General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.

- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.

- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.

- This document is paginated as submitted by the original source.

- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

NASA TECHNICAL MEMORANDUM NASA TM 75088

USE OF SATELLITE IMAGES IN THE EVALUATION OF FARMLANDS

M. en C. Ana Estela Lozano H.

(NASA-TM-75088) USE OF SATELLITE IMAGES IN THE EVALUATION OF FARMLANDS (National Aeronautics and Space Administration) 9 p HC A02/MF A01 CSCL 02C

N78-21575

Unclas G3/43 15895

Translation of "USO de imagenes de satellite en la evaluacion de cultivos", Paper presended at the UN'FAO Regional Training Seminar on the Application of Satellite Remote Sensing, Dec. 1-9, 1977, La Paz, Bolivia, pp 1-5

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. 20546 MARCH, 1978

STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TM 75088		

4. Title and Subtitle	5. Report Date
Use of Satellite Images in the Evaluation of Farmlands	March, 1978
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
M. en C. Ana Estela Lozano H.	
	10. Work Unit No.

9. Performing Organization Name and Address	11. Contract or Grant No.
SCITRAN Box 5456 Santa Barbara, CA 93108	NASw-2791
	13. Type of Report and Period Covered
	Translation
12. Sponsoring Agency Name and Address	14. Sponsoring Agency Code
National Aeronautics and Space Administration Washington, D.C. 20546	

15. Supplementary Notes

Translation of "USO de magenes de satellite en la evaluacion de cultivos", Paper presented at the UN/FAO Regional Training Seminar on the Application of Satellite Remote Sensing, Dec. 1-9, 1977, La Paz, Bolivia, pp 1-5

16. Abstract

Remote sensing techniques in the evaluation of farmland in Mexico are discussed. Electronic analysis techniques and photointerpretation techniques are analyzed. Characteristics of the basic crops in Mexico as related to remote sensing are described.

17. Key Words (Selected by Author(s))	18. Distribution Statement
	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22.
Unclassified	Unclassified	9	

REGIONAL TRAINING SEMINAR ON APPLICATIONS OF SATELLITE IMAGES

LA PAZ, BOLIVIA

December 1-9, 1977

USE OF SATELLITE IMAGES IN THE EVALUATION OF FARMLANDS

M. en C. Ana Estela Lozano H.*

If there were more food in the world than there are human beings to /1** consume it, there would be no great importance attached to the systems used to evaluate the production of such foods, but the demographic development of the human race in the past one or two hundred years, and the trend which exists at present, lead us to carefully analyze whether or not we are using efficient methods for knowing how much we have, and how much we are going to have, of each of the products which serve as our sustenance.

Thus, beginning in the past decade, the worldwide search for new methods of measurement has become more intense, making use of techniques which are constantly becoming more complex and refined, in order to obtain reliable estimates of the volumes of production from agriculture, animal husbandry, and fishing. With the development of statistical theory in the 1950's, there has been an increase in the use of sampling methods for evaluating the progress and the results in the growing of basic products, and even non-basic ones. This has involved the application of designs used to define the sample, maps, aerial photographs, and lists of producers. Current progress in the techniques of remote sensing, especially those which depend on sensors placed in artificial satellites, has resulted in the fact that the images of the earth which these sensors collect enter into the consideration of anyone who has the

*Secretary of Agriculture and Water Resources, Mexico

**Numbers in margin indicate pagination in foreign text.

task of evaluating cultivated lands.

How can they be used? Of the various techniques of handling and extracting information, which will be the most efficient in practical application? Can they substitute for or complement present techniques?

These and other questions lead us to assume, as a basic part of our activity, the obligation to provide information on how much and where food for humanity is produced, will be produced or can be produced.

EVALUATION OF FARMLAND IN MEXICO

The agency of Mexico which is responsible for the national statistics is the Dirección General de Estadistica, of the Secretariat of Planning and Budget (Secretaria de Programacion y Presupuesto). As regards agriculture and animal husbandry, this agency has reserved the development of the decennial national census, delegating the corresponding part to the Estadisticas Continuas Agropecuarias y Forestales [Continuing Statistics on Agriculture, Cattle, and Forestry] in the Direccion General de Economia Agricola [General Directorate of Agricultural Economy], of the Secretariat of Agriculture and Water Resources. /2

In working out these statistics, various systems of data collection are used.

a) forms sent out and returned by mail, and questionnaires handled directly, among informants believed to have a knowledge of the conditions of development of agriculture or animal husbandry in the zones, regions, or political divisions in which they live;

b) questionnaires handled by personal interviews of farmers or cattlemen selected by sampling; a method in which the greatest scientific rigor is applied that the actual conditions permit. In this kind of sampling study, corrected aerial photographs are used, where they exist; these cover 50% of the usable surface of the country. Also used are maps showing current land use, on a scale of 1:50,000, developed on the

basis of color stereoscopic aerial photographs by the Department of Studies of the National Territory, with a coverage to date of 30%. In these photographs and maps, sample areas are defined and selected for 60% of the usable surface. With respect to the rest of the country, the sampling units are the political divisions, since there is an absence of appropriate maps for sampling of agricultural purposes.

REMOTE SENSING TECHNIQUES IN THE EVALUATION OF FARMLAND IN MEXICO

Starting in 1975, the techniques of remote sensing have been analyzed, evaluating the possibility of applying them in practical and extensive form for estimating the surface area seeded with basic crops.

PHOTOINTERPRETATION TECHNIQUES

We thus followed the techniques of ocular analysis of the images in false color. These techniques have permitted the drawing up of synoptic maps of land use on the scale of 1:500,000. This was done by another agency of the S. A. R. H. (Secretariat of Agriculture and Water Resources), the Department of Synoptic Cartography, which has made progress in two years, with 20 units already printed and 6 in press, of the 32 which make up the entire country.

In these maps, from 26 to 30 categories have been defined which embrace agriculture dependent on rainfall and on irrigation, pasture land, 4 categories of woods, 6 of forests, 2 of semi-desert vegetation, 5 of shrubland, 3 of hydrophilic vegetation, deserts, urban areas and bodies /3 of water, and showing the area covered by each category.

The methodology followed is the use of all existing cartographic and documentary information, which includes military topographic maps at a scale of 1:250,000 and 1:50,000, aerial photography, and verification by airplane, helicopter, and ground survey. The area is measured by gravimetric methods, weighing the layers of film which are used to form the printing of each color.

These maps are of high quality and have proven useful in locating

the agricultural zones whose situation had not been known, by which it has been possible to send samples. We have not tried to define sampling units, since the field personnel do not consider it feasible, although we are going to attempt it.

The estimation of useable areas has been utilized to adjust certain statistics which used, as auxiliary data, estimates that were already obsolete.

TECHNIQUES OF ELECTRONIC ANALYSIS TRIED IN MEXICO

With respect to the computing techniques starting from electromagnetic tapes with LANDSAT images, three systems of computing have already been tried, with attractive results, at least for farmland intensively cultivated by irrigation in winter: wheat and saffron.

The three systems of computation were tested simultaneously for a zone in northwest Mexico, the Yaqui Valley Irrigation District, from which surface area and production statistics of high reliability can be expected. The inquiry was performed by sampling and several lines of flight were photographed in color to check the points.

The ERMAN II system from NASA-IBM gave a slight underestimate which could be attributed to several factors:

a) the image did not capture about 2000 hectares in the southeastern part of the district;

b) the image has some cloudy places which cover small surface areas;

c) the roads between the blocks [of stone] are very yellow, and their reflectance modifies the color of the planted wheat along the borders.

The tests of a system generated at the National University, where the normal algorithms of multivariant analysis were also employed but were considered not to give a correlation between the bands, gave highly satisfactory results, although the short machine time available did not /4

permit estimates to be made for the whole valley.

The last system tested, developed at the IBM scientific center, which uses an algorithm based on the differences in intensity between the bands and the percentage which each one contributes to the total color of the pixel, also gave favorable results, especially because it permitted differentiation between the flax and the wheat, which the other two confused, and clearly defined "wheat with earth", and "wheat with light clouds".

These methods have not been applied to other tapes, since for those which we have been able to obtain there is no compatible terrestrial information available; and for the zones for which there are terrestrial data for two or more years, we do not have tapes.

ANALYSIS OF THE PRACTICAL APPLICABILITY IN CONTINUOUS EVALUATION

From the experience obtained, it is considered that the ocular methods of photointerpretation do not permit application to continuous evaluation of surface areas planted with crops, both because they do not permit recognition of slightly-differentiated categories, and also becuase of the scale on which they can be worked, although they are indeed aids in locating zones with significant changes.

With respect to the computing methods, they do not function by themselves as sources of information, since they always require field work in which one must be exact as to location and measurement; this is equivalent, in cost and time, to an investigation by sampling.

On the other hand, at least for Mexico, the real time elapsed between taking the image and the availability of the tape in the application centers does not satisfy the requirements for presenting estimates; besides which, if the tape is requested prior to taking the image, the result may be clouds in the zone being studied or a damaged channel (of three tapes of the valley, February, March, and April, only February could be used).

As far as the reliability of the measurement of areas is concerned, it is considered that acceptable levels can be reached with a single tape, and that excellent results can be obtained with two tapes, at least for farmlands intensively cultivated in winter, as is the case for wheat which occupies 160,000 Ha of the 200,000 in the test zone.

The cost of the study in its practical application could not be evaluated, since the cost of field work in the tests was almost zero, inasmuch as the existing records in the irrigation district and the information obtained during the investigation of production were made use of. The flight for obtaining aerial photographs was not evaluated /5 by CENTENAL, since it coincided with another study which was being carried out.

On the other hand, the cost of an investigation is never comparable with that of a project already being carried out on a routine basis.

CHARACTERISTICS OF THE BASIC CROPS IN MEXICO AS RELATED TO REMOTE SENSING

The crops which occupy the greatest surface area in Mexico are corn and beans. These are followed in importance by sorghum, wheat, and alfalfa.

Of the 15 million hectares which are sown annually, 7.5 are in corn, and 4.2 are in the other four, and so it is logical to assume that they should easily be seen in the satellite images.

Nevertheless, in about 2 million hectares corn is interspersed with beams or with squash; in at least one million Ha, the farmers allow edible herbs to grow between the furrows (huantzontle*, papaloquelita*, quelita*, purslane) during the rainy season, and in other places they grow higher than the corn and are cut for fodder. Thus in Guanajuato, in July, the fields of corn not scientifically managed have an orange color owing to the flowering of such plants.

*No English equivalents for these plant names.

It should also be considered that more than 20% of the area given over to corn is in parcels of less than two hectares, and one-half million hectares are in parcels of less than one-half hectare. The boundaries are generally defined by trees, shrubs, agaves or cochineal plants, depending on the climate.

On the other hand, corn, sorghum, and beams are chiefly spring and summer crops; that is, there are clouds during their growing season; although, in view of the diversity of climates and topography, corn is being planted and harvested somewhere every day of the year.

Wheat and alfalfa do not present any of these problems, since they are cultivated intensively and scientifically, and are in the ground in winter.

The characteristics analyzed, both as to remote sensing proper and as to the basic crops in Mexico, led to a plan of work being developed which takes these realities into account.