Chapter 4 – EVALUATION OF THE ENVIRONMENTAL IMPACTS OF THE ACTIVITIES PROPOSED FOR THE TARGET AREAS

4.1. Methodological Aspects

(a) Objectives

- Elaboration of a prospective picture of environmental conditions arising as a result of the implementation of the three plans contained in the Plan for Agricultural and Ranching Development in the Northern Region, through an analysis centred on the municipalities of Araguaína and Araguatins;
- Recommendation of measures to prevent, correct or mitigate undesirable environmental impacts; and
- Recommendation of measures to compensate for the suite of inevitable alterations expected which will be beyond the scope of control actions.

(b) Summary of the methodological stages adopted

Taking into account the secondary and primary data collected by the research team, the terms of reference applicable, and the Plan itself, the aim was to form a comprehensive perspective from which to analyse the environmental impacts, and to identify the most significant environmental processes involved.

For this purpose, the work was divided into three stages:

a) Based on the plans contained in the Plan – the Plan for the Diversification of Agricultural and Ranching Activities, the Plan for the Production Nucleus and the Plan for Environmental Conservation – as foreseen in the terms of reference and with the aim of facilitating impact detection, the following basic aspects were considered:

- Plan for the Diversification of Agricultural and Ranching Activities: the principal target populations will be the medium and large scale landowners, there being no need for the opening up of new areas. Expected activities are rotation of crops on degraded pastures with the inclusion of grain crops and pasture improvements.
- Plan for the Production Nucleus: the principal target populations will be small and medium scale producers, with consideration also being given to the possibility of opening up of new areas and community production. Expected activities include: milk production, buffalo farming, pig farming, aviculture, grain production, fruit growing and vegetable production.
- Plan for Environmental Conservation: the principal target populations will be small, medium and large scale landowners. This Plan does not involve the opening up of new areas but includes two production systems: silviculture and agroforestry systems (AFSs).

b) Prioritisation of the analyses of the environmental impacts listed in the terms of reference, while not omitting to mention other impacts that have been detected.

c) Once the environmental impacts of real interest have been defined, identification of mitigatory, optimizing or compensatory measures pertinent to each impact or group of impacts.

(c) Methods

In the process of analysing the environmental impacts, the following steps were taken:

1. Participative method to identify and analyse impacts, involving some 40 hours of meetings of the multidisciplinary team comprising agronomists, a biologist, an economist, a lawyer, an environmental engineer and a journalist specialised in rural development.
2. Having identified the impacts, they were evaluated according to the following parameters to determine their scope and hierarchical priority:
    - Nature: positive (+), when the impact results in an improvement in current environmental quality, or negative (-) when the impact compromises this quality.
    - Magnitude: small (S), moderate (M), or large (L).
    - Scale: localised (L), when the impact occurs in a specific geographic area, or diffuse (D) when the impact could spread to other localities.
    - Duration: temporary (T) when the impact occurs over the short or medium term or over a determined time period; or permanent (P) when the impact does not cease to manifest or occurs whenever the activity is done, seasonal.
    - Degree of resolution achieved by the measures proposed to reduce or make possible a given impact: low (L) when it is difficult to reduce or make possible; or high (H) when it can easily be resolved.
3. Based on their decriptions, the potential impacts were linked to mitigatory measures in the case of negative impacts, or potentialising measures in the case of positive impacts, and categorised according to their context (physical, biotic or human).

During the analysis, measures were proposed which, on account of their importance and scale, should be common to all the plans being studied.

These measures include: incentives for community participation in decision-making; environmental education at all levels; scientific research and validation of sustainable technologies; incentives for community organisation and the strengthening of rural extension services.

Because the Plan is still in the drafting phase, the actors responsible for implementing the proposed measures have not been identified.

4.2. Potential environmental impacts arising from the actions proposed in the Plan for the Diversification of Agricultural and Ranching Activities

Because of the premiss behind the introduction of this production system, namely that it will be established in an area with degraded pastures, some impacts have already occurred and there is therefore an opportunity to correct or minimise them.

4.2.1. Physical Environment

(a) Soil

- Possible occurrence of pluvial erosion due to the practices proposed. (Negative/localised/small/permanent/difficult - low).

Measures:

1. Utilisation of direct drilling;
2. Contour farming.

- Possible increase in wind erosion due to the use of mechanisation. (Negative/localise/moderate/permanent/difficult - low)

Measures:

1. Utilisation of wind breaks;
2. Maintenance of soil cover with crop residues and/or minimum cultivation.

- Possible decompaction of soil due to agricultural practices. (Positive/localised/moderate/temporary/easy - high).

Measures:

1. Minimum cultivation;
2. Use of crops with different rooting systems;
3. Soil correction;
4. Use of appropriate machinery and equipment at each phase of crop management.

- Inihibition of the process of surface run-off and increase in the infiltration of rain water into the soil as a result of soil decompaction. (Positive/localised/moderate/temporary/easy - high).

Measures:

1. Use of minimum cultivation;
2. Use of crops with different rooting systems;
3. Soil correction;
4. Use of appropriate machinery and equipment at each phase of crop management.

- Reduced nutrient loss due to the reduction in surface run-off and better nutrient uptake. (Positive/localised/moderate/temporary/difficult - low).

Measures:

1. Maintenance or improvement in the soil's physical structure;
2. Adoption of practices such as not burning off crop residues, use of deep-rooting plants and their subsequent incorporation into the soil, and the constant incorporation of organic matter.

- Improvement in the physical and chemical qualities of the soil due to the increase in soil organic matter and microbial activity. (Positive/localised/moderate/temporary/easy - high).

Measures:

1. Utilisation of species as a protein bank (*banco de proteínas*) – strips of vegetation grown amongst or near crops and pastures which improve soil fertility and encourage the natural predators of pests;
2. Use of deep-rooting plants;

3. Not burning off crop residues.

- Increase in soil pollution/contamination due to the use of agrochemicals. (Negative/diffuse/large/temporary/difficult - low).

Measures:

1. Soil and water conservation;
2. Utilisation of integrated pest management;
3. Establishment of wind breaks;
4. Maintenance and conservation of areas of permanent environmental protection;
5. Correct disposal of agrochemical packaging;
6. Observance of technical recommendations for the use and application of agricultural inputs;
7. Loading and cleaning of equipment in places remote from water resources.

- Speeding up of nutrient cycling (Positive/localised/small/permanent/easy - high)

Measure:

1. Provide incentives for the development of research into crops which promote nutrient cycling, and the validation of existing technologies.

(b) Water

- Possible eutrophication of water resources downstream due to the use of fertilisers and soil improvers. (Negative/diffuse/moderate/temporary/easy - high).

Measures:

1. Soil and water conservation;
2. Establishment of wind breaks;
3. Maintenance and conservation of areas of permanent environmental protection;
4. Observance of technical recommendations for the use and application of agricultural inputs;
5. Use of alternative measures to increase soil fertility.

- Pollution of water resources downstream due to the use of agrochemicals. (Negative/diffuse/moderate/temporary/easy - high).

Measures:

1. Soil and water conservation;
2. Integrated pest management;
3. Establishment of wind breaks;
4. Maintenance and conservation of areas of permanent environmental protection;
5. Correct disposal of agrochemical packaging;
6. Observance of technical recommendations for the use and application of agricultural inputs;
7. Loading and cleaning of equipment in places remote from water resources.

- Possible alteration in the physical properties of water. (Negative/diffuse/small/temporary/ difficult – low).

Measures:

1. Soil and water conservation;
2. Maintenance and conservation of ciliary forests (*matas ciliares*);
3. Observance of technical recommendations for the use and application of agricultural inputs;
4. Use of minimum cultivation/direct drilling.

- Improvement in the level of the water table due to the improved infiltration of water into the soil. (Positive/diffuse/small/temporary/difficult - low)

(c) Air

- Increase in air pollution due to the increase in suspended soil particles and the emission of pollutants by machinery. (Negative/diffuse/moderate/temporary/difficult - low).

Measures:

1. Appropriate maintenance of machinery;
2. Protection of the soil with organic matter or plant cover;
3. Use of minimum cultivation;
4. Application of corrective measures with effects on climatic conditions (wind and temperature), and the use of appropriate machinery.

- Increase in noise pollution due to the use of agricultural machinery, vehicles and aeroplanes. (Negative/localised/small/temporary/difficult - low).

Measures:

1. Appropriate maintenance of machinery, equipment and aeroplanes;
2. Ensuring compatibility between machinery and equipment.

4.2.2. Biotic Environment

(a) Fauna

- Possible interference in wildlife population densities, especially of avifauna, due to the increased supply of food and the use of agrochemicals. (Negative/diffuse/moderate/permanent seasonal/difficult - low).

Measures:

1. Monitoring of fauna in order to guarantee the application of appropriate management at the right time;
2. Maintenance of natural refuges and shelters.

- Reduction in wildlife due to the destruction of isolated patches of natural vegetation. (Negative/localised/small/permanent/easy - high).

Measures:

1. Minimum suppression of vegetation;
2. Establishment and/or maintenance of ecological corridors.

- Possible contamination of the aquatic ecosystem due to the pollution of water resources by agrochemicals, fertilisers and soil improvers. (Negative/diffuse/moderate/permanent seasonal/difficult - low).

Measures:

1. Soil and water conservation;
2. Integrated pest management;
3. Maintenance and regeneration of ciliary forests (*matas ciliares*);
4. Correct disposal of agrochemical packaging;
5. Observance of technical recommendations for the use and application of agricultural inputs;
6. Loading and cleaning of equipment in places remote from water resources.

- Increase in the activity and microbiological diversity of the soil due to the production system proposed. (Positive/localised/large/temporary/easy - high)

Measures:

1. Utilisation of species as a protein bank (*banco de proteínas*) established amongst pastures;
2. Protection of the soil with crop residues;
3. Utilisation of inter-harvest crops;
4. Utilisation of direct drilling.

(b) Flora

- Increase in pressure on areas with forests and ciliary forests (*matas ciliares*) due to the increased economic activity. (Negative/ localised/moderate/permanent/difficult - low)

Measures:

1. Environmental education;
2. Strengthening of the agencies responsible for environmental inspection and control;
3. Utilisation of areas which have already been opened up for agriculture and/or ranching.

- Possible introduction of exotic species brought in with purchased seed. (Negative/diffuse/small/permanent/easy - high).

Measures:

1. Utilisation of high quality seed from trustworthy sources (inspected and certified);
2. Disinfection of machinery, equipments and vehicles;
3. Soil and water conservation measures.

- Possible clearing of isolated patches of natural vegetation in agricultural areas due to the mechanisation crop management. (Negative/localised/small/permanent/easy - high).

Measure:

1. Strategic replacement of native species.

- Increase in pasture productivity due to improvements in soil quality. (Positive/localised/large/temporary/easy - high).

Measures:

1. Appropriate herd and pasture management;
2. Monitoring of soil quality.

- Reduction in the use of burn-off (*queimadas*) due to type of agricultural practice introduced (Positive/diffuse/moderate/temporary/easy - high).

Measures:

1. Implementation of environmental education programmes;
2. Utilisation of technological alternatives to the practice of burn-off;
3. Construction of firebreaks;
4. The use of burn-off only under appropriately controlled conditions.

Socio-Economic Environment

(a) Education

- Increase in the demand for schools and education due to the increased immigration of rural workers. (Positive/localised/small/permanent/easy - high).

Measures:

1. Meeting the demand for educational structures;
2. Strengthening of social organisation.

- Greater demand for training due to the technological changes that will be introduced under the proposed system. (Positive/localised/moderate/permanent/easy - high).

Measures:

1. Strengthening rural extension and training agencies;
2. Ensuring the continuity of the process of rural extension;
3. Integration of research and rural extension activities.

(b) Health

- Possible contamination of rural workers by agrochemicals and increase in chronic diseases over the long term. (Negative/localised/moderate/permanent seasonal/easy - high).

Measures:

1. Appropriate storage of agrochemical products;
2. Utilisation of biological controls and integrated pest management;
3. Use of appropriate safety equipment;
4. Correct disposal of agrochemical packaging;
5. Observance of technical recommendations for the use and application of agrochemicals;
6. Appropriate management of agrochemical products and equipment used in their application;
7. Loading and cleaning of equipment in places remote from water resources;
8. Monitoring of the health of the rural population.

- Increase in the demand for health services due to the increased immigration of rural workers. (Negative/localised/small/permanent/easy - high).

Measures:

1. Appropriate adaptation of health care structures to meet the new reality;
2. Development of preventative public health programmes;
3. Environmental education.

- Possible increase in work-related accidents due to the demands of the technologies that will be utilised (machinery). (Negative/localised/small/permanent seasonal/easy - high).

Measures:

1. Provide incentives for the adoption of security measures at work;
2. Training of operators in the management of machinery and equipment;
3. Promotion of the use of machinery and equipment in ways that imply a lower risk of accidents.

- Increase in the need for basic sanitation due to the increase in local population. (Positive/localised/small/permanent/easy - low).

Measures:

1. Ensure that the provision of sanitation systems is adequate to meet demand;
2. Environmental education.

(c) Organisational Systems:

- Increase in the demand for organisation due to the need for access to inputs and to markets. (Positive/localised/moderate/permanent/difficult - low).

Measures:

1. Skills building and training in associative and cooperative processes;
2. Provision of permanent advisory services to associative organisations.

- Possible emergence of small human settlements in rural areas due to the increased immigration into the region. (This could possibly occur but, due to the complexity of the issue, it is necessary to define the exact location of the settlement in order to make judgements as to its impact.)

(d) Economic Systems:

- Increase in family income over the medium to long term due to the increase in productivity. (Positive/diffuse/large/permanent/easy - high).

Measures:

1. Maintenance of the social organisation of rural producers;
2. Administrative, technical and financial management of the production system and its externalities.

- Increase in the demand for financial capital due to the need for more investments. (Positive/localised/large/temporary/easy - high).

Measures:

1. Analysis of the economic viability of sources of finance;
2. Search for new partners and other alternatives to reduce the cost of investment;
3. Creation of new sources of finance.

- Direct and indirect job creation. (Positive/diffuse/large/permanent/easy - high).

Measures:

1. Prioritise the direct employment of local labour;
2. Provide incentives for the expansion of job-creating activities;
3. Provide fiscal incentives (support for this measure among the research team was not unanimous).

- Concentration of income in male hands. (Negative/localised/small/permanent/difficult - low).

Measure:

1. Creation of alternative income sources for women.

(e) Market Systems:

- Increase and diversification in the supply of agricultural and ranching products due to the diversified nature of production and the increase in the number of producers. (Positive/diffuse/large/permanent/easy - high).

Measure:

1. Provide incentives for the research and dissemination of technologies geared towards crop diversification.

- A more regular supply of products due to the increase in the number of producers (Positive/diffuse/large/permanent/easy - high).

Measures:

1. Creation of transport and storage infrastructure;
2. Organisation of the commercialisation of production (when and how much to plant).

- Improvements in the quality and availability of animal feed. (Positive/diffuse/large/permanent/easy - high).

Measure:

1. Dissemination of the technology of the use of supplementary sources and alternatives for animal feed.

- Possible emergence of agro-industry due to the increased production of raw materials. (Positive/diffuse/moderate/permanent/easy - high).

Measures:

1. Promote improvements in local infrastructure;
2. Government incentives for agro-industry;
3. Provide incentives for the organisation of producers and thereby facilitate the creation of agro-industries.

- Intensification of the commercialisation of agricultural inputs, machinery and equipment. (Positive/diffuse/large/permanent/easy - high).

Measure:

1. Ensure the continuation and expansion of crop rotation plans.

- Increase in land prices. (Negative and positive/localised/large/permanent/difficult - low).

- Increase in cattle herds due to the increase stocking capacity of pastures. (Environmentally negative due to the contamination of ground water and the emission of greenhouse gases/diffuse/small/permanent/difficult - low; and economically positive because it increases the producer's profitability and the supply of products/diffuse/moderate/permanent/easy - high).

Measures:

1. Use of animal manure to increase soil fertility;
2. Use of watering troughs sited in places remote from water resources;
3. Provide incentives for research into the development of practices that mitigate this impact;
4. Appropriate herd management;
5. Use of more productive forage crops.

- Increase in the stocking capacity of pastures. (Positive/localised/large/temporary/easy - high).

Measures:

1. Soil fertility management;
2. Herd management.

- Increase in the demand for infrastructure (warehouse, roads and other forms) due to the increased production of grains (Positive/localised/large/temporary/easy - high).

Measure:

1. Promotion of the integrated planning of government actions for economic development and infrastructure.

- Increase in the demand for animal and plant health inspection services as a result of market requirements. (Positive/diffuse/large/permanent/easy -high)

Measure:

1. Strengthen the health inspection agencies responsible for overseeing agricultural and ranching activities.

4.3. Potential environmental impacts arising from the activities proposed in the Plan for the Production Nucleus (community production area)

4.3.1. Physical Environment:

(a) Soil

- Possible occurrence of soil erosion by the action of rain and wind due to the production system. (Negative/localised/moderate/permanent seasonal/difficult - low).
- Possible compaction and loss of soil structure due to the intensification of agriculture and ranching. (Negative/localised/due to the lack of detailed information on the projects, further evaluation of this impact cannot be defined by this study).
- Possible loss of soil nutrients due to erosive processes and the use of irrigation. (Negative/localised/small/permanent seasonal/difficult - low).
- Increase in soil pollution/contamination due to the use of agrochemicals, fertilisers and the release of animal manure. (Negative/diffuse/large/permanent seasonal/difficult - low).

Measures:

1. Use of animal manure in increasing soil fertility;
2. Soil and water conservation;
3. Integrated pest management;
4. Observance of technical recommendations for the use and application of agricultural inputs;
5. Protection of soils with crop residues;
6. Use of inter-harvest crops;
7. Direct drilling;
8. Appropriate herd and pasture management;
9. Monitoring of soil quality;
10. Soil improvement;
11. Appropriate use of machinery and equipment in each phase of crop management;
12. Maintenance and/or improvement of the physical structure of the soil;
13. Adoption of practices such as not burning off crop residues, use of deep-rooting plants and subsequent incorporation of these into the soil, and the constant incorporation of organic matter;
14. Biological pest control;
15. Appropriate maintenance of machinery;
16. Application of measures which favourably influence climatic conditions (wind and temperature) and of appropriate machinery;
17. Ensuring compatibility between machinery and equipment;
18. Use of species as a 'protein bank' (*banco de proteínas*) established amongst pastures.

(b) Air

- Increase in air pollution due to the increase in suspended soil particles and the emission of pollutants by machinery. (Negative/diffuse/moderate/temporary/difficult - low).
- Increase in noise pollution due to the use of machinery and vehicles. (Negative/localised/small/temporary/difficult - low).

Measures:

5. Appropriate maintenance of machinery;
6. Protection of the soil with organic matter or plant cover;
7. Use of minimum cultivation;
8. Application of measures which favourably influence climatic conditions (wind and temperature) and of appropriate machinery.

(c) Water

- Deterioration in water quality in regions downstream. (Negative/diffuse/large/permanent/difficult - low):
  (a) Possible eutrophication and pollution of water resources downstream as well as contamination of the aquatic ecosystem due to the use of fertilisers and soil improvers, animal manure, agricultural and ranching residues and agrochemicals.
  (b) Possible alteration of the physical properties of water.
  (c) Reduction in water volume due to agricultural use and through sedimentation.
  (d) Possible contamination of ground water due to intensive agricultural and ranching activities.
  (e) Increase in the risk of water contamination due to the intensification of activitiy with a greater number of producers.
  (f) Increased pressure on ciliary forest (*mata ciliar*).

Measures:

1. Soil and water conservation;
2. Establishment of wind breaks;
3. Maintenance and conservation of areas of permanent environmental protection and of the ciliary forests (*matas ciliares*);
4. Observance of technical recommendations in the use and application of agricultural inputs;
5. Utilisation of alternative ways of increasing soil fertility;
6. Integrated pest management;
7. Appropriate disposal of agrochemical packaging;
8. Use of direct drilling;
9. Environmental education;
10. Appropriate irrigation management;
11. Treatment of effluents;

12. Monitoring and evaluation of water quality;
13. Closer control of the issuance of water rights;
14. Strenghtening of water resource management agencies;
15. Use of animal manure to increase soil fertility;
16. Utilisation of drinking troughs located in places remote from water resources;
17. Loading and cleaning of equipment in places remote from water resources;
18. Strengthening the agencies responsible for environmental inspection and control;
19. Biological pest control;
20. Monitoring the health of the rural population.

4.3.2.Biotic environment:

(a) Fauna

- Possible interference in wildlife population densities, especially avifauna, due to the increase in food supply and the use of agrochemcials. (Negative/diffuse/moderate/permanent seasonal/difficult - low).
- Reduction in wildlife due to habitat destruction. (Negative/localised/ moderate/permanent/difficult - low).

Measures:

1. Monitoring fauna to ensure the application of appropriate management at the right time;
2. Maintenance of natural refuges and shelters;
3. Prioritisation of areas which have already been altered by human activity;
4. Establishment and/or maintenance of ecological corridors.
5. Appropriate disposal of agrochemical packaging;
6. Strengthening of the agencies responsible for environmental inspection and control;

(b) Flora

- Increased pressure on and suppression of native vegetation due to increased economic activity. (Negative/ localised/large/permanent/difficult - low).
- Possible introduction of exotic species brought in with purchased seed, saplings and animals. (Negative/diffuse/large/permanent/difficult - low).
- Reduced use of burn-off (*queimadas*) due to the agricultural practices introduced. (Positive/localised/moderate/temporary/easy - high).
- Alteration of the landscape. (Positive and negative/localised/moderate/permanent/ difficult – low). The nature of this impact was adjudged to be both positive and negative due to the influence of cultural factors which are different and temporary).

Measures:

1. Maintenance and regeneration of ciliary forests (*matas ciliares*);
2. Utilisation of areas whichhave already been opened up;
3. Use of high quality seed from trustworthy sources (inspected and certified);
4. Use of technological alternatives to burn-off;
5. Establishment of fire breaks;
6. Controlled use of burn-off;
7. Use of wind breaks;
8. Maintenance and conservation of areas of permanent environmental protection and legal reserves.

4.3.3. Human Environment

(a) Social:

- Loss of traditional production values due to the substitution of current systems by the system proposed. (Negative/localised/moderate/permanent/difficult - low)

(b) Education

- Increased demand for schools and education due to the increased immigration of rural workers. (Positive/localised/moderate/permanent/easy - high).
- More demand for training as a result of the technological changes to be established by the proposed system. (Positive/localised/large/permanent/easy - high).

Measures:

1. Strengthening of decisions made at a local level, and of the government agencies involved;
2. Meeting the demand for educational structures;
3. Promoting and strengthening social organisations;
4. Strengthening rural extension and training agencies;
5. Ensuring the continuity of the process of rural extension;
6. Integration of research and rural extension activities;
7. Provision of incentives for the research and dissemination of technologies geared towards crop diversification.

(c) Health

- Possible contamination of rural workers by agrochemicals and an increase in chronic diseases over the long term. (Negative/localised/large/permanent seasonal/easy - high).
- Increase in the demand for health services due to the increased immigration of rural workers and the intensified use of agrochemicals. (Negative/localised/ moderate/permanent/easy - high).
- Possible increase in work-related accidents due to the requirements of the technologies that will be utilised (machinery). (Negative/localised/small/permanent seasonal/easy - high).
- Increased need for basic sanitation facilities due to the increase in local population. (Positive/ localised/small/permanent/easy - high).
- Contamination of products due to the use of agrochemicals. (Negative/localised/ moderate/permanent/easy - high).

Measures:

1. Use of safety equipment;
2. Appropriate management of products and equipment used in their application;
3. Monitoring the health of the rural population;
4. Ensuring that health care structures are suited to the new reality;
5. Development of preventative public health programmes;
6. Promotion and adoption of safety measures at work;
7. Training operators in the management of machinery and equipment;
8. Promote the use of machinery and equipment in ways that imply a lower risk of accidents;
9. Ensure that sanitation structures are sufficient to meet demand.

(d) Organisational systems

- Increase in the demand for organisation due the the characteristics of the plan (community production). (Positive/localised/large/permanent/difficult - low).
- Increase in human settlements in rural areas of the project due to the increased immigration into the region. (This could possibly occur, but due to the complexity of the issue, any evaluation of the resulting impact will require more details on the project).

Measures:

1. Training and skills building in associative and cooperative processes;
2. Provision of permanent advisory services for associations and associative organisations;
3. Promotion and strengthening of the social organisations of rural producers;
4. Administrative, technical and financial management of the production system and its externalities.

(e) Economic factors

- Increased production. (Positive/diffuse/moderate/permanent/easy - high).
  (a) Increase in family income over the medium and long term due to the increase in productivity.
  (b) Reduction in the risks of rural productive activity due to the diversification of products.
  (c) Increase and diversification in the supply of agricultural and ranching products;
  (d) Intensified commercialisation of agricultural inputs, machinery and equipment;
  (e) Improved quality and availability of animal feed;
  (f) A more regular supply of products as a result of the intensified production.

Measures:

1. Strengthening the agencies responsible for rural extension and training;
2. Ensure the continuity of the process of rural extension;
3. Integration of research and rural extension activities;
4. Appropriate management of products and the equipment used in their application;

5. Training operators in the management of machinery and equipment;
6. Provision of incentives for the research and dissemination of technoloiges geared towards the diversification of crops.

- Increase in the number of animals due to the establishment of new production systems. (Economically positive because this increases producers' profitability and increases product supply/diffuse/large/permanent/easy - high). (Environmentally negative/diffuse/ moderate/permanent/difficult - low).

Measure:

1. Utilisation of drinking troughs located in places remote from water resources.

- Influence on economic trends.
  (a) Increased demand for financial capital due to the need for greater investment in agricultural and ranching activities. (Positive/localised/moderate/temporary/easy - high).
  (b) Direct and indirect job creation. (Positive / localised/moderate/permanent/easy - high).
  (c) Family participation in the generation of income. (Positive/localised/ moderate/permanent/easy - high).
  (d) Increase in land prices (Negative and positive/localised/moderate/permanent/difficult - low). The nature of this impact was evaluated in two ways; it was adjudged to be negative in view of the speculation in real estate and the concentration of lands and also of social exclusion; and positive due to the increased ability of rural landowners to obtain credit, and the increase in business capital).
  (e) Heating up of the local economy. (Positive/diffuse/moderate/permanent/easy - high).
  (f) Possible emergence of agro-industry due to the increase in, and more regular production, of raw materials. (Positive/diffuse/moderate/permanent/easy - high).

Measures:

1. Strengthening of social organisations;
2. Appropriate storage of products;
3. Administrative, technical and financial management of the production system and its externalities;
4. Analysis of the economic viability of existing sources of finance and the creaation of new ones;
5. Search for partnerships and other alternatives to reduce the cost of investment;
6. Support for agricultural and ranching activities;
7. Creation of transport and storage infrastructure;
8. Government incentives for agro-industry;
9. Incentives for the organisation of producers thereby promoting the creation of agro-industries.
10. Prioritisation of the direct employment of the local workforce.

- Lack of homogeneity of benefits due to the limitation of beneficiaries. (Negative/localised/large/permanent/difficult - low).

Measures:

1. Development of research for rural family farmers with scarce land and capital but who have productive potential;
2. Integration with programmes directed at the poorer sectors of the rural population with a view to increasing production whether through technology or through models founded on rural workforce cooperation;
3. Agro-environmental education at all levels;
4. Meeting the demand for education;
5. Strengthening and ensuring the continuity of agencies responsible for rural extension and training;
6. Monitoring the health of the rural population;
7. Ensuring that health care structures match the new reality, and the development of preventative public health programmes;
8. Training operators in the management of machinery and equipment;
9. Promotion of the use of machinery and equipment in ways which minimise the risk of accidents;
10. Training and skills building in associative and cooperative processes;
11. Provision of permanent advisory services to associations and associative organisations;
12. Promotion and strengthening of the social organisations of rural producers;
13. Administrative, technical and financial management of the production system and its externalities;
14. Provision of incentives for research into technologies adapted to safeguard the traditional culture of local communities.

4.4. Potential environmental impacts arising from the activities proposed in the Plan for Environmental Conservation

4.4.1. Silviculture

(a) Physical Environment / Biotic Environment

- Environmental problems caused by the change in land use:
  (a) Possible loss of biodiversity. (Negative/diffuse/moderate/permanent/difficult - low)

Measures:

1. Ensure the viability of conservation units in the project's zone of influence;
2. Environmental education;
3. Search for technical cooperation at national and international levels.

- Influence on soil quality. (Positive/localised/large/permanent/easy - high).

(a) Increase in organic matter;
(b) Improvement in the soil's physical conditions;
(c) Greater soil protection against bad weather;
(d) Reduction in erosion and consequent reduction in the sedmentation of rivers;
(e) Reduction in the leaching of nutrients;
(f) Regulation of water flows;
(g) Reduction in the risk of soil compaction;
(h) Interference in the microbial activity of the soil.

Measures:

1. Establishment of systems with greater density;
2. Use of species which provide more plant cover;
3. Use of leguminous plants;
4. Preferential use of perennially leafy species.

- Increase in the risk of pollution of water resources and contamination of living things by inputs. (Negative/difffuse/smalle/temporary/easy - high).

Measures:

1. Soil and water conservation;
2. Integrated pest management;
3. Establishment of wind breaks;
4. Maintenance and conservation of areas of permanent environmental reserves;
5. Appropriate disposal of packaging;
6. Observance of technical recommendations for the use and application of agricultural inputs;
7. Loading and cleaning of equipment in places remote from water resources;
8. Utilisation of alternative ways of improving soil fertility.

- Increased in the risk of forest fires. (Negative/ localised/ large/ permanent seasonal / difficult – low).

Measures:

1. Monitoring and control of burn-off activities (*queimadas*);
2. Construction of fire breaks;
3. Utilisation of wide field and forest tracks as a safety measure.

- Increase in the withdrawal from the soil of specific nutrients. (Negative/localised/large/ permanent/difficult - low).

Measure:

1. Alternating use of forest species with different nutrient demans, and replacement of nutrients.

- Increase in the incidence of pests and diseases due to the loss of biodiversity. (Negative/diffuse/large/permanent/difficult – low).

Measures:

1. Biological control;
2. Integrated pest management;
3. Rotations including other forest species.

- Difficulty of pulling up stumps in order to change productive activities. (Negative/localised/ large/permanent/easy - high)

Measures:

1. Use of species that produce new shoots from stumps;
2. Change to agroforestry systems.

- Possible erosion/compaction of the soil due to the felling system adopted. (Negative/localised/small/temporary/easy - high)

Measures:

1. Use of equipment with appropriate rolling and pulling systems;
2. In the case of timber, adopt a regime of cutting in alternate strips.

- Landscape alteration. (Positive and negative/ localised/moderate/permanent/difficult - low. The nature of this impact was considered to be both negative and positive due to the influence of cultural factors which are different and temporary).

- Interference in local culture due to the change in activity. (Negative/localised/moderate/permanent/difficult - low).

Measures:

1. Strengthening of decision-making at local level;
2. Strengthening of the government agencies involved;
3. Promotion and strengthening of the organisations of civil society;
4. Promotion of research and dissemination of technologies geared toward the cultural diversification.

- Possible pressure on ground water. (Negative/localised/moderate/permanent/difficult - low).

Measures:

1. Utilisation of species with lower rates of evapotranspiration, soil and water conservation; (conservation projects in local watersheds and others).

(b) Human Environment

- Insufficient mastery of existing techniques by the actors involved. (Negative/localised/moderate/temporary/easy - high).

Measure:

1. Promotion of skills-building courses among the actors involved.

- Insufficient technology and insufficient validation of existing research. (Negative/diffuse/moderate/temporary/easy - high).

Measure:

1. Provision of incentives for research and technology validation.

- Increased risk of work-related accidents due to forest management. (Negative/localised/moderate/permanent/easy - high).

Measures:

1. Use of safety equipment;
2. Skills-building courses for rural workers;
3. Use of the safest machinery and equipment.

- Influence on economic activities. (Positive/diffuse/moderate/permanent/easy - high).
  (a) Increase in opportunities for both direct and indirect employment.

(b) Activation of the local economy.
(c) Possible increase in timber processing industry.
(d) Increase in the income of the actors involved.
(e) Increase in pressure for infrastructure improvements.
(f) Activation of the export of forest products and by-products with a positive effect on the balance of payments.
(g) Greater female participation in the labour force;
(h) Increased demand for financial capital.

Measures:

1. Prioritise the employment of the local workforce;
2. Publicise the results;
3. Search for cheaper sources of finance at national and international levels;
4. Improvement in infrastructural support for production and commercialisation;
5. Government incentives for the development of the proposed activities.

- Increase in forest area

(Positive/diffuse/large/permanent/easy - high).

(a) Reduced pressure on native vegetation.
(b) Increased absorption of CO_2 or maintenance of carbon stocks.
(c) A pleasanter climate bringing marginal benefits for society.
(d) Alteration in local hydrological cycles (Positive / diffuse / small / permanent / easy - high).

Measures:

1. Environmental education;
2. Publicise benefits;
3. Provde incentives for the creation of forest nurseries for sapling production.

4.4.2. Silvipastoral and agroforestry systems

For the purposes of this analysis, the following systems were considered: "Taungya", which consists of a mixture of agricultural crops and tree species with the latter planted fairly close together so that their canopies touch; and "Alley Cropping", where the trees are planted between the rows of the agricultural crops for foliar biomass production using fast-growing leguminous tree species which produce abundant vegetation and common agricultural crops grown in strips either amongst the trees or in separate bands.

(a) Physical Environment:

The positive impacts identified were:

- Maintenance or improvement in the physical quality of water resources due to the reduction in the washing off of solid particles by rain water;
- Reduction in soil erosion due to the protection offered by the trees with consequent inhibition of surface run-off and an increase in the infiltration of rain water into the soil;
- Reduced loss of soil nutrients due to the reduction in surface run-off and the more efficient use of nutrients;
- Improvements in the physical and chemical qualities of the soil due to the fall of leaves and twigs from the trees;
- Speeding up of nutrient cycling;
- Raised ground water levels due to the promotion of the percolation/infiltration processes, with consequent regularisation of the flow in watersheds;
- Possible utilisation of marginal lands in order to recuperate their abiotic resources.

The negative impacts are:

- Accelerated loss of soil nutrients due to the increased export of products and the increase in nutrient cycling in the deeper layers; and
- Depreciation in the chemical quality of water due to the use of biocides.

The silvipastoral system shows other negative aspects, namely:

- Promotion of the processes of seed dissemination and germination due to the grazing of cattle;
- Increase in damage and mortality among trees due to the grazing and trampling of cattle;
- Possible reduction in pasture productivity due to excessive shading; and

- Possible increase in cattle diseases due to excessive local humidity.

The Taungya system also shows other negative aspects, namely:

- Possible damage to the forest component due to machanised crop management;
- Possible increase in certain pests and diseases due to the creation of an environment which is propitious for their development.

Nutrient cycles in agroforestry systems are worse than those found in natural forests due to the off-take of products (fuelwood, fruit, leaves, timber, sap, and others). In considering the use of nitrogen, attempts should be made to use plants and trees that fix nitrogen (leguminous species). Because it is deficient in acid tropical soils, phosphorous is a limiting factor as there are no sources of phosphate fertilisers in the western Amazon region.

(b) Biotic Environment:

The positive impacts are:

- Better use of the factors of production by the components, due to their greater soil cover;
- Increased crop and pasture productivity due to the improved quality of the site;
- Increase in the biodiversity of wild animals, due to the increased supply of food, shelter and refuge;
- Potential to realise interconnections between forest fragments thus enabling genetic flow in plant and animal populations;
- Increased capacity to support wild animals due to the increase in the area occupied by vegetation;
- Improved local microclimate with a reduction in microclimatic variation due to the presence of tree vegetation; and
- Reduced incidence of weeds due to shading and greater soil cover. This is also true for the Alley Cropping system.

The negative impacts are:

- Possible reduction in populations of terrestrial fauna and icthyofauna due to contamination of the food chain through the inappropriate use of biocides;
- Possible reduction in the productivity of some crops due to allelopathy and interspecific competition;
- Increased interspecific competition for light, water and nutrients.

(c) Human Environment

With regard to the human environment, the positive impacts of the systems under analysis are:

- Yields of a range of products, due to the diversification of production;
- Greater economic returns due to the increase in productivity;
- Possible utilisation of the systems for the recuperation of degraded areas;
- Minimisation of visual impact due to bushy vegetation cover.

For the Taungya and Alley Cropping systems, the following positive impacts can be added:

- Better distribution of demand for labour throughout the year due to the variety of crops;
- Retention of rural populations, due to better distribution of demand for labour throughout the year and the increase in income;
- Potential for the utilisation of the labour of all family members (men, women and children);
- Improved farmer nutrition because of the diversity of products;
- Minimisation of production losses;
- Reduction in the costs occasioned by weeds and pests due to the enabling of natural control mechanisms;
- Reduced ingress of solid particles into water resources due to reductions in erosive processes.

The negative impact on the human environment of all the systems studied is:

- Increase in public health problems due to water contamination and possible contamination of workers.

Measures:

1. Use of safety equipment;
2. Appropriate management of products and of the equipment used in their application;
3. Monitoring the health of the rural population;
4. Promotion and adoption of safety measures at work;
5. Training operators in the management of machinery and equipment.

- Influence on economic activities
  - (a) Increase in productivity through the development and dissemination of technologies (research and extension);
  - (b) Formation of well-organised associations or cooperatives to interract between the markets and the products of the organisations' members;
  - (c) Skills-building courses for small, medium and large scale rural producers.
- Recommendations for research:
  1. Identify and select native and exotic species for agroforestry systems and silviculture in the context of the Amazon region.
  2. Establish active germplasm banks for species with potential for agroforestry systems.
  3. Genetic improvement of native and exotic species with potential for agroforestry systems and silviculture.
  4. Identification, selection and enhancement of agroforestry systems and silviculture in economic, ecological and social terms.
  5. Establish agroforestry systems for demonstrative purposes.
  6. Development and/or adaptation of technologies for the industrial use of regional raw materials of plant origin.
  7. Develop alternative sources of regional raw materials of plant origin for animal feed.
  8. Development of sapling nurseries for native forest species, fruit trees, palms and timber species.
  9. Agro-economic evaluation of the association of annual crops with or in rotation with perennial crops.
  10. Development of agronomic techniques to obtain greater productivity in agroforestry systems.

4.4.3. Forest conservation projects

The following section contains some considerations on other aspects of the Plan for Environmental Conservation.

(a) Forest protection:

- Supply of diverse types of food and goods.
- Genetic bank of germplasm.
- Effective erosion control.
- Regulation of water flows.
- Reduced sedimentation in rivers.
- Buffer zone against the propagation of insects and diseases.
- Conservation of biodiversity which is a natural gene bank.
- Source of plant alkaloids for the control of pests and diseases, for medicine and in industry.
- Rich knowledge of the relation between the forest and man for use in medicine, in industry and other sectors.
- Improved microclimate, reducing the size of temperature variations, maintaining a cool layer of humid air and improving the local climate (Bank, 1978, cited by Nacimento, 1988).
- More amenable interactions between the elements that make up the ecological system (Bank, 1978, cited by Nacimento, 1988).
- Service in containing gully erosion in areas of steep or broken terrain.
- Regularity of hydrological cycles.
- Habitat of thousands of plants and animals.
- Forests have educational, cultural and scientific value.
- Recreational and touristic values.

(b) Utilisation of natural forests

1. Preservation of examples of ecosystems.
- Allows the continuation of evolutionary processes.
- Promotion of the *in situ* protection of plant and animal species.
- Benefits for humanity (aesthetic, historic, economic, ecological and cultural).
- Allows the realisation of research, educational activities and, in some cases, cultural, recreational and touristic activities.
- Benefits external to the economy, the market system does not supply this social necessity.
- High opportunity cost, and establishment and maintenance costs.
- The benefits for society are not internalised.

2. Collection of forest products

- The basic ecological characteristics of forests are not harmed.
- Extractivists have poor living standards due to the low profitability of this activity.
-

3. Management of secondary forests
- Possible conversion of forests into other types of land use.
- Does not make the permanent ecosystem irreversible.
- Can be managed for production at varying levels of intensity, for a range of goods and services.

4.5. Matrix for the analysis of environmental impacts

The classification of impacts aimed to achieve the evaluation of their significance by allocating a value to 4 types of parameter, with significant impacts being those which received most, or at least 3 of the following classifications: diffuse (D), large magnitude (L) permanent (P), dificult – low degree of resolution (L).

Table 47. Matrix for the Identification and Analysis of Impacts

PLANS	POTENTIAL ENVIRONMENTAL IMPACTS	ENVIRONMENT					CLASSIFICATION				SIGNIFICANT IMPACT
		P	B	H	+	-	L/D	S/M/L	T/P	L/H	
Plan for the Diversification of Agricultural and Ranching Activities	Possible occurrence of pluvial erosion due to the practices proposed						L	S	P	L	
	Possible increase in wind erosion of the soil due to mechanisation						L	M	P	L	
	Possible decompaction of the soil due to agricultural practices						L	M	T	H	
	Inhibition of the process of surface run-off and increase in the infiltration of rain water into the soil as a result of decompaction						L	M	T	H	
	Reduced nutrient loss due to the reduction in surface run-off and better up-take of nutrients						L	M	T	L	
	Improved physical and chemical soil properties due to the increase in organic matter and microbial activity						L	M	T	H	
	Increase in pollution/contamination of the soil due to the use of agrochemicals						D	L	T	L	X
	Speeding up of nutrient cycles						L	S	P	H	
	Possible eutrophication of water resources downstream due to the use of fertilisers and soil improvers						D	M	T	H	
	Pollution of water resources downstream due to the use of agrochemicals						D	M	T	H	
	Possible alteration of the physical properties of water						D	S	T	L	
	Improved groundwater levels due to increased infiltration of water						D	S	T	L	
	Increased air pollution due to the increase in suspended soil particles and the emission of pollutants by machinery						D	M	T	L	
	Increased sound pollution due to the use of machinery, vehicles and aeroplanes						L	S	T	L	
	Possible interference in the population densitites of wild animals, especially avifauna, due to the increased supply of food and the use of agrochemicals						D	M	P	L	X
	Reductions in wild animal numbers due to the destruction of isolated stands of native vegetation						L	S	P	H	
	Possible contamination of the aquatic ecosystem due to pollution of water resources by agrochemicals, fertilisers and soil improvers						D	M	P	L	X
	Increase in the microbiological activity and diversity of the soil due to the production system proposed						L	L	T	H	
	Increased pressure on areas of forest and ciliary forests due to the activation of the economy						L	M	P	L	
	Possible introduction of exotic species brought in with purchased seed						D	S	P	H	
	Possible clearing of isolated stands of native vegetation in agricultural areas due to the mechanisation of crop management						L	S	P	H	
	Increased pasture productivity as a result of improved soil quality						L	L	T	H	
	Reduced use of burn-off (*queimadas*) due to the agricultural practices introduced						L	L	T	H	
	Increase in the demand for schools and education due to the increased immigration of rural workers						L	S	P	H	
	Increased demand for training due to the technological changes to be established under the proposed system						L	M	P	H	
	Possible contamination of rural workers by agrochemicals and increase in chronic diseases over the long term						L	M	P	H	
	Increase in the demand for health care services due to the increased immigration of rural workers						L	S	P	H	
	Possible increase in work-related accidents due to the demands of the technologies that will be used (machinery)						L	S	P	H	
	Increased need for basic sanitation facilities due to the increase in local population						L	S	P	H	
	Increased demand for organisation as a result of the need to access inputs and markets						L	M	P	L	
	Possible emergence of small settlements in rural areas due to the increased immigration into the region										

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\- - Negative

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D - Diffuse

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H - High

Plan for the Diversification of Agricultural and Ranching Activities	Increase in family income in the medium to long term due to increased productivity						D	G	PER	A	X
	Increase in the demand for financial capital due to the need for greater investments						L	G	T	A	
	Generation of direct and indirect employment						D	G	PER	A	X
	Concentration of income in male hands						L	P	PER	B	
	Increase and diversification of the supply of agricultural and ranching products due to the diversification of production and the increase in the number of producers						D	G	PER	A	X
	Regularisation of the supply of products due to the increase in the number of producers						D	G	PER	A	X
	Improvement in the quality and availability of animal feed						D	G	PER	A	X
	Possible emergence of agro-industries due to the increased production of raw materials						D	M	PER	A	
	Intensification of the commercialisation of agricultural inputs, machinery and equipment						D	G	PER	A	X
	Increase in land prices						L	M	PER	B	
	Increase in cattle herds due to the stocking capacity of pastures						D	M/P	PER	A/B	
	Increase in the stocking capacity of pastures						L	G	T	A	
	Increase in the demand for infrastructure (warehouses, roads and other forms) due to the increase in grain production						L	G	T	A	
	Increase in the demand for animal and plant health inspections due to market requirements						D	G	PER	A	X
Plan for the Agricultural Production Nucleus	Possible occurrence of rain and wind erosion due to the production system						L	M	PER	B	
	Possible compaction and loss of soil structure due to the intensification of agricultural and ranching activities						L	P	T	A	
	Possible nutrient loss due to erosive processes and the use of irrigation						L	P	PER	B	
	Increased pollution/contamination of the soil due to the use of agrochemicals and fertilisers and the release of animal manure						D	G	PER	B	X
	Influence on water quality in regions downstream						D	G	PER	B	X
	Increased air pollution due to the increase in suspended soil particles and the emission of pollutants by machinery						D	M	T	B	
	Increased noise pollution due to the use of agricultural machinery and vehicles						L	P	T	B	
	Possible interference in the population densities of wild animals, especially avifauna, due to the increased supply of food and the use of agrochemicals						D	M	PER	B	X
	Reduction in the numbers of wild animals due to habitat destruction						L	M	PER	B	
	Increased pressure on, and suppression of, native vegetation due to the activation of the economy						L	G	PER	B	X
	Possible introduction of exotic species brought in with purchased seed, saplings and animals						D	G	PER	B	X
	Reduction in the use of burn-off (*queimadas*) due to the agricultural practices introduced						L	M	T	A	
	Landscape alteration						L	M	PER	B	
	Loss of traditional production values due to replacement of existing systems with the proposed production system						L	M	PER	B	
	Increase in the demand for schools and education due to the increased immigration of rural workers						L	M	PER	A	
	Increased demand for training due to the technological changes to be established under the proposed system						L	G	PER	A	
	Possible contamination of rural workers by agrochemicals and increase in chronic diseases over the long term						L	G	PER	A	
	Increase in the demand for health care services due to the increased immigration of rural workers						L	M	PER	A	
	Possible increase in work-related accidents due to the demands of the technologies that will be used (machinery)						L	P	PER	A	

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Plan for the Agricultural Production Nucleus		Increased need for basic sanitation facilities due to the increase in local population						L	P	PER	A	
		Contamination of products due to the use of agrochemicals						L	M	PER	A	
		Increase in the demand for organisation due to the characteristics of the plan						L	G	PER	B	X
		Intensification of human settlements in rural areas of the project due to the increased immigration into the region										
		Increased production						D	M	PER	A	
		Increase in the demand for financial capital due to the need for greater investments and agricultural and ranching activities						L	M	T	A	
		Generation of direct and indirect employment						L	M	PER	A	
		Family participation in income generation						L	M	PER	A	
		Increased land prices						L	M	PER	B	
		Heating up of the local economy						D	M	PER	A	
		Possible emergence of agro-industries due to the increase and regularisation of the production of raw materials						D	M	PER	A	
		Increase in the number of animals due to the establishment of new production systems						D	M/G	PER	B/A	
		Lack of homogeneity of benefits due to the limitation of beneficiaries						L	G	PER	B	X
Plan for Environmental Conservation	Silviculture	Increase in the withdrawal of specific nutrients						L	G	PER	B	X
		Difficulty of pulling up stumps in order to change productive activity						L	G	PER	A	
		Possible erosion/compaction of the soil due to the felling system adopted						L	P	T	A	
		Influence on soil quality						L	G	PER	A	
		Increased risk of pollution of water resources and contamination of living things by inputs						D	P	T	A	
		Possible pressure on groundwater						L	M	PER	B	
		Alteration in the local hydrological cycle						D	P	PER	A	
		Possible loss of biodiversity						D	M	PER	B	X
		Increased incidence of pests due to the loss of biodiversity						D	G	PER	B	X
		Increased risk of forest fires						L	G	PER	B	X
		Landscape alteration						L	M	PER	B	
		Increase in forest area						D	G	PER	A	X
		Interference on local culture due to the change in activity						L	M	PER	B	
		Insufficient technology and insufficient validation of existing research						D	M	T	A	
		Insufficient mastery of existing techniques by the actors involved						L	M	T	A	
		Increased risk of work-realted accidents due to forest management						L	M	PER	A	
		Influence on economic activities						D	M	PER	A	

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Conclusions

Considering the current environmental situation in the Northern Region of Tocantins State, especially in the municipalities of Araguaína and Araguatins, it can be concluded that the most relevant effects on the natural environment have already occurred. Furthermore, the interferences proposed by the plans could be assimilated without compromising physical or biotic structures.

Currently, there is significant pressure on natural resources, exercised particularly by the family farmer in the practice of slash-and-burn agriculture. In terms of area, this pressure cannot be considered greater that the environmental degradation caused by the owners of large estates. The majority of these latter category are ranchers who invest little in pasture recovery and consequently need to open up new areas to maintain animal production.

Although the pressure of the big ranchers on the environment is greater than that exercised by the small farmers, these latter deserve more attention in plans and programmes due to the extent of their influence on the food security of the community. This is mainly because the small farmers depend completely on natural capital for their survival, a fact which distinguishes them from the large landowners who have a wider range of opportunities in situations of shcok or stress.

The existence of municipal rural development plans drawn up in a participatory manner will be fundamental for the environmental success of the intervention that is proposed. It should be stressed that the planning of agricultural projects needs to embrace a long term perspective. It should be based on ecological-economic zoning and should also strive to ensure the minimum level of risk for the community as a result of the project.

Taking into account the field surveys involving small and medium scale rural producers, it is recommended that any agricultural and ranching investment in the region should prioritise:

- The recuperation of natural capital, such as soil, water resources and plant cover;
- Investment in human capital, with training in various areas and including adult literacy courses;
- The strengthening of social capital, giving special incentives for community participation in associations, unions and cooperatives;
- Investment in physical capital, especially focused on completing projects and works which are already underway such as, for example, electricity distribution networks that stop just short of rural communities, or agro-industries which cannot function because of the lack of water supplies, and also agricultural settlements which are already built but which are without basic sanitation systems;
- In parallel with this work, to prioritise the gradual increase in credit resources geared towards the rural producer.

With regard to the physical and biotic environment, efforts have been made to ensure the viability of the plans proposed by the recommendation of mitigatory measures for the impacts that have been verified. To this end, control measures, supervision programmes and the monitoring of the activities that will be subsequently defined in specific projects, will be fundamental.

The main impacts foreseen on the human environment are, for the most part, positive. The adoption of the measures proposed is extremely important in order to optimise the effect of these positive impacts.

Based on the data available at this stage of the planning, and on the studies that have been done, it can be concluded that the environmental viability of the undertaking is, at this preliminary stage, positive, assuming the appropriate and efficient implementation of the proposed plans and of the actions for environmental control indicated in this document, since in this way the purposes of the project will be effectively guaranteed.

It has become necessary to solve the relations between man and nature, as expressed in agriculture and ranching, in a new way, but without abdicating our responsibility for guaranteeing the survival of the multitudes who, whether we like it or not, are already part of the scenario at the opening of this new century. (Quirino, et. alii, 1999).

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