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16. Summary/Notes <i>The purpose of this study was to verify the LANDSAT system capability for the monitoring of the deforestation in cattle farms established in the Amazon region. Assessment of the pasture quality was also within the scope of the work. Automatic and manual methods were used to determine quantitatively the deforestation areas.</i>			
17. Remarks <i>This work was sponsored by SUDAM which is the agency responsible for the development of the Amazon region.</i>			

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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 $09^{\circ}00'$ and $13^{\circ}30'S$ and longitudes $50^{\circ}00'$ and $54^{\circ}00'$ (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.

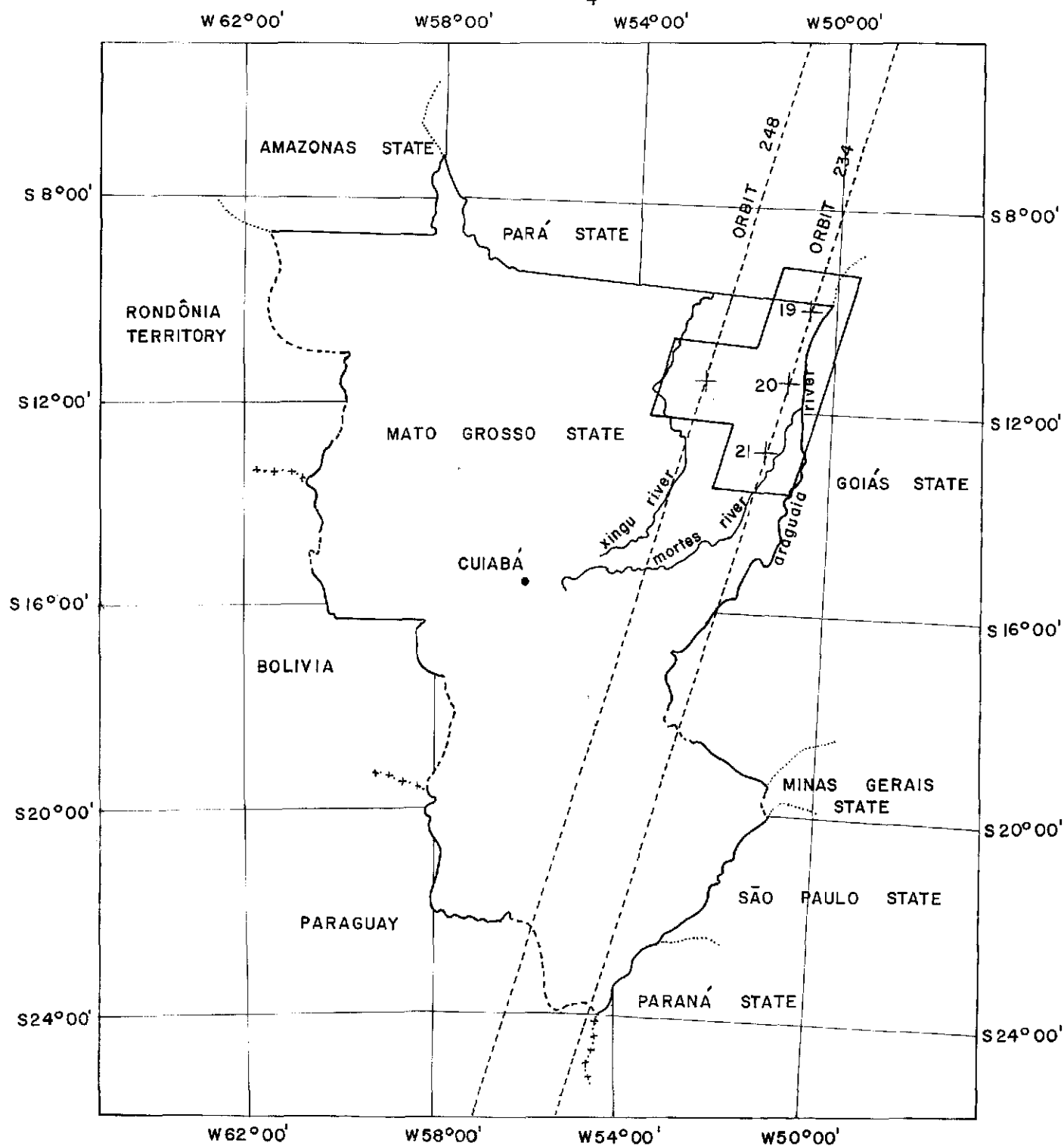
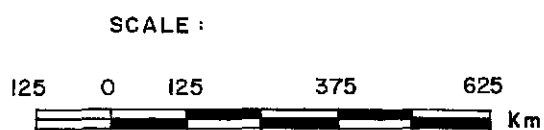


FIGURE II.1 - TEST SITE LOCALIZATION.



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 km². 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 occurring 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 km² 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
SUIA 1	26,139	26,294	-155	-0.59
SUIA 2	23,906	23,802	104	0.44
SUIA 3	3,312	3,386	-74	-2.23
SUIA 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
SUIA-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
SUIÁ-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 LÚCIA	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
SUIÁ-XINGU	20,000	870	4.3
S.J. LIBERDADE	30,000	4,419	14.7
TATU IBI	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
SUIÁ-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
SUIÁ-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 lose 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 km², only 800 km² present conditions for growing.

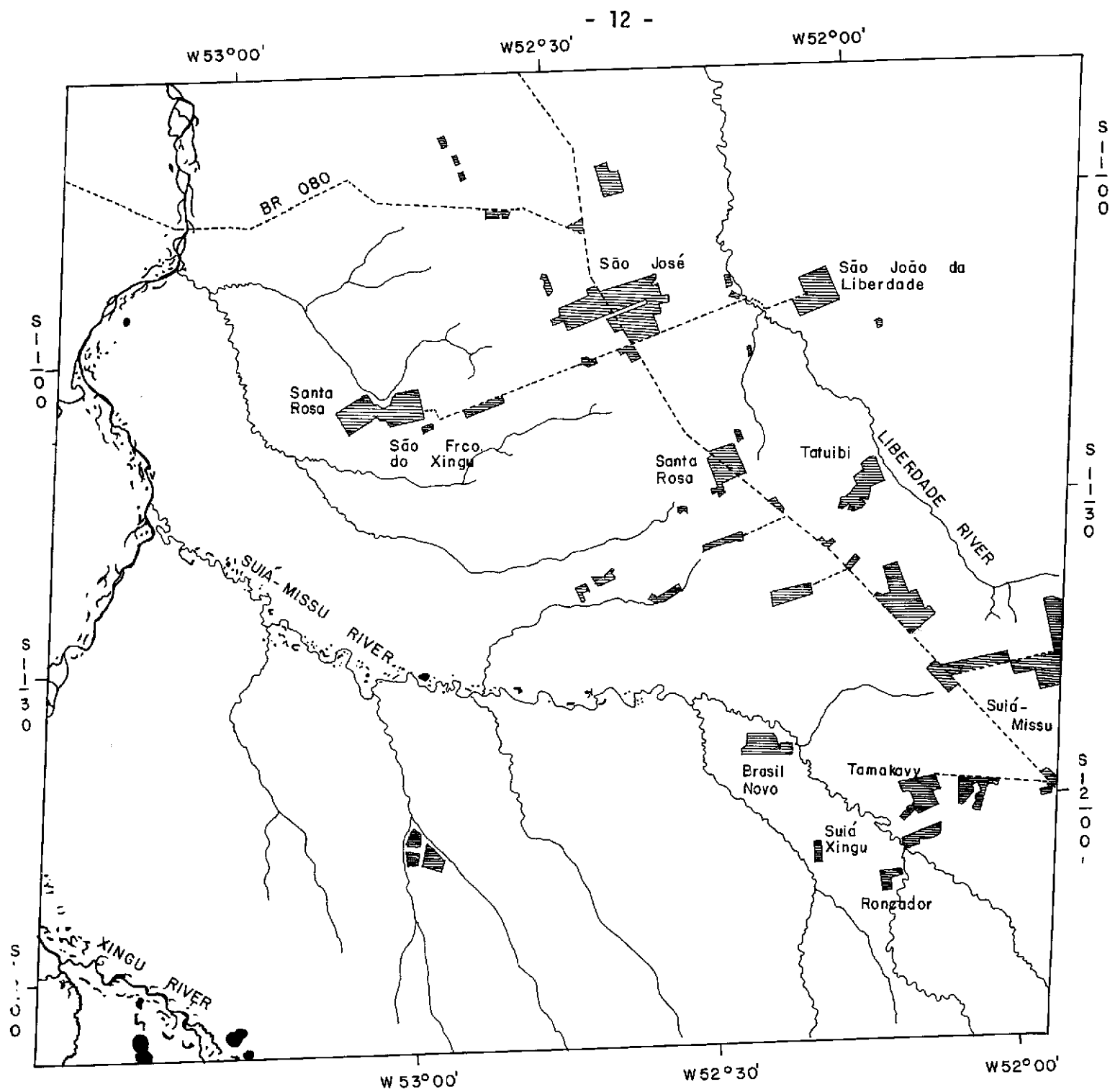


FIG. III.1 - LANDSAT IMAGE INTERPRETATION SHOWING PASTURE PROJECTS IN AMAZONIA (AUGUST, 1973).

 PASTURE PROJECT

SCALE :
10 0 10 30 50
 Km

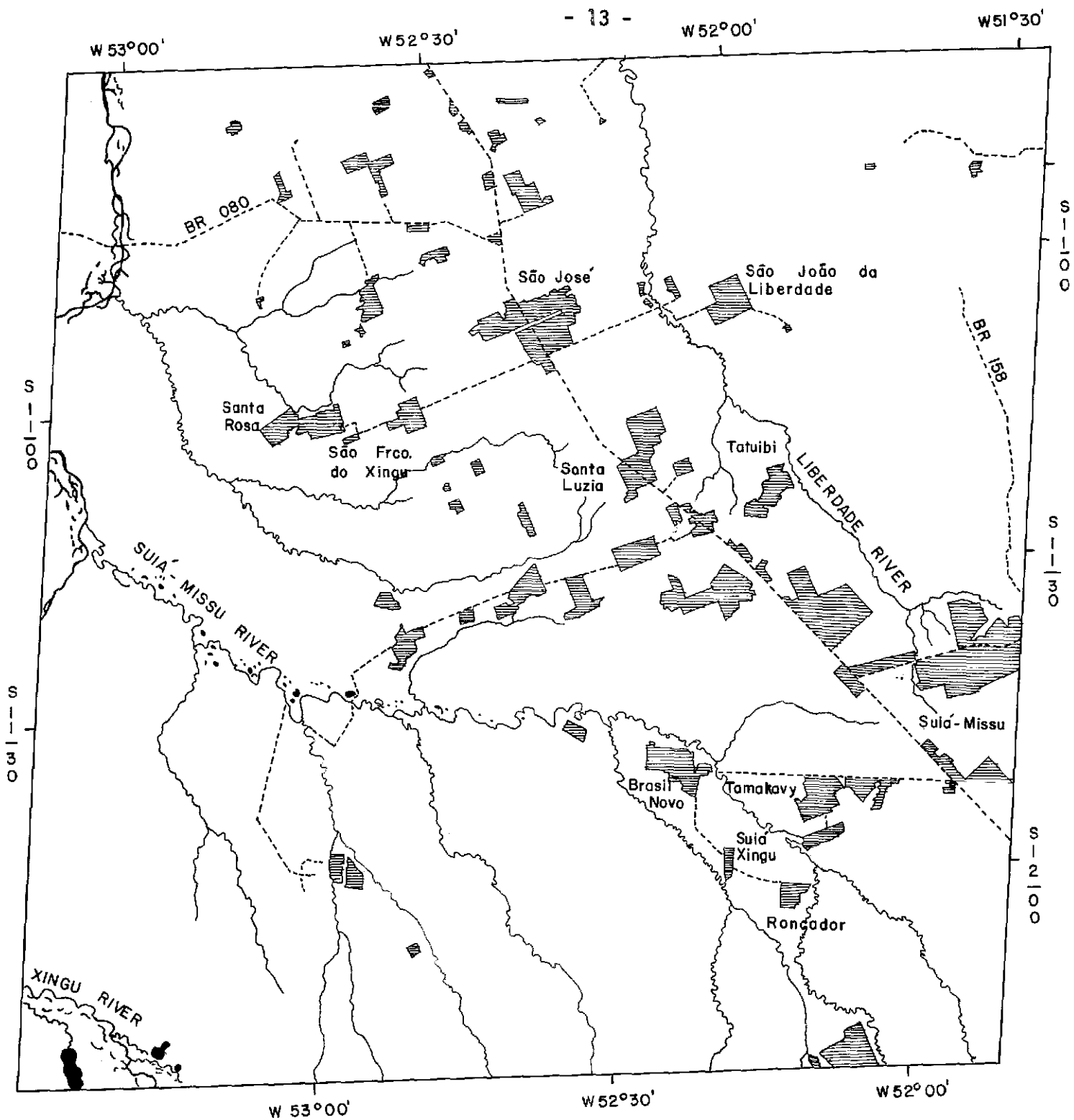


FIGURE III.2 - LANDSAT IMAGE INTERPRETATION SHOWING PASTURE PROJECTS IN AMAZONIA (JUNE, 1975).

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
SUIÁ-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
SUIÁ-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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