C12-006

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ANNUAL REPORT

Covering Period: July 1997- October 1999

Report No.5

Submitted to the Office of the Science Advisor
U.S Agency for International Development

SEDIMENT YIELD AND EROSION PROCESSES

IN

PERUVIAN MOUNTAINOUS AREAS

Principal Investigator:

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Principal Co - Investigator:

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Project Number: C12 - 006

A.I.D Grant Project Officer: Mr. David Mulenex
Project Duration: 1 September 1993 - 31 August 1997
(extended to December 1999)

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Executive Summary

Old developed systems of agricultural terraces are found in high relief settled areas in different parts of the world. The present trend is to abandon many terraced areas, process that increases erosion and sediment yield values. The general objectives of this project are to investigate the problem of determining quantitatively soil erosion rates in old agricultural terraces and analyzing the factors that control these processes. These objectives require the development of methods for determining sediment yield values in the highlands of the Andes mountains, with a view to establishing the conditions for land and water management both in a regional and physical context.

The old developed systems of agricultural terraces in the Peruvian landscapes, with one of the highest relief settled areas in the world, and in Israel with one of the oldest terrace systems, offer the opportunity to study experimentally the degradation processes after abandonment of the terraces.

The covering period was an extension of the planned program, which was delayed due to administrative delays in funding, and was devoted to finalize the field work projects in both sites, Peru and Israel, within the frames of the original budget. The El Ninio event in Peru in 1998 allowed the analysis of the effects of heavy rains in Peru on erosion processes in the terraces. Other scientific activities included the publication of a paper on the project findings in Peru in an international journal and the participation in several local and international conferences.

The collaboration between the investigators in both countries was fruitful

Section I

A. Research Objectives

The general objectives of Project C12-006 are to investigate sediment yield and soil- erosion rates in mountainous regions being abandoned by traditional agricultural techniques. The overall aim of the study have not changed.

The specific objectives for the reporting period can be summarised as follows:

i. Continuation of the field-data collecting scheme, from the experimental plots in Peru and Israel.

ii. Mapping of the study site in Israel, with the morphometric characteristics of terraces in selected areas, in order to obtain a typological analysis.

iii. To analyze terrace walls and develop an empirical model for wall terrace failure.

iv. To collect papers from the multidisciplinary symposium on terraces in Peru, in order to publish a book.

v. To summarize the different activities and prepare the final report.

B. Research Accomplishments

In the Yerca site in the Galilee in Israel, a detailed mapping survey was performed, and a one meter interval contour was obtained. Further physical soil tests were conducted, including the deeper soil layers in the terraces. Ali Zgaier, who is doing his Ph.D. thesis on the subject, finished the field data collection and submitted a first draft of his dissertation.

In Peru, a Honors thesis on the Iris terraces was presented by a student from the Department of Geography of the P. Universidad Catolica de Lima. A team of students and teachers from the P.U.Catolica, leaded by Professor Hildegardo Cordova, joined the field research activities of the project.

About 20 papers were compiled in Peru on the terraces subject, and the editing of the book is in a advanced stage.

Experimental sites in Peru and Israel

The 1997-1998 season in the coastal Peru areas was an exceptional rainy year, with a total rainfall of 650 mm in the studied sites, or about double of the average annual precipitation. (Appendix 1). Exceptional rains started in December 1997 and followed until March 1998. The effects of the heavy rains were monitored by the local observer in the San Juan de Iris village, and evaluated by the research team in their field work in 1998.
No major erosion processes affected the terraces system, despite the high amounts of rain. However, erosion features caused by the El Ninio rains were observed and surveyed in several terraces, with the collapse of walls, and along the valley slopes, where new "huaycos" (debris slides) occurred.
The local population was affected by the crop damages caused by the heavy rains, specially the potato fields, which due to the prolonged wet season rotted, resulting in the loss of most of the potato crop. Grazing was benefited and the growth of pasture increased in all the mountain areas.

In Israel rains were average, and no wall collapses were registered. The 1997-1998 rainfall season was the last field measurement year. However, field monitoring was continued during the 1998-1999 season, which was exceptionally dry.

C, D and E: Scientific Impact of Collaboration; Project Impact

The main activities were held during the visits of PI Inbar to Peru in February 1998 and September 1998. The deliberations included the remote sensing survey and the planning of the book about the terraces in Peru. The effects of the El Ninio event were analised, comparing it to previous El Ninio events, and other regions of Peru. In the San Juan de Iris village, the plan for terraces restauration under the direction of the National Forestry Authority (Pronamachs), was continued.
In Israel, the PI Inbar was a member of the organizing committee of a Symposium devoted to agricultural history and methods in Peru, organized by the Peruvian Embassy in May 1998. Inbar delivered a paper on the activities in Peru, which had a very positive public response, and a special program devoted to the project in the Israel radio.
Research studies were delivered in local scientific meetings, as well as in the Land Degradation International Symposium held in Perth (Australia) in September 1999.

F. Future work:

The last stage of the project will be devoted to summarize findings, analyze the results and data from the different aspects of the project and elaborate the final report. Two papers are in preparation and will be submitted for publication in international journals. The main task in the next months will be the preparation and submission of the final report.
A book based on the submitted papers in the Symposium is under preparation and about twenty articles have been already submitted. Publication in the first stage will be in Spanish to be accesible for the local people and students.
PI Inbar will visit Peru in February 2000 in order to coordinate the final stage of the project and material gathering for the final report.

Section II

A. Managerial Issues and B. Budget

In the reported period the major problem was the freezing of the budget for more than one year, which affected all aspects of the field work, especially in Peru, and delayed the project activities in 1998 and part of 1999. With the renewal of the payments in 1999, the last stage of the project is now in progress.

C. Special concerns

None

Collaboration, Travel, training and Publications

(i) Collaboration
The collaboration between Inbar (PI) and Llerena (Co-PI) continued through a permanent E-mail and regular mail communication.

(ii) Travel
Inbar (PI): Tel Aviv-Lima-Tel Aviv; February 1998 and September 1998

(iv) Publications

Inbar, M. 1999. Land degradation processes after agricultural terraces abandonment: case studies from Peru and Israel. *International Geographical Union Conference.Commission for Land Degradation and Desertification.* Perth, Australia.

Inbar, M. and Llerena Pinto, C. 1999. Erosion processes in the Peruvian agricultural terraces. *Mountain Research and Development.* (In press).

E) Request for A.I.D. or BOSTID Actions

None

Appendix I

SENAMHI

OFICINA GENERAL DE ESTADISTICA E INFORMATICA

ESTACION : SHEQUE /PLU-1213/DRE-04
PARAMETRO : **PRECIPITACION TOTAL MENSUAL (mm)**

LAT. : 11° 38' "S"
LONG. : 76° 30' "W"
ALT. : 3170 msnm.

DPTO. : LIMA
PROV. : HUAROCHIRI
DIST. : HUANZA

AÑO	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SET	OCT	NOV	DIC
1994	88.8	148.1	183.5	38.2	31.3	8.7	0.0	0.0	1.3	62.7	23.2	14.8
1995	70.0	38.3	74.8	28.5	10.7	4.6	0.0	0.2	4.6	16.8	28.1	58.8
1996	89.2	85.1	121.8	19.9	11.7	0.0	0.0	0.0	0.0	0.0	9.6	31.7
1997	51.9	65.8	7.9	0.0	0.0	0.0	0.0	0.0	11.0	16.3	37.2	194.5
1998	234.1	141.0	190.9	15.0	0.3	0.5	4.0	2.5	8.5	9.7	15.5	25.7

S/D = Sin Dato.

SLUMP-LEY N° 23560

INFORMACION PREPARADA PARA F.D.A.
LIMA, 01 DE DICIEMBRE DE 1999

SENAMHI

OFICINA GENERAL DE ESTADISTICA E INFORMATICA

ESTACION : CARAMPOMA /PLU-5223/DRE-04
PARAMETRO : **PRECIPITACION TOTAL MENSUAL (mm)**

LAT. : 11° 39' "S"
LONG. : 76° 31' "W"
ALT. : 3272 msnm.

DPTO. : LIMA
PROV. : HUAROCHIRI
DIST. : CARAMPOMA

AÑO	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SET	OCT	NOV	DIC
1994	91.9	122.2	77.4	41.1	2.8	0.0	0.0	0.0	9.2	0.0	28.6	64 1
1995	54.9	18.2	51.6	25.5	11.8	0.1	0.0	0.0	6.4	21.4	52.3	65.0
1996	87.4	91.9	108.4	26.1	10.8	0.0	0.0	2.1	9.5	21.3	19.1	54.2

1997	53.3	98.4	7.3	12.1	7.7	0.0	0.0	0.0	15.3	35.4	35.7	114.3
1998	148.7	119.0	142.8	15.8	0.0	0.0	0.0	0.0	2.9	24.5	19.5	50.1

S/D = Sin Dato.

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