

## Climate changes and environmental migrations in the Northeastern Semiarid

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Received 24 November 2015; accepted 20 April 2016

### Abstract

The present exploratory and descriptive study brings some thoughts and inferences about the relationships between rainfall, climate changes and environmental migrations in the small-sized municipalities of the northeastern semiarid, that is, the ones which are a part of the Caatinga biome. For this purpose, it was examined the case of Santana de Mangueira, municipality of Paraíba state, which currently has less than six thousand habitants, according to data from the Instituto Brasileiro de Geografia e Estatística – IBGE (2010), bordering in the South with Serra Talhada/PE, which was used as the rainfall data collection source, due to the lack of such records in Santana de Mangueira/PB. The studied municipality presented a significant decrease in population, in approximately eighth per cent, according to the IBGE census performed during the years of 2000 and 2010, respectively. The central inquiry that subsidized the present study was: How are the relationships between climate changes and rainfall affecting small-sized municipalities' citizens' lives in the Caatinga biome? As for the conclusions, it was found, through obtained data analysis, that the small-sized municipalities of the northeastern semiarid region, traditionally used to lose their citizens for bigger cities in the pursuit for better living conditions, tend to suffer an increase of the migration flow with the climate changes consequences worsening, as: drought period increase, desertification, and, consequently, family agriculture and cattle raising reduction.

Keywords: Caatinga, environmental migrations, climate changes, rainfall.

### 1. Introduction

Nature is unified through the so-called planet “globalization”, for the benefit of the capital. Therefore, natural resources are distributed by humankind in its transforming action and are evaluated according to their location, that is, in accordance with their geographic qualification. This phenomenon can be named as “Geography of the Capitalism”,

which generates the “urban revolution” and a model of “uneven development”, bringing about severe environmental and social consequences for every human being (Smith, 1988; Santos, 1994, Lefebvre, 2004; Santos, 2006).

As a result, Caatinga biome has been a constant target of exploitation and devastation, mainly through extensive cattle farming, agricultural practices without ecological concerns, and firewood farming, which can

develop a permanent degradation process (Santana and Souto, 2006). According to data from the Ministério do Meio Ambiente, in recent years, deforestation of reached 46% of this biome, present in every state of the Northeast and part of Minas Gerais state (Brasil, 2015).

It is worth pointing out that any human activity inducing environmental degradation will have influence on the current climate change process, which will lead to severe social and environmental impacts. Therefore, studies which promote Caatinga biodiversity preservation will always be welcomed, since many species from this region are endangered (Silva et al, 2003; Ferreira, 2013).

It should be stressed that the restlessness concerning ongoing climate changes started to intensify at the end of the 1980s, in the light of evidences regarding terrestrial atmosphere temperature increase. Currently, many researchers report that the increase in the world mean temperature is related to human activities, especially the increasing fossil fuels use, which in turn release greenhouse effect gases, main global warming causers (Verdinelli, 2002; Marengo, 2006).

In April 2014 in Berlin, Germany, a global environmental evaluation report was made available, being produced by renowned scientists, who are part of the Intergovernmental Panel on Climate Change (IPCC) from the United Nations (UN), named "Summary for Policymakers". This document brings a huge alert about the imperative need to abandon the use of pollutant fossil fuels and use cleaner energy sources to avoid the greenhouse effect, which may cause planet temperature to increase between 3.7 °C and 4.8 °C before 2100, which would be catastrophic (IPCC, 2014).

Global warming impacts, if such scenarios are confirmed, will be even more alarming for people living in the Caatinga biome, where Tropical Semiarid climate is dominant, whose most remarkable characteristics are: high temperature (going over 40 °C, during some periods), low air relative humidity (also reaching desert levels), low rainfall volume (mean precipitation of less than 800 mm), and high evaporation rates due to high temperature (Moura, 2015; Moura et. al, 2015).

In the municipalities of the Northeastern semiarid region (Caatinga biome), specially the small-sized ones, which historically have dealt with drought, that is, with the persistent periods of below-average precipitations (Nobrega, 2012), drought period increase and desertification, which reduce family agriculture and cattle raising, make many people migrate for other geographic places looking for better living conditions, and this behavior is directly associated with the man-induced irrational nature transformation process.

According to recent data from the last census performed by IBGE (2010), almost 30% of Brazilian population lives in the Northeast, which still is considered the less urbanized region of the country, in spite of its expressive urban population percentage (73.1%). But the migration dynamics of Northeastern semiarid region, for decades, follows the place conditioning logic, in accordance with the division of labor, as described by Santos (2006); in other words, citizens of the Caatinga reallocate, during long drought periods, for other economically developed regions, such as the Northeast and Southeast capital cities, looking for better living conditions (economic conditions).

Therefore, the aim of this paper is to discuss, through data analysis obtained from IBGE, Ministério do Desenvolvimento Social e Combate à Fome and Agência Pernambucana de Águas e Clima (APAC), the relationship between ongoing climate changes, low rainfall and environmental migrations, and their repercussions on the small-sized municipalities of the Northeastern semiarid, taking as reference Santana de Mangueira/PB.

## **2. Materials and methods**

### **2.1 Research area**

The municipality of Santana de Mangueira was created in December 05, 1963, by state law n° 3095. It is located in the West of Paraíba state (Figure1) specifically in the Itaporanga microregion, distant 481 km from the capital (João Pessoa), having and area of 402 Km<sup>2</sup> and an altitude of 322 m, bordering in the South with Serra Talhada/PE, in the North with Ibiara/PB, in the East with Curral Velho/PB and

Manaíra/PB, and in the West with Conceição/PB and Santa Inês/PB, and in the Northeast with Diamante/PB (CPRM, 2005, IBGE, 2015). The municipality has had a great decrease in population, according to the census performed by IBGE during the years of 2000 and 2010,

respectively, because its population in 2000 was 5,773 inhabitants and in 2010 decreased to 5,331, a decline in approximately 8%, being this behavior one of the factors motivating this study (IBGE, 2015).

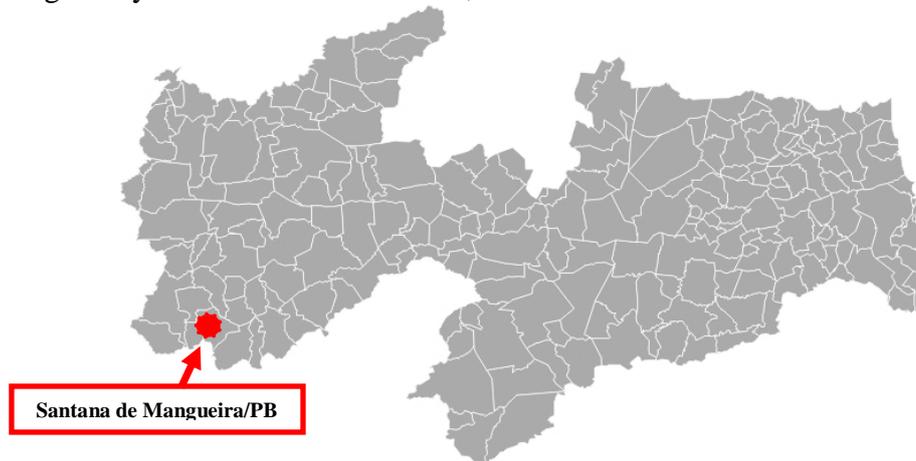


Figure1 - Map with the location of Santana de Mangueira/PB. Source: Adapted from EMBRAPA (2015).

Historically, among the main economic activities of Santana de Mangueira/PB, services sector dominates, where the public administration absorbs great part of the formal jobs. Register also: a small industry and agriculture (family) – with temporary beans, cotton, sugar cane and corn cultivation and permanent herbaceous mango and banana, as well as cattle raising (also with small representativeness of the municipality's gross domestic product).

In addition, social indicators of Santana de Mangueira/PB are alarming, presenting high rates of poverty and illiteracy, according to Ministério do Desenvolvimento Social e Combate à Fome (Brasil, 2010), in its social information report, Panorama Municipal based on the IBGE census of 2010.

## 2.2 Study classification

This study is classified as exploratory, because, according to Gil (2007, p.41), it seeks to “provide greater familiarity with the issue, aiming to make it more explicit” or to build hypothesis. It can be said that these studies have as their main objective the enhancement of ideas or intuition discovery.

Simultaneously, it can also be classified as a descriptive study, since it promotes “characteristics description of a certain

population or phenomenon, or the establishment of relationships among variables” (GIL, 2007, p.42).

## 2.3 Data collection and handling

Demographic, social and geographic data were obtained from: Instituto Brasileiro de Geografia e Estatística (IBGE), Ministério do Desenvolvimento Social e Combate à Fome and Companhia de Pesquisa de Recursos Minerais (CPRM) – Serviço Geológico do Brasil.

As for rainfall, data were obtained along with Agência Pernambucana de Águas e Clima (APAC), with the records of the last 55 years (period from 1960 to 2014), derived from the Pluviometric station n° 12, located at Instituto Agrônomico de Pernambuco (IPA) grounds in Serra Talhada/PE (because of the lack of such data in Santana de Mangueira/PB), in order to produce graphics related to the precipitation regime using the app ClimAp, version 1.1 2014 (Application program developed in Python 2.7 language, for climate studies by the alumni/researcher Mozart de Araújo Salvador, under the supervision of Prof. JoséIVALDO Barbosa de Brito, through the agreement between UACA/UFCG and INMET), to observe and analyse the results (SALVADOR, 2014).

## 3. Results and discussion

The present study results, obtained by ClimAp app, version 1.1 (2014), suggest a decrease, throughout the past five decades, on the rainfall of the Northeastern semiarid during the traditional 4-month rainy period, corresponding from January to April, from the rainfall indicators analysis contained in the APAC archive, from the Station n°12, located at

IPA premises, in the Saco Farm, w/o n°, rural zone of Serra Talhada/PE (neighboring municipality of Santana de Mangueira/PB) relating to the period from 1960 to 2014. Figure 2, referring to the historical series of January, clearly shows a significant increase of the year-to-year rainfall regime throughout the studied period, mainly from the 1980s.

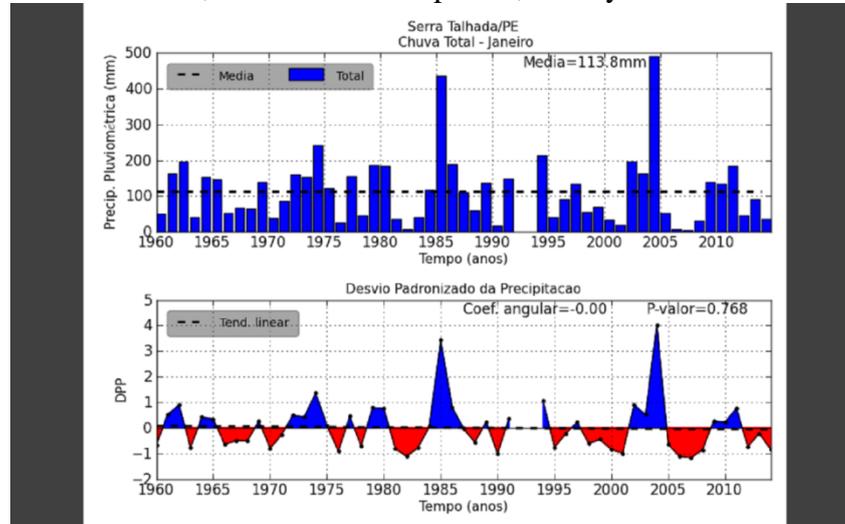


Figure 2 - Year-to-year rainfall variability in Serra Talhada/PE, historical series of January from 1960 to 2014. Source: Own elaboration through ClimAp app.

This illustration ratifies the confirmation of Moura et al. (2015), in which the rainy period of the semiarid occurs during the summer, that is, between the months of January and April, and it is characterized exactly by year-to-year

variability and low total precipitation values. These characteristics are getting even more intensified due to the climate changes (Figures 3 and 4).

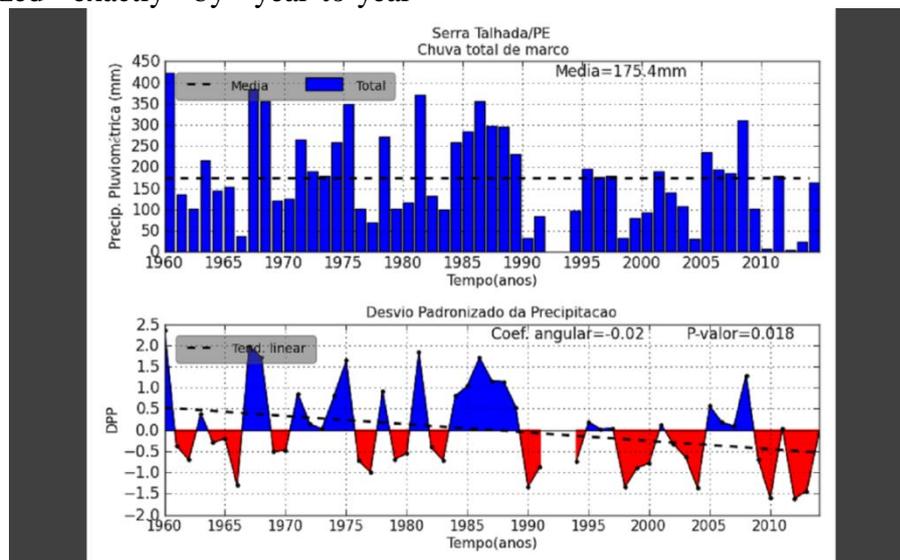


Figure 3 - Year-to-year variability and linear trend of precipitation regime in Serra Talhada/PE, historical series of March from 1960 to 2014. Source: Own elaboration through ClimAp app.

Figures 3 and 4 express the great decrease of rainfall in Serra Talhada/PE, and

consequently, in Santana de Mangueira/PB, during the months of March and April, from the

1990s; such condition stayed the same during 2000 to 2010 (pointing out that the precipitations

recorded were below the historical average in most of the years during this decade).

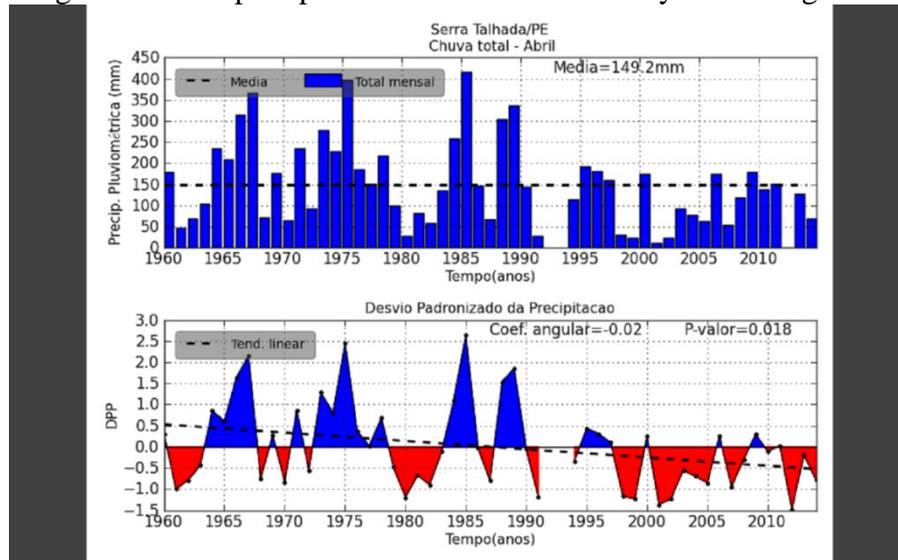


Figure 4 - Year-to-year variability and linear trend of precipitation regime in Serra Talhada/PE, historical series of April from 1960 to 2014. Source: Own elaboration through ClimAp app.

Therefore, as shown on Figures 2, 3 and 4, in addition to precipitation downturn and increase on their year-to-year variability during the months of January, March and April in the last 55 years, it can be noted a strong trend of maintenance of this scenario in the future, in light of ongoing climate changes. Such trend of rainfall reduction in the Northeastern semiarid region throughout the time ratifies a recent study published on the issue 06, number 02 of the *Revista Brasileira de Geografia Física da Universidade Federal de Pernambuco*, written by Assis et al.(2013), where it was determined a high rate of precipitation decrease in Serra Talhada/PE, around 5.29 mm per year from 1962 to 2012(For the mentioned study it was used the software *Pluwin*, HIDROMET/ITEP database manager, in order to produce the reports with information of historical monthly precipitation. The parameters used was the comparison of the total precipitation during the 4-month rainy season - January to April - from the complete historical series: 1962 to 2012).

This small amount of precipitation and its year-to-year variability represent great challenges for agriculture and cattle raising activities, and consequently for the survival of Northeastern semiarid inhabitants, of whom many are forced to migrate to other places to look for better living conditions.

Contrasting rainfall data to the IBGE census from 2000 and 2010, one can note that decrease in population of Santana de Mangueira/PB of approximately 8% (from 5,773 in 2000 to 5,331 in 2010) has coincided to rainfall decreases during the rainy season (from January to April), since for the majority of months on the decade, the rainfall was below historical average.

According to the data of the IBGE census of 2000 and 2010, respectively, there was, during this period, a significant reduction (to the tune of more than 12) of the inhabitants of the municipality studied in the age group of 15 to 29 years, which corresponds precisely to the youth. Such a reduction is mainly due to the impossibility of this portion of the population find employment and income or subsistence conditions in their own municipality, being compelled to migrate to other places, such as: Northeastern capital and other States and cities-more developed regional pole.

To illustrate the impact of annual rainfall variability in agricultural production in the municipality of Santana de Mangueira, in the year 2009, according to data of IBGE (2015), were produced 461 tons of beans, and in 2010 only 20 tons. Already in relation to livestock, in the year 2004 the municipality had 2,817 heads of goats and in 2010 a herd of just 1,497 heads.

Hence, data show that the decrease in population between the census of 2000 and 2010 match a retraction linear trend of rainfall, and the subsequent reduction of economic activities (agriculture and cattle raising).

The results of the present study also show that not only the great urban centers attract Northeasterners due to offer of greater possibilities of Jobs and income, to the detriment of resources shortages in the rural region (situation aggravated with the intensification of low precipitation periods); but this urbanization process, aggravated by climate changes, resulting from nature degradation, do also occur in Northeastern medium-sized municipalities, called regional cities, which attract migratory flows from smaller cities of their microregion, in neighbouring microregions as well as from further places.

The municipalities of Paraíba: Curral Velho, Diamante and Ibiara, all with less than 7 thousand inhabitants according to the Census of IBGE 2010, with whom Santana de Mangueira is limited, have suffered population reductions during the period studied, while the municipality of Serra Talhada, Pernambuco has a population of about 79,000 inhabitants (IBGE, 2010), considered a pole in the region, and it is limited to the South with the municipality studied, registered a population increase during this period.

Thus, evidence that the small municipalities of the semi-arid Northeast are most vulnerable and or susceptible to damaging effects of climate change in course.

#### **4. Conclusions**

Through data analysis it was determined that the municipality of Santana de Mangueira/PB, as well as all further small-sized municipalities of the Northeastern semiarid, whose inhabitants are used to migrate towards other places during drought periods, in the rush to find better living conditions, suffer great impacts with ongoing climate changes, and they will suffer even more if the scenarios of increased temperature are confirmed.

This study has demonstrated that the rainfall recorded during the traditional rainy

season of the semiarid (January to April) are remaining below historical average (climatological normal) and are causing repercussions on its population migratory flow. In other words, linear reduction trend of the rainfall regime in the Caatinga biome, attested in this study, will lead to a desertification increase and retraction of local agriculture and cattle raising activities. One example of such trend is that, specifically during the period between 2000 and 2010, there was a reduction in the mean precipitation values in the municipality (Santana de Mangueira/PB), which reflected on its agriculture and cattle productions (goatherds and banana cultivation) and a decrease in population of approximately eight percent.

Thus, it is evident the need of creating and implementing public policies truly capable of attending current and future social and economic needs of the Northeastern semiarid municipalities such as Santana de Mangueira/PB, whose population will always have to deal with drought and the trend of decreasing rainfall periods due to the climate changes. If better conditions are not offered by Public Authorities so that these people remain in their birth cities, they will keep reallocating for bigger cities, pursuing new opportunities, emphasizing the urbanization phenomenon and its wicked effect, such as increasing the number of citizens at risk in the slums and suburbs of the cities, many times living in sub-human conditions.

#### **Acknowledgements**

The authors acknowledge the Fundação de Amparo à Ciência e Tecnologia do Estado de Pernambuco (FACEPE) for granting the study doctorate scholarship, that subsidizes the realization of studies of the first author in the Northeastern semi-arid region (Caatinga biome). Simultaneously, we thank the Agência Pernambucana de Águas e Clima – APAC for providing the data and to the researcher Mozart de Araújo Salvador for providing the application program ClimAp version 1.1, 2014.

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