Project Report

Global Perspectives Grant Award

Analysis of Landslide Protection and Reclamation Outcome on Degraded Steeplands of Southern Honduras

Dr. Tom Thurow

In July, 2011 I traveled to southern Honduras with my graduate student (Melanie Mathews) to follow-through on the project proposed and funded through the Global Perspectives grant award. Thank you for this opportunity. We were met at the Tegucigalpa airport by Jesus Salas, the formal advisor to the Ministry of Agriculture (there is not an equivalent type of position in U.S. agencies – he is a high ranking employee of the government, roughly filling the role in U.S. terms as an assistant secretary of one of our federal cabinet departments or another way to put it is that he is a vice-minister). Mr. Salas had worked closely with me in the early 1990's when the multi-million dollar Land Use Productivity Enhancement (LUPE) Project of USAID and the Ministry of Agriculture was underway. One important element of the LUPE project was to facilitate adoption of a variety of soil and water conservation practices. The LUPE project was the largest extension program in Latin America in the early 1990's and consequently had very high visibility within the national and international development community and throughout the rural farming communities of southern Honduras.

Like me, Mr. Salas was also curious about documenting the long-term impact of the past LUPE project, so he spent the next two weeks in the field with us as we worked out of our base in Choluteca, Honduras and visited many of the sites of the past LUPE activities. One of the reasons for Mr. Salas's strong interest is that he is a strong proponent of soil and water conservation extension programs; he knows of the high regard the LUPE program continues to have among the farmers of the region and he would like to have a follow-up program for the LUPE project (ended in 1998) based on the lessons learned from previous activities in the region. As further evidence of government interest in learning of the long-term impact of the LUPE program, we were joined for several days in the field by Mr. Hector Sierra of the World Food Program, and Mr. Olman Rivera, the past regional director of the LUPE program.

Each day we visited different rural locales at which LUPE activities had been conducted. We focused on visiting rock terraces that had been constructed 15-25 years ago to document how many were still being maintained (13 years after the project had ended) and what crops were being grown on the terraced and the adjacent non-terraced fields. We also took a GPS reading at each field. One hundred thirty four terraced fields were visited, a daunting task given the extremely rugged terrain and poor access infrastructure.

<u>Brief summary of what we learned</u>

- All rock-wall terraces had been maintained on sites that received over approximately 900 mm/yr precipitation. Informal visits with farmers asserted that they were continuing to maintain the rock wall terraces because they believed that the terraces: 1) protected their fields from accelerated erosion and runoff thereby sustaining the use of their fields, 2) increased crop yields because of the accumulation of the soil and nutrients behind the rock walls and the better retention of water.
- Because of the perceived increase of productivity on the terraces, the farmers had moved away from the traditional maize/sorghum/beans cultivation to instead use the terraces for diverse agroforestry activities (e.g., intentional combination of both grain and tree crops for the purpose of

diversifying and increasing their income). The type of agroforestry practices applied to the terraces changed with the amount of precipitation received in the locale (we concentrated our visits at field sites that had an annual rainfall of either approximately 700 mm, 900 mm, 1400 mm, 1800 mm or 2200 mm). The farmers asserted that the agroforestry systems increased and diversified the income from their fields. They also felt that the deep tree roots were important for tying the soil to the hillside to reduce landslide risk. It was significant that farmers did not adopt agroforestry techniques on adjacent fields that had not been terraced -- on the non-terraced fields they continued to practice the traditional cultivation of maize/sorghum/beans.

- The rock terraces at the 700 mm rainfall zone were not maintained (broken down by cattle grazing in the dry season – apparently the soil and water conservation benefits were not sufficient in this drier zone to compensate for the management required to maintain the terraces).

In sum, the rock terraces were perceived by farmers to be a valued investment on sites that received at least 900 mm/yr annual precipitation. Over time the agriculture production potential was perceived by farmers to have improved, prompting them to diversify their use of the terraces by including trees as part of their production system. From a hydrologic function standpoint, these areas have gone full circle from: native forest in the 1950's → native forest cleared and used for maize/sorghum/bean production in the 1960's-1980's (resulting in accelerated runoff and erosion which threatened sustainable use of the fields and caused multiple downstream problems {e.g., flooding and sedimentation}) → one-time investment in construction of rock-wall terraces in the 1990's that was perceived by the farmers to increase agricultural productivity of the terraces → reforestation of the hillsides with an agroforestry crop production system.

When we returned to Tegucigalpa, we were invited by the USAID mission to make a presentation to their staff. This was followed by substantive visits about how we could follow-up this work longer-term research and extension activities. The USAID budget is uncertain depending on the outcome of fiscal debates in the U.S. Congress that will determine the future funding level of the agency. It was the expressed feeling that USAID –Honduras personnel would like to craft some future projects with us if their FY-12 budget will allow it.

<u>Follow-up activity</u>

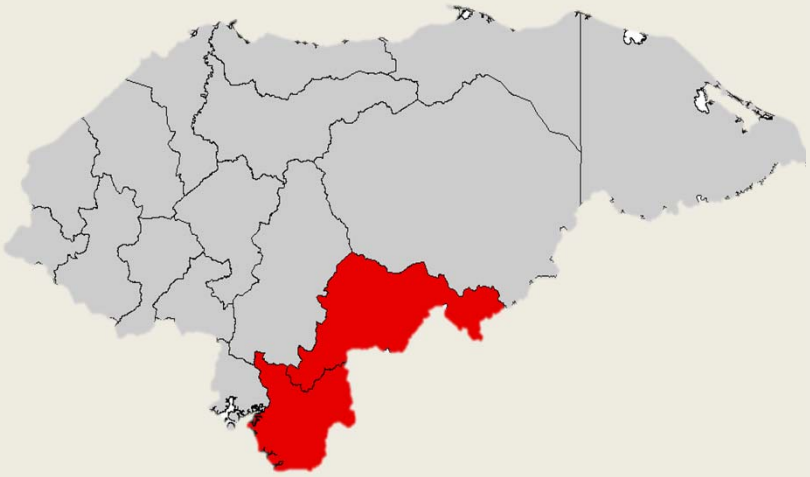
- Presented a seminar on the UW campus regarding the history of soil and water conservation investment in southern Honduras and its legacy. About 40 faculty and students attended. The attached PowerPoint presentation has many pictures of the area; the first part of the powerpoint summarizes work conducted in the 1990's, the final 13 slides show a preliminary analysis of the data we collected as part of this year's visit.
- Data analysis of landslide impact associated with Hurricane Mitch on terraced and adjacent non-terraced fields continues as part of Melanie Mathews M.S. research. This will result in a scientific journal publication (targeting Agriculture, Ecosystems and the Environment Journal).
- Data analysis of the agroforestry systems that have evolved on the terraced hillsides continues. This will result in a scientific journal publication (targeting Agroforestry Systems Journal).
- Technical bulletins summarizing both of the above articles will be prepared in both English and Spanish and distributed through the Honduran Ministry of Agriculture and USAID. We remain in contact with both organizations and continue to share the results of our analyses as they evolve.
- We will continue to pursue follow-up funding with USAID-Honduras, awaiting outcome of the FY-12 US budget.

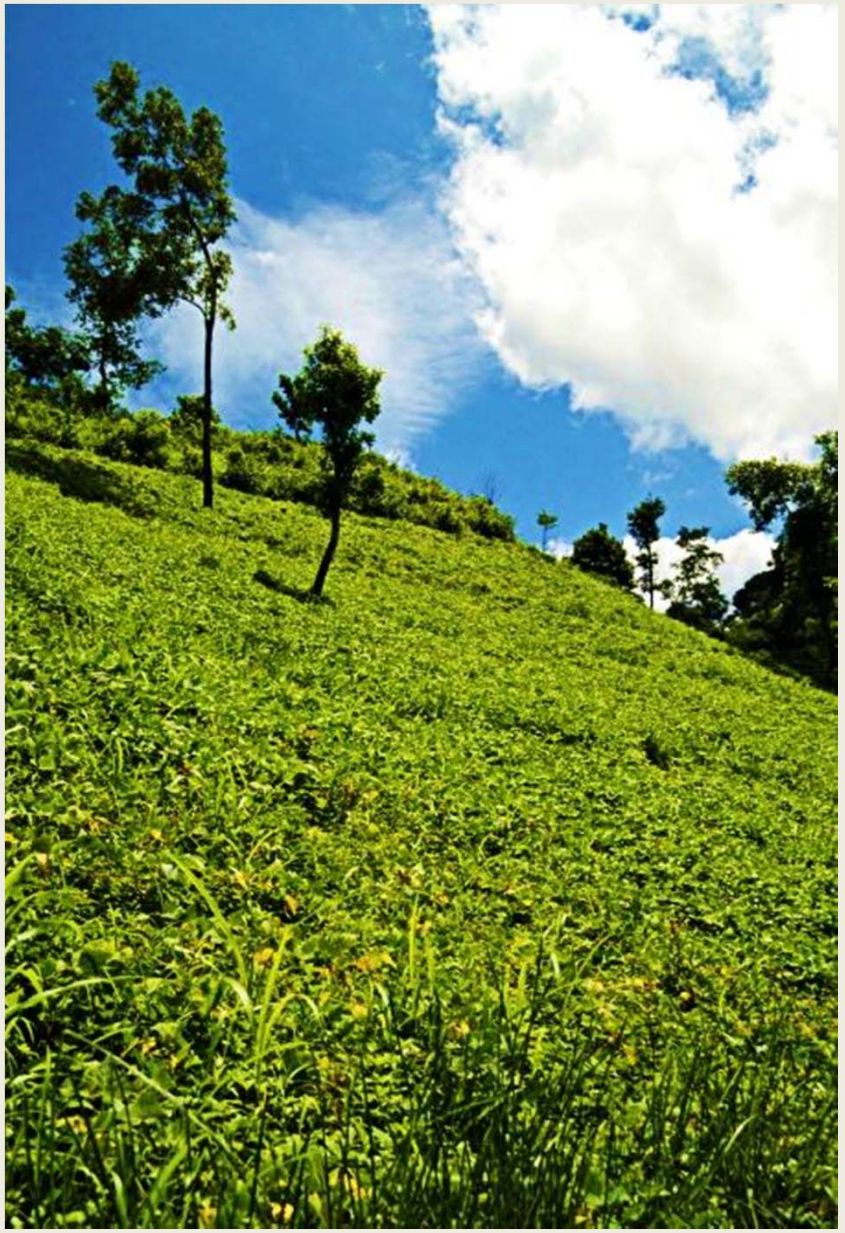
List of key officials we interacted with during our trip to Honduras

Jesus Salas:	Formal Advisor to Minister of Agriculture
Hector Sierra:	World Food Program Officer
Olman Rivera:	Choluteca Regional Director of the former Land Use Productivity Enhancement Project of USAID - Honduras
Eduardo Chirinos:	Deputy Director, USAID - Honduras
Peter Hearne:	Natural Resources & Disaster Preparedness Specialist, USAID - Honduras
Hector Santos:	Food Security Project Management Specialist, USAID – Honduras
Malick Haidara:	Agriculturalist, USAID - Honduras
Gracia Castillo:	Project Management Specialist, USAID - Honduras
Harry Kriz:	Private Enterprise Officer, USAID - Honduras
Marco Galvez:	Food Security Project Assistant, USAID – Honduras

Study Area

- 80% steeplands (>20% slope)
- Alfisols & Inceptisols
- 2 rainy seasons



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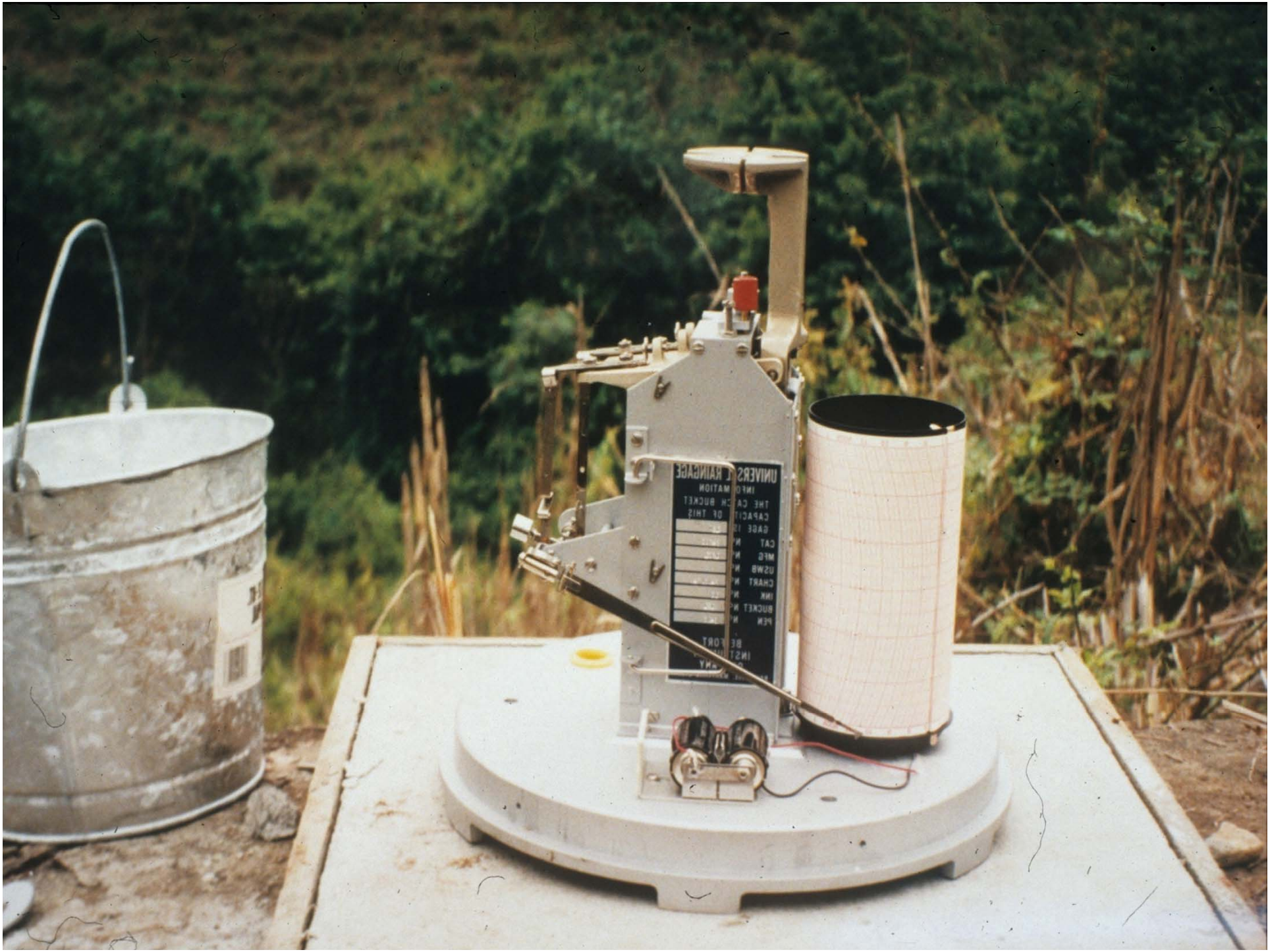

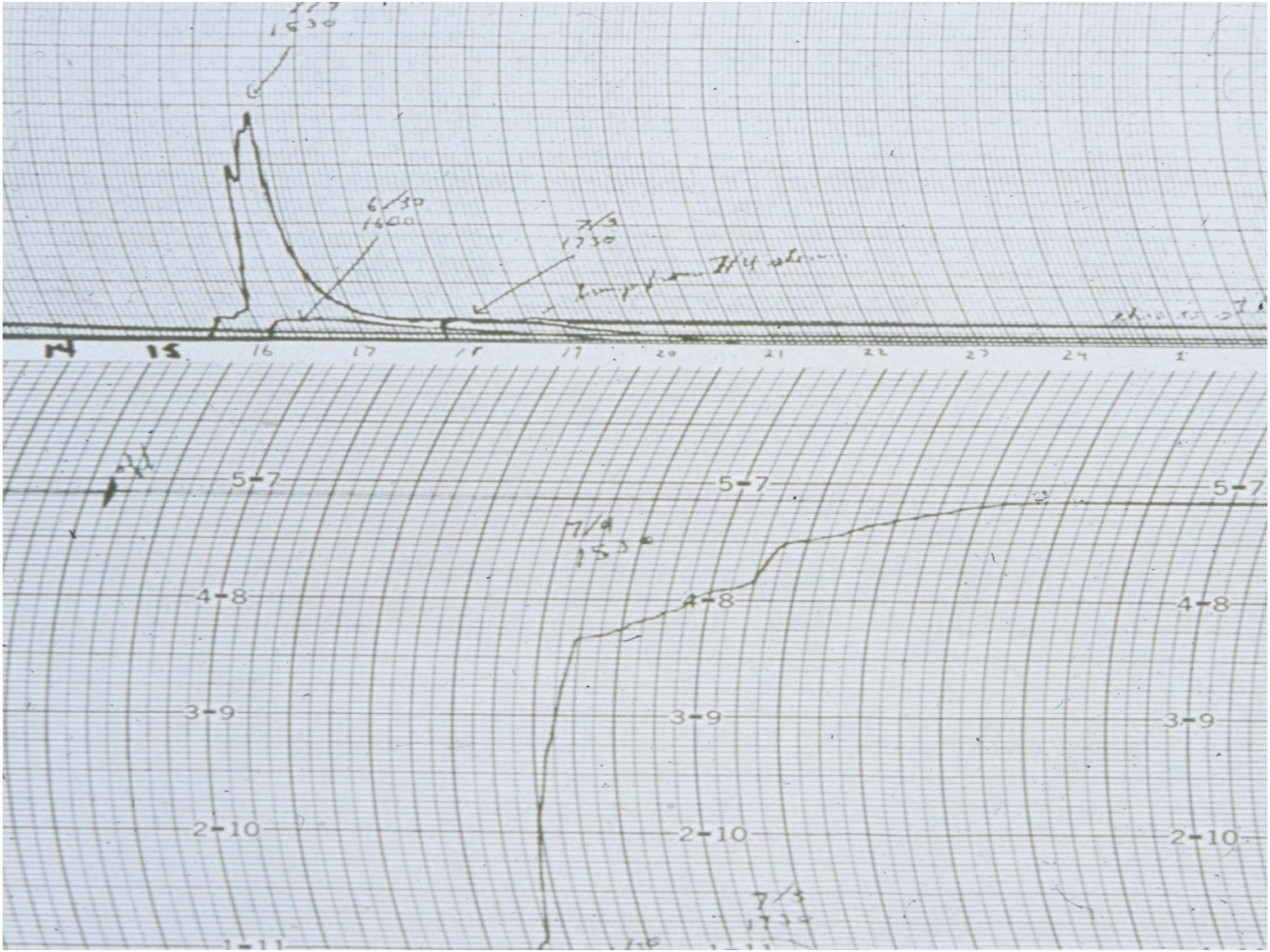
1530
6/30
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1730
14
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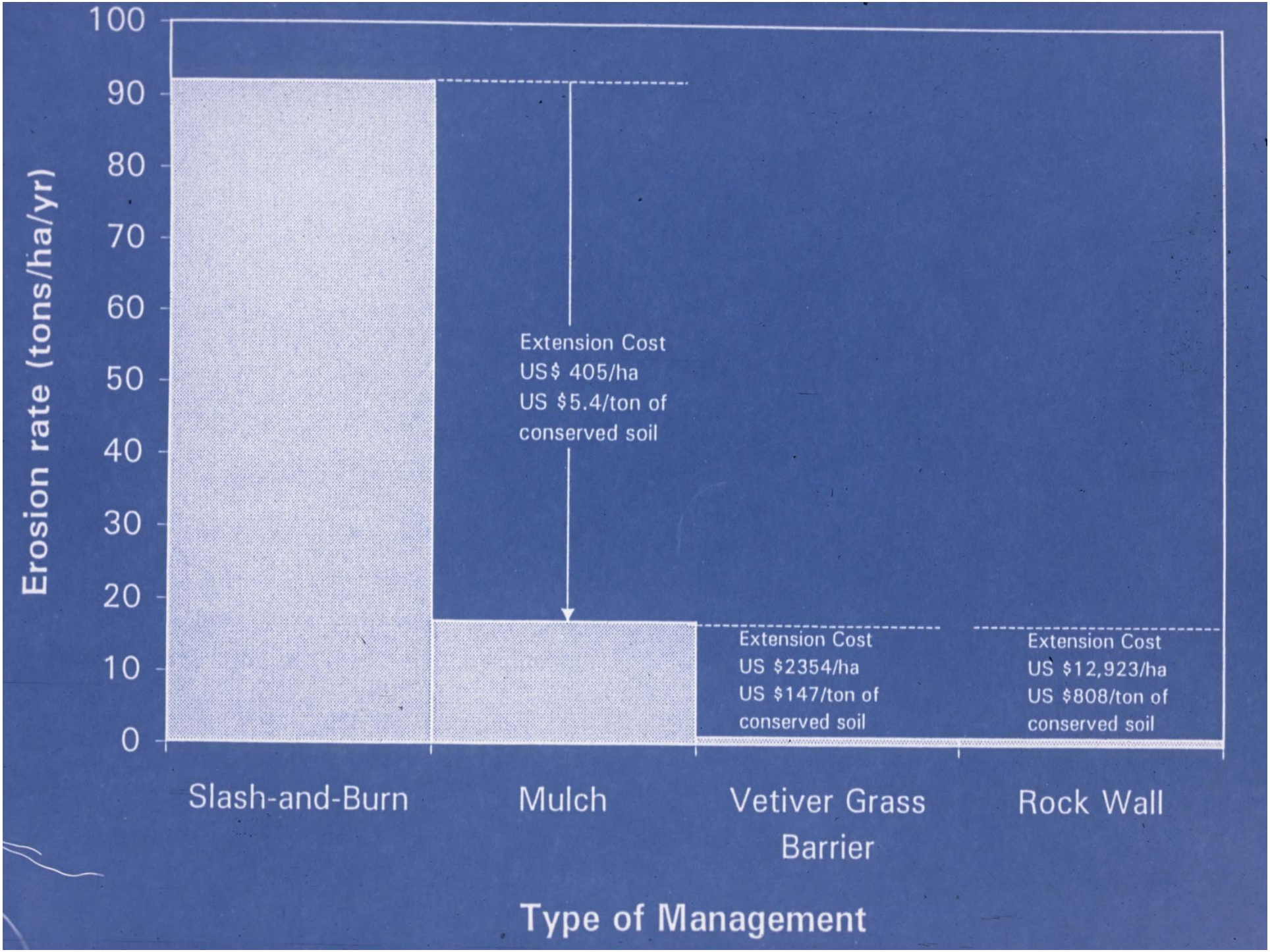
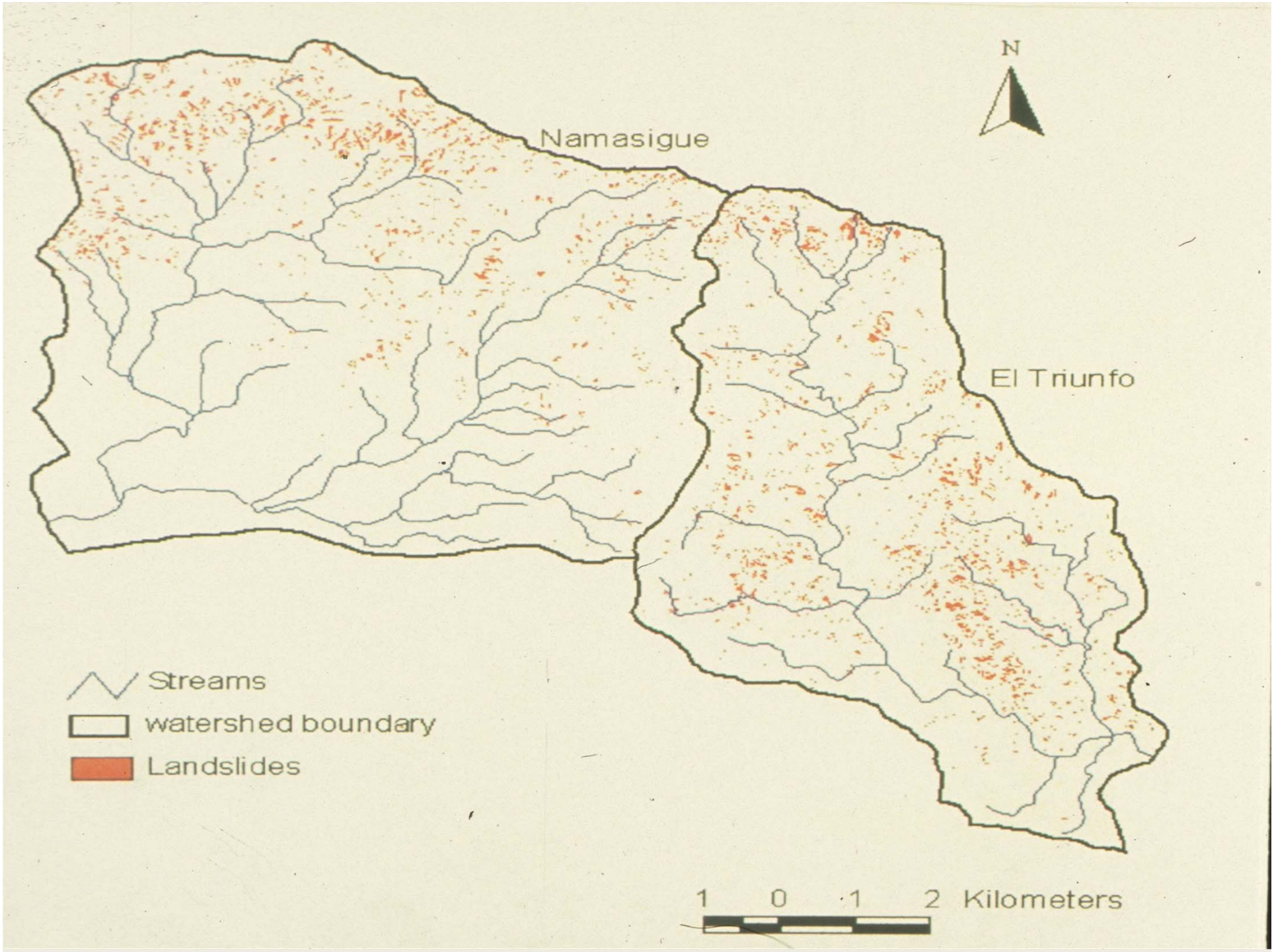
1536

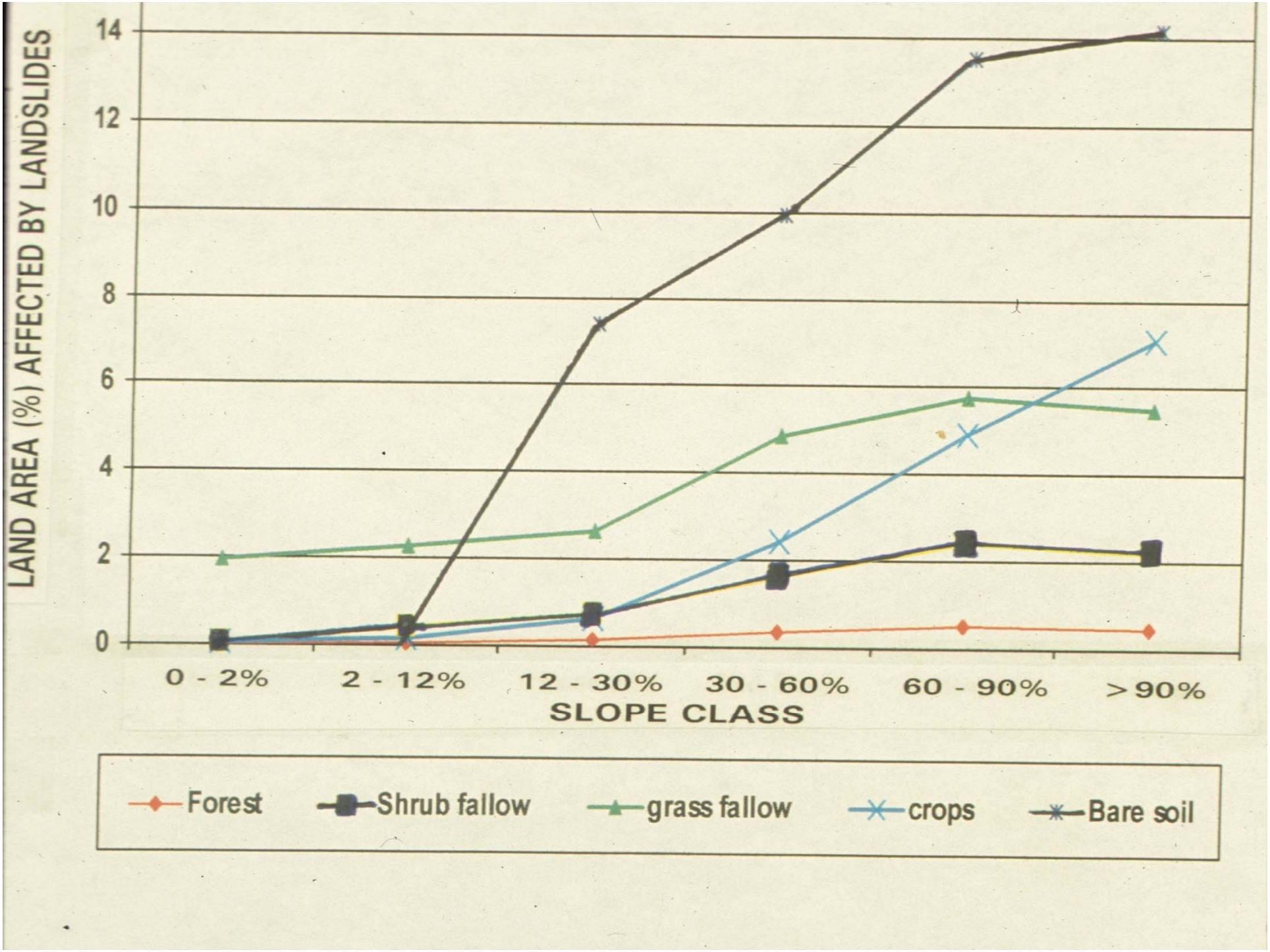

Sprint

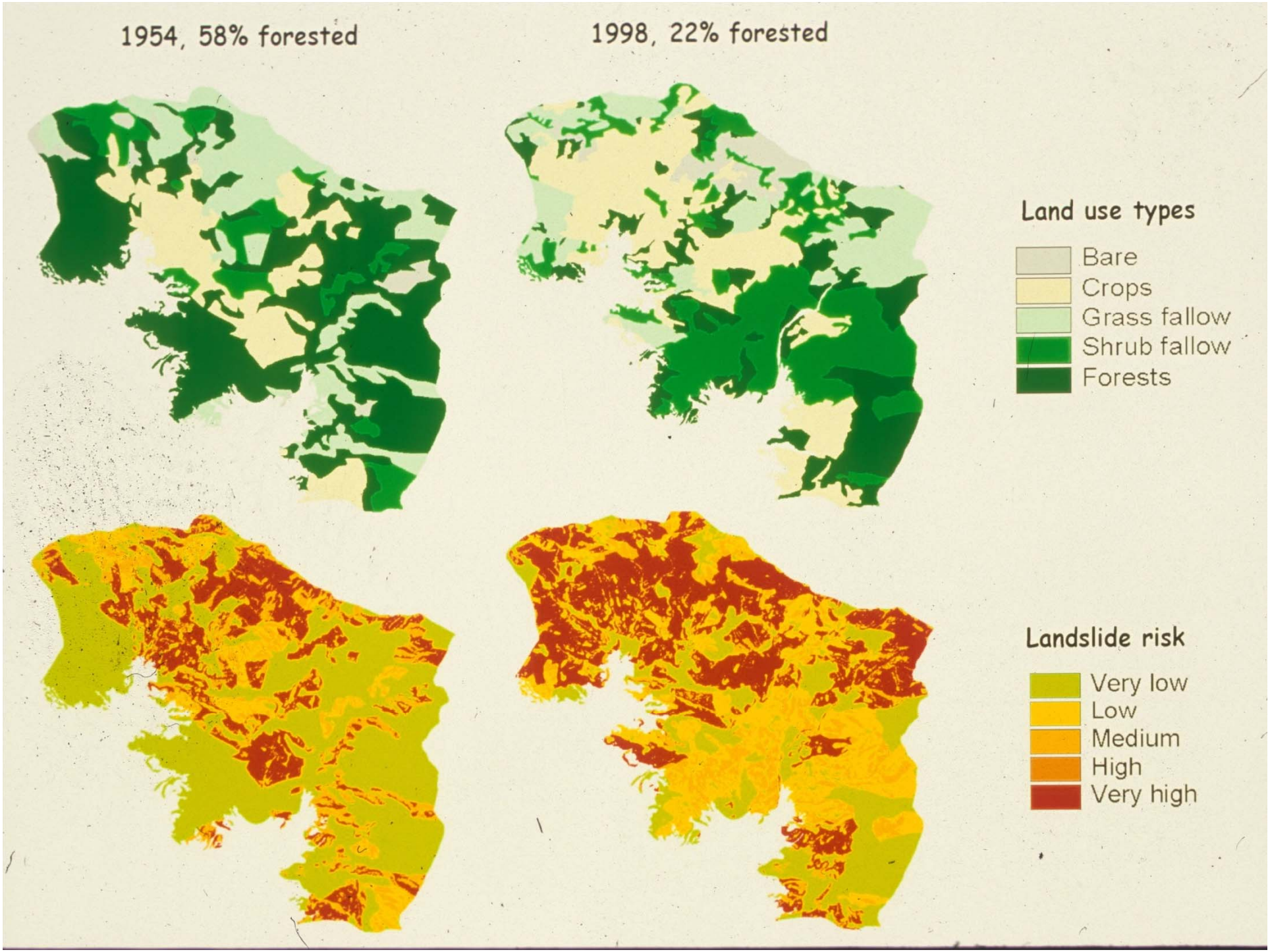

100
90
80
70
60
50
40
30
20
10
0
Erosion rate (tons/ha/yr)
Extension Cost
US$ 405/ha
US $5.4/ton of
conserved soil
Extension Cost
US $2354/ha
US $147/ton of
conserved soil
Extension Cost
US $12,923/ha
US $808/ton of
conserved soil
Slash-and-Burn
Mulch
Vetiver Grass
Barrier
Rock Wall
Type of Management

SORGHUM GRAIN YIELD (TONS/HA)

	TERRACED	NOT TERRACED
TRADITIONAL	1.77	0.80
IMPROVED SEED	2.07	0.72
IMPROVED SEED + INSECTICIDE	2.16	0.88
IMPROVED SEED + INSECTICIDE + 60 KG NITROGEN	2.66	0.98

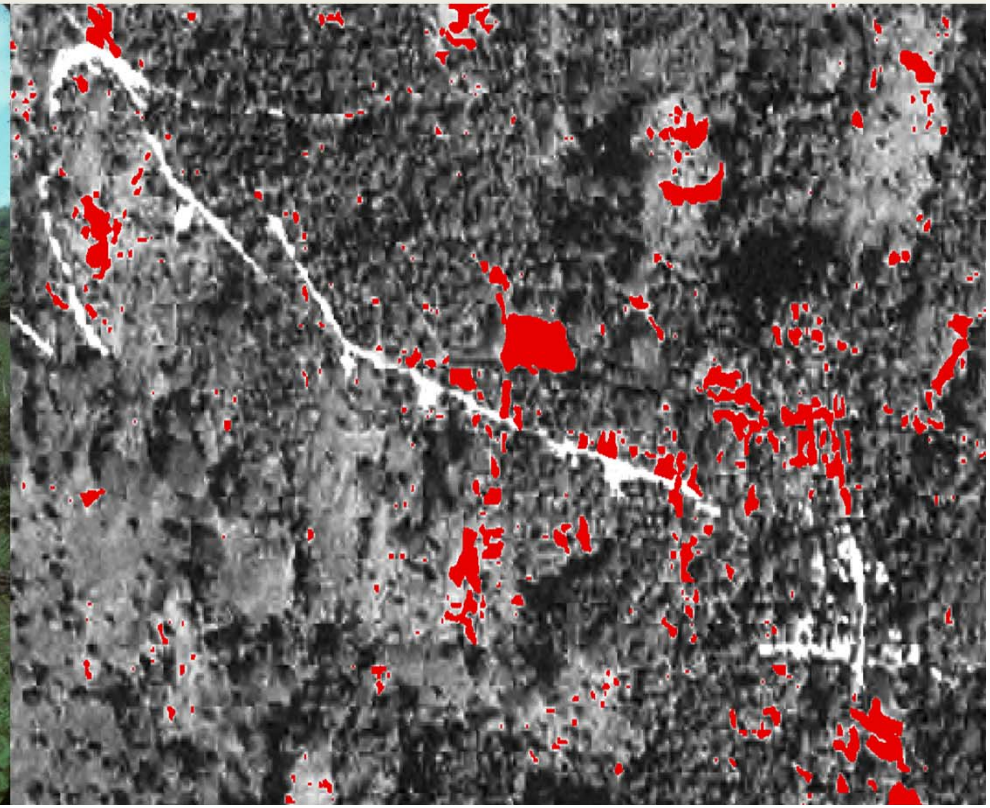

N
Namasigue
El Triunfo
Streams
watershed boundary
Landslides
1 0 1 2 Kilometers


LAND AREA (%) AFFECTED BY LANDSLIDES
14
12
10
8
6
4
2
0
0 - 2%
2 - 12%
12 - 30%
30 - 60%
60 - 90%
> 90%
SLOPE CLASS
Forest
Shrub fallow
grass fallow
crops
Bare soil


1954, 58% forested
1998, 22% forested
Land use types
Bare
Crops
Grass fallow
Shrub fallow
Forests
Landslide risk
Very low
Low
Medium
High
Very high

- 80 terraced field were visited in 2011 to record GPS, slope, current land use, & whether the terraces were being maintained

- The GPS points enable finding specific terraced fields on the 1998 aerial photos for analysis of landslide occurrence on both the terraced and adjacent fields

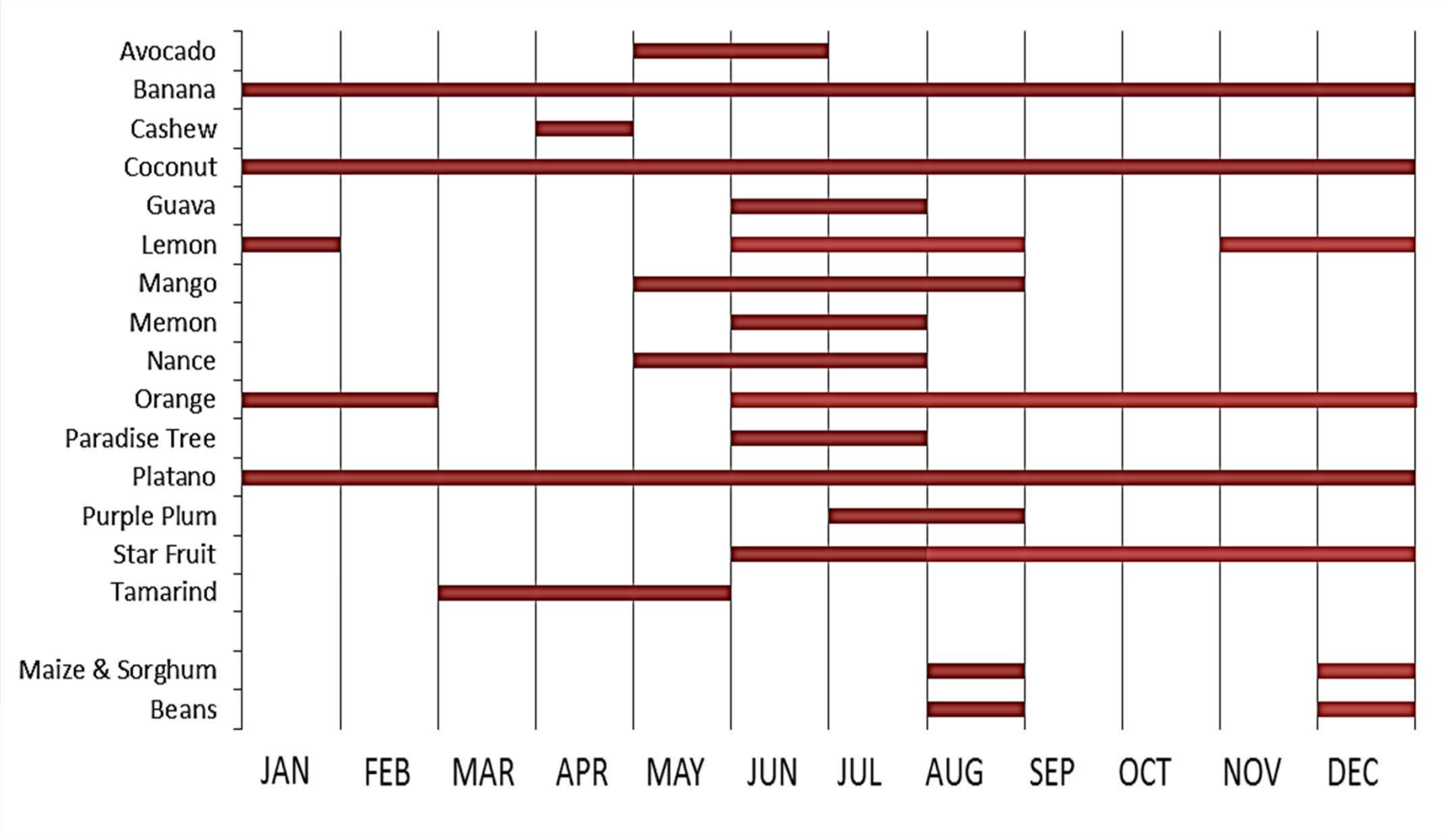


Landslide Length Class	Crop	Fallow	Forest	Total
Small <15m	642	831	13	1486
Medium 15-30m	112	129	1	242
Large >30m	56	38	0	94
Total	810	998	14	1822

Fruit or Nut Tree Species			Presence of Tree Species (%) on Terraced Fields on which Trees were Planted			
			(n = 33)	(n = 14)	(n = 31)	(n = 16)
			900 mm	1400 mm	1800 mm	2200 mm
Anacardium excelsum	Espavé	Wild Cashew	--	--	--	6
Anacardium occidentale	Marañón	Cashew	6	36	13	--
Annona muricata	Anona	Soursop	3	7	6	12
Artocarpus altilis	Fruta de pan	Breadfruit	--	--	--	6
Averrhoa carambola	Carambola	Starfruit	--	7	6	19
Byrsonima crassifolia	Nance	Nance	--	79	32	44
Carica papaya	Papaya	Papaya	6	43	10	25
Cecropia insignis	Guarumo	Cercropia	--	--	3	--
Citrus limetta	Lima	Lime	--	--	6	6
Citrus limon	Limon	Lemon	--	14	10	19
Citrus sinensis	Naranja	Orange	--	29	13	19
Cocos nucifera	Coco	Coconut	--	7	16	12
Coffea arabica	Café	Coffee	--	29	19	25
Crescentia alata	Jícaro	Jicaro	3	--	3	--
Mangifera indica	Mango	Mango	6	64	32	37
Melicoccus bijugatus	Mamón	Spanish Lime	--	14	13	25
Musa acuminate	Banana	Banana	18	100	45	50
Persea americana	Aguacate	Avocado	9	21	10	19
Psidium guajava	Guava	Guava	--	43	6	6
Simaroubo glauca	Aceituno	Paradise Tree	21	--	--	--
Spondias purpurea	Jocote	Purple Plum	--	--	--	6
Tamarindus indica	Tamarindo	Tamarind	--	14	13	19

			Presence of Tree Species (%) on Terraced Fields on which Trees were Planted			
			(n = 33)	(n = 14)	(n = 31)	(n = 16)
Timber/Fuel/N-fixation tree species			**900 mm**	**1400 mm**	**1800 mm**	**2200 mm**
Albizia lebbeck	Gavilán	Yellow Acacia	--	7	6	--
Albizia saman	Carreto negro	Rain Tree	--	--	--	6
Calycophyllum candidissimum	Sálamo	Lemonwood	3	--	--	--
Cassia grandis	Carao	Pink Shower Tree	12	43	10	--
Cordia alliodora	Laurel negro	Laurel	6	--	48	69
Cordia truncatifolia	Tigüilote macho	Laurel	--	--	3	--
Gliricidia sepium	Madero negra	Gliricidia	21	29	23	19
Gmelina arborea	Gmelina	Gmelina	--	--	10	--
Leucaena leucocephala	Leucaena	White Leadtree	24	71	39	25
Lysiloma auritum	Quebracho	Axe breaker	42	--	--	--
Swietenia humilis	Caoba	Little-leafed Mahogany	--	7	--	--

Crop Yields


Avocado
Banana
Cashew
Coconut
Guava
Lemon
Mango
Memon
Nance
Orange
Paradise Tree
Platano
Purple Plum
Star Fruit
Tamarind
Maize & Sorghum
Beans
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

Cultivated Products				Use of Terrace Fields (%) (n = 56) 900 mm	(n = 15) 1400 mm	(n = 33) 1800 mm	(n = 16) 2200 mm
Agronomic crops				43	7	6	0
Agronomic crops	N-fixation/fuel trees			0	0	6	0
Agronomic crops	N-fixation/fuel trees	Fruit/Nut		5	64	3	5
Agronomic crops	N-fixation/fuel trees		Timber	12	0	12	19
Agronomic crops	N-fixation/fuel trees	Fruit/Nut	Timber	0	31	19	0
Agronomic crops		Fruit/Nut		20	0	9	5
Agronomic crops			Timber	18	0	6	25
Agronomic crops		Fruit/Nut	Timber	2	0	12	5
	N-fixation/fuel trees	Fruit/Nut		0	0	3	0
	N-fixation/fuel trees	Fruit/Nut	Timber	0	0	3	0
		Fruit/Nut		0	0	9	10
			Timber	0	0	3	0
		Fruit/Nut	Timber	0	0	9	31

	Presence of Crop Category (%) on Terraced Fields on which Trees were Planted			
	(n = 33) 900 mm	(n = 14) 1400 mm	(n = 31) 1800 mm	(n = 16) 2200 mm
Agronomic crops	100	100	74	59
N-fixation/fuel trees	30	100	49	24
Fruit/nut trees	47	100	71	53
Timber	56	31	68	80
Species Richness/Field	1.87	6.57	3.65	4.44

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