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(E78-10192) USE OF LANDSAT DATA TO MONITOR PASTURE PROJECT IN AMAZONIA (Instituto de Pesquisas Espaciais, Sao Jose) 17 p HC A02/MF A01 CSCL 02C

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CONSELHO NACIONAL DE DESENVOLVIMENTO CIENTÍFICO E TECNOLÓGICO
INSTITUTO DE PESQUISAS ESPACIAIS

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# CHAPTER I

## INTRODUCTION

An important goal of the Brazilian Government is the general exploitation of the Amazon region on a rational base. To achieve this, the government is providing fiscal incentives for the establishment there of cattle farms, referred to in this paper as pasture projects. The government expects to raise the cattle population of that region to 5,000,000 by the end of this decade.

SUDAM is the federal agency in charge of the planning and coordination of this development effort. One of its responsibilities is the monitoring of the deforestation of each pasture project. By the Brazilian Forestry Code (Brasil, 1965), not more than 50% of the natural forest of a property can be clear cut.

The conventional methods of inspection, through field checking have proved completely inadequate, if not impossible, due to the cost involved.

To overcome this problem, INPE and SUDAM started a joint study with the purpose of verifying if the LANDSAT system could provide information that would help in the control and monitoring of the deforestation in pasture projects sponsored by SUDAM. An attempt, to assess the pasture quality was also within the scope of the study.

# CHAPTER II

# METHODOLOGY

## 2.1 - LOCALIZATION OF THE REGION UNDER STUDY

The region is located in the state of Mato Grosso between latitudes 09°00' and 13°30'S and longitudes 50°00' and 54°00 (Fig.II.1).

## 2.2 - METHODS USED IN THE DETERMINATION OF THE DEFORESTED AREAS

Four frames of the LANDSAT MSS, channels 5 and 7, in the scales 1:1,000,000 and 1:250,000 were interpreted visually. Computer Compatible Tapes (CCT) corresponding to these images were interpreted automatically in INPE's Image-100 system. The images were taken in August 1973 and July 1975, which are months in the dry season.

First, the contours of each deforested area were mapped, superimposing transparent overlays on the 1:1,000,000 images. Using information provided by SUDAM and field work, it was possible to identify most of the pasture projects in these overlays. The same type of overlays were also constructed in the 1:250,000 scale.

Two methods were used to determine quantitatively the deforested areas (Barker, 1975).

The visual method consisted of placing a 1 millimeter dot grid over the 1:250,000 overlays relating the area of each pasture project with the number of dots that fell inside each contour.

For the automatic classification (training also), the images were enlarged to a scale of approximately 1:100,000 on the TV monitor of the Image-100.

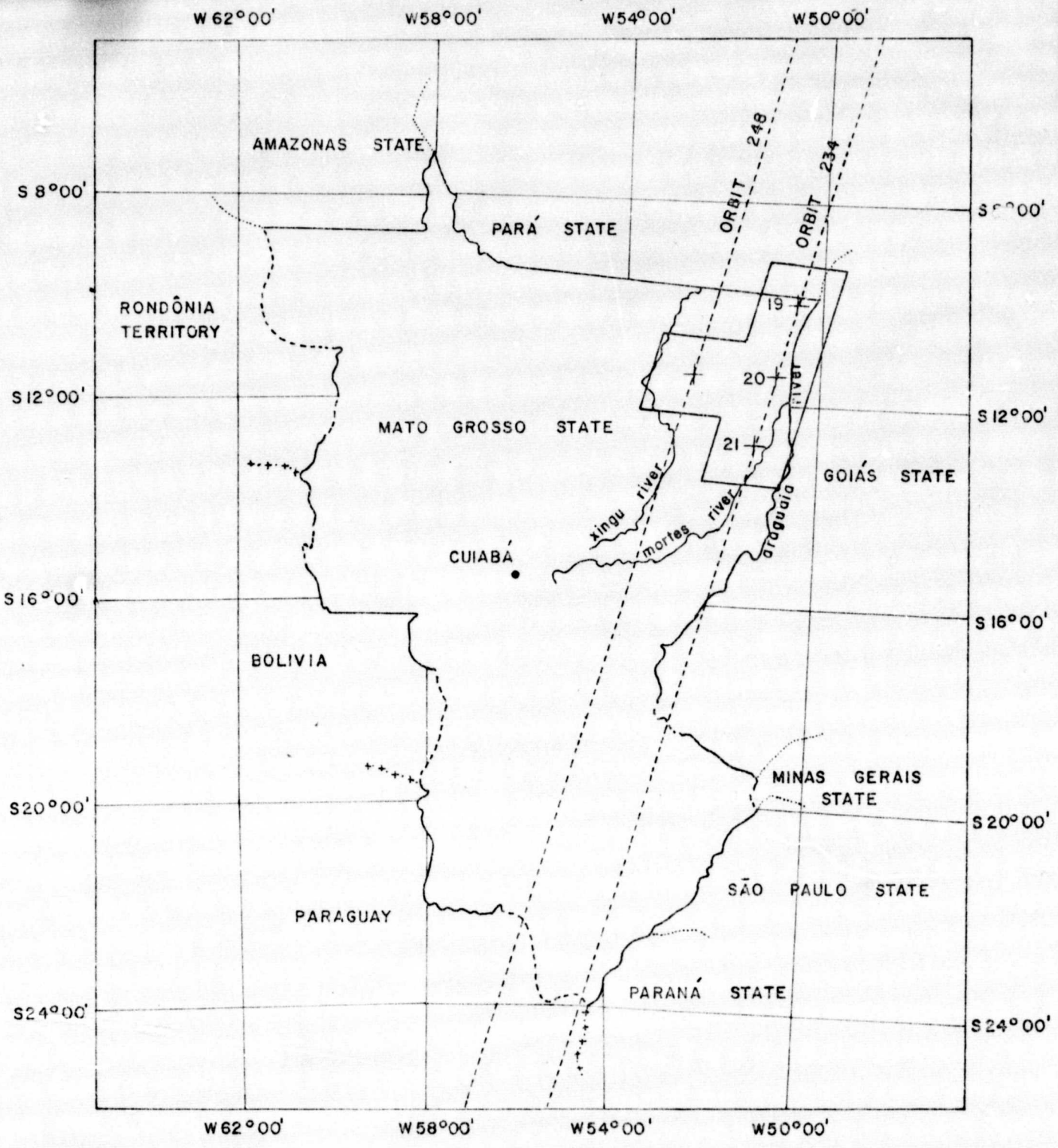


FIGURE II.1 - TEST SITE LOCALIZATION.

SCALE:

125 0 125 375 625 Km

## 2.3 - ASSESSMENT OF THE PASTURE QUALITY

Automatic classification was used in the assessment of the pasture quality. The scale was the same as the one used in the classification to determine the deforested areas. Field work on some selected pasture projects was carried out in order to locate the training areas for the automatic classification.

# CHAPTER III

# RESULTS AND DISCUSSION

## 3.1 - DETERMINATION OF THE DEFORESTATION AREAS

Comparison of the two methods (automatic and visual) to determine the areas of deforestation for the 25 pasture projects of the study, revealed that both methods gave almost similar results.

Evaluation of the deforested areas was faster by visual than by automatic interpretation. The main reason for this is that, due to the sharp contrasts between the forest and the deforested areas, the delineation of the pasture projects could be done visually very simply using only two MSS bands (5 and 7). The mean time spent to determine the deforestation area for a given pasture project took one hour on the Image-100 (including the time sent to load the image) and only 15 minutes when done visually. Table III.1 shows the results obtained by both methods for the 25 pasture projects.

Table III.2 shows that only a few projects are reaching the upper limit of deforestation permitted by law. It was also observed that several pasture projects had contiguous deforestations with more than 200 $km^2$. Due to a natural tending of these projects to be established near each other so that they can share some of the services expenses, too much deforestation is occuring in certain regions, and this may affect the local environment (climate mainly) (Molion 1975).

Table III.3 shows the increase in deforestation from August 1973 to June 1975.

In general, this increase was not high. The maximum rate was 12.4%. However, in absolute values, large areas were deforested during this period. Considering only the projects under study, there was an increment of 415 $km^2$ of deforested area in those 2 years.

TABLE III.1

DEFORESTED AREAS DETERMINED BY VISUAL AND AUTOMATIC MEANS

| NAME OF THE PASTURE PROJECT | AUTOMATIC INTERPRETATION I-100 (Hectares) | VISUAL INTERPRETATION (Hectares) | DIFFERENCE (Hectares) (Automatic-Visual) | PERCENTUAL DIFFERENCE |
|---|---|---|---|---|
| SUIÃ 1 | 26,139 | 26,294 | -155 | -0.59 |
| SUIÃ 2 | 23,906 | 23,802 | 104 | 0.44 |
| SUIÃ 3 | 3,312 | 3,386 | -74 | -2.23 |
| SUIÃ 4 | 2,450 | 2,480 | -30 | -1.22 |
| GUANABARA | 7,969 | 7,970 | 1 | 0.012 |
| COLORADO | 2,018 | 2,079 | -61 | -3.02 |
| MACIFE | 2,931 | 2,948 | -17 | -0.58 |
| URUPIANGA | 5,522 | 5,520 | 2 | 0.036 |
| PORTO VELHO | 10,853 | 10,846 | 7 | 0.064 |
| FRENOVA | 5,322 | 5,339 | -17 | 0.32 |
| PORTA AMAZONAS | 2,212 | 2,268 | -56 | 2.53 |
| SANTA LÚCIA | 389 | 399 | -10 | -2.57 |
| CODEBRA | 1,975 | 1,944 | 31 | 1.57 |
| ELAGRO | 7,564 | 7,607 | -43 | -0.57 |
| CODEARA | 16,488 | 16,318 | 170 | 1.03 |
| BRASIL NOVO | 4,992 | 4,946 | 46 | 0.93 |
| RONCADOR | 1,758 | 1,766 | -8 | -0.45 |
| SUIÃ-XINGU | 839 | 870 | -31 | -3.69 |
| SÃO JOSÉ | 13,733 | 14,071 | -338 | -2.46 |
| S.J.LIBERDADE | 4,367 | 4,419 | -52 | -1.18 |
| TATUIBI | 3,849 | 4,069 | -220 | -5.71 |
| SANTA ROSA | 6,383 | 6,464 | -81 | -1.26 |
| S FR.XINGU | 2,530 | 2,646 | -116 | -4.58 |
| TAMAKAVY | 6,606 | 6,368 | 238 | 3.60 |
| SUL DA AMAZÔNIA | 6,230 | 6,377 | -147 | -2.35 |

TABLE III.2

DEFORESTATION CONTROL

| NAME OF THE PASTURE PROJECT | TOTAL AREA OF THE PROJECT (Hectares) | DEFORESTED AREA UNTIL JUNE, 1975 (Hectares) | PERCENTAGE OF DEFORESTED AREA |
|---|---|---|---|
| SUIÃ-MISSU | 217,600 | 55,972 | 25.7 |
| GUANABARA | 30,000 | 7,970 | 26.5 |
| COLORADO | 5,414 | 2,079 | 38.4 |
| MACIFE | 30,000 | 2,948 | 9.8 |
| URUPIANGA | 50,468 | 5,512 | 10.9 |
| PORTO VELHO | 49,994 | 10,847 | 21.6 |
| FRENOVA | 93,146 | 5,339 | 5.7 |
| SANTA LŪCIA | 4,356 | 339 | 7.8 |
| CODEBRA | 25,337 | 1,944 | 7.6 |
| ELAGRO | 29,446 | 7,607 | 25.8 |
| CODEARA | 81,744 | 16,318 | 19.9 |
| BRASIL NOVO | 27,905 | 4,946 | 17.7 |
| RONCADOR | 24,251 | 1,767 | 7.2 |
| SUIÃ-XINGU | 20,000 | 870 | 4.3 |
| S.J.LIBERDADE | 30,000 | 1,419 | 14.7 |
| TATUIBI | 19,936 | 4,069 | 20.4 |
| SANTA ROSA | 19,360 | 6,464 | 33.3 |
| S.FR.XINGU | 21,000 | 2,646 | 12.6 |
| TAMAKAVY | 40,000 | 6,368 | 15.9 |
| SUL DA AMAZÔNIA | 24,200 | 6,377 | 26.3 |

TABLE III.3

DEFORESTATION INCREASE FROM AUGUST 1973 TO JUNE 1975

| NAME OF THE PASTURE PROJECT | DEFORESTED AREA UNTIL 1973 (Hectares) | DEFORESTED AREA UNTIL JUNE 1975 (Hectares) | INCREMENT (Hectares) | % OF INCREMENT RELATIVE TO THE WHOLE AREA OF THE PROJECT |
|---|---|---|---|---|
| SUIÃ-MISSU | 45,452 | 55,962 | 10,510 | 4.83 |
| GUANABARA | 6,415 | 7,970 | 1,555 | 5.18 |
| COLORADO | 1,406 | 2,079 | 673 | 12.43 |
| MACIFE | 0,000 | 2,948 | - | - |
| URUPIANGA | 3,025 | 5,520 | 2,495 | 4.94 |
| PORTO VELHO | 8,959 | 10,846 | 1,887 | 3.77 |
| FRENOVA | 5,339 | 5,339 | 0,000 | - |
| PORTA AMAZONAS | 2,268 | 2,268 | 0,000 | - |
| CODEBRA | 1,944 | 1,944 | 0,000 | - |
| ELAGRO | 7,607 | 7,607 | 0,000 | - |
| CODEARA | 13,283 | 16,318 | 3,035 | 3.71 |
| BRASIL NOVO | 3,068 | 4,946 | 1,878 | 6.73 |
| RONCADOR | 1,283 | 1,766 | 483 | 2.00 |
| SUIÃ-XINGU | 434 | 870 | 436 | 2.18 |
| S.J.LIBERDADE | 3,657 | 4,419 | 762 | 2.54 |
| SANTA ROSA | 6,464 | 6,464 | 0,000 | - |
| S.FR.XINGU | 970 | 2,646 | 1,676 | 7.98 |
| TAMAKAVY | 4,713 | 6,368 | 1,655 | 4.14 |
| SUL DA AMAZÔNIA | 6,377 | 6,377 | 0,000 | - |

Figures III.1 and III.2 show a region where the deforestation is being done very fast.

## 3.2 - ASSESSMENT OF PASTURE QUALITY

During the field work, (Tardin et al., 1976) it was observed that several deforested areas presented different pasture quality. Regrowth of natural vegetation was not significantly affected by the moisture content of the soil since, even in the dry season, it did not loose the green color as opposed to grass which became yellow. This differentiation permitted the evaluation of the pasture quality which was performed in the Image-100.

Table III.4 shows the percentage of the areas occupied by good pasture in relation to the whole deforested areas. The results show that most of the projects have good pasture only between 50% and 70% of their deforested areas.

Considering that the total deforested area under this study is about 2,000 $km^2$, only 800 $km^2$ present conditions for growing.

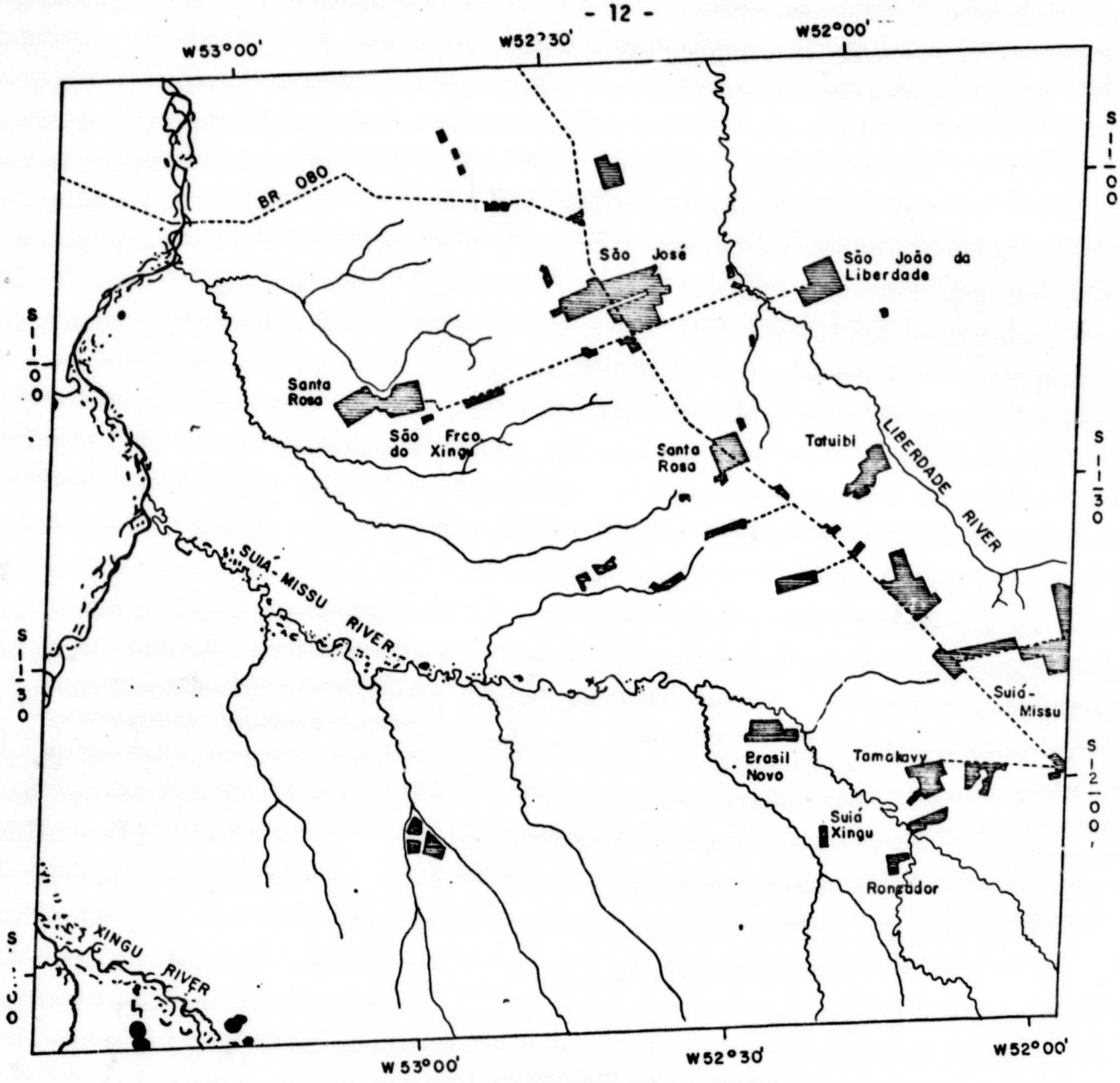


FIG. III.I - LANDSAT IMAGE INTERPRETATION SHOWING PASTURE PROJECTS IN AMAZONIA (AUGUST, 1973).

PASTURE PROJECT

SCALE :

10 0 10 30 50 Km

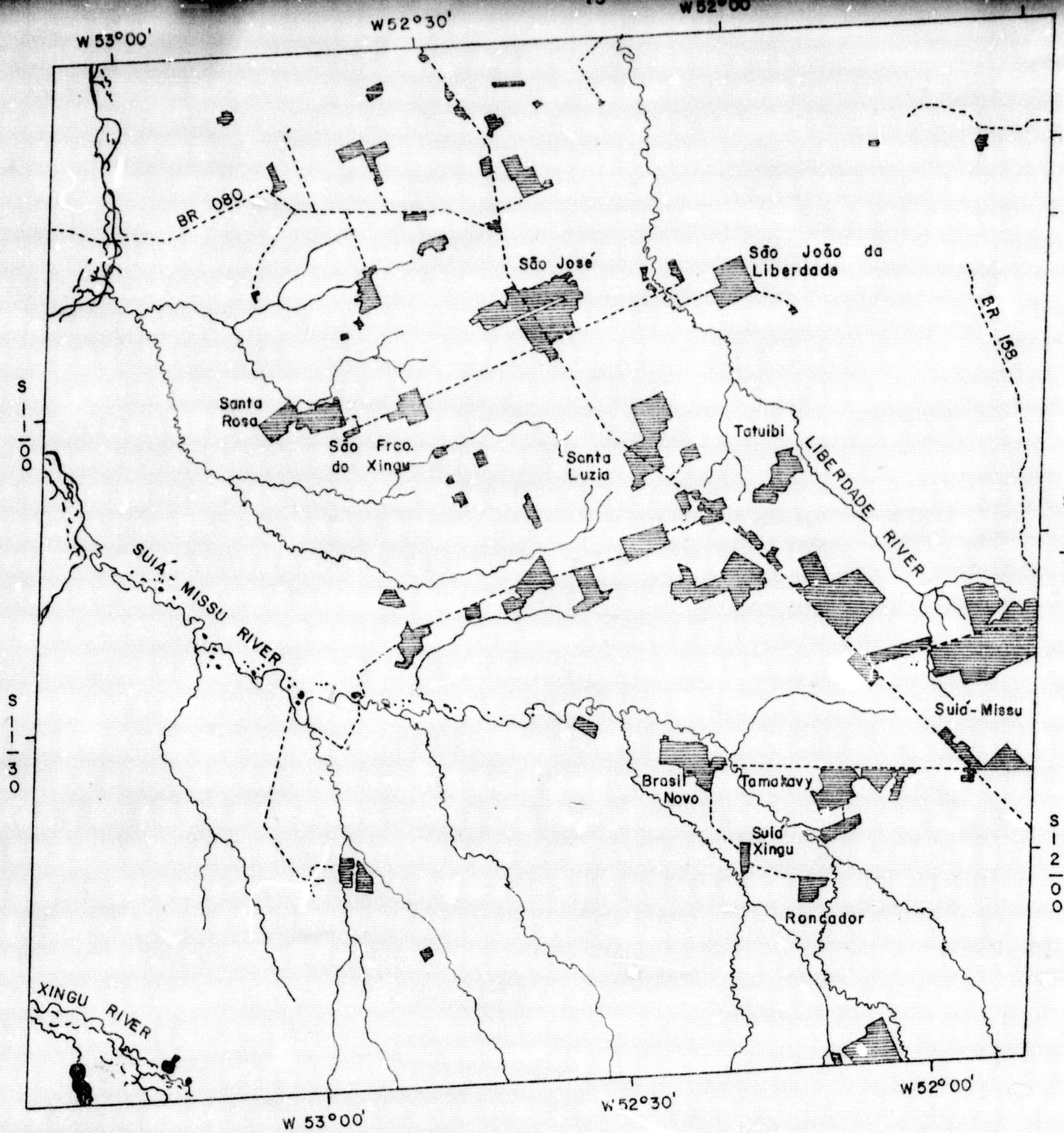


FIGURE III.2 - LANDSAT IMAGE INTERPRETATION SHOWING PASTURE PROJECTS IN AMAZONIA (JUNE, 1975).

PASTURE PROJECT

SCALE:

10 0 10 30 50 Km

TABLE III.4

EVALUATION OF THE PASTURE QUALITY

| NAME OF THE PASTURE PROJECT | AREA FOR GRAZING (Hectares) | PERCENTAGE OF THE TOTAL DEFORESTED AREA UNTIL JUNE 1975 |
|---|---|---|
| SUIÃ-MISSU | 43,066 | 76.96 |
| GUANABARA | 5,784 | 72.57 |
| COLORADO | 1,650 | 79.03 |
| MACIFE | 502 | 17.03 |
| URUPIANGA | 3,553 | 64.46 |
| PORTO VELHO | 7,748 | 71.43 |
| FRENOVA | 1,360 | 25.47 |
| PORTA AMAZONAS | 1,463 | 64.50 |
| SANTA LUCIA | 112 | 28.07 |
| CODEBRA | 1,565 | 80.50 |
| ELAGRO | 5,021 | 66.00 |
| COADEARA | 8,423 | 51.62 |
| BRASIL NOVO | 3,969 | 80.25 |
| RONCADOR | 991 | 56.08 |
| SUIÃ-XINGU | 421 | 48.39 |
| SÃO JOSÉ | 7,908 | 56.20 |
| S.J. LIBERDADE | 2,568 | 58.11 |
| TATUIBI | 2,664 | 65.47 |
| SANTA ROSA | 4,465 | 69.07 |
| S.FR. XINGU | 1,502 | 56.76 |
| TAMAKAVY | 4,759 | 74.73 |
| SUL DA AMAZÔNIA | 2,486 | 38.98 |

# CHAPTER IV

## CONCLUSIONS

- No significant differences were found between acreage evaluation by both visual and automatic interpretation of LANDSAT images.
- It is necessary to interpret both channels 5 and 7 to exactly outline the deforested areas. Channel 7 is necessary for the identification of deforested areas in the presence of recently grown natural vegetation, and channel 5 is necessary to identify the deforested areas in the "cerrado" (type of savanna) regions.
- Automatic interpretation permitted the discrimination between areas with predominant grass coverage and recently grown natural vegetation.

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