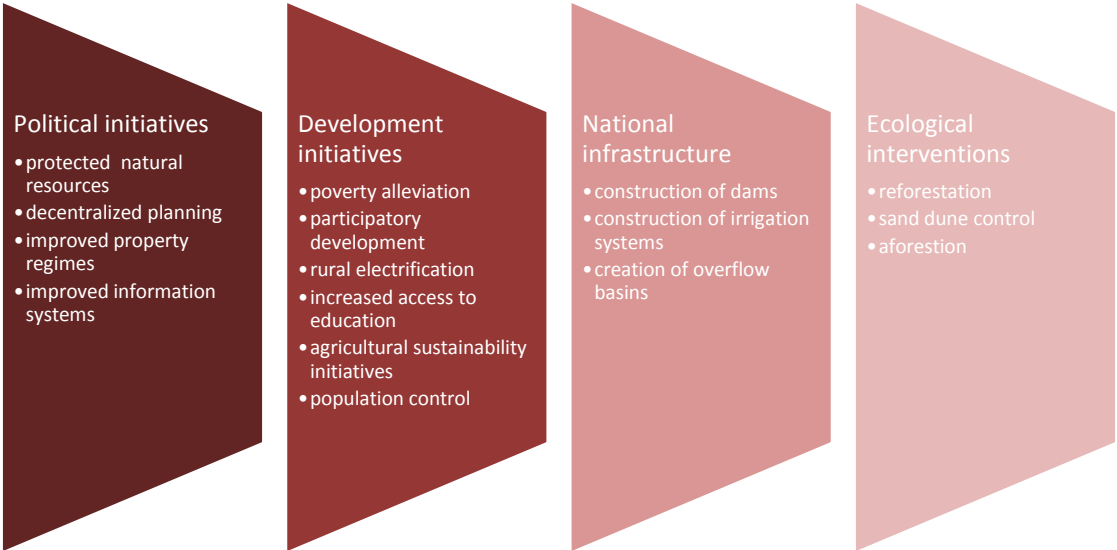


**Figure 6: The Problems and Causes of Desertification**

The programs and strategies developed as part of the PAN-LCD represent solutions to the different problem definitions. A full description of the programs is provided in Appendix B. In using this problem definition to formulate an approach, the PAN-LCD opted to emphasize poverty alleviation and participatory development as key components. The natural environmental process is not something that policy can control and political and legislative barriers were rarely mentioned among the strategies that were developed. Thus, rural electrification, increased access to education services and increased access to potable water are all defined initiatives to address the standard of living amongst the rural poor. Infrastructure development included the construction of dams, overflow basins, the construction of roads and hydraulics. To address the

ecological aspects of the issue, significant investments were put into afforestation, reforestation, tree plantations, sand dune stabilization and the establishment of protected areas and conservation sites.

The task of implementation of the PAN-LCD initiated the creation of the Organe Nationale de Coordination (ONC) which has been placed in charge of managing the plan and performing the follow-up evaluations. The ONC is headed by the Minister of Agriculture and is composed of representatives of the various ministries, NGOs and field experts. The following chart represents the compartmentalization of the initiatives.



**Figure 7: Strategic Framework**

## **6.0 FINDINGS**

### **6.1 PAN-LCD**

An examination of the macro (state-wide) solution to a problem that is micro (on the village level) in nature requires an in-depth account of the relationship between the two sets of constituents as defined by the PAN-LCD. While it is shrewd of the government to understand the importance of poverty alleviation and the inclusion of rural actors in the anti-desertification process, it may be unwise to equate development with environmental sustainability. Development initiatives have the possibility of making the problem worse. Those who advocate applying Kuznet's curve to the environment may caution against using development initiatives as a means to protect the environment. Because this discussion is most often applied to industrialization, the model may be less relevant with regards to advancing human development. However, it is nonetheless important to fully consider the unintended consequences of development initiatives. For example, the construction of roads may incentivize population expansion onto marginal lands or areas that only prove more costly to develop. Improved access to irrigation may improve yields for awhile, but the practice of pumping water from the aquifers is not sustainable in the long-run because it is essentially a finite resource. Potential consequences are depleting the resource and possibly causing land subsidence. Salinization is a problem in most other desert areas but not nearly as talked about in Morocco. This process occurs in the instance of over-irrigation as water evaporates leaving traces of salt behind. As the salt increases, the soil can become toxic to plant life.

The following chart describes a few of the indicators, the projected goal and the most recently available evaluation data retrieved from the Circulation System for Desertification Information in Morocco.

**Table 3: Indicators and Achievements**

Indicator	Goal (Source: PAN-LCD)	Current (areas measured in hectares) <sup>37</sup>
Potable water	31,000 localities by 2010	1998: 5.3% 2000: 7.8% 2001: 9.5% <sup>38</sup>
Electrification	1,500,000 rural households (amounting to 80%) by 2010	30% (2001) <sup>39</sup>
Illiteracy		48.3 % (1998) <sup>40</sup>
Overflow basins	3 million ha of overflow basin	550,400 (2006) <sup>41</sup>
Irrigation	1.36 million hectares by 2020	610,492 (2000)
Reforestation	1.5 million hectares by 2030	593,000 (2007) <sup>42</sup>
Area of fixed sand dunes		34,765 (2006) <sup>43</sup>
Passage ground development	Create 20 million hectares; rehabilitate 2 million hectares	791,727 (2001) <sup>44</sup>

<sup>37</sup> Some of the figures may differ from the numbers given by other international organizations due differences in measurement

<sup>38</sup> Système de circulation de l'information de la désertification au maroc, [www.scid.ma](http://www.scid.ma), (Accessed November 6, 2009)

<sup>39</sup> IBID

<sup>40</sup> IBID

<sup>41</sup> Fiche Thematique, « Espace Forestier » Système de circulation de l'information de la désertification au maroc, Maroc 2009.

<sup>42</sup> IBID

<sup>43</sup> IBID

<sup>44</sup> Système de circulation de l'information de la désertification au maroc, [www.scid.ma](http://www.scid.ma), (Accessed November 6, 2009)

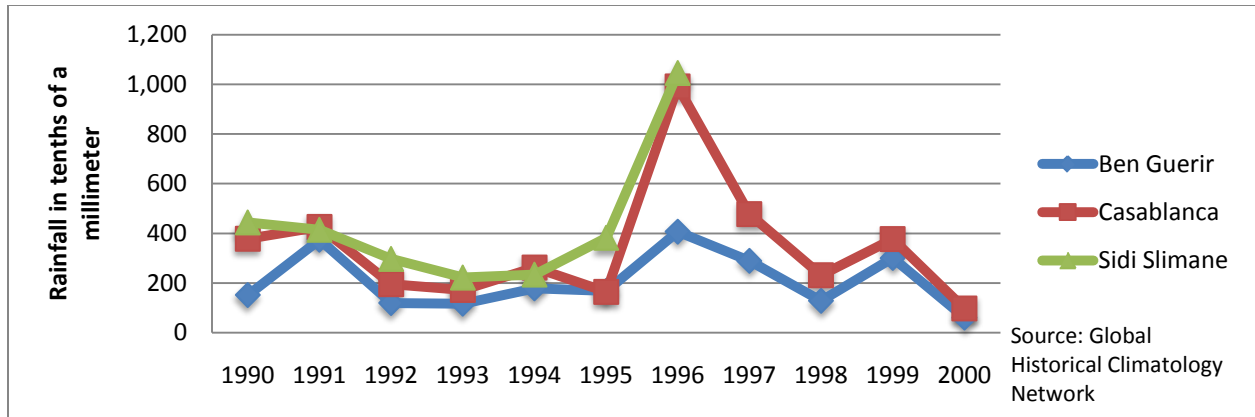
These indicators demonstrate the improvements have been made. Some of the indicators such as “Irrigation” appear to be well on its way to meeting its goals, and others, such as “passage grounds” appear to be lagging behind.

## **6.2 ENVIRONMENTAL INDICATORS**

In attempting to grasp in numbers what has been occurring in the environmental over the last 20 years, I have gathered multiple indicators of data collected through various networks. Because environmental initiatives can only show progress in the long-run, it is all together too early to say whether or not the Moroccan plan has had the intended ecological impact. It is also impossible to determine conclusively the counterfactual, or what would have happened without the efforts of the PAN-LCD. However, we can evaluate the situation and we can match the situation to what the intended outcomes were of the PAN-LCD. The following is a slight glance of the environmental trends over the past 15 years.

### **6.2.1 Precipitation**

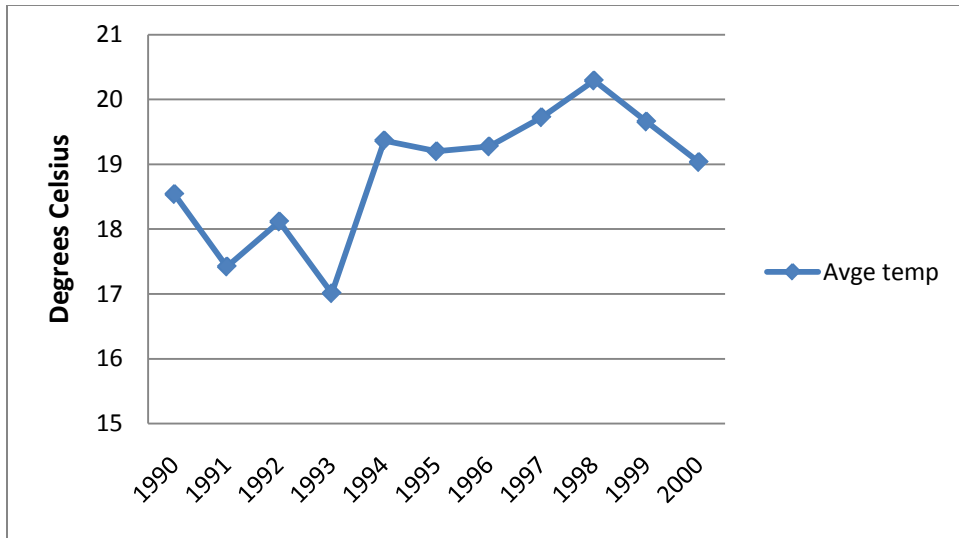
Precipitation is presented in figure 8. Data was retrieved from the Global Historical Climatology Network for three different weather stations between the years of 1990 and 2000. Again, this short period gives us problems in drawing any conclusions. The data shows similar trends for all three stations. There was an unusual spike in 1996. Overall, however, the general trend is negative as exemplified by a slope of -1.38 for Ben Gurion and -1.33 for Casablanca. If we were to eliminate 1996 in calculating the average slope, Ben Gurion has a slope of -3.4 and Casablanca has a slope of -7.9. This concludes a negative trend, but we do not know if the trend continues to the present day.



**Figure 8: Rainfall in 3 weather stations in Morocco**

### 6.2.2 Temperature

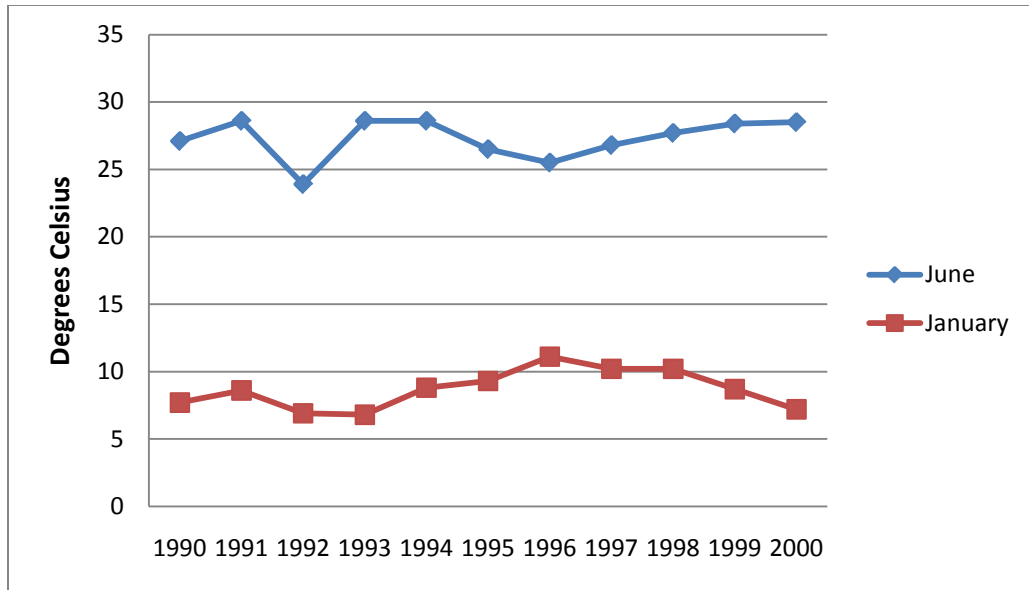
Temperature data was retrieved from the Global Historical Climatology Network from the years of 1990 to 2000 and is presented in figure 9 and figure 10. In examining the average temperature, we can observe a sharp increase starting in 1994 that eventually levels off and starts to decrease in 1998. This dataset does not tell us what happens in the 2000s, therefore, we cannot conclude as to whether or not this increase was part of natural fluctuations or part of a long-term trend.



**Figure 9: Average Temperature**

Because averages do not account for worsening extremes in the data, I also observed the temperature trends of the peak winter month of January versus the peak summer month of June in figure 10. They appear to be inversely related. Starting in 1996, the two lines begin to diverge suggesting the possibility of an increase in extremes. However, again, we do not know if this trend is continued or not into the 2000s. The trend is not drastic enough to draw any conclusions.

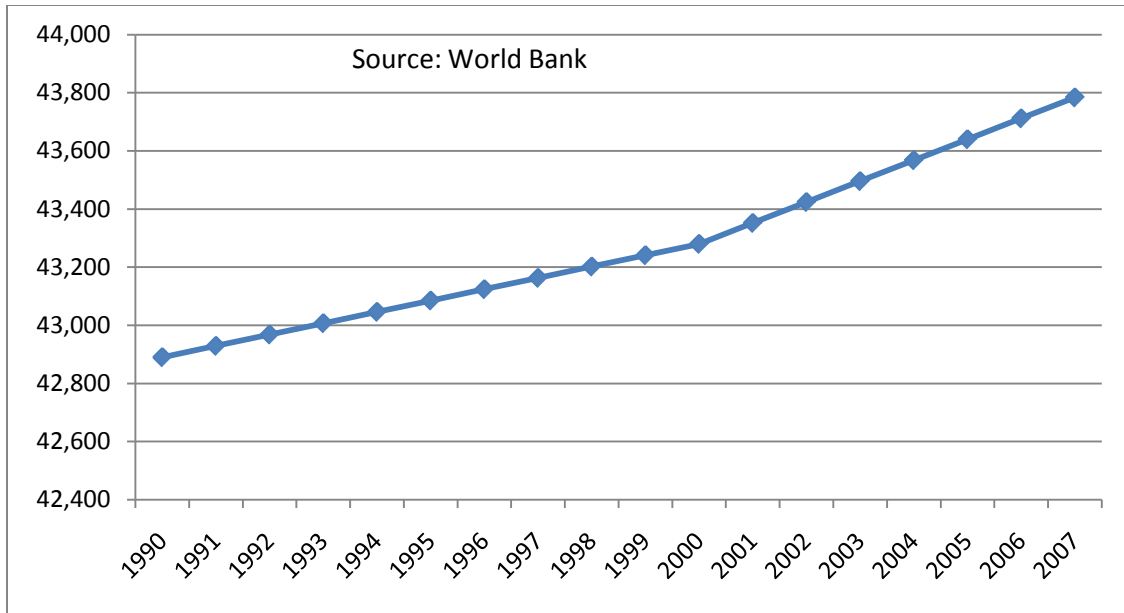




**Figure 10: Temperature Extremes**

### 6.2.3 Forestation

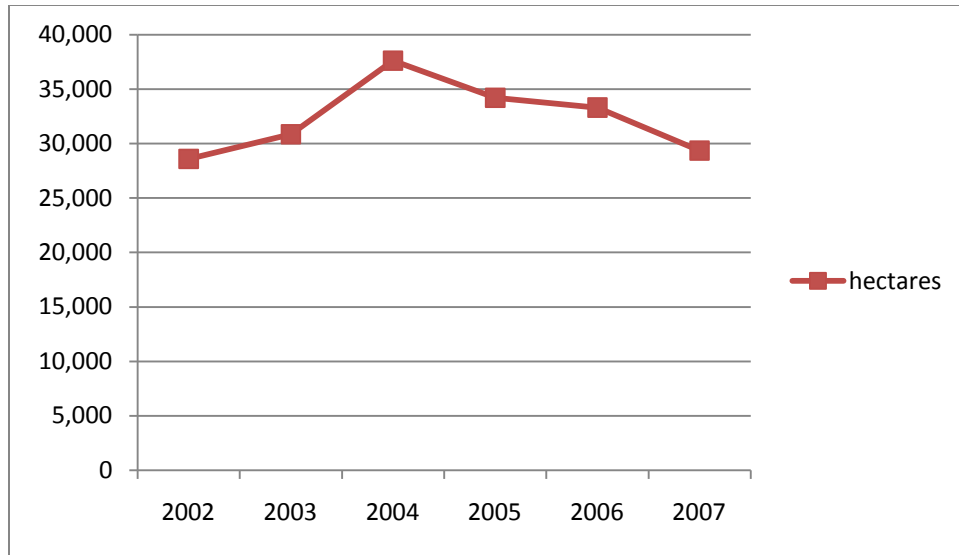
The World Bank data indicates that there has been an increase since the early 1990s in forestation from 42,890 sq km in 1990 to 43,784 sq km in 2007, illustrated in figure XX. This is, by no means, a dramatic increase particularly considering that the goal since 1996 has been to increase forest area by 15,000 km (1.5 million hectares) by 2030, but the growth is, nonetheless, in the right direction indicating that efforts to improve forestation have succeeded in halting a pattern of an annual net loss in forest area. It has been estimated that 5,000,000 (50,000 km) hectares of net gain reforested area are needed to have the necessary impact on desertification (Minister of Agriculture, of Rural Development and Water and Forests 2001).



**Figure 11: Forest Area (sq km)**

#### 6.2.4 Land Degradation

The available indicators on degraded land presented in figure 12 come from the follow-up evaluation mechanism of the PAN-LCD. The figures examine the number of hectares of degraded land between the years of 2002 and 2007. In these years, we see a spike in 2003 and then a casual drop off. Ultimately, there is little change between 2002 and 2007.



**Figure 12: Land Degradation in Morocco**

Considering what we know about desertification, we would expect temperature to increase and rainfall to decrease as land degradation is exacerbated. Consequently, as more and more trees are put into the ground, we would expect the opposite response assuming that the presence of trees decreases land degradation and desertification. With the exception of “forest area,” the data collected shows little discernible trends and certainly not enough to draw conclusions upon. Data with a larger and consistent temporal range would better warrant conclusions about any relationships or trends.

### 6.3 FOCUS GROUPS

Focus Group results are not based on a representative sample; therefore, we cannot make conclusions about the region based on the responses we heard. The constructs and elements that were elicited represent only those who expressed them. In the context of policy, however, these constructs are useful for two reasons. The first is that it lays the groundwork for any future

qualitative research. Using these constructs, we can create a survey and/or interviews based on a set of understandings that came from the region itself rather than preconceived notions of the researcher. Secondly, it provides program and policymakers with a set of tools with which to stage an intervention. From these focus groups, we know that there are certain people in the village who conceive of the problem in a certain way and who may act as a “change agent.” Often times what a program or policy lacks is a means of relating the macro to the micro. In the diffusion of innovations, Rogers notes that the change agents that are from within the community are more likely to effect change than those from outside the community. For this reason, it is essential to establish a point of entry into the community, understanding the full extent of a participant’s reality, knowing that there are likely others with similar experiences.

### **6.3.1 The differences between men and women**

The men’s comments and solutions were almost always grounded in an economic reality. This is not surprising considering that it is a community steeped in tradition where the men are responsible for providing an income for their families. When discussing the obstacles to fighting desertification, money was almost always an issue. They listed examples of potential projects that they had considered, citing the lack of financing to start them. The discussion often gravitated to the problems they faced with planting trees, such as too much wind, cold nights, soil erosion, flooding, and when was the best time to plant, how to manage animals and trees at the same time, how much water do they need, and how to obtain the water. They also cited potential conflicts between different tribes and even different villagers who had separate needs of the forest.

The women, on the other hand, approached the issue from a social angle. In coming up with solutions to the problems, they emphasized education, awareness and community mobilization. The hindrances they felt were more based on disempowerment and lack of local support. There was a much stronger sense of urgency and frustration in their comments and they also had a clearer sense of what the widespread social implications of a degrading environment. At multiple times, they commented on the effects of migrating to the cities, resulting in a loss of human capital in the country and an increase in social problems in the cities. They made more comments regarding the tragedies that they had witnessed from the floods, telling stories about people who died and people who lost their homes.

Finding and contacting women for the focus group proved to be difficult because women stay in the home and there are less public arenas in which to develop a relationship with them. Going into the group interview, I was told by my recruiter that “the women here are empty inside,” they will have nothing to say. Contrastingly, upon listening to the recordings after the interview was completed, one male participant who happened to be present observed that the women were, in fact, more articulate and better-informed than the men.

This is possibly indicative of another cultural hindrance important to the development portions of desertification policy. If the feelings of my recruiter were in any way representative of the general mentality of the village, this would demonstrate that the recognition of potential female contributions is vastly underestimated. A significant amount of evidence reveals that women-centered development efforts have a high success rate. There is, therefore, a distinct possibility that women are an under-utilized resource in the rural areas which could open many more possibilities for implementing change. This is a hypothesis that is worth further exploration.

### **6.3.2 The level of awareness of the villagers**

In all of the groups, the participants were well aware of the issues of desertification. A participant in the men's group stated, "I hope that people will understand it (desertification) and feel it and start thinking about it and do something because it's really dangerous. It's a serious problem."

Many shared personal commentaries of what they witnessed and experienced in their environments, including many references to the flood damage that had occurred and their increasing inability to grow anything in this environment.

As to the causes, the responses were a bit more diverse. The most commonly cited were deforestation, environmental conditions and pollution. Many commented on the fact that nobody replants trees after they die or are cut down. Money was often the reason given as to why. The raising of livestock came up several times but was not often highlighted as a main cause.

### **6.3.3 How the problems were perceived**

Responses were divided into groups representing third person and first person in order to determine whether or not responses were different when talking about personal responsibility and about the responsibility of others. Women were disappointed by a lack of support from other villagers. Amongst the men conflicts were only mentioned in the third person, suggesting that our participants were not subject to the conflicts or at least did not want to admit it verbally. Additionally, there were few mentions of personal behavior. Nobody admitted to cutting down trees and not replacing them. However, several commented on others cutting down trees and not replacing them. One man referred to the utter nonexistence of replanting efforts: "I am 34 years

old and I've never seen a tree that was planted in my generation. All the trees I see are old and nobody replanted the trees.”

#### **6.3.4 How the solutions were perceived**

A strong emphasis was placed on tree planting for economic gain, almonds in particular. Several made in-depth thought-out proposals for how to manage the different needs of the community while addressing the environment. A common theme that also came up was about mobilizing the community. Comments regarding the need to unify the region were made in addition to the need for leadership and support. Some of the women felt that the attempts they made to preserve the environment were not appreciated by others and even mocked, “It's like the plastic bowls that we find outside. We (re)use them but a lot of people laugh at us and say ‘oh, look at what they're doing,’ but we're trying to do something. We're trying to recycle...But nobody is trying to help us.” During my initial meeting with the women, they showed me the ways in which they reused much of what is thrown out on the ground by other villagers. They created baskets out of candy wrappers, decorative trees out of large soda bottles, seasoning jars out of small soda bottles, and much more. They clearly demonstrated creativity and skill about addressing what they saw as problematic. Education was also mentioned among both men and women but particularly among the women.

#### **6.3.5 Government Responses**

Only two comments were made suggesting a role for the government in addressing the problems, but several were made regarding the potential assistance of charitable giving or an NGO intervention. This suggests that the participants do not tend to look to the government as part of the solution. Both men and women commented at least once about the lack of involvement of the

government and the empty promises leading to a certain degree of disillusionment. However, it is important to note another potential bias in our study which is that my team of recruiters and facilitators are known within the region for engaging in tree planting initiatives. Because of this, I suspect that the participants zeroed in on the particulars of planting trees and grassroots organizing rather than engaging in a discussion of effective governance, regardless of whether or not questions were asked about government actions. With that said, however, a sense of distrust in government initiatives was expressed at multiple times throughout the discussion.

### **6.3.6 Policy Implications**

Perhaps the most important implication of these focus group results is that villagers are aware of the realities of desertification and the need to fight it actively. This constitutes the first step in Rogers' "diffusion of innovations." Because this is not a representative sample, the views of these participants could be minority opinions, but what is important is the conditions are present for first-movers or innovators to begin the change process. If the views expressed are in fact representative of the population, then innovations should be even easier.

What these focus group discussions also indicate is that the PAN-LCD was right to have identified poverty as a key obstacle to fighting desertification. This sentiment was repeated consistently throughout each of the focus groups. What is less clear, however, is how to manage economic development and environmental preservation. Villagers mentioned many obstacles to initiating interventions. With planting trees for harvest, the lack of time and money prove to be prohibitive factors. Managing the environmental situation seemed to be a particularly vicious obstacle. Lack of sufficient rainfall, too much wind, infertile soil, too many hills, and rapid temperature fluctuations are not easily remediable with policy particularly when environmental



conditions vary from village to village. When funding and administrating agricultural production and tree plantations, the government cannot possibly account for all of these obstacles at the heart of desertification. Similarly, resolving potential disputes between tribes and or villagers which are bound to arise anytime the status quo is changed is a task that state-wide administration cannot likely address.

Ultimately, the PAN-LCD has been correct in identifying the crucial role of participatory development. It is no wonder that past efforts to fight desertification have failed when they did not involve the local population. The lack of money is perceived almost like imprisonment for the people that want to enact change. Considering the extent of the localization of the issue, it is incumbent upon policymakers to engage in a more decentralized approach. While the PAN-LCD often mentions the importance of community involvement, it does not present a clear strategy for doing so. As far as the villagers of El Mers are concerned, they have yet to be affected by any government-run initiative. In conclusion, our focus group responses indicate that the state-wide policy is correct in knowing their limitations in fighting desertification on the local level, but has yet to generate a plan to facilitate direction in the areas where they cannot respond.

## 7.0 RECOMMENDATIONS

### 1) Employ a decentralized approach to resource management –

As has been demonstrated by Elinor Ostrom and Arun Agrawal, the decentralized approach offers a solution to the problems of implementing policy from the state level to a vast stretch of rural areas. It is important, however, to keep in mind the appropriate levels of control.

### 2) Incorporate programs that focus on the mobilization of women –

As has been demonstrated in the past, women-centered initiatives have proven to be effective. All indications are that women are an under-utilized resource in the fight against desertification.

### 3) Close management of development initiatives.

Development initiatives should be handled carefully because of the potential to exacerbate environmental degradation. The construction of roads may lead to an expanse in habitation onto marginal lands. Improved access to irrigation systems can lead to over-watering, further salinization of the soils and depletion of the aquifers. Further consequences may be land subsidence and a prohibitive increase in the marginal cost of extracting water. Similarly, an increase in income can lead to an increase in consumption of environmentally destructive behavior, such as the purchasing of automobiles, industrialization, and an expanding rural population, --for example, larger homes, more spread out--.

- 4) Sustainable development should be emphasized, i.e. how to manage low-impact lifestyles.

Development initiatives can focus on ways to conserve the environment that may also increase standards of living. Reducing the amount of waste fuel and water can lead to an increase in production and profits while also conserving natural resources.

- 5) Awareness campaigns are a crucial first step throughout the regions.

While the focus group responses demonstrated a substantial amount of awareness among the affected villagers, there was less of a degree of community mobilization. Campaigns that emphasize people-centered approaches may help to nurture a sense of personal responsibility. Following up with a set of tools for people to become proactive in preserving their environment will reinforce the initiative. This recommendation comes from frequent allusions to frustration in not feeling capable of addressing issues of concern to desertification.

- 6) Government-subsidized innovations

Those who wish to transition to a lifestyle that is more conducive to preserving the environment should not be penalized by the cost of entering into a new market. A set of environmentally-appropriate occupations should be established, such as growing almond trees, and then incentivized by reducing the cost of implementation.

7) Sustainable innovations:

The findings of past research on the diffusion of innovations should be used to introduce lifestyle innovations that facilitate a healthier environment. Possibilities may include:

- Swaling
- Low maintenance and low investment household water catchment techniques
- Alternative solutions for fuel sources:
- Varieties of trees that are fast-growing and can provide a constant source of kindling
- Alternative stove designs for a more efficient use of heat
- Organic waste, i.e. fruit/nut casings and pits
- Sustainable farming practices
- Increase biodiversity

## 8.0 CONCLUSION

Balancing initiatives to promote sustainable economic growth is a complicated process for developing countries. Fighting desertification takes a significant amount of resources and political will, but it is possible to accomplish. In a country like Israel or the United States the fight is more feasible due to the immense capabilities of technology, governing structures and rich academic environments. Throughout countries in Africa, however, where two thirds<sup>45</sup> of the continent is at risk of desertification, poverty is thrown into the picture making the problem infinitely more complicated. When individuals cannot afford to internalize the negative externalities of their actions, they are left with no options but to continue on in the same vein despite the consequences. As the government attempts to address these issues, they are faced with the age-old problem of using centralized policies to address local issues. Environmental conditions vary from village to village as does the relationship that individuals have with their environment. It is mostly impossible to head-up small-scale initiatives from the state capital.

In the case of Morocco, poverty alleviation has been identified as a key determinant in a successful fight against desertification. However, it is possible that poverty alleviation could affect the population in ways that actually harm the environment. For this reason, it is imperative that the government use careful consideration in all of their development initiatives. This should include developing in-depth understandings of the populations in order to determine where are

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<sup>45</sup> UNCCD, "Regional Profiles," <http://www.unccd.int/regional/africa/menu.php>.

the hidden resources within the local populations that can be unleashed in order to mobilize change.

The results of qualitative research suggest that women may be an under-utilized resource. This is concluded by several indications including their invisibility within the functions of the village and the seldom mention of women throughout the PAN-LCD. The results also suggest a relatively high degree of awareness and willingness to act on the part of villagers, but very little sense of how to act or what are the capabilities of the villagers.

The fact that humans are the primary causes of desertification suggests that humans can also be the primary solution. Considering the conclusion that rural civilians sparsely populated throughout the Moroccan wilderness have facilitated the destruction of their environment, it is subsequently reasonable to assume that by focusing efforts on the realignment of lifestyle practices of civilians, the impending crisis of desertification can be largely averted. The task ahead is determining the most effective way to mobilize rural populations to preserve their environment.

## APPENDIX A

### FOCUS GROUP MATRIX

**Table 4: Focus Group Matrix**

	Hindrances	Personal Experiences	Solutions	Knowledge and beliefs	Behavior	Attitudes
Local Government					Occasional assistance	
State Government	<p>Lack of trust of government promises and actions</p> <p>“When the government cleaned the land and planted trees, they are worried they will come and take it.”</p>	<p>Government efforts to plant trees</p>	<p>We should stage protests</p> <p>We need government involvement</p> <p>“...The people aren’t going to do it, the government has to do it...”</p>	<p>Lack of trust of the government</p>	<p>Uninvolved government with empty promises</p> <p>“Sometimes government representatives come and say they are going to do this or that for you then they never come back”</p>	
1 <sup>st</sup> person	<p><b>Disempowerment</b></p> <ul style="list-style-type: none"> <li>- Money</li> <li>- Infrastructure</li> </ul> <p>Length of time for trees to come to fruition and provide an income source</p> <p>Cold weather</p> <p>“ Of course the tree doesn’t give results until three years, so what am I going to do in these three years? I’m just going to pray? I need to eat something and we need to take care of our families. So what can we do?”</p>	<ul style="list-style-type: none"> <li>- Low survival rate of trees</li> <li>- Poor harvest</li> <li>- Reduction in rainfall</li> <li>- Fewer and fewer trees</li> <li>- Minimal replanting</li> <li>- Not enough market power</li> </ul> <p>“I am 34 years old and I’ve never seen a tree that was planted in my generation. All the trees I see are old and nobody replanted the trees.”</p>	<ul style="list-style-type: none"> <li>- Plant trees</li> <li>- Education about pollution</li> <li>- Plant fruit trees</li> <li>- Plant non-fruit trees for timber and future generations</li> <li>- Plant trees in plots to leave room for animals</li> <li>- Keep the animals inside</li> <li>- We need a leader</li> </ul>	<p><b>Causes</b></p> <ul style="list-style-type: none"> <li>- Humans</li> <li>- Not enough trees</li> <li>- Pollution</li> <li>- Don’t know how to prevent floods</li> <li>- Too many hills</li> <li>- Not enough trees</li> <li>- Not enough rain</li> <li>- Too much dryness</li> <li>- Soil erosion</li> <li>- Too much wind</li> <li>- Too much rain at</li> </ul>		<p>Personal responsibility</p> <p>“We need to educate. We’re all responsible for the environment, our families, our brothers, our neighbors. Everybody. Everybody needs to be responsible.”</p>

				<ul style="list-style-type: none"> <li>- once</li> <li>- Cold nights</li> <li>- Too many storms</li> </ul>		
3 <sup>rd</sup> person	<ul style="list-style-type: none"> <li>- We need people to support us.</li> <li>- Money!!</li> <li>- Not enough water</li> <li>- No money to build pumps</li> <li>- Conflicting interests between those with livestock and those with trees</li> <li>- People with livestock don't want trees to take away grazing grounds</li> <li>- People don't have enough space</li> <li>- Trees are a long-term investment with no short-term gain</li> <li>- People cut trees to build dams to divert water</li> <li>- It's too expensive to keep livestock indoors</li> <li>- Tribal conflicts in the region</li> </ul> <p>"Now when trees die, nobody plants another one. Why don't people do it? Because they don't have enough materials or money to do it. To replant trees, there's a lot of things to do, work, money, water, especially for fruit trees."</p>	<p>Flood destruction</p> <p>"For example in one village, a flood happened almost a year ago in September 2008 and now they don't have a road, they can't cross the river. There was one story about a guy who was trying to cross the river with a cable but he fell and broke his leg. That's just one example. This guy he was lucky because he didn't die but maybe somebody else died or almost lost his life."</p> <p>"...In our village one lady and her son died because of the floods. Here, too, almost all the houses that were built were destroyed and people left their homes because they were afraid. And one lady died because she lived close to the river but now people don't do that anymore."</p>	<ul style="list-style-type: none"> <li>- We need more help and support</li> <li>- Education</li> <li>- Create incentives for people to stay or come back</li> <li>- Stage protests to the authorities</li> <li>- First we must be unified</li> <li>- Plant trees and maintain animals at the same time</li> <li>- Become a region of almond tree growers, known as such throughout the country</li> </ul> <p>"The first thing is that we need to educate people to not just ignore his land or leave it just because a flood happened."</p>	<ul style="list-style-type: none"> <li>- Not enough education regarding pollution</li> <li>- There is awareness regarding desertification</li> </ul> <p>"I hope that people will understand it (desertification) and feel it and start thinking about it and do something because it's really dangerous. It's a serious problem."</p> <p>"...People see it. People know that there is desertification and that they're losing the soil."</p>	<ul style="list-style-type: none"> <li>- People who lost everything in the flood moved to the city which causes problems there</li> <li>- Others often laugh at our conservation efforts</li> <li>- People cut down trees and don't replant</li> <li>- People don't test the soil before planting</li> <li>- People cut down trees for wood and let animals graze</li> <li>- Some build walls out of rocks to fight erosion</li> <li>- We want to plant almond trees</li> <li>- Nobody replants trees because of no money.</li> <li>- People cut trees to build dams to divert water</li> <li>- Some don't let others plant trees.</li> </ul> <p>"It's like the plastic bowls that we find outside. We (re)use them but a lot of people laugh at us and say oh, look at what they're doing, but we're trying to do something. We're trying to recycle...But nobody is trying to help us."</p>	<p>Some don't want trees.</p> <p>"(Some) people here don't like to plant trees that they are not going to use. Sometimes if you bring trees that people don't want, they will stop.... That's what happened several times. People said if you plant trees in the forest, you will close the forest and then we cannot use the forest for our animals... and they will stop you."</p>



NGOs			<ul style="list-style-type: none"> <li>- Must talk to the people first</li> <li>- Dig wells for communal use</li> </ul> <p>“If you give trees or bees, you need to make a deal that next year he will give 5 bees to other people and he can keep two for him and do the same thing for all the people. After two or three years, people will be with you 100%. Just you need to do something that people will see the results in the first year.”</p>			
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## APPENDIX B

### PROGRAMS AND STRATEGIES OF THE PAN-LCD

**Table 5: Programs and Strategies of the PAN-LCD**

Strategy or Plan	Objectives
<i>Principle programs addressing: Rural and agricultural development, the preservation of natural resources and the fight against desertification and drought</i>	
The orientation plan for the development of irrigation	Extend irrigation to potentially irrigable areas.
The national management plan for overflow basins	Create 3 million hectares of overflow basins
Plan for reforestation	Reforest 1.5 million hectares.
Strategy for development of passage grounds	<ul style="list-style-type: none"> <li>• Create and manage 20 million hectares</li> <li>• Rehabilitate 2 million hectares</li> </ul>
Plan for the Protection of Surface Areas	Manage and conserve 156 sites of biological and ecological interest
The National Forest Program	
The plan for conservation management of agricultural lands	Promote the conservation and management of agricultural lands.
<b>Important initiatives addressing: Infrastructure and basic social services</b>	
Strategy for the development of water resources	<ul style="list-style-type: none"> <li>• Construct 70 medium and large dams, (3 per year)</li> <li>• Mobilize subterranean water from deep aquifers</li> </ul>
Program for the supply of potable water for rural populations (PAGER)	Provide potable water for 31,000 localities
National Program for the Construction of Rural Routes (PNCRR)	Construct and/or rehabilitate 11,200 km of roads and rural paths
Program for Global, Rural Electrification (PERG)	Electrify 1,500,000 rural households to achieve an electrification rate of 80%
Program of Social Priorities (BAJ1)	Improve the rate of access to basic education services in the 14 poorest provinces.
Development of irrigated lands	Extend irrigation to: <ul style="list-style-type: none"> <li>• 86,120 ha of large hydraulics</li> <li>• 13,620 ha of medium and small hydraulics</li> </ul> Rehabilitate: <ul style="list-style-type: none"> <li>• 14,400 ha of large hydraulics</li> </ul>

	<ul style="list-style-type: none"> <li>• 136,500 ha in (PMH zones)</li> </ul>
Program for the Development and management of Forests	<ul style="list-style-type: none"> <li>• Afforest 14,700 ha</li> <li>• Reforest 114,000 ha</li> <li>• Fight against erosion in 6 overflow basins</li> <li>• Stabilize sand dunes on 1,800 ha</li> <li>• Manage biodiversity in 21 identified sites.</li> </ul>
Program for the improvement and quality rendering of agricultural production	<ul style="list-style-type: none"> <li>• Plant olive trees on 150,000 ha</li> <li>• Renew argume plantations on 34,000 ha</li> <li>• Genetic improvements of egg and beef production</li> </ul>

## APPENDIX C

### LOGIC MODEL OF THE PAN-LCD

**Table 6: The Logic Model of the PAN-LCD**

Inputs	Activities	Outputs	Short-term Outcomes	Intermediate Outcomes	Long-term Outcomes
Investments in infrastructure	<ul style="list-style-type: none"> <li>• Construction of dams</li> <li>• Overflow basins</li> <li>• Construction of roads</li> </ul>	<ul style="list-style-type: none"> <li>• 14.5 billion square meters of water harvesting for agriculture, potable use and hydroelectric energy</li> <li>• 500,000 Overflow basins</li> </ul>	<ul style="list-style-type: none"> <li>• More have access to potable water</li> <li>• Increased access to agricultural water</li> </ul>	<ul style="list-style-type: none"> <li>• General health indicators improve</li> <li>• Increased agricultural yields</li> </ul>	<ul style="list-style-type: none"> <li>• Increased standard of living and higher productivity</li> <li>• Increased productivity</li> <li>• Increased economic stability</li> <li>• Increased food security</li> </ul>
Legislation <ul style="list-style-type: none"> <li>• Forest</li> <li>• Water resources</li> </ul>	<ul style="list-style-type: none"> <li>• Creation of national parks</li> <li>• Institutionalized protected areas</li> </ul>	<ul style="list-style-type: none"> <li>• 4 national parks and multiple reserves</li> <li>• 5 million hectares of protected forest area and springs</li> </ul>	Protect forest areas from degradation	Maintain the biodiversity of Morocco	Maintain the biodiversity of Morocco
Dune spreading prevention mechanisms	Sand dune control	33,000 hectares of sand dune control	Halt the spread of sand dunes	Minimize the spread of the desert	Minimize the spread of the desert
Micro-financing	Participatory development	Creation of village forests, wind breaks, rainwater catchment techniques and renewable energy			
Ecological interventions	Reforestation	530,000 hectares	Regenerate forest ecology	Increase biodiversity	Regenerate the hydrologic cycle
Development	<ul style="list-style-type: none"> <li>• Increase access</li> </ul>	<ul style="list-style-type: none"> <li>• Provide</li> </ul>	<ul style="list-style-type: none"> <li>• Increased</li> </ul>	<ul style="list-style-type: none"> <li>• General</li> </ul>	<ul style="list-style-type: none"> <li>• Increased</li> </ul>

initiatives	to education <ul style="list-style-type: none"> <li>• Increase access to potable water</li> <li>• Rural electrification</li> </ul>	potable water for 31,000 localities <ul style="list-style-type: none"> <li>• Improve basic education services to 14 of the poorest provinces</li> </ul>	accessibility to water <ul style="list-style-type: none"> <li>• Increased accessibility to education</li> <li>• Improved Living standards</li> </ul>	health indicators improve <ul style="list-style-type: none"> <li>• Illiteracy rate decreases</li> </ul>	standard of living and higher productivity <ul style="list-style-type: none"> <li>• More informed decision-making</li> </ul>
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