RICE PROJECT FOR THE NORTH REGION

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PROGRAM FOR STRENGTHENING AGRICULTURAL RESEARCH IN NORTHERN BRASIL

RICE PROJECT FOR THE NORTH REGION

1. INTRODUCTION

1.01. The objective of the rice project for the north region is the solving of technical problems through the adaptation of existing technology to the Amazonian situation and the formation of new technology as needed. Those Regional Research Centers (Unidades de Execução de Pesquisas no Âmbito Estadual - UEPAE) which presently offer possibilities for the most efficient development of the proposed studies and which would be most likely to produce results on a short term basis will be strengthened.

1.02. The states of the north region where such Regional Research Centers (UEPAE) are located are the following:

State	UEPAE
Pará	Belém
Amazonas	Manaus

1.03 These regional centers work in coordination with the program of the National Rice Research Center, located in . Goiânia, in the State of Goiás. Basic research will be conducted in the regional center selected for satelite activities (atividades satélites) and adaptive research at experiment station and in farmers fields in the area in question.

1.04. Research with irrigated and non-irrigated rice will be conducted. The recommendation for the localization of the research in the states mentioned is based on the fact that the State of Pará produces approximately 75% of the total Amazon region rice production. The inclusion of the State of Amazonas is based on its great potential for the production of irrigated rice.

1.05. The proposed research program will include plant breeding, genetics, agronomy, soils, plant nutrition, irrigation and drainage, plant protection, and economics of production systems.

2. HISTORICAL

A) The product

2.01. Production data for the states and territories of the North region from the period of 1968 to 1972 are presented in table 1. Although the region consumes all of the rice which it produces it is not self-sufficient in rice and imports from the states of Goiás, Minas Gerais, Rio Grande do Sul, São Paulo and Maranhão, the quantities necessary to satisfy local demand.

2.02. The North region produces the least rice of any of Brazil's physiographic regions, only 1.5 percent of the National total. The State of Pará is the most important producer in the region, the value of the rice crops being only to that of Cassava in the state's economy.

2.03. In spite of this low production in comparison to other Brazilians states, the state of Pará has enormous potential for rice production. The situation with respect of soil, climate rainfall, hydrography and topography would permit the cultivation of irrigated rice throughout the year.

B) Present situation in the State of Pará

2.04 Almost always present in mixed plantings under shifting cultivation as a subsistence crop, rice represents aproximately 18 percent of the gross value of agricultural production of the state of Pará. However, the production per farm unit is very small and of little economic importance. The inefficiency of the farm units and the fact that the rice generally is planted with other crops as well as the low yield potential of the varieties planted are responsible for the low yields of rice in the state varying from 900 to 1,200 kg per hectare.

2.05 The variation in prices, highly subject to conditions of supply and demand, desencourages rice growers. However, since the production of basic foodstuffs has become an activity of high priority throughout the world, since climatic conditions in the state of Pará are excellent for rice culture and since the crop is important in the economy and life of the rural population, the state extension service (ACAR-PARÁ) has established a plan of action for rice culture. The objectives of the plan are increasing per hectare yields and increasing overall production by using the results obtained in research and by improving the marketing system in the state.

2.06 Research already has had some effects on rice production. The introduction of the rice variety IAC-1246 in 1971 provided new stimulus for producers of upland rice, principally in the area of the Transamazon highway. Rice production in the region increased from 15,240 metric tons in 1970 to 26,054 metric tons in 1973 and 31,500 tons in 1974. In 1972, the extension service was reaching 3432 farmers planting 8,374 hectares of rice and in 1974; 5,795 farmers planting 24,065 hectares. In 1976, the extension service hopes to reach 7,928 farmers planting 33,910 hectares. The introduction of the varieties DAWN, APURA e CICA-4 for lowland planting was favorably received by rice planters along the Caeté River in county of Bragança. If an adequate seed supply were available on the county level, the results would certainly surpass those already attained.

2.07 As a result of a study whose objective was to specificy and measure the effects of selected variables on the amount of rice produced, consumed and available for sale in selected areas of the state of Pará. It was found that variations in price not only of rice, but also of competitive and complementary commodities, will affect the number of rice farmers in the region that produce, consume, and sell. The short and long term elasticities of supply for the

State of Pará were estimated at 0,3 and 0,5 respectively. Hence a one percent change in the price of rice would provoke change of 0,3 and 0,5 per cent in the amount of rice produced on a short and long term basis respectively.

2.08. The short term price elasticity of demand on the wholesale level in the state is on the order of 2,1 indicating that a variation of 1% in the price of rice, other things being equal, will provoke a 2,1% reduction in the amount of rice bought on the wholesale market. On a long term basis, the price elasticity demand was found to be 4,1.

C) Present situation in the State of Amazonas

2.09. Rice culture is practically inexistent in the state of Amazonas. What little is planted is cultivated under the same primitive system that persist thoroughout the North region. The state rice production is estimated at 1.500 metric tons, while the demand for rice at the wholesale level in the city of Manaus in 1973 was 2.756 tons.

2.10. Although the limited production of the state has been attributed to lack of incentive for farmers the low production also brings high price to consumers. Per capita rice consumption in the area is therefore much lower than in other parts of Brazil. The rapid growth of the city of Manaus (approximately 7% per year) and the implantation of cattle projects in the Free-Trade Zone around the city would indicate an increase in demand for the product.

2.11. If rice were to be planted in the low areas along the rivers what are abundant in the state, high yield would be possible since there soils are quite fertile.

2.12. Price elasticity of demand for rice in the market of Manaus has been estimated at 10,8, thus, a 1% increase in rice prices should provoke 10,8% drop in demand. The high elasticity of demand of rice in the Manaus market is explained by the fact that rice is presently quite expensive and not consumed by large segments of the population.

2.12. An analysis of wholesale warehouse facilities in the state indicated that there was an excess capacity of 50%. Based on observation of present market behavior in the city of Manaus demand for 1975 is projected at 6.300 metric tons while in 1980 this figure should be 8.500 metric tons.

D) Actual situation of research

2.13. Rice research has been carried out in the States of Pará, Amazonas and Acre and territories of Amapá and Rondonia. However, only in the state of Pará and in the territory of Amapá there has been a continuous research effort by researchers who worked exclusively with rice.

2.14. Of the various institutions which have at some time carried out research with rice such as Instituto de Desenvolvimento Econômico e Social do Pará - IDESP (Institute for Economic and Social Development of Pará), Institute de Pesquisa Agropecuária da Amazônia Ocidental - IPEAOc (Western Amazon Institute of Agricultural Research), only the Faculdade de Ciências Agrárias do Pará - FCAP (University of Agricultural Sciences of Pará) the representation of EMBRAPA (Brazilian Agricultural Research Corporation) in the State of Pará and Amapá - formerly known as Instituto de Pesquisa Agropecuária do Norte - IPEAN (North Region Institute for Agricultural Research), and the IRI Research Institute contracted by Jari Enterprises on the Jari River in the Territory of Amapá, have published results of experimentation.

2.15. The Representation of EMBRAPA has carried out research at various experimental stations (Bragança, Altamira and Itaituba in Pará, Pedreiras and D. Pedro in Maranhão; Macapá in Amapá); in cooparation with INCRA (National Institute of Colonization and Land Reform) at Santa Izabel in Pará and at Barra do Corda in Maranhão, and at Transamazon Highway; with the Secretary of Agriculture of Pará at Santarém in Pará; with the Pará Extension Service (ACAR-PARÁ) at Castanhal in Pará; with the Manoel Barata Vocational Agriculture

School in Castanhal; and various farmers fields in Bragança and Altamira in Pará as well as its headquarters in Belém.

2.16. Rice research has been carried out in the following areas: plant breeding (varieties trials, introduction of new varieties selection from crosses and local varieties), fertilization, time of planting, spacing, planting methods, plant pathology, weed control, pest control and intercropping, mainly by EMBRAPA - PARÁ.

2.17. Although 90% of the rice production of the north region come from non-flooded areas, generally intercropped with other food crops, (principally maize and manioc), the research institutions have done research with irrigated rice, upland rice and rice growing under natural flooding. The latter system, which predominates in alluvial areas in the region, although of considerable potential, does not account for more than 10% of the regional production.

2.18. With regard to rice breeding, EMBRAPA has introduced various cultivars from other breeding program into the region following goog perfomance in local variety trials under its supervision. The most sucessful introduction of this type has been the introduction of the cultivars IAC 1246 and IAC 47 for upland plantings. These cultivars have a grain type, disease resistance and yield superior to the traditional upland varieties of the region such as "CANELA DE FERRO" and "COME CRU ZEBU". EMBRAPA has supplied more than 10 tons of basic seed of these cultivars to the agencies responsible for seed reproduction in the area. EMBRAPA presently has under observation the F_3 generation of a cross of PRATÃO and PÉROLA, the F_1 generation of a cross of CANELA DE FERRO and PÉROLA and the M_3 generation of IAC 1246. For areas of natural irrigation, EMBRAPA's research has indicated the superiority of the cultivars APURA and BOEWANI from Surinam and DAWN from U.S.A. over TEXAS PATNA and AGULHINHA, the varieties presently planted. Through direct distribution of the seed to farmers and through the Pará State Secretary of Agriculture, these new cultivars are presently supplanting the traditional varieties. Experimental work with irrigated rice has included variety trials with material from varions research program, especially that of CIAT in Colombia. In these trials, the cultivars IR 665-33-2-5 and IR 665-23-3-1 produced over 16.000 kg per hectare in two sucessive crops. Since each crop of these cultivars required only 110 days from planting to harvest, an annual production of 20 tons per hectare should be possible with existing technology. EMBRAPA has also participated in the IRRI International Rice Variety Trial. The IRI Research Institute has tested a great deal of material from IRRI but until now has been most sucessful with the cultures APANI, AWINI and PISARI from Surinam.

2.19. Soil fertility studies have been carried out on the soil types most commonly used for rice production in the region. These area yellow latosols (HAPLORTHOX), red yellow quartz sands (PSAMMENTS), red yellow podzols (OXIC USTALFS), stwetured terra roxa (OXIC PALEUSTALF) and humic gleys (AQUEPTS). On the yellow latosols, red yellow podzols and structured terra roxa, responses to phosphorus were always obtained. There were never responses to potassium and responses to nitrogen were sporadic depending upon the length of fallow and organic matter content of the soils in question. On the structured terra roxa and red yellow podzols, levels of P_2O_5 in excess of 60 kg per hectare did not lead to increased yields. However higher levels of this element were needed in the yellow latosols. On the structured terra roxa soil, there was no difference observed between triple superphosphate and simple superphosphate as sources of Phosphourus nor between urea and ammonium sulfate as sources of Nitrogen although Sulfur deficiences were observed in irrigated rice at the Jari Project on humic gley soils. On the red yellow quartz sands, there were responses to Nitrogen, Phosphorus and Potassium, but ever with high levels of all of these elements, increases in yield were small and did not justify the cost of fertilization. Only with the application of correctives such as Thomas slag and farm manure could increase of rice yields of 60% and 94% respectively over controls be obtained. The effect of such correctives is probably due to their content of silicon or other micro-elements since dolomitic limestone failed to produce the same effect. On humic gley soils under natural flooding in the counties of Bragança and Igarapé-

Miri, in the State of Pará, Nitrogen was the only element which significantly increased yields. In Bragança, the following response curves where X is the level of Nitrogen in kg/ha and Y the yield of rice in kg/ha were obtained: $Y = 3377 + 16{,}358\ X - 0{,}02883x^2$ for the variety "APURA" and $Y = 2910 + 11{,}410\ X - 0{,}01466x^2$ for the variety "CICA 4" were obtained. There was no difference obtained between single and split Nitrogen applications. However with present fertilizer prices, the former would realize 84% return without fertilizers and 98% return for 120 kg of Nitrogen per hectarem the level of fertilizer found to be most economic for the variety "APURA". In research on continuous irrigated rice culture on humic gley soils carried out by Jari Enterprises little response was obtained to phosphorus after the first year. Nitrogen and Potassium response only appeared in the second year. Potassium deficiences could be avoided if the straw were incorporated fllowing harvest. Application of 60 to 100 kg of Nitrogen per hectare crop as sulfate of ammonia (in order to avoid Sulfur deficiences) were found to be necessary to mantain hasvests of five to six tons per hectare for the varieties "APANI", "AWINI"e "PISARI". Such nitrogen levels, however, led to lodging of these varieties, but it was found that the lodging could be controlled by the application of 1 kg/ha a.i. of MCPA, 35 to 45 days after seeding.

2.20. Experimentation with plant spacing in upland rice has been carried on with varions varieties (CICA 4, IAC 1246, IAC 47, CANELA DE FERRO, CANA ROXA and APURA) ond different soil types (yellow latosol, red yellow quartz sands and red yellow podzols) in various counties. In spite of this variety of conditions , almost all of the experiments gave the same results: the best spacing was 30cm by 15cm when rice was planted in hills without fertilization, which corresponds to local practice. In general, planting in hills even with fertilization, gave higher yields than drill rows although the variety IAC 47, when fertilized, yièlded better when planted in drill rows, 45cm apart using 60 seeds per meter. Since no farmer in the region possesses equipment to plant drill rows or to use fertilizer, such a result is of little significance. However, this research did show thata considerable increases in rice yields could be obtained by local farmers if they were to use closer spacings than they presently employ. Research on planting density in upland rice showed the superiority of using five to ten seeds per hill and 60 seeds per meter in drill rows. Higher densities reduced yields. Under natural flooding, most rice is transplanted. Research with the aim of substituting this laborious practice with direct seeding was unsuccessful because a small crab was found to cut the seedlings soon after germination. Control of this pest was only possible through the use of insecticides with considerable residual effect whose use could not be recommended because of the lack of information about the ecological consequences of such a practice. In irrigated rice, direct seeding is generally recommended because it reduces significantly the labor required for planting. Experimental work at the University of Agricultural Sciences of Pará (FCAP) showed that higher yields were obtained with direct seeding than with transplanting. Formerly, pre-germinated seeds were recommended for direct seeding but recent work of the IRI Research Institute on the Jari River showed no difference between pre-germinates and dry seeds, which are easier to handle in seeding from airplanes. Seed densities of 80 kg per hectare were found to be superior to 60 or 100 kg per hectare.

2.21. Although the presence of the most common rice diseases such as blast (*Piricularia oryzae*), Brown Spot (*Ccochliobolus miyabeanus*), Leaf Scald (*Rhynchosporium oryzae*), Leaf Smut (*Entyloma oryzae*), True Smut (*Tilletsia barclayana*), Narrow Leaf Spot (*Cercospora oryzae*), and False Smut (*Ustilaginoidea virescens*) have been noted in upland rice in the north region, only Brown Spot and leaf scald cause serious damage. Various research activities with Brown Spot have yielded the following results: 1) Varieities which are very susceptible to the disease such as IR 665-4-5-5. CICA 4, and other IRRI germplasm have vertical resistance since they show low levels of initial inoculum but a higher degree of infection while varieties with a lower degree of infection such as IAC 47, COME CRU, IAÇ 1246, and CHATÃO had a relatively high level of initial inoculum indicating horizontal resistance; 2) Application of six tons per hectare of Thomas Slag produced low levels of disease in susceptible varieties while application of the same amounts of Magnesium, Calcium (lime equivalent), and Phosphorus as contained in the slag led to no reduction in disease incidence. This result would indicate that the Silica contained in the slag was conferring resistance. Six tons of slag led to higher yields than three tons of slag indicating that higher levels of slag would be necessary for good control. These results would confirm the observation that susceptibility to Brown Spot is due to rapid leaching of nutrients from the rooting zone during the growing season - a phenomenon to be expected on the light textured soils and with the heavy rainfall which characterize much of the area of the Amazon where upland rice is grown. Under irrigated conditions, the same diseases occur but cause little damage. Sheath Blight (*Corticium sasakii*) and Stem Rot (*Leptosphaeria sàlvinii*) have been noted under irrigated but not upland conditions.

2.22. The greater part of the research on weed control has been carried out under irrigated conditions where hand weeding is even more time-consuming than in upland rice and weed growth is more rapid due to higher soil fertility. Under Amazon conditions, however, the grasses such as *Echinocloa spp.* do not constitute a serious problem in irrigated rice. The most problematic weeds are broadleaves or sedges such as *Lophotocarpus guianensis, Sphenoclea zeylanica, Monochoria spp.,* and *Fimbistylis miliacea,* which are more efficiently controlled by phenoxyacetic acid derivatives than by propanil. Since the price and quantities needes of phenoxyacetic acid derivatives are much lower than those of propanil, weed control with these products is quite inexpensive. IRI Research Institutes recommends MCPA as the most effective of the phenoxyacetic acid derivatives while EMBRAPA's work shows that MCPA does not control *Aeschynomene sensitiva,* with has sometimes been problematic in the alluvial areas of the former North Region Agricultural Research Institute (IAN or IPEAN). The addition of 2,4,5-T or propanil to MCPA has given satisfactory control of all broadleaf weeds and sedges in the irrigated rice area on the margins of the Guamá River wich belongs to the latter institution as well as in the naturally flooded areas along the Tocantins River in the municipality of Igarapé-Miri, Pará.

IRI Research Institute is presently recommending the application of 0,5 kg per ha a.i. of MCPA thirty-five days after seeding. Efforts by IRI to reduce the cost of land preparation with the herbicides CASORON, GRAMOXONE and MCPA have not been successful. Under upland conditions, the combination of a greater species diversity of weeds and a smaller profit margin due to lower yield limit the possibilities for using herbicids for weed control. EMBRAPA carried out a trial with the pre-emergence herbicide MACHETE (Butachlor) and obtained surprisingly good control of some of the more problematic grassy weeds such as *Digitaria sanguinalis*.However, the herbicide did not eliminate the need for control of broadleaves 30 to 60 days after seeding. Also the effect of MACHETE on other crops intercropped with the rice was not determined.

2.23. Under upland conditions, rice pests have never been considered a serious enough problem to merit specific control practices. The application of 5 kg per hectare of Aldrin 40% has been recommended at seeding to control mole crikets (*Gryllotalpa spp.*) and the rice grub (*Elasmopalpus spp.*). In 1974, however,two pests created serious problems in upland rice in the Amazon region: the giant stinkbug (*Tibraca limbaventris; Pentatomidae; Hemiptera*) in the area of the Transamazon highway and the Spinach leaf beetle (*Discinycha eximica; Chrysomelidae; Coleoptera*) in the eastern part of the State of Pará and in the state of Maranhão. It was observed the inseticide SEVIN gave reasonable control if applied with an adhesive. Also, the varieties CANELA DE FERRO and CICA 4 seemed to be more resistant to *Disconycha eximica* than APURA; IAC 47; IR 22, and IAC 1246. In 1975, these pests agains caused serious damage to the rice crop and many farmers began spraying for control although they had never before done so. At the JARI project, IRI Research Institutes have noted the stem borers *Rupela albinea* and *Diatraea sacharalis* as serious pests of irrigated rice and has recommended FOLIDOL and DIAZINON for control. Efforts to substitute these products with BHC were not successful. It was also observed that nitrogen fertilization increased stem borer infestations especially in varieties. The varieties APANI and AWINI as well as some new IRRI lines such as IR 1529-677-2-3 and IR 1416-131-3-6-2 showed good resistance to stem borers.

2.24. It was pointed out that upland rice in the Amazon region is almost exclusively interplanted with other food crops, principally maize and cassava, although most of the research has been carried out on pure stand plantings. In 1974, EMBRAPA undertook a research program with intercropping. This program has produced the following results:

a) Rice varieties which yield well in pure stands such as IAC 47 and IAC 1246 also yield well under intercropping.

b) The reduction in yield under mixed cropping is greater in fertile soils. In poor soils, intercropping with maize and manioc do not reduce rice production.

c) Intercropping of manioc with rice (cultivar IAC 47) in areas of red yellow quartz sands in the eastern part of the state of Pará did not significantly reduce yields in comparison with the pure stands.

d) Broadcasting potash as muriate of potash (300 kg of K_2O per hectare) sixty days after planting significantly increased rice yields in pure stands but not in stands intercropped with cassava.

e) Broadcasting Thomas Slag at the time of rice emergence or poking holes filled with triple superphosphate between the hills of rice significantly increased rice yields under mixed cropping. Broadcasting triple or simple superphosphate or mixing triple superphosphate with the rice seed did not lead to increased yields.

3. PERSPECTIVES FOR THE NORTH REGION

3.01. In the state of Pará, the Secretary of Agriculture has already prepared a rice project which will begin to be installed within the next two years in the municipality of Porto de Moz in the northern part of the state where the Xingu River flows into the Amazon. The project will encompass an area of fifty thousand hectares and should produce 450 thousand tons of high quality,long grain rice annually. The alluvial areas where the project will be located should be of considerable fertility. Due to a warm climate throughout the year and an adequate water supply, two crops a year should present no difficulties.

3.02. The agro-industrial rice project forms a part of the program of the federal government for the development of the Amazon region which has as its objectives the colonization of the Amazon, the development of the agro-industrial sector through the improvement of the technical level of traditional agriculture, and the production of exportable products. Furthermore, the growing Brazilian population is creating a growing demand for rice. With its solid technological base and economic potential, the project is a pioneering effort which will revolutionize agricultural production in the Amazon basin, utilizing swampy areas which are presently unproductive and providing opportunities for some of Brazil's most unfortunate rural inhabitants.

3.03. The technological and economic base of the project is the production of high yields of high quality rice which should receive high prices on both national and international markets. Sophisticated technology in administration, training, extension and experimentation combined with a horizontally and vertically integrated cooperative organization will guarantee the solid technological base which efficient production demands. The technological viability of the scheme is revealed by the experience of the IRI Research Institute on a similar, adjacent area in the Amazon basin and by research results obtained by EMBRAPA in the floodplain of the Guamá River. In these areas, over five tons of rice per hectare were produced under field conditions that were considerably less than ideal. Such yields are even more impressive when compared with yields obtained presently in the state of Pará where upland rice yields vary from 500 to 1200 kg per hectare and naturally flooded rice produces 3000 kg per hectare under primitive conditions. The high potential of the use of modern methods of rice production in the region is shown by small scale variety trials where several new lines showed a genetic potential of over 8000 kg per hectare under local conditions.

3.04. A secondary benefit of the project will be the econimic stimulus given to the local economy by the chain reaction which such a project would be expected to set off. The stimulus would include not only direct effects from the construction of the project and the activities of the cooperative but also the buying power of people employed in these activities. Thus, the administrative talents of the farmers would be compensated for by a per capita income much above that prevalent in the Amazon region at the present time. The increased income would contribute significantly to increasing consumer demand in an expanding economy.

3.05. The cost of implantation of the project is on the order of two thousand dollars per hectare which would cover all of the necessary preparations including rice mills, port facilities, and a sophisticated system of water control. The prospectus of the project was approved by the National Monetary Council (Conselho Monetário Nacional) which authorized the Bank of Brazil to provide funds for the cost of setting up the project.

3.06. In the State of Amazonas, the Superintendency of the Manaus Free Trade Zone (SUFRAMA) has set up an agricultural distict under its supervision for the development of that area. A viability study of the agricultural district was carried out in 1969 with the aim of setting up a research infrastructure. Based on this study, SUFRAMA began a series of research activities which have included soil survvey as well as plant, animal and soil fertility research. Within, this scheme, a plan was worked out for the development of research with food crops presently grown or consumed in the area. The research will furnish information about climatic condictions, varietal adaptation, time of planting, and fertilizer recommendations.

4. THE PROJECT

a) Description

4.01. The project will be executed principally in the States of Pará and Amazonas.

4.02. These states possess great ecological potential for the expansion of rice culture although, at present, the production of the North region is only a small part of the total Brazilian rice production. In the State of Pará, 90% of the production comes entirely from upland plantings whiles 10% comes from lowland are subjected to natural flooding. In the State of Amazonas, the production comes entirely from upland plantings.

4.03. For the execution of this project, two regional research centers (UEPAE) will be used:

a) Pará - in the municipality of Belém pertaining to EMBRAPA.

b) Amazonas - in the municipality of Manaus pertaining to EMBRAPA.

4.04. The Regional Research Centers responsible for carrying out the research in the region will act in close coordination with the National Rice Research Center and with the Center of Agricultural Research for the Humid Tropics. The Regional Research Center in question will be responsible for the adaptation on a state level of technology developed by the National Rice Research Center.

4.05. The Regional Research Center will develop research whose aim will be to institute integrated production systems adapated to the region which can be transferred to local farmers. In this area, the regional centers will have to work in close cooperation with extension and technical assistance agencies as well as other aspects of the production and marketing infrastructure.

B) The research program

4.06. In order to obtain its objective of studying production systems for farmers possessing different amounts of inputs and technology, the rice program, integrating various disciplines in a single project, should include the following disciplines:

a) Breeding. Introduction of cultivars with a view to selecting promising material for upland and irrigated conditions; and utilizing germplasm from various sources, the incorporation of desirable characteristics such as short stature, high productivity, insect tolerance, and grain quality into land varieties possessing disease resistance and resistance to lodging and shattering.

b) Crop management and cultural practices.

In this area, the following topics will receive attention

b.1) Plant spacing. Determination of spacing for maximum light utilization and weed control.

b.2) Intercropping and crop rotations. Development of more productive and stable production systems.

b.3) Weed control. Determination of the principal weed species in upland and irrigated plantings and finding the most economic and effective means of control.

b.4) Land preparation. Determination of methods of preparing land for upland and irrigated rice that will be inexpensive less wasteful of natural resources, and conducive to high yields of rice and subsequent crops.

b.5) Irrigation and drainage. Areas such as times of flooding, water depth, and times of drainage will be investigated.

c) Soil fertility. Identification of the principal macro and micronutrient deficiencies in upland and irrigated plantings and the determination of inexpensive corrective measure. The role of correctives such as organic matter and basic slag in increasing yields should be investigated to see if the same effects can be obtained with less expensive materials.

d) Plant pathology. The proposed studies will cover the following areas:

d.1) Correlation between climatic factors and the incidence of Brown Spot (*Cochliobolus miyabeanus*) in upland rice.

d.2) Evaluation of the damage caused Brown Spot.

d.3) Varietal resistance to Brown Spot under upland conditions.

d.4) Measurement of yield reduction caused by disease in upland rice.

e) Entomology. Proposed entomological studies will have the following objectives:

e.1) Measurement of yield reduction caused by the principal insect pests.

e.2) Classification and control methods, including biological control, of the principal insect pest.

f) Agricultural meteorology. Investigation of the effect of time of planting on the occorrence of unfavorable climatic conditions and on the incidence of pest and diseases for varieties with different growing seasons.

g) Agricultural botany. The objetive in this area will be the botanical description of land varieties so that synonyms for the same material cam be avoided.

h) Agricultural economics. Determination of the fixed and variable production costs for different production systems of upland and irrigated rice.

i) Plant physiology. Methods of breaking dormancy , reducing lodging, and increasing tillering perhaps deserve further investigation, Physiological disorders in irrigated rice grown on soils high in organic matter will probably become of increasing importance as such areas are brought into production. Physiological aspects of resistance to Brown Spot should be studied.

C) Training and advisory program

4.07. The principal objective of the Training and Avisory Program is to provide training for rice agronomists at a Masters' Degree level and for four agronomists at a Ph.D. level.Courses and apprenticeships of one years' duration at rhe International Rice Research Institute (IRRI), at the Centro Internacional de Agricultura Tropical (CIAT), at the Surinam Rice Project, and at the Instituto Riograndense de Arroz (IGA) for fifteen agronomists are also envisaged. This program will be entirely coordinated by the National Rice Research Center.

4.08. The advisory program will remain under the responsibility of the multidisciplinary team of the National Rice Research Center. This team will give periodic assistance and orientation for specific research problems.

4.09. The figures show the training calender and cost of training respectively.

D) Land, buildings and equipment

4.10. Land. The two Regional Research Centers poseess sufficient areas for rice research programs. If it should be found necessary to increase the areas of the centers, land is readily available.

4.11. Buildings. The two Regional Research Centers have buildings which could be used for the research programs. However, some remodeling will be necessary; and additional laboratories, warehouses, offices, greenhouses, and garages will have to be constructed.

4.12. Machinery and equipment. A considerable amount of land preparation, planting, and harvesting equipment will have to be acquired. Laboratory equipment will be needes and a controlled humidity chamber for seed storage constructed. Other vehicles will have to be bought.

E) Personnel

4,13. The necessary professionals with college degrees, persons with vocational training, administrators, and other aids as well as field workers for the rice project are listed in Table.

4.14. Personnel will be incorporated into the project as it develops. The timetable for their incorporation is given in Table.

4.15. The rice project, in accordance with the institutional model of EMBRAPA, will be regulated by the multidisciplinary team of the National Rice Research Center.

4.16. Since such infrastructural elements already exist, the rice project will have the support of the sectors of Information and Documents, Human Resources, Diffusion of Technology, and Administration and Finance of the Regional Research Centers.

4.17. The researchers in the areas of agricultural economics, statistics, soil fertility, entomology, agricultural botany, climatology, and seed technology can also participate in other project developed by the Regional Research Centers.

5. BENEFITS AND ECONOMIC JUSTIFICATION

5.01. The rice research project for the Amazon region has as its objective the development of a better and more efficient technology for rice growing. To this end, it must be closely tied to the extension and rural credit activities so that the results of research can reach and be adopted by the rice producers.

5.02. The five year period of research initially envisioned for the project, combined with the activities already in progress, should significantly increase the bases for a more effective extension program.

5.03. The project will develop new rice cultivars which, together with other modern methods and inputs, will create a foundation for the development of a certified seed program permitting higher economic returns to rice growers.

5.04. The results obtained by the rice research will be of great use to the government project of producing 450 thousand tons annually of high quality, long grain rice on fifty thousand hectares under artificial irrigation. The project will also be of use to the federal land reform and colonization agency (INCRA) in areas of colonization along the Transamazon, North Perimeter, and Cuiabá -Santarém highways.

5.05. For the short term, the project will improve the profissional level of rice researchers in the area. The formation of eighteen Masters' and four Ph.D. level rice researchers and the specialized training of fifteen other workers will have considerable impact on the existing level of rice technology in the region.

5.06. The chief objective of the project, satisfying the region's demand for rice, cannot, however be brought about entirely as a result of a rice research program. Such an objective will depend on the following factors:

a) Previous research results

b) Extension and technical assistance programs

c) Effectiveness of diffusion of research results

d) Programs of rural credit to rice producers

e) Guaranteed prices and marketing controls

f) Effectiveness of certified seed programs.

g) Incentives to increase the area in rice production

h) Assistance to farmers desiring to use new production methods.

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TABLE 1 - RAW PADDY PRODUCTION OF NORTH REGION BY STATE OR TERRITORY (1,000 ton) (1968-1972)

STATES OR TERRITORIES	1968	%*	1969	%*	1970	%*	1971	%*	1972	%*
RONDÔNIA	18,9		18,9		18,9		24,1		25,3	
ACRE	3,6		4,3		4,5		3,5		4,8	
RORAIMA	1,7		1,3		2,3		1,8		1,5	
AMAZONAS	1,8		2,1		2,5		2,1		2,4	
AMAPĀ	0,4		0,5		0,4		0,3		0,3	
PARĀ	74,9		63,8		73,0		71,4		74,9	
T O T A L	101,3	1,53*	90,9	1,42*	101,6	1,35*	103,2	1,62*	109,2	1,54*

* % of total national raw paddy production

TABLE 2 - YEAR OF ENTRY OF SCIENTISTS IN COURSE OF PROJECT

AREA OF SPECIALIZATION	M.S.					B.S.				
	YEAR					YEAR				
	1	2	3	4	5	1	2	3	4	5
BREEDING	2						1	1		
PLANT SCIENCE						2	1	1		
PLANT PATHOLOGY	2									
ENTOMOLOGY							1	1		
IRRIGATION AND DRAINAGE		1	1							
SOIL FERTILITY						1		1		
CLIMATOLOGY						1	1			
PLANT PHYSIOLOGY		1	1							
SEED TECHNOLOGY						1	1			
AGRICULTURAL ECONOMICS		1	1							
STATISTICS		1	1							
AGRICULTURAL BOTANY								1		
TOTAL PER YEAR	4	4	4			5	5	5		

TABLE 3 - YEAR OF ENTRY OF OTHER PROFESSIONALS AND ADMINISTRATIVE AIDS

PERSONNEL	YEAR					TOTAL
	1	2	3	4	5	
TÉCNICO AGRÍCOLA II	1	1	1			3
TÉCNICO AGRÍCOLA I	4	4	4			12
MESTRE RURAL	4	4	4			12
OPERÁRIO RURAL	4	4	4			12
AUXILIAR RURAL II	6	6	6			18
AUXILIAR RURAL I	24	24	24			72
AUXILIAR ADMINISTRATIVO II	20					20
AUXILIAR ADMINISTRATIVO I	20					20
AUXILIAR DE SERVIÇOS	20					20

TABLE 4 - TRAINING SCHEDULE FOR PROFESSIONAL PERSONNEL DURING RICE PROJECT

YEAR / COURSES	YEARS PERSONS PER YEAR					TOTAL
	1	2	3	4	5	
M.S.	-	6	12	12	6	18
Ph.D.	-	2	4	4	2	4
APPRENTICESHIPS	5	5	5	-	-	15
T O T A L	5	13	21	16	8	37

TABLE 5 - SCHEDULE OF CAPITAL INVESTMENTS IN COURSE OF PROJECT (CR$ 1,00)

SPECIFICATION	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
BUILDINGS	1.100.000	1.000.000	-	-	-	2.100.000
FURNITURE AND INSTALLATIONS	100.000	50.000	50.000	-	-	200.000
IMPROVEMENTS TO REGIONAL RESEARCH CENTERS	180.000	90.000	90.000	-	-	360.000
MACHINERY AND EQUIPMENT	159.140	30.150	29.470	18.040		236.800
REPAIR AND MAINTENANCE	190.080	190.080	190.080	190.080	190.080	950.400
VEHICLES	73.200	-	73.200	-	-	146.400
LABORATORY EQUIPMENT	180.010	49.715	49.715	44.560	-	324.000
SUB-TOTAL	1.982.430	1.409.945	482.465	252.680	190.080	4.317.600

TABLE 6 - SCHEDULE OF COSTS OF TRAINING FOR RICE PROJECT (CR$ 1,00)

COURSES	YEARS					TOTAL
	1	2	3	4	5	
M.S.	-	104.400	208.800	208.800	104.400	626.400
Ph.D.	-	34.800	69.600	69.600	34.800	208.800
APPRENTICESHIPS	60.000	60.000	60.000	-	-	180.000
T O T A L	60.000	192.200	338.400	278.400	139.200	1.015.200

TABLE 7 - SCHEDULE OF PAYMENT OF OPERATIONAL COSTS IN COURSE OF PROJECT

SPECIFICATION	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
1 - SALARIES AND BENEFITS						
1.1. SCIENTISTS	754.643	1.509.324	2.264.011	2.264.011	2.264.011	9.056.000
1.2. OTHER PROFESSIONALS	441.567	883.206	1.324.809	1.324.809	1.324.809	5.299.200
1.3. ADMINISTRATIVE AIDS	405.120	405.120	405.120	405.120	405.120	2.025.600
2. MOVEMENT						
2.1. PER DIEM	256.239	384.451	512.570	512.570	512.570	2.178.400
2.2. TRANSPORTATION	72.835	109.271	145.698	145.698	145.698	619.200
3. SUPPLIES	630.232	840.316	1.260.484	1.260.484	1.260.484	5.252.000
SUB-TOTAL	2.560.636	4.131.688	5.912.692	5.912.692	5.912.692	24.430.400

TABLE 8 - ESTIMATE OF TOTAL COST OF RICE PROJECT

ITEMS	CR$ 1.000,00			US$ 1.000,0			%		
	LOCAL	BIRD	TOTAL	LOCAL	BIRD	TOTAL	TOTAL COST OF PROJECT	LOCAL CONTRIBUTION	BIRD CONTRIBUTION
I - CAPITAL INVESTMENTS									
1. BUILDINGS	1.050,0	1.050,0	2.100,0	131,3	131,2	262,5	6,86	3,43	3,43
2. FURNITURE AND INSTALLATIONS	92,0	108,0	200,0	11,5	13,5	25,0	0,65	0,30	0,35
3. IMPROVEMENTS REGIONAL RESEARCH CENTERS	305,0	55,0	360,0	38,1	6,9	45,0	1,18	1,00	0,18
4. MACHINERY AND EQUIPMENT	83,0	153,8	236,8	10,4	19,2	29,6	0,77	0,27	0,50
5. REPAIR AND MAINTENANCE	917,0	33,4	950,4	114,6	4,2	118,8	3,11	3,00	0,11
6. VEHICLES	122,4	24,0	146,4	15,3	3,0	18,3	0,48	0,40	0,08
7. LABORATORY EQUIPMENT	18,0	306,0	324,0	2,2	38,3	40,5	1,06	0,06	1,00
SUB-TOTAL	2.587,4	1.730,2	4.317,6	323,4	216,3	539,7	14,11	8,46	5,65
II - TRAINING									
1. M.S.	306,0	320,4	626,4	38,2	40,1	78,3	2,05	1,00	1,05
2. Ph.D	153,0	55,8	208,8	19,1	7,0	26,1	0,68	0,50	0,18
3. APPRENTICESHIPS	153,0	27,0	180,0	19,1	3,4	22,5	0,59	0,50	0,09
SUB-TOTAL	612,0	403,2	1.015,2	76,4	50,5	126,9	3,32	2,00	1,32
III - COST OF OPERATION									
1. SALARIES AND BENEFITS									
1.1. SCIENTISTS	5.203,0	3.853,0	9.056,0	650,4	481,6	1.132,0	29,59	17,00	12,59
1.2. OTHER PROFESSIONALS	3.179,2	2.120,0	5.299,2	397,4	265,0	662,4	17,32	10,39	6,93
1.3. ADMINISTRATIVE AIDS	1.224,0	801,6	2.025,6	153,0	100,2	253,2	6,62	4,00	2,62
2. MOVEMENT									
2.1. PER DIEM	1.224,0	954,4	2.178,4	153,0	119,3	272,3	7,12	4,00	3,12
2.2. TRANSPORTATION	306,1	313,1	619,2	38,3	39,1	77,4	2,02	1,00	1,02
3. SUPPLIES	3.152,6	2.099,4	5.252,0	394,1	262,4	656,5	17,16	10,30	6,86
SUB-TOTAL	14.288,9	10.141,5	24.430,4	1.786,2	1.267,6	3.053,8	79,83	46,69	33,14
IV - LAND									
1. ESTIMATED VALVE OF EXPERIMENTAL AREAS	840,0	-	840,0	105,0	-	105,0	2,74	2,74	-
SUB-TOTAL	840,0	-	840,0	105,0	-	105,0	2,74	2,74	-
GRAND TOTAL	18.328,3	12.274,9	30.603,2	2.291,0	1.534,4	3.825,4	100,00	59,89	40,11