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Study of the effects of drought on the production and export of the main Ceará fruits (2012 to 2015)

Jessica Maria do Nascimento [i]
Pesquisadora autônoma, Crato, CE, Brasil
Nataniele dos Santos Alencar [ii]
Universidade Estácio de Sá, Mauritii, CE, Brasil
Denis Fernandes Alves [iii]
Universidade Federal de Pernambuco, Recife, PE, Brasil
Francisco de O' de Lima Júnior [iv]
Universidade Regional do Cariri, Crato, CE, Brasil

Summary
The study aims to verify whether there was both economic and social impact of the drought on fresh fruit production in Ceará, in the period from 2012 to 2015; as well as to verify the feasibility of production in the period studied. The methodology adopted presents a qualitative approach, starting from the literature review and comparative descriptive statistics. The analysis of the results shows that the economy of Ceará was impacted by this phenomenon, which has caused several social problems such as the migration of the country people from their hometown to urban centers, hunger, disease, unemployment, among other calamities. The consecutive droughts directly impact the water supply and agricultural production. Agricultural production suffers the most in periods of drought. It is worth noting that exports are declining, as well as the production of fresh fruit through irrigation, which was a viable agricultural activity until 2013, but with the persistence of the drought, from 2014 the production of fruit from irrigation begins to show negative variations, since irrigation makes use of water stored in reservoirs.
Keywords: Drought. Agribusiness. Fruticulture.

Estudo dos efeitos da seca sobre a produção e exportação dos principais frutos de cearenses (2012 a 2015)

Resumo
O estudo visa verificar se houve um impacto económico e social da seca na produção de frutos frescos no Ceará no período de 2012 a 2015; bem como verificar a viabilidade da produção no período estudado. A metodologia adoptada apresenta uma abordagem qualitativa, baseada na revisão bibliográfica e em estatísticas descritivas comparativas. A análise dos resultados mostra que a economia do Ceará é afectada por este fenómeno, que tem causado vários problemas sociais, tais como a migração do sertão da sua cidade natal para os

centros urbanos, fome, doenças, desemprego, entre outras calamidades. A seca consistente tem impactos directos no abastecimento de água e na produção agrícola. Sendo a produção agrícola a mais afectada nos períodos de seca. É de notar que as exportações estão a diminuir, tal como a produção de frutos frescos através da irrigação se mostra como uma actividade agrícola viável até ao ano 2013, mas com a persistência da seca, a partir de 2014 a produção de frutos através da irrigação começa a apresentar variações negativas, uma vez que a irrigação faz uso da água armazenada nos reservatórios.
Palavras-chave: Seca. Agronegócio. Fruticultura.

1 Introducion

In Brazil, the Northeast region is marked by constant droughts. This phenomenon makes the country people live in a scenario of uncertainties regarding productivity and water issues, which have a direct impact on the economy of this region. Drought presents itself as a social fact that has intensely marked the society of the Northeast, affecting mainly the peasants (SOUZA; MEDEIROS FILHO, 1983).

Ceará has been going through periods of drought since the 2000s, and the situation intensified in the temporal cut that corresponds to the years between 2012 and 2015, which were lower than the historical average of the state. This aggravates the effects of the scarcity of water resources, given that droughts occurred in subsequent years.

Approximately 90% of Ceará's territory is located in the region whose climate is predominantly semi-arid, which besides being characterized by scarcity and irregularity of rainfall, has shallow soils with low fertility. The consequences of drought directly impact agricultural production, since subsistence agriculture and livestock are the predominant economic activities in much of Ceará's territory (IPECE, 2015).

Ceará has been going through a period of below-average rainfall for five years. According to studies conducted by the Ceará Meteorology and Water Resources Foundation - FUNCEME (2016), only on two occasions has Ceará experienced five consecutive years of drought, which were in the years 1979 to 1983 that drastically

affected the entire Northeast and in the years 2012 to 2016, the data also show that the current period of drought is among the worst ever recorded. Almost 60% of Ceará's territory presents extreme or exceptional drought, which are the two most serious levels of drought indicated by the Drought Monitor.

However, the process of diversification of the productive structure in Ceará is based on the stimulated activities and the policies of internalization of development. Based on the agribusiness-industry-tourism tripod, which is the vector of the Ceará development promotion policies in the last two decades, it has shown positive repercussions, as well as using public policies aimed at living with drought (LIMA JÚNIOR, 2014).

Among the stimulated activities, fruit farming stands out, which has provided a great boost in the Ceará economy, being considered one of the most successful sectors in the state (FERREIRA et al. 2014). Despite the difficulties imposed by the drought, Ceará conquers a prominent position in relation to the national scenario, emerging as one of the main agents of the northeastern transformation with respect to the production and export of tropical fruits. According to IBGE (2016), the growth of the State in relation to the production of fresh fruit was so expressive that in 2011 it already occupied the 4th place in the national ranking, behind only the States of São Paulo, Bahia, and Rio Grande do Sul.

Therefore, irrigated fruit culture emerges as a dynamic activity, which is characterized in the production of foods with higher added value, with an advanced cultivation method, through modern and appropriate technologies for the largest growth of production, so as to make it competitive, and constitute itself as one of the most important sectors for the agricultural production of Ceará.

The potential in the production of fresh fruit, presents to Ceará, a great chance for the development of the agricultural sector, exploring the fruit culture in a satisfactory way, ensuring the supply of consumers in the domestic and foreign markets, being that the main products are melons and bananas. However, with the difficulties faced by producers due to drought and the reduction of water reserves in Ceará, the production of fresh fruit

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has experienced oscillations and consecutive drastic drops in production. In this sense, the question that problematizes the study is: is the production of fresh fruit in Ceará, through irrigation, a viable agricultural activity aimed at exports during periods of drought?

Therefore, the study aims to analyze the economic and social impacts of drought on fresh fruit production in Ceará between 2012 and 2015. The study aims to analyze the economic and social impacts of drought on the production of fresh fruit in Ceará between 2012 and 2015; as well as to verify the feasibility of production in the period studied. Starting from the hypothesis that drought directly impacts agriculture, livestock and agribusiness, with rainfall irregularities there is no way for such productive activities to develop fully, which leads to a lack of economic resources and generates hunger, poverty, migration, among other calamities. It is important to highlight that the focus is on the years 2012 to 2015, which is due to the fact that Ceará is going through a dry period of almost 5 years.

The justification of the study is based on the consequences of drought on the production of fresh fruit, considering that the sector has extreme importance in the economy of a given location is of fundamental importance when aiming to prioritize areas of high productivity that suffer from this natural phenomenon (SILVA et al., 2004).

The methodology adopted presents a qualitative approach, starting with a literature review and comparative descriptive statistics, used to observe the impact of drought on fruit production from the rates obtained with the variables addressed. The study area is Ceará, which according to the 2010 census, the state had a population of 8,452,381 inhabitants, being composed of 184 municipalities, it also has an approximate area of 148,825 km² and is divided into 12 hydrographic basins. The data used are of a secondary nature, from official bodies, such as: the Brazilian Institute of Geography and Statistics - IBGE; the Institute for Research and Economic Strategy of Ceará - IPECE; and the Development Agency of the State of Ceará - ADECE.

Besides this introduction and the final considerations, the work is organized in four other sections. In the second section, a brief history of drought in the Northeast is discussed, as well as the main theories on drought. The fourth section analyzes the

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results and discussions about the effects of drought on agricultural production of irrigated fruit.

2 Drought and its impacts: conceptual and reflexive aspects

There are several theories about drought. Among them is the traditionalist approach, which attributes drought to a question of fate, a "punishment from God" or a law of nature, against which nothing can be done. Drought would thus be a fatality that would define the destiny of the northeasterners. This fatalistic vision of the "sertanejos" in the face of drought is derived, in sum, from their frequent experience with droughts. For the sertanejo, the success in planting is a result of the luck that each sertanejo possesses, and they attribute to a divine wish, the floods, the droughts, as well as wealth, poverty and suffering, that is, everything only occurs because God wishes and man is unable to change the proper direction of the facts. However, drought occurs as a punishment, for all the sins done by mankind, becoming one of the stages to get God's forgiveness for the sins committed, the path to purification (SOUZA; MEDEIROS FILHO, 1983).

As far as the technicist approach is concerned, drought is caused by the irregularity of rainfall, the absence of rain periodically reproduces its negative biography, since there is no accumulated water to relieve the thirst of herdsmen and backwoodsmen. For the technicists, with water accumulated in wells, dams and weirs, everything would be safe (SOUZA; MEDEIROS FILHO, 1983). Souza and Medeiros Filho (1988) portray drought as a social process generated by the periodic scarcity of rainfall or also by rainfall precipitation in the months when "winter" is expected, which has exerted in time and space a profound negative influence on the rural society of the Northeast.

Campos and Khan (1989), state that the abnormal climatic situation that causes frustrations in agricultural harvests, also presents itself as a social phenomenon, which is often pointed out as the cause of the Northeastern region's backwardness. They also point out that subsistence agriculture is the source of work and livelihood for most small rural producers and, thus, is the most affected in droughts; in some cases, the crisis has

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more damaging effects on the livestock sector. This gives rise to the characteristics of social calamity that the Northeast region goes through in intensive drought periods.

In this context, subsistence agriculture becomes the most fragile in periods of drought, since it presents a small productivity only for the very subsistence of the "sertanejo" without expectations of profits, besides making use of traditional technologies, thus absorbing most of the existing rural labor force. This activity presents a lower degree of proximity to the markets and this makes subsistence agriculture more apt to constant production crises. In terms of employment, the drought of rains provokes the phenomenon of rural unemployment that, in turn, in search of better living conditions, the sertanejos migrate to urban centers in search of employment and better living conditions, however, when they reach the urban centers, they are considered incapable of inserting themselves into the existing work mode there (CAMPOS; KHAN, 1989).

During the second half of the 1980s, the Programa de Irrigação do Nordeste - PROINE (Northeast Irrigation Program) was created, this program had the objective of changing customary agriculture, starting with the inauguration of irrigation projects and the growth of agro-industry, in order to transform agriculture into a sector focused on the market economy (HOLANDA et al., 1999).

Droughts constantly affect the semi-arid northeastern region, causing great economic and social effects on the entire rural population, which is the most affected, affecting the entire regional economy. The negative effects of the constant droughts in the region make the Northeast of Brazil a problem region not only regionally, but nationally (KHAN et al., 2005).

Droughts are a common occurrence in the Northeast region, occurring every five to ten years, sometimes being prolonged for consecutive years, as is the case of the last two major droughts that occurred in the Northeast from 1979 to 1983 and from 1989 to 1993 (RAMOS, 1996). From the sociopolitical point of view, drought is a climatic phenomenon, a social fact. Therefore, this approach proposes an analysis of the context to better understand the devastating action of drought in the Northeastern semi-arid

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region. From this perspective, drought is considered a structural problem that cannot be solved simply by modernization (MENEZES; MORAIS, 2002).

Among the semi-arid regions of the planet, the Brazilian semi-arid is considered one of the largest in the world and occupies an area of 982,000 km², its population is made up of 22 million people, which represents approximately 12% of the Brazilian population, besides being divided into nine states, namely: Alagoas, Bahia, Ceará, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, Sergipe and Minas Gerais (INSA, 2012).

When a major drought occurs, agricultural crops, especially fruit farming, are directly affected. Livestock is weakened or decimated and surface water reserves are depleted, all of which occurs because droughts can occur in the form of a large spatial or temporal decrease and centralization of annual rainfall. Viewed by these conditions, the poorest categories of the rural population are directly vulnerable to the climatic phenomenon (TRAVASSOS; SOUZA; SILVA, 2013).

In periods of drought, fruit farming, which is an activity of great importance for economic and social aspects, has also been negatively impacted (FERREIRA et al. 2014). It is one of the divisions of agriculture, which aims to produce fruits in general in a rational way, with the purpose of marketing fruits.

3 The drought in Ceará in recent years

Much of Ceará's territory is located in the semi-arid region, which is characterized by water shortages, a dry climate, and irregular rainfall. Between the years 2012 and 2014, the average rainfall in Ceará was 502 mm. The places most affected by drought disasters have extremely fragile social and economic structures. It can be seen that development policies have been adopted over the years and have enabled the establishment of a new dynamic in the economies of Ceará's semi-arid region, with the emergence of sectors that generate complementary income and new employment opportunities (IPECE, 2015).

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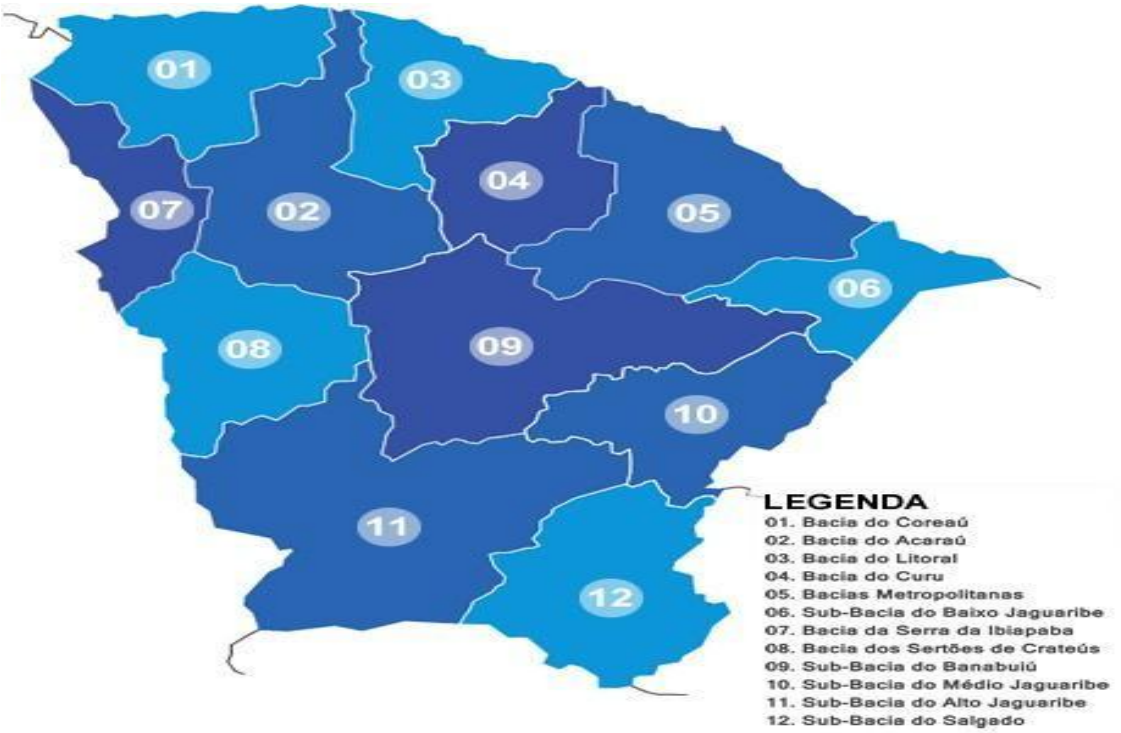
Ceará is formed by 12 hydrographic basins, which are: Coreaú, Litoral, Serra da Ibiapaba, Acaraú, Curu, Metropolitan Basins, Crateús, Banabuiú, Lower Jaguaribe, Upper Jaguaribe, Middle Jaguaribe and Salgado basins, as illustrated in Figure 1. The Jaguaribe river basin covers more than 54% of the State, being 610 km in length.

Figure 1: Bacias hidrográficas do Ceará



Fonte: Fórum Cearense de Comitês de Bacias Hidrográficas (2017).

The State of Ceará currently has 153 dams, since this is the way most used by governments for water storage, these dams are monitored by the Territorial Water Management Program (IPECE, 2015). The average rainfall varies from region to region between 200 mm and 800 mm annually. The semi-arid region is the wettest place on the planet, but the rainfall is irregularly distributed in time and space, so there are short periods of heavy rainfall, but on the other hand there are long periods of drought. The soil is highly impenetrable and causes the water from the few rains that one has to evaporate quickly, thus having a very reduced water catchment (ASA, 2016).

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As is known, drinking water is a right of every human being and of extreme importance for survival. However, the semi-arid region is marked by a lack of rainfall and, consequently, a lack of water. In this sense, many families suffer for not having access to this good. It is important to emphasize that the lack of water is not only due to the climate of the region, but also to a social issue, in which there is an unequal concentration of water in the hands of a minority, who use it for their own benefit, turning water into private property, which will not benefit the population that needs it most, preventing people from satisfying their basic needs (ASA, 2016).

Table 1 shows the situation of Ceará's reservoirs between 2012 and 2015.

Tabela 1 - RESERVA HÍDRICA DO ESTADO DO CEARÁ DE 2012 A 2015

Stored Volume				
Bacia	**2012**	**2013**	**2014**	**2015**
Coreaú	72%	43%	31%	36%
Litoral	49%	35%	24%	44%
Serra da Ibiapaba	88%	64%	43%	25%
Acaraú	74%	47%	26%	14%
Curu	51%	22%	7%	5%
Bacias Metropolitanas	62%	36%	31%	31%
Bacias dos Sertões de Crateús	44%	13%	4%	5%
Banabuiú	69%	41%	23%	8%
Baixo Jaguaribe	62%	22%	10%	2%
Alto Jaguaribe	87%	64%	53%	40%
Médio Jaguaribe	68%	51%	37%	24%
Salgado	57%	35%	39%	25%
Ceará	**69%**	**47%**	**33%**	**23%**

Fonte: Elaboração própria a partir de dados das FUNCEME (2016).

Therefore, it is evident the reduction in Ceará's water reserves from 2012 and this reduction is directly related to the irregularity of the rains that occurred from 2012 to 2015. It is important to note that 2011, according to data from FUNCEME (2016), was the last

year that had a volumetric increase in the dams, after which there were gradual reductions in water reserves. It can be seen that, in some basins, the reduction in storage varies more than in others, a fact that is justified by the different types of use, since some basins cover more locations than others and, consecutively, consume more.

Of the Ceará basins, the most delicate cases in 2015 occurred in the Baixo Jaguaribe, with only 2% of storage capacity. Next are the Curu and the Sertões de Crateús regions, both with 5% of capacity. In better circumstances for 2015 are the regions of Coreaú, with 36% of storage capacity and Litoral, with 44%. It is important to note that the storage volume of all basins has been decreasing every day, leaving all regions in a state of alert.

The Metropolitan and the Coastal Basins are responsible for supplying water to the most densely populated areas. The Castanhão dam is located in the middle Jaguaribe Basin, which together with the Banabuiú Basin, are responsible for the distribution of the largest irrigation area in Ceará, as well as the supply of the Metropolitan Region of Fortaleza, with the inclusion of the Pecém Industrial and Port Complex, hence the justification for the drastic reduction of reserves in these basins. In 2013, irrigation activities in the irrigated areas of the Curu valley were suspended, also occurred the limitation of water use in irrigated localities of the Jaguaribe, Banabuiú and Acaraú valleys, which directly impacted the agricultural sector. Therefore, the decrease in water reserves in the state impacted cities in all basins of Ceará, which led several cities to declare a state of emergency (IPECE, 2015).

4 Production and export of the main fruits from Ceará in the period from 2012 to 2015

The world fruit production has shown continuous growth, characterized by the great diversity of cultivated species, consisting largely of temperate climate fruits, produced and consumed mainly in the Northern Hemisphere (ADECE, 2013).

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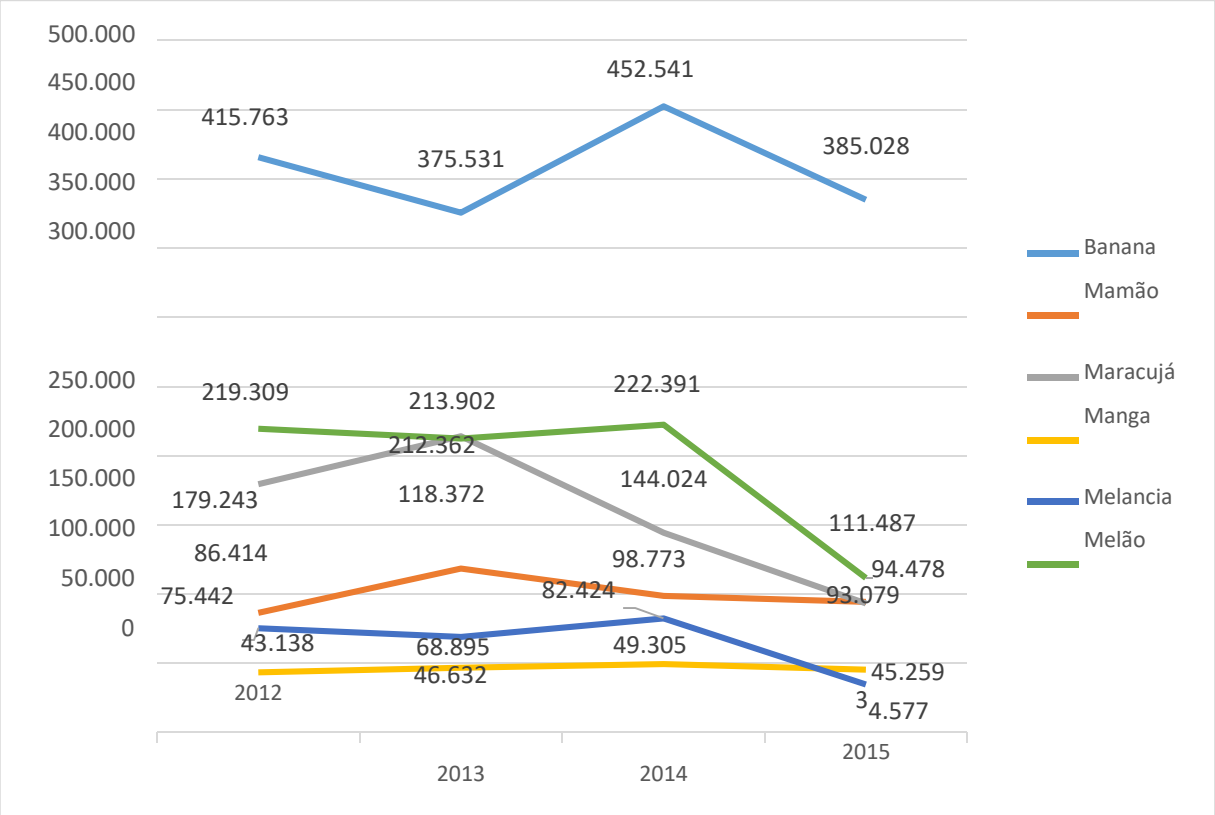
Fruit farming is the highlight of Ceará's agribusiness. According to data from IBGE (2013), in the year 2013, Ceará had in its production line 545 thousand hectares of fruit, generating a fruit production of 1,650 thousand tons. During the year 2013, the state was the 6th national fruit producer, was the 1st producer of cashew, the 2nd of coconut, passion fruit and melon, and the 3rd of papaya, thus producing a Gross Value of Production of R$ 1,358 million.

From the irrigated fruitculture, Ceará has conquered a great space both in the internal and external market, but the development through fruitculture has been at risk. The drought brings serious consequences, causing a lower production and insecurity on the part of producers who are afraid to invest and lose the harvest. Graph 1 shows the production in tons of fruit from Ceará, from 2012 to 2015.

Graph 1 - Production in tons of Ceará fruits, from 2012 to 2015



Fonte: Elaboração própria a partir de dados do IBGE e IPECE (2017).

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Considering that 2011 was the last year in which Ceará had sufficient rainfall for water reserves, a comparison with the respective year is important. Even though fruit production has an opposite relationship to droughts, during 2012 there was a reduction of 1.7% in the production of fresh fruit. In the comparison between 2012 and 2011, being a period of drought, some fruits showed growth in production, as was the case of melon, which obtained a growth of 52.8%, with an increase in production of 75,843 tons more than in 2011. Watermelon was produced in 18,532 tons more than in 2011, presenting a growth of 32.6%, while papaya showed a reduction in production of 26,165 tons. Until the year 2013, it is visible that the drought does not impact drastically on the production of fruit, thus occurring oscillations in production. This occurs due to the irrigation of fruit by the use of water from reservoirs.

The year 2013 was characterized by the second consecutive year of drought. However, there is a growth in the production of some fruits. This occurred because in the previous year, the drought was even more intense than in 2013. In 2012, the average rainfall in the state was 389 mm, representing 52.3% of rainfall volume below average, while in the year 2013, the average rainfall was 576 mm, 29.4% below average, occurring a higher volume of rainfall in 2013 when compared to 2012 (IPECE, 2014).

However, due to the use of irrigation, fruit production is little affected in periods of droughts, the lack of water recharges in reservoirs makes it limited to irrigation impacting directly on production (IPECE, 2014). However, in 2013, the production of fresh fruits showed an increase in production when compared to 2012. Among the fruits in Chart 1, it is noted an increase in the production of papaya that produced 31,958 tons more than the previous year, passion fruit also had an increase in production of 34,659 tons, the mango was the fruit that showed less variation compared to the previous year, producing only 3,494 tons more. The fruits that showed reductions in production were banana, watermelon and melon that showed reductions respectively of 40,232, 6,547 and 6,947 tons compared to the previous year.

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The amount of rainfall in 2014 was close to the volume of 2013, but both were below average. In 2014, the distribution of rainfall during the year was better than in 2013 favoring temporary crops such as watermelon and melon. The production of melon yielded 10,029 tons more than the year 2013, banana yielded 77,01 tons more and watermelon 13,529 tons more. These three fruits showed good results during 2014. Passion fruit production, on the other hand, had a reduction of 32.67%, producing 144,024 tons, or 69,878 tons less than the previous year. There were 98,773 tons of papaya produced, 19,599 tons less than the year 2013. During the year 2014, the situation regarding the irrigated system became worrisome, since the state was experiencing the third consecutive year of drought and water reserves had been reducing since 2012 (IPECE, 2015).

The year 2015 is characterized as the 4th consecutive year of drought and can be considered as one of the worst years for the agricultural sector of Ceará. In 2015, the few rains started late and their distribution occurred unevenly. The consecutive drought caused damage to the soil and loss of moisture, with a drastic reduction in water reserves. The reduction in water reserves caused negative effects on irrigated fruit farming, since with the reduction of reservoirs, irrigation in several poles was limited and in some poles irrigation was prohibited (IPECE, 2016).

With the reduction of Ceará's water reserves and the decrease in the distribution of water to the irrigated poles, fruit producers restricted the planting areas, which directly impacted the state's fruit farming, compromising fruit production. It is visible in Graph 1 that during the year 2015, all six fruits showed a reduction compared to previous years, highlighting the three fresh fruits most exported by the state, the melon that produced only 111,487 tons, a difference of 110,875 tons less than 2014. The year 2015, showed that the production of melon showed the most negative variation when compared to the years 2012, 2013 and 2014, which is justified by the consecutive drought of 4 years. According to IPECE (2016), the melon from Ceará occupied the first position in the production of fresh fruit, but before this drastic reduction fell to third place.

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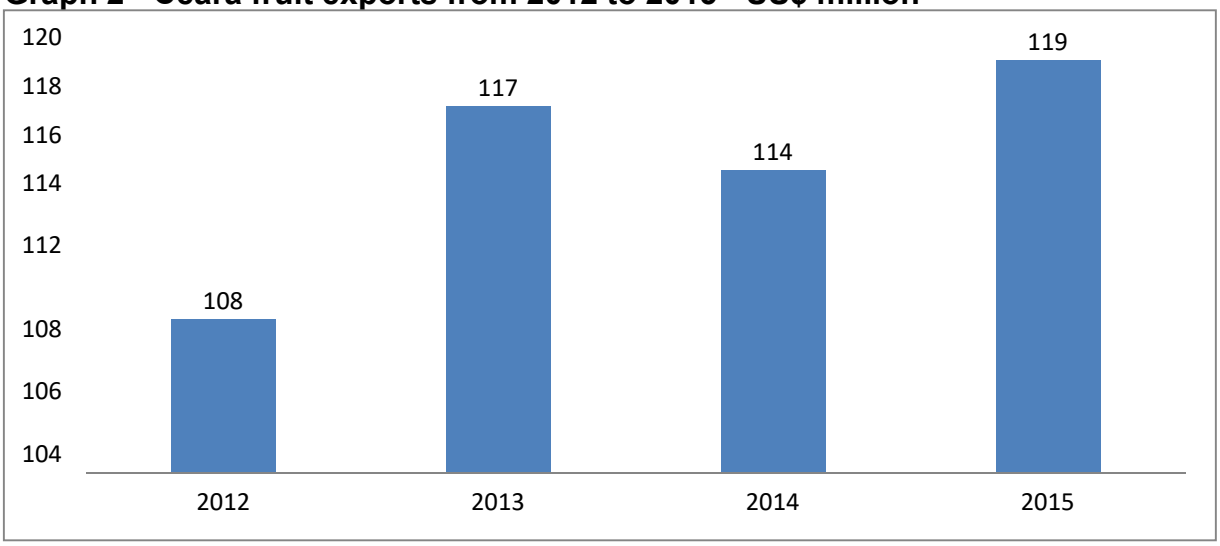
Compared to 2014, watermelon and banana production showed drastic reductions. 82,424 tons of watermelon were produced, while in 2015 34,577 tons were produced, that is, in 2014, 47,847 tons more were produced than in 2015, which represented a reduction of more than 50% in watermelon production in the state. As for banana production, 385,028 tons were produced in 2015, 67,513 tons less than the previous year, and passion fruit 50,945 tons less than in 2014.

With respect to the state's export agenda, fruit exports ranked third with a 10.9% share, when compared to the year 2012 the fruits grew by 8.0%. During the year 2013, there was an increase in the production and export of some fruits compared to the year 2012, exports of melons showed a growth of 12.9%, these increases occur because as already stated, the level of rainfall in 2013 was higher and better distributed than in 2012 (IPECE, 2014). Graph 2 shows Ceará's fruit exports from 2012 to 2015 in U$$ Million.

Graph 2 - Ceará fruit exports from 2012 to 2015 - US$ million



Fonte: Elaboração Própria a partir de dados da ADECE (2017).

In the year 2015, 118.9 million fruits were exported, and of the exports made, papayas accounted for 4% of the total, mangoes 3%, bananas 6%, watermelons 12% and other fruits 1%. Even the melon showed a 49.87% reduction in its production in 2015, compared to the year 2014. During the year 2015, more than 50% of the total exported in Ceará was Melon, with a total of US$ 88,710,968 million, representing 74% of the total

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exported during the year 2015. It is important to note that Ceará has in its agenda melons, bananas and watermelons as main products. The main countries to which the state exports fruit are Holland, United Kingdom and Spain. During 2015, in Ceará, exports to the three main countries were 46% of the total value of fruit exported to the Netherlands, 32% to the United Kingdom and 12% to Spain (ADECE, 2016).

5 Final considerations

The drought that Ceará has been experiencing since 2012 to 2015 directly impacts the production of fruit in the state. Ceará's fruit culture is a sector that has been growing for years, conquering a space in the national and international market. The state exports fresh fruit to several countries, but both exports and productions are reducing, not to mention the disbelief of the producers who live so much with the drought phenomenon that they already have a pessimistic view regarding the productions.

The production of fresh fruit through irrigation is a viable agricultural activity until 2013, but with the persistence of the drought, from 2014 the production of fruit through irrigation begins to show negative variations, since irrigation makes use of the water stored in reservoirs. As the lack of recharge in the basins, several Ceará irrigation poles are with reduced activities. This directly affects both the production and export of Ceará's fruits. Therefore, the growth that fruit culture was presenting in Ceará is at risk due to its hydric situation.

It is up to the State to create more efficient adaptation strategies to the effects of droughts, as well as plans to live with the drought, since drought is a natural phenomenon and the need to create better strategies to live with it is evident. It is from the planning and joint action of the government and society that simple and innovative actions can be successful, guaranteeing the survival of rural families in the semi-arid region during periods without rain. In short, in order to improve the actions and their application, a dialogue between the responsible public agencies and society itself is necessary.

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[i] **Jéssica Maria do Nascimento,** ORCID: https://orcid.org/0000-0002-6961-4268
Curso de Economia, Centro de Estudos Sociais Aplicados (CESA), Universidade Regional do Cariri (URCA).
Economista pela Universidade Regional do Cariri (URCA). Mestre em Economia Rural pela Universidade Federal do Ceará (UFC).
Contribuição de autoria: Revisão de literatura e elaboração do artigo
Lattes: http://lattes.cnpq.br/5793270607618764
E-mail: economiajessica@gmail.com

[ii] **Nataniele dos Santos Alencar,** ORCID: https://orcid.org/0000-0001-6229-5973
Curso de Ciências Contábeis, Universidade Estácio de Sá.
Economista pela Universidade Regional do Cariri (URCA). Mestre em Economia Rural pela Universidade Federal do Ceará (UFC).
Contribuição de autoria: Metodologia e resultados.
Lattes: http://lattes.cnpq.br/4571400170979488
E-mail: natanielesalencar@gmail.com

[iii] **Denis Fernandes Alves,** ORCID: http://orcid.org/0000-0003-3322-2075
Programa de Pós-Graduação em Economia da Universidade Federal de Pernambuco (PIMES/UFPE), Departamento de Economia, Universidade Federal de Pernambuco.

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Doutorando em Economia pelo Programa de Pós-Graduação em Economia da Universidade Federal de Pernambuco (PIMES/UFPE). Mestre em Economia pelo Programa de Pós-graduação em Economia da Universidade Federal do Rio Grande do Norte (PPECO/UFRN). Bacharel em Ciências Econômicas pela Universidade Regional do Cariri (URCA).
Contribuição de autoria: Metodologia e resultados Redação e aprovação final do artigo.
Lattes: http://lattes.cnpq.br/1654658687522883
E-mail: denis_fernandes@outlook.com

[iv] **Francisco do O' de Lima Júnior,** ORCID: https://orcid.org/0000-0002-6049-3893
Reitor da Universidade Regional do Cariri, Secretaria de Educação do Estado do Ceará, Governo do Estado do Ceará.
Doutor em Desenvolvimento Econômico pelo Instituto de Economia da Universidade Estadual de Campinas (IE-Unicamp). Professor Associado do Departamento de Economia da URCA (DE/URCA), e também da Diretoria do Geopark Araripe. Membro Permanente do Programa de Pós-graduação em Planejamento e Dinâmicas Territoriais do Semiárido (Mestrado Acadêmico), da Universidade do Estado do Rio Grande do Norte (UERN). Reitor da Universidade Regional do Cariri (URCA), de 2019-2023.
Contribuição de autoria: Supervisão e Considerações finais.
Lattes: http://lattes.cnpq.br/0923647677816521
E-mail: lima.junior@urca.br

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