Food and Agriculture Organization of the United Nations

FUNDING PROPOSAL TO THE GREEN CLIMATE FUND

-IRES-CUBA-
INCREASED CLIMATE RESILIENCE OF RURAL HOUSEHOLDS AND COMMUNITIES THROUGH THE REHABILITATION OF PRODUCTIVE AGROFORESTRY LANDSCAPES IN SELECTED LOCALITIES OF THE REPUBLIC OF CUBA

APPENDIX 2.1 Climate Change Justification of Project Implementation Areas

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Republic of Cuba

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1. Climate Change in Cuba: Evidence

The future climate of Cuba "can be described as more arid and extreme, characterized by prolonged and intense droughts and severe water deficit. The dry landscapes of the eastern zone will intensify and advance progressively towards the west, producing a transformation from the current climate (humid tropical) to a dry sub humid one with threats of desertification processes. The current climate trends and the scenarios considered (A2 and B2 of the IPCC) for the next 100 years, will produce a deterioration of the environmental quality in general, as a consequence of the reduction of the water availability, the loss of land in low coastal areas, the impoverishment of the soil, reduction of agricultural yields, loss of biodiversity (mainly in coastal areas), affectations to coastal settlements, the increase of transmissible diseases and the consequent negative impact on the economic activity". (Second National Communication, Republic of Cuba, 2015).

The climatic conditions of the Cuban Archipelago are determined by its geographical position, in the northern hemisphere. Cuba receives high levels of solar radiation throughout the year, which conditions the warm character of its climate; in turn, the proximity to the Tropic of Cancer presupposes the seasonal influence of organisms of both the tropical and extra tropical atmospheric circulation. Among the studied factors that model the climate and its variation are the global atmospheric circulation, the sea surface temperature in the North Atlantic Ocean, the cold fronts and particular meteorological events such as tropical storms, hurricanes, as well as the incidence of the ENSO phenomenon / Southern Oscillation (known as "El Niño" and "La Niña").

Observations show that the country's climate has been changing, which is evidenced by the increase in: (Second National Communication, Republic of Cuba, 2015)

- The surface temperature of the air at 0.9 ° C; conditioned by the increase of the average minimum temperature by 1.9 ° C, producing a decrease in the daily oscillation of the temperature;
- The frequency of long and severe droughts, especially in the eastern region and in some municipalities in the central region, which can extend to almost the entire country, as occurred in the years 2003-2005.
- Precipitation in the dry season, and decrease in the rainy months; and increase in rainfall associated with heavy rainfall in winter.
- The occurrence of moderate and strong coastal floods caused by penetrations of the sea or intense rains.
- The occurrence of moderate and strong coastal floods, independently of the meteorological events that generate them.
- The beginning since 1996, of a new very active period of hurricane activity in Cuba. Between 1990 and 2017, the country was affected by 29 hurricanes, 5 of them of great intensity.

According to the current climatic trends and the scenarios considered for the next 50 to 100 years, there will be a deterioration of the overall environmental quality which will result in: the reduction of water resources on a regional scale, the loss of land in low coastal areas, the impoverishment of the soil, the salinization of underground aquifers, the decrease of agricultural yield in crops of national interest, the loss of biodiversity, the harmful impact on coastal human settlements, the increase of transmissible diseases and the consequent impact on economic activity in general.

It is expected that climate change will have a significant impact on the factors that influence the quality of life of the population, which will experience a possible increase in risk to certain diseases and extreme hydro meteorological events with various repercussions.

2. Evidence of affectations attributed to climate change in areas selected by the project

Numerous municipalities of Cuba will suffer the effects of climate change. The municipalities of Jobabo, Colombia and Amancio in the province of Las Tunas and Corralillo, Quemado de Güines, Santo Domingo in Las Villas and the Arabos in the province of Matanzas, are between those that will be affected by this problem due to their condition of being mostly coastal and of being in the regions of the center and east of the island, where the manifestation of some phenomena associated with climate change shows an increasing evidence in the coming years.

Among the main impacts attributed to the effects of climate change in the intervention areas of the project are:

- Agricultural drought
- Saline Intrusion
- Floods due to heavy rains
- The increase in hurricane impacts over the last 30 years
- The loss of biodiversity and the expansion of exotic and invasive plant species
- The decrease of cultivated land and the increase of the idle areas.

Below will be explained how these effects are manifested in the areas where the project intends to intervene in order to mitigate and / or reverse this situation

Agricultural Drought

Changes in the behavior patterns of rainfall and its reduction, as well as the increase in evaporation, have a significant impact on the manifestation of agricultural droughts. Map 1 reflects the municipalities most affected by agricultural drought in the country, based on data calculated with records that begin in 1951 and continue up to 2018. The statistics extracted from this map show that 78 municipalities in the country, which represent nearly 50907 km2, about 46% of the national territory, have virtually the most intense values of agricultural drought with more than 50 days a year, with the presence of this phenomenon that will affect the beneficiaries of the proposed projects in particular.

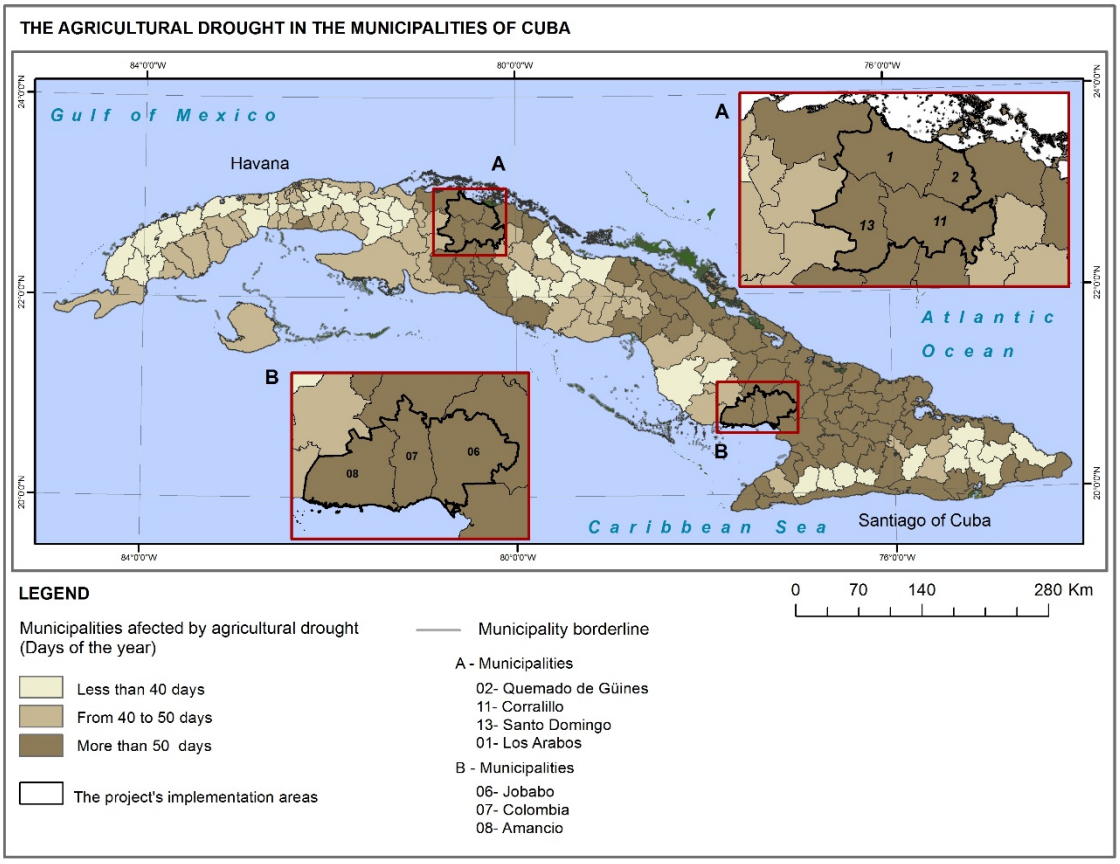
Table 1. Municipalities vulnerable to agricultural drought

Average number of days per year with agricultural drought	Number of Municipalities	Area of affected municipalities (in km2)	Area of affected municipalities (in %)
Less than 40	38	23799,21	21.91
Between 40 and 49	52	33871,03	31.19
More than 50	78	50907,32	46.88
Total	168	108577.57	100

Source: Prepared by the authors based on the agricultural drought information in: Centella A, B. Lapinel, O. Solano, R. Vázquez, C. Fonseca, V. Cutié, R. Baéz, S. González, J. Sille, P. Rosario and L. Duarte (2006). The meteorological and agricultural drought in the Republic of Cuba, and the Dominican Republic. Volume I, 172 pp,

The selected AIPs in the Central and Eastern region are among the municipalities most affected in the country by agricultural drought (See Figure 1: Municipalities of Cuba affected by the agricultural drought). In both areas the drought processes have favored the expansion of invasive plants better adapted to the scarcity of water and the aridity of the soils and the exodus of the population of the human settlements and of the rural spaces in these territories.

Figure 1. Municipalities of Cuba affected by the agricultural drought



Source: Prepared by the authors based on the agricultural drought information in: Centella A, B. Lapinel, O. Solano, R. Vázquez, C. Fonseca, V. Cutié, R. Baéz, S. González, J. Sille, P. Rosario and L. Duarte (2006). The meteorological and agricultural drought in the Republic of Cuba and the Dominican Republic. Volume I, 172 pp.

Saline intrusion

The decrease in rainfall associated with climate change will reinforce the potential deficit of fresh water, due to the impact that marine intrusion will have on coastal aquifers. Such a situation would lead to a significant reduction in the delivery of groundwater and, in less powerful coastal aquifers, could represent the final salinization of its reserves.

Map 2 reflects the provinces most affected by saline intrusion up to 2015, the intervention areas of the project are located in some of the most impacted provinces by this problem that may worsen in the new context of climate change, where a decrease in the volume of rainfall will affect the direct beneficiaries of the project particularly.

Figure 2. Provinces in Cuba impacted by saline intrusion

Source: Prepared by the authors - Inputs from (Second National Communication, Republic of Cuba, 2015).

In Las Tunas these areas represent about 73071.8 ha, which corresponds to 3% of the affected territory in Cuba, and 32% of the study area of the three municipalities of the central region.

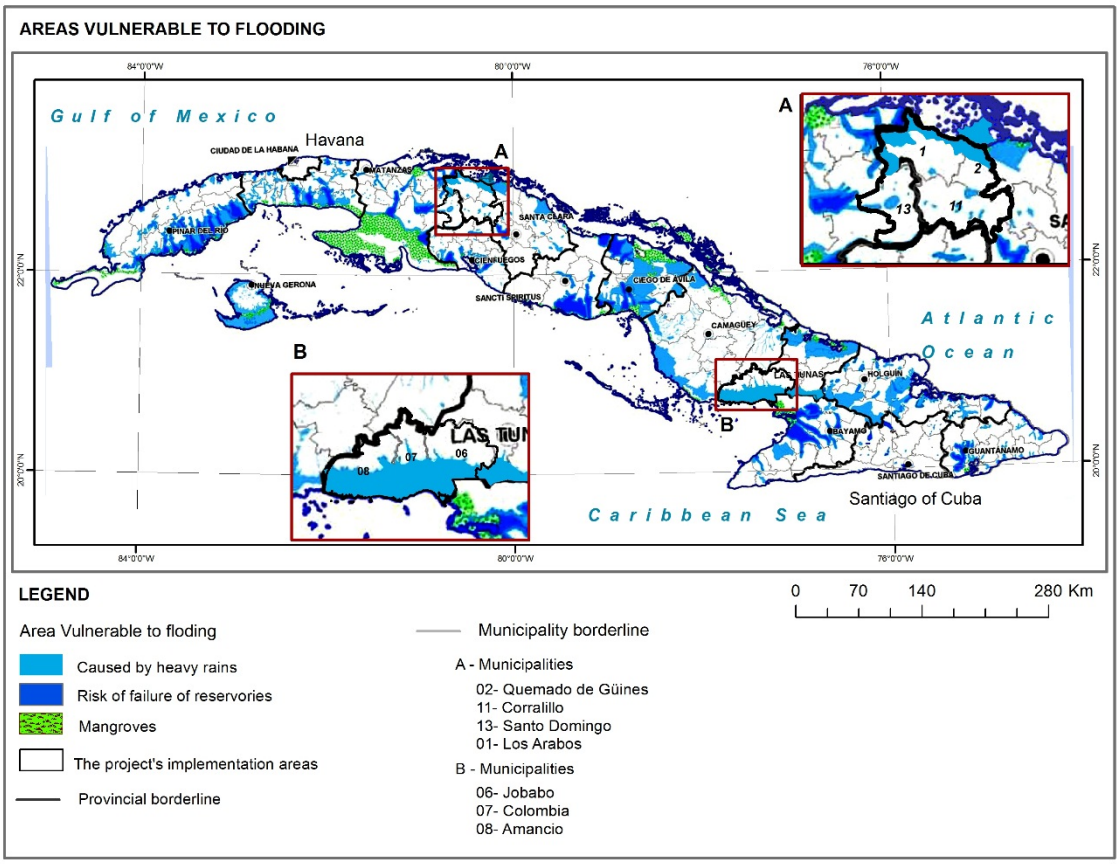
In the municipalities of Las Villas, these areas represent 46,882.7 ha, corresponding to 2.09% of the affected territory in Cuba and 16% of the study area of the 2 coastal municipalities of this region.

Floods due to heavy rains

The increase of moderate and strong coastal floods during the last three decades is closely related to the incidence of cyclones of different categories and the entry of cold fronts, which is why the areas facing the greatest dangers are located in low-lying areas in plain relief, near rivers or channels or areas with poor drainage, or where the impervious surface favors surface runoff and its accumulation in low areas and prevents the infiltration of water.

The north coast of the Central zone, in particular by the municipalities of Corralillo and Quemado de Guines, and the south coast of the Jobabo, Amancio and Colombia municipalities are among the territories periodically affected by flooding, associated with the incidence of these meteorological conditions that have increased their impact in these territories in the last 30 years

Figure 3. Vulnerable areas to floods in Cuba due to heavy rains



Source: Prepared by the authors - Inputs from (Second National Communication, Republic of Cuba, 2015).

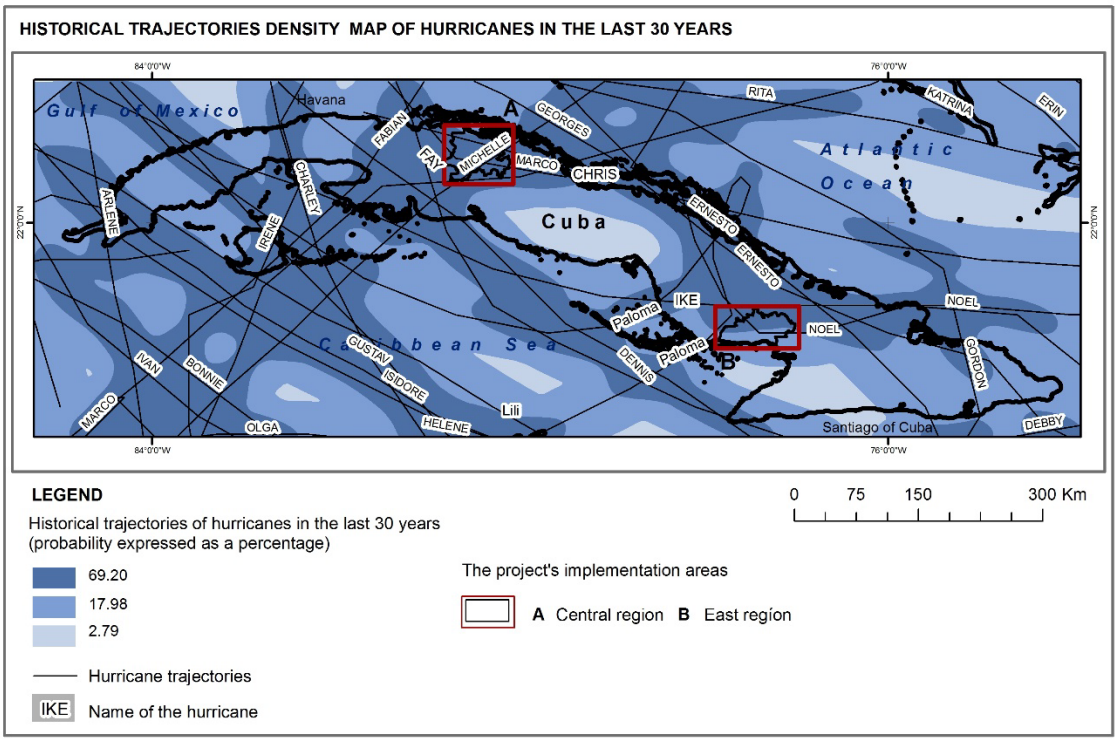
In the municipalities of Las Tunas, the areas vulnerable to flooding occupy about 13,996 ha, representing 2.3% of the vulnerable areas of Cuba and 61% of the Eastern region, where the project would intervene, while in Las Villas the most affected occupy about 61303.3 ha, representing 1.8% of Cuba and 21.77% of the Central region, a condition that will mainly affect the direct beneficiaries of the project.

The island of Cuba is located within a geographical area historically affected by hurricanes in the Atlantic Ocean basin. Over the last 30 years, these meteorological phenomena have had a significant increase in their frequency and intensity. According to some experts, an active cycle is being experienced, adding up the possible effects caused by global warming as a result of climate change.

Global warming raises water temperatures in the oceans by converting them, along with hot air, into fuel for hurricanes, and AIPs are under the influence of the historical trajectory of hurricanes. The last 30 years have been a very active period of hurricane activity on Cuba. Between 1990 and 2017, the country was affected by 29 hurricanes. In recent years, the central and eastern region of the country have been stricken by some of the most intense organisms that hit the island, a meteorological phenomenon that has impacted the beneficiaries of the project in a particular way.

Figure 10 represents a density surface that visualizes the areas with the highest concentration in the historical trajectories of hurricanes from 1990 to 2017, expressed as the percentage values of probability. It is significant how, unlike what has historically happened in this last period, the activity has been concentrated in central and eastern areas of the island where the AIPs are located.

Figure 4. Historical trajectory of hurricanes in the vicinity of Cuba over the last 30 years



Source: Prepared by the authors from data downloaded from: https://www.nhc.noaa.gov/data/

At the same time, this situation has had a decisive influence on food security and the population of these municipalities, an aspect that will be addressed in the next section.

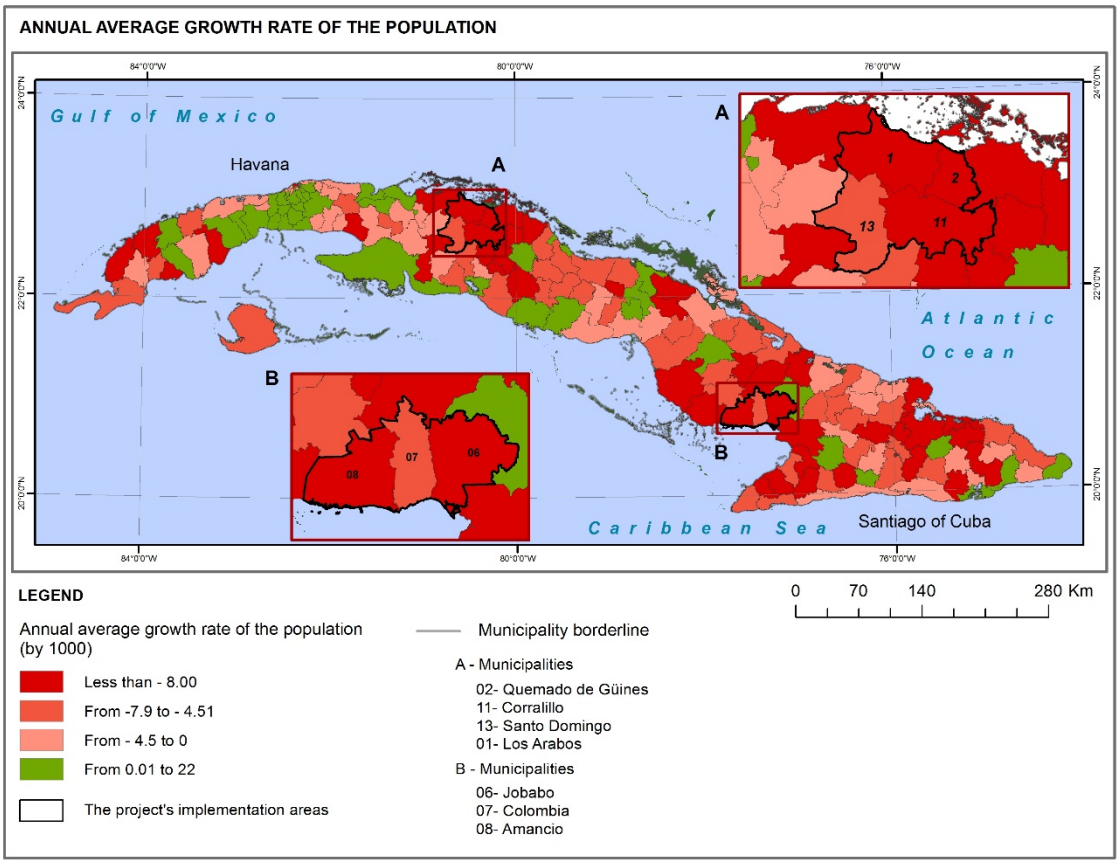
3. Effects on the Population: Modification of its Demographic Indicators

Variation in the population growth rate

Modifications to the socio demographic component of the municipalities of the AIPs due to factors associated with climate change such as drought, hurricanes, saline intrusion, among others, seen in the national context, evidence that these municipalities are in the segment of population that reports negative demographic growth rates for the period 2012-2017, with values of minus 8 per thousand live births in five of them and negative values between 4.5 and 7.9 in the two others.

The five municipalities of the AIP included in the first of these ranges with negative rates, are part of 20% of the surface of all the municipalities of the country included in this range; the two municipalities included in the second range, also with negative rates, are part of the municipalities that represent about 20% of the total area of the municipalities belonging to this range, which makes them representative of the existing situation in more than 77 municipalities of the country and justify their selection for the implementation of projects that contribute as much as possible to vary this behavior and increase the amount of beneficiary population (see Map 5 and Table 2).

Figure 5. Average annual rate of population growth



Source: ONEI (2017). Demographic indicators of Cuba and its territories, 2017. Havana.

Table 2. The municipalities of Cuba according to population growth rate

Population growth rate (per thousand inhabitants)	Number of municipalities	Area in km^2	Area in %
Less than -8	34	22163	20,41
From -4.51 to -8	43	22184	20,43
From 0 to -4.51	46	31984	29,46
From 0.01 to 22	45	32247	29,70
Total	168	108578	100,00

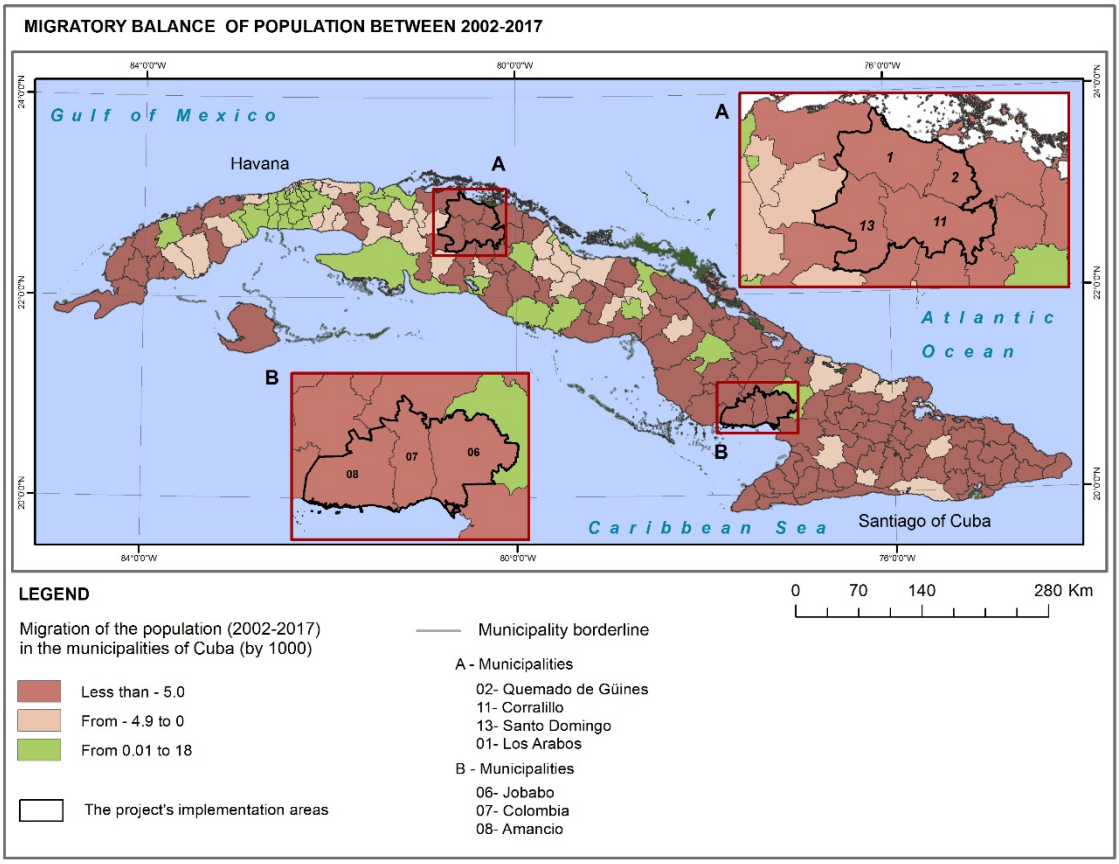
Source: ONEI (2017). Demographic indicators of Cuba and its territories, 2017. Havana; ONEI (several years). Demographic yearbook of Cuba. Havana; ONE (2012) Demographic series 2000-2010. Magnetic support.

Variation of the total migratory balance

The variations reported in the total migratory balance in the municipalities of Cuba are relevant. An important part of the causes that give rise to this demographic process are related to factors associated with climate change such as drought, hurricanes, saline intrusion, among others, which affect the emergence of what can be classified as environmental migration or migration due to deterioration of the physical-geographic components of ecosystems. Of the totality of the municipalities of the country that report this situation of deterioration of the conditions of the

ecosystems, 66 are indicated with negative rates of this indicator, with values of 5 per thousand people living in them during the period 2002-2017 and who occupy 41 of the national surfaces. The seven selected municipalities are part of this group of municipalities, which makes them representative of the current situation in more than 66 municipalities of the country, which has given rise to a migration of an environmental nature, and justifies their selection for the implementation of projects that contribute as much as possible to change this behavior and increase the amount of beneficiary population (see Map 6 and Table 3).

Figure 6. Migratory balance of the population between 2002-2017



Source: ONEI (2017). Demographic indicators of Cuba and its territories, 2017. Havana; ONEI (several years). Demographic yearbook of Cuba. Havana; ONE (2012) Demographic series 2000-2010. Magnetic support.

Table 3. The municipalities of Cuba according to the values of the total migratory balance rate, 2012-2017

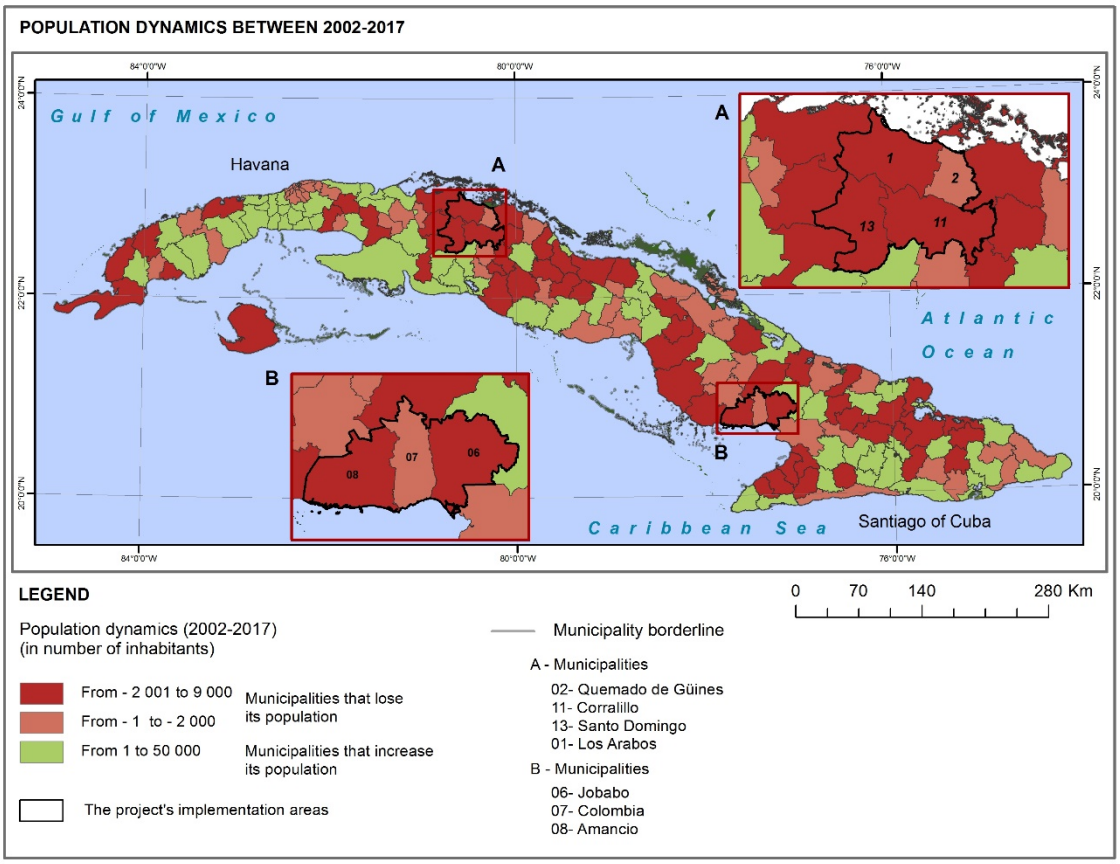
Migratory balance rate (per thousand inhabitants)	Number of Municipalities	Area in km2	Area in %
From 0.01 to 18	68	40923	38
From 0 to -4.9	34	22672	21
Less than -5	66	44983	41
Total	168	108578	100

Source: ONEI (2017). Demographic indicators of Cuba and its territories, 2017. Havana; ONEI (several years). Demographic yearbook of Cuba. Havana; ONE (2012) Demographic series 2000-2010. Magnetic support.

Variation in the size of the population

Changes in the amount of population in the municipalities of Cuba have intensified to the same extent that the effects of phenomena, not only of an environmental nature associated with climate change are becoming more evident. However, the incidence of the latter has gained relevance in many municipalities that have seen their ecosystems deteriorated by the increase in drought, saline intrusion, losses in human lives and materials by the passage of hurricanes. These phenomena have accelerated the exodus of a large part of the population and the calculations based on demographic statistics show that 89 municipalities have decreased their population in the period 2002-2017. With the largest decreases in its population in the range 2001 to 9000 inhabitants, 55 municipalities are reported, which occupy 41.4% of the country's surface. In this range are the seven municipalities selected, which makes them faithful exponents of the processes of a demographic nature that affects a large part of the national territory, which justifies their selection for the implementation of projects that contribute as much as possible to varying this behavior and increase the amount of population that can be benefited with its realization (see Map 7 and Table 4).

Figure 7. Variation in population rates between 2002-2017



Source: ONEI (2017). Demographic indicators of Cuba and its territories, 2017. Havana; ONEI (several years). Demographic yearbook of Cuba. Havana; ONE (2012) Demographic series 2000-2010. Magnetic support.

Table 4. The municipalities of Cuba according to ranges of decrease in population, 2002-2017

Ranges of variation in the amount of population (Inhabitants)	Number of Municipalities	Area in km^2	Area in %
From 1 to 50 000	79	40955	37,72
From -1 A to 2 000	34	22672	20,88
From -2001 to -9000	55	44951	41,40
Total	168	108578	100

Sources: ONEI (2017). Demographic indicators of Cuba and its territories, 2017. Havana; ONEI (several years). Demographic yearbook of Cuba. Havana; ONE (2012) Demographic series 2000-2010. Magnetic support.

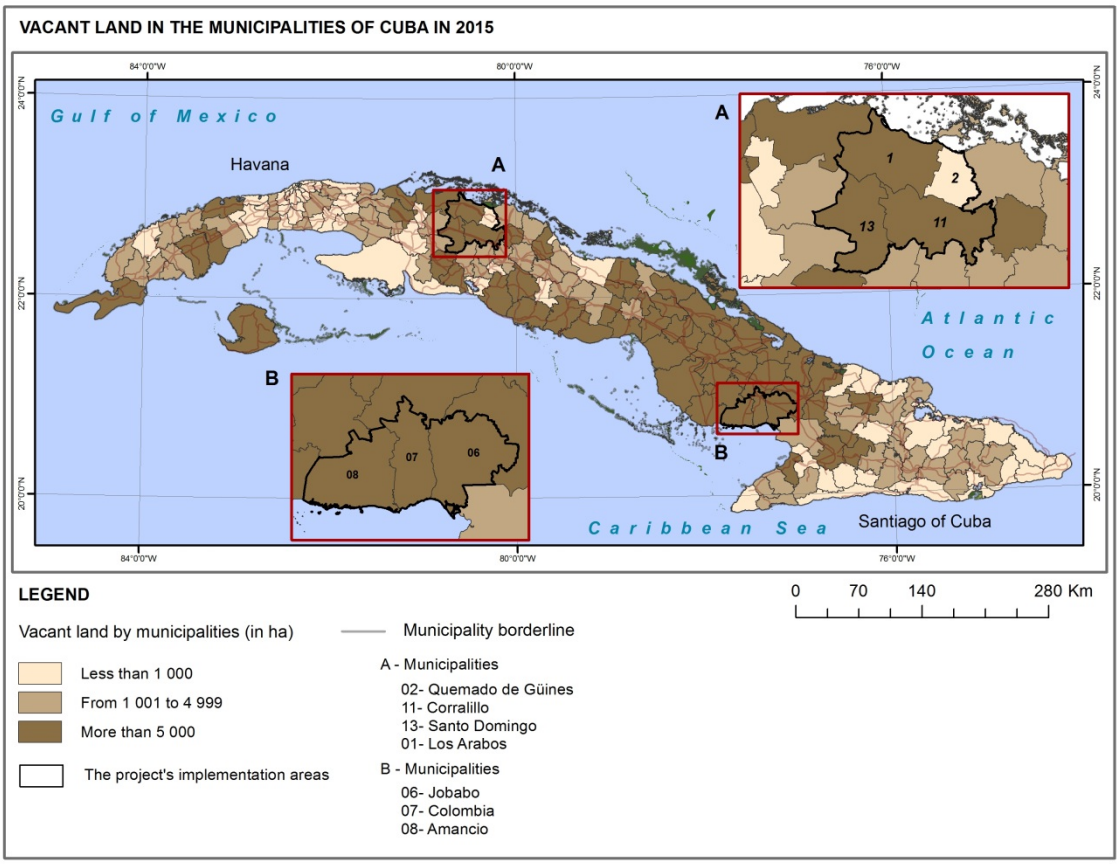
4. Effects on Food Security and the Beneficiary Population

One of the production factors that have the greatest impact on agricultural and forestry production is the land, so the increase in idle area decreases the values of the productive indicators in this activity, endangering national food security. In addition, it causes the diversion of increasing financial resources for the importation of food and other possible products that could be produced here, if an efficient and sustainable land use.

For several decades factors associated with climate change such as drought, hurricanes, salt intrusion, among others, caused the decrease of the total land that make up the cultivated area; lands became part of the idle lands category, whose lack of exploitation demands projects that contribute to curb the effects of climate change on them. Although all of the municipalities of Cuba witness this phenomenon, the intensity is not similar in all of them.

A range of idle lands exceeding 5 thousand ha have been verified among 53 municipalities, which represent 44.57% of the national surface and of which, 6 are part of the seven municipalities proposed for the implementation of projects aimed at a sustainable land use. In a range where the amount of idle land is between 1,000 and 5,000 hectares, there are 54 municipalities that represent 30.37% of the national surface and of which one of the selected municipalities is part of the Province of Villa Clara (Quemado de Güines), becoming representative of a national problem, justifies their selection and grants them the possibility of increasing the amount of population that can be benefited through the project outcomes. (see Map 8 and Table 5).

Figure 8. Idle land by municipality in 2015



Source: Prepared by the authors based on the balance of use and land tenure of MINAG (2015).

Table 5. The municipalities of Cuba according to values of idle surface, 2015

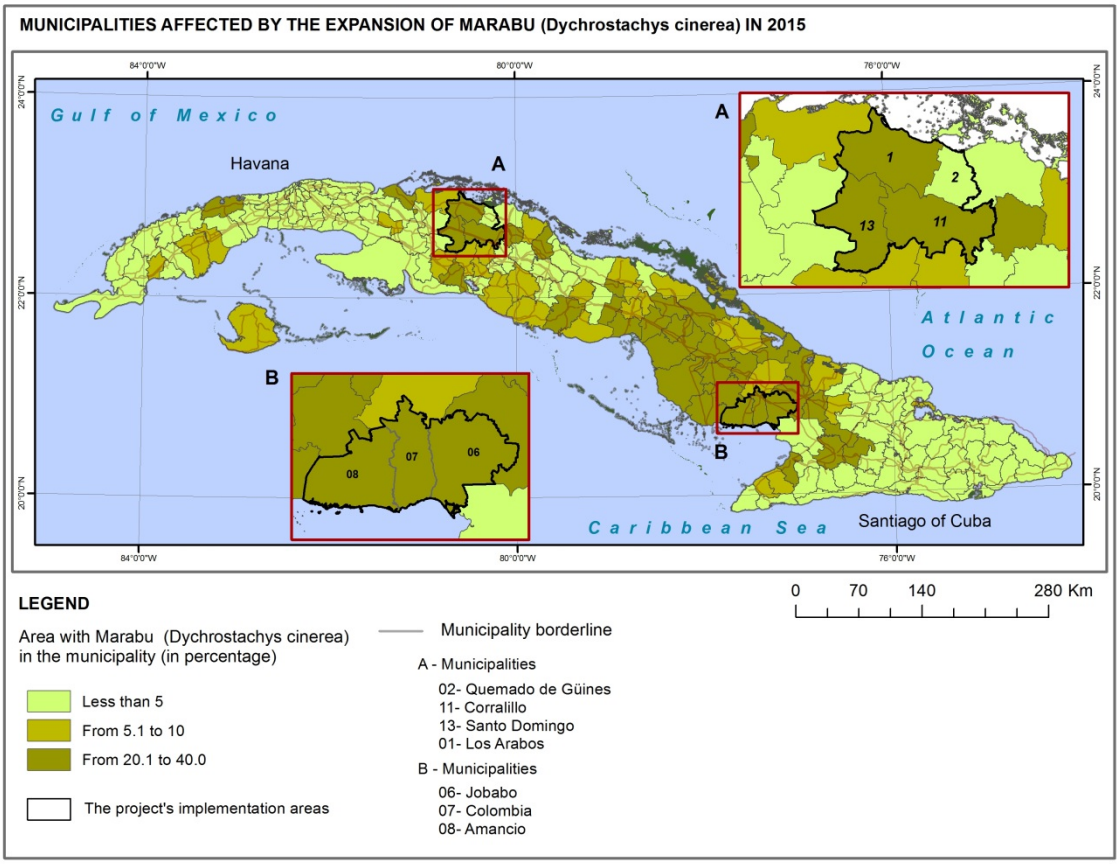
Value ranges of idle surface	Number of Municipalities	Area in km2	Area in %	% of all municipalities
From 0 to 1000 ha (1)	61	27208	25,06	36,31
From 1000 to 5000 ha (2)	54	32971	30,37	32,14
More than 5000 ha (3)	53	48398	44,57	31,55
Total	168	108578	100,00	100,00

Source: Prepared by the authors based on the balance of use and land tenure of MINAG (2015).

Another factor that is negatively influencing the results of the productive activity of the agricultural and forestry sector is the degree of marabou infestation of agricultural lands. This invasive plant not only represents a loss of biodiversity at the municipality scale that transcends the country, but also a decrease in the cultivation areas, at the same time it favors the expansion of exotic and invasive plant species, becoming a risk to national food security. In addition, it causes the diversion of increasing financial resources for the importation of food and other possible products that could be produced here, if there was an efficient and sustainable land use. Its presence and dissemination

have been verified in all municipalities of the country. Its range of infestation varies and it reaches more than 10% of the surface in 34 municipalities, among which are six of the seven municipalities proposed for the implementation of targeted projects to a sustainable use of the land and its recovery as an important productive factor. The seventh of the selected municipalities, belonging to the province of Villa Clara (Quemado de Güines), is in the range of 5 to 10% coverage of marabou, which makes them representative of a national problem and justifies the possibility of increasing the amount of population that can be benefited with their selection (see Map 8 and Table 6).

Figure 9. Municipalities affected by the expansion of the marabou (dychrostachys cinerea) in 2015.



Source: Prepared by the authors based on the balance of use and land tenure of MINAG (2015).

Table 6. The municipalities of Cuba according to values of the surface occupied by marabou, 2015

Range of surface values covered by marabou	Number of Municipalities	Area in km2	Area in %	% of all municipalities
From 0 to 5 % (1)	106	57760	53,20	53,20
From 5 to 10 % (2)	28	21637	19,93	19,93
More than 10 % (3)	34	29181	26,88	26,88

Source: Prepared by the authors based on the balance of use and land tenure of MINAG (2015)

Beneficiary population

The food crisis of the 90s in the last century revealed the importance of the small smallholder farmer producer in national, provincial, municipal and local food security, it influenced as well, the promotion of policies to encourage family farming, different forms of cooperative organization in rural areas of Cuba, which decreased the participation of the state form of production in the national structure from approximately 80% to less than 30%. The impulse given to family and smallholder farmer agriculture and to the small producer represented a stimulus to the growth of agricultural production and has tried, as one of its objectives, to stop the rural-urban exodus.

However, factors associated with climate change such as drought, hurricanes, saline intrusion, among others, represent a strong limitation for this policy aimed at food security from family and smallholder farmer agriculture, to achieve the expected objectives. We are in the presence of a migration of environmental origin, caused mainly by the effects of climate change in these territories. The rural-urban exodus maintains alarming figures, the socio demographic structure is dominated by the aging of rural spaces at ages 60 and older, the lack of job opportunities and investments in sustainable development projects in these areas, that could represent an alternative to physical-geographical deterioration accelerate the trend of abandonment of rural areas.

The provinces that are selected for the implementation of projects whose nature is aimed at counteracting the effects of climate change and its aftermath, are characterized by being national exponents of the growth of family and smallholder farmer agriculture, of the forms of cooperative organization of the production, to be examples of a new rural governance aimed at achieving food security, so that their stay in the field is a task of national importance. These provinces selected for the AIPs have approximately 22% of the nationally reported holdings, 22% of the agricultural area and 19% of the cultivated area. In them lies the importance in national food security that small producers have in non-state forms (family and smallholder farmer agriculture, cooperative forms, usufruct), their permanence in the field and the possibility to increase the amount of population that it can benefit with through projects.

The municipalities have been selected to combat the effects of climate change, the harmful processes that result, stop the environmental migration that is present in them and contribute to food security, a priority objective of the United Nations Organization for Agriculture and Food (FAO). The justification for selecting these territories for the AIP is because of the high number of tenants that reside in them, exponents of the importance of family and smallholder farmer agriculture, the small producer, the usufructuary, the participation of cooperative forms of production, the risk of continuing to feed migrant flows and the abandonment of rural areas, which would affect their status as potential beneficiaries.

In the Los Arabos municipality, its number reaches 2,042 producers who hold 96% of the agricultural land as tenants; in the municipalities of Corralillo, Quemado de Güines and Santo Domingo in the province of Las Villas they represent approximately 99% of the holders and own 85% of the cultivated land of the total agricultural area; in the municipalities of Amancio, Colombia and Jobabo in the province of Las Tunas they represent 99% of the producers and 90% of the agricultural area.

The total of producers in non-state management forms (family and smallholder farmer agriculture, cooperative forms, usufruct) in these municipalities that run the risk of joining the flow of environmental migrants is 14,831 holders, and considering the average family size in the country, this migratory flow can reach up to 60 thousand producers and rural population as a whole. The contribution that the implementation of the proposed modules can make will transform them into

beneficiaries and curb the flow of migrants due to causes associated with climate change (see Table 7).

Table 7. Indicators according to forms of state and non-state organization of agricultural activity in the municipalities selected for the implementation of the projects (ha)

Entity	Municipalities of the AIP		
	All forms of state and non-state organization and management	Non-state forms of management (family and smallholder farmer agriculture, cooperative forms, usufruct)	%
Los Arabos (Matanzas			
Holders	2 056	2 042	99,32
Total Surface	75 835	34 592	45,62
Agricultural Surface	53 889	32 115	59,59
Cultivated	17 441	16 796	96,30
Las Villas			
Holders	7 133	7 082	99,29
Total Surface	204 819	137 912	67,33
Agricultural Surface	169 204	129 143	76,32
Cultivated	71 325	60 572	84,92
Las Tunas			
Holders	5 751	5 707	99,23
Total Surface	229 813	119 181	51,86
Agricultural Surface	167 425	102 510	61,23
Cultivated	49 500	45 032	90,97

Source: Prepared by the authors based on the balance of land use and tenure 2016. National Center for Land Control. Ministry of Agriculture. Havana.

If we consider in particular the population benefited by the 259 modules proposed by the popular council in the selected municipalities of the three provinces (39 in the province of Matanzas, 104 in

the province of Villa Clara and 116 modules in Las Tunas), this figure approximates to 20 thousand producers and rural population as a whole. The indirect beneficiaries as a result of their stay in the field, of the new projects to be executed, their productive results, the existing service infrastructure and to develop, is valued at more than 238 people. The distribution of the beneficiaries is shown in table 8.

Table 8. Indicators of the beneficiaries of the AIP by municipality and province

Province/ Municipality	Surface		Beneficiaries (households)						Indirect Beneficiaries	
	Ha	%	H	%	M	%	Total	%	Uno	%
Las Tunas	**13,675.50**	38.3 %	**5,558.0**	43.3 %	**1,339.0**	42.9%	**6897**	43.2 %	**116,198**	48.4%
Amancio	3,950.00	11.1 %	1,862.0	14.5 %	514.0	16.5%	2376	14.9 %	38,900	16.2%
Colombia	2,276.00	6.4%	586.0	4.6%	235.0	7.5%	821	5.1%	32,665	13.6%
Jobabo	7,449.50	20.8 %	3,110.0	24.2 %	590.0	18.9%	3700	23.2 %	44,633	18.5%
Matanzas	**2,581.70**	7.2%	**475.0**	3.7%	**233.0**	7.5%	**708**	4.4%	**24,604**	10.3%
Los Arabos	2,581.70	7.2%	475.0	3.7%	233.0	7.5%	708	4.4%	24,604	10.3%
Villa Clara	**19,476.76**	54.5 %	**6,812.0**	53.0 %	**1,551.0**	49.7%	**8363**	52.4 %	**99,315**	41.4%
Corralillo	13,068.76	36.6 %	3,560.0	27.7 %	492.0	15.8%	4052	25.4 %	26,592	11.1%
Quemado de Güines	934.00	2.6%	684.0	5.3%	203.0	6.5%	887	5.6%	21,851	9.1%
Santo Domingo	5,474.00	15.3 %	2,568.0	20.0 %	856.0	27.4%	3424	21.4 %	50,872	21.2%
Total general	**35,733.96**	**100%**	**12,845.0**	100%	**3,123.0**	**100%**	**15968**	**100%**	***240,117***	100%

Source: Ministry of Agriculture and National Statistical Annual Report. ONEI, 2014.