Dario Rodríguez-Bejarano
Escuela Nacional de Agricultura
Chapingo, Edo. de México, México

The Teaching of Photo-Interpretation and Photogrammetry in the Field of Natural Resources

Remote Sensing and Photogrammetry in Mexico and Central America

Abstract: *The state-of-the-art and trends in photogrammetry and photo-interpretation courses in the field of natural resources in higher education (college, university, or specialized schools) are analyzed in Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Mexico.*

The author has served in Mexico as a teacher of photointerpretation at the Escuela Nacional de Agricultura (Universidad Autónoma Chapingo) and, during a two-and-a-half week visit to the five countries in Central America, gathered much of the information for this report. Fifteen institutions were visited in Central America, ranging from lower-level, through mid-level technical agricultural schools.

Specialized programs and availability or lack of equipment are reported. Courses of photogrammetry and photointerpretation on the higher educational level in Mexico are discussed, particularly those pertaining to natural resources.

Several conclusions concerning the quality of the courses, projections and needs of remote sensing education in these countries are presented.

Introduction

A brief review of *Photogrammetric Engineering* covering the last 12 years will show several reports dealing with the trends, needs, and projections of photogrammetry and remote sensing in the U.S.A. and Canada[1 2 3 4 5 8 9 10 11]. Unfortunately, this same interest has not been extended to the rest of the American Continent; i.e., Central and South America. Recognizing the need for such a report, the author undertook a two-and-a-half week study-trip to Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica. Several educational institutions dealing with the study of natural resources were visited to learn of their present and probable near future use of remote sensing techniques and their specialized fields. At the same time, the present and future trends of remote sensing education in the field of natural resources at the higher educational level in Mexico were analyzed. Figure 1 shows the countries and institutions mentioned in this report.

The courses in remote sensing offered at college and university levels are generally in the fields of forestry, soils, agriculture, geology, civil engineering, and more recently in

Photogrammetric Engineering and Remote Sensing,
Vol. 43, No. 3, March 1977, pp. 285-291.

FIG. 1. Places visited and reported upon.

TABLE 1. TOTAL LAND AREA AND FORESTED AND AGRICULTURAL LAND OF COUNTRIES REPORTED.

	Total Area 1000 ha.	% Forested Area	% Agricultural Area
Guatemala	10750	38	25
El Salvador	2139	11	58
Honduras	11190	53	17
Nicaragua	13700	47	8
Costa Rica	4869	61	37
México	196068	20	50

rangeland management for animal husbandry students. More specialized courses, the product of specific needs, are generally fulfilled by private or government institutions that recognized these needs. Courses in remote sensing techniques in the countries reported upon are referred to as aerial photography, aerial photo-interpretation, photo-interpretation, and photogrammetry. It should be noted that the courses in soils, geology, geography, surveying, forest inventories, and cartography include photo-interpretation and photogrammetry. However, in many instances these two subjects are covered only in theory.

In order to understand the importance of remote sensing education in these countries it is necessary to understand the importance of natural resources to their economies. Table 1 shows the total land area of the six countries mentioned and the percentage of forested and agricultural land, and illustrates how important agricultural and forested lands are to the economies of these countries.[6]

It is principally within the fields of forestry and agriculture that remote sensing is mostly applied and taught at colleges and universities. Thus, one can see the urgency with which remote sensing techniques are needed. This urgency has increased since the launching of the Landsat program. As in many other activities, the technological gap between the industrialized nations and Latin America is widening, which is illustrated by the restricted application of Landsat data in the latter.

INSTITUTIONS VISITED AND REPORTED UPON

The institutions visited in Central America ranged from lower-level, through mid-level technical agricultural schools to universities. In Mexico these intitutions are mostly government universities and technical schools. Table 2 shows the places visited in Central America and those reported on in Mexico. It also indicates the type of education each offers and the courses available in photogrammetry and remote sensing.

The remote sensing courses, when offered, were hindered by the lack of proper

TABLE 2. INSTITUTIONS VISITED AND REPORTED UPON.

Country	Institution	Location	Type of Education Offered*	Remote Sensing Courses
Guatemala	1. Faculty of Agricultural Sciences, University of San Carlos of Guatemala.	Guatemala City	Agricultural Engineering (5½-year program).	Aerial Photogrammetry and Photo-interpretation (Department of Agricultural Engineering).
El Salvador	2. National School of Agronomy	San Andres	Agricultural Technician (3 year program).	None
	3. Faculty of Agricultural Sciences, National University of San Salvador	San Salvador	Agricultural Engineering (5 year program).	None as such. Photo-interpretation is an element in the courses of Soils and Cartography of Soils.

TABLE 2—*continued*

Country	Institution	Location	Type of Education Offered*	Remote Sensing Courses
Honduras	4. Regional University Center of the Atlantic Coast, National Autonomous University of Honduras.	La Ceiba	Agricultural and Forest Engineering (5 year program).	Photogrammetry (Department of Forest Sciences at Tegucigalpa).
	5. Panamerican School of Agronomy.	El Zamorano	Agricultural Technician (3 year program).	None as such. Aerial Photography is an element in the course of Soils.
	6. National School of Forest Sciences	Siguatepeque	Forest Technician (3 year program)	Photo-interpretation (Dasonomy students) and an element in courses of Forest Protection, Reforestation, Soils, and Forest Inventory.
	7. Agricultural School	Atlántida	Agricultural Specialist (1 year program).	None
Nicaragua	8. School of Agricultural Engineering, National Autonomous University of Nicaragua	Managua	Agricultural Engineering (5 year program)	None as such. Photo-interpretation is an element in courses of Geomensuration, Edafology, and Cartography.
	9. Faculty of Agriculture and Livestock Sciences, Department of Biology and Natural Resources, Central American University (UCA)	Managua	Biology and Natural Resources (5 year program)	Cartography and photo-interpretation.
	10. National School of Agriculture and Cattle Raising.	Managua	Agricultural Engineering (5 year program)	None as such. Photo-interpretation is one element in the course of Dasonomy given to students specializing in Natural Resources.
Costa Rica	11. Faculty of Agronomy, University of Costa Rica.	San José	Agricultural Engineering (5 year program)	None as such. Photo-interpretation is an element in the courses of Geography and Soils.
	12. Centro-American School of Geology, University of Costa Rica.	San José	Geology (5 year program)	Photo-geology course.
	13. Faculty of Sciences of the Earth and Sea,	Heredia	Earth and Sea Sciences (5 year program).	Principles of Photogrammetry and Photo-interpretation (School of Geography).
	14. School of Topography and Surveying, National University.	Heredia	Topography Technician (surveyor) (2 year program)	Photogrammetry (three semesters).
	15. Tropical Agronomic Center of Research and Teaching (CATIE)	Turrialba	Graduate studies (about 2 years)	None
México	16. Forest Department, National School of Agriculture (Autonomous University of Chapingo) ENA/UACH	Chapingo	Forest Engineering (5 year program)	Photogrammetry, Forest Photo-Interpretation, Photogrammetry and Photo-interpretation applied to Animal Husbandry*, Photo-grammetry and Photo-interpretation applied to Soils* Photo-interpretation applied to Irrigation*.

TABLE 2—*continued*

Country	Institution	Location	Type of Education Offered*	Remote Sensing Courses
				*These courses, given by the Department of Forestry, belong to the curriculae of Animal Husbandry, Soils, and Irrigation Departments respectively.
	17. School of Agriculture, Autonomous University of Aguascalientes.	Aguascalientes	Agricultural Engineering (5 year program)	None
	18. School of Agriculture, Autonomous University of Baja California	Mexicali	Agricultural Engineering (5 year program) and agricultural Technician (3 year program).	Photogrammetry and Photo-interpretation
	19. Regional Technological Institute at La Laguna	Torreón	Agriculture and Animal Husbandry Technician (3 year program).	None
	20. Higher Institute of Agriculture.	Iguala	Agricultural Technician (3 year program.)	None as such. Photogrammetry and Photo-interpretation are elements of the Dasonomy course.
	21. School of Agriculture, University of Guadalajara.	Guadalajara	Agricultural Engineering (5 year program)	Photogrammetry
	22. School of Geology, National Politechnic Institute.	México, D.F.	Geological Engineering (5 year program)	None as such. Photogeology is an element of the Geomorphology course.
	23. Faculty of Sciences, National Autonomous University of México.	México, D.F.	Geological Engineering (5 year program)	Photo-geology (Photo-interpretation).
	24. School of Agriculture and Livestock, University of Sonora.	Hermosillo	Agricultural Engineering (5 year program).	Photogrammetry and Photo-interpretation (Irrigation option).
	25. School of Engineering, University of Sonora	Hermosillo	Geological Engineering (5 year program)	Remote Sensing (2 semesters).
	26. Higher College of Tropical Agriculture	Cárdenas	M.S. in Tropical Agriculture (about 2 years)	None
	27. School of Engineering, University of Veracruz	Xalapa	Geological Engineering (3 year program)	Photogrammetry
	28. Autonomous University of San Luis Potosí	San Luis Potosí	Geological Engineering (5 year program)	Photo-geology
	29. School of Agriculture, Autonomous University of Chihuahua	Chihuahua	Agricultural Engineering (5 year program)	None
	30. Higher School of Agriculture "Hermanos Escobar"	Cd. Juárez	Agricultural Engineering (5 year program)	None
	31. National Militarized School of Forest Guardas "Dr. Manuel Martínez Solorzano".	Uruapan	Forest Guards (3 year program)	Photogrammetry and Photointerpretation
	32. Faculty of Agrobiology, University of Michoacán "San Nicolas de Hidalgo".	Uruapan	Agricultural Engineering (5 year program)	None as such. Photo-interpretation is an element in the courses of Ecology and Edafology.

* A 5 year program at a university is the equivalent of the B.S. or B.A. degree. A 2-3 year program at a university or technical school is equivalent to a medium-level technician. Less than a 2 year program at a technical school is equivalent to a lower-level technician.

equipment to carry out laboratory work. Thus, it is important to analize the equipment and technical staff available that will be used to teach these courses. Table 3 presents a summary of the instruments, photography, and staff. The institutions respond to the numbers which appear in Table 2.

Observations and Recommendations

The difference in equipment, personnel, number of remote sensing courses and specialized fields in natural resources between Mexico and Central America is almost as great as that between Mexico and the United States.

It is evident that the usefulness of remote sensing techniques in evaluation, planning, and management of natural resources has been understood in Mexico, although not to the degree necessary[7]. It appears that several of the agricultural schools still need to incorporate these techniques in their programs.

The remote sensing panorama in Central America is much bleaker. Although the people interviewed realized the importance

Table 3. Equipment and Personnel of Institutions Visited and Reported.

Institutions	Instruments and Aerial Photography Available	Personnel Teaching Courses
1	2 Mirror Stereoscopes 1 Parallax Bar Photography of Guatemala at various scales.	Photogrammetrist, also working with the National Cartographic Institute of Guatemala.
2	None	None
3	10 Pocket Stereoscopes Photography of El Salvador at various scales.	Soils engineer.
4	None (equipment for course borrowed from the National Agrarian Institute of Honduras).	None (personnel from National Agrarian Institute of Honduras).
5	None	None
6	10 Mirror Stereoscopes 6 Parallax Bars 17 Pocket stereoscopes 2 Old Delft Stereoscopes 1 Aero-Sketchmaster LUZ Zeiss Photography of Honduras at various scales.	Photo-interpreter of Forestry.
7	None	None
8	None	None
9	3 Pocket stereoscopes Photography at various scales	Photo-interpreter of Natural Resources
10	4 Pocket Stereoscopes Photography of Nicaragua at 1/20,000 scale	Agronomist
11	None	None
12	13 Mirror Stereoscopes 20 Pocket stereoscopes Photography of Costa Rica at various scales.	Geomorphologist specialized in Photo-geology
13	2 Mirror Stereoscopes 20 Pocket stereoscopes Photography at various scales	Geomorphologist specialized in Photo-geology
14	6 Mirror Stereoscopes 30 Pocket Stereoscopes 6 Parallax Bars 1 Zeiss C 8 Stereoplanigraph 2 Multiplex 2 Stereotop Zeiss 2 Aero-Sketchmaster LUZ Zeiss 1 Doble Optical Projector DP1 Photography at various scales	Two Photogrammetrists from a German Technical Assistance Program

TABLE 3—*continued*

Institutions	Institutions and Aerial Photography Available	Personnel Teaching Courses
15	7 Mirror Stereoscopes 7 Pocket Stereoscopes 7 Parallax Bars 2 Old Delft Stereoscopes 1 Aero-Sketch master LUZ Zeiss 1 Vertical Sketchmaster Gordon Enterprises 2 RS-II Radial Secator Zeiss 1 Stereotop Zeiss 1 Radial Line Plotter Hilger & Watts Photography of Costa Rica at various scales	None
16	30 Mirror Stereoscopes 42 Pocket Stereoscopes 30 Parallax Bars 1 Luz Aero-Sketchmaster Zeiss 1 Vertical Sketchmaster Gordon Enterprises 1 Stereotop Zeiss 1 Plan-Variographe r+a Rost 1 Stereo-Sketch Hilger & Watts 1 Radial Line Plotter Hilger & Watts 1 Zoom transferoscope Bausch & Lomb 2 Old Delft Stereoscopes 1 Dual Stereoscope Condor T-22 1 Dual Stereoscope Sokkisha 1 Stereoscope Sokkisha M-S 27 Photography of Mexico and other countries at various scales	Two Foresters specialized in Photo-interpretation and Aerial Photography One Geologist specialized in Photo-geology. One Soil engineer specialized in soils Photo-interpretation. One Agronomist specialized in Photo-interpretation.
17	None	None
18	Data not available	Data not available
19	None	None
20	None	None
21	Data not available	Agronomist
22	30 Mirror Stereoscopes 1 Universal A-8 Wild 1 Radial Line Plotter Photography of Mexico at various scales	Geologist
23	100 Mirror Stereoscopes 100 Parallax Bars Photography of Mexico at various scales	Photo-interpreter
24	Data not available	Data not available
25	Data not available	Data not available
26	None	None
27	Data not available	Data not available
28	Data not available	Data not available
29	None	None
30	None	None
31	7 Mirror Stereoscopes 36 Pocket Stereoscopes 1 Parallax Bar Photography of Mexico at various scales	Forest Photo-interpreter
32	1 Pocket Stereoscope Photography of Mexico at various scales.	Agronomist

of remote sensing in their specialties, not much has been done to incorporate these courses. There seems to be a growing realization in Costa Rica, Honduras and Guatemala for incorporating courses of photo-interpretation in soils, forestry and agronomy.

Generally, the remote sensing courses already existing in the countries reported tend to reflect local needs and a narrow scope of the problems. However, there is plenty of room for improving these courses and also for widening their outlook.

The data produced by the Landsat program will gradually be put to use in Central American universities. Mexico has already begun using this data at the ENA/UACH in Chapingo, incorporating it in its courses of photogrammetry and photo-interpretation.

The use of Landsat data has underlined the technological gap that exists between the U.S. and Canada as opposed to Mexico and Central America. The widening of this gap is due precisely to the lack of photogrammetry and photo-interpretation courses at the university level. It is to be expected that the gap will continue to exist and widen.

In order to improve the panorama and to slow down the widening of this technological gap the author proposes that the following steps be taken:

(1) Implementation of remote sensing courses at the university level, especially within Agronomy and Forestry Schools.
(2) An ambitious instructors' training program within Central America should be started by the already existing C.I.A.F. (Inter-American Center of Photo-interpretation) in Colombia, and perhaps by ENA/UACH in Mexico.
(3) That the governments concerned give their full support to the acquisition of teaching equipment such as mirror and pocket stereoscopes and approximate restitution equipment (sketchmasters, transferscopes, optical projectors, etc.).

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Articles for Next Month

Duane C. Brown, Densification of Urban Geodetic Nets.

Dr. R. L. Hardy, Least Squares Prediction.

Raymond J. Helmering, Ph.D., A General Sequential Algorithm for Photogrammetric On-Line Processing.

Victor A. O. Odenyo and *David E. Pettry,* Land-Use Mapping by Machine Processing of LANDSAT-1 Data.

Kenneth R. Piech, David W. Gaucher, John R. Schott, and *Paul G. Smith,* Terrain Classification Using Color Imagery.

Patrick M. Walker and *Dennis T. Trexler,* Low Sun-Angle Photography.