# Climate Uncertainty, water availability and social behavior in Mexican Agriculture

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**Abstract**
High variability in both space and time has had huge impact on Mexico's agriculture forcing farmers to change economical activity. Planted area on the irrigation districts (where 73% of the GIP of agriculture is produced) has declined over time triggering the use of pumping water depleting aquifers at an estimated rate ranging from 0.5 to 2.5 meters per year. The first impact of this is the reduction of water quality below international standards. On the other hand, rainfall uncertainty in rain feed agriculture has forced farmers to emigrate to other states, other activity or to other country. This paper analyses the impact of rainfall uncertainty in the agricultural sector having economical and social decision variables as output to development plans in Mexico.
**Keywords:** water management, emigration, modeling.

## Introduction

Over the last 50 years water availability in Mexico has declined in 74% going from 18,035 $m^3$ to 4,573 $m^3$ per year per inhabitant through year 2005 (Maderey y Carrillo, 2005) see figure 1. According this trend it is expected that in 2010 water availability will be 850 $m^3$ per year per inhabitant.

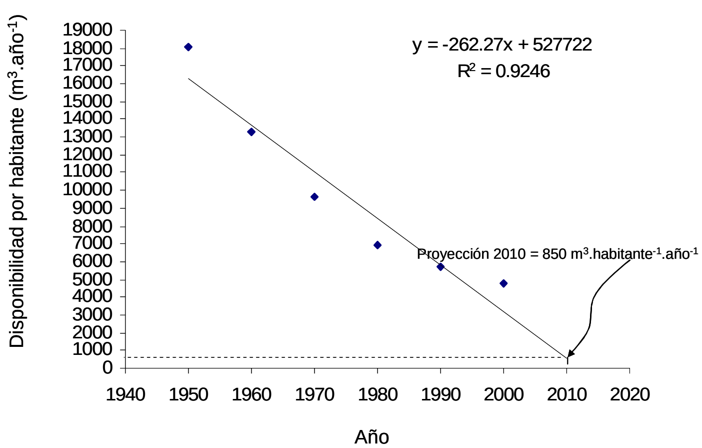


Figure 1: Water availability variation in Mexico and projection

Out of 653 aquifers in Mexico 104 are overexploited from which more than 60% of water for different uses comes from (CNA 2007).

Mexico climate variability is huge in such a way that it may be found a wide range of water availability across the country for different uses. On the other hand, the Mexican water paradox is that the south accounts for 68% of the total runoff of the country; it has only 23% of the population and produces only 14% of the GIP. The north accounts for 32% of the total runoff, 77% of the population and produces 86% of the GIP. In this part of the country are located the main irrigation districts. (See figure 2)

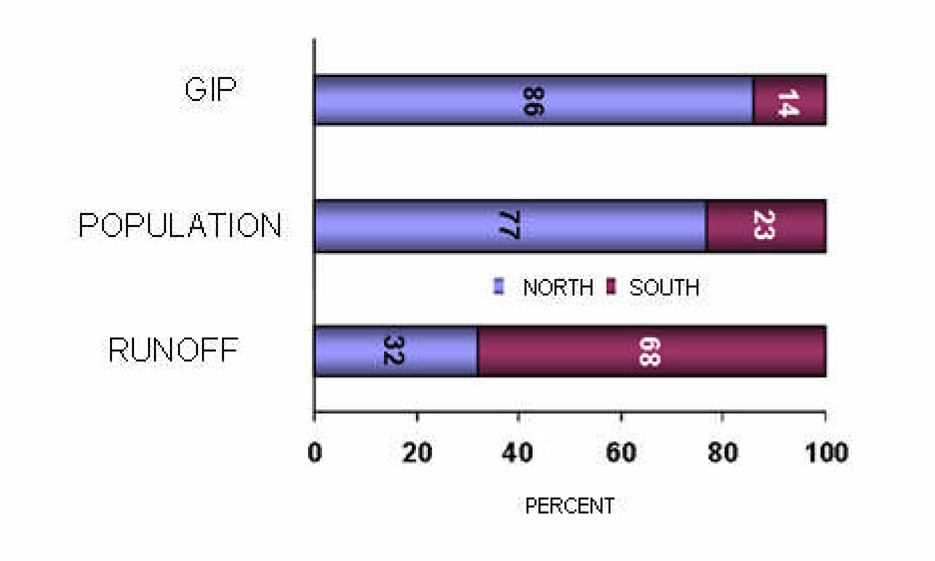


Figure 2: Relation between economical development and water availability in Mexico

Figure 3 shows the main uses of water in Mexico. Agriculture accounts for almost 80% of the total water use; nevertheless, this economic sector has a global efficiency of 40% (Sanchez, *et al* 2002). This situation is mainly due to hydraulic infrastructure deterioration and bad operation of irrigation systems. On the other side water prices are too low discouraging farmers to be more efficient.

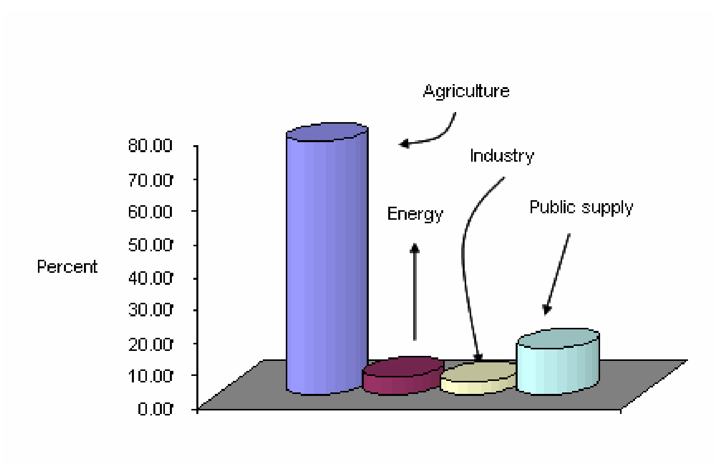


Figure 3: Water uses in Mexico

**Impact of climate uncertainty on Mexican agriculture**

In terms of labor force agriculture is the sector more impacted by climate uncertainty (Papail and Arroyo, 2004). In this way, since 1920 emigration from agriculture increased in such a way that nowadays a daily average of 400 people emigrates from that sector to the cities or to the USA. (See figure 4).

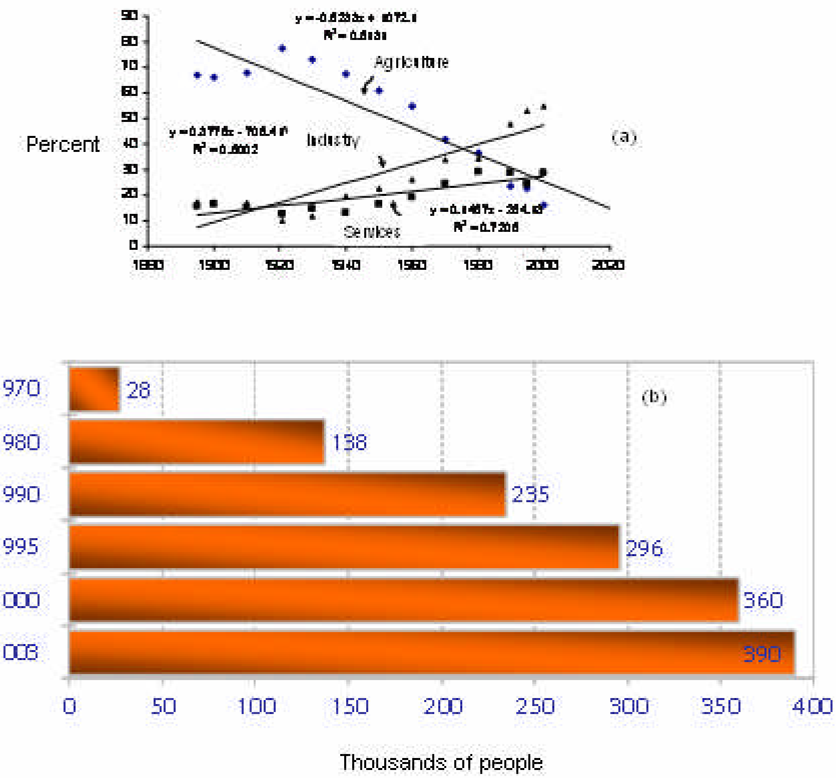


Figure 4: Sector dynamics in terms of labor (a) and agriculture emigration (b). Data from SEDESOL, 2004

If the rate of emigration continues it is estimated that to year 2030 the Mexican agricultural sector will lose its labor force totally. Also, it is worthwhile to mention that climate is not the only cause of rural emigration; moreover, this phenomenon follows a very complicated interaction among political, social, environmental and economical variables (Sanchez, *et al* 2007). Nevertheless climate explains in great measure the emigration process as Figure 5 shows.

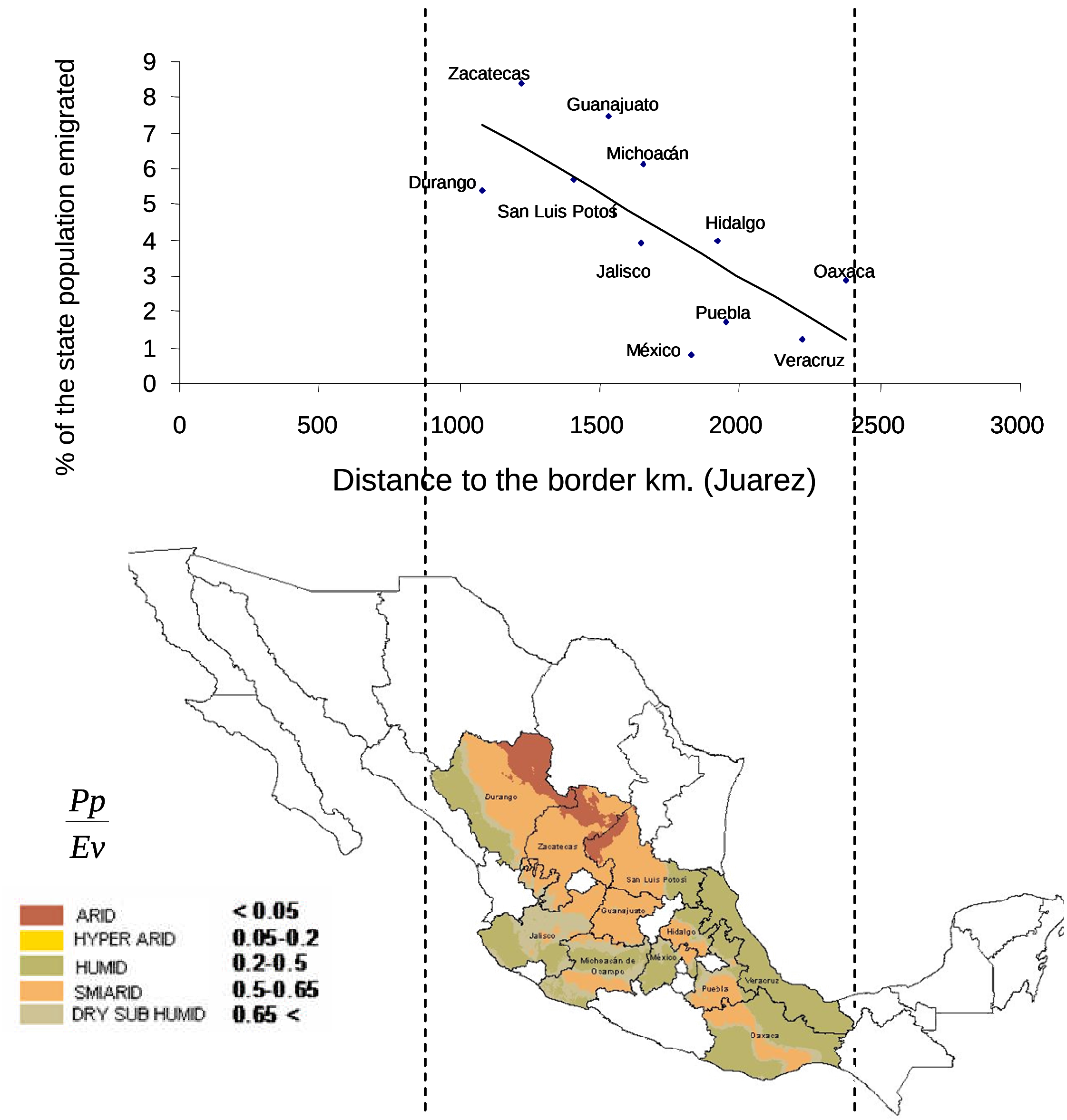


Figure 5: Relation between climate, distance to the border and emigration in Mexico.

Figure 5 shows that the estates with the most emigration rates are under arid and semiarid conditions. In this way, the climatic situation exacerbates the emigration process and depicts the vulnerability of these ecosystems.

## Conclusion

Climate uncertainty, economy, health and other situations have triggered emigration from agriculture to the U. S. and other sectors of the economy in Mexico. According the trend and the economic model of the country, these situations will aggravate affecting the agricultural sector and the proportion of the GIP that this sector generates. More vulnerable population to the climatic extremes is tied to poorness and poorness is tied to culture and education; nevertheless, 28% of Mexican population makes their living out of agriculture even though this generates only 5% of the GIP.

Climatic variability in the country is huge existing an imbalance between water availability, development and productivity. In this context, resilience strategies should be distinctive according possibilities of different economic regions. This depicts the need of mitigation mechanisms evaluation in order to have an objective appreciation of the impacts and actions to be taken under climatic extremes situations. Climate modeling and the use of hydrological models constitutes a powerful analytical tool for decision taking considering different socio economic situations.

## Literature


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