NOAA/EDIS/CEAS CLIMATIC IMPACT ASSESSMENTS AND TECHNOLOGY TRANSFER TO DEVELOPING COUNTRIES: PROGRAM SUMMARY

Louis T. Steyaert 1/

Since July, 1979, the NOAA/Center for Environmental Assessment Services has been issuing biweekly assessments of climatic impact on the food security in developing countries of the Caribbean Basin, Africa, South and Southeast Asia, Central America and the Andes countries of South America. The purpose is to support disaster preparedness and relief operations by providing decision makers, planners and economists with timely, reliable early warning information on climatic impact including the potential for subsistence food shortfalls. Assessments are based on continuous monitoring of environmental conditions and can increase the lead time for cost-effective planning of food assistance strategies. Also, measures for disaster avoidance can be recommended so that potential climatic impact can be mitigated. Post-analysis and independent verification of past NOAA/CEAS assessments (Sahel Region, 1979, 1980, 1981; Haiti 1979, 1980; and Southern Asia 1981/82) have demonstrated that reliable early warning information on drought impact can be provided by as much as 30-60 days before the beginning of crop harvest. For example, the CEAS assessment and subsequent verification results for the 1979 drought in the Sahel countries are shown in Attachment 1. In addition to permitting time for field verification, this can represent as much as a three to six month lead-time before socio-economic impacts occur.

The CEAS assessment cables are provided to American Embassies, US/AID Missions, AID/W, UN/FAO, UN/UNDRO and the USDA through U.S. Department of Commerce communication facilities. Climatic impact on potential subsistence food supplies, subsistence crop conditions and field operations are assessed. Information on crop calendars, estimated soil moisture, agroclimatological case study analysis and statistical comparisons to analogous conditions in previous years are discussed. Unusual or severe weather events such as flooding, high winds and other meteorological extremes are reported. If available, information from ancillary sources is included to supplement NOAA/CEAS analysis. The assessment is based on quantified data which are available on request. For example CEAS prepared special assessment reports for AID (Office of U.S. Foreign Disaster Assistance, Food for Peace, etc.) on 1981/82 drought impact in Bangladesh, Sri Lanka Malaysia, Tanzania and Botswana.

The Early Warning System was developed at the request of the AID/OFDA and with cooperation from US/AID Missions and host countries. The system is operational for the Caribbean Basin, Sahel Countries of Africa and Southern Asia. The assessment methodology for sub- equatorial Africa and Latin America will be tested beginning in January, 1983. The system is based on weekly rainfall/weather analysis and climatic impact assessment models for more

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than 300 agroclimatic regions (Attachment 2). Weather assessments begin with an analysis of precipitation amount. Regional rainfall estimates are determined from ground station reports received through an international communications network. Satellite cloud data are used to improve the accuracy of precipitation estimates, particularly in those regions where weather data are sparse and unreliable. Weather data are then interpreted by regional agroclimatic indices which indicate potential crop production in relative terms. Finally, climatic impact and the potential for abnormal food shortages are identified from these indices which have two forms: statistical climate/crop yield models and crop condition indices. Various historic data bases were developed to determine the appropriate index for each region. Local agricultural practices, historic episodic reports and results of experimental studies were incorporated in the choice of each index. Episodic reports on documented occurrences of famine, drought, crop failure and other events are used to establish critical thresholds for potential food shortages and to interpret indices.

Improved assessment tools are being developed to upgrade the assessments by providing: 1) regional rainfall estimates from automated processing of satellite data, 2) vegetation stress indices from direct readout of daily meteorological satellite data and 3) drought/potential food shortage indices from relationships between drought and anomalous large-scale atmospheric/oceanic circulation patterns. The association between these patterns and the abnormal beginning of the rainy season is also being investigated.

CEAS has also been working with AID to transfer climatic impact assessment technology to developing countries. Intensive six week training courses on agroclimatic modeling and the assessment process are provided to qualified scientists (Attachment 3). Existing data are used to develop, test and implement a "stand-alone" assessment capability. The assessments are based on three types of models which can benefit decision makers involved with planning and economic analysis. Drought monitoring and crop condition assessments can supplement existing crop production forecast systems, particularly in the early growing season. Such assessments can also contribute to economic analysis for recommending short-term policy on expected import/export requirements, pricing incentives, and marketing decisions. Crop/weather advisories containing information on soil moisture status, recommended irrigation scheduling and pest/weather relationships can be provided to the extension service for dissemination to farmers. Finally, agroclimatic data and analysis can be used to support land use studies (crop type, planting date, irrigation requirement, etc.) as another way to mitigate and reduce climatic vulnerability. CEAS has technology transfer projects currently underway in Latin America and Southern Asia with plans being developed for similar projects in The Caribbean Basin and The Sahel Region of Africa.

TABLE 8
NOAA/EDIS CEAS EARLY WARNING ASSESSMENTS
SUB-SAHARAN AFRICA: 1979

DROUGHT INDEX			CROP MODELS[3]			
COUNTRY	WEEK BEGINNING DROUGHT[1]	SEVERE DROUGHT[2]	JUL/AUG	AUG/SEP	SEP/OCT	VERIFICATION
MAURITANIA	7/16	8/12-10/28	20	15	10	1. DEC 79: FAO Recommended Food Aid Relief 2. JAN 80: FAO/WFP Assistance Approved
SENEGAL	8/13	8/20-10/28	12	5	5	1. NOV 79: FAO Recommended Food Aid Relief 2. JUN 80: DAKAR 3190 Declared Disaster
THE GAMBIA	9/17-10/15		25	5	5	1. FEB 80: FAO Recommended Food Aid Relief 2. SEP 80: BANJUL 2323 Declared Disaster
MALI	8/13-8/20	9/10-10/15	5	5	20	1. JAN 80: FAO/WFP Recommends Emergency Food Aid
UPPER VOLTA	8/6-8/12	7/30- 8/5	5	10	5	1. MAR 80: FAO Recommended Food Aid Relief for Regional Cereal Deficits In North and Central Regions
NIGER	8/6-8/26		15	15	10	FAO Reported Normal Crops
CHAD	7/2-9/10		5	5	5	1. Drought and Civil Strife 2. NOV 79: NDJAMENA 3404 Discussed Food Aid Needs
SUDAN			10	15	20	1. DEC 79: Aid For Refugees 2. Drought Impact On Crops

NOTES:

1. Drought defined as 8 week cumulative precipitation between 40-60 percent normal.

2. Severe drought defined as 8 week cumulative precipitation less than 40 percent normal.

3. Crop model indices expressed in percentiles ranging for 0.0 to 100.0. Historically, abnormal food shortages have been associated with index values below the 20th percentile.

Attachment 1

EXECUTIVE SUMMARY

PROPOSED AGROCLIMATIC ASSESSMENT METHODS FOR EARLY WARNING OF DROUGHT/FOOD SHORTAGES IN SOUTH AND SOUTHEAST ASIA: FINAL REPORT

Louis T. Steyaert, V. Rao Achutuni and Atanas V. Todorov [1]

The Agency for International Development (AID) needs reliable early warning of potential food shortages to make decisions affecting many of its programs for disaster relief, preparedness, and food security in South and Southeast Asia. Many of these agriculturally oriented economies are highly vulnerable to climate variability. Severe drought and flooding have historically led to crop failures, economic losses, and famine. For these reasons, the AID/Office of U.S. Foreign Disaster Assistance sponsored this project, Agroclimatic Analysis and Development of Climate/Crop Yield Models for South and Southeast Asia.

The objectives of this project were accomplished. An inexpensive Early Warning Program was developed to provide reliable, timely information on potential food shortages triggered by climatic events. Computerized data bases were assembled and used to determine historical relationships between climate anomalies, crop failures and the causes of abnormal food shortages. Qualitative impact assessments of unusual and severe weather events were provided to AID/OFDA on a biweekly basis during the project.

The Early Warning Program is based on 1) biweekly weather assessments and 2) monthly assessments of crop conditions. Weather assessments begin with an analysis of precipitation amount, the most important meteorological element influencing crop productivity in the subtropics. Regional rainfall estimates are determined from ground station reports received through an international communications network. Satellite cloud data are used to improve the accuracy of precipitation estimates, particularly in those regions where weather data are sparse and unreliable. Weather data are then interpreted by agroclimatic indices which indicate potential crop production in relative terms. Finally, the potential for abnormal food shortages is identified from these indices.

Regional agroclimatic indices are the core of the Program (see figure). These indices have two forms: statistical climate/crop yield models and crop condition indices. Various historical data bases were developed to determine the appropriate index for each region. Local agricultural practices, historical episodic reports and results of

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[1] Respectively, Research Meteorologist, Center for Environmental Assessment Services/Climatic Impact Assessment Division-Models Branch of NOAA/EDIS and Research Associates, Atmospheric Science Department, University of Missouri-Columbia, Columbia, Missouri.

experimental studies were incorporated in the choice of each index. Episodic reports on documented occurrences of famine, drought, crop failure and other events are used to establish critical thresholds for potential food shortages and to interpret indices.

Agroclimatic indices and associated crop calendars for major food crops were defined for 107 agroclimatically homogeneous regions throughout southern Asia. Historical meteorological data (1950-1978) from more than 350 stations were used to compute the indices. Statistical crop yield models developed include: 1) individual state models for rice (autumn, winter and summer crops), wheat and sorghum in India, 2) national models for the aus, aman and boro rice crops in Bangladesh, 3) a national model for the yala rice crop in Sri Lanka, 4) a national model for the main rice crop in Burma, 5) regional models for the main rice crop in Thailand, 6) a national model for maize in Thailand and 7) individual state models for the main rice crop in Peninsular Malaysia.

Before the Early Warning Program in South and Southeast Asia becomes operational, the indices should be tested. The proposed evaluation should include: 1) statistical testing, 2) refinement and calibration, 3) routine test assessments, 4) user feedback and 5) continued development. This would provide experience in report preparation and improve the assessment procedure.

This program can potentially benefit AID by:

1) increasing lead time for planning food assistance strategies,

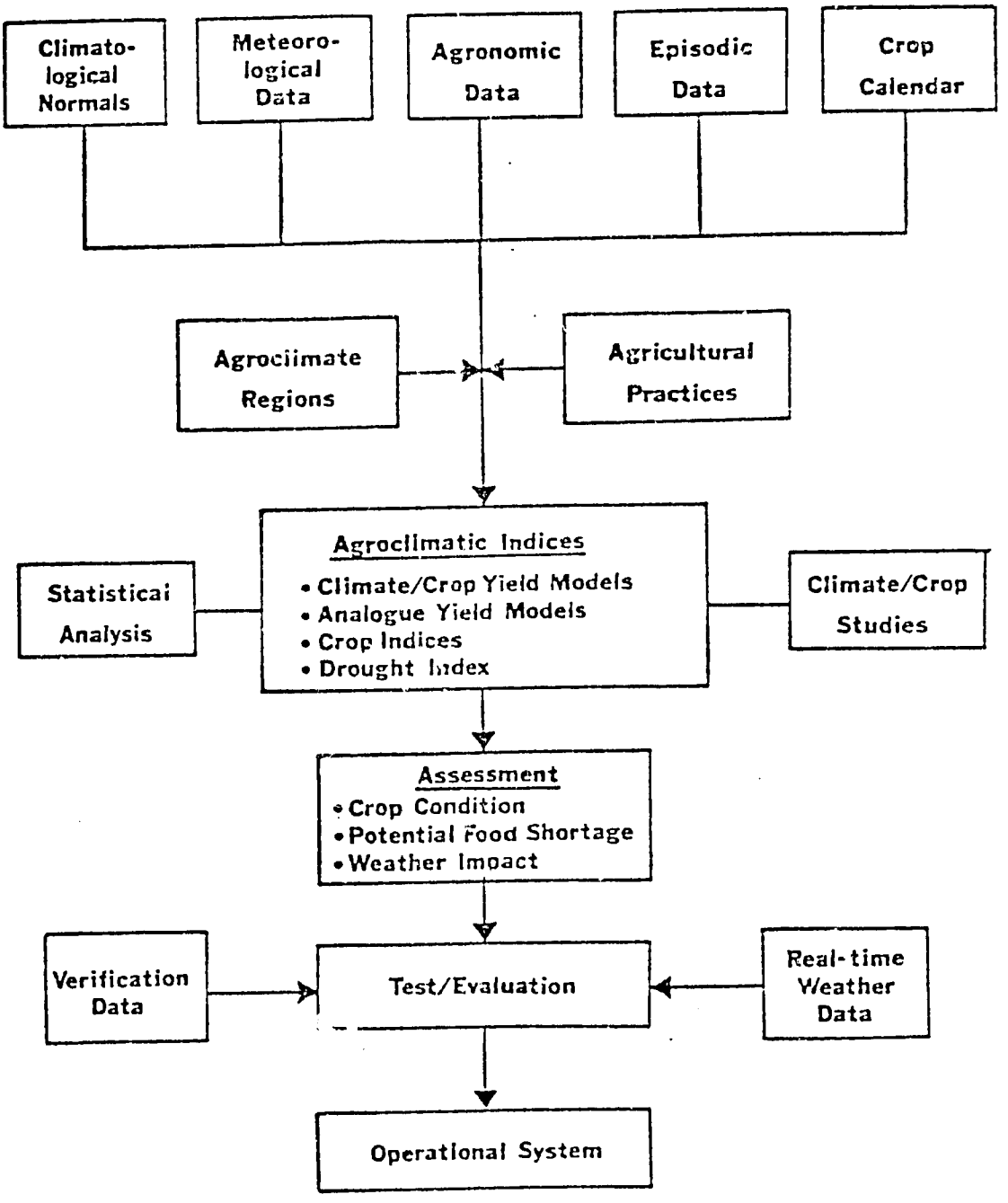
2) enhancing the U.S. capacity to identify disaster conditions, thus improving recommended measures for disaster avoidance and mitigation, and

3) transferring agroclimate technology to developing countries.

The methods proposed in this report provide inexpensive and timely information which is consistent with known local agricultural practices. This Early Warning Program can provide reliable information 30-60 days before harvest of the crop. This could represent a 3-6 month warning prior to drought-related food shortages.

This project report includes three supplements: Meteorological Data, Crop Data and Episodic Data.

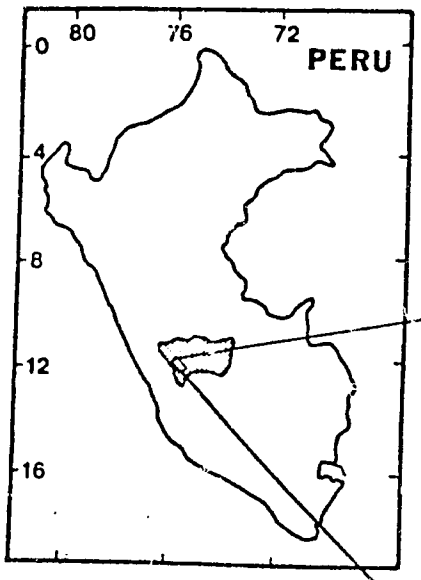
AGROCLIMATIC ANALYSIS FOR DROUGHT IMPACT

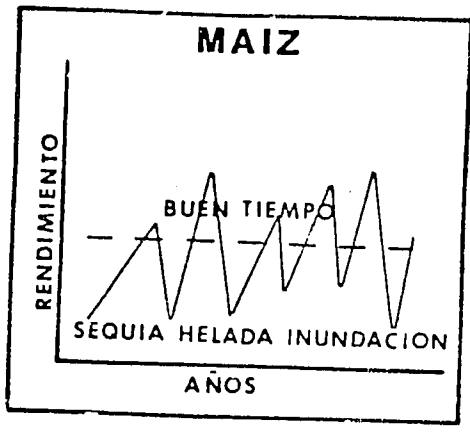


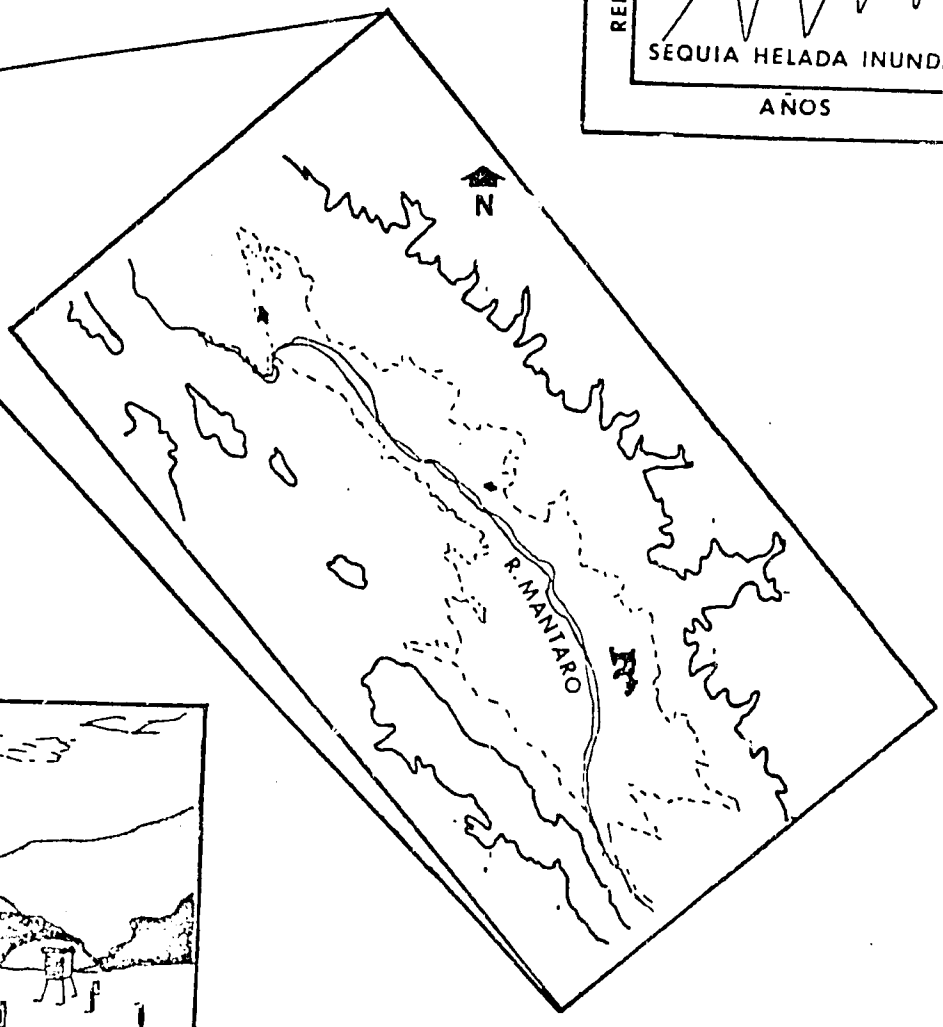
Components of Agroclimatic Analysis for Investigation of Drought Impact on Crop/Food Shortage Conditions

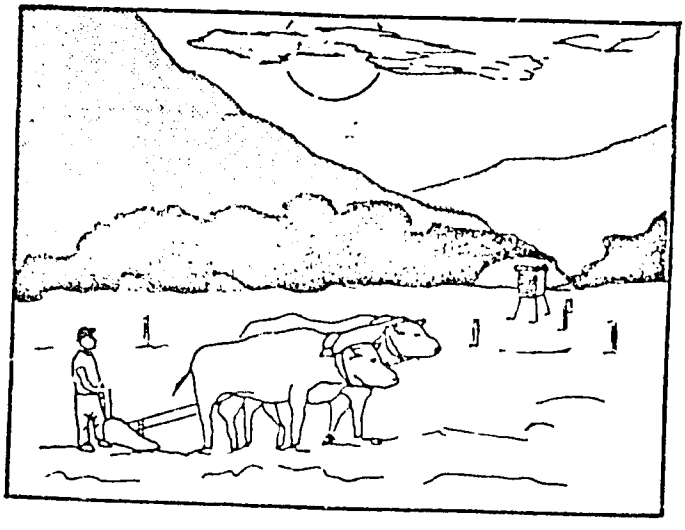
Attachment 3

AGROMETEOROLOGICAL ASSESSMENT MODELS FOR ECONOMIC PLANNING AND RURAL DEVELOPMENT IN THE MANTARO VALLEY OF PERU









Walter A. Sánchez

MODELOS AGROMETEOROLOGICOS DE RENDIMIENTO DE CULTIVOS Y SUS APLICACIONES EN LA PLANIFICACION Y DESARROLLO RURAL EN EL VALLE DEL MANTARO, PERU

AGROMETEOROLOGICAL ASSESSMENT MODELS FOR ECONOMIC PLANNING AND RURAL DEVELOPMENT IN THE MANTARO VALLEY OF PERU

Final Report

to

National Agrarian University
Department of Physics
and Meteorology
La Molina
Lima, Peru

and

Ministry of Agriculture
and
National Meteorological and
Hydrologic Service
Lima, Peru

by

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for

Agency For International Development
Lima, Peru

Agency For International Development 2/
Office of U.S. Foreign Disaster Assistance
Washington, D.C.

U.S National Oceanic and Atmospheric Administration
National Environmental Satellite, Data and Information Service
Center for Environmental Assessment Services
Washington, D.C. and Columbia, Missouri

March, 1982

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2 This project was sponsored by AID/OFDA under NOAA/AID PASA CC/OFDA-001-6-80 and conducted at NOAA/CEAS - Models Branch, Columbia, Missouri.

EXECUTIVE SUMMARY

AGROMETEOROLOGICAL ASSESSMENT MODELS FOR ECONOMIC PLANNING AND RURAL DEVELOPMENT IN THE MANTARO VALLEY OF PERU

Walter A. Sanchez

Agriculturally oriented economies are especially vulnerable to climatic extremes, particularly in Peru where 40 percent of the labor force is involved in agriculture. An example is the disastrous 1977-80 drought, the magnitude of which can be seen in the drought index for Cajamarca, Peru presented in Figure 1. Food production in Peru was reduced to the lowest levels in the 1970's. Potato, beef, subsistence food production and sugar for export were particularly affected. This in turn increased rice and wheat imports, influencing the balance of payments and foreign exchange. Frost can also result in significant economic loss; an estimated 2.5 million Soles ($7,812 U.S. 1980 currency rates) were lost in the potato, corn and lima bean crops from the frost of December 20, 1980 in the Mantaro Valley. Some of the climatic events and their economic impact in the Mantaro Valley are shown in the attached table. In addition, the "normal" or mean climatic conditions determine potential land use and therefore the agricultural practices which are necessary to minimize climatic risk.

This report documents agroclimatic models and climatic impact assessment methods which can be used by managers to mitigate potential climatic impact and reduce climatic vulnerability. Historic climatic data, primarily monthly rainfall, were used to develop three types of agroclimatic models for the Mantaro Valley, Junin Department, Peru. These include: 1) statistical climate/crop yield models (attached table) and agroclimatic/crop condition indices to provide crop yield and production forecasts 2) preliminary models for

providing early warning crop/frost advisories to farmers so that possible actions can be taken to mitigate disastrous frost damage to crops, and 3) crop water requirement and water balance models plus methods to estimate potential evapotranspiration all of which are necessary tools for land use studies in the Valley and other areas in the Sierra.

The potential short and long-term economic benefits of climatic impact assessments to decision makers are illustrated. Real-time weather information is used to run the models which convert climatic information into economic terms, e.g., relative crop production loss due to drought. Early warning of drought impact on agricultural production can be provided by at least 30 days prior to the beginning of the crop harvest. This information can contribute to agricultural production forecasts and provide a lead time of one to three months before the actual economic impact of drought occurs. This lead-time permits the adjustment of marketing and pricing policy, importing and exporting plans, or other economic programs. Disaster preparedness plans can be established to mitigate climatic impact on socioeconomic conditions in rural areas. Another important application of real-time weather data for short-term economic benefit is in the crop weather advisory for farmers. In addition to early warning of potential frost, farmers can also be advised on recommended planting date, scheduling of irrigation and application of pesticides. The advisory could also involve extension services. Agroclimatic models can contribute to land use studies by helping determine the regionally appropriate crop, its optimum planting date, and the potential economic returns. This type of model helps to reduce climatic vulnerability and lowers the risk of crop failure.

Agroclimatic models can be used to support the planning, development and implementation of a National Agrometeorological Assessment Project for Peru. The data and technical resources to implement a project already exist. Minimal support is needed for a regional project which can demonstrate the economic benefit and value to decision makers and users. This can lead to a national program which is based on historic climatic data, an under-utilized national resource. It is suggested that agroclimatic models and assessments are essential in formulating long term economic plans for agricultural and rural development, with the ultimate goal of national food self-sufficiency.

PERU

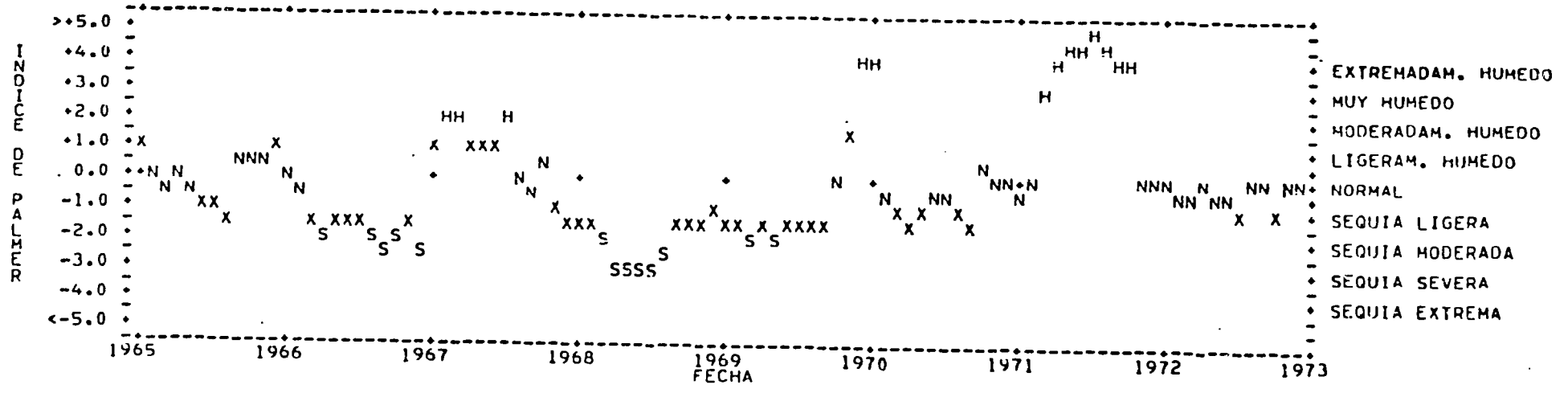
Preliminary Statistical Climate/Crop Yield Forecast Models for the Mantaro Valley, Peru.[1]

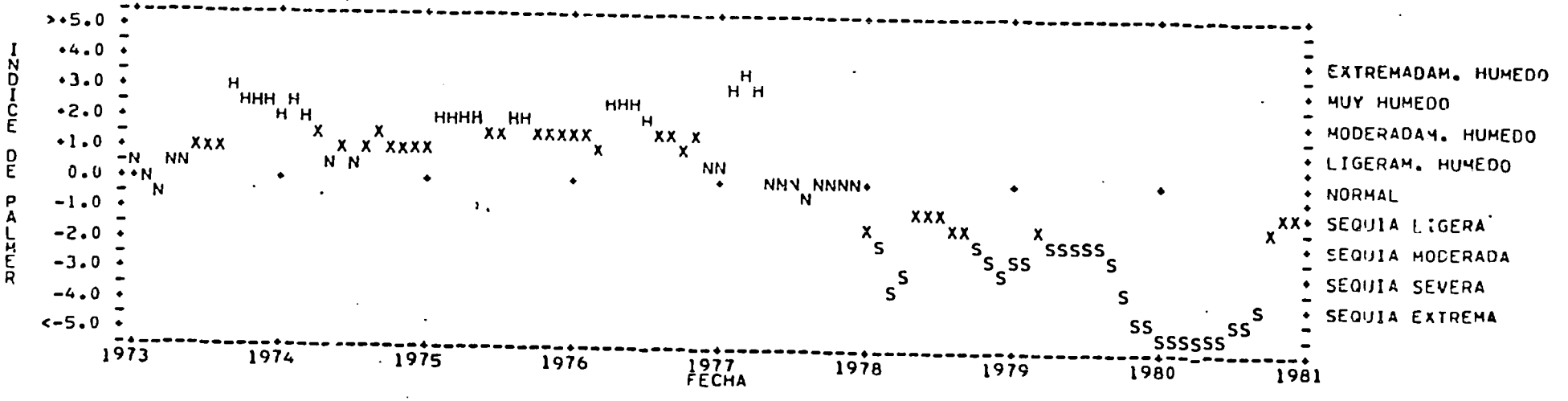
Crop	Crop Variable	Bo	Trend	Weather Variables B1	B2	B3	R^2%	Standard Error of Estimate	Harvest Month	Crop Forecast Month
Barley	XYLD1	1.3240		P2-4 .00098	T2 -.0402		80.0	.0363	Jun	May 1
Barley	XYLD1	.7579		P2-4 .00132	T2 -.0945	T4 .0976	93.2	.0237	Jun	May 1
Wheat	XYLD3	.9051	.0278	LP11-1 .00074			79.6	.0533	Jun	Feb 1
Wheat	XYLD3	.9067	.0357	LP12-1 .00081			76.8	.0568	Jun	Feb 1
Field Corn	XYLD4	1.0488	.0136	P1 .00071			67.8	.0350	May	Feb 1
Sweet Corn	XYLD5	6.5478		P2-4 .0036			66.1	.1418	Mar	May 1
Dry Field Peas	XYLD6	1.6474	.0212	LT10 -.0511			68.0	.0507	Apr	Nov 1
Dry Field Peas	XYLD6	.9793		LP11 .0018			54.4	.0506	Apr	Dec 1
Green Peas	XYLD7	-9.9718	.1578	LT11 1.1127			73.6	.5619	Mar	Dec 1
Dry Lima Beans	XYLD8	2.8108	.0646	LT11 -.1585			86.0	.0850	Apr	Dec 1
Dry Lima Beans	XYLD8	.7174		LP11 .0055			81.9	.0894	Apr	Dec 1
Green Lima Beans	XYLD9	6.9740	.0780	P2-3 -.0097			93.4	.1572	Mar	Apr 1
Green Lima Beans	XYLD9	8.6425	.1662	LT11 -.3643			76.2	.2987	Mar	Dec 1
Traditional Potatoes	XLYD10	1.6873	.4942	P2-4 .0056			99.5	.1000	May	May 1
HYV Potatoes	XYLD11	4.8649		P1-3 .0101			76.4	.3555	Apr	Apr 1

Note[1]: Bo is constant; Trend is "Trend coeff"; B1, B2, B3 are weather variable coefficents, R2 is explained variance; standard error of estimate is in mt/ha.

PALMER DROUGHT INDEX / INDICE DE SEQUIA DE PALMER

CAJAMARCA, PERU





Attachment 3

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TABLE

Episodal event data for the Mantaro Valley, Peru
Source: Diario "La Voz de Huancayo"

Weather Event	Date	Place	Affected Crops	Estimated Loss* (Peruvian Soles)
Hail	1/19/79	Mantaro Valley	Potato Corn Lima Beans	-
Hail	3/29/79	Concepcion Ocopa	Barley Lima Beans Wheat Quinua	-
Drought	12/26/80	Mantaro Valley	Potato Corn	-
Hail	11/18/80	Chupaca	Corn Lima Beans	-
Hail	11/18/80	Mantaro Valley	Corn Lima Beans	-
Frost	12/20/80	Mantaro Valley	Potato Corn Lima Beans	2,500,000.00
Frost	12/27/80	Sicaya Pilcomayo	Potato Corn	-
Drought and Frost	12/24/80	San Jose de Quero	Barley Lima Beans Pastures	4,000,000.00
Flood	2/3/81	Chupaca	Potato Barley	-
Flood	2/10/81	Huayucachi	Potato Corn Lima Beans	-

*1 US$ = 320 soles (July, 1980), 500 soles (Dec., 1981) approximately.

Weather Event	Date	Place	Affected Crops	Estimated Loss* (Peruvian Soles)
Flood	2/27/81	Sincos Mito Muqui Muquiyauyo 3 de Diciembre Huamancaca Chico	Potato Corn Lima Beans Peas	-
Flood	3/10/81	Jauja	Potato Corn Lima Beans	-
Flood	3/10/81	Matahuasi Yanamuclo Maravilca	Potato Corn Peas Wheat Barley	
Flood	3/13/81	Ataura Huayucachi Chupaca Pilcomayo Ingenio	Corn Wheat Barley Potato Lima Beans	3,000,000.00
Drought	2/3/80	Sais Cahuide	Potato (cows and sheep)	15,000,000.00