E7 8-10193
CR-157383

(E78-10193) ASSESSMENT OF THE DAMAGE CAUSED BY THE FROST OF 1975 TO COFFEE AND WHEAT CROPS IN THE NORTHWEST OF THE STATE OF PARANA USING LANDSAT IMAGES WITH AUTOMATIC (Instituto de Pesquisas Espaciais, Sao Jose) G3/43

N78-31492

Unclas
00193

CONSELHO NACIONAL DE DESENVOLVIMENTO CIENTÍFICO E TECNOLOGICO
INSTITUTO DE PESQUISAS ESPACIAIS

1.Classification *INPE-COM.3/NTE*	2.Period *1975*	4.Distribution Criterion internal [ ] external [X]
3.Key Words (selected by the author) *Frost* *Remote Sensing* *LANDSAT images* *Automatic interpretation*		
5.Report Nº *INPE-1007-NTE/078*	6.Date *March, 1977*	7.Revised by *Jorge de Mesquita* Jorge de Mesquita
8. Title and Sub-title *ASSESSMENT OF THE DAMAGE CAUSED BY THE FROST OF 1975 TO COFFEE AND WHEAT CROPS IN THE NORTHWEST OF THE STATE OF PARANÁ USING LANDSAT IMAGES WITH AUTOMATIC CLASSIFICATION*		9.Authorized by *Nelson de Jesus Parada* *Director*
10.Sector	Code *421*	11.Nº of Copies *20*
12.Authorship *Antonio Tebaldi Tardin* *Carlos Vicente Barbieri Palestino* *Claudio Roland Sonnenburg* 13.Signature of the responsible *Antonio Tebaldi Tardin*		14.Nº of Pages *13* 15.Price

16.Summary/Notes

The purpose of this work is to test the utilization of LANDSAT images with automatic classification in the assessment of the damage caused by frost to coffee and wheat crops. An area corresponding to three LANDSAT frames in the northwest of the State of Paraná was chosen for the study.

17.Remarks

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

The frost which occurred in the south of Brazil on 17-18 July 1975 caused severe crop damage in the northwest of the State of Paranã. Coffee was the crop most seriously affected, although wheat was also damaged to some extent.

The Brazilian Institute for Space Research - INPE, subordinate to the National Council for Scientific and Technological Development, through its Department of Remote Sensing of Earth Resources, carried out a study to assess the damage caused by the frost, using different remote sensing techniques.

First, an area of approximately 1,000 km^2 was selected in a characteristically coffee producing region near the city of Maringã (northwest of Paranã State) to be covered by aerial photography. Color infrared film in an approximate scale of 1:21,000 was used in this coverage. This work, already presented in the report INPE-745-NTE/126, showed the feasibility of performing rapid and efficient assessments of crop damage, in small areas, using aerial photography. The main results of this work were:

(i) approximately 60% of the wheat in the surveyed area was damaged;
(ii) 100% of the coffee in the surveyed area was damaged.

The purpose of this report is to describe what has been done to assess the damage to the coffee crop using, basically, LANDSAT images and automatic classification with INPE's Image-100 system. SKYLAB images and aerial photographies were also used to support the study, in addition to field work.

CHAPTER II

THE SURVEYED AREA

The area chosen for the study is located between the latitudes $22^{o}00'$ and $25^{o}00'$ South and longitudes $50^{o}00'$ and $53^{o}00'$ West (Fig. II.1). It is characterized by an intense agricultural activity with coffee, soybeans and wheat being the most important crops. In the past, roughly 35% of the brazilian coffee came from this area.

The area corresponds to three LANDSAT MSS frames, which are indicated in figure II.1 by dashed lines. We will refer to these frames as the Londrina frame (orbit 206, point 28), Maringá frame (orbit 220, point 28) and South of Maringá frame (orbit 220, point 29).

The area corresponding to the aerial survey is shown in figure II.1 as a shaded rectangle.

Figure II.2 shows the localization of the surveyed area within the State of Paraná.

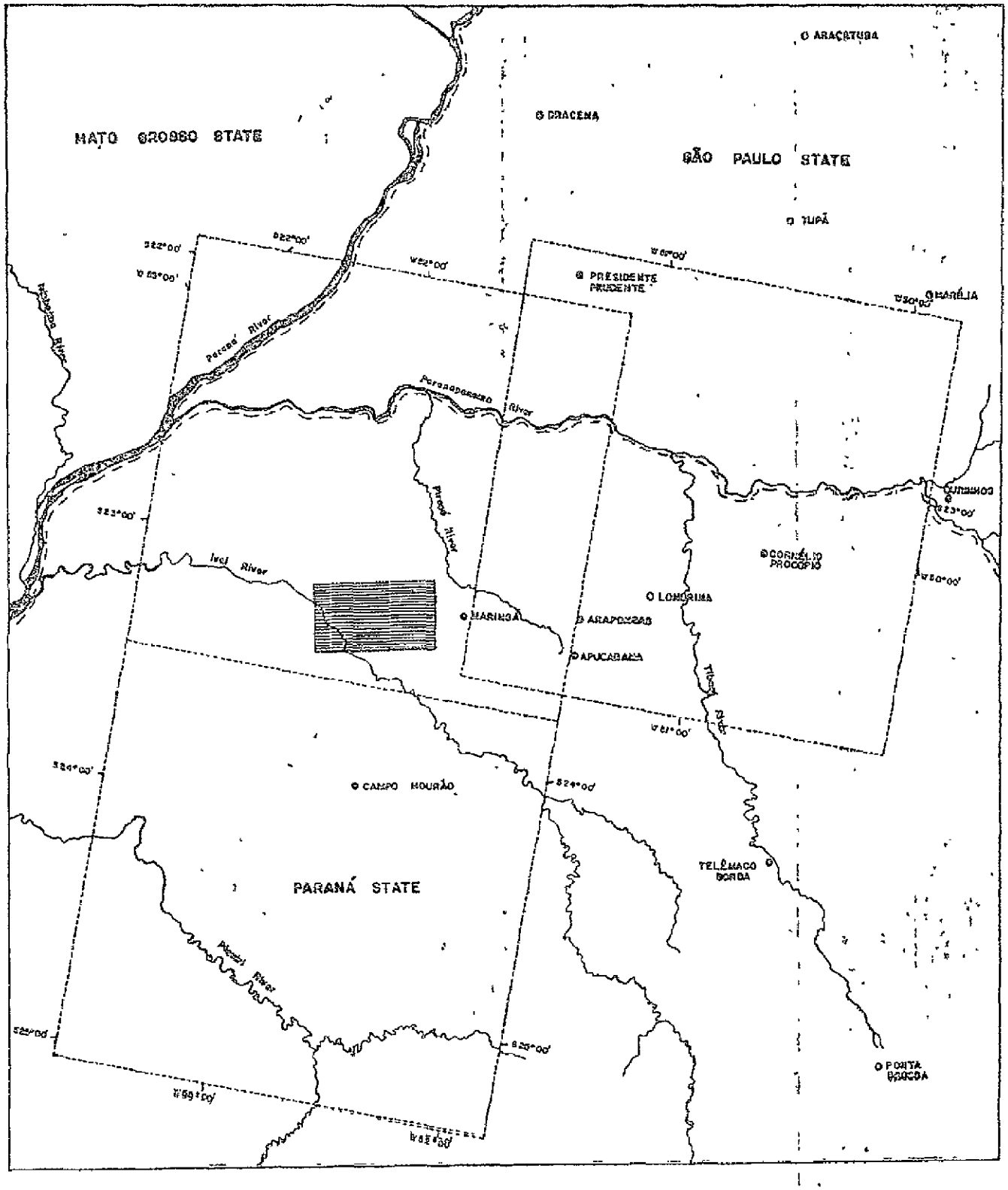

FIGURE II.1 - AREA UNDER STUDY

LEGEND

- RIVERS
- CITIES
- STATE BOUNDARY
- AREA COVERED BY LANDSAT IMAGE
- AREA COVERED BY AERIAL PHOTOGRAPHY

SCALE:

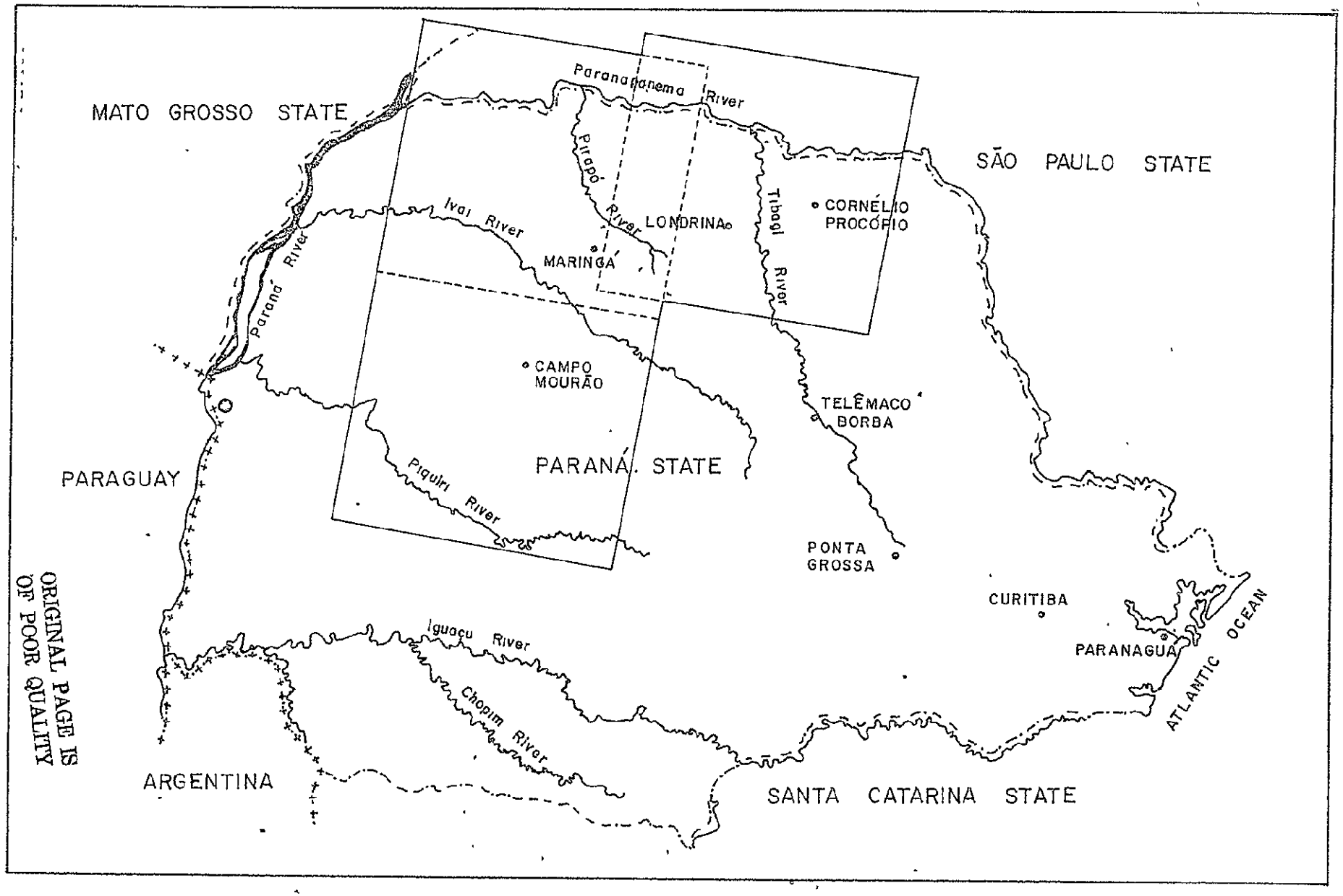

FIGURE II.2 – LOCALIZATION OF THE AREA UNDER STUDY WITH REFERENCE TO STATE BOUNDARIES.

CHAPTER III

METHODOLOGY

To carry out the work described in this paper, we used an automatic image classification system, which is briefly described in the following section.

3.1 - THE GENERAL ELECTRIC IMAGE-100 SYSTEM

The Image-100 (I-100) is a Multispectral Image Analysis System designed for extracting useful information from remotely-sensed data. Image-100 operates on the general principle that all objects possess unique spectral characteristics, also refered to as signatures. The system uses this signature uniqueness to identify similar features in an image. Features having identical spectral characteristics are assigned pseudo colors or themes, which are then displayed on a color CRT. It is also possible to derive the area of each theme assuming that the area of the whole image is known.

The basic classification scheme of the I-100 consist of a training phase and the classification proper. In the training phase, the machine determines the minimum and maximum reflectance among the pixels in the training area of the image for the four channels, in case of LANDSAT images. This minimum and maximum reflectance determines a hyperparalelepiped which is the decision volume used in the classification phase. Each pixel of the image is tested to see whether it falls inside or outside this volume; if it falls inside the volume, it belongs to the class, otherwise it does not. I-100 has other more elaborate classification schemes that are based on the one described above..

3.2 - IMAGERY USED IN THE STUDY

Besides using the CCT's of the LANDSAT MSS corresponding to the following dates:

- August 1st, 1975 image (Londrina frame);
- August 2nd, 1975 image (Maringá frame);
- August 2nd, 1975 image (South of Maringá frame),

other image products, listed below, were used as supplementary data:

(i) Normal and false color infrared photographic images of SKYLAB 1:300,000 scale;
(ii) Infrared false color aerial photographs, 1:21,000 scale, obtained with INPE's aircraft just after frost occurrence; and
(iii) LANDSAT images, 1:1,000,000 and 1:250,000 scales, channels 5 and 7, corresponding to the CCT's mentioned above.

Some ground truth data was obtained by a field team from INPE and the Agriculture Department of the State of Paraná during July 23 and 24, 1975.

3.3 - METHODOLOGY

In the study, each LANDSAT frame was partitioned in four equal subframes cutting the latitudes and longitudes of each frame in the middle. The signature acquisition for the automatic classification was completely independent for each subframe, that is, the signatures derived for one subframe were not used in any other subframe. Within each subframe, a number of places corresponding to the aerial photographies were localized and enlarged in the I-100 so that the signature acquisition for the crops of interest could be performed with good confidence. We found that the plantations affected by the frost could be well identified in the aerial photographies. Visual analysis of SKYLAB and LANDSAT images, together with the field survey, supplemented, whenever possible, the signature acquisition task. The classification method used in the work was the simple one described in section 3.1.

Calculation of the areas of the plantations, affected and not affected by the frost, was performed using a program available in the I-100.

Figure III.1 shows a false color composition of one of the studied subframes. Figure III.2 shows the corresponding classificati where red is frost affected coffee and blue is wheat (affected or not affected by frost).

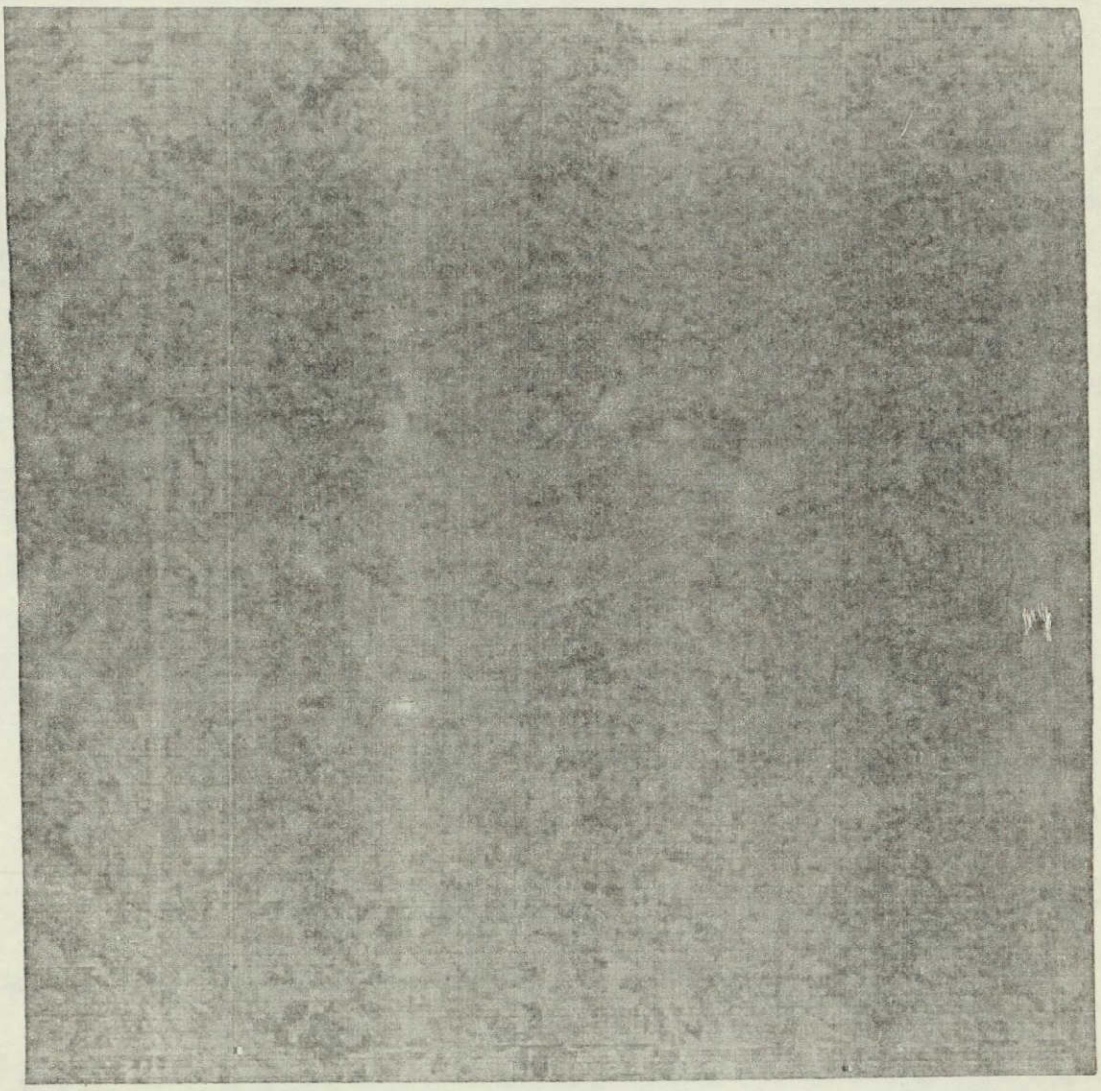

Fig. III.1 - LANDSAT-2 false color composition.

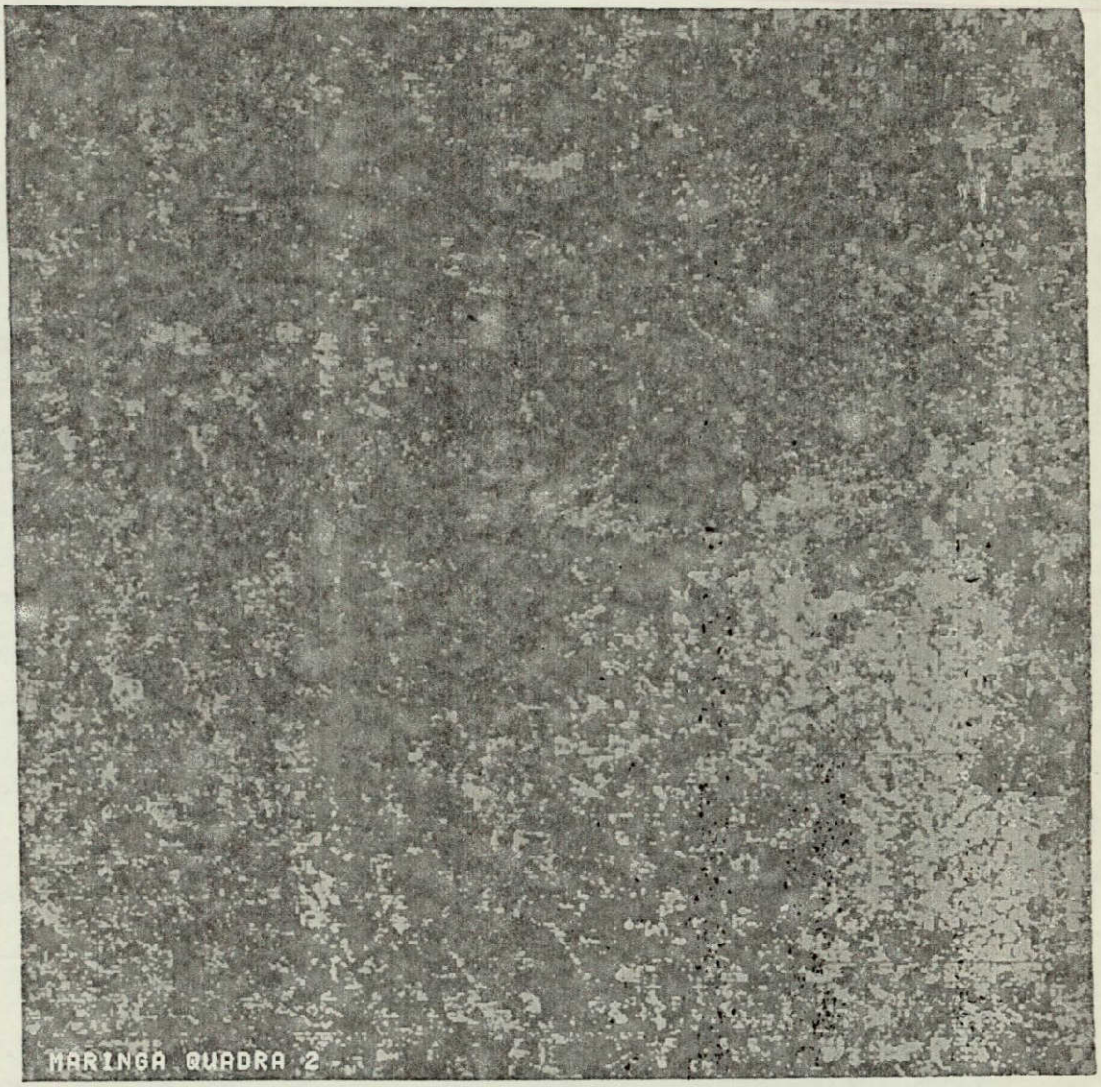

Fig. III.2 - Image-100 classification showing frost affected coffee (red) and wheat (blue) areas.

tree-top and ground level (ground-truth) data, thus supplementing, with more detailed data on areas of specific interest, the synoptic view provided by the satellite images.

TABLE IV.1

AREAS (HA) CORRESPONDING TO FROST AFFECTED AND NORMAL COFFEE

QUARTERS	MARINGÁ FRAME		LONDRINA FRAME		SOUTH OF MARINGÁ FRAME	
	NORMAL COFFEE	FROST-AFFECTED COFFEE	NORMAL COFFEE	FROST-AFFECTED COFFEE	NORMAL COFFEE	FROST-AFFECTED COFFEE
1	-	25,492	4,700	56,970	-	94,793
2	-	109,863	-	87,638	-	80,934
3	-	49,514	20,317	35,454	-	92,734
4	-	114,646	8,846	104,841	-	-
TOTAL	-	299,515	33,863	284,903	-	268,461

TOTAL NORMAL COFFEE: 33,863

TOTAL FROST-AFFECTED COFFEE: 852,879

PERCENTAGE OF FROST-AFFECTED COFFEE: 96%