

The Two Perspectives of the Climate Change: Social vs. Scientific

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Abstract. Climatic conditions become ostensible in human activities altering agricultural production, forestry and civil security, increasing vulnerability risk of socio-environmental disaster. In regions where natural resources proliferate in good condition and therefore are declared protected areas, it is essential to determine whether there is indeed climate changes or, if there are just climate variations because ethnic and peasant communities depend entirely of their natural resources to survival. The aim of this study was to compare local people perception of weather variations respect what was found by scientists to analyze long series of traditional climatic data. To understand social vs. scientific perception of the same phenomenon we rely on a case study in the Sierra Otomí Examination of both temperature and precipitation showed no significant differences between 1944 and 2010. However, the overall trend in temperature was to decline 0.5 °C. When crossing statistical information regarding natural and anthropogenic historical phenomena, there seems no climate change in the region. On the other hand, social perception is that there is a major climate change in the region, increasing trouble scheduling crops because the rain is delayed or comes suddenly and everything floods. It also tells people that the temperature is getting warmer than ever, because the nights are cooler and the days are hotter than some years ago. Although the perception of the population is not supported by scientific data, the feeling is strong, but is due to cultural, economic criteria, and traditional beliefs. This information is important to develop specific programs for management of natural resources in rural places with adjoining protected natural areas.

Keywords: landscape management, holism, conservation biology, ethnic communities, xajay.

1. Introduction

Mexico is recognized worldwide as a megadiverse country in ecosystems and cultures. What is not known is that the most conserved areas of nature coincide with the territories of the most intact ethnic groups today. The relation man-nature on these sites is much closer than we might think, because their survival, lifestyle, traditions, wealth and welfare depend almost entirely on what they themselves get and produce from their lands. Their natural capital is their most valuable landscape patrimony, but now it is in serious danger of disappearing due to the increase of environmental pollution, extraction of huge quantities of water to pump to the cities and to other agriculture lands and by the lost of productive land in the surroundings of their mountains. In addition, variations in meteorological data are increasing trouble-scheduling crops because when the rain is delayed the cropland is dried; but when it suddenly rains, cultivated lands and housing are completely flooded. A clear example of recent loss of land productivity and biological diversity is found in the Sierra Otomí of Querétaro with the consequent loss of cultural identity of Hñä-Hñö. Xajay, a small village with large tradition (ca. 700 yr.) of occupation into the Sierra Otomí is about to disappear. For this reason, many people from the community have been in dire need to migrate to other farmland as pawns or the cities to work as bricklayers [1].

Because the people in the community and some authorities blame the erratic rainfall pattern and changes in the upper and lower limits of temperature, every time warmer and cooler respectively, to climate change, we have decided to analyze meteorological data to establish a strategy of land arrangement and uses of the natural capital in the Sierra Otomí Management strategy will depend on whether climate change or if there

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is a weather variation considered within normal parameters for the region. For it is being produced a regional climate change adaptation strategies to climate change is sought; but if there are weather variations, different ways of managing resources, rehabilitation programs soils and vegetation and landscape conservation with holistic approach will be promoted [2]. Because it is clear that for landscape management programs need to be effective collaboration between authorities, communities and academics, the confrontation of social perception on climate change with scientific results is very important. The result will be reflected in the way in which information is to be transmitted to the community and the concrete action plans.

2. Methodology

2.1. Area of study

Mexican government protects the Sierra Otomías area of water recharge and by its many environmental services provides to local people and citizens of the surrounded cities since 1941 [3]. The most prominent landscape in lower lands is agro corn parcels (2200 to 2400m altitude). The well preserved wooded area belonging to Xajay, ranges from the slopes of the mountain massif El Pelón (2400masl) within the cross Neovolcanic, and consists mainly of a forest where the red oak (*Quercus obtusata*) and the rough oak (*Q. rugosa*) are the dominant species. Other common oaks like *Q. eduardi* and *Q. frutex* are less abundant but in different altitudinal strata, in the middle of the mountain (about 2700masl), mixed with pines (*Pinus oocarpa*). At the top of the hills (3100masl) are found some elements of vegetation typical of high altitudes as the arbutus, ahile, oaks and, many shrubs belonging to the Compositae family, mixed with proper pasture mountain with little soil. Fig. 1 shows the area of study, Xajay in the heart of the Sierra Otomía Central Mexico. In the same figure we can also see the location of the closest weather stations to the area of study.

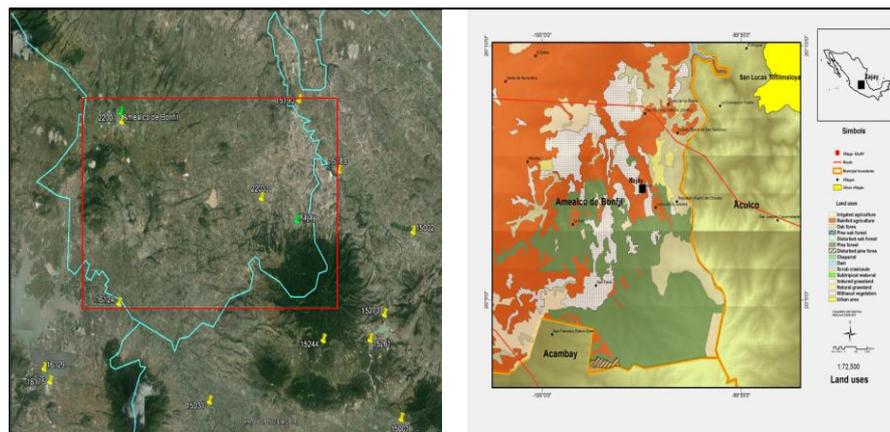


Fig. 1: Location of the area of study with the weather stations considered to the climatic analysis. Xajay village and Amealco weather station are in green marks.

2.2. Fieldwork

The fieldwork was carried out from October 2012 to October 2014. First, the labor consisted in earning the trust of the residents, because like they belong to a very old race and with little contact with the outside it is not easy to be accepted. Once accepted, interviews and surveys were done to know about their way of life, culture, traditions and activities in the community, in the mountain and in the agro systems. In addition, some questions were conducted in the direction to know if they want to migrate for getting job in the capital city or in United States. Their perception concerning quantity of rain and temperature as well as the rain season duration was inquiry in different interviews. Population was divided into categories: by age: old people, adults and young; by gender, male and female; and by occupation: peasant, farmer, logger, bricklayer or laborer. Finally, in the interviews we have gathered information related to their sensitivity to environment. Some important questions in the interview were designed to determine whether they know the historical and current ecological rehabilitation programs in their mountains and grassland and, about the behavior of the authorities in relation to environmental and productive areas.

2.3. Climatic analysis

The cabinet network was focused in gathering weather information of the closest weather seasons to the area of study. Three items were considered to select the meteorological stations for the analysis: 1, reliability; 2, the length of time series monitored; 3, data type gathered. From the 15 nearest data stations, only Amealco had a series of enough-long time to conduct the climate studies with high certainty, as well as continuity in monitoring diverse meteorological data [4]. Other four stations were also considered to reinforce our conclusions especially because there is a small gap in the Amealco Station that occurred in the 90's. This period could be remedied with statistical trends of the whole region.

3. Results

3.1. Social perception of local climate change

Present community people mention that their grandparents have told them in many occasions that their communal forest has been restored in the fifties because was almost entirely cut to make railroad tracks in the twenties of the last century. On the other hand, they become aware that before it rained more than now and the land was a bit more productive. The oldest people in the community point out that the temperature has changed over the past twenty years, the days are warmer and the nights are cooler.

Locals also feel that although the Sierra Otom íis protected since 1941, its declaration has only served to limit the access for them. However, most of the forest is young because pines and oaks were almost totally cut about 70 yrs. ago to build the railroad. Nowadays there are no management program for forestry; the natural springs supply water is pumped to irrigated the croplands in the region of San Juan del R ó and for drinking water in the surrounding cities, leaving almost no water to the locals, so they have to cultivated in lower lands, furthermore, they know they have to move to live in the more vulnerable land to flood risk. Despite these contrarities product of public administration, they perceive that their main problems of low production and recurrent environmental disasters are due to climate change.

3.2. Climatic data analysis

Amealco weather station has data from about 60 years with only a small break in the rainfall during the nineties (8). Therefore this station data were used to construct the ombrothermic diagram shown in Fig. 2. The general climate of the region is temperate with summer rains (Cw). The annual temperature variation is less than 5 °C.

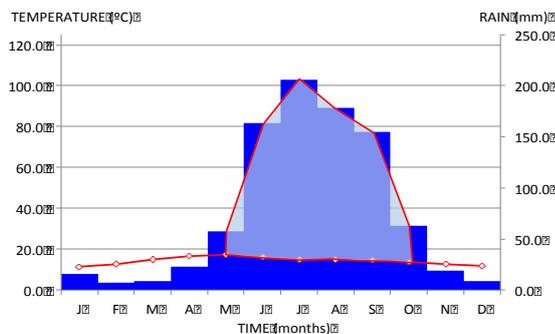


Fig. 2: Ombrothermic diagram of the Amealco weather station

The annual average is around 23 °C with maximum in May and lowest in January. Due to summer and winter rainfall pattern that serves as a temperature mitigating, temperatures in January and August to September are attenuated, as well as frost season (Fig. 3).

The time series include information since 1944 to 2011, but with little gaps between 1980 and 2000. The mean historical annual precipitation is 1253 mm (considering only years with at least 75% of daily records), but with considerable variation among them. Throughout the first two decades of records (1945-1961), annual pluviometry was generally less than 600 mm; but from 1962 until present, the rainfall exceeds 800 mm. This difference is quite observable by anomalies analysis related to the base period 1961-1990 (895 mm yr⁻¹) as shown in Fig. 4 of rainfall anomalies Amealco.

The trend analysis (linear fit, solid line) shows an increase in rainfall about 124 mm decade⁻¹ (12.4 mm yr⁻¹). The simple index of intensity of daily rainfall (average rainfall during the days with rain, SDII) shows a

similar relationship stabilizing in recent decades around 12 mm day⁻¹. Number of consecutive dry days (CDD), ≤ 1 mm day⁻¹ of pluviometry, significantly decreased from the 70's in <60 days yr⁻¹. The consecutive wet days (CWD) have had less variability in recent decades, approximately 10 days yr⁻¹.

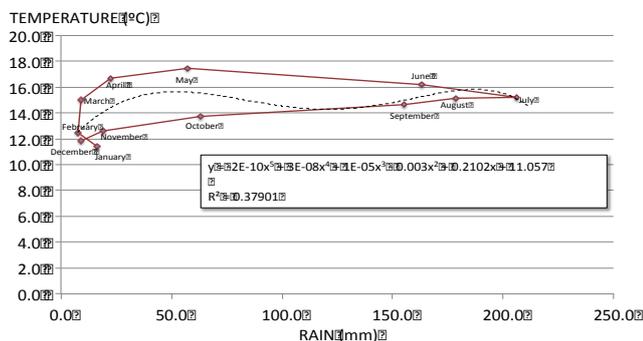


Fig. 3: Diagram of monthly thermohiets for Amealco region, compared to rain

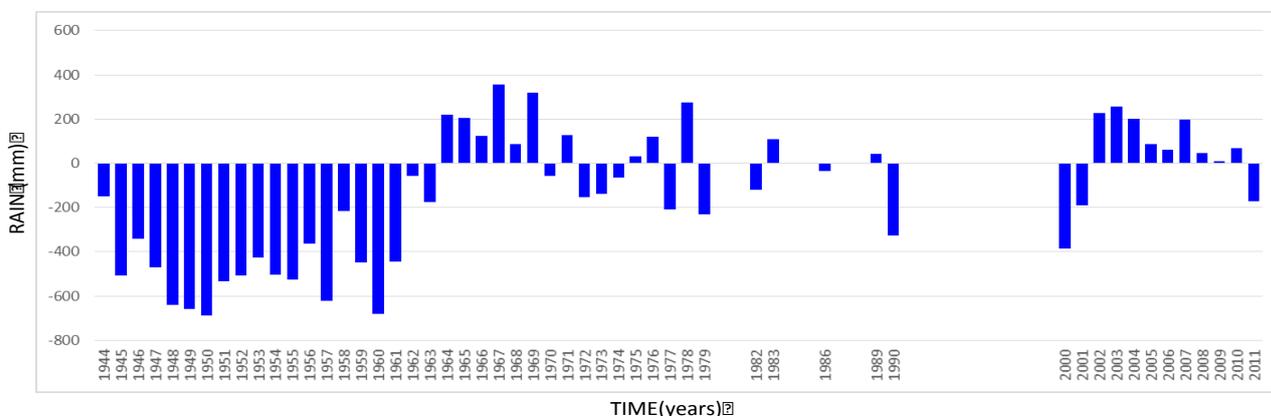


Fig. 4: Registration of precipitation anomalies (Amealco 1944-2011)

The time series of temperature is sufficiently complete. Linearization of the data indicates that temperature has dropped by 0.4 °C along these 60 years (dashed line). However it is worth notice that temperature fluctuations found in three periods indicate that the minimum periods of low temperature are short (3-5 years) but with lower temperatures (13-15 °C as monthly average) than when there is a high temperature period (Fig.5). It is also noteworthy that from 2007 to date monthly average temperatures are a bit above average. Figure 5 shows a solid line of smooth temperature data through the statistical procedure of mobile average every 5 years, confirming that since 2007 temperature oscillation is in an increasing phase.

4. Discussion

Perception of people of Xajay concerning climate change is more supported by its long history of marginalization and resource privation than by technical reports or precise data. The environmental vulnerability increase, alimentary insecurity, lack of welfare and health services slant the perception of the people concerning climate conditions. First, they believe that temperature is increasing every year since sixties when they were young...this bias could be due to short-time memory, owing to the fact that since 2007 temperature is higher than before. Secondly, the feeling that there is less rain every year when the data show the opposite trend may be due to four reasons: 1) Increased external demand for water; 2) Growing population of Xajay; 3) Erratic environmental policies by local and State authorities; 4) Natural meteorological variations.

The climatological studies often use a method to reconstruct data consisted in derived ordinal indices of intensity from the information of historical databases of weather stations [5]. The way in which rainfall data were taken 60 years ago may have been subject to errors, which would manifest in a secondary processing of information by developing ordinal indices at different spatial and temporal scales and by analyzing other climate stations in the region.

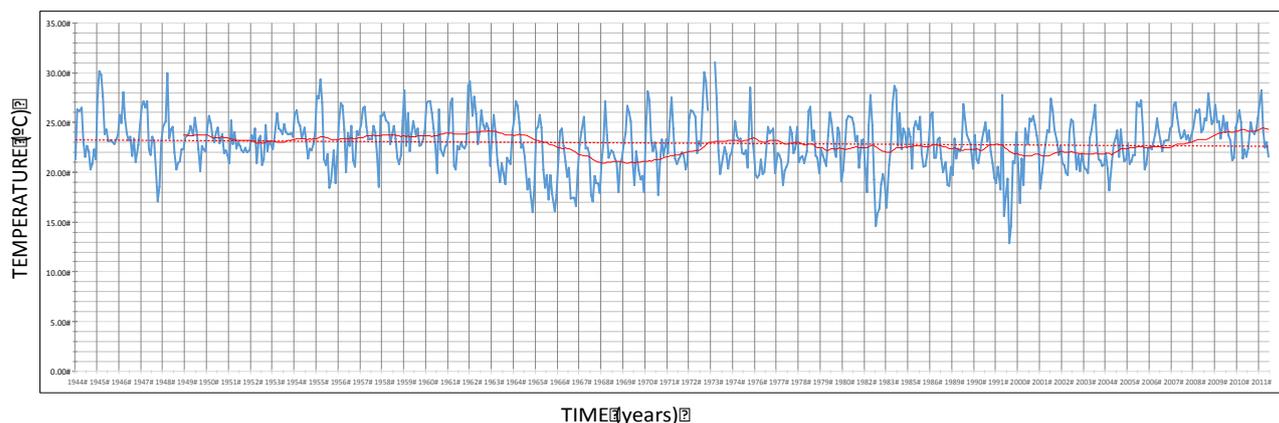


Fig. 5: Average monthly temperature of Amealco from 1944 to 2011

In this preliminary study subject to completing the analysis of nearby weather stations, we have chosen another method that is also widely used in climatology. The method consists in indexing the documentary evidence in a discreet manner assigning values for -2, -1, 0, 1 and 2; numbers representing years very dry, dry, normal, moist and wet respectively [6]. This analysis although with discrete data, confirms that climate variations in the region are recurrent, therefore, seems to be no climate change, weather variations exist only enhanced by the social perception.

5. Conclusions

What remains clear is that climate studies help to landscape sciences in elucidating how the holistic management of the natural heritage must be performed. Indigenous communities perceive less rain because not enough for them that endows them the city council and suffer temperature changes because of the deteriorated ecosystems of the Sierra and because many of the local informants are rather old and cold perception is very different with age. That is, climate change is social and demographic. Holistic management helps to harmonize the activities of the locality with municipal land uses and the ever-growing needs of the locals and far towns for water and ecosystem services.

6. Acknowledgements

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