GOVERNO DO ESTADO DO CEARÁ
Secretaria dos Recursos Hídricos

Socioeconomic Evaluation of Results and Impacts of Ceará Hydroenvironmental Development Project and Suggested Policies

Volume 6

Série: Tecnologias e Práticas Hidroambientais para Convivência com o Semiárido

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Volume 2 - Práticas Inovadoras de Controle Edáfico e Hidroambiental para o Semiárido do Ceará

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Volume 3 - Avaliação Geoambiental de Práticas Conservacionistas Implantadas na Microbacia do Rio Cangati, Canindé-CE

Volume 3 - Geoenvironmental Evaluation of Conservational Pratices Implemented in Cangati River Microbasin, Canindé - CE

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SOCIOECONOMIC EVALUATION OF RESULTS AND IMPACTS OF CEARÁ HYDROENVIRONMENTAL DEVELOPMENT PROJECT AND SUGGESTED POLICIES

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FOREWORD

The contents of this book refer to social and economic effects of he Hydroenvironmental Development Project (PRODHAM) developed by the Secretariat of Water Resources (SRH) and implanted by the Superintendence of Hydraulic Works of the State of Ceará (SOHIDRA) in partnership with FUNCEME, on communities located in Cangati River hydrographic microbasin in Canindé-CE.

In addition to such partnerships, to make PRODHAM action development feasible SRH was supported by its major partner, the Inter-American Reconstruction and Development Bank (The World Bank), which understood the importance of such actions and supported them through a Loan Agreement signed with SRH.

PRODHAM actions started in 1999 and completed in 2009 comprised the introduction of techniques for hydroenvironmental preservation, water and soil management, participatory environmental monitoring and control involving selected communities. At the same time, the project promoted the local farmer organization strengthening, as well as sensitization, mobilization and awareness of productive agents in the microbasin toward the practice of a sustainable agriculture and exploration or other innovative economic activities.

The participatory methodology allowed the stakeholders the understanding of local potentialities and limitations, and their participation in the planning of actions required to promote the sustainable development of Cangati River microbasin. As such, farmers started to know and adopt sustainable exploration techniques, among which the productive use of sediments and water accumulated in successive dams, economic exploration of areas of influence of underground dams, contour line cultivation, ground burning control, dissemination of apiculture in several communities, and *pet* bottle recycling for handmade brooms production stand out.

The fact of methodology adopted by PRODHAM has created a new "culture" of coexistence with semiarid region materialized by a new attitude toward the care with natural resources is remarkable. Now, farmers minimize deforestation and ground burning, replant the ciliary forest, use the soil for contour line cultivation, take advantage from stone barriers and terraces, take a good care of domestic waste, in addition to other sustainable practices.

This book is the result of ten years of work involving governmental agents and local actors. It discusses scientifically-based analyses and suggestions and their adherence to the reality of a hydrographic basin located in semiarid region, the reason why we recommend the replication of PRODHAM technologies and practices in other microbasins of Ceará semiarid region.

Finally, we are grateful to all managers and governmental technicians involved in the Project, as well as the local actors for the partnership, teaching and validation of such technologies and practices implanted by PRODHAM.

Augusto César Pinheiro
Secretary of Water Resources of the State of Ceará

CONTENTS

1 Introduction

1. INTRODUCTION

The Hydroenvironmental Development Project (PRODHAM) designed under Ceará Integrated Water Resource Management Program – PROGERIRH/CE developed experimental articulated and sustainable actions focused on recovery/preservation of environmental resources and socioeconomic development in four selected hydrographic microbasins in Ceará semiarid region. That Project, which started in 1999 and ended in 2009, was financially supported by the World Bank.

PRODHAM actions comprised the introduction of basic hydroenvironmental preservation, water and soil management, and participatory environmental monitoring and control techniques in selected areas. At the same time, the project encouraged the strengthening of local farmer organizations, and sensitivity, mobilization and awareness of HMB social actors.

Selection of PRODHAM activity areas was based on a participatory diagnosis made in 1999. The four selected areas included the hydrographic microbasins of Cangati river in the municipality of Canindé; Batoque River in the municipality of Paramoti; Pesqueiro River in the municipality of Aratuba; and Salgado/Oiticica Rivers in the municipalities of Pacoti and Palmácia.

This way, it is intended to achieve the best evaluation of works carried out and make future adjustments aimed at a far-reaching diffusion of tested methodologies adapted to different areas of Ceará semiarid region. This results in the need of making a participatory socioeconomic monitoring of PRODHAM actions.

Because of the experimental aspect and consequent generation of scientific contributions and results for a comprehensive diffusion of tested methodologies and practices adapted to different areas of Ceará semiarid region, the Secretariat of Water Resources (SRH/CE), responsible for PRODHAM, implanted in 2004 the Project monitoring consisting of the implantation of a socioeconomic monitoring system in Cangati River hydrographic microbasin in Canindé-CE.

The monitoring system started with the preparation of baseline diagnosis named "Global Socioeconomic Analysis of Cangati River Hydrographic Microbasin in Canindé-CE."

That diagnosis included a thorough survey of the initial conditions of all families/producers living in Cangati River hydrographic microbasin (HMB), followed by a systematic, participatory monitoring using socioeconomic indicators and evaluation of five focal groups that gave the project more accurate results that are consistent with the local reality and benefited communities' expectations.

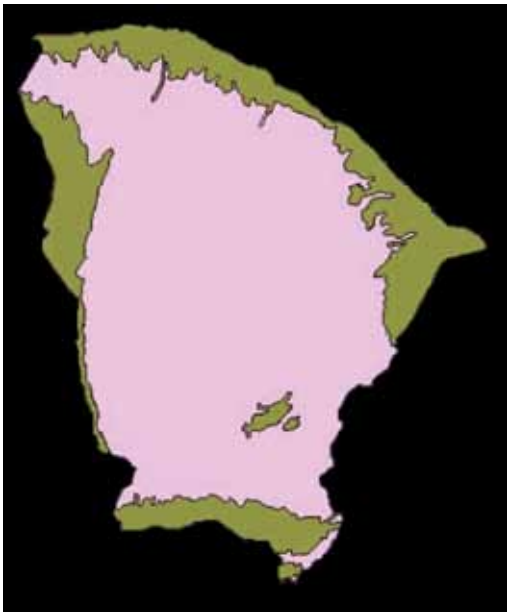
During the monitoring and evaluation works, periodic balances of activities performed and respective products were scheduled through the issuance of Bi-monthly Interim Reports (BIR), Semi-annual Interim Reports (SIR), Annual Evaluation Report and Final Evaluation Report.

This book incorporates the contents of the Final Evaluation Report in addition to other results generated over PRODHAM implantation. This report provided, therefore, the analysis of project implantation and performance, as well as suggestions for its total or partial replication in other hydrographic basins in Northeastern Brazil semiarid regions, especially in Ceará.

2 Rationale in Light of Semiarid Region Problems

2. RATIONALE IN LIGHT OF SEMIARID REGION PROBLEMS

The State of Ceará covers a surface area of 148,016 km^2, populated by some 8.55 million inhabitants, according to estimates by the Brazilian Geography and Statistics Institute (IBGE) for 2009, more than 70% of which live in urban areas, corresponding to a demographic density of 57.7 inhabitants/km^2, which promotes a great anthropic pressure on the environment. In that same area, the combination of irregular precipitation regime with a high predominance of crystalline soils occupying some 75% of the State surface area (Map 1) determines that all its rivers are intermittent and may dry up in low precipitation years; in normal years, such rivers flow only during the rainy season.



Map 1 – The State of Ceará and its Geological Configuration. Crystalline Soils are In Central Area, while Sediments (State Edges) are in all Other Areas

Source: SRH-CE/Infrastructure Coordination Unit (COINF).

Therefore, the water management model developed for the State, which is the best structured model among all Brazilian states and is a leading model in the sector at international level, derived from both a long process of fight

against droughts and an outstanding learning and political dispute process. The innovating proactive behavior at the implementation of water resource management policies is probably explained by Ceará people's need of surviving to nature adversities.

In addition to the need of overcoming the water shortage and deficient distribution, other factors have contributed to this process, among which the following stand out:

a) interventions by the Federal Government through the National Department for Drought Relief Works (DNOCS) constituted a significant baseline, combined with DNOCS location in Fortaleza, which allowed the formation of an important technical staff specialized in water resources;

b) political dissentions, political-institutional reforms started in 1987, and political-administrative continuity in Ceará, in the period from 1987 through 1999;

c) introduction of a scientific-technological mindset and a most effective involvement of government's professionals with expertise in that area;

d) institutional-financial support from international institutions to consolidation of model under construction.

As stated by Teixeira (2004), water resource policy in place covers two different stages delimitated by the establishment of the Secretariat of Water Resources in 1987: the first stage (before 1987), where there was no specific institutional instrument for the water resource sector at State level or a planned and structured involvement in that area, and activities were restricted to the construction of small wells and small reservoirs without any technical criteria. Such conditions did not contribute to reduce the State vulnerability to droughts. In that period, interventions implemented according to technical criteria and some planning tools were carried out by DNOCS.

During the second stage (after 1987), the Government of the State of

Ceará started to act more actively to establish technical, legal and institutional instruments for a new water resource policy in the State.

In December 1987, the Superintendence of Hydraulic Works (SOHIDRA) was crated by Law no. 11,380 to replace the Superintendence of Works of the State of Ceará (SOEC). This body was created to counteract the initial SRH "irrigation bias". In that same year and under the same reform, Fundação Cearense de Meteorologia (FUNCEME) started to report to the Secretariat of Water Resources (SRH), the main challenge of which was to address the water resource problems in the State, by playing an outstanding role in the task of measuring and storing information on water supplies and reservoir volumes. Today, FUNCEME is part of the Secretariat of Science, Technology and Higher Education (SECITECE).

This way, between 1988 and 1991, the State Water Resource Plan (PLANERH) was formulated, which supported the preparation of programs aimed to expand the water infrastructure and implement management models, such as the Urban Development and Water Resource Management Project (PROURB-RH), the Sustainable Water Resource Development Subprogram for Brazilian Semiarid Region (PROÁGUA/Semiárido), and Ceará Integrated Water Resource Management Project (PROGERIRH). The important role played by Áridas Project[1] should also be highlighted, which was implanted in 1993-1995 according to the strategy that gave priority to concerns with development sustainability.

For the first time ever, the planning process incorporated the sustainability concept recommended by both the International Commission on Irrigation and Drainage (ICID-92) and Rio de Janeiro Conference (ECO 92), and expanded that concept from environmental to global, where economic, social and political aspects played a critical role In that new scenario, development would be sustainable as long as it showed durability conditions over the time. For that,

1 - ÁRIDAS Project was a joint effort of Federal and State Governments and Non-Governmental Entities committed to sustainable development objectives in Northeastern Brazil. It aimed to formulate sustainable development strategies for Northeastern Brazil, based on sustainable natural resource use, social, economic and political criteria.

it should be economically healthy, socially fair, environmentally responsible, and politically based on the population's participation.

As such, the concept incorporated by public programs and policies in the State of Ceará also incorporated the long-term view required for identification of immediate and future priorities under a planning effort to overcome or achieve a sustainable coexistence with climate problems in Ceará.

The most innovative and necessary perception was the incorporation of guidelines for decentralization and population's participation to public policy planning concept, the practice of which would require a new role for the government and the determination of social participation mechanisms at all levels (BRAZIL, MPO, 1995). t is clear, therefore, the need of taking both infrastructural and social, economic and cultural actions.

This way, ahead of the Federal Government, the Government of the State of Ceará established the Secretariat of Water Resources in 1987 and enacted the Law No. 111.996/1993, which provided for the State Water Resource Policy and created the Integrated Water Resource Management System. In the following year, Companhia de Gestão dos Recursos Hídricos (Water Resource Management Company) - COGERH was established to promote water resource management in the State's territory.

As mentioned by Lobato (2004), Ceará model has allowed the State to neutralize eventual restrictions (competitive disadvantages) derived from uncertainties related to water supplies.

An other important aspect in the State of Ceará is the incentive and support to the creation of Hydrographic Basin Committees, which are collegiate bodies composed of representatives of the Federal, State and Municipal governments, water users, and civil society.

The composition of basin committees responsible for the management of water in a particular basin is a way to make each participant control its own actions, prevent others' illegal actions, and strengthen the controlling entities' actions for the welfare of the hydrographic basin stakeholders.

The phenomenon at issue may be observed from the view of interrelations between the hydraulic development and the construction of citizenship in social change scenario. This way, democratization and environmental protection in Ceará seem to converge and fee themselves in the new paradigms and challenges as "studies of the environment, more specifically water are understood as a population's analytic tool: how decisions on water management are made, and the controlled water systems provide much information on democracy stages and health" (Grigg, 1998).

Therefore, from the simple construction of water infrastructure works, SRH shifted to the development of complementary programs and projects, without which both the durability of works and the quality and quantity of stored water resources would be serious endangered. This way, PRODHAM emerged in that holistic scenario established by legal aspects, policies and programs of the State of Ceará focused on the sustainable management of water resources and brushwood ecosystem.

Photo 1 - Aspect of Semiarid Region during Dry Period and Rainy Season
Source: PRODHAM.

PRODHAM Characterization 3

3. PRODHAM CHARACTERIZATION

3.1. The Project

The Hydroenvironmental Development project (PRODHAM) constituted a pilot project that developed innovative ways to promote water and geoenvironmental resource sustainability in rural communities of the State. It also aimed to contribute to mitigating the social and economic drought impacts and correct the environmental degradation process resulting from the combination of cyclic dry periods and a strong anthropic pressure, especially in hydrographic basin springs. (CEARÁ, 2008).

Designed, implanted and evaluated by the Secretariat of Water Resources of the State of Ceará (SRH-CE) in partnership with SOHIDRA and FUNCEME, PRODHAM created hydroenvironmental mechanisms favorable to the recovery of selected hydrographic basins where natural resources are quite scarce and climate conditions are characteristic of Northeastern semiarid region.

PRODHAM developed articulated and sustainable environmental resource recovery and preservation and socioeconomic development actions in rural communities located in the semiarid area of four selected hydrographic microbasins where the environmental degradation rate was high.

- Selection of project areas followed the following criteria:
- natural resource degradation rate;
- concentration of micro and small rural producers in HMB;
- areas provided with fourth-class watercourses;
- good community association organization level;
- great number of resident families;
- high number of reclaimed areas/rural resettlements;
- municipal government's interest in establishing partnerships to implement environmental recovery actions;

- consent by the hydrographic basin committee.

Among the most outstanding project characteristics its proposal of participatory work involving the pilot-area populations and other stakeholders (municipalities, community associations, non-governmental organizations (NGOs), schools, State Government's agencies, women groups, etc.) stands out, which allowed everybody to feel jointly responsible and participant of the socioenvironmental and economic recovery process targeted by the project.

Benefited public included association entities, rural producers and selected hydrographic microbasin populations. The project included the following components:

a) Implantation of water works and conservational practices

Replacement of ciliary vegetation on watercourse margins, reforestation of river springs and reclamation of degraded areas in river springs upstream to reservoirs.

Construction of natural moisture / sediment accumulation mechanisms for soil preservation and recovery and water erosion control: successive dams for sediment contention, underground dams, terraces and contour line stone barriers, dead cover, contour-line cultivation of alternated crops, control of surface runoff upstream to reservoirs and hydrographic basin rivers.

Increased water availability through the construction of multiuse reservoirs (rain cisterns, piezometric wells) and adoption of other mitigatory actions to control desertification, such as, for example, controlled deforestation and ground clearing by fire.

b) Environmental education

Capacity building of rural producers in conservational techniques and construction of small water works.

Control of water resource polluting agents and rational use of surface water and groundwater at springs.

Prevention of mining activities on riverbeds.

Engagement of teachers of municipal schools in activities to disclose the importance of natural resource maintenance and preservation in Northeastern semiarid region.

c) Organizational strengthening

Support to association development (organization, transparency, autonomy, operation capacity, etc.).

Incentive to social inclusion in association movement (especially women and youngsters).

Participation of several rural social actors in planning and relevant public policies, and their engagement in Hydrographic Basin Committees.

Implantation of PRODHAM integrated, participatory management system, the Management Board.

d) Development of production systems

Development and test of alternative production systems that are more consistent with the preservation of biophysical environmental and improvement of income and life quality or rural families, such as, apiculture exploration, workmanship, and implantation of small factories (brooms made of recycled *pets*).

e) Participatory monitoring

Monitoring of activity program and project interventions.

Follow-up, evaluation and documentation of socioeconomic and biophysical changes resulting from project implantation.

Periodical evaluation of biophysical and anthropic changes resulting from Project.

3.2. Selected Hydrographic Basins

Selection of areas was based on a participatory diagnosis made in 1999. The four selected areas includes the hydrographic microbasins of Cangati river in the municipality of Canindé; Batoque River in the municipality of Paramoti; Pesqueiro River in the municipality of Aratuba; and Salgado/Oiticica Rivers in the municipalities of Pacoti and Palmácia. Their characteristics include:

a) Cangati River Hydrographic Microbasin

- Hydrographic Microbasin: Metropolitan
- Municipality: Canindé / CE
- Location: District of Iguaçu
- Number of communities: 5
- Number of families living in the microbasin: 213
- Number of Associations: 5

Photo 2 - Air View of Iguaçu Community in Canindé-CE
Source: PRODHAM.

b) Pesqueiro River Hydrographic Microbasin

- Hydrographic basin: Metropolitan
- Municipality: Aratuba / CE
- Location: upstream to Pesqueiro reservoir
- Number of communities: 66
- Number of families living in the microbasin: 441
- Number of Associations: 9

c) Batoque River hydrographic microbasin

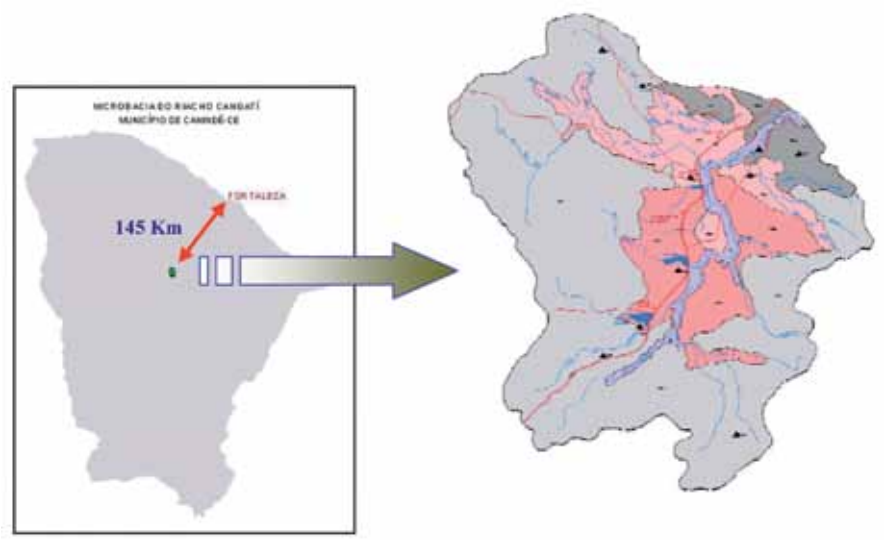
- Hydrographic basin: Curu
- Municipality: Paramoti / CE
- Location: upstream to Pereira de Miranda reservoir
- Number of communities: 16 communities
- Number of families living in the microbasin: 297
- Number of Associations: 11

d) Salgado and Oiticica River hydrographic basin

- Hydrographic basin: Metropolitan
- Municipalities: Palmácia and Pacoti / CE
- Location: upstream to Acarape do Meio reservoir
- Number of communities: 17 communities
- Number of families living in the microbasin: 1205
- Number of Associations: 17

Diagnosis or baseline called "Global Socioeconomic Analysis of Hydrographic Basin" was determined for all selected hydrographic microbasins. However, socioeconomic monitoring and evaluation were performed only in Cangati River hydrographic microbasin, as it was selected to be the pilot microbasin in the Project. Accordingly, it was in that HMB where PRODHAM actions were given a higher priority, intensified and systematically evaluated, providing a substantial documentation of "underway" evaluation. Because of such characteristics, evaluations and suggestions included in this book refer essentially to works developed in Cangati River HMB, in the district of Iguaçu, Canindé-CE. Site maps of that microbasin are shown below. (Maps 2 & 3).

Map 2 – Location of the Municipality of Canindé-Ceará-Brazil
Source: available at: http://pt.wikipedia.org/wiki/Ficheiro:Ceara_Municip_Caninde.svg.



Map 3 – Map of Cangati River HMB in Canindé-CE and its location in relation to Fortaleza
Source: Fundação Cearense de Meteorologia (FUNCEME).

3.3. Socioeconomic Profile of Cangati River Hydrographic Microbasin

3.3.1. Population

Diagnosis, or baseline, of Cangati River HMB indicates that the population had a population of 871 inhabitants distributed over 213 families. Average number of family members was 4.09. Microbasin surface area is 75.65 km^2, corresponding to a demographic density of 11.51 inhabitants per km^2.

There was a slight predominance of male inhabitants (50.86%) over female inhabitants (49.14%).

Most of population was in the age range of 7-15 years old (25.72%). There was an equilibrium in HMB population percentage at age ranges of 0-6, 16-21, 22-30, 31-40, and 51-65 years old, with a variation of 11-13%.. Age range with the lowest percentage of inhabitants was that of 66-70 years old (2.18%). Age ranges of 41-50 and 70+ years old accounted for 8.27% and 4.25% of population, respectively.

Most heads of family were in the age range of 30-59 years old. It was observed that most of them were men, but there are a significant number of families headed by women (13.62%). Such female heads of family were widows with or without children, unmarried mothers, women with children and partners, and women with spouses engaged in temporary migration.

Of total population, 26.64% were illiterate. That percentage was reduced to 15.31% when the age range of 0-6 years old was disregarded. Functional illiterates accounted for 5.86% of total population, being 4.85% in the male gender, and 6.95% in the female gender.

Percentage of individuals that completed elementary school or other literacy courses was 9.30% of total population. That accounted for 9.03% of all men and 9.59% of all women in HMB.

It should be pointed out that individuals that started but did not complete basis school represent a higher number accounting for 43.05% of total population. That percentage represented 40.97% of total number of males, and 45.32% of total number of females

Individuals that completed basic school accounted for 2.99% of total population. That percentage included 3.96% of men and 1.92% of women.

The expressive percent difference between population classified as "individual that completed basic school" and "individual that started but did not complete basic school" should be highlighted. It can be concluded that a high number of people start but do not complete basic school.

By analyzing the schooling level of heads of families, it was noted that 40.85% of total HMB inhabitants were illiterate. Functional illiterate heads of family represented a lower percentage of 10.33%; those who completed elementary school or other literacy courses accounted for 18.78%; those who started but did not complete basic school accounted for 22.54%; heads of family who completed basic school accounted for 0.47%; those who started but did

not complete high school accounted for 1.88%; and those who complete high school accounted for 4.69%. Heads of family who started but did not complete middle school accounted for 0.47%. No heads of family who completed higher education were identified in the HMB.

3.3.2. Social infrastructure

Most families live in masonry houses (81.43%). Other types of houses included mud house (16.67%) and improved mud house (1.90%).

In general, dwellings have more than one water supply source. Such sources were grouped into cisterns, water holes and wells used by 83.57% of families; reservoirs and clay pits by 57.75%, collective systems (piped water) supplied by Companhia de Água e Esgoto do Ceará (CAGECE) and the Municipal Government accounted for 52.11%. other infrequently used sources included desalinator, individual piping system, and tank trunk, which were together used by 2.35% of families.

Sewerage was quite deficient in most dwellings. In 53.52%, sewage was disposed on ground surface; 51.64% had not toilet in the bathroom; and 31.92% had no bathroom.

Domestic waste destination was still a concern, as 24.64% of families disposed waste on vegetation or on the margins of BR-020 road. Most common practice was burning, adopted by 64.93% of families.

As means of transportation, families used especially bicycles (69.01%), tamed animals (45.07%) and motorcycles (8.92%). Other means of transportation that were little used include: motor car, load cart or light cart, and truck.

3.3.3. Farming production

Main use of landed-estate soil was agriculture, mentioned by 89.20% of properties; 23.00% use soil for pasture; 3.75% for forests or reforestation; and 28.17% of properties have fallow land.

Main products of agricultural production in Cangati River HMB included maize and beans mostly explored in integrated plantations, although some single crops were identified at a lower level. Such crops as broad beans, rice and cotton also occur, although their yields are low. Yields are very low, due to the lack and poor distribution of rains and inadequate crop management.

Total amount of production, based on the average price of sold products, was R$ 77,422.97 in 2004. R$ 20,825.00 of that amount (26.90%) correspond to the portion of production sold.

Livestock production was significant and comprised apiculture, fowls, bovine, ovine, equine and porcine cattle. Portion of production sold generated an income of R$ 33,244.40. Main product sold was mil, accounting for 31.89%; followed by swine (19.93%); beef (18.80%); eggs (11.68%); honey (7.60%); chicken (5.50%); goats (4.01%), and sheep (only 0.60%.

In addition to agriculture and livestock, Cangati River HMB dwellers perform extractive activities to obtain recipes. Extractive activities included coal production, manufacture of barbecue spits, and fishing. Such activities generated an annual income of some R$ 26,000.00.

3.3.4. Economic infrastructure and production technology

Infrastructure was divided into two segments, as follows: aquifers and accessions. Aquifer infrastructure comprise a household clay pit, water hole (piezometric well), cisterns (rain cisterns) and artesian wells, and accessions comprised sheep pens, warehouses, flour houses, pigsties and stable/corral.

Water resource infrastructure comprising household clay-pit, water hole, artesian well and rain cisterns included 111 units distributed over the communities.

Economic accessions existing in HMB rural properties amounted to only 21 units, comprising sheep pens, warehouses, flour houses, pigsties and stables.

Pens were most representative, accounting for 38.10% of total accessions. They were followed by pigsties (28.57%), stables (19.05%), flour houses (9.52%), and warehouses (only 4.76%).

With respect to agricultural equipment used in Cangati River HMB, there were 29 pieces of equipment, including tractor hire (hours/year) and animal-powered cultivator.

In terms of number of carpentry and civil construction tools, agricultural appliances, and other instruments, the most significant of them included hoes, scythes, axes, animal-powered equipment, handcarts and mattocks, to mention only those appliances exceeding 50 units.

With respect to state-of-the-art equipment, it was noted that some producers used tractor, irrigation conduits, forage machines and sprinklers.

Agricultural defensives, veterinary products and general seeds were used. Use of selected seeds by most producers was supported by the State Government. In spite of selected seeds, yield was very law because of soil degradation level, precipitation regime and farmers' cultural and income level.

With respect to rural financing, it was noted in Cangati River HMB that producers resort to the following sources: several facilities granted by the national Family Agriculture Strengthening Program (PRONAF), self-financing, financing from governmental projects (São José and other projects), and other forms of bank and informal credit.

3.3.5. Existing community associations

There were five associations in the microbasin, one in each community, namely: Association of Small Producers of São Luiz Farm, Association of Small producers of Iguaçu, Association of Settlers of Lages Settlement, Association of Small Producers of Barra Nova, and Association of Small Producers of Cacimba de Baixo. Four of them were at full operation, while the other, although duly

organized, was still pending of the issuance of registration with the Corporate Taxpayer Registry (CNPJ). Today, all such five associations are at full operation. All of them were composed of small producers and involved 265 members from 221 families, where 57.58% were heads of family, 32.95% were spouses, 7.95% were children, and the remaining 1.52% included stepchildren, brothers in law and uncles. As there are a total of 213 families in the microbasin, some families have members in more than one association entity.

It was also noted that all associations derived from local leaderships, except for Barra Nova association, which had a collective status and included the presence of a female leadership. This fact exalts the participation of Northeastern women in the effort to improve life conditions in Iguaçu district located in Cangati River HMB.

Objectives for creating associations were multiple, what can be considered a positive principle, as they led to the development of efforts in several demand fields in Cangati River HMB.

This way, objectives of all five associations, as mentioned in surveys, included: access to governmental programs, means to obtain financial funds, community improvement (sickness and maternity benefits, and retirement), seeds for plantation, and representation to public bodies.

All of them were focused on assistance to small farmers, most of which work in agricultural production, although cattle-raising activity is also important. It was also noted that many activities that were typical of urban-rural sector were performed in the communities.

Historically, the oldest of such communities is Cacimba de Baixo, which was born in 1982, that is, 22 years ago. However, its foundation was only made official in 1996.

Most frequent types of support came from São José Project of the State Government, in benefit of São Luiz, Iguaçu, Lages and Cacimba de Baixo

associations, including the following actions and objectives:

- electric power supply for São Luiz community houses;
- water supply infrastructure in Iguaçu district;
- electric power supply for 22 houses in Lages community;
- water supply system in Cacimba de Baixo community.

Empresa de Assistência Técnica e Extensão Rural do Ceará (EMATER-CE) also supported Iguaçu Association through an agricultural project for the purchase of equipment and agricultural plantation benefiting 18 families.

Another project (Canindé Project) supported Iguaçu association for cotton plantation. Iguaçu association was also supported by the Government of the State of Ceará for the development of an electric power infrastructure development.

Cacimba de Baixo association benefited of SOHIDRA-CE Project, with the installation of a water desalinator in a deep well.

4 PRODHAM as a Pilot-Project

4. PRODHAM AS A PILOT-PROJECT

4.1. Objectives

General PRODHAM objective is:

> to contribute to developing a practical approach for the involvement of local community, by implementing sustainable solutions that will help to promote the better soil and vegetation management in hydrographic basins located downstream of water works constructed in the State of Ceará, by enhancing water preservation, minimizing erosion, and maximizing the natural water storage mechanisms with the primary objective of improving the subsistence of inhabitants of those areas (CEARÁ, 2008).

Specific objectives in turn include:

a) in hydroenvironmental infrastructure area:

- to reduce the soil erosion processes by improving the natural water retention and preservation conditions, recovering and expanding biodiversity and water availability in selected hydrographic microbasins;
- to construct a hydroenvironmental infrastructure and natural water storage network (underground dams, successive dams for sediment retention, contour stone barriers and terraces, etc.);
- to implant water catchment, storage and ration use systems (well, cisterns, etc.);
- to install units for demonstration of conservational soil and vegetation protection practices.

b) In production systems:

- to implant an agrosilvopastoral system to maximize the opportunities of sustainable local resource use by using family agricultural workforce and adopting sustainable agricultural practices from environmental and economic perspectives;

- to modernize the current production system (subsistence) by adopting contour line practices, dead cover, crop alternation, ground fire control, terraces, stone barriers, , etc;

- to implement a technical and organizational qualification program in all four HMBs for the large-scale adoption of integrated production models tested and adapted to local conditions of each HMB, especially in rural activities for family subsistence;

- to inform the rural producers the technical, environmental and socioeconomic advantages of production systems that are most adequate to their reality;

- to sensitize and quality local producers to develop strategies and small family and associative/community initiatives for storage, processing and sale of their excess marketable rural production.

c) in environmental education:

- to make the resident population aware, informed and education with respect to environmental issues that are more related to HMB reality, and develop small community initiatives in this sense;

- to make global socioenvironmental diagnoses (status of natural resources, population's practices and habits impacting the environment), as well as physical-environmental diagnoses (forests, fauna, water, soil erosion, waste, etc.) in each HMB;

- to disclose the results of environmental or physical sector-related diagnoses of sensitization and environmental education of HMB associations, schools and general population;

- to establish actions for mobilization and capacity building of association human resources to plan small community socioenvironmental and production initiatives (reforestation, waste recycling, changes of inadequate agricultural practices, adoption of adequate technologies, etc.) proposed by integrated plans, including those supported by financial resources, formulated under PRODHAM jointly with managing associations.

d) In community development:

- to provide local consolidated association entities with leaderships and skills human resources (management, design and implantation of projects, etc.) able to develop small joint and articulated community rural development initiatives;

- to support the improvement of association performance (internal democracy, leadership selection, etc.), including incentive for the adoption of strategies for social inclusion (gender balance, youngsters' participation, etc.), rendering of accounts, consultation and information among members;

- to establish partnerships among several HMB associations to perform joint activities and encourage the creation of local forums for discussions and experience exchange, and the creation of jointly managed revolving funds;

- to support the organization of HMB dweller/producer association, including the capacity building of their members for use and maintenance of implanted hydroenvironmental infrastructures.

e) In participatory monitoring:

- to adopt a system to monitor and evaluate the biophysical (of hydroenvironmental infrastructure network) and socioeconomic aspects of Project only in Cangati River HMB, based on a participatory focus;
- preparation of physical-environmental diagnoses in HMB covered by the Project.

f) Dissemination of Project experience:

- Publication of technical books on experience and topic related to PRODHAM;
- Availability of Project Technical-Operational Manual in a physical medium and in the Internet;
- Publication of 11 textbooks on hydroenvironmental technologies and practices;
- Creation and maintenance of PRODHAM gateway;
- Availability of videos about the Project;
- Availability of databases of field surveys performed.

4.2. Participatory Methodology Adopted

The core strategy for all PRODHAM actions was the hydrographic microbasin (HMB), because it a natural landscape where rainwater converge to the same place: river, stream or reservoir.

HMB, as a rural space planning and monitoring unit, has been adopted by other projects similar to PRODHAM, like Paraná Project, where they adopt the hydrographic microbasin as a practical alternative that produces results

that are more consistent with the vision of an integrated and unique world. Combination of efforts among the population, community and governmental sectors has been the basic requirement for expected benefits of a sustainable development project to be achieved.

This way, promoting actions for integrated, sustainable rural development where having the hydrographic microbasin as the planning unit, and the producer organization as the action strategy is the best work process to obtain gains of productivity and use of adequate technologies from environmental, economic and social standpoint.

In short, the methodology adopted by PRODHAM included the effective participation of involved populations and assimilation of news forms of procedures that allowed those populations to fully feel co-authors of environmental recovery processes. That also leads to the development of a work focused on awareness of populations and agents involved in Project operation areas, with respect to their permanent responsibility for preservation and multiplication of that hydroenvironmental recovery and preservation experience

4.2.1. Participation of target public

The objective of preparation of proposal of joint work with communities aimed to ensure an effective participation of social actors in project planning and management, and a greater transparency of actions and application of funds.

A work system was developed, where leaderships and representatives of several communities became aware of the scope of Project, the importance of creation of discussion forums for the project and other activities occurring in the area, in addition to the importance of electing representatives that were committed to the community development and the participatory management process.

To ensure the correct application of funds allocated by the State to local managing associations, capacity building of all leaderships in basic accounting took place, which allowed the selection of "community accountants" that are today responsible for the whole management of agreements signed with associations. That action led to the accreditation of associations with bank institutions and governmental program managing bodies.

To provide the community with information, a socioenvironmental and economic diagnosis of communities was performed, which served as a basis for the formulation of Integrated Hydrographic Microbasin Plans.

With the objective of further strengthening that joint management action, training and activity monitoring were performed in several community associations, the main objective of which was to support their internal organization and provide them with instruments for a transparent and comprehensive operation.

In close partnership with Municipal Secretariats of Education, a literacy program was implemented for all adults involved in Project activities, to enable both knowledge democratization and social inclusion process.

Aiming to increase the self-esteem of communities located in the area, strengthen their entrepreneurial spirits, and redeem local cultural identity, the Project supported the formation of cultural groups.

Discussion on interrelationship between environmental degradation, poverty and socioeconomic development led PRODHAM to formulate an intervention proposal aimed to encourage the population to adopt environmental practices consistent with the environment where they live.

Photo 3 – Aspect of Event of Involvement of Women in PRODHAM Strategic Discussions. Source: PRODHAM.

Simple reforestation actions in urban areas and ciliary forest, selective waste collection, composting, adequate handling and use of water resources available for human consumption (cisterns, wells, etc.), domestic animal management, change of inadequate agricultural practices, and adoption clean technologies, among others, were encouraged.

Operation took place in communities and households with the assistance of municipal school teachers and environmental guards, which acted on risk factors to which the population is subject, by giving priority to family and establishing ties between the community and the Government. A substantial improvement of environment conditions monitoring was immediately sought, especially with respect to domestic waste issues, to reduce significantly the pollution of water resources and the impairment of drinking water supply.

4.2.2. Monitoring and evaluation

From the methodological standpoint, it was sought to provide the

monitoring and evaluation system with participatory operational methods integrating especially the local actors' views and opinions to the definition of information indicators and/or parameters, or trying to engage them as much as possible in the process of collection/measurement/qualification of a significant part of information, especially those of qualitative aspect or relatively more sophisticated measurement.

That was equally sought at the option of an instrumental apparatus designed to interact the Project technical staff with the local actors and facilitate their participation in the operation of the work monitoring and evaluation system in Cangati River HMB.

In that context, five focal thematic discussion groups were established with the objective of collecting qualitative information and validating the sampled survey results. The other form of primary data collection consisted of collection/measurement based on a systematic sampling (end of winter and end of summer) of the universe of HMB families.

4.2.3. Indicators of project results

Setting result indicators is the backbone of any monitoring and evaluation system. This way, the identification or selection of indicators for a particular action is delicate and required a judicious evaluation to allow the system to work properly, especially when it is known that there are a number of possibilities, as each objective may be measured on the basis of different indicators. To make that selection, some criteria cam be applied, especially to know whether the indicator will allow the measurement of what is effectively required to be measured (validity, relevance, objectivity, etc.), estimate the readiness of its use (simplicity, easy handling, etc.), or estimate a good cost-benefit ratio derived from its adoption.

Results Obtained and Replication Suggestions

5

5. RESULTS OBTAINED AND REPLICATION SUGGESTIONS

5.1 Successive Dams for Sediment Retention

a) Expectations of component effects

According to Engineer José Artur Padilha, creator of Zero-Base dams (successive dams), such dams

> have the shape of lying, sloped Roman arches appearing in a plan view like last quarter or first quarter moons. They operate in a convex-concave geographic disposition in river spring-mouth direction. They work, therefore, pressed by the water runoff power. [...] Such works have a sustainable structure because, by having a designed format and constructive organization, they work under pure compression strengths. This type of strength induces the structural consolidation by compressing the stone blocks against one another and the whole work against the larger supporting blocks located at their ends. (PADILHA, 1997).

With respect to such successive dams for sediment retention, Padilha (1997) adds:

> they also promote a gradually improved operation of dams, by "cementing" their interblock gaps by small debris equally compressed by the same strengths. Such small works [...] constitute very simple, low-cost structures.

From physical view, successive dams have a void-filling effect on water-borne sediments that basically comprise mineral material and organic matter.

Sediment deposit gives rise to layers that are initially composed of organic matter and subsequently of mineral material of several granulations, building an inverted-alluvium soil profile. Over the years, all material becomes mineralized like a normal soil profile. Watercourse channels are filled by several

layers to build terraces that, because of their moisture and mineral composition, promote biodiversity composition.

Sequence of successive dams and progressive terracing allows the real possibility of resurgence of micro and meso flora and fauna. Over the years, if we could have an air view of a microbasin provided with successive dams, its image would resemble a dry leaf with several green veins cause by moisture. In Cangati River microbasin the appearance of water springs is noted, while in the most humid microbasin (Pesqueiro River Microbasin in Aratuba), small streamlets that existed in the far past reappeared as a result of successive dams constructed under the Project.

Photo 4 – Air view of a Series of Dams and Surrounding Stone Barriers in Dry Period (Summer), in a HMB assisted by PRODHAM
Source: PRODHAM.

b) Socioeconomic and environmental effects of this component

In a relatively short period and at a low cost, successive dams can generate several possibilities of economic exploration of areas that were idle in light of the high erosion level of hydraulic basins of their watercourses. Sedimentation, depending on the area where the microbasin is located, creates humid terraces that allow economic exploration, including the extension of agricultural

exploration period, irrespective of precipitation occurrence. This is a great advantage for semiarid regions with restricted tillable soil availability.

In Cangati River HMB dams, in Canindé, several explorations took place, the results of which are encouraging. In addition annual crops, such as maize and beans, papaya, watermelon, tubercles and rice were cultivated.

However, the major limitations to a more intensive use of successive dams are related to land tenure structure, as most agricultural properties located in Ceará semiarid region either are very small, where the adoption of hydroenvironmental practices are unfeasible, or have an adequate size but their owners are not interested in such innovations because of related costs, absenteeism or indifference. This reality makes the adoption of successive dams more expensive, due to the need of involving several properties having common interests in a community hydroenvironmental development project in the HMB.

It is inadmissible that an individual owning a land of approximately 150 ha is considered a great producer; however, in Cangati River microbasin, because of population concentration, there is a large segment of landless families whose living is based on transfers and small routine jobs or workforce sale. Even in such small areas there is some absenteeism, most of them are not cultivated or are cultivated under a partnership regime.

Landless farmers believe that production would be better if they worked in successive dams, which are not properly explored because landowners to not allow their use. According to local actors, another factor responsible for the little use of successive dams was rain shortage in 2005, 2007 and 2010.

With respect to environmental issues, in all four assisted microbasins soils have a pre-Cambrian origin, the main characteristic of which is the small depth, that is, they are mostly shallow soils with a softly undulated to undulated relief and often full of stones. Over the years, such soils have been explored like European soils, through deforestation and exposure to sun and rains, and

mostly covered by plantations that favored floods, thus generating serious consequences for the maintenance of their surface layers that allow agricultural production and microorganism life development.

In equatorial zone where the State of Ceará is located, precipitation regime is characterized by scarce or heavy rains and high insolation. Such characteristics make current agricultural and cattle-raising exploration inadequate, and make such natural resources very fragile and degraded. To reverse that picture, adopting hydroenvironmental development projects and sustainable exploration systems is necessary. PRODHAM is, however, an effort toward finding of ways and alternatives to reverse the degradation stage referred to above.

PRODHAM action involving the successive dams allowed the recovery of part of Cangati River HMB, specifically in previously dry grottos, which are now recovered and humid. There were changes in soil structure, including a gradual productivity increase, reduced surface runoff and soil loss as a result of erosion reduction, reappearance of water sources and several flora and fauna species.

Photo 5 - Aspect of Sediment Retaining Dam and Agricultural Exploration Upstream to Dam.
Source: PRODHAM.

c) Major constraints and ways to overcome them

Major constraints found at the implantation of such technologies in PRODHAM coverage area included:

- need of capacity building of local community population for construction services. This is not necessarily a problem, but rather a step to achieve the target. This knowledge may be obtained from short training activities, but it will require a firm extended social commitment;
- successive stone dams were only implanted at high-scale after local technical studies;
- need of continuous constructive and complementary interventions after floods until full rock filling consolidation;
- man's incapacity to quickly perceive the benefits of structural action of successive dams;
- land tenure characterized by very small properties (less than 10 ha), what makes the adoption of hydroenvironmental works fully impracticable;
- absenteeism of owners of larger properties, which generated a lack of interest in constructing such dams.

d) Suggestions for successive dam replication in other microbasins in Ceará semiarid region

Given the most changed natural aspect of semiarid region caused by inadequate anthropic activities, which has contributed to adverse flood effects and serious consequences to soil structure and reduction of tillable surface layers, opting for the implantation of successive dams in semiarid region was a way to retain part of erosion-carried soils while promoting biodiversity revitalization and the greater productivity of agricultural explorations.

This technological option must be associated with the construction of stone barriers or terraces in tillable areas, as a way to retain part of sediments in soils and prevent greater damages. Successive dams, together with stone barriers and terraces, are highly necessary, as there will always be sediment carrying, although in small quantities, in soils used for agriculture.

5.2. Underground Dams

a) Expected effects of this component

Expected effects of this component are water storage in artificial aquifers to meet water needs in rural environment, especially for vegetal and animal consumption. Increased water in soil is sufficient to meet water needs of crops, thus enabling agricultural exploration by family farmers all over the year. Under such conditions, it promotes a significant increase of annual crop exploration, including grasses, tubercles and fruits in its hydrographic basin.

Photo 6 - Aspect of an Underground Dam under Construction
Source: PRODHAM.

Subsurface damming will allow water to accumulate between land intervals, prevent or substantially reduce evaporation by supplying water all over the year and providing conditions to agricultural and cattle-raising exploration.

Underground dams, because of their characteristics, have the following advantages:

- stored water does not cover tillable areas, thus allowing soil exploration;
- promote less water loss by evaporation and infiltration, as compared to surface dams;
- areas can be used for grain, fruit tree and grass plantation;
- stored water is filtered and therefore protected against pollution and contamination;
- there is risk of breaking through;
- in the event of serious water shortage, they can also be used for human consumption through the use of water stored in piezometric well.

b) Socioeconomic and environmental effect of this component

The major underground dam effect is the possibility of economic exploration. Upstream alluvial soil area may be occupied by several crops, as moisture is available for plantation all over the year. In Cangati River microbrasin area, the first underground dam was cultivated with elephant grass. This grass remains green all over the year and is available for animal feeding. In the underground dam, the plantation area is its actual hydrographic basin. Upon the transportation of solid particles by rainwater, this area will become silted up every year and create fertile soil layers favorable to agricultural exploration.

In the case of Cangati River microbasin, the great problem for economic

exploration of underground dams has been the fact that landowners in benefited areas are not interested in their economic exploration, either because they cannot afford it or have already other sources of income.

From environmental standpoint, rainwater flows to the dam hydrographic basin and slowly infiltrates into the soil, thus creating or raising the water table, which a practice that, in addition to storing water with low evaporation losses, will promote soil conservation by erosion reduction. This is today considered a great challenge to maintaining the physical, chemical and biological soil characteristics. It also promotes vegetation resurgence in alluvial areas and edges, as a result of increased moisture.

Even the fact of no economic exploration of underground dams in Cangati River hydrographic microbasin has provided ecological gains derived from the recovery of micro and meso fauna, as vegetation remains green all over the year.

c) Major constraints and ways to overcome them

- Need of skilled workers for their construction

  Like for successive dams, the construction of an underground dam requires training. This problem can also be solved by in-service training in work sites, including the involvement of landowners and rural workers from the community.

- Need of many workers for trench excavation or heavy machinery

  Trench excavation for blanket implantation requires a great number of workers, as it takes times to excavate and fill the trench after blanket implantation and well assembly. Very often, when machinery is available, such a backhoe, its use is more practical.

- Risk of accidents

  There is a risk of accident in trench excavation, as when the original

material (stone or gravel) is very deep, a deep trench should be excavated, which form very high walls with high landslide and work accident risks.

- High financial costs

  Costs of blanket to seal the soil vertically, trench excavation, rings for well assembly and some other implements make the underground construction cost high for the economic standard of Canindé families. The best way to overcome this problem is gathering together several small producers (work group) to construct a dam that benefit all of them. The landowner would be required to make a public donation to benefited community.

- The best construction site is not close to the beneficiary population

  Na underground dam cannot be constructed in any location. Some criteria must be followed, such as avoiding a very wide river mouth, as narrow ones are preferable because they do not require a great trench excavation; having a reasonable wide and an upstream alluvium to allow the accumulation of much water and a good economic exploration; and having an upstream hydrographic basin with good recharge capacity.

d) Suggestions for the component replication in other microbasins of Ceará semiarid region

Not all locations provided with a hydrographic network can benefit of underground dam construction. It is necessary that the hydrographic network of area to be explored is provided with a good alluvial area. Based on this criterion, this environmental practice should be disseminated in the semiarid region, because in all locations where they have been constructed water availability for population has been efficient, in addition to enabling their economic exploration at the landowner's option.

Photo 7 – Aspect of Economic Exploration in the Hydrographic Basin of an Underground Dam
Source: PRODHAM.

5.3. Surrounding Stone Barriers

a) Expected effects of this component

Effects of the construction of stone barriers on semiarid soils include the increased soil capacity for water accumulation and retention of sediments generated by erosion processes. Increase water availability in the soil give the crops conditions to withstand longer dry periods, what is crucial for semiarid region given the constant short summer seasons. Also, the increased soil moisture makes the crops to develop more quickly and become stronger, thus increasing their productivity. Sediment retention prevents the soil from losing surface layers, thus maintaining its physical-chemical characteristics that are critical for crops.

Photo 8 - Surrounding Stone Barriers
Source: PRODHAM.

b) Socioeconomic and environmental effect of this component

Upon the implantation of stone barriers, the soil becomes protected from the severe flood action. Soil remains retained within the stone barrier structure and water cannot flow easily, thus tending to infiltrate in stops formed by barriers. This promotes a more effective economic exploration of soil, thus reducing the risks inherent to agricultural subsistence activity.

Experiments by farmers in Cangati River microbasin point to an increase of up to 300% in maize and bean yield upon the adoption of stone barrier technique. Unfortunately, as most producers are not landowners and the initial use of stone barriers was followed by two years of scarce rains (Table 1), it was not possible to identify deeper changes in rural producers' income. It is known, however, that crop productivity increased, according to some producers' experiments.

Table 1 - Monthly Precipitation Recorded in Canindé Station-CE, 1998-2007

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
1998	122,7	37,2	61,0	13,0	2,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	236,1
1999	8,8	32,0	152,9	28,4	67,2	17,2	0,0	0,0	0,0	0,0	18,5	45,0	370,0
2000	124,4	120,9	122,3	154,5	38,5	56,0	45,5	59,2	0,0	0,0	0,0	9,2	730,5
2001	23,9	6,4	113,5	220,2	5,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	369,0
2002	224,1	19,6	91,5	153,6	70,8	13,2	15,6	0,0	0,0	0,0	0,0	0,0	588,4
2003	36,8	119,4	276,0	132,1	86,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	651,1
2004	331,5	196,0	126,1	26,1	49,6	16,7	0,0	0,0	0,0	0,0	0,0	12,9	758,9
2005	42,6	45,1	57,6	74,5	122,2	57,6	0,0	0,0	0,0	0,0	0,0	0,0	399,6
2006	0,0	110,6	307,1	199,7	118,4	91,1	8,6	1,6	0,0	0,0	0,0	0,0	837,1
2007	0,0	159,8	31,4	180,4	23,0	17,0	0,0	0,0	0,0	0,0	0,0	0,0	411,6

Source: FUNCEME

With respect to the effect on the environment, soil retention by stone barrier is visible. Local producers say that, when it rains, "waters make no noise any longer. In the past, they made a big noise. Everything is now held by stone barriers and successive dams."

c) Major constraints and ways to overcome them

- Need of skilled workers for their construction

Workers should be trained for their construction. Most producers that participated in stone barrier construction in Cangati River HMB were trained in service. They shortly managed to master the use of crowfoot and amazingly constructed the contour lines.

- Purchase of crowfoot required to lay out the contour lines

As mentioned previously, contour lines are drawn by crowfoot. This is a tool that is not available for sale in the market, but a good woodworker can guide its construction. The construction of several crowfeet will reduce their unit cost, making them affordable to the small producer.

- Need of many stones in the area

A great problem in the construction of stone barriers is the need of many

small Stones around the construction area. In the lack of stoned of adequate size, larger stones should be broken by a club, or stones should be removed from one place to another. The need of breaking larger stones requires the purchase of a club and a lever to displace stones. Very often, stones are buried and only a small part of them is exposed. In such a case, they should be unburied and then broken.

- Stone loader should be constructed

Stone loader is highly important to transport stones from one place to another. Local workers may construct it themselves. It is simple, rustic and easily handled equipment that requires only two men to transport rock material to the barrier site. As areas are normally large, the use of several loaders and several pairs of workers is necessary.

- Soil cannot be very shallow

Soil should not be very shallow, because during the stone barrier construction a 15-cm deep excavation is made and stones are placed ones on the others on the heaped soil above that excavation, so that alignment is perfect, to cover the whole contour line.

d) Suggestions for component replication in other microbasins in Ceará semiarid region

For the whole area located in semiarid region, where cultivation has been or are being carried out, stone barriers are recommended as a way to preserve the soil and maintain its fertility. It is essential that this technology is disseminated all over the semiarid region. Its replication is easy and only depends on the acquisition of crowfeet to draw the contour lines.

Photo 9 - Detail of a Surrounding Stone Barrier in Pacoti-CE
Source: PRODHAM.

5.4. Contour Line Cultivation

a) Expected effects of this component

Expected component effect is to prevent floods from flowing down the hill. Northeastern farmers have the habit of cultivating down the Hill, making the soil become more susceptible to floods. In Cangati River microbasin, contour line cultivation recommendation was absorbed by most producers. However, it is still possible to find cultivations that fail to apply that technique. Component effects arise upon water accumulation by reduced sediment transportation derived from contour line cultivation. By reducing the loss of soil surface layer, its natural fertility is maintained thus preventing the loss of crop productivity.

This technique is associated with the use of other recommendations, such as:

- combination of plantation strips with other crops to prevent the soil from becoming very exposed and protect it from erosion;

- stone barriers, terracing and vegetation barriers;
- rows of crop waste to prevent water speed increase and erosion;
- use of dead cover, which incorporates organic matter and preserves soil moisture for a longer period, thus allowing the soil to resist more to short summer seasons;
- use of o alternate grass clearing to prevent the soil from becoming uncovered and unprotected and make water runoff easier.

It should be pointed out that this technique is efficient for soils with declivities up to 3%. For more sloped soils, use of stone barriers or terraces is better.

For Cangati River microbasin areas, all such techniques were successfully used, as shown by Photo 10.

Photo 10 – Air View of Cangati River HMB showing Vegetation Remains Row, Surrounding Stone Barrier, Successive Dam and Contour Line Cultivation Techniques.
Source: PRODHAM.

b) Socioeconomic and environmental effects of component

All such techniques listed above were concomitantly used in Cangati River microbasin, with the objective of reducing soil loss caused by floods. The economic effect from the use of several techniques (stone barriers, terraces and contour line cultivation) is reported by local producers by comparing it to the use of the same area in previous years when the techniques were not used. Irregular precipitation during socioeconomic monitoring did not allow this change to be noted in survey data. There was some complaint by the producers with respect to lack of rains and crop failure in 2005 and 2007.

It is clear the many producers have absorbed the guidance, as they are using such techniques in their properties. Use of contour lines and such other techniques as stone barriers, terraces, dead cover, and crop waste rows has contributed to recover fertility in tillable areas, increase soil moisture and generate perspectives of production increase from productivity gains and expanded cultivated area.

c) Major constraints and ways to overcome them

Major constraint for the adoption of that cultivation technique is local producer's rooted habit of traditional "down-the-hill" cultivation. It is very difficult to convince the producer that the correct is cultivation in contour lines. Only after the adoption of that experience by some producers and the respective results the technique will be disseminated to all producers. It is known that in Cangati River microbasin that technique has already been adopted by many producers.

d) Suggestions for component replication in other microbasins of Ceará semiarid region

This practice has already been adopted by the State's technical assistance and rural extension system. Therefore, it is not a new practice. It is being disseminated all over the semiarid region. It mass communication is however necessary by means of capacity building events for technicians, farmers and

rural workers, field activities, pilot projects, what requires the governmental support to make such actions financially feasible.

5.5. Preservation and Recovery of Ciliary Forest

a) Expected effects of this component

Expected effects of ciliary forest reintroduction are forest protection from river silting-up to prevent floods and open spaces for biodiversity recovery with the resurgence of meso and micro fauna and flora. In addition, it aims to prevent soil loss during flood periods, like that occurred in Cangati River in 2004. During focal group meetings, local producers stressed the important role played by ciliary forest when Cangati River was hit by a great flood in 2004. The reforested area resisted well to water strength. In some areas, water was as high as tree tops. But even so, neither vegetation nor the soil where it was planted was destructed.

Photo 11 – View of a Section of Cangati River and its Ciliary Forest
Source: PRODHAM.

The ciliary forest protected the area where it had been replanted and prevented margin erosion, working as a filter for polluting agents and serving as a shelter for birds and animals by promoting the formation of biodiversity corridors and preserving flora and fauna biodiversity, among other ecological benefits.

b) Socioeconomic and environmental effect of this component

There is no explicit economic return in ciliary forest recovery and reforestation. The return is preventing alluvial soil loss, what represent a significant gain, because if loss value was calculated upon the occurrence of floods, the expenditure of thousands reais would be recorded. As in semiarid region most of crops are cultivated in alluvium soil, the economic effect of that action can be deduced.

From environmental standpoint, recovery of ciliary forest and degraded areas by reforestation allows flora and fauna species to reproduce, thus ensuring the restoration of local biodiversity and generating better life conditions for local populations.

In Cangati River Microbasin in Canindé-CE, by watching the recovered areas, one can not that birds and other wildlife have returned to riparian zone

c) Major constrains and way to overcome them

- High replanting costs

  Recovery of ciliary forest of a particular region requires investments in seedlings, labor and implantation of fences to prevent animals from destroying the seedling plants.

- Need of formation of a forest park

  For seedling production, a Forest park is necessary. This park should comply with technical standards and be provided with cover to reduce insolation. Usually, it is not difficult to make the producers to

build themselves the park. In the case of Cangati River microbasin, the producers built the park and produced the seedlings under the guidance of PRODHAM technical staff.

- Fencing the area to prevent wildlife entry

  It is indispensable that the area selected for ciliary forest replacement is fenced to prevent animals from eating the seedling plants at least until they reach an ideal size.

Photo 12 – Aspect of Reforestation in the Riparian Zone of Cangati River in Canindé-CE
Source: PRODHAM.

d) Suggestions for component replication in other microbasins of Ceará semiarid region

All rivers in Ceará semiarid region cross areas of devastated ciliary forest, and therefore revegetation on margins of such rivers is highly recommended to prevent alluvial soil losses in flood periods. It is important that the respective municipal governments undertake this task by creating forest parks in several communities across the municipalities and provide seedlings to be planted by the population in deforested areas.

5.6. Agrosilvopastoral Exploration System

a) Expected effects of this component

Agrosilvopastoral exploration system was developed by Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA – Caprinos e Ovinos) with the objective of offering the family producer a cost-effective option to obtain income from a productive area by performing joint activities, such as agriculture, breeding of small animals under grazing regime, and maintenance of part of brushwood reserve base don the preservation of sizeable vegetation. The system uses the actual brushwood area to compose the forage support to the property, by making some manipulations with the introduction of leucaena and other cultivated leguminous plants. This way of exploring the area is quite favorable to small family producers, as more recent studies by EMBRAPA Caprinos e Ovinos suggest that the generated income is sufficient to support a family at conditions that are worthier than those prevailing in the present days.

Photo 13 – Sheep Grazing in an EMBRAPA Experimental Agrosilvopastoral System Area.
Source: João Ambrósio de Araújo Filho.

b) Socioeconomic and environmental effect of this component

From economic standpoint, the component has some advantages over sheep and goat breeding under the traditional system, because, in addition to income generated from cattle, sheep and goat breeding and bee exploration, it also obtain an additional income from the sale of agricultural exploration

surplus. It also generates patrimonial benefits from preservation of part of forest, dead cover, trash blanketing, and ground burning, which are factors that value the land because it will produce more food and maintain the ecological balance. On expense side, use of native pasture of diversified types and rich of proteins will reduce the cost of animal food. When deforestation is smaller, labor costs of area thinning is reduced. Table 2 shows the economic-financial indicators that support the statements above.

Table 2 – Comparison between Results Obtained for Agrosilvopastoral and Conventional Models*, based on experiments developed by EMBRAPA Caprinos e Ovinos

Results	Agrosilvopastoral Model	Conventional* Model
Herd at stabilization – head	280	280
Property surface area – ha	50	193
Valuation of naked land	281%	0%
Total investment – R$	69,400.00	80,418.00
New investments – R$	47.900,00	30,068.00
Labor costs – R$	10,200.00	8,100.00
Profitability - %	22.20	18.50
Return of investments	10 years	+10 years
Annual net profit – R$	4,972.96	368.84
Monthly net margin – R$	569.41	267.07
Monthly family income – R$	1,419.41	942.07
Financial IRR - %	35.48	23.67
Economic IRR - %	52.03	35.17
Cost/benefit ratio	1.39	1.27

Source: França; Holanda Junior e Sousa Neto (2007).
(*) With the adoption of minimum Technologies recommended by EMBRAPA Caprinos e Ovinos.

From environmental standpoint, maintaining part of brushwood in explored area is a way to reverse the destruction situation without stopping the economic use of land. Brushwood is an extremely fragile ecosystem, in most part of which soils are shallow and covered by shrubby vegetation. This combination is sensitive to anthropic activities, as upon clearing the area for plantation, soil becomes exposed to rains that are usually scarce in semiarid region, but are heavy in rainy periods and carry part of the soil.

Photo 14 - Brushwood Thinning at an Experiment of Agrosilvopastoral System in a Property in Cangati River HMB, Canindé-CE
Photo: PRODHAM.

c) Major constraints and ways to overcome them

In Cangati River HMB, agrosilvopastoral system faced some difficulties at its implementation, as specified below:

- Difficulty in persuading the producer to accept this production system

Breeding of small animals in semiarid region is typically on the loose without any benefit to the grazing area, not even deforestation or construction of fences. This habit made difficult to persuade the countryman of the feasibility of this sustainable agroforestry practice..

- High cost

Implantation of agrosilvopastoral system requires some investments that small producers cannot afford. The combination of small-size animals with agriculture, including controlled deforestation, requires the implantation of 8-strand barbed wire fences, which is a high-cost investment. This is the major constraint in the application of that technique.

d) Suggestions for component replication in other microbasins in Ceará semiarid region

This component replication in other microbasins requires the implantation by governmental agricultural development bodies of several experiments similar to that in Cangati River HMB for several consecutive years to convince the producers of the advantage of the recommended system, and guide them on their implantation.

It also requires continuous specialized technical assistance provided by public bodies and the implantation of credit mechanisms that would make the small family farmers in semiarid region afford a profitable and ecologically feasible economic activity.

Further, NGO support may be sought for dissemination of that technique and aggregation of commercial value of 'organic' products generated in properties adopting that production system.

Feasibility of exploration of swine and caprine cattle by family farmers, in particular with the adoption the agrosilvopastoral system, is based on the following factors:

- low animal food cost, due the quantitative and qualitative abundance of manipulated native pasture (brushwood);
- higher economic and social stability for the farmer due to the greater production diversification and resistance to annual water shortage and periodic droughts;
- increased soil productivity, as it occupies only one third or area required by traditional exploration;
- landed estate valuation as a result of ecological gains, inexistence of ground burning, dead cover and soil enrichment;

low cost of property management, because it is small and easily administered by its owner, who also pays the role of rural worker.

For consolidation and sustainable management of the proposed model, the following recommendations are made:

- corporate organization and sustainable management of productive process;
- family farmer's sensitization and capacity building for new paradigms, in light of focus on agribusiness and sustainable agriculture;
- qualification and availability of technical assistance agents specialized in sustainable agricultural production systems;
- implantation of mechanisms to allow family farmers to have access to financing and incentives for an ecologically correct production line;
- differentiation of products sold by means of organic and/or origin stamps.

Photo 15 – Air View of Agrosilvopastoral System Area in Cangati River HMB, Canindé-CE
Source: PRODHAM.

5.7. Rain Cisterns

a) Expected effects of this component

Rain cistern is a type of covered, semiburied cylindrical water reservoir for catchment and storage of rainwater flowing down from the roofs through zinc or PVC ducts. Rain cisterns enable water storage for human consumption in a reservoir protected against evaporation and contamination caused by animals and excrements carried by rains.

Manual pumps were introduced near each cistern constructed in Cangati River microbasin to prevent water contamination. With a manual pump, introducing buckets or pans is not necessary, as they were contaminating waters in pumpless cisterns. In addition to efficient water storage, cisterns have a low cost and can be constructed by the population itself. PRODHAM experience in Cangati River HMB involved private companies that were initially responsible for total cistern construction using local workforce. Later, the contracted firm was responsible for logistic and construction jointly with the community.

Qualifying professionals to work as masons able to lead the work group constructing a cistern is easy, and it is quite possible that all houses are provided with a cistern, provided that they have a water catchment area on the roof. In addition to learning rainwater storage and handling, masons are trained to transfer their knowledge to other families, thus multiplying the number of families in conditions to enjoy that great benefit.

Experience has shown that in Cangati River HMB a 16,000-liter cistern can guarantee drinking water for a 4-member family to drink and cook for five months. Cisterns improve women and children's lives, as they will no longer be required to fetch water far from home, in addition to improving everybody's health, especially children and elderly health by drinking water consumption.

Photo 16 – Aspects of External Plaster of a Rain Cistern
Source: PRODHAM.

b) Socioeconomic and environmental effect of this component

The economic effect of cistern construction lies on time saving and even money saving in the purchase of water for human consumption. In Cangati River HMB communities, families have the option to obtain water from a desalinator at a cost that only covers the equipment maintenance, and many families have a rain cistern at home. Taking into account that cistern requires no disbursement, the effect is a good saving for the family in addition to optimizing the time required to bring water from a reservoir to the houses in appropriate barrels.

c) Major constraints and ways to overcome them

- Beneficiaries are required to excavate the hole

Monitoring in Cangati River HMB identified that the only obligation

of the benefited family with respect to the cistern is to provide the excavation of storage tank foundations for cistern construction, as all the rest is under PRODHAM responsibility. In such a case, initially many families were not willing to excavate the hole and therefore were not beneficiaries of the work. Later, after being aware of the great benefit provided by the cistern, they agreed to make the excavation and benefited o the work.

Photo 17 - Rain Cistern Constructed by PRODHAM
Source: PRODHAM.

- Participation principle

Success of rain cistern construction depends, since the beginning, on user participation. This requirement makes the beneficiary committed to the equipment maintenance. In more organized communities, it is possible to obtain a mass adhesion. In the case of Cangati River HMB, initially there was some disregard with participation, which was later overcome by the community organization and capacity building process.

d) Suggestions for component replication in other microbasins ion Ceará semiarid region

Un semiarid region, rains concentrate in the beginning of the year and flow to riverbeds and then to the sea. In deeper soils, water is quickly absorbed and can only be collected through artesian or piezometric well. In all other months of the year, Brazilians living in semiarid region are hit by drought. A solution to avoid wasting such a valuable good as water it the construction of cisterns close to families' houses. This equipment is made of preformed cement plates and is able to store all rainwater flowing from house roofs.

5.8. Organizational Strengthening

a) Expected effects of this component

Expected effects of this component include the creation of conditions for the occurrence of changes in producers' behavior in selected hydrographic microbasins, with respect to the use of soil and water preservation technologies, hydroenvironmental infrastructure construction and living this proposal as a daily practice.

In this sense, a full capacity building work was developed for leaderships and other social actors able to mobilize communities toward their awareness of recovery and preservation of natural resources (water, soil and vegetation), as well as on techniques to use such resources, with the objective or improving the population's life conditions and replicating that experience in other areas where natural resources are in degradation process.

Also, capacity building courses were offered to managers of community associations to increase their management skills, including the definition of participatory rules and methodologies to allow them to transfer such techniques to other areas in similar conditions. Several association technique courses were also held, which were attended by representatives of several local communities. In addition to such events, courses on use of *pet* bottles, apiculture and other

courses of the community's interest and consistent with PRODHAM strategies were also held.

b) Socioeconomic and environmental effect of this component

Socioeconomic effects of this work derived from the participatory process that provided local actors with knowledge of reality and importance of action planning, as well as its implementation in a participatory manner. As a result, forms of perception of reality and identification of solutions for problems related to interaction with the natural environmental emerged.

Several economic activities stemmed from several institutional strengthening actions under PRODHAM. Among them, the following stand out: productive use of successive dam sediments; cultivation in underground dam areas and water use for human and animal consumption; apiculture dissemination in several communities; and use of *pet* bottles for handmade broom production.

c) Major constraints and ways to overcome them

Major constraints identified in monitoring and socioeconomic evaluation of this component included:

- Population's education level

The great problem of communities in Northeastern semiarid region it the population's low education level. In Cangati River microbasin, that level is also low and the population is sticky about reversing this situation. In PRODHAM, there was an attempt to link community works of hydroenvironmental work implantation to attendance to literacy courses, where many workers were reluctant to the rule, but even so some progress was achieved.

- Lack of incentive to adopt recommended edaphic and agricultural practices

Actually, lack of incentive is due to several factors, such as the lack of credit for crop implantation, high cost of implementation of some agricultural practices, such as agrosilvopastoral system, and the occurrence of a great number of landless farmers. Addressing such structural problems depend on the implantation of a land tenure system where everybody will have access to land, and the institution of adequate financing sources to make local economic activities feasible.

- Discontinuity of PRODHAM actions

Another great problem mentioned in several meetings with HMB leaderships was the discontinuity of PRODHAM actions due to changes in the government. During the Project implantation years some changes in the government occurred, which replaced Project managers, thus bringing serious consequences to its implantation and generating action discontinuity. The solution of this problem would have only required the maintenance of technicians responsible for the Project upon any changes in the State Administration.

Lack of financing for implementation of actions under the Project

Most producers have no access to land and therefore have no access to credit. PRODHAM, on the other hand, did not provide for productive activity financing. As a pilot project, many actions were not provided for, including productive activity financing. Should funds were available to finance productive activities, the economic effect would probably be more visible and identified by previous surveys.

- Irregular precipitation

Another determinant for the low economic performance of implanted hydroenvironmental infrastructure use, according to producers' information, was both droughts occurred during PRODHAM implantation. In 2005 and 2007, rains were scarce in the region, what substantially affected the economic use of completed infrastructure and the edaphic practices, such as contour line cultivation and dry farming (on-site catchment system).

d) Suggestions for component replication in other microbasins in Ceará semiarid region

For this component replication in other microbasins, the observance of all recommendations learned from PRODHAM experience is critical, with special attention to participatory planning, to avoid problems referred to above. Even the selection of microbasin to be assisted should be quite judicious.

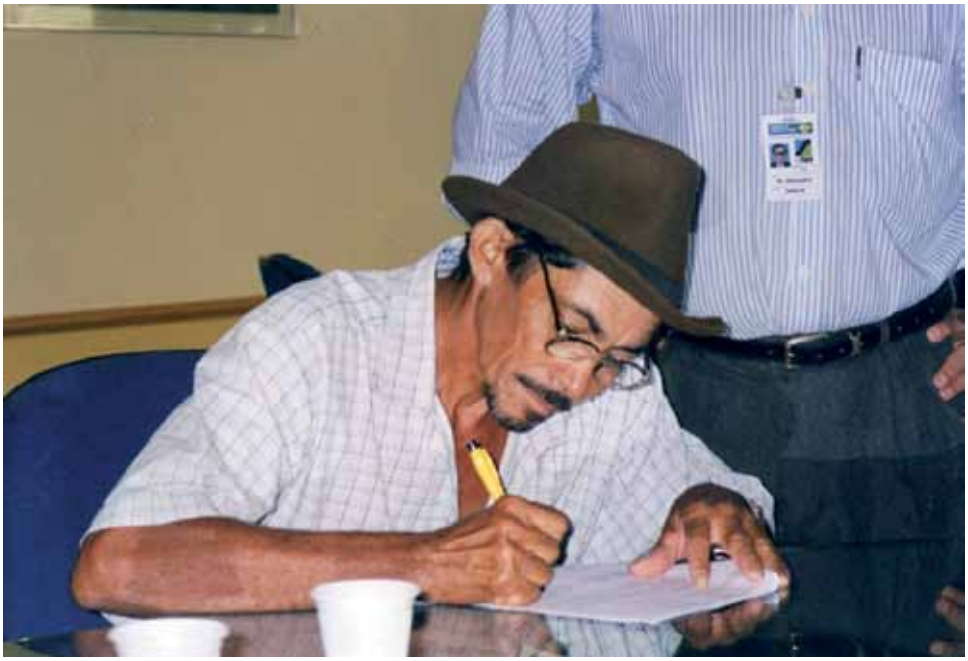


Photo 18 – Signing of Agreement between SRH-CE and Iguaçu Community Association, Canindé-CE
Source: PRODHAM.

5.9. Environmental Education

a) Expected effects of this component

With this component, it is expected that the populations living in microbasins become aware and well informed of environmental problems affecting their daily life as human beings and productive agents. As human beings, because of their difficult survival in light of extreme shortage of water and natural resource degradation. As productive agents, for the consequences of difficult effective exploration of natural resources and implanted infrastructures.

Photo 19 – Aspect of an Activity Used in an Event on the Environment held in Cangati River HMB, Canindé-CE
Source: PRODHAM.

Mobilization work aimed to arouse the critic awareness of involved technicians and local communities on environmental problems most relevant to HMB reality, and seek solutions with the required technical support. As such, interactive courses for mobilization and capacity building of human resources of associations were held to promote small community initiatives related to socioenvironmental and productive aspects.

Another confirmed expectation was the constitution of groups of multipliers of environmental preservation and rational use techniques.

Water exploration and rational use practices and sustainable cultivation practices were adopted. For that, it was sought to induce changes of habits and actions to allow the communities to be aware of situation and change the way they interacted with nature.

With respect to diffusion of developed techniques, partnerships with

several institutions were sought to allow techniques to be diffused and have a greater effectiveness in microbasins.

b) Socioeconomic and environmental effect of this component

Environmental education is the most adequate tool for PRODHAM work implantation. It allows all objectives to be pursued. Since the time when PRODHAM team entered the area, they gave start to environmental education works. Several assumptions formulated the general lines for execution of works, such as full engagement of microbasin population, thus created a link between what the producers were doing and what was being done by PRODHAM team. For that, several educative methodologies were used, among which such techniques as do-and-learn, games, theaters, text reading, etc. were stood out.

It was tried to value personal skills and identify situations that would lead to the construction of a new perception of reality, with the objective of improving the care with the environment for its better exploration and generation of generate economic goods.

A work with public state and municipal institutions was also developed to involve them not only in environmental education activities, but also in formal education, which is a major structural problem in all four selected HMBs.

Finally, efforts were made toward a critic consideration of local reality, and identification and discussion of several alternative actions to overcome it.

Woman, as a major opinion maker, played a significant role in PRODHAM works in building preservation awareness. For that, woman's issues were a subject of all project events.

Works with youngsters were highly important to allow them to identify themselves with the new techniques under implementation for future sustainability.

c) Major constraints and ways to overcome them

Major constraints included:

- Discontinued capacity building

PRODHAM works were adversely affected by institutional and administrative changes that interfered with the development of works and generated capacity building action discontinuity, resulting in dissatisfaction among the several stakeholders of Cangati River microbasin. That discontinuity was offset by PRODHAM team's efforts in execution of works, even without relying on desirable logistic support.

- Difficult participation of other institutions

Several institutions were invited to participate in PRODHAM works, especially because of the relationship between such institutions and PRODHAM and similar objectives, but those partnerships were not possible due to varied restriction to their participation. In the case of Ematerce, it was argued that no funds were available for its effective participation in microbasin area. Therefore, the Project lacked technical assistance. Supporting official technical assistance provided in PRODHAM design never occurred. Unavailability of funds was also the major reason for Ematerce non-participation in PRODHAM. That problem could have been solved if the project had provided for funds for technical cooperation agreements with Ematerce.

- Deep-rooted habits

Some new techniques experienced some restrictions to their adoption, i.e., HMB farmers' deep-rooted habits. Techniques transmitted from father to son, generation after generation, became the major restriction to a better understanding of sustainable development principles.

In addition to cultural aspect, short-term vision and lack of prior knowledge of positive results derived from sustainable environmental practices also precluded a greater adhesion of local population.

d) Suggestions for component replication in other microbasins in Ceará semiarid region

As a suggestion for PRODHAM environmental education replication in other microbasins in Ceará semiarid region, it can be said that such practice was the base for PRODHAM success, and therefore there is no restriction to the component replication in other microbasins in Ceará semiarid region.

Photo 20 – Detail of a Capacity Building Event Involving the Community Assisted by PRODHAM
Source: PRODHAM.

Analysis of Innovative Economic Activities Promoted by the Project 6

6. ANALYSIS OF INNOVATIVE ECONOMIC ACTIVITIES PROMOTED BY THE PROJECT

6.1. Apiculture

Creating a new work alternative for Cangati River microbasin farmers, and promoting an economic activity unlikely to endanger the environment, which is, on the contrary, a complementary activity for brushwood preservation, was the major objective of this productive segment.

Apiculture improved the income of some families that believed in that activity. Starting some years ago with 12 beehives scattered all over Cangati River microbasin, which rely on an association constituted exclusively to integrate beekeepers and strengthen the activity.

One of beekeepers started to construct its own beehives and sold them to other beekeepers in the region. The Association has Honey House, where centrifugation, filtering and bottling are made.

Photo 21 – Beekeeper at Honey Collection Activity in Iguaçu Community, Canindé-CE
Source: PRODHAM.

Apiculture contributed to increase both the income of those who believed in that activity, and their awareness, respect and understanding of the relationship between bees and the environment. Today, apiculture can be considered an alternative economic activity for microbasin communities. The promotion of this activity was important, because it led to sustainable development, respect to the environment and income generation. That activity also provided integration with the ciliary forest recomposed under PRODHAM.

6.2. Factory of Brooms Made of Recycled *Pets*

Plastics are polymers produced by petrochemical processes. *Pet* (ethylene Polyterephthalate) is one of them, which was developed in 1941. Because it is an inert, light, resistant and transparent material, it began to be used in the manufacture of beverage and food packing in the 1980s. Brazil currently produces some three billion *pet* bottles. This is a 100% recyclable product, but currently the recycling volume is around 50%. This means, in practice, that at least one and a half billion of non-biodegradable plastic bottles are discarded in the environment every year, taking hundred of years to be absorbed by nature. (WIKIPEDIA, 2009).

Photo 22 – Youngsters Working in a Factory of Recyclable Plastic Brooms (*pet*) in a Community Assisted by PRODHAM
Source: PRODHAM.

Intensive use of *pet* bottles by beverage industry is a problem for the whole population, as very often they are not reused and are heaped in landfills with serious consequences for the environment. Based on that reality, PRODHAM coordination unit decided to offer building capacity courses on the use of recycled *pets* to people interested in learning another economic activity, in addition to contributing to the environment by giving a use to discarded vessels.

That gave rise to the possibility of exploration of discarded *pet* bottles (waste) to produce handmade brooms. The course gave rise to the idea of implanting a broom factory in the community. This factory is in operation with the use of raw material (*pet*) from that community and close villages. Raw material supply by bottle pickers has been encouraged in Canindé. The major restriction is the lack of working capital to purchase the bottles. Such problems are being discussed by Iguaçu HMB communities to find a solution.

6.3. Small Scale Production and Extractivism

In Iguaçu community, PRODHAM technical staff promoted the capacity building of farmers engaged in wood extraction for coal and barbecue spit production, with the objective of making such activities economically and ecologically sustainable. Similarly, the extraction of leaves from a native plant called *jaramataia* (*Vitex gardneriana Schauer*), used in the form of tea used for renal problems, bone cicatrization and as anti-inflammatory was also encouraged.

In Salgado and Oiticica stream HMB, located in the municipalities of Pacoti and Palmácia, small scale production using banana-tree, corn and timber straw extracted in the region is a craftwork promoted by the Project. It should be pointed out that, in addition to guidance for rational management of tree that provides timber for manufacture of rosaries, bags and other products, the Project disseminated the cultivation of that tree to ensure the business sustainability in the long term.

Photo 23 – Craftwork Products Made of Banana-Tree Straw, Pacoti-CE
Source: PRODHAM.

6.4. Waste Treatment

In Cangati River HMB, waste has been a concern since the beginning of Project implantation. Waste, in technical language, is synonymous of solid waste represented by materials discarded by human activities. In Cangati River HMB, there were great quantities of such materials scattered in several areas, without any collection or reutilization.

PRODHAM decided to address seriously the problem and gave start to a local population capacity building process through theater plays, indicating the best ways to reuse waste components that could be reused. This way, the project started to face the problem as a solution to solve other local problems without causing damages to the environment or public health. Once it was identified that *pet* bottle accumulation in HMB was substantial, actions were planned to allow the local community to recycle such *pet* bottles to produce brooms and sell to recycling companies such other materials as cardboard, metal, glass, etc.

Photo 24 – School Children's Sensitization in *pet* Bottle Recycling Training in Canindé-CE
Source: PRODHAM.

The HMB started to adopt the sustainable procedure by following a world tendency of reutilization of *pets* from domestic waste to manufacture new objects through recycling process, what has represented an economy of raw material and energy. This way, concept of waste tends to be modified to be understood as "things that can be useful and reusable by man."

6.5. Qualification of Local Workers in Technologies Introduced by PRODHAM

An action that most calls the attention in PRODHAM activities is the continuous process of capacity building of producers, women and children in activities that are being promoted by PRODHAM. Population's qualification starts at the identification of associations that will be assisted by the Project. Once such associations are identified, that showing the best conditions to share the Project management is selected. The selection of managing association is followed by the stage of qualification of its officers by management and accounting courses.

Once this phase is completed, field activities included in the Project will start, including the capacity building of producers that will implement the practices introduced by PRODHAM. Capacity building includes explanatory presentations and field work according to the constructivist process "learning and doing, doing and learning". All trained producers are able to pass on such technologies to other semiarid regions, as they constitute a team trained in hydroenvironmental work construction.

By this process, the Project qualified more than 400 workers specialized in hydroenvironmental work construction. Such workers' learning was made possible by the implantation of large stone barrier areas, terraces, underground dams, successive dams, rain cisterns, in addition to recovery of rural roads and ciliary forest.

Photo 25 – Organizational Capacity Building Event in Iguaçu, Canindé-CE
Source: PRODHAM.

7 Prodham Effects on Leading Role in Iguaçu Community

7. PRODHAM EFFECTS ON LEADING ROLE IN IGUAÇU COMMUNITY

7.1. Start of leading Role with the Management Committee Creation

During PRODHAM works, the main role of the management committee was its involvement as participant of the Project strategic planning that was joined by representatives of community associations and other local government sectors (schools, etc.).

In addition, the committee gave assistance to project management and decisions made on the implementation of actions and mechanisms in its operation area. It also supervised the accounts related to the agreement with the selected community association with the objective of monitoring the application of funds. All actions were intensively discussed and decisions were made by majority.

The committee was composed of representatives of each community – three or four members – including a chairman and an alternate and a leader of project team. It also had a secretary to draft the minutes of meetings. Meetings were regularly scheduled with a great mobilization and involvement of community. The executive board was a sector of the management committee, which was responsible for the implementation of all actions and rendering of accounts.

7.2 Creation of a PRODHAM "Culture" in Farming Activities and People's Behavior

PRODHAM methodology created a kind of "culture" in local population's behavior in relation to their position on care with natural resources, thus avoiding deforestation, reducing the use of trees for coal production, replanting the ciliary vegetation, using the contour line planting system, caring with waste, and adopting other sustainable practices.

They became aware that survival depends directly on care with it most important to them – the land. In paying a higher attention to the land, it can provide best results, as shown by stone barriers, terraces and contour line planting, which have continuously improved crop productivity.

A local population' positive attitude to the care with waste and the best way to recycle it was also disseminated. Non-deforestation and replacement of ciliary forest have become a habit in Iguaçu community.

Photo 26 - Meeting of the Management Committee of Salgado/Oiticica Stream HMB
Source: PRODHAM.

7.3. Association Strengthening

PRODHAM is an innovative Project, because it adopt new methodologies to address the microbasin environmental degradation by using new work approaches in the rural area, such as those intended to solve problems caused by floods, through the implantation of hydroenvironmental and edaphic works,

new forms of cultivation, and especially the way to tackle the problem by the collective awareness of local reality, supported by association organization strengthening and continuous qualification of all actors sensitive to problems. Therefore, participatory methodologies were adopted as strategies to ensure the local population's engagement in problem solution.

At the beginning of activities, a work was carried out to select the managing association for the Project, named Mother Association, in the case the Community Association of Small Producers of Iguaçu. This Association for selected for its better organization, structure and capacity to assume the management responsibilities of project.

After the singing of the agreement with Iguatu Association, the capacity building of its leaders was scheduled (see Photos 26 and 27), with emphasis on the matter of account control supported by accounting courses. In addition to courses, several activities were performed by the association, provided that no actions were taken without the involvement of its board and members.

Photo 27 – PRODHAM Managers and Technicians and Iguaçu District Leaderships Attending an Organizational Strengthening Event
Source: PRODHAM.

Interaction Between Project Actions and Public Policies

8

8. INTERACTION BETWEEN PROJECT ACTIONS AND PUBLIC POLICIES

Given the climatic and edaphic limitations in semiarid regions and their socioeconomic effects on the populations living in those areas, interaction between public bodies and such region policies and programs is highly important to minimize such vulnerabilities.

In this sense, it was tried to identify the interaction between the Federal Government and PRODHAM, a project of the Government of the State of Ceará.

Aiming to improve production and income conditions in Cangati River HMB, PRODHAM implanted works and services focused on water shortage mitigation, soil degradation and deforestation, and consequently provided the required conditions for more sustainable farming activities in the form of hydroenvironmental structures implanted in HMB rural properties. In this sense, it qualified, trained and supported farmers during the construction of hydroenvironmental works, such as terraces, stone barriers, successive dams for sediment retention, underground dams, cisterns and other practices.

The presence of the Federal Government in Cangati River HMB is identified in at least four programs:

- Family Allowance
- Rural Retirement
- PRONAF
- Crop Insurance

8.1. Family Allowance Program

At institutional level, Family Allowance is a conditional direct income transfer program. It benefits families in poverty conditions, which a monthly income of R$ 60.01 to R$ 120.00 per person, and in extreme poverty conditions,

with a maximum monthly income of R$ 60.00 per person. It was instituted by Law 10,836, of January 9, 2004 and Decree no. 5,749, of April 11, 2006.

At the Initial Diagnosis (Baseline), the existence of 21w families in Cangati River HMB was confirmed. Out of that total, 110 families benefited of Zero Hunger, Gas Voucher and School Allowance programs, which were transformed together into the current Family Allowance program. Notwithstanding its slight variations in August-December 2006, it shows a growth trend, when July 2007 and January 2008 survey is considered (Table 3).

Table 3 – Occurrence of Family Allowance Program in Cangati River HMB

Specification	Occurrences
Baseline	**110**
August 2006 sampling	**101**
December 2006 sampling	**105**
July 2007 sampling	**115**
January/08 sampling	**136**

Source: FHAMA – Baseline and August/2006, December/2006, July 2007 and January/2008 samplings

Analysis of Table 3 above shows that Family Allowance Program contribution to HMB family income had a slight percent reduction between the Baseline and the years of 2006 and 2007, which was lower than the other items, except Crop Insurance. This comparison is made between the Baseline and the year of 2006, because 2007 was and atypical year due to the occurrence of drought.

Part of group of beneficiaries that participated in the survey declared that Family Allowance represents an important source of income, as almost all families benefit of that governmental grant. In fact, according to family sampling, governmental grants that include the Family Allowance rank third (Table 4).

Table 4 – Percent Income Distribution per Activity, Retirement and Governmental Grants in Cangati River HMB

Specification	Baseline (%)	Sampling (%)	
		2006	2007
Agriculture	24.04	11.22	5.87
Livestock	22.74	13.73	15.21
Retirement pension	49.30	63.28	63.10
Family Allowance	13.92	10.77	11.82
Crop Insurance	0	0	3.99
Total	100.00	100.00	100.00

Source: FHAMA – Baseline and August/2006, December/2006, July 2007 and January/2008 survey.

8.2. Rural Retirement

Rural retirement grants 60-year-old male workers 55-year-old female workers a monetary benefit equivalent to one minimum wage.

The grant of this benefit requires an evidence of rural activity, even discontinuous, for the period established in article 142 of Law 8,213/91, also known as grace period. In 2006, that period was equivalent to 12 years and six months. For 2007, this period increased to 13 years.

This form of public policy is evidently another approach used by the Federal Government to be present in Cangati River HMB.

It can be noted that from Baseline to July 2007 sampling, the number of occurrence increased by 52.24%. In January 2008 sampling, although the number of occurrences reduced by 27.45%, it exceeded that of Baseline (Table 5).

Table 5 – Retirement Occurrences in Cangati River HMB.

Specification	Occurrences
Baseline	67
August 2006 sampling	77
December 2006 sampling	83
July 2007 sampling	102
January/08 sampling	74

Source: FHAMA – Baseline and August/2006, December/2006, July 2007 and January/2008 samplings.

As shown in Table 4, retirement pensions accounted at Baseline for 49.30% of total HMB income. That percentage increased to 63% in 2006 and 2007. That is, therefore, the most important income component, as it exceeds farming activities and other income course figures. Increased retirement pensions are probably reflecting the increase minimum wage in periods of analyses.

8.3. PRONAF

PRONAF-National Family Agriculture Support Program is rural development support program coordinated by the Ministry of Land Development through the Secretariat of Family Agriculture. It aims to strengthen family agriculture by establishing a sustainable development standard for family farmers and their respective families aimed to increase and diversity production and consequent employment and income levels, thus enhancing the social welfare of families involved in Project.

That program is integrated by:

- municipality: the Municipal Government, Municipal Sustainable Rural Development Council (CMDRS), family farmers, family farmer organizations, and other public or private municipal bodies and entities;
- state: the State Government, the State Sustainable Rural Development Council (CEDRS), State Pronaf Executive Secretariat, Regional Superintendence of National Colonization and Land Reform Institute (INCRA), and other public or private state bodies and entities;
- federation: the Federal Government, the National Sustainable Rural Development Council (CNDRS), the Family Agriculture Secretariat and other public or private bodies and entities.

Funds allocated by PRONAF to Cangati River HMB amounted to 65 occurrences at Baseline. In following samples, occurrences were much smaller,

even by summing together August and December/06 figures, and July/07 and January/08 figures, respectively (Table 6).

It can be concluded from that behavior that the demand for production financing has falling. Two explanations may be given for that fall. One is the concealment of information, due to any default with the bank. The other, less probable, is the full financing repayment.

Table 6 – Occurrences of PRONAF Financing in Cangati River HMB.

Specification	Occurrences
Baseline	65
August 2006 sampling	4
December 2006 sampling	11
July 2007 sampling	10
January 2008 sampling	10

Source: FHAMA – Baseline and August/2006, December/2006, July 2007 and January/2008 samplings.

8.4. Crop Insurance Program

Crop Insurance is a program instituted by Law no. 10,420, of April 10, 2002, amended by Law no. 10,700, of July 09, 2003 and regulated by Decree no. 4,363, of September 06, 2002, which considers drought effect in semiarid region, with the objective to Grant a minimum income to family farmers who eventually incur at least a 50% losses in their crops as a result of water shortage. It represents a benefit by reducing the effects of crop failures in semiarid zones.

In Cangati River HMB, crop insurance only appeared in January 2008 sampling, when 113 were granted a total benefit of R$ 36,984.55, equivalent to 68% of agricultural production value. This resource minimized the impact of agricultural production failure in the first half of 2007.

9 Prodham Effects Measured by Monitoring and Evaluation System

9. PRODHAM EFFECTS MEASURED BY MONITORING AND EVALUATION SYSTEM

9.1. Farming and Extractivism Production Systems

9.1.1. Agricultural production

At Baseline, agricultural production activities in Cangati River HMB were based on five products, namely cotton, maize, beans, broad beans and rice. However, maize and beans stood out, while the others were less significant. At surveys performed for economic monitoring, only maize and bean production was identified. Maize and bean production occur under an intercropping and single-crop systems. Agriculture is basically family-based and for subsistence.

a) Integrated Agricultural Production

Agricultural production recorded at Baseline corresponds to the first half of 2004. Therefore, it is comparable to August 2006 and July 2007 samplings that correspond to the first half of 2006 and 2007, respectively.

Analysis started with integrated production, according to surface area (ha), production (kg) and yield (kg/ha) parameters.

At Baseline, maize cultivated area was 168 ha, which produced 149,676 kg at a yield of 893 kg/ha. Samplings in August 2006 and July 2007 show a surface area decreased to 99 ha and 135 ha, respectively. Production increased by 5.8% in August 2007 sampling, and decreased by 46.1% in July 2007 (drought year). Therefore, there was a well significant increase of Baseline productivity as compared to August 2006 sampling However, in July 2007, a great productivity reduction is noted, as compared to August 2006 and Baseline samplings, as another drought occurred that year. Average precipitation in Canindé is 756.0 mm (IPECE, 2009), but in 2007 it was only 411.6 mm, that is, 54.4% of annual average.

Areas cultivated with beans at Baseline and samplings were the same cultivated with maize, as these are integrated crops. Thus, like with maize, bean productivity was expressively higher in August 2006. There a productivity fall in July 2007, although it was still a little above that of Baseline (Table 7).

Table 7- Surface Area, Production and Productivity of Integrated Maize and Bean Crops in Cangati River HMB

Periods	Maize			Beans		
	Surface Area (ha)	Prod. (kg)	Productivity (kg/ha)	Surface Area (ha)	Prod. (kg)	Productivity (kg/ha)
Baseline	168	149,676	893.32	167	15,602	93.49
Aug/06 sampling	99	158,400	1,600.00	99	22,640	229.00
Jul/07 sampling	135	80,711	598.00	135	16,975	126.00

Source: FAHMA – Family samplings – July/2007, August/2006 and Baseline.

b) Agricultural production under single crop

At Baseline, maize crop occupied a surface area of 33.25 ha, having a production of 36,600 kg and productivity of 1,100 kg/ha. August 2006 and July 2007 samplings, areas increased to 58 and 59 ha, respectively. Production recorded in August/06 sampling increased by 79.4% over that at Baseline, while productivity increased by only 2.9%. From August 2006 to July 2007, there was an equally expressive reduction in both production and productivity of 73.2% and 73.4%, respectively (Table 7).

Table 8 - Surface Area, Production and Productivity of Maize and Beans under Single Crop System in Cangati River HMB

Periods	Maize			Beans		
	Surface Area (ha)	Prod. (kg)	Productivity (kg/ha)	Surface Area (ha)	Prod. (kg)	Productivity (kg/ha)
Baseline	33.25	36,600	1.100.75	13.75	2,280	165.82
Aug/06 sampling	58.00	65,650	1,132.32	21.5	5,970	278.00
Jul/07 sampling	59.00	17,564	298.00	31.00	3,998	128.00

Source: FAHMA – Family samplings – July/2007, August/2006 and Baseline.

Areas used for beans amounted to 13.75 ha at Baseline; 21.5 in August 2006 sampling, and 31.0 ha in July 2007 sampling. From Baseline to August 2006 and July 2007 samplings they increased by 161.8% and 75.3%, respectively. With respect to productivity, it increased by 67.6% in August 2006 and decreased by 22.8% in July 2007 in relation to Baseline.

Considering that productivity is an important indicator, it is noted that its behavior related to maize and beans, under both intercropping and single-crop systems, showed the best results in August 2006 sampling.

It should be highlighted that maize productivity under intercropping in August 2006 and July 2007 sampling exceeded that under single-crop system, what in some way deviated from expectations.

Averaging maize and beans production at Baseline and August 2006 and July 2007 samplings, 844 kg/ha for maize and 191 kg/ha for beans were obtained. To realize the productivity in Cangati River HMB, which is included in semiarid region, average productivity in Ceará in 2003-2005 period, according to IBGE, was 769 kg/ha for maize and 309 kg/ha for beans. Such results indicate that average maize and bean productivity in that microbasin is consistent with the average productivity in the State of Ceará, notwithstanding it is very low as compared to the country's productivity that, according to data recorded by IBGE (2010) was 3,741 kg/ha for maize in 2007. This figure is well above the productivity of 1,132.32 kg/ha recorded in August 2006 sampling. The same comparison for beans in relation to Brazilian average, productivity was 847 kg/ha.

c) Value of Agricultural Production

Total mount of agricultural production increased 24.7% in August 2006 sampling over the Baseline. In July 2007 sampling, however, there was a reduction of 28.8% in relation to baseline and 42.9% in relation to August 2006 (Table 9).

Table 9 – Total Value of Consumption and Sale of Agricultural Products

	Baseline			August/06 sampling			July/07 sampling		
Product	Production (R$)	Cons. (R$)	Sales (R$)	Production (R$)	Cons. (R$)	Sales(R$)	Production (R$)	Cons. (R$)	Sales (R$)
Beans	17.882,00	17.527,00	355	28.542,00	28.232,18	309,82	20.972,31	20.153,08	819,23
Maize	58.530,97	38.850,97	19.680	66.711,60	49.284,33	17.427,27	33.413,47	27.151,93	6.261,54
Total	**76.412,97**	**56.377,97**	**20.035**	**95.253,60**	**77.516,51**	**17.737,09**	**54.385,78**	**47.305,01**	**7.080,78**

Source: FAHMA – Family sampling – July 2007, August 2006 and Baseline

Percentage of self-consumed production Is highly significant, accounting for 73.8%, 81.4% and 87.0%, respectively for Baseline, August 2006 and July 2007 samplings.

Also based on Table 9, it is noted that value of production sold showed a fall trend from Baseline to August 2006 and July 2007 samplings; that fall was 11.5% and 64.7%, respectively.

It should be pointed out that beans produced are almost totally sold for family consumption and respective sale prices are insignificant.

Although maize production is mostly intended for consumption, a significant quantity is sold, especially at baseline and August 2006 sampling.

9.1.2. Livestock and exploration of small animals

Importance of livestock and exploration of small animals derives from provision of food and generation of income from the sale of surplus. The number of animals existing in Cangati River HMB is shown in Table 10.

Table 10 – Animal Existing at Baseline and Samplings in Cangati River HMB

Animals	Baseline	Sampling			
		Aug/06	Dec/06	Jul/07	Jan/08
Bee (beehive)	66	0	184	118	161
Poultry (head)	2,749	2,717	2,090	4,404	2,420
Bovines (head)	282	47	123	285	400
Goats (head)	26	23		131	84
Sheep (head)	68	16	40	161	68
Swine (head)	240	147	97	213	258

Source: FAHMA – Family sampling – July 2007, August 2006 and Baseline

Apiculture has proved to be a promising activity, especially for the constitution of local income. It should be noted that at Baseline 66 beehives were recorded, increasing to 161 in January/08, that is, an increase of 143.9%. According to information collected from community leaderships in Iguaçu, in 2010 it already exceeds 300 beehives at production stage.

With respect to poultry, which constitutes an activity always present in the production of chicken and eggs, a reduction of 12% is noted in January/2008 in relation to the Baseline. The greatest number of such animals was recorded in July 2007 sampling.

Number of bovines, which represent an important activity for HMB population feeding, including beef, milk and several byproducts, increased in January 2008 sampling by 41;8% over the that at Baseline.

Number of swine and sheep remained in January 2008 practically equal to that of baseline. Number of goats increase by 123.0% in the same period.

Production, consumption and sales values at baseline refer to 2004. Likewise, the sum of production, consumption and sales values in August and December 2006 refer to the year of 2006, while values in July 2007 and January 2008 correspond to the year of 2007, what makes this comparison possible.

With respect tot the total amount of livestock production, there was a 14.7% reduction between Baseline and 2006, and a 12.3% increase between Baseline and 2007 (Table 11).

Table 11 – Total Amount of Livestock Production in Cangati River HMB

Products	Baseline (R$)	Samplings	
		2006 (R$)	2007 (R$)
Chicken (head)	3,692.34	29,900.70	29,606.96
Eggs (unit))	6,494.65	31,896.86	18,602.28
Bovine - Beef (head)	10,646.75	3,971.22	25,436.38
Milk (l)	37,518.00	17,634.97	37,927.66
Swine (head)	17,810.53	7,849.57	13,849.17
Goats (head)	1,333.40	0.00	1,909.06
Sheep (head)	5,408.51	722.03	5,715.64
Honey (l)	2,525.00	14,980.76	7,840.87
Total	125,429.18	106.956.11	140,888.02

Source: FAHMA – Family sampling – January/2008, July/2007, December/2006, August/2006 and Baseline.

The highest growth in 2007 in relation to Baseline was bovine-beef at 138.9%. At baseline, the most important product in composition of gross amount was cow milk, which remained that way in 2007.

Value of honey production increased in 2007 by 32.2% over the Baseline, although in 2006 there was an expressive increase in relation to that at Baseline and 2007. This is an incipient activity that has displaying high growth rates.

Table 12 shows that the total value of livestock product consumption decreased by 19.7% and 18% in 2006 and 2007, respectively, in relation to Baseline. In terms of consumption of products, the most significant reduction was in beef (87.2%) and swine (50.8%), between Baseline and 2007. Egg consumption also reduced by 34.6%%.

Table 12 – Value of livestock product consumption in Cangati River HMB.

Products	Baseline (R$)	Sampling	
		2006 (R$)	2007 (R$)
Chicken (head)	21,864.34	27,229.12	22,525.61
Eggs (unit)	22,612.65	29,201.05	14,786.05
Bovines - beef (head)	496.75	0.00	564.29
Milk (l)	26,916.00	16,985.14	29,859.48
Swine (head)	11,186.53	730.32	5,508.67
Goats (head)	0	0.00	409.62
Sheep (head)	5,208.51	0.00	691.18
Honey (l)	0	164.62	1,218.95
Total	92,184.78	74,310.25	75,563.85

Source: FAHMA – Family sampling – January/2008, July/2007, December/2006, August/2006 and Baseline

Value of sale of animal products from Baseline to 2006 remained practically stable. In 2007, it increased by 96.5% over the Baseline. At Baseline, milk sale was the most significant, accounting for 31.9%. In 2007, sale of beef was the most representative, accounting for 38.1% (Table 13).

The highest growth in sales was seen in sheep products, which increased in 2007 by 298.0% over Baseline, and has a greatest weight in sold product structure.

Table 13 – Value of sales of livestock products in Cangati River HMB

Products	Baseline (R$)	Sampling	
		2006 (R$)	2007 (R$)
Chicken (head)	1,828.00	2,671.59	7,081.35
Eggs (unit)	3,882.00	2,695.81	3,816.22
Bovines - beef (head)	6,250.00	3,971.22	24,872.09
Milk (l)	10,602.00	649.83	8,068.18
Swine (head)	6,624.00	7,119.25	8,340.50
Goats (head)	1,333.40	0.00	1,499.44
Sheep (head)	200	722.03	5,024.46
Honey (l	2,525.00	14,816.14	6,621.92
Total	33,244.40	32,645.87	65,324.16

Source: FAHMA – Family sampling – January/2008, July/2007, December/2006, August/2006 and Baseline

9.1.3. Extractive production

Extractive production consists of the exploration of items available in nature, such as the production of barbecue spits derived from quince tree exploration; vegetal coal from tree trunks and wood remains; exploration of medicinal plants (geramataia leaves); and extractive fishing.

In terms of production vale, this is the component that gives the lowest contribution to the gross total production of HMB, as compared to agriculture and animal exploration. However, it is an activity that complements the families' income in HMB.

Value of extractive production reduced in 2006 and 2007 in relation to Baseline (43.9% and 5.0%, respectively. At Baseline, the most significant

production was barbecue spits, accounting for 76.0% of total. In 2006, coal production became the most significant at 74.4%, and in 2007, barbecue spit production remained to be the most significant. Fishing recorded values in 2007 accounting for only 10.6% of total (Table 14).

Table 14 – Extractive production at Samplings and Baseline in Cangati River HMB

Extractivism	Baseline	2006	2007
Barbecue spits			
. Production (1,000)	**3,043**	**508**	**1,937**
. Sales Value (R$)	**18,258.00**	**3,446.00**	**15,192.56**
Coal			
. Production (sack)	**-**	**4.838**	**2,211**
. Sales Value (R$)	**5,765.00**	**10,036.00**	**4,428.12**
Geramataia Leaves			
. Production (sack)	**-**	**-**	**157**
. Sales Value	**-**	**-**	**784.47**
Fishing			
. Production (kg)	**-**		**688**
. Sales Value	**-**	**-**	**2,408.54**
TOTAL VALUE (R$)	**24,023.00**	**13,482.00**	**22.813.69**

Source: FAHMA – Family sampling – January/2008, July/2007, December/2006, August/2006 and Baseline

To conclude this topic, the total amount of HMB production and the average production amount per family at Baseline and in 2006 and 2007 are shown below (Table 15).

According to such consolidated data (Table 16), animal production is the most significant in HMB, taking into account that their percentages at Baseline and in 2006 and 2007 were 55.5%, 49.6% and 64.6%. With respect to agricultural production, those percentages were respectively 33.8%, 44.2% and 24.9%, respectively, at Baseline, in 2006 and in 2007. Extractivism participation is less significant, with percentages of 10.6%, 6;3% and 10.5% in the same periods, respectively.

Table 15 – Value of Total Production and per Family in Cangati River HMB

Products	Baseline	2006	2007
Animal Exploration	125,429.18	106,956.11	140,888.02
Extractivism	24,023.00	13,482.00	22,813.69
Total	225,885.15	215,691.71	218,087.49
Number of families	213	213	213
Agricultural Production	76,412.97	95,253.60	54,385.78
Production amount per Family	1,060.40	1,012.64	1,023.88

Source: FAHMA – Family sampling – January/2008, July/2007, December/2006, August/2006 and Baseline

Table 16 – Percentage of Agricultural, Animal and Extractive Production on total Production Amount

Products	Baseline	2006	2007
Agricultural Production	33.83	44.16	24.94
Animal Exploration	55.53	49.59	64.60
Extractivism	10.64	6.25	10.46
Total	100.00	100.00	100.00

Source: FAHMA – Family sampling – January/2008, July/2007, December/2006, August/2006 and Baseline

Based on the information above, it is possible to calculate some indicators, By dividing the total value of production by the number of HMB families, the average value of production per family is obtained. This leads to an average value of R$ 1,060.40 per family at Baseline; R$ 1,012.64 per family in 2006; and R$ 1,023.88 per family in 2007. It appears the climate influence on agricultural production is more accentuated than on animal production, although the latter segment is also affected.

9.2. Environmental Education

Environmental education is a participatory process. Values leading to a harmonious coexistence with the environment and all species living in certain regions should be sought, to make man rethink and reflect critically over the anthropocentric principle that has caused the negligent destruction of natural flora and fauna resources.

Nature is not an inexhaustible source of resources. Its reserves are finite

and should be rationally used by avoiding waste and considering recycling as a critical process. Both rural schools and communities in a participatory system should be prepared to play a role in that segment.

In Cangati River HMB, environmental issues were considered in such topics as waste, joint activities by families, communities and associations, and acquisition of educational information ion environmental matters.

Waste destination is directly related to cultural aspect and its effects on the environment, taking into account that its inadequate destination may adversely affect the water resources, soil and other nature aspects. An example is burying the waste with possible damages to groundwater. Adequate treatment of solid waste can minimize the environmental impacts and, in some cases, generate income.

Waste destination showed some progress and backslides in surveyed periods. "At Baseline, only four destinations were identified, namely "disposal on vegetation", disposal in BR-929 road margins, burning and sale." All such practices are inadequate as far as environmental preservation is concerned. In subsequent samplings, other forms of waste destination were recorded. Some of them indicated progress, such as collection by the local government, selective collection for further recycling in some cases; however some practices still persist and other inadequate methods not present at Baseline were recorded (Table 17).

Table 17 – Waste Destination in Cangati River HMB at Baseline and Samplings

Waste destination	Baseline	Sampling			
		Aug/06	Dec/06	Jul/07	Jan/08
Vegetation	47	39	22	13	
BR-020 road margins	5			131	3
Burning	139	124	155		161
Burning and sale	20				
Watercourse		4		10	
Burning and vegetation		4		46	7
Local government collection		43	47	100	26
Recycling and burying				7	
Collection and burning					3
Collection / open sky burning					3
Truck collection					10
Burying and burning					3
Partly recycled/partly burnt					3

Source: FAHMA – Family sampling – January/2008, July/2007, December/2006, August/2006 and Baseline

Meetings with community members addressed the occurrence of many previous discussions on waste destination, but even so the practice of giving the waste inadequate destinations still persists. Community members consulted about this matter acknowledged that they used wrong practices, but continue to use them in the absence of other options.

Photo 28 - Detail of a Commemorative Event Involving Children
Source: PRODHAM.

Recording the occurrences of joint activities or actions is aimed to analyze the participation of families, communities and associations in initiatives to address common environmental problems. This has a close relationship with environmental awareness, especially the identification of problems and search for solutions to improve community life quality.

At Baseline, several actions were identified, such as reforestation, river, stream and reservoir decontamination, waste destination, among others. However, in August and December 2006 and January 2008 samplings nothing was observed with respect to such initiatives and actions. In July 2007 sampling, initiatives and actions involving reforestation, river decontamination, basic sanitation and waste destination were repeated, but their number was well below that recorded at Baseline (Table 18). Such records may have derived from failures during field surveys, as at meetings with focal groups where that information was provided there was some controversy, including the record of situations that contradict some information collected during field survey.

9.3. Community Development

Initially, understanding community development requires the identification of associations located in a particular region, which were established to meet their respective members' economic and social demands. Such associations may be organizations of small rural producers, producers of specific products, persons resettled by land reform, or other organizations with special objectives for certain population segments.

In Cangati River HMB, objectives that gave rise to the constitution of associations included qualification to buy rural landed estates financed by Banco da Terra program, search for benefits for communities, search for jobs in work fronts, search for funds from the government, and representation to public bodies.

It is noted that this form of community representation developed from Baseline to that last January 2008 sampling, when the number of associations increased from five to eight (Table 18).

Table 18 – Number of Associations at Baseline and Samplings

Associations	Number of Associations
Baseline Zero	**5**
August/06 sampling	**6**
December/06 sampling	**7**
July/07 sampling	**7**
January/08 sampling	**8**

Source: FAHMA – Association Update – January/2008, July/2007, December/2006, August/2006 and Baseline

Informally, the oldest association if that of Cacimba de Baixo community, which dates back to 1982. It became official in March 1996. Iguaçu Small Producer Association, one of the oldest associations, was informally established in 1984 and became official in 1988. The others have no exact date of informal constitution. Officially, Fazenda São Luiz Community Association was created in 1994; Lages Settlers Association in 2004; and Barra Nova Small Producer Association in 2005.

With respect to the number of members, both in terms of individuals and families, it is quite common the same person to be member of several associations. This was identified at Baseline and samplings. This is explained by the fact that the number of family members exceeds the number of HMB families, like in January 2008 sampling.

Association update held in August 2006 recorded the emergence of a new association named Lages do Inácio Community Small Producer Association, informally established in September 2005 and made official in October of the same year. December 2006 update recorded the emergence of Nuclear Beekeeper Association of Cangati River HMB. That association was informally established in 2002 and became official in 2006. July 2006 update recorded no new associations, but in January 2008 the creation of a new association named Association of Producers and Youngsters of Cangati River HMB was recorded.

In some associations recorded at Baseline, there was some increase in the number of members. That was the case of Cacimba de Baixo, Lages and Fazenda São Luiz Small Producers Associations.

In other associations, as Iguaçu Small Producers Association and Lages Settlers Association, there was some significant reduction in the number of members. However, upon the creation of new associations in August 2006 through January 2008, such members may have migrated to other associations or even lost their interest in associativism (Table 19).

Table 19 – Number of Members at Baseline and Respective Updates

Associations	Baseline	Update			
	No. of Members	Aug/06	Dec/06	Jul/07	Jan/08
B. Nova Small Producers	40	45	45	55	40
C. Baixo & Lages Small Producers	63	63	63	48	67
Iguaçu Small Producers	78	78	78	55	63
Lages Settlers	47	25	25	25	25
Faz. São Luiz Small Producers	50	50	50	74	75
Lages do Inácio Small Producers	0	21	21	22	21
Cangati River HMB Beekeepers	0	0	20	23	20
Cangati River HMB Producers & Youngsters	0	0	—	—	27

Source: FAHMA – Association Update – January/2008, July/2007, December/2006, August/2006 and Baseline

Number of families in associations identified at Baseline increased in Cacimba de Baixo, Lages, Iguaçu and Fazenda São Luiz Small Producers Associations. In Lages Settlers Association there was a significant reduction. Iguaçu Producers Associations recorded an increase of the number of families concomitantly with a reduction of the number of individuals. In Barra Nova Small Producers Association there no change in the membership, which maintained the same number of individuals and families recorded at Baseline (Table 20).

Table 20 – Number of members among Families at Baseline and Respective Updates

Associations	Baseline	Update			
	No. of Families	Aug/06	Dec/06	Jul/07	Jan/08
B. Nova Small Producers	28	28	28	31	28
C. Baixo & Lages Small Producers	53	53	53	36	63
Iguaçu Small Producers	48	48	48	47	55
Lages Settlers	38	13	13	13	13
Faz. São Luiz Small Producers	37	37	37	47	46
Lages do Inácio Small Producers	0	11	11	12	11
Cangati River HMB Beekeepers	0	0	17	18	17
Cangati River HMB Producers & Youngsters	0	0			18

Source: FAHMA – Association Update – January/2008, July/2007, December/2006, August/2006 and Baseline

With respect to organization and operation, all associations have bylaws, scheduled general meetings and periodic meetings. The existence of internal regulations was not identified in any of them.

Over that period, some associations made some changes to their respective bylaws, in addition to changes to their management. Boards comprise chairman, vice-chairman, secretaries, undersecretaries, treasurer, alternate treasurer, corporate board, sport board and administrative board. The number of women occupying management positions has increased throughout updates. This fact shows a greater female participation, but there is no woman occupying the chairman position.

In general, associations obtained projects and financing related to electric power, piped water, water supply infrastructure, purchase of equipment and agricultural costs, construction of houses and purchase of female cattle. That support came from the Government of the State of Ceará through several institutions, São José project, and the Ministry of Land Development. Only in Barra Nova and Lages Producers Associations, Beekeeper Association, and Cangati River HMB Producers and Youngsters Association no external support had been recorded until January 2008.

Importance of associations may also be noted in activities supported by PRODHAM.

PRODHAM allowed individuals and families to participate in actions that generated income and knowledge on the environment, hydroenvironmental practices, production systems and reforestation. Income derived from the construction of hydroenvironmental works, capacity building actions, and implantation and modernization of production systems. Education was focused on environmental awareness.

For evaluation of the strengths and weaknesses of associations by representatives of associations and PRODHAM technical staff, 23 topics were selected, as shown in Table 21. Evaluation results are shown in Table 22.

Topics selected for evaluation of strengths and weaknesses of Associations
1. Association regularization / formalization
2. Internal organization and operation of association
3. Board legitimacy to members
4. Association management and/or financial management
5. Understanding of associativism principles and instruments
6. External influences or pressures
7. Members' interest, engagement and active participation
8. Youngsters' interest / active participation
9. Women's interest / active participation
10. Identification of priorities, work or activity topics
11. Design and implantation of project and/or an activity program
12. Raising and management of funds for selected projects or activities
13. Relationships with State entities (at local and State level)
14. Relationships with or support from other entities or projects (São José, for example)
15. Relation with or support from PRODHAM
16. Articulation and cooperation with other HMB associations
17. Community mobilization
18. Organization of community actions
19. Skills/capacity building (production system /agroecology)
20. Skills/capacity building (soil preservation works and techniques)
21. Skills/capacity building (fund management and environmental education)
22. Skills/capacity building (management, commercialization, credit, etc)
23. Skills/capacity building (rural associativism)

Schedule 1 – Topics selected for Evaluation of Strengths and Weaknesses of Associations

Table 21 – Percent Results of Self-Evaluation and PRODHAM Evaluation from August 2006 to January 2008

Evaluation Specifications	Self-Evaluation				PRODHAM Evaluation			
	Aug/06	Dec/06	Jul/07	Jan/08	Aug/06	Dec/06	Jul/07	Jan/08
Strengths	50.7	40.4	48.9	51.0	71.0	47.2	50.00	47.8
Weaknesses	47.8	57.1	46.7	44.0	25.4	49.1	47.3	50.0
Irrelevant or unknown	1.4	2.5	5.4	4.9	3.6	3.7	2.7	2.2

Source: FAHMA – Family sampling – January/2008, July/2007, December/2006, August/2006 and Baseline

It is noted that association representatives were more severe as compared to July 2007, as 51.0% of 184 possible answers (8 associations x 23 selected topics = 184), 51.0% were considered strengths, 44.0% were considered weaknesses, and 4.9% were considered irrelevant. In relation to 2007, strengths increased by 2.1%, while weaknesses decreased by 2.7%, and irrelevant topics decreased by 0.5% in the same period.

Institutional evaluation by PRODHAM technicians recorded the following performance: 47.6% of answers were considered as strengths, 50.0% as weaknesses, while irrelevant topics reached 2.2%.

In general, it a convergence is noted between self-evaluation and PRODHAM evaluation to strengths, while greater differences refer to items considered irrelevant.

9.4. Participatory Monitoring and Socioeconomic Evaluation

PRODHAM participatory monitoring and evaluation comprised three systems. The first refers to the design of the global PRODHAM matrix. The second refers to monitoring system matrix: indicators per objectives and results. The third refers to the evaluation made by focal groups.

For a socioenvironmental project like PRODHAM, a participatory monitoring approach should take into account the tracking of project results by other involved social actors, especially by local communities that are its most direct beneficiaries. This can be achieved as follows:

- adoption of methodologies promoting the active participation of such actors in monitoring process, which would allow their evaluation of results and perceivable impacts (especially on local social and economic reality) of different project actions to be know by direct consultation;

- inclusion in project monitoring system of some simple indicators (baseline indicators) selected on the basis of those communities' main expectations over the project (what assumes the selection of indicators that reflect the perception of that improvement, and established by both the project and beneficiaries).

Although it may be regarded as less objectively measurable (what actually not always occurs), the type of information that this participatory methodology and such indicators allow to be obtained tends to equilibrate the system with appropriate volumes of relevant qualitative information and give monitoring a greater accuracy and efficiency to collect and analyze information that usually is overlooked in traditional quantitative and qualitative examination.

In short, it can be said that the participatory monitoring system adopted could better reflect the reality of socioeconomic impacts among social segments, whose welfare constitutes the "essential purpose" of Project.

Once the data of families and associations in Cangati River HMB were recorded and the Baseline report was issued, the project participatory monitory started according to the manual of socioeconomic monitoring operation system including the following instruments:

- collection of data through sampling survey of families/producers;

- update of association data;

- meetings with focal groups.

At the end of every twelve months of monitoring procedure application,

a seminar of participatory evaluation of results was held. Such seminars were attended by PRODHAM implantation and supervision teams from Secretariat of Water Resources and Funceme, FAHMA technical staff, representatives of associations and families, and representatives of other social actors involved in project.

Photo 29 – End of a Focal Group Meeting in front of PRODHAM House in Iguaçu, Canindé-CE
Source: PRODHAM.

9.4.1. Family sample sampling

Sampling, according SEM Operation System Manual of Cangati River HMB, comprised two types of samples: permanent and non-permanent. Initial selection of both groups was randomized and stratified at community level, where families of permanent sampling group were repeated in all semi-annual surveys with the objective of obtaining more robust information. This way, permanent and non-permanent samples were constituted of 10% and 20%, respectively, of Cangati River HMB families, selected proportionally to the number of families in each community.

As the total number of Cangati River HMB families sampled at Baseline was 213, total sample is composed of 66 families, being 22 permanent and 44 non-permanent samples (Table 22).

Table 23. Total Number of Families and Number of Sample Members in Five Communities in Cangati River HMB

Community	Total Families	Permanent Sample	Non-Permanent Sample	Total Sample
Barra Nova	21	2	4	6
Cacimba de Baixo	65	7	14	21
Iguaçu	63	6	12	18
Lages	27	3	6	9
São Luiz	37	4	8	12
Total	213	22	44	66

Source: FAHMA – Amostragem das famílias – janeiro/2008, julho/2007, dezembro/2006, agosto/2006 e Marco Zero

Families comprising permanent sample were selected in August 2006 and interviewed at each sampling. Families of non-permanent sample were selected specifically for each sampling.

Quantitative and qualitative information was obtained from semi-structured interviews made by FAHME technicians during their visit to producers. For data survey, a specific form (Family/Producer Record) was used).

9.4.2. Update of association data

Data on associations existing in Cangati River HMB were updated at meetings with their legal representatives. Such meetings were chaired by an expert in community development from FAHMA and held in the same period when family sample data were surveyed.

To update association data, a specific form (Association Record) was used, according to Socioeconomic Monitoring Operation manual of Cangati River HMB.

9.4.3. Focal groups

Focal group is a teamwork methodology aimed to collect detailed information in a particular topic (thematic) from a group of selected participants. The advantage of use of focal groups is that data disclose more information than that obtained from other survey topics (universe of sampling as in the case of PRODHAM). This occurs because participants feel free to disclose the nature and origins of their opinions on a particular matter, thus allowing the surveyors to understand more broadly the issues. (BARBOUR; KITZINGER, 1999; GATTI, 2005).

For PRODHAM action monitoring, it can be considered that the evaluation methodology is that known as triangular, as it involves the census of benefited families per universal and focal group sampling.

Focal groups had the following profile:

a) Thematic groups composed of representatives of local families and associations of Cangati River HMB, aimed to collect information related to baseline indicators at routine organization of meetings to consider, discuss and evaluate the parameters for such indicators.

b) Focal groups addressed seven baseline topics or variables of PRODHAM participatory monitoring system:

- Food safety
- Environmental education and awareness
- Environmental practices and initiatives
- Associativism
- Community development
- Biophysical monitoring

- Participatory monitoring
- All seven topics were addressed by five focal groups, as described below:

Group 1 – Food Safety

Group 2 – Environmental Education and Awareness and Environmental Practices and Initiatives

Group 3 – Associativism and Community Development

Group 4 – Biophysical Monitoring

Group 5 – Participatory Monitoring

Focal group of "PRODHAM biophysical monitoring" topic was supervised by FUNCEME team, and the results from discussions were included in the book published by the Secretariat of Water Resources of the State of Ceará titled "Geoenvironmental Evaluation of Conservational Practices Implemented in Cangati River Microbasin in Canindé-CE".

The following aspects were considered:

a) for each thematic group, an objective questionnaire was prepared for questions to be discussed and evaluated;

b) meetings and workshops of focal groups were chaired by an expert in community development, who acted as facilitator; and

c) participants were invited to compose the focal group, but their adhesion was voluntary.

Taking into consideration that Cangati River HMB has 213 families and 8 producer associations, it was suggested that each group was constituted of 10 members proportionally to the respective number of families, including representatives of all communities/ however, in practice, some meetings were attended by more than 10 members, and others were attended by less than 10 members.

For Group 1 – Food Safety and Group 5 – Participatory Monitoring the quantities indicated in Table 24 were suggested as representatives.

Table 23 – Participation of each Cangati River HMB Community in Focal Groups 1 and 5

Community	Number of Members
Barra Nova	**1**
Lages	**1**
São Luiz	**2**
Iguaçu	**3**
Cacimba de Baixo	**3**
Total	**10**

Source: FAHMA

Members of Group 2 – Environmental Education/Awareness and Environmental Practices/Initiatives were selected in the same way that those of Groups 1 and 5, including two members that were given educational information on environmental preservation, and three members belonging to the family group that had adopted conservational practices.

Group 3 – Associativism and Community Development was suggested to be composed of two members of each community, one of which should represent the local community association.

Members of focal groups were selected as follows:

- Groups 1, 2, 5 and representatives of Group 3 communities were invited among the members of selected families;
- Representatives of Group 3 associations were appointed by the respective associations.

9.4.4. Guidelines for Organization of Sensitization, Discussion and Capacity Building Workshops

Sensitization/discussion or capacity building workshops were held with focal groups, with two objectives: the first was to maintain the focal

group members, as representatives of families, associations and communities, mobilized, sensitized and qualified for continuous participation in Project monitoring. The second objective was to collect qualitative information and analyze the results of PRODHAM actions and their effect and impact on socioeconomic development of families and community as a whole.

The following methodologies were applied to workshops:

- to achieve the first objective, appropriate group activities were used;
- to achieve the second objective, semi-structured interviews were made using previously defined schedule to allow open answers.

That schedule was adjusted during the monitoring and socioeconomic evaluation process, according to suggestions made by focal group members.

For each focal group, discussions were held about local conditions evaluated through Cangati River HMB family/producer records and association records, initially, to establish the Baseline, and then to monitor sampled families and associations. Future perspectives of families, agricultural properties and associations with respect to topics addressed at each focal group were discussed.

Schedule and topics discussed at each focal group are shown below:

Focal Group 1 – Food Safety

a) main sources of income;

b) land ownership and use;

c) main rural productive activities: agriculture, cattle-raising and extractivism;

d) main production infrastructures, equipment and inputs used by family;

e) financing, technologies and technical assistance;

f) family participation in construction of Project infrastructure network;

g) production systems.

Focal Group 2 - Environmental Education/Awareness and Environmental Practices/Initiatives

a) sustainable production systems; and

b) environmental education.

Focal Group 3 – Associativism and Community Development

a) organization and current operation;

b) current membership;

c) support to projects and completed financing; and

d) evaluation of strengths and weaknesses of associations by focal group members.

Focal Group 4 – Biophysical Monitoring

Development of works with this Focal Group was under SRH/FUNCEME responsibility.

Focal Group 5 – Participatory Monitoring

The objective of this focal group was to determine the operational aspects and efficiency of results by examination means.

For that, results listed below, which were obtained by means of examinations, were presented and discussed with members of this focal group:

a) family/producer records;

b) association records;

c) list of works and activities;

d) survey of family sample data;

e) focal groups; and

f) annual participatory evaluation seminars

9.4.5. Summary of Discussions and Suggestions by Focal Groups

Results obtained from focal group meetings were analyzed and summarized based on three factors. The first is the pioneering experience of use of this methodology as a source of studies in rural area to obtain information on producers' thinking in semiarid regions of the State of Ceará hinterland.

The second refers to the preparation of questions asked to members of Focal Groups, that is, what to ask, and the third was the approach or translation of focal groups' opinions and remarks in the Project work process.

Based on such considerations, the summary of discussions and focal group suggestions on Food Safety, Environmental Education/Awareness and Environmental Practices/Initiatives, Associativism and Community Development, and Participatory Monitoring topics are provided below.

a) Summary of FG 1 – Food Safety

The topic of this focal group refers to secure to the human being the basic survival principles by providing them with the basic proteins for a worthy life.

Agricultural activity was the first to be addressed, as food safety matter stood out in producers' perception observed in focal groups, although at Baseline and samplings it was noted that values for livestock and animal breeding exceeded those of agriculture.

Maize and beans are the main crops in HMB. Both maize and beans are produced for consumption, although there is some maize surplus that is

sold, while beans are basically intended for family consumption. That fact was observed in samplings and confirmed by producers at focal group meetings.

However, producers discussed the fact that intercrop maize and bean production exceeds single crop production, but it was reminded that such results were obtained from information provided by producers themselves. Some producers argued that it may have happened because not all producers have an exact notion of their respective production, and other producers expressed their views about the possibility of one or another producer may have failed to inform correctly its production fearing to lose any benefit from the government, such as Family Allowance Program.

With respect to other crops, there are some data at Baseline related to broad bean, rice and cotton production, although they have not been detected at samplings. Producers could not say the reason why those crops were no longer produced. Introduction of new crops in HMB was also the subject matter of several focal groups, but producers mentioned such restrictions as lack of credit and technical assistance, ignorance of management of such crops, and the impossibility of implanting some crops that are inadequate (non-zoned) to the type of HMB soil, and thereby they are not financed by banks or other governmental bodies.

At meetings of that focal group, producers stressed that the major production constraint relates to insufficient precipitation, but this is not the only factor. The lack of financial conditions to increase production was mentioned, as well as the use of obsolete production techniques, insufficient assistance and poor quality seeds.

Such testimonies were repeated by several focal groups. At a particular meeting, the real interest in increasing the production was challenged. Many producers declared that they have interest, but are restrained by the lack of options. PRODHAM works were reminded, the major objective of which is to contribute to increase production. It was noted, however, that there are several reasons for the deficient use of such works.

One of such reasons is that many landowners do not allow cultivation next to such works. Another reason is related to the fact that some producers do not believe that such works will perform well, notwithstanding the positive reports by other producers. There are also those who prefer to continue to produce using the traditional practice, that is, clearing and burning the cultivation area due to the greater simplicity and low cost of that traditional practice. There were also some reports about the fact that some producers prefer to receive governmental grants and by food in the local market instead than increasing production.

Another matter that was much discussed at meetings was the coexistence of agriculture with livestock. On one side, landless producers claim that the landowner's consent for agricultural production is subject to intercropping system, because the landowner is interest in forage and straws. It should be pointed out that, notwithstanding all such constraints, after many focal group meetings there were reports about the progress of the increased use of such works, even at a low level.

Commercialization of agricultural production surplus, according to producers' reports, is basically made by middlemen. There is no type of partnership or understanding among producers on a collective commercialization of surplus sales and input purchases.

Livestock and small animal breeding was another segment discussed in focal group, the importance of which is present in food safety, because of several products derived from those activities. Products and byproducts under analysis refer to bovine, swine, sheep, goat, bee and poultry breeding.

As mentioned previously, value of livestock production exceeds that of agricultural production and generates products for self-consumption and sale. Upon the presentation of the number of animals, there were some questions about them, especially for bovines, at the first sampling. It should be remembered that, in many cases, some producers declared that they not always know the exact number of animals and values, like in agriculture.

In any way, especially in the case of bovines, information from last sampling is consistent with the figures indicated by focal group participants. It was reported that milk production is basically intended for family consumption.

There were reports indicating that livestock product commercialization is similar to that of agricultural surplus, that is, through middlemen.

At Baseline and samplings, the increase of apiculture was perceivable. In focal groups, that activity was confirmed to be promising leading to the creation of the Nuclear Beekeeper Association of Cangati River HMB, in addition to the installation of the Honey House. At focal group meetings, it was informed that commercialization is by direct sale to consumers.

However, at several meetings, there was some expressions of interest in expanding that activity, including by supplying the product to the National Food Supply Company (CONAB). At the last focal group meeting in February 2008, it was detected some lack of motivation in light of constraints to give continuity to the project. They recognized that problems in activity management and organization, although they also recognized the potential that can be recovered by a better management.

b) Summary of FG 2 – Environmental Education Awareness and Environmental Practices/Initiatives l

This topic is hardly discussed in a community where there are more evident signs of ignorance of its importance in the real word.

Even so, some progress could be identified along group discussions. Environmental problems, pollution, water supply, waste collection, reforestation and deforestation, need of inhabitants' awareness of such issues, influence of the environment on food production and other punctual topics were discussed.

Notwithstanding the progress achieved at the meetings of this focal group, much remains to be done in terms of formal and informal environmental education and environmental practices to allow the families living in Iguaçu

district, in Canindé-CE, to overcome the cultural barriers inherited from their ancestors and are still adopted in Cangati River HMB. To expand Iguaçu residents' perception and keep it at a good level, technical curses, behavioral education, presentations, field visits and effective practices of environmental activities are required in the community's daily life.

In analyses and their subsequent discussions, several contradictions were noted in community's view on the topic, on which some comments will be made.

It was noted that in Cangati River HMB populated by 871 inhabitants, the occurrence of pollution of reservoirs, rivers and streams is responsible for water-borne diseases, such as cholera, allergies and leptospirosis, among others.

Origin of that pollution was attributed to the lack of basic sanitation, use of reservoirs for inadequate purposes (cloth and home appliance washing) and waste disposal on river, stream and reservoir margins.

Also with respect to this matter, discussions about waste disposal raised many comments by participants of this focal group. There is no collection or correct disposal for that waste, whether solid or organic waste. Some persons burn the waste in the lack of alternatives, others dispose it outdoors, others bury the waste, and so on. It was observed that correct practices for waste disposal are seldom adopted.

The Municipal Government of Canindé, after having been compelled by community associations, provided drums for waste collection only in Iguaçu district, as reported at meetings. Such drums were not subject to any systematic collection and ended by leading to other types of problems. Most waste included plastic packing, cups and other plastic materials that were spread out along streets, plots of land and depressions close to houses.

At more recent meetings, it was stated that recyclable waste components were collected by people from outsiders, what resulted in no financial return to the community.

Organic waste is intended to animal feeding (swine and poultry). However, death of bovines caused by the ingestion of such products was reported, although the focal group members have no further details on that fact.

They also considered that waste issue is related to the lack of toilets in houses, but they cannot afford to provide that benefit. Attempts to raise funds to construct toilets were unsuccessful. In addition, waste issue outweighs this sanitation problem.

Participants also declared that they foresaw no solution for waste, and collection remained irregular.

When asked about initiatives and actions by individuals and associations with respect to environmental issue, several opinions were expressed. Regarding waste problem, they informed that only one community member recycles, buys and sells waste. It is noted that these are small non-permanent actions that are insufficient to solve the problem, even partially.

The group is aware that, with respect to environmental issues, the community can act without the public sector through educational campaigns in schools to prevent ground burning, to use dead cover and contour line cultivation, avoid deforestation and contribute instead to reforestation and ciliary forest recomposition. It is expected that this will occur by self initiative, although no concrete actions have been expressed with respect to this matter.

With regard to non-occurrence of environmental practices adopted by families' self-initiative, the group does not consider that such environmental practices should be PRODHAM or other institution's initiative. What is lacking it a perception of the possibility of doing things differently, instead of burning the waste or throwing it in open, even being aware of alternatives that are more consistent with the environment and personal health preservation.

They also stated that, although there are good ideas among community leaderships in Cangati River HMB for a harmonious coexistence with the

environment, they are not shared or supported. They affirm that local leading role is not fully taken over by unions and associations, as the former do not give priority to implantation of new initiatives, and associations work deficiently.

As reported, water supply by the public sector is centralized, that is, it does not cover all communities, but only Iguaçu and Cacimba de Baixo, through Companhia de Água e Esgoto do Ceará (CAGECE).

Other water supply sources include water holes, cisterns, wells, reservoirs, clay pits and tank trucks. Use of cisterns for purposes other than human consumption (drinking water) was questioned. Supply by tank trucks occurs when rains are not sufficient, especially to fill cisterns. It was noted that there is still some demand for cistern and other works in HMB, as well as the occurrence of cisterns with structural problems derived from construction process.

With respect to reforestation, information indicates that it was made especially by people engaged in PRODHAM works, and other involved communities with the objective of replacing the ciliary forests. In addition, it was reported that cattle had eaten part of reforestation seedlings. As a contribution to a better adherence to reforestation activities, planting of fruit trees was suggested, such as: cashew, mango, coconut and soursop trees, in addition to *"nin", algaroba, mufumbo, jucá* and *leucaena*.

It was noted that most producers are aware that burning is harmful to the environmental and soil and therefore avoid doing that. Others say that in the first year burning is necessary, but not in the second year. They also mention the lack of funds to prepare soil for plantation. It is noted that many of them are not aware of the problem. Others say that they adopt contour line cultivation and therefore reject burning. In this sense, it was noted that there a great doubt about burning or not. This doubt arises from family tradition.

Also with respect to environmental issues, use of pesticides and agricultural defensives was also addressed. They informed that used pesticides to control bean plagues (worms and grasshoppers), but they expressed their

interest in using natural defensives. For that, they requested training. When asked about the increasing the use of agricultural defensives, they did not agree, as they could not afford it.

Matters about training and other environmental issue aspects were addressed. In this sense, they expressed their interest in presentations on environmental preservation, conservational practices and plague control. In this aspect, events only occurred in 2006, including waste destination, visit to a broom factory in the municipality of Pacoti, and training in production of ecological brooms and recycling.

More recently, the Municipal Government of Canindé through its Secretariat of Education promoted a campaign involving topics related to the environment, waste and dengue. They did not agree with the fact that people engaged in PRODHAM work construction were able to apply them to their agricultural activities. They also informed that farmers use mechanically the hydroenvironmental infrastructure, and require more capacity building, technical assistance and financing.

When requested to list HMB environmental problems, they mentioned the following issues: ground burning, deforestation and lack of sanitation.

In relating production to environmental issue, group members informed that rural producers continue to plant in the traditional manner: they clear and burn the ground and cultivate. Upon PRODHAM start, some stopped burning and started to cultivate in contour lines, being more informed of environmental issues. Those who planted in stone barrier areas also achieved goods results, including water for animals.

The group reported that, to produce in an ecologically and sustainable manner, more profitable crops should be introduced and more modern technologies should be adopted. Inclusion of vegetables was defended.

With respect to animal breeding, it was reported that they are bred

practically on the loose and eat rests of organic waste and liquid effluents (open sky sewage). Food for such animals is supplemented by maize and ration. In this sense, cost of confined or locked animal is higher, but higher sale prices are obtained because they are "clean" animals.

Finally, focal group views about the importance of PRODHAM works was collected, which were contradictory in terms of acceptance and non-acceptance, as reported below.

Some declared that they not believed in the importance or environmental preservation and works because until then they had not perceived any production increase. Others said that maize production increased. Other recognized that such works as stone barriers, terrace and contour line are important because they allowed water storage in the soil. They agreed that stone barriers humidify the soil. Others, more negative, also declared that if they owned some land, would not allow the construction of terraces and stone barriers because they caused accidents and animal fall.

On one side, the group agreed that the community know the results of works, but needs rains.

They also expressed that if no technical assistance is available for agricultural practices, both for a better production and search of more profitable alternatives, PRODHAM works would not be valued.

When asked about successful experiments provided by PRODHAM in that topic, they replied: reforestation in São Luiz, Iguaçu and Cacimba de Baixo communities remained, in addition to ciliary forest recomposition on Cangati River margins. "It was also through PRODHAM that waste collection was started in Iguaçu, by the Municipal Government, including by the provision of drums."

c) Summary of FG 3 – Associativism and Community Development

Associative awareness appears to be weak due to low participation. This

matter was discussed at a meeting of this focal group, where some participants argued that the only way to increase member attendance would be by announcing additional benefits.

Interest in membership is related to the search for benefits, such as retirement, maternity allowance, in addition to other social benefits. They forget that the association has more far-reaching objectives, such as the application for Crop Insurance, which is a compensation for losses in agricultural production when there is a great crop failure due to rain shortage, in addition to increasing the capacity of claiming for benefits to the public bodies and negotiation with private institutions.

Some contradictions in the group were also noted when they relate the receipt of some benefits from the association to membership, when many of such benefits are granted by legal institutional instruments of federal, state and municipal governments, regardless of being or not a member.

It was also reported that at meetings only one person, in general the chairman, expressed his opinions without allowing contradictions by other participants, thus making difficult new ideas to arise after discussions and debates.

With respect to involvement with PRODHAM, many people refuse this relationship because they do not believe in works.

They also reported that several members did not like to take on any positions, such as president of association, because there was no remuneration. They said they would work more and should transfer to the government the obligation of compensate them, arguing that the President of the Republic, the Governor of the State and Mayors are remunerated. They did not perceive that it is the association that establishes that compensation upon drafting its bylaws or at any reform, as it is organized to defend the community interests. The public sector may not transfer public funds to pay expenses incurred by private associative entities of collective interests. This and others aspects confirm the ignorance of what is an association and its governing laws.

It was also noted that work groups are created to tackle problems that are not under rural producer association responsibility, such as cleaning the road margins. This shows a lack of interaction with the public sector, in addition to performing duties that are not provided for in the association bylaws.

Positively, an interest in vocational and associativism courses was noted in each of communities. With respect to vocational courses, options would include electrician, plumber, clay craftwork, hairdresser, manicurist, dressmaker and mechanical activities; associativism courses would include such topics as association operation, bylaws and drafting of meeting minutes.

Another indication of need of courses and training was noted when they were asked "what an association serve for?" The answer clearly showed their ignorance of what an entity of this kind is. The president of an association declared that he did not know. Somebody else said that is served to provide services to the community. Another said that it served for a lot of things, and without it nothing would be obtained, including retirement.

Another president went beyond that and said that an association serves to discuss problems and requested a greater participation of members. They considered that it was the best way to obtain benefits from the government.

With respect to production commercialization through associations, the group expressed their preference for individual commercialization. This contradicts the principles of associativism, as they should operate as a cooperative entity. A group member agreed that the cooperative system was important. Regarding the purchase of inputs under a collective system, the participants said that they did not purchase inputs as there is no return. They exaggerated by saying that not even chicken manure had any return.

At evaluation of strengths and weaknesses of associations by the group, it was noted that weaknesses included, among others, organization and operation, financial management, active participation of members, identification of priorities, design of projects, articulation and cooperation between HMB associations.

Expressions like "members ignore the principles of associativism, they do not know what an association is" were frequently mentioned. Association reorganization was another topic mentioned. At another meeting of this focal group, several boards containing information on HMB were displayed for discussion. Results of such discussions indicated in particular the youngsters' indifference in participating, while adults' engagement is related to obtaining social benefits, such as food basket, maternity allowance, retirement, PRONAF financing, cisterns, etc. It was also mentioned that associations are not united in the fight for common welfare.

An increase in drinking water supply and use by most families of cistern or piped water was highlighted.

It was also said that there was a significant increase in open sky drain. They related that fact to the increased number of houses with piped water, what led to the increase of wastewater. They did not know, therefore, how to reuse wastewater. Other effects on water were mentioned, such as: backwater increase the incidence of gnats, dengue mosquitoes and swine contamination. They attributed such facts to the lack of basic sanitation (piped water and sewerage).

With respect to non-occurrence of joint actions of families in communities or associations to solve environmental problems, the group agreed that such actions really to not exist. They are aware of the need of such actions, but do not interact with one another. Joint actions are frequent only in family groups or close relationships.

At one of meetings, it was asked about the association perspectives for 2007. There was no expression of optimism. Most members declared that they were in default with the association and avoided attending the meetings for that reason. They concluded that upon the termination of PRODHAM the associations will also finish. People do not believe in future, only in present. Contradictorily, many lost their faith in PRODHAM, perhaps because of some delays caused by bureaucratic constraints.

The group was requested to provide information on how associations could operate to increase the family income without the support of PRODHAM. They said that this would only be possible with the integration of associations, what they found difficult due to lack of interest of members. For that, they declared that PRODHAM advice could not be disregarded. This behavior shows once again the disagreement between associations and the lack of skills to design projects.

At a meeting the reason why the objective of many people is not the involvement with associativism was discussed. Several opinions on the matter were discussed. An association president believes that this is why people do not want to worry with associativism and prefer transfer all responsibilities to their presidents. Others believe that this arises from immediacy. In some way they confirm that there is some incredibility in the association capacity to mobilize to reach its progress objectives. Provenly positive results for some communities that mobilized and joined together are known, but even so many people do did not feel motivated.

With respect to associativism courses promoted by PRODHAM, many participants, although aware of the importance of knowledge gained, found that results were insignificant, as many people that participated in the courses did not applied their knowledge to associations, and others did not participate because they considered the courses unimportant.

It was noted that, although the participants confirmed the lack of motivation toward associations, the number of associations increased in the period. This fact was not explained by the group.

Based on information provided by sampled families, income in Cangati River HMB communities was estimated. Many participants found the average income too high. It was pointed out that farmers are disappearing, because old men are losing their strength and youngsters are not willing to work in the land. It was also mentioned by the participants that if the government comes

to extinguish retirements and Family Allowance Program, many people will starve.

For the group, one of successful PRODHAM practices is related to capacity building.

Participants' perception of focal groups was positive. Some of them declared to have perceived that "not everything falls from heavens", emphasizing that meetings provided knowledge that "was not absorbed only by those who did not want to."

d) Summary of FG 5 – Participatory Monitoring

Policies for population participation in promotion programs started in the 1980s. Initially, many of those practices were adopted with a high level of suspicion by social movements and popular leaderships, which perceived some attempts of political co-optation by the government. At that time, the political culture prevailing in several social movements was openly anti-institutionalist. However, in the late 1980s and early 1990s, many leaderships and advisors of such social movements started to be elected as mayors and town councilors. From then to the present days, a great progress has been achieved, although some obstacles remain in the form and performance of participation.

In was in that context of participation development that PRODHAM welcome that experience and adopted it to follow up the actions developed in Cangati River HMB, by submitting this topic to local approval or rejection through existing association representatives.

Initially, some clarifications were made to the focal group on baseline and samplings, as well as on PRODHAM concerns with the environment, water, health, waste and social welfare, the final objective of which would be to improve the life conditions and increase the income of HMB families.

The group role was to discuss PRODHAM operation, including its errors and successes. Meetings of this group started in December 2007.

In this group, the results from other focal groups were discussed. In general, the group believes that results were positive, especially to know what was happening and then identify errors and successes.

The group considered that there are some difficulties to evaluate the other instruments of PRODHAM Socioeconomic Monitoring System, as they do not know their results, such as bi-monthly, half-yearly and annual reports, in addition to other evaluation instruments.

For participants, successful PRODHAM practices included the focal groups, managing board, annual evaluation seminars, and association records, in addition to field surveys.

The group was given the opportunity to make some suggestions for PRODHAM implantation in other communities. Some of such suggestions included:

- alternatives for waste problem;
- association management course;
- replacement of mud houses;
- construction of toilets in houses;
- creation of a managing board since the startup;
- involvement of landowners in project activities;
- Project operation as an activity to support production;
- decentralization of project financial management instead of its concentration in one single entity;
- provision of fruit seedlings by PRODHAM for reforestation, not only from native forest.

9.4.4. Database

A computer-based database was prepared to store and manage PRODHAM socioeconomic monitoring information. Through this database, access to publications and reports produced throughout the experimental monitoring application will be possible. This database is installed in FUNCEME. With the objective of providing all information from PRODHAM experience, a PRODHAM gateway was created, which is available in the website of the Secretariat of Water Resources of the State of Ceará[2].

The database comprises a computer-based system constituted of three units: data entry modules, storage module, and data availability and reference module.

Data entry module was developed in Delphi language through which system monitoring data are inserted.

Storage unit is constituted of a Postgre 8.1 database, which is fed by the data entry module. Availability (output) and reference module was developed in PHP language. Through this module, consultations can be made to monitoring results. Consultations to database can be made by Intranet by formal request.

Upon accessing the reference module, the following options are offered:

- socioeconomic monitoring;
- biophysical monitoring;
- verifiable indicators;
- publications.

9.5. Verifiable Indicators for Cangati River HMB

As provided in SEM Operation System Manual of Cangati River HMB, verifiable socioeconomic indicators comprise the following components:

2 - Available at: www.srh.ce.gov.br.

Component 1 – Hydroenvironmental infrastructure

Component 2 – Production system

Component 3 – Environmental education

Component 4 – Community development

Component 5 – Participatory monitoring

Evolution of verifiable socioeconomic indicators related to family samplings and updates of Cangati River HMB association data during the period of application of monitoring procedures is shown in this topic.

Indicators of Component 1 – Hydroenvironmental infrastructure (biophysical) were not determined, because values of respective variables were not available at the preparation of this report, due to bureaucratic problems with the hiring of the firm responsible for that work. The following indicators were found:

Indicator 1	**Percentage of PEA participation in construction of Project hydroenvironmental infrastructure network.**
2004	**2007**
PEA: 495 individuals **No. of participants: 124** **Indicator 1: Year of 2004 = 25.05%**	**PEA: 543 individuals** **No. of participants: 171** **Indicator 1: Sampling (Jan/08) = 31.39%**
In period at issue, PEA increase by 9.7%, while indicator 1 increased by 25.31%. Thus, in 2004 124 individuals were directly involved with PRODHAM, increasing to 170 in 2007. In addition to presenting a high rate, the indicator increased in the period, showing PRODHAM strong involvement with the benefited community, complying therefore with the innovative strategy, which is the participatory aspect of Project.	

Indicator 2	Percent evolution of population participation in social/productive use of hydroenvironmental infrastructure network and/or water storage/rational use systems.
2004	2007
Total families: 213 No. of user families: 161 Indicator 2: Year of 2004 = 75.59%	Total families: 213 No. of user families in Dec/07: 174 Indicator 2: Sampling (Jan/08) = 81.69%
Considering that most population living in Cangati River HMB are farmers, and PRODHAM practices and technologies are linked to farming production systems, indicators reflect the high and increasing involvement of farmers with the Project.	

Indicator 3	Percent evolution of population participation in social/productive use of hydroenvironmental infrastructure network and/or water storage/rational use systems.
Baseline (2002)	2007
Values not collected	Total families: 213 No. of eligible families until Dec/07: 174 Indicator 3: Sampling (Jan/08) = 81.69%
Information for the baseline comparison year (2002) was not collected because PRODHAM works and actions were just starting. In 2007, however, it was noted that mo than 80% of families was involved or benefited of Project infrastructure and qualitative actions. The high percentage indicates that works and events developed by PRODHAM met the expectations of Iguatu district population.	

Indicator 4	Evolution of number of families upon the adoption of practices recommended by PRODHAM in "winter" and "summer".
1st Half of 2007	2nd Half of 2007
Total number of families: 213 Adopted PRODHAM practices: "Winter" of 2007: 128 Indicator 4: impaired by drought	Total number of families: 213 Adopted PRODHAM practices: Summer 2007: 213 Indicator 4: impaired by drought
Drought occurred in 2007 made the preparation of this indicator impracticable due to agricultural and livestock exploration disorganization.	

Indicator 5	Evolution of gross value of faming production of families.	
2004	2006	2008
GPV - agriculture: R$ 77.422.97 GPV - livestock: R$ 125,429.18 Total: R$ 202,852.15 Total families: 213 Indicator 5: GPV per family = R$ 952.36	GPV - agriculture: R$ 95,253.06 GPV - livestock: R$ 106,956.12 Total: R$ 202,209.72 Total families: 213 Indicator 5: GPV per family = R$ 949.34	GPV - agriculture: R$ 54,385.78 GPV - livestock: R$ 140,828.02 Total: R$ 195,213.80 Total families: 213 Indicator 5: GPV per family = R$ 916,50
It can be said that such three indicators show a stability level that is very common in farming exploration in semiarid zones. It should be pointed out, however, that such values are very low, what requires the search for other forms of family income complementation, especially governmental programs, such as Family Allowance, Rural Retirement, etc.		

Indicator 6	Ratio between consumption value and gross farming production value.	
2004	2006	2008
GPV - total: R$ 202,852.15 Agricultural cons: R$ 56,597.97 Livestock cons.: R$ 92,184.78 Total cons.: R$ 148,782.75 Indicator 6: Consumption/GPV = 73.35%	GPV farming: R$ 202.209.72 Agricultural cons.: R$ 56.377.97 Livestock cons.: R$ 74.310.25 Total consumption: R$ 130.688.22 Indicator 6: Consumption/GPV = 64.63%	GPV total : R$ 195.213,80 Agricultural cons.: R$ 47.305,01 Livestock cons.: R$ 75.523,85 Total cons.: R$ 122.828,86 Indicator 6: Consumption/GPV = 62.92%
As farming exploration is still strongly characterized as subsistence exploration, it is reasonable that all three indicators have high magnitudes. However, a self-consumption is noted, due to increased income from other non-agricultural sources and decrease of production value.		

Indicator 7	Increase rate of number of members of community associations.
2004	2007
Number of members: 278	Number of members: 338 Indicator 4: Increase of members = 21.58%
The indicator shows that 60 people joined as new members of community associations in Cangati River HMB. The most probable reason for that increase derives from the possibility of a most effective performance of those associations as a direct result of construction of hydroenvironmental works with the participation of members, and from the organizational strengthening work that prepared the associations to apply and/or be eligible to benefit of governmental policies and programs.	

10 Major Critical Landmarks

10. MAJOR CRITICAL LANDMARKS

a) Hydrographic microbasins

The major landmark in selected microbasin is the existence of many landless farmers, most of which cultivate their crops under a partnership regime in third party's land. This practice has restricted the performance of economic exploration of hydroenvironmental infrastructures, which were further impaired by two years of scarce precipitation (2005 and 2007).

The construction of stone barriers, terraces, successive dams and underground dams very often in absent owners' land did not allow full economic exploration, as the landowners were not interested in maximizing their land exploration or assign the land to tenants, not even under a formal commitment signed for that purpose.

b) Communities

In communities, the outstanding landmark was the occurrence of many illiterate farmers without a fixed activity, who depended on transfers from the Federal Government and local economic activity focused exclusively on subsistence agriculture.

c) Project management

The major landmark in project management was its variability. During PRODHAM implantation, there were many manager and many changes. Each management change required a long lapse of time for normal resumption of Project, what generated discontinuity in implementation of actions and cost increases.

d) Inter-institutional integration

Inter-institutional integration was quite adversely affected by the lack of synergy and institutional cooperation. Many institutions were invited to join PRODHAM works. As an example of lack of integration, Ematerce, Semace and even the municipal government of Canindé were invited by declined to participate.

11 Proposed Support to Actions and Policies by Entities Involved with Northeastern Semiarid Region Problems

11. PROPOSED SUPPORT TO ACTIONS AND POLICIES BY ENTITIES INVOLVED WITH NORTHEASTERN SEMIARID REGION PROBLEMS

a) For the Government of the State of Ceará and Governmental Agents

This experience is highly effective for Ceará semiarid region, given the holistic nature of attention given to the problem of countryman survival under extremely unfavorable conditions treatment. By operating under physical, social and environmental aspects, PRODHAM places a special emphasis on man as a solution for that problem. Local conditions can be improved, provided that man is able to identify in the environmental where he lives the means necessary to ensure that survival and then growth.

Use of participatory system organization techniques based on environmental recovery works is followed by a decentralized planning to identity potentialities than can be developed, by using all power of local organization for social management.

Notwithstanding the short time of Project monitoring, changes were highly significant. For a more attentive observer, the solution of northeastern semiarid region problems will depend on the recovery of degraded areas, using the successful technologies applied by PRODHAM associated with the continued capacity building of countrymen.

Therefore, for the Government of Ceará and other governmental agents, this is a proposal than can be adopted with small local adaptations.

This way, the main PRODHAM-derived assumptions suggested to public agents include:

- Sustainable technological process: PRODHAM adopted technologies that guided the exploration of traditional and innovative economic

activities based on the sustainable use of natural resources;

- Fight to desertification: all Project works involved actions promoting the adoption of conservational practices aimed to reduce to the extent possible the damages caused by anthropic activities.

- Improvement of soil quality: soils were given a special treatment by PRODHAM actions, as they are the base of economic exploration in rural Ceará.

- Intensification of implantation of hydroenvironmental practices developed by PRODHAM in dry years, like in 2010, as a way to occupy the rural workforce in sustainable activities in the long run.

b) For nongovernmental organizations

Nongovernmental organizations (NGOs) can draw on PRODHAM experience as a great work opportunity for such institutions and an instrument to achieve sustainable development targets.

c) For Banco do Nordeste

Banco do Nordeste, in its capacity of major financing agent for Northeastern region development actions, the major concern of which it the environment, can draw on this experience and work together with other institutions of Northeastern States to implement actions consistent with PRODHAM techniques.

Banco do Nordeste, as a development bank, should lead and coordinate the development agents of all such States, based on the territorial development view, herein delimited by the hydrographic microbasin, in the location where it operates and productive chains are built, which may be expended if supported by other development agencies, where Banco do Nordeste would be the process leader.

d) For international institutions operating in semiarid region

The World Bank, as PRODHAM financing body, showed the other international institutions the importance of trusting in local technical skills to solve their own problems. PRODHAM proved that it was not only an environmental recovery project, but also a high-level local development project. In an environmental recovery process there is an extensive work of development of actions to improve socioeconomic conditions of microbrasin families.

e) For farmers and their associations

The Hydroenvironmental Development Project contributed to the development of a practical approach with the involvement of local community, by implementing sustainable practices that improve soil and vegetation management and preservation in hydrographic basins, increase water conservation, minimize erosion and maximize natural water storage mechanisms with the objective of improving the live of inhabitants of such areas and provide economic sustainability conditions.

By using a methodology for degraded area recovery, based on human resource capacity building and involvement of all farmers and their associations, PRODHAM provided solutions that can contribute to solve problems of farmers in semiarid regions.

f) For teaching institutions

Teaching institutions are now supported by this new education view developed by PRODHAM for semiarid region, based on understanding and awareness of local reality, to identify deficiencies and then find solutions. Nothing can be done without a full understanding of that reality.

Role of schools is, therefore, critical for the dissemination of environmental education across students of different age ranges, in light of its pedagogical aspect.

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