



# The International Treaty

ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

## Full Project Proposal Format

Third Call for Proposals under the Benefit-sharing Fund

*Deadline for submitting full project proposal: 5<sup>th</sup> of December 2014  
at [Treaty-Fund@fao.org](mailto:Treaty-Fund@fao.org) and [PGRFA-Treaty@fao.org](mailto:PGRFA-Treaty@fao.org)*

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## PROJECT PROPOSAL COVER SHEET

Project No. W2A-PR-200-Cuba

Project Title: The diversity of forage resources to mitigate the effect of climate change on livestock systems in Cuba (FITORED)

Project duration: 24 months

Target crops: Andropogon gayanus, Canavalia ensiformis, Trypsacum laxum, Brachiaria spp., Panicum maximum Tithonia diversifolia, Pennisetum purpureum, Leucaena spp., Vigna sp., y Centrosema sp.

Targeted developing country/ies Cuba

Other Contracting Party/ies involved \_\_\_\_\_

Project geographic extension (km<sup>2</sup>) 5 958.19

Total requested funding 200 000,00 USD

Total co-funding 2 295 195,50 CUP<sup>1</sup> and 200 000,00 USD

**Please select the type of project you are applying for:**

- Single-country Immediate Action Project (Window 2)
- Multi-country Immediate Action Programme (Window 2)
- Single-country Co-development and Transfer of Technology project (Window 3)
- Multi-country Co-development and Transfer of Technology project (Window 3)

**Applicant**

Name of Organization: Estación Experimental de Pastos y Forrajes “Indio Hatuey”

Type of organization Government. Institution for Science, Technology and Innovation

Project Contact: (name and position) \_\_\_\_\_

E-mail address: \_\_\_\_\_

Telephone: \_\_\_\_\_

\_\_\_\_\_

<sup>1</sup> Official exchange rate 1CUP=1USD.

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## SECTION A: EXECUTIVE SUMMARY

### 1. Executive summary

The project aims at minimizing two of the most pressing problems limiting livestock development in Cuba: the low availability of promise FGR for livestock feed and inadequate access of producers to these resources. To this was plotted as a overall objective: To contribute to food security, adaptation and mitigation of climate change from increasing biodiversity of forage resources in Matanzas and Camagüey covers four specific objectives: Build a logical framework for participatory dissemination of resources fodder for local conditions and their conservation; evaluate the effectiveness of the production, preservation and dissemination of forage resources locally, as well as technologies for its use; implement a training program that allows to develop skills related to the production, use and conservation of plant genetic resources and, implement an outreach program that allows the socialization of results and experiences achieved in the project. The main expected results relate to the conservation and use of varieties adapted to local conditions, where it is expected that at least 9 varieties will be introduced with a concept of sustainable production, based on agro-ecological principles and the characterization of existing germplasm to the conditions prevailing in local livestock ecosystems; with the transfer and validation of technologies for production, conservation and use of seed corresponding to the different agro-ecosystems of the six municipalities beneficiaries, including the creation of a local system of seed production, seed introduction of new species forage and implementation of seed production technologies of at least 13 varieties; by implementing management technologies and utilization of herbaceous and tree genetic resources for agricultural production systems, where at least the 5% of the entities and the 70% of grazing area will be covered with improved pastures and 100% entities will use agroecological methods of management; by implementating and validating a program to build skills in management, utilization and conservation of forage resources to 20 farms beneficiaries and by implementating and validating a program for the dissemination of results, including the creation an inter-institutional network to access to the information on forage genetic resources, agronomic and livestock management and regionalization of pasture and forage. The FGR used will be: *Andropogon gayanus*, *Canavalia ensiformis*, *Tripsacum laxum*, *M. maximus*, *Urochloa decumbens*, *Tithonia diversifolia*, *Leucaena leucocephala*, *Cenchrus purpureum*, *Vigna unguiculata* and *Centrosema molle*. The 3382 direct project beneficiaries are mainly concentrated in two provinces (Matanzas and Camagüey) and six municipalities and are constituted by 2572 farmers in 20 productive entities, broken down into eight Basic Units of Cooperative Production (UBPCs), 11 Cooperative Credit and Services (CCS), an Agricultural Production Cooperative (CPA) and 810 workers from three research centers involved, the Experimental Station of Pastures and Forages "Indio Hatuey", the Institute of Animal Science and the Experimental Station of Pastures and Forages Camagüey. The indirect beneficiaries are the 234,095 inhabitants of the 6 municipalities with access to the production that is generated by the implementation of technologies in their territories. The population of Matanzas and Camagüey (1,026,925 inhabitants) provinces will be indirectly affected by the project, which means a geographical extent of involvement of 5 958.19 km<sup>2</sup>.

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## **SECTION B: PROJECT DESCRIPTION AND CONTENTS**

### **2.1. Problem definition**

On a global scale is of particular importance the climate change in the areas dedicated to livestock (2.2 million hectares), 75% of the soil presents erosion problems and has since the last century, drought worsened and the temperature increased by 0.9°C. In the last 25 years due to economic problems and the damages of climate (droughts, hurricanes, etc.) seed production of pasture and forage in Cuba has been significantly depressed and therefore the development and introduction to production systems varieties adapted to these extreme conditions and the reduction of external inputs. This is coupled with poor management of livestock grazing areas, which has led to overgrazing and soil erosion, declining fertility, loss of native forests and the decrease of the yield of plants and animals. The lack of integration and management between academia and the productive sector, through the ministries involved, is another aspect that involves the articulation of agricultural processes and agricultural productivity. The guidelines of economic and social policy of the country indicate accurately the need for a new management model for the sector, encouraging the development of productive forces. In that sense, the guideline 192 states: "Continue the development of the livestock vaccination program in activities, swine, poultry and small livestock, enhancing the genetic development of herds and increase domestic sources of animal feed." The proposed policy for livestock development, the economic and financial committee of the National Assembly of Popular Power, approved, among its 13 measures, which states: "Ensuring the cattle feed primarily on pasture, fodder, protein crops and agro-products and the sugar industry ... "The action of the project aims at minimizing two of the most pressing problems limiting livestock development in the country: the low availability of FGR promising for livestock feed and inadequate access of producers to these resources.

1. Low availability of promising FGR. There is insufficient access to seed production technology and capacity building for developing these, which affects food security and import substitution. Seed production of pasture and forage is currently insignificant and do not have a consistent view about the importance of development at the country level. The improved pastures have decreased (less than 20%); no grass species are planted, only fodder (cane and king-grass); there is little reforestation and significant increase of grazing areas infested by Marabou, an invasive prickly plant, representing more than 30%. Several scientific institutions have scientific results and related technologies FGR such as: production technologies, processing and storage of seeds, regionalization of herbaceous and tree varieties for different soil and climatic conditions, soil management techniques and meadows on agro-ecological bases, which may contribute to increased production and import substitution seed and food, as well as adaptation and mitigation of climate change. However, there is a low utilization and generalization of these results in the production base, while there is ignorance by producers of this potential.

2. Insufficient access of producers to forage genetic resources. Inadequate integration between the academia and business due to centralized extension system has caused failures in technology transfer and innovation. With the action of the project is to increase biodiversity of forage resources, involving the actors in a self-managed and decentralized participatory plant breeding. This action includes the construction of knowledge producers, enabling increased food production and contribute to adaptation and mitigation of climate change, from increased soil cover farmers with FGR, which would facilitate the protection of these by means of biomass in surface and anchoring of this through its root system, mainly in the tree fodder for the large potential in the physical-chemical soil recovery and capture greenhouse gases.

## **2.2. Project objectives: Overall and specific objectives**

Overall objective: To contribute to food security adaptation and mitigation of climate change from increasing biodiversity of forage resources in Matanzas and Camagüey. A process that demonstrates the impact on food production an increase of the diversity (PGRFA) of species adapted, proper management during periods of food shortage, caused by the severe drought, and the use of correct soil and prairie. Camagüey and Matanzas were selected because these have a high concentration of people (1,026,925), with high demands for food and also because the first represents the eastern Cuba, with livestock production tradition of milk and meat and, second, to the western region, with strong impact on livestock production. Empowerment of local producers and actors through generating skills and access to information and knowledge through reflection and action spaces, and the provision of methodologies and agroecological technologies to accomplish such purposes will be preferred. To facilitate the appropriation process mechanisms and existing institutions to environmental joint municipal level will be activated.

Specific objectives: (i) Construct a logical participatory dissemination of fodder resources for local conditions and their conservation scheme. (ii) evaluate the effectiveness of the production, preservation and dissemination of forage resources locally, as well as technologies for use. (iii) Implement a training program that allows to develop skills related to production use and conservation of plant genetic resources. (iv) Implement an outreach program that allows socialization of results and experiences gained in the project. The project will work participatory dissemination of forage resources and the implementation and practical demonstration of technologies for seed production level cooperatives and farms in 6 municipalities and areas of productive, educational performance and service delivery. The direct project beneficiaries (farmers and producers of 20 farms selected in the 6 municipalities) can increase productivity from the implementation of a set of 13 technologies developed in three research centers, the Experimental Station of Pastures and Forages Indio Hatuey ( EEPFIH), the Institute of Animal Science (ICA) and the Experimental Station of Pastures and Forages of Camagüey (EEPFC). The added value of the action is framed in the fact that it becomes a demonstrative experience that will catalyze local processes of sustainable agricultural innovation, it will also affect the strengthening of relations between research and production with a high potential for multiplication and articulation between the scientific and productive sector.

## **2.2. Targeted outputs, activities and related methodology of implementation**

**Outcome 1:** Conserved and successfully used varieties adapted to local conditions. The action is conceived in two parts 1) the activation of gene banks of the three research centers, the integration of these institutions, banks forming seed production in selected provinces, to revive the formal flow management on an agroecological basis and 2) Participatory plant breeding involving the artisanal producer and the formal system that constitutes an experience that has been developed successfully in Cuba, mainly in agricultural crops. **(A.1.1)** Development of diagnostic baseline and to identify existing varieties in production systems and demand flows and relationships of actors in the systems. It is expected that at least 9 varieties will be introduced, though made after the baseline, you may be able to increase when the demands of varieties and technologies that are needed by each entity. The flow prioritizes real and active ongoing participation of the peasantry in strengthening diversity but agricultural innovation for sustainable production based on agroecological principles. **(A.1.2)** Making strategic investments to ensure the research-development-innovation (R + D + i) cycle. The institutions that possess the gene banks should characterize accessions and backgrounds that are pending certification and received from abroad to increase the flow of varieties dissemination system. New

identification techniques (electrophoresis and molecular markers), evaluation and selection that allow, for a shorter period of time, to certify and disseminate new varieties for different conditions of soil and climate where entities are operating, following up the process with actions focused on plant health, soil and analysis of its nutritional value. (A.1.3) Characterization of the existing germplasm to the conditions prevailing in livestock ecosystems to identify varieties that are adapted to the local context. Assessment methodology adopted for the flow of varieties are used, as well as participatory plant breeding (2. Action evaluate four community conservation initiatives established to ensure long-term local conditions selected for survival varieties and at least 50% of the varieties will be multiplied and disseminated. Four of the species listed in Annex 1 of the Treaty, and six new obtained in the project, will be made available in accordance with the conditions of the Multilateral System. (A.1.4) Implementation of appropriate identification, selection and dissemination of forage resources that contribute to adaptation and mitigation of climate change and increased production methodologies. (A.1.5) Introduce foreign species tested to similar to soil conditions and climate **Outcome 2:** Transferred and proven technologies for production, conservation and use of seed corresponding to the different agro-ecosystems of the six municipalities beneficiaries. Participatory breeding method for technology diffusion and dissemination of the seed as a way to facilitate access of farmers to the diversity of species with a management that does not affect the environment will be used. (A.2.1). Creating local seed production system. This system also includes existing, alternative production of farmers on their farms. (A.2.2). Introduction to the local seed system new forage species that are of interest for animal feed. Will be introduced in forage seeds entities that were not part of the herding culture in the area, taking into account the soil and climate of each entity (20), and the analysis conducted with beneficiaries. At least five initiatives from the entities for the production and distribution will allow to try at least 13 varieties. Diversity will be supported with the methodology that had shown excellent results and over ten years of working experience mainly with agricultural crops for human consumption. It is a way to channel the necessary flow of seed, places of great variability of FGR to those where there is little availability (A.2.3) Determination of methods and procedures to assess the physiological and phytosanitary quality of seed produced. At least two methods and techniques for analyzing the quality of seeds adapted and developed, three systems will be established in two of the municipalities to produce and determine the quality. **Outcome 3:** Implemented management technologies and utilization of herbaceous and tree genetic resources for agricultural production systems. Enter improved species adapted and managed on agro-ecological foundations that promote environmental stewardship, since the endemic flora has little nutritional value and must protect the soil ecosystem basis. (A.3.1) Inclusion of technologies for the use of trees and shrubs in livestock systems. Planting strata with herbaceous and woody plants including improved grasses, herbaceous legumes and tree browsing addition to offering high quality food for livestock, improve the diversity and functionality of species, care for the soil, sequester carbon and provide animal welfare. The action focuses on introducing the technology to at least two entities. (A.3.2) Implementation of new and comprehensive methods of grazing management and conservation of forages adapted to the small scale. Successful introduction into the production systems of agroecological methods that do not harm the environment. Implemented two techniques of food preservation from PGRFA to solve the dry season deficit, in at least two entities. **Output 4:** Implemented and validated a program to build skills in management, utilization and conservation of forage resources to beneficiaries of 20 farms. (A.4.1) Design and implementation of training programs on issues of agrotecnia and use of fitorecursos, environment and gender. 500 producers trained and qualified on these issues and their influence on adaptation and mitigation to climate change. Three local meetings from farmer to farmer, which consists of visits to reference farms in each province is expected. (A.4.2). Workshops exchanges between

producers beneficiaries of the action. Experiences converge spaces where the protagonists of the action socialize and participate with the producers and decision makers. At least two meetings between producers, academics and policy makers made, with a minimum of 40 participants. **Output 5:** Implemente and validate a program for the dissemination of results. **(A.5.1).** Systematization and publication of the experiences and results of the project to other regions and provinces. The initiatives systematization and publication of experiences and results of the project will result from the coordination between partners and the articulation of these with the ANAP and the various ministries. Three experiences will be broadcast by provincial telecentres and Cubavisión nationwide, on a daily basis to reach a wider fabric of actors. Creation of six training materials and other information products (2 controllers, 1 websites, 3 folding) for building skills. **(A.5.2).** Creating an inter-institutional network for access to information on forage genetic resources, agronomic and livestock management and regionalization of pasture and forage. The organizational structure is constituted by three scientific institutions involved and the six municipalities with a total of 20 productive entities belonging to 10 CCS, 8 UBPCs and CPA. In municipalities close coordination with the municipal councils of the PP and the provincial offices of the Ministry of Technology and Environment (CITMA) and the Institute of Meteorology (IM) and the ANAP at all levels and with other international projects will be established, Basal and PIAL, sponsored by SDC, CARE and German Agroacción, among others. There will be coordination with the National Commission of Seed, which is the responsible institution in Cuba and belongs to MINAG. Additionally, relations with the digital network of agricultural powers of the Ministry of Higher Education (MES) will be established. Networking and capacity building, promote the sustainability of the project and its results.

#### **2.4. Targeted PGRFA**

***Andropogon gayanus*:** Gramínea belonging to the family Poaceae, subfamily Panicoidae, genus *Andropogon*. He is a native of West Tropical Africa and is distributed in Sudan, Central African Republic, Nigeria and Southern Africa. Introduced in Cuba from samples of international banks genes. Fits dry environments, with periods of up to nine months drought and extreme soil acidity, poor and low fertility. Not tolerate prolonged waterlogging. It is highly tolerant to Pt fly or spit. It is excellent fire resistance to trampling and also tolerate long periods of cold. Can be used for grazing in the production of meat and bovine milk and hay, is a rustic grass, but palatable and excellent digestibility.

***Canavalia ensiformis*:** Legume belonging to the Fabaceae family, genus *Canavalia* and is native to the New World. Introduced in Cuba from samples of international banks genes. It has high adaptability to climatic conditions, thrives in a temperature range of 14 ° C-27 ° C, ranging from warm temperate areas to tropical high rainfall. It thrives in the range of rainfall from 700 to 4200 mm and survive during prolonged dry periods. Fits a wide range of soil conditions, poor and acidic soils (pH 4.3 to 6.8) is Menois than other legumes to waterlogging and salinity affects. It has wide applications: for feeding ruminants and monogátricos and human (grains) and soil protection.

***Tripsacum laxum*:** It belongs to the family Poaceae, subfamily Panicoideae, *Tripsacum*. Local variety which has no variety or cultivar elite, fits temperatures de18-30 ° C, grows at altitudes from 800 m 0-1, grows well in a range between 800-4000 mm rainfall / year, the pH should be greater than 4.5, so that tolerates acidic aluminum soil, medium requires highly fertile soils and good drainage. It has a high production of foliage and quite rustic. It is used to cut and carry, in partnership, to silvopastoralism, as silage, hay and green manure.

***M. maximus (Panicum maximum)*:** Gramínea family Poaceae, belonging to the genus *Megathyrsus*, originally from Kenya. Introduced in Cuba from samples of international banks genes. It is a species with wide range of adaptation as it develops from sea level to 2500 meters, grows well in soils with high fertility and supports moderate levels of drought for its large root system, resists moisture, but not prolonged waterlogging, adapts and thrives well under the shade of tree



legumes. It is generally used for grazing, but can be used for hay and forage and silage. ***Urochloa decumbens (Brachiaria decumbens)***: is a grass that belongs to the family Poaceae, subfamily Panicoideae, Brachiaria. It is native to Africa. Introduced in Cuba from samples of international banks genes. Fits environments with rainfall between 700 and 1500 mm. Persists well in poor soils, sandy to loamy texture, but well drained. Tolerates poor soils with acid pH (4.2), but not waterlogging by moderate or long periods. It is resistant to drought and moderate way to shade. It is widely used in grazing systems for the production of milk and beef, but also a quality forage. ***Tithonia diversifolia***: It belongs to the Asteraceae, genus Tithonia family. It is found in tropical and subtropical areas of the planet and its center of origin is Central America, although it is possible that it is South America. Local variety that grows in different conditions of soil and climate, from sea level up to 2500 m.; rainfall from 800-5 000 mm and in a wide range of soils, from acid to neutral and up poor soil fertile. It is used in cut and carry systems as protein fodder for both ruminants and monogastric. Its flowers are used for flower arrangements and prey on beekeeping. ***Leucaena leucocephala***: It is a legume belonging to the family Fabaceae, subfamily Mimosoideae, Leucaena genus. It is native to Mexico and was introduced from Central America to the world. Introduced in Cuba from samples of international banks genes. Fits environments rainfall from 700 to 3000 mm. Do not tolerate prolonged waterlogging. It prefers deep soils, good internal drainage and pH between 6.0 and 7.5. It tolerates low levels of P. Fits clay, heavy and saline soils. It is the quintessential woody forage for silvopastoral systems in the tropics, with outstanding results in the production systems of milk and beef and lamb. It is used both grazing and forage production. Set high amounts of N to the soil and its impact on the conservation of soil and grass quality is high. ***Cenchrus purpureum (Pennisetum purpureum)***: is a grass that belongs to the family Poaceae, subfamily and genus Cenchrus Panicoideae. Clones obtained through biotechnological methods (tissue culture in vitro), in this case the Cuba CT-115, the OM-22 and Cuba CT-169, widely used today in areas of grazing and forage the country, respectively. They grow well from sea level to 2200 m. Grow well at temperatures from 18 to 30 ° C, with optimum at 24 ° C. They behave well in acidic to neutral soil, withstand drought and high humidity and rainfall between 800 and 4000 mm per year. Do not tolerate waterlogging. ***Vigna unguiculata***: is a legume belonging to the family Fabaceae, subfamily Faboideae, genus Vigna. It comes from West Africa. Introduced in Cuba from samples of international banks genes. It requires a warm season for germination and good drainage, but tolerate poor soil nutrients and high acidic conditions, as well as less than 300 mm annual rainfall regimes, is resistant to shade. Prefers loose soils and not chalky or heavy as clay and sunny exposures. They are very sensitive to cold, excessive humidity and winds. It is used as green manure, cover, hay, silage, concentrate, cut and carry and Food. ***Centrosema molle (pubescens)***: is a legume that belongs to the Fabaceae, Centrosema family. Native to Central and South America. Introduced in Cuba from samples of international banks genes. It grows up to 1700 m, precipitation 1 000-1 750 mm / year. Fits soils with low to medium fertility, low levels of P and pH of 4.5 to 7.0. It is used in grazing systems, mainly associated with grasses and silvopastoral systems, with good results in production of meat and milk. Can also be used as a cover crop in areas of fruit, by fixing nitrogen to the soil. PGRFA that will be used in the execution of the project, four are listed in Annex 1 of the International Treaty (*Andropogon gayanus*, *Canavalia ensiformis*, *Tripsacum laxum*, *Cenchrus purpureum (Pennisetum purpureum)*) PGRFA that are obtained in the project will be available in accordance the terms of the multilateral system. Similarly, the information that is generated in the project from the assessment of plant genetic material will be made available to the public one year after completing this, as set out in Resolution 2/2013 the Governing Body.

## **2.5. Target groups and beneficiaries**

The direct beneficiaries of the project are 2,572 producers belonging to 20 productive entities (cooperatives) and 810 workers from three research centers, including researchers, specialists, technicians and workers, which are related to technical services offered, are mainly concentrated in two provinces (Matanzas and Camagüey) and six municipalities. Producers are broken down into eight Basic Units of Cooperative Production (UBPCs), 11 Credit and Service Cooperatives (CCS) and Agricultural Production Cooperative (CPA). The six municipalities in which are located the bodies corresponding to the following geographical location in the country: Jimaguayú is located between 21 ° 17 '30' 'north latitude and 77 ° 47' 30 " west longitude, with a altitude of 118 m; Esmeralda is located approximately 21° 51 'North Latitude (N) and 78° 07' West Longitude (W); Jagüey Grande is located in the south-central Matanzas, in the plain of La Habana part - Matanzas, between coordinates 22 ° 31 'and 40' 'north latitude and 81 ° 7' and 40 " of west longitude; 10 m; Columbus is located at 22 54 'and 22 37' north latitude and 81 07 'and 80 42' west longitude, is part of the central municipalities in the province of Matanzas who lack coasts; Martí is located northeast of the province of Matanzas, bordered to the north by the Straits of Florida, south to the Perico and Colon municipalities east by the province of Villa Clara and west to the town of Cardenas and Perico located in Havana plain red -Matanzas in - West-central part of the province, bounded on the northwest by the municipalities of Cárdenas and Martí, west to Jovellanos and Jaguey Grande and southeast by the municipality of Columbus. Table 1 presents a detailed characterization of the 20 cooperatives that will receive the support and direct project support is offered. This proposal has been formulated in close consultation with the direct beneficiaries who were also invited to participate in the various activities of planning and coordination that have been made. The direct beneficiaries are characterized as follows:

**Production** The representatives of the food chain with starring roles in the production and/or in the food processing for human and animal consumption, are the main beneficiaries while the key executors of the actions developed. These farmers, several farms or cooperatives, together with other actors plan, will implement and evaluate their activities. Moreover, they constitute the main stages of learning, where technologies will be applied in their productions among other groups of local and national context.

Table 1. Producers organizations.

| Province          | Municipality  | Co-op                    | Workers |    | Age                               | Studies                           |
|-------------------|---------------|--------------------------|---------|----|-----------------------------------|-----------------------------------|
|                   |               |                          | M       | F  |                                   |                                   |
| Matanzas          | Colón         | CPA 6to Congreso         | 100     | 38 | 64                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | CCS José Maceo           | 84      | 17 | 49                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | CCS Sabino Pupo          | 312     | 55 | 62                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   | Martí         | CCS Camilo Cienfuegos    | 203     | 36 | 65                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | CCS Pedro González       | 135     | 27 | 48                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | CCS Sandalio R. Díaz     | 102     | 30 | 45                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   | Perico        | CCS Ramón Rodríguez      | 247     | 68 | 62                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | CCS José Martí           | 117     | 23 | 60                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   | Jagüey Grande | CCS Camilo Cienfuegos    | 246     | 18 | 68                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | CCS Félix Duque          | 336     | 56 | 70                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
| CCS Vicente Ponce |               | 217                      | 24      | 62 | 6 <sup>to</sup> y 9 <sup>no</sup> |                                   |
| Camagüey          | Jimaguayú     | UBPC La Paz              | 10      | 1  | 57                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | UBPC Pablo Cacero Moya   | 8       | 2  | 45                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | UBPC Combate Pacheco     | 6       | 2  | 56                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | UBPC Patria o Muerte     | 10      | 0  | 54                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   | Esmeralda     | UBPC Matanza de Caonao   | 9       | 4  | 48                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | UBPC Frank País          | 13      | 4  | 47                                | 6 <sup>to</sup> y 9 <sup>no</sup> |
|                   |               | UBPC Desembarco Galvanic | 7       | 1  | 50                                | 6 <sup>to</sup> y 9 <sup>no</sup> |

|  |  |                        |       |     |    |                                   |
|--|--|------------------------|-------|-----|----|-----------------------------------|
|  |  | UBPC Lidia y Clodomira | 4     | 0   | 46 | 6 <sup>to</sup> y 9 <sup>no</sup> |
|  |  | Total                  | 2 166 | 406 |    |                                   |

### **Research workers**

All technical specialists and scientists that will participate as active actors and facilitators of diversification of forage resources with the support of specialized knowledge and facilitating access to and availability of PGRFA. They will offer technical advice in

| Province     | Municipality  | Population     |         |
|--------------|---------------|----------------|---------|
| Matanzas     | Colón         | 72 000         | 184 789 |
|              | Martí         | 22 361         |         |
|              | Perico        | 30 847         |         |
|              | Jagüey Grande | 59 581         |         |
| Camagüey     | Jimaguayú     | 19 994         | 49 306  |
|              | Esmeralda     | 29 312         |         |
| <b>Total</b> |               | <b>234 095</b> |         |

each of the stages of the project. The indirect or final beneficiaries are the 234,095 inhabitants of the 6 municipalities (Table 2 above) with access to production that is generated with the implementation of technologies in their territories. Through the dissemination activities and multiplication expected an indirect effect on the population of the provinces Matanzas and Camagüey (1,026,925 inhabitants).

### **2.6. Impact and impact pathways**

The proposal is a new experience of research-production integration, in which the producers not only conserve germplasm delivery by scientific institutions, but produce their own seed in artisan conditions and spread it. Seed dispersal will have an impact on increasing the diversity of species and their conservation on farms involved, so it should improve livestock feed and care for the soil. The rational use of land and improvement possible to reduce the effect of drought and food shortages that this causes, as well as increased CO<sub>2</sub> uptake and decreased methane emissions, by ingesting ruminant animals plants more quality, mainly legumes (C3) and shrubs and trees, among other factors. Another important aspect is to build knowledge and capacity building in producing, from the creation of an interagency network linking all actors, for better access to technology, with the aim of contributing to the development sustainable agricultural locally. The action is intended that the impact on production, dissemination and management of FGR may have a range in both communities v beneficiaries of the project and beyond these, through the dissemination of results generated therein.

#### **2.6.1. Food security and poverty alleviation**

The action will have an impact on increasing the diversity of species, from achieving increased access and availability of seed of improved varieties, allowing their spread and establishment for use by animals, with an effect on the increased production due to higher dry matter yields and nutritional quality, when compared with existing ones. As a result higher monetary gains are obtained without jeopardizing the care of the environment and have greater food supply for recipients, contributing to food security. This process will be organized in a participatory manner, allowing access to all cooperative members not only of beneficiary farms, allow knowledge sharing, seed, and the dissemination and sustainability of technological innovations.

#### **2.6.2. Adaptation to climate change and environmental sustainability**

The action plans to deliver the direct beneficiaries germplasm of species adapted to the soil and climate of the participating entities, which allow reproduction, preservation and dissemination within a short period. The introduction and spread of these species of grasses and herbaceous legumes as well as trees and other woody forage increase resilience and adaptation to climate change significantly. Among the set of technologies can include the development of agroforestry, forest grazing, systems integration agriculture-livestock, grass-legume associations, alternative bioenergy production programs, the application of bioproducts and integrated health system plant. All these, comprehensively contribute to the recovery of soil fertility, decrease erosion, carbon sequestration, improving the habitat of animals and plants, as well as enriching the soil with soil biota methods agroecological management. Agriculture-livestock integration will increase the income of farmers, with the sale of a diversified production and quality. The implementation of food preservation methods for small scale allow use in periods of scarcity or severe drought.

### **2.6.3. Scientific impact**

It aims to maximize the spread of plant genetic resources at the farm level, and the same applied, by hand, the seed production technologies developed by research centers through decades of research. This would allow an exchange of germplasm between producers and in turn, the development of a participatory plant breeding and farmer experimentation, which would result in obtaining long-term more resilient to climate change and anthropogenic varieties and management in the increased production of seeds for the promotion of livestock areas. This in turn would strengthen the research and technology transfer from research centers involved, since all have genebanks and in two of them original and basic seed and forage grasses occurs. Currently, all directly involved in the introduction of results in the productive sector and EEPFIH and ICA have master's and doctoral programs in the field of pasture and forage and animal nutrition, which will allow overcoming young scientific staff and also can have a significant impact on the creation of national strategies. The project results will be published in scientific journals recognized internationally (Cuban Journal of Agricultural Science and Pastures and Forages Magazine) and information leaflets with affordable beneficiaries language.

### **2.6.4. Capacity development and empowerment**

In the province of Matanzas the EEPFIH is responsible for the production of basic seed and there is a seed farm in the Cattle Company Martí. Other agricultural entities banks have few species, but generally not eligible for varietal purity. The flow of formal seed production is impaired. The action of the project proposes a new scheme that maintains the part of the formal system in place, with improvements genebanks of scientific institutions and strengthening a farm and seed bank, but added the estates of beneficiaries, where will produce alternative or craft seed varieties that have been certified and selected directly from genebanks. The system records and national certification should be strengthened. It is anticipated, parallel to the introduction of PGR on farms, the development of in situ research on methods of establishing these, the most appropriate agrotechnical practices, production and conservation of seeds, and the use of these FGR in animal and human consumption, all based on the application of agroecological practices. Thus, to complete the project researchers and producers have developed capabilities in research and development in culture systems integrated, selection and processing of seeds, the use of biological controls, bio-fertilizers, animal traction, fodder banks of energy forage and protein for livestock feed, among

others, all to meet the needs of their own families and their fellow citizens. In this context of change, will emphasize the development of the practice of farmer to farmer, to convey the technologies and results for the transformation of farms and their sustainability over time.

## **2.7. Relevance to national or regional priorities in its plans and programmes for PGRFA**

The project is inserted into country strategies for sustainable development and increased production of animal and human food, national research and development programs organized by the Ministry of Science, Technology and Environment (CITMA) since 2012 which is responsible for directing environmental policy in Cuba. The National Environmental Strategy (edition 2011-2015) identified problems that are related to those pursued minimize the project, which include: degradation, disruption of forest cover, soil pollution, loss of biodiversity and impacts climate change. Moreover, in the Comprehensive Program of Livestock Ministry of Agriculture of Cuba and its Strategic Projection to 2015 explicitly state that the main constraints to ensure stable feeding of livestock universe are, among others: systematic decrease in the areas of pasture and forage, the decrease in the production of hay and silage, declining soil fertility and high invasion of grazing areas for woody shrub. Given that the economic and social policy of the country is proposed in the guideline 188: "Develop a comprehensive policy that contributes to enhance the production, storage and marketing benefit seed", MINAGRI convened a National Program on Science, Technology Conserve, enhance and improve the genetic resources of plants and animals and forest genetic resources through the establishment and growth: Innovation that a comprehensive program of seed production (including plant genetic resources), where his priorities are proposed study of collections of plant and animal species present economic importance and / or potential as well as the conservation and management of forest genetic heritage, while new varieties and breeds that contribute to the sustainability of agriculture are developed Cuban. The proposal from integrating into the project 13 varieties of grasses and tree fodder for uses in agriculture, supports the integration of components of plant genetic resources in regional action plans and land on adaptation to climate change.

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## **SECTION C: OPERATIONS**

### **3.1. Methodology of project implementation**

The main problem in livestock systems is the decreased production of milk and meat, which has as its root cause low availability of promising forage genetic resources and inadequate access of producers to these resources. The results and goals reflected in the logical framework are in line with the priorities and needs of the country and focus on the effects: Propose a logical framework for the dissemination and participatory conservation of forage resources for local conditions, evaluate the effectiveness of the production, preservation and dissemination of forage resources locally, as well as technologies for use, implement a training program that allows to develop skills related to production use and conservation of plant genetic resources and implement an outreach program that allows socialization of results and experiences gained in the project. These effects will result in a set of products: Conservation and successful use of varieties adapted to local conditions; Transferred and validated technologies for production, conservation and use of seed corresponding to the different agro-ecosystems of the six municipalities beneficiaries; Implemented management technologies and utilization of herbaceous and tree genetic resources for agricultural production systems, Implemented and validated a program to build skills in management, utilization and conservation of forage resources to beneficiaries in 20 farms and implemented and validated a program for the dissemination of results. To obtain these products will be necessary to develop a set of activities in which research centers interact with their beneficiaries productive entities, the association of farmers, local governments, technical organizations, among others, to facilitate the exchange, dissemination and training, access to seed more than 10 species and more than 10 management technologies forage resources, with participatory methods that will increase the diversity of species on agro-ecological bases, adapted to climate change; in the six municipalities in which women and men benefit and empowerment will enable sustainability of these systems on farms. For the project agreements between institutions management processes allow for the implementation thereof shall be established. Responsible for coordinating the project will be the Indio Hatuey Experimental Station. He held financial and accounting management, project logistics and management monitoring equipment. Maintain links with FAO as a financier. The Coordination Team shall consist of representatives of the three participating institutions to provide qualified personnel, seed and technology components. Participating institutions provide highly qualified human resources, actively participate in the design and implementation of training and exchange processes. These institutions have genebanks including a close relationship be established and should organize the identification, characterization and classification of varieties according to the demands of farms as well as complete information and investigations necessary for promising accessions and cultivars for conditions infertility and prolonged droughts, which also require introducing foreign material. After entities characterized and identified varieties to be introduced as seed demand, delivery by genebanks be organized. These institutions not only provide seed diversity of forage resources, but the technology components required for handling these and play important roles in training for effective implementation. Table 3 shows the most important roles are summarized.

The project's activities are supported by the producers for execution, despite their fundamental role consists in the introduction, experimentation, local spread of new variants and managed agricultural agro-ecological bases that contribute to food security and climate change technologies. To do this will be incorporated and disseminate participatory practices, which consist of an informal alternative method for the production,

multiplication and dissemination of seed farms. This new alternative system will be called locally and not to be confused with local banks that owned state enterprises in the formal system. Commitment agreements with each entity will be established to be effective operation of the system. To start this process, the seed is delivered to the farms of peasants comes from the genebank of scientific institutions, and will be strengthened after the farms and banks of the formal system in the towns, which will be put into operation this other means of production so far not work effectively. To promote grazing systems in the entities the same route of delivery of seed will also be used, ie genebanks. Fairs participation will be created in the more developed institutions where conditions exist, ie where banks were established introduced species. The fairs developed on farms will be sampled farmer experimentation and enable interactive learning. Also involved in the project visit scientific institutions and farms that have promise in plant genetic resources and livestock management as a practical farmer to farmer. However a training program on participatory plant breeding, management of plant genetic resources for the importance of regionalization of varieties according to soil and climatic conditions, characteristics and requirements of seed production by variety, the requirements will develop a proper pasture management and conservation of fodder for periods of scarcity, among others. It is proposed to create a network of actors (FITORED) for the information generated by the institutions and, to be shared with the fabric of actors involved in the project productive entities; the association of farmers, local governments, universities and technical organizations, among others, who have offices in every province, which have experience in the implementation of activities for local development and are implementing new changes guided by the state; in turn receive new contributions farmer innovation. More established practices will be integrated into the policies of organizations, institutions and sectors (municipal governments, ANAP, ACTAF, ACPA, MES, and CITMA MINAG) working in Cuba and focus the municipal agricultural development. Additionally, technicians, farmers and other actors involved, know the Project and are motivated and sensitized with work, so despite the short time of it to determine impacts on livestock production can realistically make actions and expected results.

Table 3. Partners roles and expertise.

| <b>Institution</b>   | <b>Location</b>     | <b>Role</b>  |   |
|--|---------------------|--|---|
| EEPF Indio Hatuey  | Matanzas            | National Coordination leading institution in Matanzas  | Project management according legislations<br>National platform organizes an annual basis<br>Organize national meeting to inform donors<br>Make agreements and meets the agreed<br>Systematizes the information resulting from the actions and facilitates the monitoring and evaluation team<br>It offers accounting and financial information and prepares report<br>.Informa Operating plan<br>Design learning processes methodologically |
| Instituto de Ciencia Animal  | Mayabeque           | Team coordination  |   |
| Instituto de Pastos y Forrajes   | Camagüey            | Team coordinator and director in Camagüey  |   |
| Farmers' cooperatives and other forms, and other possible local actors | Matanzas y Camagüey | Introduction, experimentation, local spread of new agricultural technologies and variants and / or marketing that contribute to food security and climate change.<br>Diversification of production on agroecological basis<br>Contribute and participate in learning processes<br>Disseminate good practices incorporated into their productions |   |

### **3.2. Partnerships and collaboration arrangements**

The project sees the integration of three leading institutions in the field, two from the Ministry of Higher Education (the Experimental Station of Pastures and Forages "Indio Hatuey" and the Institute of Animal Science) and a part of the Ministry of Agriculture (Station of Pastures and Forages of Camagüey). The Indio Hatuey, science and technology institution and attached to the University of Matanzas "Camilo Cienfuegos", founded in 1962 and its current mission is "to contribute to sustainable local development through agro-ecological production models that integrate production innovation Station food and energy, aimed at promoting socio-economic development, environmental protection and human welfare with gender equality ". To fulfill its mission, the institution has 46 researchers, of which 50% are doctors of science and over 55% are masters of science in various branches of scientific knowledge and technical. The research is carried out through national, branch and institutional projects, which belong to priority programs of the country in the branches of animal feed, human, energy, environment and local development. At present 12 national and projects 4 Institutional develop. In the institution of postgraduate education activities where the Master stands in Pastures and Forages and graduate studies in Silvopasture are made. Short courses, trainings and internships are also offered. The center is authorized institution for the development of doctorates in agricultural branch, together with the University of Matanzas. The institution plays a key role in the formation of agricultural specialists through the faculties of Agronomy and Veterinary officiating at the center. Pastures and Forages magazine, scientific publication with four issues a year, which is indexed in 4 international databases and recorded at 14. The station is the introducer of species and varieties national center is edited by alien introductions and / or surveys and national collections. Also, evaluate and select varieties of grass, forage and fodder woody interest for livestock in the country and preserved through its genebank (unique in the country) and ex situ germplasm conservation of useful species for this area . In that sense, the institution custody 702 accessions of herbaceous legumes, 383 woody shrub legumes, grasses and 84 687 trees. On the other hand, produces, evaluates and provides the foundation seed of pasture and forage Research Institute in Pastures and Forages, under the Ministry of Agriculture, which is responsible for disseminating them through its network of experimental stations, located in several provinces. The Institute of Animal Science (ICA) was created in 1965 and is located in the town of San José de las Lajas, Mayabeque province, in western Cuba. The center's mission is to "Build, develop and transfer best and most profitable technologies in the field of tropical animal production through research, extension, training, dissemination and efficient collaboration, meeting the demand of livestock and promoting social participation. "More than 90 professionals from the center, organized in multidisciplinary groups, form the technology transfer system, which introduces more than 32 technologies and trains from 2000-3000 producers and professionals dedicated to livestock annually. Many of their results have made up their scientific novelty and contribution to science Awards Academy of Sciences of Cuba and expressed in methodologies and integrated technologies that have been accepted and applied in the country and in different countries of the tropics. It has two programs Collaborative Doctoral Curriculum, the Animal Production and Biometry, the first accredited excellence by the National Accreditation Board as the Master of Animal Production for the Tropical Zone, is also has a Postdoctoral Training Program and Specialties Production of milk and meat for ruminants as well as a wide range of training courses and graduate services offered to the whole country and the tropics. With regard to forage plant genetic resources, the entity working on breeding different species, most notably the production of clones of Pennisetum, both for forage, grazing. It also evaluates varieties of grasses and designs operating systems. Delivery on original material and seeds producing the Indio Hatuey station for conservation. The Experimental Station of Pastures and Forages of Camagüey (EPPF), under the Ministry of



Agriculture and is located in the town Jimaguayú, Camaguey Province, in the east. The center is part of the network of stations Research Institute of Grassland and Fodder (IIPF). The EEPF, since 1977, the year it was founded, has been implementing programs for technological development of productive entities of livestock in the province, through technical assistance, technology transfer and introduction of technological packages, dedicated to developing animal production systems, improvement and introduction of pasture and forage seed production of grasses and grains, weed control and strategy to mitigate the effects of drought. Its mission is "to achieve leadership in technology transfer and training in agrotecnia activity, feeding and management of beef cattle in the province of Camaguey, which will contribute to the sustainable development of livestock production and production certified seed that satisfies customer demand. " Within their collective work (14 professionals) has a doctor and four teachers of Science, working in all companies in the province in technology for the management and control of marabou and constitute the provincial center producing basic seed and registered pasture and forage. They are also linked to Agricultural Extension System in the country and work on 5 projects of interest to the province and the national project PGR leading the Indio Hatuey station.

### **3.3. Project management team**

The project management team is comprised of: Station "Indio Hatuey" (EEPFIH), Institute of Animal Science (ICA) and the Research Institute of Grassland and Fodder (IIPF)

**EEPFIH:** Responsible for coordinating and implementing the project. It will provide highly qualified human resources, actively participate in the design and implementation of training and exchange processes, provide seed diversity and technological components; and the formation and strengthening of the primary centers of diversity in different environments in Cuba. He held financial and accounting management of the project at central level and project logistics.

**ICA, IIPF:** Methodological support and guidance on priority issues for the project (interactive action learning, management, conservation and local spread of PGRFA and exchange of experiences for farmers, participatory evaluation process innovation).

Locally acting different actors and sectors whose roles are essential for their involvement and social, productive and commitment to the environment.

**Local Government:** Represents the structure closest to the community government and social organization, becoming its representative. It will be a major player in facilitating the project activities, observing and participating in these actions both to make learning it considers appropriate for management to share his experience with other stakeholders.

**National Association of Small Farmers (ANAP):** It is a fundamental alliance project in all municipalities of action for its proximity and involvement in the productive base. It will provide knowledge of Agroecology Movement and Campesino a Campesino and his extensive experience in gender work. It will facilitate the work of the project in relation to the diversification of PGRFA and its environmental management.

**Cuban Association of Agricultural and Forestry Workers (ACTAF)** is considered an important actor for his experience in working with local stakeholders in the agricultural development and promotion of agroecological alternatives Cuban agro production systems.

**Ministry of Agriculture (MINAG):** It is a major player with which you will work in close partnership and cooperation. Contributor to learning and technologies, also from local instances of coordination and management of agricultural strategies. Represents the most important element for food sovereignty and import substitution at local and national level. Participate in local learning groups with specialists, researchers and policy makers.

Cuban Association of Animal Production (ACPA): Non-governmental organization with vast experience in diversified livestock, animal feed and genetics for racial improvement. Participate in learning groups providing knowledge and expertise in their areas of action and receiving learning related to the diversification of PGRFA.

**Ministry of Foreign Trade (MINCEX):** This player does not have municipal representation, but with provincial authorities with which close cooperation and exchange will remain to establish links that facilitate good project management in line with the provisions of the rules, regulations and laws relating to international cooperation.

**Ministry of Higher Education (MES):** An organism that has the most extensive national network for knowledge management and which belong most of the project partners. MES entities ascribed to participate in learning groups as active actors and animators with the contribution of specialized knowledge. In addition, through the methodology of action learning is expected to interact with networks instituted MES in Cuba, such as Environment Network and the network of branch Programme for University Management Science and Innovation for Local Development (GUCID), with which, as it has been working. This project will create a municipal structure for knowledge management and innovation at the local level, therefore, establish close working relationships with other programs and projects involved in selected municipalities which will strengthen the basis for the process of innovation and System Management Integrated Value Chains (SIGCV) that contribute to food security in these municipalities. In Columbus Local Agricultural Innovation Programme (PIAL) program Urban and Suburban Agriculture in conjunction with the project will strengthen the work in this county. In Martí Program Municipal Local Development Initiative (IMDL), Urban and Suburban Agriculture and the project will work closely with these purposes and in the remaining municipalities the project will work primarily with Urban and Suburban Agriculture. Synergies will be established with programs that are having different purposes interventions in selected municipalities (BIOMAS-Cuba, PIAL and Local Human Development Project (PDHL).

### **3.4. Sustainability**

One of the most sustainable and effective to preserve the genetic diversity of a crop ways is through their own use in the hands of producers. These, besides making spontaneous experimentation, have been interested in the knowledge generated about diversity, either by theoretical knowledge in scientific or through traditional knowledge from other producers. To ensure post-project sustainability a number of strategic actions that will give consistency to the planned activities and investments will be made to face. During the first year of the project a diagnosis of the soil and climate and biodiversity in each scenario will allow for constructing a logical framework for contextualizing the identification, selection and participatory dissemination of fodder resources for local conditions and conservation of these will be made and thus able to take more coherent technologies to meet the demands and productive model that should serve. The post-project sustainability is the cornerstone of the entire project and has its essential components: Empowerment of local actors from his role and training, consolidation of the basic concepts of sustainable agriculture on agro-ecological bases farmers, technicians, policy makers and the community; Activation and strengthening of local institutions and structures; Promotion of technologies and little dependent on external components to the territory productive conceptions; Adjust total real interests and capacities of local actors from participation; From these intentions and approaches of the project can be expected to achieve during his two years of implementation, the start of a continuous process of local development for food security both in target municipalities and the rest of the country.

1) **Financial Sustainability:** Incorporating design elements of the systems that ensure high economic and energy yield of production processes is a technology component to ensure

financial sustainability. Moreover, increased productivity and diversity allow implanted production systems more resilient to climate change, can be inserted and permanently adapt to the demand for food of the population and have a stable and growing income will improve the level of income of farmers. The restoration of local seed production starting allow farmers to have this indispensable resource for sustainable food production. The system itself will implicitly sustainability through the availability of genetic material adapted to the soil and climate, the preferences of farmers and the local market. The systematic predictable adjustment of the national economy, based on the support for agriculture and decreased imports, will result in increased funding to support agriculture and farmers have the opportunity to enhance their productions in convertible currency and thus have necessary funds to reinvest in productive processes.

2) **Institutional sustainability:** This is based on not creating new institutions for the project, but in strengthening existing institutions as EEPFIH, ICA, EEPF Camagüey, Program Urban and Suburban Agriculture, Municipal Delegation of Agriculture, among others, considering the mission and institutional goals each and from structural strengthening, training and coordination of actors that the project will provide them.

3) **Political sustainability:** It will be ensured through the support and project support to programs and policies for development and local food security and promoted by the MINAG CITMA and the Cuban government. The strengthening of horizontal coordination of actors at local level; productive design alternatives based on participatory concepts, process technologies tailored to the conditions, resources, knowledge and productive local traditions. The project will affect the social recognition of the work of farmers and agro-ecological standards and practices as a means for sustainable agriculture and what it represents in terms of food security and sovereignty.

4) **Environmental Sustainability:** The project is aimed at developing practices and agroecological methods, consistent with the preservation of the environment. The redesign of production systems will favor the recovery of biodiversity, reforestation of agricultural areas, crop rotation and appropriate land use, implement anti-erosive practices, promote nutrient recycling and the use of agricultural residues for animal feed, create the conditions for the production and use of organic fertilizers. In addition, emphasis on the use of irrigation practices and technologies that do not threaten water reserves, the use of renewable energy for water pumping (windmills) and waste (digesters) will be promoted. The application of these practices and others, adapted in each case to the specific site conditions, guarantee make an environmentally appropriate agricultural production.

Implanted agroecological systems are designed so as to minimize possible emissions of greenhouse gases on the production performed by increasing their energy efficiency, productivity and land equivalent ratio (LER) with the use of low external inputs. Livestock-agriculture-forestry integration is a basic component of environmental sustainability. The integration is how this diversity becomes functional in closing cycles and interactions among system components, allowing the sustainability of production in the short, medium and long term. With this greater energy efficiency that allows a lesser unit energy consumption and hence optimization of available resources will be achieved by avoiding depletion.

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**SECTION D: APPENDIXES**

By signing this submission form for full proposal, the applicant confirms that all the above statements, including the attached Appendixes, are true to the best of his/her knowledge. Any deliberately untruthful response will lead to the automatic exclusion from the further screening and appraisal process, and may lead to the denial of awarded grants from the Benefit-sharing Fund.

**Signature of contact person:**

**Date and location**

