ANNEX XVII

AGRICULTURAL RESEARCH IN THE STATE OF TOCANTINS

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1 Introduction

The execution of the agricultural research process in the State of Tocantins shows lack of adequate State Agricultural Research System to attend the needs of the private sector. In general, continued alterations in the executing organizations and coordination of that process is found, as well as new research programs have been already granted to organizations such as RURALTINS, State Secretariat of Agriculture (SAG) and eventually UNITINS.

Besides, three Master Plans of research have been elaborated, one in 1989, developed in Araguaina under the coordination of SAG/RURALTINS, other in 1992, developed in Palmas in coordination with SAG and, the last one also in 1992, executed in Gurupi in coordination with UNITINS.

However, few research projects defined in those programs were executed in practice due to various reasons such as: lack of appropriate infrastructure in the executing institutions (lack of laboratories, experimental fields, and, in sometimes qualified human resources). Especially lack of funds for the project implementation. It is remarkable that the temporal Non availability of project funds in time, makes the implementation of these projects difficult in field.

It is possible to identify a the areas that needs strengthening by analyzing the period 1992-1997 when the Agricultural Research of the State was put under the responsibility of UNITINS, especially regarding the selection and hiring of new researchers for the state. These professionals come from renowned Universities of Brazil related to specialized areas of Agriculture Sciences. However, the potential of human resources available in the period (1992-1997) are facing limitation regarding the lack of necessary infrastructure and adequate specific budget for the implantation of the research plan elaborated in 1992. Even considering this situation, some important programs were started in several regions of the State (Araguaina, Gurupi, Pedro Alfonso, and Formoso) with the support of EMBRAPA and CNPq (See item 2, research project executed by/ in coordination with UNITINS).

In case of UNITINS, the period 1992-1996 is characterized as a period of instability and institutional fragility. The head of the administration (rector) of the University had 7 changes in only 5 years. Besides, in 1995 there was a significant reduction in the strength of teaching staff and redistribution of the teaching hours among the teachers. This increased teaching hours together with the above mentioned constraints reduced the enthusiasm for the elaboration and execution of research works.

During the period of 1995 to 1997, the Agricultural Research in UNITINS was restrictedly carried out through the University Center at Gurupi, with the support of EMBRAPA, CNPq and through some agreements with private companies. In spite these non-conducive environment, a small number of projects were carried out well, thanks to the interest and individual efforts of some researchers. On the other hand, the demand for researches on specific aspects by the productive agricultural sector is continuously on increase. Therefore, the gap between the execution and the demand of quality research in agricultural sector is becoming wider. Regarding this point, Federations and Associations that represent the agricultural sector together with the financial institutions are always requesting for the improvement of this sector, every time that issue be treated.

The Agricultural Ministry through EMBRAPA implements the Public Policies of the Federal Government. EMBRAPA is internationally considered as a competent and elevated organization, has recently defined its work guidelines in the state of Tocantins, adopting the strategically idea of partnership with the local institutions which execute or would like to execute researches. Then, this stage is marked as restructuring period of the research within the State System view where the role of each institution within the system may be established and the interlocutors of the process shall be clearly defined. Therefore, this policy makes clear the probabilities to create new EMBRAPA units in Tocantins.

Within this context, the Foundation/University of Tocantins is interested to participate effectively in the definition of an organization and strengthening proposal for the Agricultural Research to be executed by UNITINS within a State Research System also to be implemented from the elaboration of the "Master Plan".

The UNITINS, through the Agronomy and Veterinary Faculty, plays an important role in the execution of Agricultural Research, in partnership with the State Agriculture Secretary SAG, Agriculture Federation of Tocantins FAET, EMBRAPA and others, under the coordination of the Science and Technology Council of the State (CECT).

In spite of the organizational and structural obstacles, the UNITINS, is developing research projects in the state through the University Centers related to the agricultural sector (Araguaína, Miracema, Paraíso, Palmas, Porto Nacional e Gurupi). Those University Centers are located in the north, center and south region of Tocantins, giving a better articulation in order to stimulate the agricultural development in the state.

2 Proposal for Creation of State Agriculture Research System - SEPA

The Agricultural Research in Tocantins has went through several transformation stages during the 9 years of the State's existence and it still was not strong enough to satisfy the rural producers' wishes who are looking for suitable technology. The State is characterized for the lack of functional and organization policy for the execution of research that may attend the requirements of the State government and farmers.

In Tocantins, there are several government and private institutions, association and cooperatives directly related to the agricultural sector. However, each of these institutions is isolated one and developing insolated activity, besides the human, financial and physical resources, being misused and the results reached were of not high importance.

The proposal for the creation of a State Agricultural Research System - SEPA in Tocantins has as main purpose of maximizing the efforts through partnerships among the institutions in order to develop priority research programs capable of efficiently covering the society's requirements.

The integration of the activities of the university, public institutions and the private sector through SEPA is an important aspect especially considering that they belong to three different segments. However, to make this system function adequately, it is necessary to compromise the involved institutions clearly defining the role of each partner.

The following agencies shall become the constituents of the systems with corresponding functions.

(a) State Council of Science and Technology (CECT)
- To coordinate the State System of Agricultural Research – SEPA
- To define the research priorities in the Science and Technology area
- To attract and transfer financial resources for the prioritized projects
- To represent the State in the CONSEPA

(b) Agricultural Research Coordination Agency (CPA/CECT)
- To investigate the demands of farmers
- To define the priorities proposals referred to the Agricultural Research
- To select the suitable partners for the execution of the researches

The following agencies are proposed to be involved in the system

(a) State Agriculture Secretary (SAG)
- Receiving and collection of the productive sector's demands
- Establishment of agricultural guidelines
- Introduction and adaptation of technologies
- Selection and transfer of technologies
- Collaboration in the execution of researches

(b) Rural Development Institute of Tocantins - RURALTINS
- Transference of technology
- Collaboration in the execution of researches
- Validity of the existing technologies
- Survey of the Productive Sector

(c) Agriculture Federation of Tocantins - FAET
- Survey of demands together with the farmers
- Support in the execution of researches
- Support in the validation of existing

(d) University of Tocantins Foundation - UNITINS
- Execution of Agricultural Researches
- Adaptation, generation and validation of technologies
- Survey of demands
- Transfer of technologies
- Representation of the State together with CONSEPA

(e) Brazilian Company of Agricultural Research - EMBRAPA
- Collaboration in the development of Agricultural Research
- Financial support to research and technological development
- Adaptation, generation and validity of technology
- To make transference of technologies

The State Council of Science and Technology – CECT and the University of Tocantins Foundation – UNITINS, might represent to the Sate of Tocantins, in the National Council of States System for Agricultural Research – CONSEPA.

The creation of an Agricultural Research Coordination – CPA, together with the CECT is the State Agriculture Secretary – SAG, Agriculture Federation of Tocantins State – FAET and the University of Tocantins Foundation UNITINS, shall compose a proposal that represent the guidelines of the state government for the agricultural sector, the rural producers and the agricultural research sector.

The operation shall have the following aspects:

- To collect the demands originated in the partnership institutions and guide them to the CECT to be prioritized.
- After the demands are identified by the CECT, select the partner institute for the execution of research or validation of technologies.

3 Current Agricultural Research Programs of UNITINS

The Agricultural Research programs under execution at present by the University are demonstrated as follows:

3.1 Sustainable Management in Agriculture Production Areas

3.1.1 Sustainable Management in the Cerrado Area

(1) Production of Seeds, Grains and Roots

Research on following crops have been going on with specific aspects as below:

(i) Corn – Plant protection, fertility, evaluation of crop performance
(ii) Soybean - Evaluation of crop performance, plant protection
(iii) Sunflower – Evaluation of crop performance
(iv) Sorghum -- Evaluation of crop performance
(v) Upland rice - Cultivation techniques, evaluation of crop performance
(vi) Leguminous crops-Evaluation of crop performance

(2) Alternative soil management

(i) Green Fertilizer (ii) Direct Planting System

(3) Fruit Production System

- Pineapple

(4) Vegetal Production System

(i)Tomato, (ii) Red Pepper, (iii) Cole, (iv) Cabbage, (v) Lettuce (v) Pumpkin

(5) Animal Production System

Forage - Evaluation of Sorghum Crops

(6) Family Agriculture Production System

Soil fertility, Productivity and Technology transfer in Penha Settlement

3.1.2 Sustainable Management of Production (Várzeas) Areas

(1) Production of Seeds and Grains

(i) Corn - Evaluation of crop performance
(ii) Soybean - Evaluation of crop performance, plant protection
(iii) Rice - Evaluation of crop performance, plant protection
(iv) Sorghum - Evaluation of crop performance

(2) Animal Production

Forage Systems - Evaluation of Sorghum crop performance

3.2 Cattle Development

(1) Animal Production

(i) Forage for bovines
(ii) Swine Breeding
(iii) Poultry

(2) Animal Health

Collection of information on main animal diseases

(3) Animal Reproduction

Analysis of the bovine reproductive performance

(4) Physical-Chemical and Microbiology Analysis

(i) Analysis of Milk
(ii) Analysis of Water Quality

(5) Development and Diffusion of Technologies

3.3 Rural and Agribusiness Development

(1) Sociological, Economical and Environment studies related to PRODECER III

(i) Cost-Benefit Analysis
(ii) Study for the provision of qualified manpower
(iii) Social-economical and environmental issues

(2) Agriculture Commercialization

Study of the state market indicators

(3) Agribusiness Study related to the Pineapple

(i) Cost Analysis
(ii) Commercialization crops
(iii) Study for the promotion of new farmers
(iv) Agriculture feeding Study
(v) Cooperative Policies with the farmers

(4) Social-Economical and Environmental Study about Jalapao

Social-Economical Study of the Production Units

(5) Rural Development Organizations

(i) To evaluate the cooperative policies in the State
(ii) To evaluate the farmers organization role
(iii) To analyze the income and employment generation capacity available in the rural properties
(iv) The role of the woman in the production unit
(v) Recycling of residual wastes
(vi) Rural Development Plan for the municipality of Rio do Sono
Lumiar Project (Supply of technical assistance in settlements)

3.4 Environmental Monitoring

(1) Quality of Air

(i) Preliminary Studies on the Quality of Air
(ii) Monitoring of fire

(2) Quality of Water

(i) Evaluation of the physical and chemical properties of water
(ii) Ecology of the microbial population
(iii) Study on fish-fauna
(iv) Limnologic (lake and no-running water) Monitoring
(v) Qualitative and Quantitative Monitoring
(vi) Microbasin Management

(3) Agrometeorology

- Agrometeorological Monitoring

(4) Environmental Education

(i) Training of multipliers for the use and preservation of running water
(ii) Project for the improvement of the life quality of the riverside communities
(iii)Basic health improvement in low income communities

3.5 Industrialization of Agricultural Products

(1) Integrated Study of Babaçú Coconut

- Extraction of Babaçu oil

(2) Study of the Buriti Oil Extraction

(3) Data Processing

- Automation of data on the agricultural products

4 Research on Cultivation Technology of Major Crops Cultivated in the State of Tocantins

Most of the agricultural researches in the Tocantins State are carried out by the University of Tocantins mainly by the University Center at Gurupi and some of the agricultural researches of the University of Tocantins are carried out in collaboration with EMBRAPA. The varieties and cultivation technology of the crops followed in these agricultural researches are published as Technical information pamphlets which are jointly published by the Secretariat of Agriculture, University of Tocantins, Foundation of Investigation Support and RURALTINS.

In this section, the information published in these pamphlets and other sources are combined and are described briefly on the major crops with regard to their soil and climatic requirements, and the major varieties cultivated in the Tocantins State. The crops in the State can be divided into two groups of temporary annual crops (growth cycle of shorter than 12 months) and perennial crops (growth cycle of longer than 12 months). Temporary Annual crops include rice, corn, soybean, feijao beans etc. and the Perennial crops include cassava, pine apple, banana, sugarcane etc.

4.1 Rice (Oryza sativa L.)

(1) Requirements

Water requirement - Among all the factors, water is the most determinant factor for the production of rice. Sensibility of rice plant to water deficiency is variable according to the growing stage of the plant. Regarding the total water consumed, rice needs 30% during the vegetative phase, 55% during reproductive phase and 15% during maturing phase. Generally, rice is cultivated in areas with a rain fall of more than 1.000mm per year. The daily consumption of water is considered approximately 5 to 10 mm per day. Water requirements of rice cultivation is influenced by climatic and soil factors.

Temperature - Each phase of rice plant development is favored by different level of temperature. Critical temperature is below 20°C and above 30°C, with a variation according to the development of plant. When it is lower than 20°C, low germination of seeds, delay in emergence of plants, yellowing of leaves, apical sterility, delay in flowering, dry grains, and unequal maturity occur. When the temperature exceeds 35°C, damages depends on the growing phase such as reduction of shooting in the vegetative stage, reduction of grains in the reproductive stage, higher sterility in maturing stage and reduction of grain per panicle.

Solar Radiation - Necessity of solar radiation for rice cultivation vary according to the growing phase of the plant. Decreasing of yield is caused by low solar radiation during the vegetative phase and decreasing of number of grains during reproductive phase. Solar radiation has the major influence on the yield during the reproductive phase of the plant, flowed by the maturity phase demonstrating a low influence in the vegetative

phase. The most critic phase of rice plant regarding solar radiation need is the beginning of flowering.

Soil - Rice is cultivated in the most variable pedogenic and morphological characteristics of soils. The texture of the soil vary from clay to sandy texture with a pH of 4 to 9, organic matter varies from 1% to 50%, and the concentration of salts vary from 0% to 1% and a the soil fertility vary from very low to very high level. For upland rice, the texture and topography are the most important factors since they determine the water level in soil.

(2) Cultivation Technology

The rice cultivation is very important for the Tocantins State, and is cultivated all over the state, mainly through traditional upland cultivation, flooding (basin) irrigation and low land cultivation based on the variability of the existing macro-ecological regions. The average yield is normally 1,200 kg/ha for the traditional upland cultivation; 2,500 kg/ha for the lowland cultivation and around 4,000 kg/ha for the irrigated rice cultivation.

Traditional Upland Rice Cultivation

Because of the climatic hazard, mainly due to drought, the level of inputs application can be variable. In this cultivation system, where the occurrence of veranicos during the rainy season is a serious problem, the productivity is affected, making the farmer utilize low levels of inputs and cultural practices.

Soil Preparation - The deep plowing is a practice which can avoid the soil compaction, making the plants more resistant to drought.

Seeding Period - The seeding is carried out in the rainy period, extended until middle of January. The choice of seeding period, associated to the correct choice of variety is the fundamental to reduce the hazards due to drought.

Spacing and Seeding Density - For a certain condition of climate, soil, variety and management practices, there is limit of number of plants per unit of area which maximizes the production. For short cycle varieties (Guarani and Carajás), the recommended seed rate is 60 to 70 seeds per meter with a spacing of 40 to 50cm between lines. For medium cycle varieties (IAC - 47, Caiapó, Araguaia, etc.), 50 to 60 seeds per meter, with the same spacing.

Liming and Manure application - The recommendations for reclaiming the soil to reduce the soil acidity and manure application should be carried out based on the results of soil analysis.

Control of Pests and Diseases - Chemical treatment of seeds is recommended for the control of soil pests. As for the brusone, the management practices, associated to the use

of resistant varieties, can help in their control, without the need to utilize agro-chemicals.

Recommended Varieties - Based on the results of the research programs of rice genetic improvement, some varieties with important attributes, which contribute for a major efficiency in the productive process are chosen. For Tocantins, the following rice varieties are recommended: Araguaia, Rio Paranaíba, IAC - 47, Caiapó of medium cycle, Guarani and Carajás of advanced cycle.

Cultivation of Irrigated Rice

This cultivation system is predominant in the lowlands of the Javaés Valley (Araguaia river Basin) and accounts for approximately 12% of the State cultivated area. This activity is carried out by producers with entrepreneurial capacity, or who are organized in cooperatives, with interest and knowledge for the adoption of advanced technologies.

Soil Preparation - Normally, it is carried out in dry soil, and at first the ploughing shall be superficial (approximately 20 cm). Afterwards, one to three ploughing are carried out using leveling grader, depending on the type of soil.

Seeding Period - Normally, it is carried out mechanically during the months of October/ November, simultaneously associated to manuring.

Seeding Rate and Spacing - About 100 to 150kg/ha of seeds are used, which are placed at a depth of 5 cm, in lines spaced at 20 cm.

Liming and Manure Application - The liming of the irrigated rice is recommended based on the soil analysis to minimize the iron toxicity and/or supply calcium and magnesium. The manure application shall be carried out based on the results of the soil analysis.

Water Management - The beginning of the irrigation is, approximately 15 after the emergence of plantules, and the water shall be continuously renewed. The height of water affects the productivity and causes influence over the infestation of weeds.

Control of Weeds - Several species of identified weeds cause damages to the irrigated rice cultivation. One important gramineous is the red rice, which can cause losses of until 20% in the productivity, besides creating serious problems in the processing, industrialization and commercialization of the white rice, by depreciating its quality. Therefore, good quality seeds shall be utilized and the control of the crops infestation level shall be carried out through several management alternatives, including the minimum cultivation, the crops rotation and the use of herbicides.

Recommended Varieties - The recommended irrigated rice varieties for Tocantins State, after the realization of a series of evaluations, are: Metica 1 and Aliança of medium cycle and Javaé of precocious cycle.

4.2 Corn (Zea mays L)

The natural habitat of corn is tropical area, however due its high adaptation capacity it is found in temperate climate. It has a high water requirement and a critical period related to the lack of soil moisture that happen in the flowering and grain formation stage.

(1) Requirements

Water requirement - Corn needs an effective rain fall of 400mm to 800mm/year of well distributed rain during the crop period. Water requirements according to the growing stage is about 2.5 mm/day from germination to formation of panicles; 6mm to 8 mm/day in the large growing stage and 8mm to 10 mm during the grain formation stage. Lack of water during the flowering period reduce production by 30% to 50%.

Temperature - Generally, corn has a requirement of high and regular temperature of over 15°C with an optimum temperature of 23°C to 28°C. Temperatures of lower than 13°C result in a slow germination, and the maximum temperature limit is around 43°C.

Solar Radiation - Corn is a neutral day crop and the production can be damaged by solar radiation. On the other hand, a reduction of 90% of radiation during the 3 to 6 days of the reproductive phase can affect production, and even more if it happened in other growing phases.

Relative Humidity - Atmospheric humidity index required by corn is 60%.

Soil - Corn is sensible to variation of soil fertility; in case of nitrogen deficiency, it is responsible for the reduction of number of grain lines in the ear. High development is reached in soils rich in organic material with a pH 6 to 6.5 and sandy-clay texture. Normally the roots can reach a depth of 1.0m.

(2) Cultivation Technology

In the harvest 1994/95, 37 varieties of corn were evaluated, being 7 of super-precocious cycle, 19 of precocious cycle and 11 of normal cycle, in the municipalities of Pedro Afonso, Aliança, Araguaína and Natividade.

Spacing - For the varieties of super-precocious and precocious cycles the spacing was 0.90 x 0.20 m, with an approximate population of 55,000 plants/ha. The normal cycle varieties had a spacing of 1.00 x 0.20 m, with a population of 50,000 plants/ha.

Manure Application - The manure application followed the technological level of each area. In Pedro Afonso, the planting manuring was 20kg of Nitrogen/ha, 100kg of P_2O_5/ha and 60 kg of K_2O/ha. In the other places, the planting manuring was 15 kg of Nitrogen/ha, 75 kg of P_2O_5/ha and 45 kg of K_2O/ha.

Classification Of Varieties According To The Productivity (Kg/Ha),
In The Average Of The Localities

Precocious Cycle	Normal Cycle	Super-Precocious Cycle
BR 3123	ZENECA 8501	AG 9012
P 3041	XL 380	
PL 401	P 3210	DINA 766
BR 205	C 132	
P 3051		C 855
C 435	ZENECA 8568	
P 3071	AG 1051	AGN 3150
BR 201	AGN 1043	
ZENECA 8452	XL 660	AGN 3100
C 166	XL XL 655	
C 701	AGN 1040	HATÃ 3001
C 425	BR 106	
HATÃ 1001		AGN 3060
AG 5012		
AG 5011		
92 HDI QPM		
AGN 2014		
AGN 2016		
BR 473		

The nitrogen manure application in Pedro Afonso, was carried out at 30 and 45 days after the emergence, applying 45 kg of Nitrogen/ha/application. In the other places, only one coverage at 35 days after the emergence was carried out, with a dose of 60 kg of Nitrogen/ha.

Days For Female Blossoming (Df) And Grains Productivity (Kg/Ha)
In Pedro Afonso - To

Precocious Cycle	DF	kg/ha	Normal Cycle	DF	kg/ha	Super-Precocious Cycle	DF	kg/ha
BR 3123	54	9204	ZENECA 8501	59	7944			
P 3041	53	8852				AG 9012	52	8926
BR 205	55	8565	P 3210	61	7833			
ZENECA 8452	55	8296				DINA 766	50	8648
AGN 2016	55	8204	AG 1043	65	7611			
AG 5011	53	8037				HATÃ 3001	50	7704
92 HDI QPM	52	8019	C 132	60	6667			
PL 401	51	7833				C 855	50	7704
HATÃ 1001	54	7778	XL 380	63	6556			
BR 201	53	7630				AGN 310	51	7556
AGN 2014	52	7630	AG 1051	65	6259			
P 3071	54	7556				AGN 3060	50	7537
C 435	55	7333	XL 660	62	5981			

C 166	53	7333				AGN 3150	51	7444
P 3051	52	7259	XL 655	63	5722			
C 701	54	7222						
AG 5012	54	7222	ZENECA 8568	63	5444			
C 425	53	7185						
BR 473	53	6407	AGN 1040	65	5241			
			BR 106	64	4648			

Corn Production with Subsurface Irrigation System

The efforts between the Government and the private sector of Tocantins State and the EMBRAPA/CNPMS and COPERJAVA (Rural Mixed Cooperative of the Javaés Valley Ltd.) allowed the introduction of corn cultivation in an irrigation project (flooded rice) in the Araguaia river valley, at the south of the State.

The Project of Araguaia river Valley occupies an area of 35,000 ha and COPERJAVA operates in 12,000 ha, which, by utilizing technology specially developed for tropical climate irrigated agriculture, was obtaining good yields of rice and soybean, in two harvests a year.

In the search for one more alternative for winter planting, COPERJAVA found in the cooperative work with EMBRAPA/CNPMS technologies for the establishment of corn cultivation with subsurface irrigation. The works comprehended the control of weeds, treatment of seeds, manuring of planting and coverage, depth of planting, control of pests and diseases, direct planting, conventional planting, competition between varieties and irrigation.

Previously, a productivity of above 3,500 kg/ha couldn' t be obtained: at present, the technological improvements caused a productivity up to 7,600 kg/ha. In 1995, the first commercial planting was carried out in an area of 1,600 ha, obtaining a productivity of above 6,000 kg/ha. This result encouraged the enlargement of the cultivated area to 5,000 ha, in 1996, probably the largest continuous area cultivated with corn, utilizing subsurface irrigation, with a foreseen productivity of over 6,000 kg/ha, and sometimes reaching up to 7,500 kg.

The economic results obtained by COPERJAVA are promising, since, for a cost of close to 70 bags/ha, an average a productivity of 100 bags/ha is obtained.

An expansion of the regional production is expected with the implantation of the projects Luiz Alves do Araguaia (GO) with 15,000 ha; Pedro Afonso (TO), with 20,000 ha; and Javaés, in study stage, with a potential of 255,000 ha. The results obtained by the present, although can be used as technological basis for the expansion of corn cultivation, still demand more studies.

Although the technology developed for the production of corn in subsurface irrigation is not yet definitive, it is sufficient for productions of above 6,000 kg/ha. Some basic information used for the corn cultivation in the COPERJAVA areas, in 1996 is presented below.

Competition of varieties - Since the number of corn varieties entering the market is too large, varieties competition tests are annually carried out to identify those more adapted to the environment. In the already carried out tests, seven varieties, for commercial cultivation, were selected, and in 1996, other 32 new varieties are being tested.

Control of weeds - The tests carried out with herbicides in the COPERJAVA areas show that the post-emergent ones are the most appropriate for the control of weeds. The producer can utilize the post-emergent herbicide, according to the type and quantity of weeds (large or narrow leaves). In certain areas, the application of herbicide is even unnecessary.

Control of pests and diseases - A good control of pests and diseases is being attained by the treatment of seeds and one or two applications of insecticides, as soon as they start to appear. In COPERJAVA, tests are starting with the biological insecticide *Baculovirus spodoptera*, developed by EMBRAPA/ CNPMS, and with other selective insecticides, thus avoiding the aggression against the environment.

Manure Application - Manure application is carried out according to the soil analysis. In conditions of subsurface irrigation, the depth of manure application is very important. It shall be placed deeper than the traditional planting, in order to place in a more moist soil layer, thus facilitating its utilization by the plants. That is because the fertilizer placed in the upper layer is not totally soluble, due to the fast drying of the surface, which restricts s their utilization by the plants.

Top application of Nitrogen - The top application is carried out in one only time, when plants have between six to eight leaves which, in the region of Rio Formoso Project, occurs normally 20 to 25 days after germination. As a source of nitrogen, the urea is utilized, which shall be incorporated to stay in contact with the soil moisture and to be better absorbed by the plants.

Planting depth - The planting depth is determined, mainly, by the soil moisture contents. This soil moisture content is important not only for the fast germination but also to dissolve the insecticide utilized in the seed treatment, increasing the efficiency.

Plants population - To compensate the attack of pests (mainly the "clasmo" lizard) and to reach the desired final stand, normally 23 to 25 kg/ha of seeds are used. 30% more seeds shall be used in the planting .

Planting systems - Both conventional and direct planting systems are utilized. The direct planting can be carried out after the rice harvest, in case it hasn' t caused furrows in the soil. The saving of the direct planting comparing to the conventional planting can be up

to 15%. This saving is mainly due to the non necessity of soil preparation and use of post-emergent herbicides.

Water control - The water control is important not only to culture development but also to dissolve the insecticide utilized in seeds treatment, the planting manure and the nitrogen manure of coverage. In the blossoming period, the soil moisture, besides supplying the culture requirements, also soothes the high nocturne temperature which normally occurs in this period.

Harvest - In general, the harvest is carried out with 24% of grains moisture content, allowing a fast soil preparation for the next cultivation and avoiding thus the first strong rains and winds which appear in this period. The ideal would be to harvest with a grains moisture around 18%; thus there would be a great saving in transportation as well as in grains drying.

4.3 Soybean

Soybean is the most important oleaginous crop, which produces more protein per hectare than any other crop. Areas where soybean is cultivated vary from cool regions to tropical regions depending on the use of variety suitable for each climate, it is widely cultivated in a latitude of 20° to 50°.

(1) Requirements

Water requirement - For a maximum yield, water requirement of soybean cultivation during the whole cycle varies between 450 to 800 mm, depending on the climatic conditions, management of crops and duration of cycle.

Quantity of available water is frequently the main factor which limit the production of soybean. A deficit of 100 mm is a limitation where it is still possible to cultivate this crop without irrigation system. A long dryness period or a wet condition in excess during the germination period produce considerable damages reducing the percentage of emergence of plants. If there is a soil moisture deficit during two or four weeks immediately after formation of flower bottom, growing of plant decrease and, flower and snap beans fall down.

Besides possibility to survive during short dryness period, soybean can also resist dry soils during short periods, which is uncommon for corn cultivation. On the other hand, an excess of moisture during short periods after flowering cause low yields but is dangerous if it happens during harvest season.

Temperature - Suitable production is obtained with temperatures between 20°C to 30°C, and the ideal being around 30°C. With temperature lower than 10°C , the vegetative growing of soy bean is low or null, the same as temperature above 40°C where the capacity of snap beans retention start decreasing. This problem is emphasized in case of water deficiency.

Solar Radiation - Soy bean is normally considered as a short day plant but in large cultivation it can be found that some plants are practically indifferent to the length of day or those which stop flowering due the lack of minimum period of day length.

Critical Periods of Soybean Growth - Soy bean has two well defined periods regarding water. First is during germination and emergence when soil moisture is important to obtain an uniform population of plants per area. The second is during the formation of legumes or filling up of grains, or in the flowering to maturing stage.

Depth of root system - In soils with good permeability and drainage condition, the axial root can reach up to 150 cm, and secondary roots up to 180 cm. Major part of absorption roots are located in the top 15 cm.

The main varieties which are recommendable for the state of Tocantins are:

BB-10 (Teresina), BR-27(Cariri), Embrapa 20(Doko RC), Engopa-301, Engopa 303, Engopa-305, Engopa306 (Chapada), GO BR-25 (Areuanã), and IAC-8.

(2) Cultivation Technology

The soybean, the third most important cultivated crop in Tocantins State, is presenting low productivity levels in relation to the national average due, among other factors, to the lack of information about the genotypes behavior in different soil-climatic conditions. The average productivity for the period in between two harvests is 1,738 kg/ha and 2,101 kg/ha (IBGE, 1993). The identification of genotypes adapted to different cultivation systems, together with the creation of new materials, by the continuous improvement of those most adapted ones, will allow the increase of the present productivity indexes and the incentive to the increment of the agricultural production, resulting in major gains to the producers and creating a larger number of direct and indirect employment.

Aiming to evaluate the behavior of soybean genotypes (recommended or with good adaptation possibility to the Tocantins State soil-climatic conditions), genotypes competition tests were carried out in Formoso do Araguaia and Pedro Afonso in 1994, 02 in the period between harvests and 02 during the harvest.

The seeding density was 16 seeds/m, corresponding to a population of 400,000 plants/ha. The seeds inoculation was carried out at the planting, the basic manure application was 350kg/ha in the formulation of 2-28-20. Many parameters were evaluated for the varieties, and the results are shown in the following tables.

Average Yield Parameters Of 10 Soybean Varieties Evaluated In The Period In Between Harvests In 1994 In Formoso do Araguaia

VARIETY	CYCLE	HUSK HEIGHT (cm)	PLANT HEIGHT (cm)	YIELD (kg/ha)
Aruanã	late	13	66	2012
Cristalina	medium	08	46	1975
Seridó	late	11	58	1968
Teresina RC	late	13	79	1925
Cariri RC	medium	13	63	1906
Doko RC	medium	09	45	1537
EMGOPA 308	medium	12	56	1450
IAC - 8	precocious	10	55	1131
EMGOPA 305	medium	10	52	1171
EMGOPA 303	medium	11	47	1106

Average Yield Parameters of 10 soybean varieties evaluated in 1994/95 harvest in Formoso do Araguaia

VARIETY	CYCLE	HUSK HEIGHT (cm)	PLANT HEIGHT (cm)	YIELD (kg/ha)
Aruanã	Late	13	53	3205
Cariri RC	Medium	05	48	2470
Seridó	Late	06	57	2450
Teresina RC	Late	12	59	2210
Cristalina	Medium	08	47	1850
EMGOPA 303	Medium	09	43	1613
EMGOPA 305	Medium	12	45	1596
Doko RC	Medium	11	47	1400
IAC - 8	Medium	11	57	1390
EMGOPA 308	Medium	12	61	1275

Average Results Of Maturation And Yield In Kg/Ha And Bags/Ha.
Formoso Do Araguaia, 1994.

VARIETY	CYCLE	YIELD (kg/ha)	YIELD (bag/ha)
EMGOPA 313	Precocious	1,809	30.1
EMGOPA 309	precocious	1,742	29.0
EMGOPA 311	precocious	1,673	27.9
EMGOPA 307	medium	1,646	27.4
EMGOPA 308	medium	1,493	24.9
EMGOPA 310	medium	1,471	24.5
EMGOPA 302	precocious	1,432	23.9
IAC - 8	precocious	1,426	23.8
EMGOPA 312	medium	1,421	23.7
Itiquira	precocious	1,343	22.4
Doko RC	medium	1,323	22.1

Aruanã	late	1,273	21.2
EMGOPA 304	precocious	1,121	18.7
EMGOPA 305	medium	899	15.0
EMGOPA 306	medium	758	12.6

Average Results Of Yield In Kg/Ha And Bags/Ha And Cycle For Some Tested Varieties. Pedro Afonso, 1994/95.

VARIETY	CYCLE	YIELD (kg/ha)	YIELD (bag/ha)
Cariri RC	medium	2,838	47.3
CAC - BR 43	precocious	2,619	43.6
Vale Rio Doce	medium	2,519	42.0
EMGOPA 308	medium	2,492	41.5
Bays	late	2,275	37.9
Mina	medium	2,225	37.1
Seridó	late	2,181	36.3
EMGOPA 305	medium	2,150	35.8
Doko RC	medium	2,081	34.7
Teresina RC	late	2,008	33.5
Itaqui	medium	1,900	31.7
Paranagoiana	late	1,808	30.1

4.4 Feijao Beans

As a leguminous crop, feijão has in important role in the basic food of Africa, Central and South America, being cultivated in temperated regions, sub-tropical and tropical regions between latitudes 40° N and 40°S.

4.4.1 Feijão Phaseolus (Phaseolus vulgaris)

(1) Requirements

Water requirement - Feijão is very exigent in relation to a balanced water availability. Absent or excess of water cause considerable influence on crop growth. Water requirements of feijão are met to its optimal level when it rains 300 mm to 400 mm during the growing cycle, with a regular monthly distribution around 100mm. It is considered that the lower and upper limit of rain fall is 200mm and 600 mm respectively.

The higher water requirement happen during the pre-flowering phase and if it is not satisfied, the flower area is decreased. Lack of moisture during flowering and fruits formation period affects growing of flower and fruits regarding damages in filling up of beans, decreasing reduction of seeds weight. On the other hand, a dry period during harvesting season is important to guarantee a better grain quality.

Temperature - Feijão Phaseolus class finds a favorable growing environment with a temperature between 18°C and 30°C, and the optimum rage is considered as 18°C to 27°C. The ideal temperature is 22°C. Temperatures lower than 18°C bring damages to the vegetative development and higher than 30°C decrease the productive capacity as an effect of the reduction of number of leaves and flowers as well as quantity of beans per husk.

Solar radiation - In Tocantins State, where duration of day and night has no variation, feijão beans as a neutral day plant finds suitable conditions for cultivation.

Relative Humidity - Atmospheric humidity is considered an important factor for the development of this crop due the damages caused by the lose of water. An excess of humidity is an strong limitation for this crop, and a relative humidity of 50% to 60% is considered as optimum for the Phaseolus class.

Soil - The feijão bean of Phaseolus class is a superficial root crop and consequently has low Requirements regarding soil depth. Based on this characteristics, it can be cultivated in soils with a minimum depth of 30 to 60 cm whenever they have suitable soil moisture, air, good physical conditions, good fertility and content of organic material but not excessive clay or sand. The pH of the soil is between 5.5 and 7.5.

Critical Period - Flowering is the critical period when lack of water cause more damages. In this period lack of water stop flowering and growing of young beans besides avoiding the filling up of s husk, damaging the potential production of plants. This period begins in the 25 days of growing and finish in the 50th day.

Depth of root system - Up to 0.20 cm deep

4.4.2 Feijão Vigna (Vigna sinensis (L) Savi)

(1) Requirements

Water requirement - Negative effect of dryness are remarkable in the pre-flowering, flowering grain stage of grains. Requirements of optimum rain fall during vegetative cycle is around 400 mm.

Temperature - Optimum temperature for germination, growing and production of feijão Vigna is between 18°C and 30°C, temperatures lower than 16C/18°C are noxious for growing and temperatures higher than 30°C reduce the production capacity of the plant.

Solar radiation - The Vigna class needs neutral days.

Relative Humidity - The relative humidity required by this crop is between 40% and 80%, and the optimum level is 45%.

Soil - Clay-silty soils, flat or softly undulated and rich in humus are suitable for Vigna class. Due the pivoting root system, with a main root reaching more than 1 m, the crop development depends on the physical and chemical properties of soil, permeability and depth level. The most suitable pH is between 6 to 7.5, with a medium to high fertility.

Vegetative cycle - Vigna varieties have a vegetative cycle from 70 to 120 days and average of 90 days. So, there are more premature varieties producing after 70 to 120 days of planting.

Critical Period - The critical period when the production is damaged by the lack of water is from the 35th day up to the 60th day.

Depth of root system - The root depth is 30 cm

(2) Cultivation Technology

Feijão Caupi (Vigna unguiculata (L.)Walp.)

Due to the inexistence of introduction tests and evaluation of Feijão Caupi lineages in Tocantins State and before the necessity of the producers in increase their gains through low cost technological innovations, tests were carried out with the branched and bush types, which were installed in Gurupi, at the south of the State, in February.
Feijão Caupi, if compared with the Feijão Arranque, is more rustic, with smaller demands of manure application and an always assured production.

Spacing - For the branched type Feijão Caupi, which possesses long guides, a spacing of 0.80 m between lines and 0.40 m between holes for two plants can be used. For the bunch type Feijão Caupi, which presents half-erect plants, the spacing shall be 0.60 m between lines and 0.25 m between holes, with two plants.

Manure application - The planting manure application shall be according to the soil analysis, with possibility to be dispensable coverage manuring.

Varieties - The bush type Feijão Caupi, detached with a production above the test average, was the variety BR-12 Canindé, with a production of 1,049 kg/ha and the detached branched type Feijão Caupi was the BR-14 Mulato, which produced 754 kg/ha

4.5 Permanent Perennial Crops

4.5.1 Cassava (Manihot utilissima Crantz)

Cassava is cultivated in all tropical and sub-tropical regions between latitudes 30°N and 30°S. Cassava plants belongs to the Euphorbiáceae family, generous Manihot and include several species, and the Manihot is the most utilized due its economical importance.

(1) Requirements

Water requirement - The ideal climate for the cassava plant is related to humid tropical characteristics, with abundant well distributed rain and suitable solar radiation. This plant requires regular distribution of rainfall during the first 4 months, then the resistance to lack of water is higher due to water accumulated in the roots.

Cassava plant can be developed under varied rainfall regimes, from 500mm to 2.500mm, being ideal around 1.250mm during the development phase of the plant, well distributed during 6 to 8 months of the cycle. After the first growing period, the plant can resist long dryness period. This resistance is demonstrated in the north-east of Brazil, where it is cultivated in regions with a rainfall of lower than 600mm. Besides, it also resists excess water with 3.000 mm annual rainfall if the soils are well drained.

Temperature - Cassava cultivation has better yield in hot and humid areas, resisting up to 35°C without remarkable damages, however, the advisable temperatures are between 25°C and 29°C, temperature lower than 15°C paralyzes the vegetative activity.

Solar Radiation - It is considered a neutral day plant, requiring 9 to 10 hours of solar light and 2 to 6 hours of indirect radiation.

Relative Humidity - The most favorable humidity for this crop is around 60%.

Soil - Cassava is adapted to several varieties of soils, since they are light, deep and easy draining. Free from swampy and inundation, and with good fertility. Soils with 1m deep are more recommendable, with good amount of organic material, rich in potassium and with a K/N relation between 3 and 4. Potassium has an important role for translocation of carbohydrates from the high part to the roots.

Suitable soil pH is between 6.0 to 7.0; and a pH lower than 5.0 shall be corrected in order to avoid decreasing of production caused by bactera; or a pH higher than 7.8 is not recommendable.

Growth cycle and the Critical Period - This crop has a cycle of 16 to 18 months. The first 120 days after planting, are the main important for a successful production. And 20 days of dryness cause damaging of stacks.

(2) Cultivation Technology of Cassava (*Manihot esculenta Crantz*)

Brazil is the major cassava producer in the world, being responsible for 18% of the production. It possesses a cultivation area of around 2 million ha, however having one of the lowest yields, an average of 11.7 ton/ha. Brazil explores only 20% of the cultivation productive potential, which is 60 to 70 ton/ha. The cassava sector is characterized by a large pulverization of the production, predominantly in mini scale farms, with restrained markets and not much assisted by credit mechanisms.

The cassava cultivation increase is limited to the lack of alternative markets for the roots, being restricted to the production of flour and starch. Conventionally, cassava is utilized as fresh roots, table flour (water, mixed and dried) and starch. For animal feeding, scrapings, hay, and fresh roots are utilized. However, there are many other alternatives for the starch, such as: Bakery cassava flour, Products pre-cooked by extrusion (breakfast cereals, children food, pudding, etc.), Metal casting, petroleum wells perforation, production of adhesives and alloying agents, refining (mining), detergents and biodegradable plastics, Partial substitute for blood plasma, sterilization of surgical gloves, chemical indicators and electrophoreses.

Perspectives of Expansion of the Cultivation in the State - Tocantins State possesses a great potential for the cassava cultivation exploitation, which is verified through the strong presence of the cultivation in all municipalities. Soils under Cerrado vegetation are predominant in most of its territory, where this cultivation can compete, advantageously, with other more requiring cultivations, mainly considering its adaptability to acid and low fertility soils.

A great amount of starch, flour and other by-products of cassava commercialized in the State are derived from São Paulo, Santa Catarina, Goiás and Pará states, showing that the state production is far lower the consumption.

Preparation of planting material: The cassava is a plant of asexual propagation, multiplying through segments of the stem or branch, known as manivas. The manivas can conduct parasites (insects and acarids) and also pathogen agents (fungus, bacteria and virus). Therefore, the selection of planting material is fundamental for the obtainment of a productive cassava plantation. For the obtainment of manivas, the following measures are recommended:

(i) Selection of stems of healthy plants which don' t present incidence of pests and diseases;
(ii) Utilization of plants of 10 to 12 months of cycle;
(iii) Planting of manivas from a recent crop or which have been well conserved;
(iv) Utilization of manivas of 20 to 25 cm, never smaller, specially in few rain periods.

Planting period - The ideal is to plant the cassava in the first three months of the rainy season, when the soil is moist. In the first 4-5 months, the plant is very demanding as for water, and this is the period which will propitiate a good initial development of the plant, allowing it to go through the dry season in good conditions.

Planting system - The planting in furrows is more indicated, and the maniva shall be placed in a horizontal position, at a depth of 5 to 10 cm, totally covered by earth. It must be avoided that the manivas get in direct touch with the manure applied in the furrow, mixing or covering it with a small layer of earth.

The recommended spacing is the simple line - 100 to 120 cm between lines and 60 - 80 cm between plants; and the double line - 200 cm between lines and 60 to 80 cm between

double lines and between plants. The double line is more recommended for inter-cropping.

Varieties - For the Cerrado ecosystem, 8 varieties are recommended for industrial purposes (flour and starch): Mantiqueira, Jaçanã, Sonora, IAC - 12829, IAC 7-127, IAC 356-6, EAB 81, EAB 651, which represent 18 months cycle and average productivity around 20 to 30 ton/ha, depending on the technological level adopted by the producer.

Manure application - The manure application recommendation shall be carried out according to the soil analysis.

4.5.2 Sugar Cane (Saccharum officinarum L.)

Sugarcane is commercially produced in 58 countries located among the north-south latitudes 35°. The sugar cane is plant with high adaptation power, however better production are obtained in humid and hot areas, with high solar radiation during the growing stage. Dry period are required for maturation and harvesting stages.

(1) Requirements

Water requirement - In tropical areas, rainfall of 1.300mm to 1.800mm during the growing period are suitable for higher productivity. The ideal annual rainfall is around 1,500 mm.

Temperature - The ideal temperature for germination is 22°C to 23°C. The desirable growing is reached with a daily mean temperature between 22°C to 30°C.

Solar radiation - Sugar cane is a day neutral plant with an optimum light period of 12h and 30 m of daily sunshine.

Relative Humidity - The ideal humidity is over 70%, however, high humidity increase probability of diseases.

Soil - Sugar cane reaches higher development in deep soils (1 m), with good aeration, with sandy or clayey-sandy texture with a high capacity for retention of water; and medium to high fertility. Soils with more than 1 m deep and more than 15% of available water are the most recommended.

This crop can be developed in soils with pH between 5.0 to 8.5, and the optimum pH being 6.5. Salinity affects moderately to this crop, decreasing the production.

4.5.3 Banana (Musa Spp.)

It is a tropical and subtropical crop and the economical cultivation is located in the area between 25° North and South latitude.

(1) Requirements

Water requirement - The ideal rainfall for the banana is around 1,200 and 1,500 mm well distributed (100mm to 150 mm monthly, with an optimum of 120mm). The annual rainfall amplitude varies from 2.200mm to 1.000mm. During dry season, the growing of the banana stops, the cycle of the crop increases, the leaves turn yellowish, bunches are smaller and fruits quality is lower.

Temperature - The optimum temperature for the development of this crop is 26°C. With a temperature lower than 16°C the banana stops its activities and above 35°C growing is inhibited due dehydration of tissues.

Solar radiation - Banana is a day neutral crop.

Relative Humidity - This crop reach an optimum yield in areas where the relative humidity is between 40% and 80%.

Soil - Deep soils (1m), permeable, clayey and clayey-sandy, rich in organic material, with medium to high fertility are presented as ideal soil conditions for this crop. In general, sandy soils shall be avoided because of its low fertility, low moisture retention power and favorable for dissemination of nematodes. This crop reach an optimum vegetative development in soils with pH between 4.5 to 7.0.

4.5.4 Pineapple (Ananás comosus L.)

(1) Requirements

Pineapple has a remarkable physiological property: the cells of its leaves have the capacity to store water, characteristic that enable the adaptation of this plant to semi-arid regions. It can be cultivated in regions with rainfall regimes between 600 mm to 2.500 mm annual, being the optimum around 1.500 mm.

Other remarkable behavior is that cultivation of pineapple developed in semi-arid regions presents more defined characteristic of taste and aroma than cultivation developed in humid regions.

Temperature - Temperature is an important factor for pineapple, since it is fundamental for growing of different parts of the plant and consequently for the complete development. The optimum temperature required by this plant is between 23°C and 27°C.

Low temperatures represent a low development of plants, and more rigid leaves. Fruits are smaller with a weak color of pulps and elevated acidity level and consequently low amount of sugar and total solids.

In hot regions, better development of leaves is observed, producing big fruits with a high amount of sugar and low acid level, however, problems regarding respiration and excessive transpiration may occur.

Solar radiation - Intensity of solar radiation received by the pineapple since the planting period up to harvesting is an important factor for the development of the plant and quality of fruits. In areas with low solar radiation, there will be smaller fruits with low amount of sugar. However, in regions with very intensive sunshine, burning of fruits can be found. The relation between solar intensity and production is that for each reduction of the 20% of radiation, there is a reduction of 10% in the yield. This reduction is associated to the synthesis of hydrocarbons of leaves and utilization of nitrogen by the plant.

Duration of the day is a stabilizer factor of the crops cycle. In this case, the pineapple plants needs around 2,500 to 3,500 hours of daylight per year. It is a neutral day crop.

Relative Humidity - The optimum relative humidity for this crops is 70%.

Soil - Soil requirements of pineapple plants is related, in general to the aeration of the root system, which is very superficial. This crop requires a minimum depth of 0.6 m.

Soils with medium-sandy texture are recommended for this crop, but in case of sandy soils if they are excessively drained, problems regarding water deficiency shall be resolved. The most suitable areas for pineapple are found in soils with a medium texture, well drained and with a pH around 5.0.

4.6 Date Palm

The date (*Phoenix dactylifera* L) is a typical species of hot and dry regions. In Brazil, it is being researched in CPATSA/EMBRAPA, in the Bebedouro Experimental Field, in Petrolina - PE, and it can become an excellent alternative source of income for the farmers of the North and Northeast regions of the Country.

The favorable climate and adaptation capacity of the date palm are factors which make it an excellent option for Tocantins State.

In the date palm, almost everything is utilized, in several utilization alternatives:

(a) *Fruit*: Cooking (dried fruit, honey, liqueur, sweet, wine, brandy, yeast, palm cabbage, flour, jelly, alcohol), pharmaceutical products, etc.;
(b) *Stem*: Tile, firewood, baskets fabrication, handicrafts;
(c) *Leaves (foliole)*: Threads, clothes and mattress;
(d) *Thorns:* Tricot needles and pins.

In Brazil, the date palm starts to produce approximately within two years, overcoming the production of the origin countries, where it occurs within four years. The varieties

more indicated for our conditions are the Medjool and Zahidi, which are presenting an excellent performance by now.

Seedling - The production of date palm seedlings is carried out in 23 x 15 cm black polyethylene bags. The small bags, after filled with a substratum, of earth, dried cattle excrement and sand, in the proportion 3:2:1, shall be irrigated and go through a treatment with fungicide (spreading the superior part of the bags). Soon after, they shall be put in a nursery with a "sombrite" web, to receive the seeds, which are placed in the center of the bag, in a depth of 2 to 3 cm. The germination will occur uniformly, after 30 days.

Planting - The seedlings shall stay in the nursery after the germination, at least for 90 days. They shall be planted in the definitive place, in the spacing of 9.0 x 9.0 m, for the crown of palms doesn' t touch each other and to avoid the creation of a favorable microclimate for the incidence of diseases.

The holes shall be preferably open one month beforehand, with approximately 60 x 60 x 60cm. After the planting, they shall be immediately closed with earth with cattle excrement (20 to 30 liters of dried cattle excrement) and shall be manured with 400g of NPK - 20 - 20 - 10 per hole or similar. The seedling shall be irrigated until it grasped to the earth and the soil shall be covered with a thick layer of straw. After 30 days, utilize sulfate of ammonia in coverage, in average of 40g per hole. Make this coverage with sulfate of ammonia each 6 months, in the first two years.

Productivity - The date palm produces 2 to 8 ton/ha of fruits per year, presenting clusters weighting 5 to 6 kg, in average, in a total of 20 to 80 kg of fruits/palm per year.

5 Priority Areas for Research in the Veterinary Field

The following specific fields are identified as priority areas for research in the veterinary sector.

(1) Cattle Rising

- Improved breeds
- Management of pastures
- Degradation of pastures
- Invader plants
- Plagues and plants diseases
- Native pasture
- Rational utilization of the quartz sands
- Toxic plants
- Infectious and parasite diseases

(2) Beef Bovine Breeding

- Identification and evaluation of suitable native species
- Introduction, evaluation and selection of potential forage plants, suitable to the soil and climate conditions of Tocantins;
- Identification and control of native and cultivated toxic plants
- Implementation system study, recovering and maintenance of pastures
- Control of pasture plagues
- Nutritive and mineral supplement and nutritive alternative during the dry period
- Reproductive efficiency study and management of beef cattle
- Regionalized study of disease and incidence of endo or ecto parasit and adaptation to the practices and control methods
- Beef bovine production system

(3) Milk Bovine Breeding

- Evaluation of milk breeds and crossing with zebu for the improvement of the genetic breed in Tocantins
- Accompanying of cattle ranches as instrument for the characterization and determination of the technologic profile of the producer and to analyze the milk production systems utilized in the main basin of the state
- Milk production based on cultivated or native forage species (pastures or grasses) conserved forages (silo and hay), and concentrated, sub-products, remaining and management in rainy and dry period
- Production system establishments

(4) Buffalo Breeding

- Survey of the State areas suitable for breeding of buffalo;
- Evaluation of existing and exotic breeds in the State, nutrition sources through a milk and beef production system.

(5) Equine Breeding

- Evaluation of existing and introduced breeds and crossing aiming to obtain improved animals with better performance for the service;
- Survey of the disease incidence and of the endo and ecto parasites and adaptation to practices and control methods;
- Establishment of management systems and ration;
- Introduction and evaluation of forage plants.

(6) Caprine and Sheep Breeding

- Survey of the production system utilized in the State and limitations
- Evaluation of the existing and introduced breeds aiming the utilization of productive animals and adaptable to the different ecological places, intensive breeding system and to the predominant production system of the State

- Identification of diseases, ecto and endo parasit diseases and adaptation of control technologies
- Evaluation of alternative nutrition sources – native and exotic forages, cultivation of pastures, sources and methods of supplementary nutrition during critical period, specially using cultural remaining
- Study of alternative production systems

(7) Swine Breeding

- Introduction and evaluation of breeds "beef type"
- Evaluation of alternative food sources, composition and alternative management for nutrition according to the phase of swine and the production system
- Study of the environment conditions and management influence on the productivity, fertility, health and type of installations

(8) Poultry Farming

- Suitable type of poultry yard adapted to the climatic conditions of the state
- Establishment of the poultry density, according to the purpose of the activity, type of installation and climatic conditions
- To identify and evaluate the different materials for poultry "beds"
- To evaluate regional alternative for nutrition' s

ANNEX XVIII

PROJECT EVALUATION

ANNEX XVIII PROJECT EVALUATION

1. Principles for Evaluation

The Integrated Development Master Plan Study for Agriculture and Livestock of the State of Tocantins is expected to be carried out for the target year of 2015 comprising the following six major programs, namely:

- Regional Development Program
- Agricultural Production Supporting System Strengthening Program
- Environment Conservation Program
- Technological Development Program for Sustainable Agriculture and Livestock Farming
- Specific Sectors Development Program
- Private Sector Incentive Program

Amongst these programs, the Regional Development Program is a heterogeneous program, because the content of which has not been materialized yet but to be formulated in the coming near future subject to implementation of detailed field survey as well as compiling and making analysis of the survey result. Hence, this program shall be alienated from the task of project evaluation. Similarly, the Specific Sectors Development Program which envisages to encourage two specific sectors that are considered to be important sectors for future agricultural development of the State of Tocantins, is excluded from economic evaluation because of its rudimentary status of project formulation.

In so far as the Agricultural Production Supporting System Strengthening Program is concerned, the program consists of four subprograms and all of them are featured by the component for strengthening including beefing up of human resources. The cost for these subprograms has been estimated, but the benefits accrued from them are hard to be quantified. In the light of this difficulty, the economic evaluation which accompanies inevitably calculation of the internal rate of return shall not be conducted for this program.

The Technological Development Program for Sustainable Agriculture and Livestock Farming has been formulated in view of attaining sustainable farming system through establishment of a development technology demonstration center. This program, which is proposed to be put into implementation under project-type technical cooperation, aims to disseminate technologies to be developed there to indefinite "cerrado" lands extended over the state territory and its direct benefits are difficult in quantification because it is not easy to identify the program's direct beneficiaries, as the case of the Agricultural Production Supporting System Strengthening Program. Due to the reason mentioned herewith, this program shall not be evaluated economically.

The Private Sector Incentive Program, meanwhile, is composed of five subprograms to be implemented by the private sector with supports rendered by the public sector for their encouragement. In this context, an economic evaluation on this program shall not be conducted.

Finally, the Environmental Conservation Program which consists of two subprograms: the environmental conservation and the Green Village, shall be subject to economic evaluation in so far as tangible benefits are conceived; at least some projects included in the latter subprogram which contemplate to realize sustainable crops and livestock production in harmony with an appropriate management of natural resources shall be a target of economic evaluation together with financial analysis at farm level.

2. Anticipated Benefits of the Master Plan

The proposed programs included in the Master Plan are expected to have a considerable impact on the social, productive and environmental considerations of the rural areas of the State of Tocantins. They would benefit under-developed rural sectors of the state by introduction of unconventional and sustainable farming practice together with strengthening and enhancement of the structure and capability of agriculture-supporting entities. These programs would benefit a number of rural families by improving their living conditions, increasing household income, generating rural employment and introducing better natural resource management practices.

The implementation of these programs shall expand state production of crops and livestock, which, in turn, lead to encourage development of agriculture-related industries. All of these accomplishments shall flourish regional economy and contribute to improvement of fiscal status of the state government accordingly. On the other hand, the project's environmental conservation component would directly reduce the degradation and begin the replenishment of the State's valuable soil. In addition, local populations both in urban and rural sectors would be able to enjoy healthier life owing to implementation of the environmental conservation program.

The anticipated benefits for respective program may be summarized as given hereinafter.

Programs	Anticipated Major Benefits
Regional Development	- Intensification of land use and increase in crops and livestock output. - Increase in farmers' income - Sustainability of farm production owing to introduction of crop-livestock

	rotation - Generation of job opportunity for rural labor and agricultural marketing and industrial sectors - Activation of regional economy
Agricultural Production Supporting System Strengthening	- Enhancement of supporting services to producers to contribute to improvement of farm production both in quality and quantity.
Environmental Conservation	- Enhancement of environmental conditions and amelioration of rural life - Reduction in emission of carbon dioxide gas to curb global warming - Sustainability of crops and livestock production - Intensification of land use and increase in agricultural output - Introduction of innovated farming practice to promise farmers and their descendants sustainable agricultural and livestock production
Technological Development for Sustainable Agriculture and Livestock Farming	- Prevention of soil degradation and maintenance of soil fertility
Specific Sectors Development	- Optimization of natural resources - Increase of farmers' income - Diversification of nutritive status of local population
Private Sector Incentive	- Promotion of regional economic activities - Elevation of value-added of agro-products - Generation of job opportunities

The anticipated benefits cited above can be divided into tangible and intangible ones and the former is estimated in the subsequent section.

3. Economic and Financial Evaluation of Selected Projects

As explained in the section 1, the economic and financial evaluation shall be limited to some projects included in the Green Village Program of the Environmental

Conservation Program in view of the fact that the benefits accrued from the program are easily quantificable; the Green Village Program is constituted by four subprograms, of which two subprograms, Improvement of Rural Environment and Sustainable Farming Model, contains the components which serve to estimate project's costs and benefits tangibly. Thus, the economic and financial evaluation for the present Master Plan Study shall be conducted with regard to the six (6) projects conceived in these two subprograms. These six projects are as listed below.

Subprograms	Projects	Abbreviation
Improvement of Rural Environment	Introduction of Sustainable Agriculture by Mini and Small Scale Farmers in the Bico do Papagaiyo Region	IPE-1
	Introduction of Integrated sustainable Agriculture of Buffaloes Raising and Fruits Cultivation in Jalapão	IPE-2
Sustainable Farming Model	Integrated Vegetables and Swine Production by Mini and Small Farmers in Suburbs	SFM-1
	Farming Integrated Cereals and Beef Cattle Production by Small Farmers	SFM-2
	Farming Integrated Cereals and Beef Cattle Production by Medium and Large Scale Farmers	SFM-3
	Fruits Production in Tocantins State	SFM-4

The salient features of these projects are as resumed in the following table.

Project Abbreviation	Farming System	Development Area (ha)	No. of Beneficiaries	Project Cost Total (/ha)
IPE-1	Mixed farming of vegetables production and rearing of swine	540	30	R$ 921,650 (R$1,707)
IPE-2	Mixed farming of fruits cultivation and raising of buffaloes	150	5	R$ 1,098,400 (R$ 7,323)
SFM-1	Mixed farming of vegetables production and rearing of swine	1,050	30	R$ 3,750,900 (R$ 3,572)
SFM-2	Mixed farming of cereals production and rearing of beef cattle	4,800	30	R$ 9,918,000 (R$ 2,066)
SFM-3	Mixed farming of cereals production and rearing of beef cattle	3,000	3	R$ 3,256,600 (R$ 1,086)
SFM-4	Pilot fruits production	100	5	R$ 1,227,500 (R$ 12,275)
Total		9,640	103	R$ 20,173,050 (R$ 2,093)

3.1 Evaluation methodology

The economic and financial evaluation is carried out in compliance with the conventional methodology that is commonly applied for evaluation of development projects in Brazil under finance of the World Bank and other bilateral and multilateral financing institutions.

The indicators used for evaluation are Internal Rate of Return (IRR) and apart from this indicator, the Net Present Value has been calculated so as to present the magnitude of the projects' incremental benefits.

3.2 Economic Cost

Generally speaking, the economic rate of return is calculated with base costs plus physical contingencies, less transfer items including taxes, interests, and price contingencies, but for the sake of the present evaluation, physical contingencies have not been taken into account because of smaller share of civil and building works within the cost components. The opportunity cost of capital was estimated to be12%.

3.3 Pricing

The exchange rate of the Brazilian Real against US dollar is currently determined in the open market without intervention of the government. Furthermore, given the policy reforms and the opening of the economy that has been taking place over a couple of years in the past, trade restrictions have been eliminated and domestic prices tend to correspond much closer to border prices. For the purpose of economic analysis, border price were estimated for all tradable commodities to be produced by the projects, based on the World Bank projections (February 1996), while the price of non-tradable commodities was set the same as prevailing domestic market prices. A conversion factor of 0.90 was used for machinery and fertilizers, with the exception of urea and potassium phosphate for which specific conversion factors of 0.82 and 0.86 were used, respectively.

While the projects would generate on-farm and off-farm employment in the priority areas in which it would be implemented, unemployment and under-employment would not be eliminated. Therefore, shadow prices for unskilled labor were estimated at 0.80 of the market wage rate. In the case of skilled labor, the market rate was assumed to reflect its opportunity cost.

3.4 Yields and Farm Operation Balance

In the without-project situation, in which marginal and small farmers conduct subsistence farming without producing cash crops to be traded at market the profit and

loss of farm operation is assumed to be balanced, although there are indications that, in the absence of soil conservation measures, yields have been declining as a result of degradation of soil fertility. Meanwhile, farm operation balance with-project situation has been prepared on the basis of the target yields attained by agriculturally developed regions in Brazil together with farm-gate price and production cost prevailed in the country.

The proposed crop production of the projects is featured by mechanized and sustainable farming system, hence it is presumed that target yields of crops (grains, vegetables and fruits) are to be attained at the initial stage of the project, while farm income of the livestock is expected to be obtained from the 3rd year of the project because it takes twenty four (24) months before the cattle raised at farm are traded.

Bearing durable years of projects' major facilities (irrigation system and rural installations) in mind, the project life for all projects has been set forth as twenty years.

3.5 Projects' Anticipated Returns

With annual inflow (benefits) and outflow (costs) at market and economic price estimated to comply with the methodology presented in the previous sub-sections, an annual incremental net benefits (annual benefits minus annual costs) have been incorporated to cover the whole project life (20 years). These incremental benefits constitute the basis for calculating an IRR for both economic and financial term and a NPV with discount rate of 12%.

The result for calculation of IRR and NPV for respective project and for integrated components of all of these projects is as given in the table below.

Project	Economic Returns		Financial Returns	
Abbreviation	IRR(%)	NPV(R$)	IRR(%)	NPV(R$)
IPE-1	41	4,152,082	21	1,335,128
IPE-2	96	2,491,447	28	1.036,462
SFM-1	40	5,064,983	17	1,000,276
SFM-2	21	5,674,069	13	501,804
SFM-3	19	1,488,723	9	- 690,728
SFM-4	26	826,333	15	190,250
Global	28	19,967,638	14	3,373,192

The above outcomes indicate that with the exception of the SFM-3 (Mixed farming of cereals production and rearing of beef cattle to be conducted by medium and large farmers), the implementation of projects listed above has been justified from both economic and financial viewpoints, to have been confirmed by their values of IRR superior to the opportunity cost of capital in Brazil, which is estimated to be 12% .

3.6 Farmers' Income Analysis

The farmers' income analysis under the present Master Plan is carried out on two model farms chosen from six projects presented herewith. The principal reason to realize this farm income analysis falls on assessing whether farmers by different categories of farm size and farming system are capable of realizing financially sound farm operation with attaining sufficient returns even being in debt to banks in the form of rural credit for capital and recurrent expenses of farm properties and crops and livestock farming.

The two model farms thus chosen have the following features, namely:

Model Farm No.	No.1	No.2
Project Abbreviation	SM-1	SM-2
Farming System	Mixed farming of vegetables and swine	Mixed farming of cereals and beef cattle
Land Holding Size (ha)	70	320
Cultivated Area (ha)	35	160
Land Use	Tomato & onion: 5 ha Maize: 31 ha Millet: 31 ha	Soybeans: 40 ha Feijao: 30 ha Maize: 10 ha Millet: 40 ha Pasture: 120 ha
Farm Property	Irrigation system (Drip) Warehouse, Swine Fattening ban, Compost Shed	Irrigation system (Center Pivot), Warehouse

In build-up of crop budget all prices are quoted in market price as of mid-1997. The cost for family labor was excluded from this crop budget, and cost of mechanical operation was estimated for both models on the basis of hours of operation and unit rate of machine hire. In livestock farming, it is proposed that part of fodder needed to feed cattle will be supplied by the same farm, so cost of fodder except for concentrates has been reduced.

Crop and livestock yields coincide with those which have been applied for economic and financial evaluation, meanwhile farm-gate prices are calculated in actual term.

Landholders of model farms are supposed to be deficient in financial resources for realizing farm operation, establishment of rural installations and purchase of agricultural machinery with their own fund. Thus, they shall have depend on rural credit rendered by relevant banks and the conditions for this credit are: TJLP (with some percentage of discount) + 6% of interest rate and repayment in 6 years with grace period of two years.

It is assumed that both landowners of model farm have to undertake without rural property represented by agricultural machinery and equipment, so large amount of capital cost is required for procurement of on-farm irrigation facilities, agricultural machinery and rural installations. Under the situation, it is predicted that the farm operation would result in deficit for the for some years from the commencement of farm operation, and accumulated debt would not be written off until 13th year for the case of the model farm No.1 and 15th year for the case of the model farm No.2. Nevertheless, owing to intensification of land use and application of advanced farming technologies, these two model farms can anticipate substantial farm profits per year

Indicators related with farm income analysis of model farms are as given hereinafter

Model Farm No.	Turning Year[1/]	Annual Surplus[2/]	FIRR over 20 years	NPV at discount rate of 12%	
				Total	Per ha
1	13th	50,450	19%	R$ 39,021	R$ 1,115
2	15th	21,735	12.5	R$ 6,477	R$ 40

Note: 1/ The year when accumulated debt is to be written off.
2/ After canceling payment for rural installations and completing repayment of rural credit.

4. Master Plan's Socio-economic Impacts

Albeit having high potentials for agricultural development endowed with fertile soil condition, abundant water resources, favorable climatological conditions, etc., the State of Tocantins has not attained anticipated agricultural development up to date. Major constraints which have braked the development of the agriculture sector are geographical disadvantageous position of the State located far away from leading marketing entrepots for agricultural commodities and inputs of the country and deficient provision of institutional supporting services to producers; the former constraint is expected to be mitigated with progress of the Multimodal Central-Northern Transportation Corridor which is highly benefitable to the agricultural sector of the State in hastening export of agricultural products of the State not only to other states of the country but also to the international market. Meanwhile, in so far as the latter constraint is concerned, despite both federal and state governments have proposed policies to invigorate agricultural and livestock productive activities of the State, no outstanding outcome has been shown up to date.

Under the circumstances, the present master plan has forged a number of programs and projects in relation with strengthening of institutional capacity including manpower development of public organizations in charge of supporting services to producers. These programs and projects have been designed to contribute to improvement of agricultural production, both in quality and quantity, and they are proposed to benefit directly unspecified number of farmers in Tocantins. Therefore, they shall bring about

immeasurable direct benefits to the economy of the State of Tocantins.

Besides said institutional strengthening programs and projects, the Master Plan also comprises programs and projects which have been formulated aiming at ameliorating environmental condition and introduction of unconventional farming practice that leads to realize sustainable agricultural production in harmony with conservation of natural resources. Farming system proposed in these programs and projects does not seek for intensive use of land with excessive application of fertilizers and agro-chemicals, but is designed to make it viable for farmers to use land resources as sustainable as possible with introduction of crop-pasture rotation, agro-forestry, etc. so that future generations can also gain considerable livelihood depending on them. Apart from these environmental implication, the programs and projects envisages innovated farming system for the State of Tocantins such as mixed farming of crops and cattle or minor animals like buffalo and hog, fruit cultivation and export-oriented grains production. Furthermore, the integrated agricultural and livestock plan shall have significant impact on alleviation of rural poverty, because one of the objectives of some projects is to enhance living standard of marginal peasants who are actually conducting nothing but subsistence farming.

It is accordingly judged that the integrated agricultural and livestock development plan is justified from institutional, environmental and socio-economic points of view. In addition, some projects which have definitely quantificable benefits have been proved to be economically and financially feasible. Nevertheless, it is advisable that the government should propose some exceptional policy applied to producers who embark environmentally sustainable farming practice sacrificing economic profitability of farm operation.

Apart from above direct benefits, it is anticipated that the following indirect benefits are to be accrued through implementation of the integrated agricultural and livestock plan.

- Generation of job opportunity owing to expansion of agricultural activities
- Development of agriculture-related industry (processing of agro-products, manufacturing of fertilizers, rural small-scale industry, etc.) attributable to increase of agricultural output.
- Earning of foreign exchange as an outcome of growth in production of export-oriented grains and livestock products.
- Alleviation of exodus of rural population toward urban area
- Mitigation of socio-economic disparity between the State of Tocantins and other states of the country.
- Relaxation of social conflict owing to elevation of income among marginal peasants and generation of job opportunity among landless farmers.
- Dissemination of farming system suited to the "Cerrado" area to other states.

- Contribution to constrain global warning as a consequence of curbing in emission of carbon dioxide gas.

Due to above-mentioned direct and indirect benefits, it is expected that the fiscal income of the state government of Tocantins would be grown substantially, which, in turn, contributes to ameliorate living circumstances of local population, as a result of switching state government's policy for earmarking budget to development of social infrastructure for education, public health, water supply and sewerage from prevailing major allocation of finance to economic infrastructure represented by highways and roads, electric generation works and communication network. The State of Tocantins thereby may manage to get rid of the situation of socio-economic under-development in economic term (the second lowest GRP per capita in Brazil) and in social term (22nd position in HDI value among the country's 27 states and federal district).

Table XVIII-3(1) Supporting Data for Project Evaluation

Subprogram: Improvement of Rural Environment
Project: Introduction of a Sustainable Agriculture Model for Mini and Small Scale Farmers in the Bico de Papagaio Region

I. Feature of the Project

Farming system:	Mixed fanning of vegetables production and rearing of swine
Beneficiaries:	Three associations consist of each 10 households of mini and small farmers in and around Bico do Papagaio
Development area:	18 ha/household (average) x 10 x 3 associations = 540 ha

II. Project Cost

II-1. Capital Cost

Unit: R$

Items	Quantity	Unit	Unit Cost Financial	Unit Cost Economic	Amount Financial	Amount Economic	Remarks
1) Land consolidation	540	ha	450	405	243,000	218,700	
2) Irrigation system (Drip)	60	ha	3500	3150	210,000	189,000	2 ha x 30
3) Farm machinery							
- Tractor (128 HP, 4WD)	3	unit	62,000	55,800	186,000	167,400	
- Combine with attachment of corn picker	3	unit	95,000	85,500	285,000	256,500	
- Straw chopper	3	unit	9,400	8,460	28,200	25,380	
- Planter	3	Unit	17,000	15,300	51,000	45,900	
- Disk harrow 20" x 24	3	unit	12,000	10,800	36,000	32,400	
- Pack roller	3	unit	4,400	3,960	13,200	11,880	
- Broadcaster	3	unit	5,000	4,500	15,000	13,500	
- Injector or vacume car (for liquid manure of swine)	3	unit	3,500	3,150	10,500	9,450	
- Power sprayer 400liters	3	unit	3,000	2,700	9,000	8,100	
- Truck 5 tons	3	unit	70,000	63,000	210,000	189,000	
Sub-total					843,900	759,510	
4) Rural installations							
- Warehouse	1200	m^2	180	171	216,000	205,200	40 m^2 x 30 units
- Swine breeding barn	150	head	1500	1425	225,000	213,750	
- Swine fattening barn	3000	m^2	40	38	120,000	114,000	100 m^2 x 30 units
- Farm machinery shed and workshop with equipment and tools	1380	m^2	280	266	386,400	367,080	460 m^2 x 3 unit
- Compost shed	750	m^2	30	29	22,500	21,375	25 m^2 x 30 units
- Simple feed mixture factory with machinery and equipment	1410	m^2	265	252	373,650	354,968	47 m^2 x 30 units
- Maize storage silo	900	ton	45	43	40,500	38,475	300 tons x 3 unit
- Simple buchery	600	m^2	460	437	276,000	262,200	200 m^2 x 3 units
Sub-total					1,660,050	1,577,048	
5) Breeding animals	156	head	400	400	62,400	62,400	
Total					3,019,350	2,806,658	

II - 2 Recurent Costs of Installations and Machinery (R$/year)

Unit: R$

Item	Annual Cost	
1) Repair and maintenance of agricultural machinery	46,800	41,460
2) Operation of simple feed mixture factory	12,000	11,400
3) Simple buchery (to be included in calculation of benefits)	-	
4) Maize storage silo	2,100	1,995
Total	60,900	57,855

II - 3 Replacement Costs of Machinery, Installations and breeding animals

Unit: R$

Item		Cost for Replace.	
1) Agricultural machinery:	10 years	843,900	759,510
2) Irrigation equipment (drip):	5 years	210,000	189,000
3) Building:	20 years	-	
4) Breeding animals	4 years	62,400	62,400

Table XVIII-3(1) Supporting Data for Project Evaluation - Continued

Subprogram: Improvement of Rural Environment
Project: Introduction of a Sustainable Agriculture Model for Mini and Small Scale Farmers in the Bico de Papagaio Region

III. Estimation of Anticipated Benefits

III-1 Farm Operation

[Without Project]

Supposed to be balanced in profit loss of farm operation

[With Project]

(1) Crop production (Cropping intensity = 200%)

Crops	Area (ha)	Yield (t/ha)	Output (ton)	Price(R$/t) Financial	Price(R$/t) Economic	Gross Return (R$) Financial	Gross Return (R$) Economic	Production Cost (R$) F (Per ha)	Production Cost (R$) E (Per ha)	Production Cost (R$) F (Total)	Production Cost (R$) E(Total)	Net Return Financial	Net Return Economic
Tomato	60	55	3300	360	360	1188000	1188000	13500	10395	810000	623700	378000	564300
Onion	60	20	1200	370	370	444000	444000	3000	2310	180000	138600	264000	305400
Maize*	480	3	1440	100	160	23000	36800	210	162	100800	77616	-77800	-40816
Millet**	480	-	-	-	-	0	0	50	39	24000	18480	-24000	-18480
Total												540200	810404

Note: * Only 690 tons are sold, the rest are used for feeding swine raised by member farmer of the association
** Cover crop and no commercial value

(2) Livestock

Animals	Total Head	Weight(pork) (kg/head)	Weight(pork) Total	Price (R$/kg) Financial	Price (R$/kg) Economic	Gross Return Financial	Gross Return Economic	Production Cost (R$) F(Per ha)	Production Cost (R$) E(Per ha)	Production Cost (R$) F(Total)	Production Cost (R$) E(Total)	Net Return Financial	Net Return Economic
Swine	2400	95	228000	1.3	1.3	296400	296400	75	58	180000	139200	116400	157200

Total of farm operation benefits	656,600	967,604

III-2 Operation of simple buchery	Financial	Economic
Gross Income x 10% = 296400 x 1.2 x 0.2= (round)	71,000	71,000
Total of Annual Benefits	727,600	1,038,604

Table XVIII-3(1) Supporting Data for Project Evaluation - Continued

Subprogram: Improvement of Rural Environment
Project: Introduction of a Sustainable Agriculture Model for Mini and Small Scale Farmers in the Bico de Papagaio Region

IV. Project's Cash Flow
IV-1. Market Price

	Cost					Incremental
Year	Capital	Recurr.	Replace.	Total	Benefits	Benefits
1	3,019,350	60,900		3,080,250	399,300	-2,680,950
2		60,900		60,900	563,450	502,550
3		60,900		60,900	727,600	666,700
4		60,900		60,900	727,600	666,700
5		60,900	62,400	123,300	727,600	604,300
6		60,900	210,000	270,900	727,600	456,700
7		60,900		60,900	727,600	666,700
8		60,900		60,900	727,600	666,700
9		60,900	62,400	123,300	727,600	604,300
10		60,900		60,900	727,600	666,700
11		60,900	1,053,900	1,114,800	727,600	-387,200
12		60,900		60,900	727,600	666,700
13		60,900	62,400	123,300	727,600	604,300
14		60,900		60,900	727,600	666,700
15		60,900		60,900	727,600	666,700
16		60,900	210,000	270,900	727,600	456,700
17		60,900	62,400	123,300	727,600	604,300
18		60,900		60,900	727,600	666,700
19		60,900		60,900	727,600	666,700
20		60,900		60,900	727,600	666,700
					IRR =	21%
					NPV =	1,335,128

IV-2. Economic Price

	Cost					Incremental
Year	Capital	Recurr.	Replace.	Total	Benefits	Benefits
1	2,806,658	57,855		2,864,513	554,802	-2,309,711
2		57,855		57,855	849,953	792,098
3		57,855		57,855	1,109,604	1,051,749
4		57,855		57,855	1,109,604	1,051,749
5		57,855	62,400	120,255	1,109,604	989,349
6		57,855	218,700	276,555	1,109,604	833,049
7		57,855		57,855	1,109,604	1,051,749
8		57,855		57,855	1,109,604	1,051,749
9		57,855	62,400	120,255	1,109,604	989,349
10		57,855		57,855	1,109,604	1,051,749
11		57,855	948,510	1,006,365	1,109,604	103,239
12		57,855		57,855	1,109,604	1,051,749
13		57,855	62,400	120,255	1,109,604	989,349
14		57,855		57,855	1,109,604	1,051,749
15		57,855		57,855	1,109,604	1,051,749
16		57,855	189,000	246,855	1,109,604	862,749
17		57,855	62,400	120,255	1,109,604	989,349
18		57,855		57,855	1,109,604	1,051,749
19		57,855		57,855	1,109,604	1,051,749
20		57,855		57,855	1,109,604	1,051,749
					IRR =	41%
					NPV =	4,152,082

Table XVIII - 3(2) Supporting Data for Project Evaluation

Subprogram: Improvement of Rural Environment
Project: Introduction of a Sustainable Agriculture Model of Buffaloes Raising and Fruits Cultivation in Jalapao

I Feature of the Project

Farming system	Mixed farming of fruits cultivation and raising of buffaloes
Beneficiaries	5 households of small farmers in the suburb area of Sao Felix
Development area	30 ha/household (average) x 5 = 150 ha

II Project Cost

II-1 Capital Cost

Unit: R$

Items	Quantity	Unit	Unit Cost Financial	Unit Cost Economic	Amount Financial	Amount Economic	Remarks
1) Land consolidation	100	ha	450	405	45,000	40,500	20 ha x 5
2) Irrigation system (Drip)	100	ha	3500	3150	350,000	315,000	20 ha x 5
3) Farm machinery							
- Tractor (50 HP, 4WD)	2	unit	23,000	20,700	46,000	41,400	
- Disk harrow (for tractor)	2	unit	8,000	7,200	16,000	32,000	
- Mower	2	unit	4,700	4,230	9,400	8,460	
- Power sprayer 400liters	2	unit	3,000	2,700	6,000	5,400	
- Truck 5 tons	1	Unit	70,000	63,000	70,000	63,000	
- Truck 2 tons	5	Unit	45,000	40,500	225,000	202,500	
Sub-total					372,400	352,760	
4) Rural installations							
- Warehouse	500	m^2	180	171	90,000	85,500	100 m^2 x 5 units
- Farm machinery shed and workshop with equipment and tools	100	m^2	280	266	28,000	26,600	100 m^2 x 1 unit
- Workshop	1000	m^2	200	190	200,000	190,000	200 m^2 x 5 units
- Simple cheese factory	100	m^2	150	143	15,000	14,250	100 m^2 x 1 unit
- Buffalo dairy with equipment	100	m^2	250	225	25,000	22,500	100 m^2 x 1 unit
Sub-total					358,000	338,850	
5) Purchase of Buffaloes	105	head	200	200	21,000	21,000	
6) Establishment of Orchard							
- Banana	50	ha	4300	3311	215,000	165,550	
- Pineapple	50	ha	1900	1463	95,000	73,150	
Sub-total					310,000	238,700	
Total					1,098,400	967,960	

II - 2 Reccurent Costs of Installations and Machinery (R$/year)

Unit: R$

Item	Annual Cost Economic	Annual Cost Financial
1) Repair and maintenance of agricultural machinery	18,600	17,670
2) Simple cheese factory (to be included in calculation of benefits)	-	-
3) Buffalo dairy (to be included in calculation of benefits)	2,500	2,500
Total	21,100	20,170

II - 3 Replacement Costs of Machinery, Installations and breeding animals

Unit: R$

Item		Replacement Cost Economic	Replacement Cost Financial
1) Agricultural machinery	10 years	372,400	335,160
2) Irrigation equipment (drip)	5 years	350,000	315,000
3) Buffalo	6 year	2,500	2,500
4) Building	20 years	-	-

Table XVIII - 3(2) Supporting Data for Project Evaluation - Continued

Subprogram: Improvement of Rural Environment
Project: Introduction of a Sustainable Agriculture Model of Buffaloes Raising and Fruits Cultivation in Jalapao

III Estimation of Anticipated Benefits

III-1 Farm Operation

Supposed to be balanced in profit/loss of farm operation

【With Project】

(1) Crop production (Cropping intensity = 100%)

Crops	Area (ha)	Yield (t/ha)	Output (ton)	Price(R$/t) Financial	Price(R$/t) Economic	Gross Return (R$) Financial	Gross Return (R$) Economic	Production Cost (R$) F (Per ha)	Production Cost (R$) E (Per ha)	Production Cost (R$) F (Total)	Production Cost (R$) E(Total)	Net Return Financial	Net Return Economic
Banana	50	40	2000	120	120	240000	240000	3000	2310	150000	115500	90,000	124,500
Pineapple	50	40	2000	245	245	490000	490000	2900	2233	145000	111650	345,000	378,350
Elephant grass	50	-	-	-	-	0	0	130	100	6500	5005	-6,500	-5,005
Total										301,500	232,155	428,500	497,845

Note. * Only 230 tons are sold, the rest are used for feeding swine raised by member farmer of the association
** Cover crop and no commercial value

(2) Livestock

Total buffalo per farm. 105 (100 females and 5 males)

Category	Total Head	Milk Production (kg/year)	Milk Production Total	Price (R$/kg) Financial	Price (R$/kg) Economic	Gross Return(R$) Financial	Gross Return(R$) Economic	Production Cost (R$) F(Per kg)	Production Cost (R$) E(Per kg)	Production Cost (R$) F(Total)	Production Cost (R$) E(Total)	Net Return(R$) Financial	Net Return(R$) Economic
Milk*	70	1,500	101,850	-	-	0	0	0	0	17,315	13,241	-17,315	-13,241
Category	Total Head	Sale of buffalo (head/year)	Total	Price (R$/kg) Financial	Price (R$/kg) Economic	Gross Return(R$) Financial	Gross Return(R$) Economic	Production Cost (R$) F(Per h)	Production Cost (R$) E(Per h)	Production Cost (R$) F(Total)	Production Cost (R$) E(Total)	Net Return(R$) Financial	Net Return(R$) Economic
Infant buffalo	70	35		200	200	7,000	7,000	50	39	3,500	2,695	3,500	4,305
Adult male buffalo	0 8	0 8		250	250	200	160	80	62	64	49	136	111
Adult female buffalo	17	17		150	150	2,550	2,550	80	62	1,360	1,047	1,190	1,503
Sub-total						9,750	9,710			4,924	3,791	4,826	5,919
Total										9,848	7,583	-12,489	-7,322

Note * Milk are processed by association for production of cheese

III-2 Operation of Simple Cheese Factory

Net Benefits = (Gross return of milk production) x 1 5 - operation cost = 101,850 x 0 3 x 1 5 - 3750 =	42,090	42,000
Total Sum of the Benefits (At full development stage)	458,012	532,523

Table XVIII - 3(2) Supporting Data for Project Evaluation - Continued

Subprogram: Improvement of Rural Environment
Project: Introduction of a Sustainable Agriculture Model of Buffaloes Raising and Fruits Cultivation in Jalapao

IV. Project's Cash Flow
IV-1 Market Price

Year	Cost Capital	Recurr.	Replace	Taotal	Benefits	Incremental Benefits
1	1,098,400	21,100		1,119,500	127,000	-992,500
2		21,100		21,100	127,000	105,900
3		21,100		21,100	416,012	394,912
4		21,100		21,100	416,012	394,912
5		21,100		21,100	416,012	394,912
6		21,100	350,000	371,100	416,012	44,912
7		21,100	2,500	23,600	416,012	392,412
8		21,100		21,100	416,012	394,912
9		21,100		21,100	416,012	394,912
10		21,100		21,100	416,012	394,912
11		21,100	722,400	743,500	416,012	-327,489
12		21,100	2,500	23,600	416,012	392,412
13		21,100		21,100	416,012	394,912
14		21,100		21,100	416,012	394,912
15		21,100		21,100	416,012	394,912
16		21,100	350,000	371,100	416,012	44,912
17		21,100		21,100	416,012	394,912
18		21,100		21,100	416,012	394,912
19		21,100	2,500	23,600	416,012	392,412
20		21,100		21,100	416,012	394,912
					IRR =	28%
					NPV =	1,036,462

IV-2 Economic Price

Year	Cost Capital	Recurr.	Replace	Total	Benefits	Incremental Benefits
1	967,960	20,170		988,130	490,262	-497,868
2		20,170		20,170	490,262	470,092
3		20,170		20,170	532,523	512,353
4		20,170		20,170	532,523	512,353
5		20,170		20,170	532,523	512,353
6		20,170	315,000	335,170	532,523	197,353
7		20,170	2,500	22,670	532,523	509,853
8		20,170		20,170	532,523	512,353
9		20,170		20,170	532,523	512,353
10		20,170		20,170	532,523	512,353
11		20,170	650,160	670,330	532,523	-137,807
12		20,170		20,170	532,523	512,353
13		20,170	2,500	22,670	532,523	509,853
14		20,170		20,170	532,523	512,353
15		20,170		20,170	532,523	512,353
16		20,170	315,000	335,170	532,523	197,353
17		20,170		20,170	532,523	512,353
18		20,170		20,170	532,523	512,353
19		20,170	2,500	22,670	532,523	509,853
20		20,170		20,170	532,523	512,353
					IRR =	96%
					NPV =	2,491,447

Table XVIII - 3(3) Supporting Data for Project Evaluation

Subprogram: Sustainable Farming Model
Project: Integrated Vegetables Production and Swine Farming by Small Farmers

I. Feature of the Project

Farming system:	Mixed farming of vegetables production and rearing of swine
Beneficiaries:	Three Associations consists of 10 households of small farmers in Araguaina, Palmas and Gurupi
Development area:	35 ha/household (average) x 10 x 3 associations = 1,050 ha

II. Project Cost

II-1. Capital Cost

Unit: R$

Items	Quantity	Unit	Unit Cost Financial	Unit Cost Economic	Amount Financial	Amount Economic	Remarks
1) Land consolidation	120	ha	450	405	54,000	48,600	4ha x 30
2) Irrigation system (Drip)	120	ha	3500	3150	420,000	378,000	4 ha x 30
3) Farm machinery							
- Tractor (128 HP, 4WD)	6	unit	62,000	55,800	372,000	334,800	
- Tractor (85 HP, 2WD)	6	unit	31,000	27,900	186,000	167,400	
- Corn picker	3	unit	15,000	13,500	45,000	40,500	
- Straw chopper	3	unit	9,400	8,460	28,200	25,380	
- Planter	3	Unit	17,000	15,300	51,000	45,900	
- Disk harrow 20" x 24	3	unit	12,000	10,800	36,000	32,400	
- Pack roller	3	unit	4,400	3,960	13,200	11,880	
- Broadcaster	3	unit	5,000	4,500	15,000	13,500	
- Injector or vacume car (for liquid manure of swine)	3	unit	3,500	3,150	10,500	9,450	
- Power sprayer 400liters	3	unit	3,000	2,700	9,000	8,100	
- Truck 5 tons	6	unit	70,000	63,000	420,000	378,000	
Sub-total					1,185,900	1,067,310	
4) Rural installations							
- Warehouse	1800	m^2	180	171	324,000	307,800	60 m^2 x 30 units
- Swine breeding barn	315	head	1500	1425	472,500	448,875	
- Swine fattening barn	6000	m^2	40	38	240,000	228,000	200 m^2 x 30 units
- Farm machinery shed and workshop with equipment and tools	900	m^2	280	266	252,000	239,400	300 m^2 x 3 unit
- Compost shed	750	m^2	30	29	22,500	21,375	25 m^2 x 30 units
- Simple feed mixture factory with machinery and equipment	600	m^2	265	252	159,000	151,050	200 m^2 x 3 units
- Maize storage silo	1800	ton	45	43	81,000	76,950	600 tons x 3 unit
- Simple buchery	900	m^2	460	437	414,000	393,300	300 m^2 x 3 unit
Sub-total					1,965,000	1,866,750	
5) Breeding animals	315	head	400	400	126,000	126,000	
Total					3,750,900	3,486,660	

II - 2 Recurent Costs of Installations and Machinery (R$/year)

Unit: R$

Item	Annual Cost	
1) Repair and maintenance of agricultural machinery	59,000	56,050
2) Operation of simple feed mixture factory	16,000	15,200
3) Simple buchery (to be included in calculation of benefits)	-	
4) Maize storage silo	4,000	3,800
Total	79,000	75,050

II - 3 Replacement Costs of Machinery, Installations and breeding animals

Unit: R$

Item		Cost for Replace	
1) Agricultural machinery:	10 years	1,185,900	1,067,310
2) Irrigation equipment (drip):	5 years	420,000	378,000
3) Building:	20 years	-	
4) Breeding animals	4 years	126,000	126,000

Table XVIII - 3(3) Supporting Data for Project Evaluation - Continued

Subprogram: Sustainable Farming Model
Project: Integrated Vegetables Production and Swine Farming by Small Farmers

III. Estimation of Anticipated Benefits

III-1 Farm Operation

【Without Project】

Supposed to be balanced in profit/loss of farm operation

【With Project】

(1) Crop production (Cropping intensity = 200%)

Crops	Area (ha)	Yield (t/ha)	Output (ton)	Price(R$/t) Financial	Price(R$/t) Economic	Gross Return (R$) Financial	Gross Return (R$) Economic	Production Cost (R$) F (Per ha)	Production Cost (R$) E (Per ha)	Production Cost (R$) F (Total)	Production Cost (R$) E(Total)	Net Return Financial	Net Return Economic
Tomato	60	55	3300	360	360	1188000	1188000	13500	10395	810000	623700	378000	564300
Onion	60	20	1200	370	370	444000	444000	3000	2310	180000	138600	264000	305400
Maize*	930	3	2790	100	160	165000	264000	210	162	195300	150381	-30300	113619
Millet**	930	-	-	-	-	0	0	50	39	46500	35805	-46500	-35805
Total												565200	947514

Note: * Only 1650 tons are sold, the rest are used for feeding swine raised by member farmer of the association
** Cover crop and no commercial value

(2) Livestock

Animals	Total Head	Weight(pork) (kg/head)	Weight(pork) Total	Price (R$/kg) Financial	Price (R$/kg) Economic	Gross Return Financial	Gross Return Economic	Production Cost (R$) F(Per ha)	Production Cost (R$) E(Per ha)	Production Cost (R$) F(Total)	Production Cost (R$) E(Total)	Net Return Financial	Net Return Economic
Swine	4500	95	427500	1.3	1.3	555750	555750	75	58	337500	261000	218250	294750

Total of farm operation benefits	783,450	1,242,264

III-2 Operation of simple buchery	Financial	Economic
Gross Income x 10% = 555750 x 1.2 x 0.1= (round)	67,000	67,000
Total of Annual Benefits	850,450	1,309,264

Table XVIII - 3(3) Supporting Data for Project Evaluation - Continued

Subprogram: Sustainable Farming Model
Project: Integrated Vegetables Production and Swine Farming by Small Farmers

IV. Project's Cash Flow
IV-1. Market Price

	Cost					Incremental
Year	Capital	Recurr.	Replace.	Total	Benefits	Benefits
1	3,750,900	79,000		3,829,900	458,725	-3,371,175
2		79,000		79,000	654,588	575,588
3		79,000		79,000	850,450	771,450
4		79,000		79,000	850,450	771,450
5		79,000	126,000	205,000	850,450	645,450
6		79,000	420,000	499,000	850,450	351,450
7		79,000		79,000	850,450	771,450
8		79,000		79,000	850,450	771,450
9		79,000	126,000	205,000	850,450	645,450
10		79,000		79,000	850,450	771,450
11		79,000	1,605,900	1,684,900	850,450	-834,450
12		79,000		79,000	850,450	771,450
13		79,000	126,000	205,000	850,450	645,450
14		79,000		79,000	850,450	771,450
15		79,000		79,000	850,450	771,450
16		79,000	420,000	499,000	850,450	351,450
17		79,000	126,000	205,000	850,450	645,450
18		79,000		79,000	850,450	771,450
19		79,000		79,000	850,450	771,450
20		79,000		79,000	850,450	771,450
					IRR =	17%
					NPV =	1,000,276

IV-2. Economic Price

	Cost					Incremental
Year	Capital	Recurr.	Replace.	Total	Benefits	Benefits
1	3,486,660	75,050		3,561,710	688,132	-2,873,578
2		75,050		75,050	1,048,948	973,898
3		75,050		75,050	1,376,264	1,301,214
4		75,050		75,050	1,376,264	1,301,214
5		75,050	126,000	201,050	1,376,264	1,175,214
6		75,050	48,600	123,650	1,376,264	1,252,614
7		75,050		75,050	1,376,264	1,301,214
8		75,050		75,050	1,376,264	1,301,214
9		75,050	126,000	201,050	1,376,264	1,175,214
10		75,050		75,050	1,376,264	1,301,214
11		75,050	1,445,310	1,520,360	1,376,264	-144,096
12		75,050		75,050	1,376,264	1,301,214
13		75,050	126,000	201,050	1,376,264	1,175,214
14		75,050		75,050	1,376,264	1,301,214
15		75,050		75,050	1,376,264	1,301,214
16		75,050	378,000	453,050	1,376,264	923,214
17		75,050	126,000	201,050	1,376,264	1,175,214
18		75,050		75,050	1,376,264	1,301,214
19		75,050		75,050	1,376,264	1,301,214
20		75,050		75,050	1,376,264	1,301,214
					IRR =	40%
					NPV =	5,064,983

Table XVIII - 3(4) Supporting Data for Project Evaluation

Subprogram: Sustainable Farming Model
Project: Integrated Cereals and Beef Cattle Production by Small Scale Farmers

I. Feature of the Project

Farming system:	Mixed farming of cereals production and rearing of beef cattle
Beneficiaries:	Three associations consist of each 10 households of small farmers in Araguaina, Palmas and Gurupi
Development area:	160 ha/household (average) x 3 associations x 10 = 4,800 ha

II. Project Cost

II-1. Capital Cost

Unit: R$

Items	Quantity	Unit	Unit Cost Financial	Unit Cost Economic	Amount Financial	Amount Economic	Remarks
1) Land consolidation	1200	ha	450	405	540,000	486,000	40 ha x 30
2) Irrigation system (Center Pivot)	60	unit	90000	81000	5,400,000	4,860,000	2 units x 30
3) Farm machinery							
- Tractor (128 HP, 4WD)	6	unit	62,000	55,800	372,000	334,800	
- Tractor (85 HP, 2WD)	6	unit	31,000	27,900	186,000	167,400	
- Combine with attachment of corn picker	3	unit	95,000	85,500	285,000	256,500	
- Straw chopper	3	unit	9,400	8,460	28,200	25,380	
- Planter	3	Unit	17,000	15,300	51,000	45,900	
- Disk harrow 20" x 24	3	unit	12,000	10,800	36,000	32,400	
- Pack roller	3	unit	4,400	3,960	13,200	11,880	
- Broadcaster	3	unit	5,000	4,500	15,000	13,500	
- Power sprayer 2000liters	3	unit	12,000	10,800	36,000	32,400	
- Power sprayer 400liters	1	unit	3,000	2,700	3,000	2,700	
- Truck 5 tons	6	unit	60,000	54,000	360,000	324,000	
Sub-total					1,385,400	1,246,860	
4) Rural installations							
- Warehouse	1800	m^2	180	171	324,000	307,800	60 m^2 x 30 units
- Farm machinery shed and workshop with equipment and tools	2100	m^2	280	266	588,000	558,600	700 m^2 x 3 unit
- Fence	150	km	1100	1100	165,000	165,000	5 km x 30
Sub-total					1,077,000	1,031,400	
5) Purchase of breeding bulls and cows							
- Cow	6480	head	220	220	1,425,600	1,425,600	
- Bull	180	head	500	500	90,000	90,000	
Sub-total					1,515,600	1,515,600	
Total					9,918,000	9,139,860	

II - 3 Replacement Costs of Machinery, Installations and breeding animals

Unit: R$

Item	Annual Cost	
1) Repair and maintenance of agricultural machinery	72,000	68,400
2) Repair and maintenance of fence	16,500	16,500
Total	88,500	84,900

Unit: R$

Item		Cost for Replace.	
1) Agricultural machinery:	10 years	1,385,400	1,246,860
2) Irrigation equipment (Center pivot):	20 years	-	-
3) Building:	20 years	-	-
4) Fence	15 years	165,000	165,000

Table XVIII - 3(4) Supporting Data for Project Evaluation - Continued

Subprogram: Sustainable Farming Model
Project: Integrated Cereals and Beef Cattle Production by Small Scale Farmers

III. Estimation of Anticipated Benefits

III-1 Farm Operation

[Without Project]

Supposed to be balanced in profit loss of farm operation

[With Project]

(1) Crop production: 40 ha of land for each farm(grains production in dry season, and cover crop in rainy season; three harvests a year)

Crops	Area (ha)	Yield (t/ha)	Output (ton)	Price(R$/t) Financial	Price(R$/t) Economic	Gross Return (R$) Financial	Gross Return (R$) Economic	Production Cost (R$) F (Per ha)	Production Cost (R$) E (Per ha)	Production Cost (R$) F (Total)	Production Cost (R$) E(Total)	Net Return Financial	Net Return Economic
Soybeans	1200	2.4	2880	250	300	720000	864000	440	339	528,000	406,560	192,000	457,440
Feijao	900	2.2	1980	660	660	1306800	1306800	800	616	720000	554400	586800	752400
Maize	300	3	900	100	160	90000	144000	210	162	63,000	48,510	27,000	95,490
Millet*	1200	-	-	-	-	0	0	50	39	60,000	46,200	-60,000	-46,200
Total						2,116,800	2,314,800			1,371,000	1,055,670	745,800	1,259,130

Note: * Only 230 tons are sold, the rest are used for feeding swine raised by member farmer of the association
** Cover crop and no commercial value

(2) Livestock

No. of cattle to be fattened per year: 150heads (2.5 head/ha/year)
Average live weight for slautering: 375 kg
No. of breeding cow: 216 heads
No. of breeding bull: 6 heads
Caalving rate: 70%
Culling rate: 18% (bull), 15%(cow)
Calf mortality: 10%
Adult mortality: 3%

At Full Development Stage

Animals	Total Head Raised	Head for Slaughter	Price (R$/head) Financial	Price (R$/head) Economic	Gross Income (Total in R$) Financial	Gross Income (Total in R$) Economic	Cost (R$/head) F(Per ha)	Cost (R$/head) E(Per ha)	Cost (Total in R$) F(Total)	Cost (Total in R$) E(Total)	Net Return (Total in R$) Financial	Net Return (Total in R$) Economic
Breeding cattle*	6660	1200	220	220	264000	264000	65	51	432900	339660	-168,900	-75,660
Fattening cattle	4500	4500	370	350	1665000	1575000	50	40	225000	180000	1,440,000	1,395,000
Total					1,929,000	1,839,000			657,900	519,660	1,271,100	1,319,340

Note: * 18% of the breeding cattle are to be slaughtered every year
Cost for breeding cattle include that for additional purchase of breeding cattle (18% of initial purchase = R$/head)

Table XVIII - 3(4) Supporting Data for Project Evaluation - Continued

Subprogram: Sustainable Farming Model
Project: Integrated Cereals and Beef Cattle Production by Small Scale Farmers

IV. Project's Cash Flow
IV-1. Market Price

	Cost					Incremental
Year	Capital	Recurr.	Replace.	Total	Benefits	Benefits
1	9,918,000	88,500		10,006,500	87,900	-9,918,600
2		88,500		88,500	87,900	-600
3		88,500		88,500	87,900	-600
4		88,500		88,500	2,016,900	1,928,400
5		88,500		88,500	2,016,900	1,928,400
6		88,500		88,500	2,016,900	1,928,400
7		88,500		88,500	2,016,900	1,928,400
8		88,500		88,500	2,016,900	1,928,400
9		88,500		88,500	2,016,900	1,928,400
10		88,500		88,500	2,016,900	1,928,400
11		88,500	1,385,400	1,473,900	2,016,900	543,000
12		88,500		88,500	2,016,900	1,928,400
13		88,500		88,500	2,016,900	1,928,400
14		88,500		88,500	2,016,900	1,928,400
15		88,500		88,500	2,016,900	1,928,400
16		88,500	165,000	253,500	2,016,900	1,763,400
17		88,500		88,500	2,016,900	1,928,400
18		88,500		88,500	2,016,900	1,928,400
19		88,500		88,500	2,016,900	1,928,400
20		88,500	-110,000	-21,500	2,016,900	2,038,400
					IRR =	13%
					NPV =	501,804

IV-2. Economic Price

	Cost					Incremental
Year	Capital	Recurr.	Replace.	Total	Benefits	Benefits
1	9,139,860	84,900		9,224,760	739,470	-8,485,290
2		84,900		84,900	739,470	654,570
3		84,900		84,900	739,470	654,570
4		84,900		84,900	2,578,470	2,493,570
5		84,900		84,900	2,578,470	2,493,570
6		84,900		84,900	2,578,470	2,493,570
7		84,900		84,900	2,578,470	2,493,570
8		84,900		84,900	2,578,470	2,493,570
9		84,900		84,900	2,578,470	2,493,570
10		84,900		84,900	2,578,470	2,493,570
11		84,900	1,246,860	1,331,760	2,578,470	1,246,710
12		84,900		84,900	2,578,470	2,493,570
13		84,900		84,900	2,578,470	2,493,570
14		84,900		84,900	2,578,470	2,493,570
15		84,900		84,900	2,578,470	2,493,570
16		84,900	165,000	249,900	2,578,470	2,328,570
17		84,900		84,900	2,578,470	2,493,570
18		84,900		84,900	2,578,470	2,493,570
19		84,900		84,900	2,578,470	2,493,570
20		84,900	-110000	-25,100	2,578,470	2,603,570
					IRR =	21%
					NPV =	5,674,069

Table XVIII - 3(5) Supporting Data for Project Evaluation

Subprogram: Sustainable Farming Model
Project: Integrated Cereals and Beef Cattle Production by Middle and Large Farmers

I. Feature of the Project

Farming system:	Mixed farming of cereals production and rearing of beef cattle
Beneficiaries:	Three households of medium and largel farmers in Araguaina, Palmas and Gurupi
Development area:	1,000 ha/household (average) x 3 = 3,000 ha

II. Project Cost

II-1. Capital Cost

Unit: R$

Items	Quantity	Unit	Unit Cost Financial	Unit Cost Economic	Amount Financial	Amount Economic	Remarks
1) Land consolidation	480	ha	450	405	216,000	194,400	160 ha x 3
2) Irrigation system (Center Pivot)	6	unit	90,000	81000	540,000	486,000	2 units x 30
3) Farm machinery							
- Tractor (128 HP, 4WD)	6	unit	62,000	55,800	372,000	334,800	
- Tractor (85 HP, 2WD)	6	unit	31,000	27,900	186,000	167,400	
- Combine with attachment of corn picker	3	unit	95,000	85,500	285,000	256,500	
- Forage harvester	3	unit			0	0	
- Planter	3	Unit	17,000	15,300	51,000	45,900	
- Disk harrow 20" x 24	3	unit	12,000	10,800	36,000	32,400	
- Pack roller	3	unit	4,400	3,960	13,200	11,880	
- Broadcaster	3	unit	5,000	4,500	15,000	13,500	
- Power sprayer 2000liters	3	unit	12,000	10,800	36,000	32,400	
- Power sprayer 400liters	1	unit	3,000	2,700	3,000	2,700	
- Truck 5 tons	3	unit	70,000	63,000	210,000	189,000	
- Truck 2 tons	3	unit	45,000	40,500	135,000	121,500	
Sub-total					1,207,200	1,086,480	
4) Rural installations							
- Warehouse	300	m^2	180	171	54,000	51,300	100 m^2 x 3 units
- Farm machinery shed and workshop with equipment and tools	1800	m^2	280	266	504,000	478,800	600 m^2 x 3 unit
- Fence	38	km	1100	1100	41,800	41,800	12.6 km x 3
Sub-total					599,800	571,900	
5) Purchase of breeding cow and bull							
- Cow	2880	head	220	220	633,600	633,600	
- Bull	120	head	500	500	60,000	60,000	
Sub-total					693,600	693,600	
Total					3,256,600	3,032,380	

II - 3 Replacement Costs of Machinery, Installations and breeding animals

Unit: R$

Item	Annual Cost	
1) Repair and maintenance of agricultural machinery	60,000	57,000
2) Repair and maintenance of fence	4,200	4,200
Total	60,000	57,000

Unit: R$

Item		Cost for Replace.	
1) Agricultural machinery:	10 years	1,207,200	1,086,480
2) Irrigation equipment (center pivot)	20 years	-	-
3) Building	20 years	-	-
4) Fence	15 years	41,800	41,800

Table XVIII - 3(5) Supporting Data for Project Evaluation - Continued

Subprogram: Sustainable Farming Model
Project: Integrated Cereals and Beef Cattle Production by Middle and Large Farmers

III Estimation of Anticipated Benefits

III-1. Farm Operation

[Without Project]

Supposed to be balanced in profits/loss of farm operation

[With Project]

(1) Crop Production

Land use for each farmer: 160 ha for irrigated land (40 ha for grains production, 2.7 harvests a year, 120 ha for pasture)
810 ha for non-irrigated land (285 ha for grains production, single harvest a year, 555 ha for pasture)

Crops	Area (ha)	Yield (t/ha)	Output (ton)	Price(R$/t) Financial	Price(R$/t) Economic	Gross Return (R$) Financial	Gross Return (R$) Economic	Production Cost (R$) F (Per ha)	Production Cost (R$) E (Per ha)	Production Cost (R$) F (Total)	Production Cost (R$) E(Total)	Net Return (R$) Financial	Net Return (R$) Economic
Soybeans*	204	2.4	489.6	250	300	122400	146880	440	339	89760	69115.2	32640	77764.8
Soybeans**	570	2.2	1254	250	300	313500	376200	350	270	199500	153615	114000	222585
Feijao*	90	2.2	198	660	660	130680	130680	800	616	72000	55440	58680	75240
Maize*	30	3.0	90	100	160	9000	14400	210	162	6300	4851	2700	9549
Maize**	120	2.7	324	100	160	32400	51840	170	131	20400	15708	12000	36132
Maize***	150	2.4	360	-	-	0	0	440	339	66000	50820	-66000	-50820
Sugracane***	65	2.4	36	-	-	0	0	700	539	10500	8085	-10500	-8085
Millet	120	-	-	-	-	0	0	50	39	6000	4620	-6000	-4620
Total												137,520	357,746

Note: * Irrigated farming, **Non-irrigated farming; *** For silage

(2) Livestock (Beef cattle farming)

Technical coefficient for each farm

No. of cattle to be fattened per year: 625 heads (300 heads in 120 ha of irrigated land and 325 heads in 170 ha of non-irrigated land)
Average liveweight for slaughtering: 375 kg
No. of breeding cow: 960 heads
No. of breeding bull: 40 heads
Culling rate: 18%(bull), 15%(cow)
Calf mortality: 3%
Adge for slaughtering: 30 months

Animals	Total Head Raised	Head for Slaughter	Price (R$/head) Financial	Price (R$/head) Economic	Gross Income (Total in R$) Financial	Gross Income (Total in R$) Economic	Production Cost (R$/head) Financial	Production Cost (R$/head) Economic	Production Cost (Total in R$) Financial	Production Cost (Total in R$) Economic	Net Return (Total in R$) Financial	Net Return (Total in R$) Economic
Breeding cattle*	3,000	540	220	220	118,800	118,800	65	50	195,000	150,150	-76,200	-31,350
Fattening cattle	1,875	1,875	370	350	693,750	656,250	48	37	90,000	69,300	603,750	586,950
Total					812,550	775,050			285,000	219,450	527,550	555,600

Table XVIII - 3(5) Supporting Data for Project Evaluation Data Sheet - Continued

Subprogram: Sustainable Farming Model
Project: Integrated Cereals and Beef Cattle Production by Middle and Large Farmers

IV. Project's Cash Flow
IV-1. Market Price

	Cost					Incremental
Year	Capital	Recurr.	Replace.	Total	Benefits	Benefits
1	3,256,600	60,000		3,316,600	-147,480	-3,464,080
2		60,000		60,000	-147,480	-207,480
3		60,000		60,000	-147,480	-207,480
4		60,000		60,000	665,070	605,070
5		60,000		60,000	665,070	605,070
6		60,000		60,000	665,070	605,070
7		60,000		60,000	665,070	605,070
8		60,000		60,000	665,070	605,070
9		60,000		60,000	665,070	605,070
10		60,000		60,000	665,070	605,070
11		60,000	1,207,200	1,267,200	665,070	-602,130
12		60,000		60,000	665,070	605,070
13		60,000		60,000	665,070	605,070
14		60,000		60,000	665,070	605,070
15		60,000		60,000	665,070	605,070
16		60,000	41,800	101,800	665,070	563,270
17		60,000		60,000	665,070	605,070
18		60,000		60,000	665,070	605,070
19		60,000		60,000	665,070	605,070
20		60,000	-27,800	32,200	665,070	632,870
					IRR =	9.0%
					NPV =	-690,728

IV-2. Economic Price

	Cost					Incremental
Year	Capital	Recurr.	Replace.	Total	Benefits	Benefits
1	3,032,380	60,000		3,092,380	138,296	-2,954,084
2		60,000		60,000	138,296	78,296
3		60,000		60,000	138,296	78,296
4		60,000		60,000	913,346	853,346
5		60,000		60,000	913,346	853,346
6		60,000		60,000	913,346	853,346
7		60,000		60,000	913,346	853,346
8		60,000		60,000	913,346	853,346
9		60,000		60,000	913,346	853,346
10		60,000		60,000	913,346	853,346
11		60,000	1,086,480	1,146,480	913,346	-233,134
12		60,000		60,000	913,346	853,346
13		60,000		60,000	913,346	853,346
14		60,000		60,000	913,346	853,346
15		60,000		60,000	913,346	853,346
16		60,000	41,800	101,800	913,346	811,546
17		60,000		60,000	913,346	853,346
18		60,000		60,000	913,346	853,346
19		60,000		60,000	913,346	853,346
20		60,000	-27,800	32,200	913,346	881,146
					IRR =	19%
					NPV =	1,488,723

Table XVIII - 3(6) Supporting Data for Project Evaluation

Subprogram: Sustainable Farming Model
Project: Fruits Production in 5 Regions

I. Feature of the Project

Farming system:	Pilot fruits production
Beneficiaries:	5 households of small farmers in 5 regions
Development area:	20 ha/household (average) x 5 = 100 ha

II. Project Cost

II-1. Capital Cost

Unit: R$

Items	Quantity	Unit	Unit Cost Financial	Unit Cost Economic	Amount Financial	Amount Economic	Remarks
1) Land consolidation	100	ha	450	365	45,000	40,500	20 ha x 5
2) Irrigation system (Drip)	100	ha	3500	3150	350,000	315,000	20 ha x 5
3) Farm machinery							
- Tractor (50 HP, 4WD)	5	unit	23,000	20,700	115,000	103,500	
- Mower	5	unit	4,700	4,230	23,500	21,150	
- Power sprayer 400liters	5	unit	3,000	2,700	15,000	13,500	
- Truck 2 tons	5	unit	45,000	40,500	225,000	202,500	
Sub-total					378,500	340,650	
4) Rural installations							
- Warehouse	500	m^2	180	171	90,000	85,500	100 m^2 x 5 units
- Farm machinery shed and workshop							100 m^2 x 5 unit
machinery and equipment	500	m^2	280	266	140,000	133,000	
- Workshop	500	m^2	200	190	100,000	95,000	
Sub-total					230,000	218,500	
5) Establishment of orchard							
- Banana	20	ha	4300	3311	86,000	66,220	
- Pineapple	20	ha	1900	1463	38,000	29,260	
- Lemon	20	ha	2900	2233	58,000	44,660	
- Acerola	20	ha	2100	1617	42,000	32,340	
- Palmito	20	ha	7000	5390	140,000	107,800	
Sub-total					224,000	172,480	
Total					1,227,500	1,087,130	

II - 2 Reccurent Costs of Installations and Machinery (R$/year)

Unit: R$

Item	Annual Cost	
1) Repair and maintenance of agricultural machinery	13,600	12,920
2) Operation of workshop	5,000	5,000
Total	18,600	17,920

II - 3 Replacement Costs of Machinery, Installations and breeding animals

Unit: R$

Item		Cost for Replace.	
1) Agricultural machinery:	10 years	378,500	340,650
2) Irrigation equipment (drip):	5 years	350,000	315,000
3) Building:	20 years	-	

Table XVIII - 3(6) Supporting Data for Project Evaluation - Continued

Subprogram: Sustainable Farming Model
Project: Fruits Production in 5 Regions

III. Estimation of Anticipated Benefits

III-1 Farm Operation

Supposed to be balanced in profit/loss of farm operation

【With Project】

(1) Crop production (Cropping intensity = 200%)

Crops	Area (ha)	Yield (t/ha)	Output (ton)	Price(R$/t)		Gross Return (R$)		Production Cost (R$)				Net Return	
				Financial	Economic	Financial	Economic	F (Per ha)	E (Per ha)	F (Total)	E(Total)	Financial	Economic
Banana	20	40	800	120	120	96000	96000	3000	2310	60000	46200	36,000	49,800
Pineapple	20	20	400	245	245	98000	98000	2900	2233	58000	44660	40,000	53,340
Lemon	20	3	60	100	160	23000	36800	210	162	4200	3234	18,800	33,566
Acerola	20	33	660	500	500	330000	330000	6600	5082	132000	101640	198,000	228,360
Palmito	20	2.4	48	950	950	627000	627000	1700	1309	34000	26180	593,000	600,820
Total												292,800	365,066

Table XVIII - 3(6) Supporting Data for Project Evaluation - Continued

Subprogram: Sustainable Farming Model
Project: Fruits Production in 5 Regions

IV. Project's Cash Flow
IV-1. Market Price

Year	Capital	Cost Recurr.	Cost Replace	Cost Total	Benefits	Incremental Benefits
1	1,227,500	18,600		1,246,100	87,840	-1,158,260
2		18,600		18,600	175,680	157,080
3		18,600		18,600	234,240	215,640
4		18,600		18,600	292,800	274,200
5		18,600		18,600	292,800	274,200
6		18,600	350,000	368,600	292,800	-75,800
7		18,600		18,600	292,800	274,200
8		18,600		18,600	292,800	274,200
9		18,600		18,600	292,800	274,200
10		18,600		18,600	292,800	274,200
11		18,600	728,500	747,100	292,800	-454,300
12		18,600		18,600	292,800	274,200
13		18,600		18,600	292,800	274,200
14		18,600		18,600	292,800	274,200
15		18,600		18,600	292,800	274,200
16		18,600	350,000	368,600	292,800	-75,800
17		18,600		18,600	292,800	274,200
18		18,600		18,600	292,800	274,200
19		18,600		18,600	292,800	274,200
20		18,600		18,600	292,800	274,200
					IRR =	15%
					NPV =	190,250

IV-2. Economic Price

Year	Capital	Cost Recurr.	Cost Replace	Cost Total	Benefits	Incremental Benefits
1	1,087,130	17,920		1,105,050	109,520	-995,530
2		17,920		17,920	219,040	201,120
3		17,920		17,920	292,053	274,133
4		17,920		17,920	365,066	347,146
5		17,920		17,920	365,066	347,146
6		17,920	315,000	332,920	365,066	32,146
7		17,920		17,920	365,066	347,146
8		17,920		17,920	365,066	347,146
9		17,920		17,920	365,066	347,146
10		17,920		17,920	365,066	347,146
11		17,920	655,650	673,570	365,066	-308,504
12		17,920		17,920	365,066	347,146
13		17,920		17,920	365,066	347,146
14		17,920		17,920	365,066	347,146
15		17,920		17,920	365,066	347,146
16		17,920	315,000	332,920	365,066	32,146
17		17,920		17,920	365,066	347,146
18		17,920		17,920	365,066	347,146
19		17,920		17,920	365,066	347,146
20		17,920		17,920	365,066	347,146
					IRR =	26%
					NPV =	826,333

Table XVIII - 3(7) Supporting Data for Project Evaluation

Global Evaluation of Subprograms (Improvement of Rural Environment and Sustainable Farming Model)

A. Market Price

Year	Cost					Incremental
	Capital	Recurr.	Replace.	Total	Benefits	Benefits
1	22,270,750	328,100	0	22,598,850	1,013,285	-21,585,565
2	0	328,100	0	328,100	1,461,138	1,133,038
3	0	328,100	0	328,100	2,168,722	1,840,622
4	0	328,100	0	328,100	4,968,832	4,640,732
5	0	328,100	188,400	516,500	4,968,832	4,452,332
6	0	328,100	1,330,000	1,658,100	4,968,832	3,310,732
7	0	328,100	2,500	330,600	4,968,832	4,638,232
8	0	328,100	0	328,100	4,968,832	4,640,732
9	0	328,100	188,400	516,500	4,968,832	4,452,332
10	0	328,100	0	328,100	4,968,832	4,640,732
11	0	328,100	6,703,300	7,031,400	4,968,832	-2,062,569
12	0	328,100	2,500	330,600	4,968,832	4,638,232
13	0	328,100	188,400	516,500	4,968,832	4,452,332
14	0	328,100	0	328,100	4,968,832	4,640,732
15	0	328,100	0	328,100	4,968,832	4,640,732
16	0	328,100	1,536,800	1,864,900	4,968,832	3,103,932
17	0	328,100	188,400	516,500	4,968,832	4,452,332
18	0	328,100	0	328,100	4,968,832	4,640,732
19	0	328,100	2,500	330,600	4,968,832	4,638,232
20	0	328,100	-137,800	190,300	4,968,832	4,778,532
					IRR =	14%
					NPV=	R$3,373,192

B. Economic Price

Year	Cost					Incremental
	Capital	Recurr.	Replace.	Total	Benefits	Benefits
1	20,520,648	315,895	0	20,836,543	2,720,482	-18,116,061
2	0	315,895	0	315,895	3,485,968	3,170,073
3	0	315,895	0	315,895	4,188,210	3,872,315
4	0	315,895	0	315,895	6,875,273	6,559,378
5	0	315,895	188,400	504,295	6,875,273	6,370,978
6	0	315,895	897,300	1,213,195	6,875,273	5,662,078
7	0	315,895	2,500	318,395	6,875,273	6,556,878
8	0	315,895	0	315,895	6,875,273	6,559,378
9	0	315,895	188,400	504,295	6,875,273	6,370,978
10	0	315,895	0	315,895	6,875,273	6,559,378
11	0	315,895	6,032,970	6,348,865	6,875,273	526,408
12	0	315,895	0	315,895	6,875,273	6,559,378
13	0	315,895	190,900	506,795	6,875,273	6,368,478
14	0	315,895	0	315,895	6,875,273	6,559,378
15	0	315,895	0	315,895	6,875,273	6,559,378
16	0	315,895	1,403,800	1,719,695	6,875,273	5,155,578
17	0	315,895	188,400	504,295	6,875,273	6,370,978
18	0	315,895	0	315,895	6,875,273	6,559,378
19	0	315,895	2,500	318,395	6,875,273	6,556,878
20	0	315,895	-137,800	178,095	6,875,273	6,697,178
					IRR =	28%
					NPV=	R$19,697,638

Table XVIII - 3(8) Supporting Data for Project Evaluation

Financial analysis of Model Farm: Model Farm No. 1

Subprogram: Sustainable Farming Model
Project: Integrated Vegetable Production and Swine Farming by Small Farmers
Beneficiary: Small Farmers with Land Holding of 70 ha
Farming System & Land Use: Mixed farming for vegetable production and rearing of swine

Unit: R$

Year in Order after Commencement of Farm Operation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
I. Initial Investment																						
- Farm Investment[1]	59,530	0	0	0	0	14,000	0	0	0	0	53,530	0	0	0	0	14,000	0	0	0	0		
- Rural Installation[2]	65,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Total	125,030	0	0	0	0	14,000	0	0	0	0	53,530	0	0	0	0	14,000	0	0	0	0		
II. Returns from Farm Operation																						
- Gross Value of Agricultural Production[3]	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425	78,425		
- Production Cost[4]	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310	52,310		
- O/M and On/Off-farm System[5]	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630	2,630		
Net Farm Return	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485	23,485		
BALANCE BEFORE FINANCING	-101,545	23,485	23,485	23,485	23,485	9,485	23,485	23,485	23,485	23,485	-30,045	23,485	23,485	23,485	23,485	9,485	23,485	23,485	23,485	23,485	19%	R$39,021
ACCUMULATED BALANCE	-101,545	-78,060	-54,575	-31,090	-7,605	1,880	25,365	48,850	72,335	95,820	65,775	89,260	112,745	136,230	159,715	169,200	192,685	216,170	239,655	263,140		
III. Financing																						
- Loan from Bank for Cropping and Livestock[6]	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	0	0	0	0	0	0	0	0		
- Loan from Bank for On/Off-farm Investment[7]	125,000	0	0	0	0	14,000	0	0	0	0	53,530	0	0	0	0	0	0	0	0	0		
Sub-total	175,000	50,000	50,000	50,000	50,000	64,000	50,000	50,000	50,000	50,000	103,530	50,000	0	0	0	0	0	0	0	0		
IV. Repayment of Loan																						
- Loan for Cropping and Livestock[8]	55,750	55,750	55,750	55,750	55,750	55,750	55,750	55,750	55,750	55,750	55,750	55,750	0	0	0	0	0	0	0	0		
- Loan for On/Off-farm Investment[9]	14,375	14,375	32,783	30,391	27,999	27,217	24,825	24,646	3,381	3,117	8,602	8,338	15,596	12,141	11,187	10,232	9,278	8,500	0	0		
Sub-total	70,125	70,125	88,533	86,141	83,749	82,967	80,575	80,396	59,131	58,867	64,352	64,088										
V. Net Cash Flow																						
- Annual Cash Flow	3,330	3,360	-15,048	-12,656	-10,264	-9,482	-7,090	-6,911	14,354	14,619	9,133	9,398	23,485	23,485	23,485	9,485	23,485	23,485	23,485	23,485	17%	R$12,854
- Accumulated Net Cash Flow	3,330	6,690	-8,358	-21,014	-31,278	-40,760	-47,850	-54,761	-40,407	-25,788	-16,655	-7,258	16,228	39,713	63,198	72,683	96,168	119,653	143,138	166,623		

Result	
- IRR:	
- NPV at discount rate of 12%:	

Note: 1/ Consists of costs for land consolidation, irrigation system, agricultural machinery (property of association, quota for member farmer) and breeding hogs
2/ Consists of cost for warehouse, swine breeding ban, swine fattening ban, farm machinery shed, compost shed, simple feed mixing factory, etc.
3/ Market price of output
4/ Cost of actually purchased farm input expressed in market price
5/ Agricultural machinery, etc.
6/ Credit Line for "PROAGRI"
7/ Credit Line for "PROAGRI"
8/ Interest rate is presumed to be: TJLP (with discount of 50%) + 6.0%/year (Agro-year 97/98); repayment: at every harvests
9/ Interest rate is presumed to be: TJLP (with discount of 50%) + 6.0%/year (Agro-year 97/98); repayment: in 8 years with two years of grace period

Table XVIII - 3(8) Supporting Data for Project Evaluation

Financial Analysis of Model Farm: Model Farm No. 2

Subprogram: Sustainable Farming Model
Project: Integrated Cereals and Beef Cattle Production by Small Scale Farmers
Beneficiary: Small Farmers with Land Holding of 320 ha
Farming System & Land Use: Mixed farming for cereals production and raising of beef cattle

Unit: R$

Year in Order after Commencement of Farm Operation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
I. Initial Investment																						
- Farm Investment[1/]	244,180	0	0	0	0	0	0	0	0	0	46,180	0	0	0	0	0	0	0	0	0		
- Rural Installation[2/]	35,900	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,500	0	0	0	-3,700		
- Purchase of breeding cattle	50,520	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Total	330,600	0	0	0	0	0	0	0	0	0	46,180	0	0	0	0	5,500	0	0	0	-3,700		
II. Returns from Farm Operation																						
- Gross Value of Agricultural Production[3/]	70,560	70,560	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860	134,860		
- Production Cost[4/]	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130	75,130		
- O/M and On/Off-farm System[5/]	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950		
Net Farm Return	-7,520	-7,520	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780		
BALANCE BEFORE FINANCING	-338,120	-7,520	56,780	56,780	56,780	56,780	56,780	56,780	56,780	56,780	10,600	56,780	56,780	56,780	56,780	51,280	56,780	56,780	56,780	60,480	12%	R56,477
ACCUMULATED BALANCE	-338,120	-345,640	-288,860	-232,080	-175,300	-118,520	-61,740	-4,960	51,820	108,600	119,200	175,980	232,760	289,540	346,320	397,600	454,380	511,160	567,940	628,420		
III. Financing																						
- Loan from Bank for Cropping and Livestock[6/]	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000												
- Loan from Bank for On/Off-farm Investment[7/]	330,000	0	0	0	0	0	0	0	0	0	46,000	0	0	0	0	0	0	0	0	0		
Sub-total	405,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000												
IV. Repayment of Loan																						
- Loan for Cropping and Livestock	83,625	83,625	83,625	83,625	83,625	83,625	83,625	83,625	83,625	83,625												
- Loan for On/Off-farm Investment	37,950	37,950	86,625	80,300	73,975	67,650	61,325	55,000	0	0	5,290	5,290	12,016	11,142	10,268	9,394	8,520	8,000	0	0		
Sub-total	121,575	121,575	170,250	163,925	157,600	151,275	144,950	138,625	83,625	83,625	5,290	5,290	12,016	11,142	10,268	9,394	8,520	8,000	0	0		
V. Net Cash Flow																						
- Annual Cash Flow	-54,695	-54,095	-38,470	-32,145	-25,820	-19,495	-13,170	-6,845	48,155	48,155	5,310	51,490	44,764	45,638	46,512	-41,886	48,260	48,780	56,780	60,480	7%	-R564,245
- Accumulated Cash Flow	-54,695	-108,790	-147,260	-179,405	-205,225	-224,720	-237,890	-244,735	-196,580	-148,425	-143,115	-91,625	-46,861	-1,223	45,289	87,175	135,435	184,215	240,995	301,475		

Result	
- IRR	
- NPV at discount rate of 12%[8/]	

Note: 1/ Consists of costs for land consolidation, irrigation system, agricultural machinery (property of association, quota for member farmer) and breeding hogs
2/ Consists of cost for warehouse, swine breeding ban, swine fattening ban, farm machinery shed, compost shed, simple feed mixing factory, etc
3/ Market price of output
4/ Cost of actually purchased farm input expressed in market price
5/ Agricultural machinery, etc.
6/ Credit Line for "PROAGRI"
7/ Credit Line for "PROAGRI"
8/ Interest rate is presumed to be: TJLP (with discount of 50%) + 6.0%/year (Agro-year 97/98); repayment: at every harvests
9/ Interest rate is presumed to be: TJLP (with discount of 50%) + 6.0%/year (Agro-year 97/98); repayment: in 8 years with two years of grace period