PN-ABE-140
65446

TRAINING REPORT

SATELLITE CROP MONITORING WORKSHOP

INDONESIA

Conducted By

U.S. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
COOPERATIVE INSTITUTE FOR APPLIED METEOROLOGY,
UNIVERSITY OF MISSOURI-COLUMBIA
U.N. ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC
ASIAN INSTITUTE OF TECHNOLOGY

Sponsored By

USAID OFFICE OF FOREIGN DISASTER ASSISTANCE
U.N. DEVELOPMENT PROGRAMME

July 1989
Bangkok, Thailand

PN-ABE-742

INCORPORATION OF NOAA SATELLITE DATA IN THE CROP MONITORING/ASSESSMENT PROCESS

A TRAINING WORKSHOP REPORT
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JULY 1989

INCORPORATION OF NOAA SATELLITE DATA

IN THE CROP MONITORING/ASSESSMENT PROCESS

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ACKNOWLEDMENTS

The workshop on Setelitte Crop Monitoring was undertaken by The Economic and Social Commision for Asia and Pacific (ESCAP) and Cooperative Institute of Applied Meteorology (CIAM), University of Missouri, and funded by the United States Agency for International Development,Office of Foreign Disaster Assistence (USAID/OFDA), and the United Nations Development Programme (UNDP)

The workshop of the phase II of the Agroclimatic Assessment Project is a continuation of the training initiated during phase I of the Food Shortage/Drought Assessment Project Workshop conducted by NOAA/ESCAP/UMC/USAID in 1984. The phase II workshop program was coordinated by Dr. Gary E. Johnson.

We would like to express our sincere thanks and appreciation to the following persons who organized and institutions which supported and financed the training workshop:

Dr. Gary E. Johnson and Dr. Rao Achutuni of NOAA, Dr. Wayne Decker and Mrs. Sandra Waisman of CIAM, University of Missouri, Dr. John E. Lukens of Asian Institute of Technology, Mr. Michael Sheinkman of UNDP (UNBRO), Dr. Oranut aisarnuchapong of Met. Dept. Royal Thai Geovernment, for their assisstance and guidance during the course of training; to Mr Jan Orsini of ESCAP for his logistic support and assisstance during the course. Finally, to UNDP/ESCAP and USAID for providing financial support which made the workshop successfull.

EXECUTIVE SUMMARY

This report summarizes a four week workshop on the Satellite Crop Monitoring conducted by ESCAP and NOAA in AIT, 12 June - 7 July 1989. This workshop utilized NOAA/AVHRR Satellite data which can be recieved twice daily by any country with the resources to install an appropriate antenna and data reception and analysis system. The NOAA satellite can provide assessors with timely qualitative estimates of crop and pasture conditions over large areas. The data enables a continuous real time analysis of the phenology of any crop. The Monsoon cloud contamination can be minimized by selection of the clouds free areas of sequence of superimposed images. The software was redesigned in order to provide imagery display and analytical procedures.

One of the main advantages of NOAA/AVHRR satellite data is the economical repetitive coverage. The coverage can show a time series of vegetation indices which indicates the dynamics of the vegetation in an area. Vegetation indices are designed to condence spectral information to discriminate vegetation from non vegetation, and to assess crop conditions for a range of agricultural condition. A vegetation index is a ratio of reflectance values in the Near Infrared (NIR) and the visible region of the spectrum which can be seen as a measure of the ammount of green vegetation. The most popular vegetation indices are the Normalized Difference Vegetation Index (NDVI) which is used qualitatively to compare current values with the same period in the previous year. This index is being evaluated to determine alternative ways of establishing relationship between it and yield and being analyzed to determine the spatial and temporal variation.

The utilization of the satellite data will provide satellite imagery and vegetative index analysis which will more one step closer to reliable and timely quantitative crop yields estimates. The analyses will be incorporated into monthly drought early warning system bulletin already produced in Indonesia as a result of the phase-I activities.

I. INTRODUCTION

Food security can be significantly improved by establishing an early warning agro-climatic crop condition assessment program which provide decision and policy makers with key information on the impact of recent weather on agricultural crops and crop production. The Cooperative Institute of Applied Meteorology (CIAM), University Missouri, Columbia working with the UN Economic and Social Commission for Asia and Pacific (ESCAP) and US Agency for International Development (USAID), has designed and developed a drought early warning system for food crops in tropical regions. The long term objective was to establish a crop monitoring tool to be used by food security decision makers on a near real-time basis. In the phase I workshop which conducted by NOAA/ESCAP/UMC/USAID in 1984, a rainfall analysis system was introduced by utilizing cummulative rainfall indices and statistical climate crop yield models to monitor drought and assess the impact on crop production, since in tropical areas, rainfall is the meteorological element with the highest spatial and temporal variation, while other elements such as temperature, sunshine duration, air humidity, etc., are of lesser importance to agriculture.

A Crop Assessment Team was established within governmental framework following the phase I training workshop to produce and disseminate Crop Assessment Bulletins for food security decision makers in each participating countries.

The phase II training workshop, which is a continuation of the phase I, is on the use of NOAA/AVHRR Satellite Data products in the form of imagery and Normalized Difference Vegetation Index (NDVI) analysis, in strengthening the existing Early Warning Program. Phase II is co-funded by the USAID/Office of Foreign Disaster Assistance (OFDA) and The United Nations Development Program (UNDP), accomodated four trainees from Indonesia was held at the Asian Institute of Technology (AIT) in Bangkok from June 12 to July 7, 1989. The goal of the training workshop is to provide users in government agencies with better assessments based on the model already developed. In this training workshop phase II, remote sensing is viewed as an usefull tool for providing valuable information concerning crop production development. The combination of visible and near infrared from NOAA/AVHRR satellite data revealed valuable information on the growing condition of crops. Although the current assessment technology must be thoroughly tested and evaluated, this proposed assessment program has the potential to provide reliable, timely and inexpensive information. It will strengthen the capability to analyze and assess the crop production level since in the assessment program which is established in Indonesia since 1984, several constraints have been faced in order to provide reliable information,

such as the limitation of meteorological stations and inaccuracy and unreliability of crop production data. This information can be used as an additional information source to complement and suplement existing or planned information sources used for food policy and decision making. It will contribute to the improvemnet of agriculture and food security program in Indonesia.

II. INCORPORATION OF NOAA SATELLITE DATA IN THE CROP MONITORING/ASSESSMENT PROCESS

A. NOAA Satellite Data Characteristics

At present time there are some satellite launched by various countries for remote sensing purposes, which have polar and geostationary orbit (figure 1). The remote sensing data can be utilized more efficiently by understanding the characteristics of the data such as spatial,temporal and radiometric resolutions as shown in table 1.

Eventhough SPOT/HRV and LANDSAT/TM data have higher spatial resolution, these data are not economical for crop monitoring purposes due to the lower temporal resolution, and expensive operational cost. As an alternative the NOAA satellite data, which have polar orbiting and sun syncronuous satellite, is appropriate for these purposes.

NOAA satellite have five main sensors; namely: a)Advanced Very High Resolution Radiometer (AVHRR) b)TIROS Operational Vertical Sounders (TOVS) c)Data Collection System (DCS) d)Space Environment Monitor (SEM), and e)Search and Rescue Satellite (SARSAT)

The most relevant sensor for crop monitoring purpose is the AVHRR, because the AVHRR has radiometric resolution which can record reflectance and emission of the radiation energy from the earth surface, including vegetation reflectance. This sensor is relatively inexpensive and has high temporal resolution.

NOAA/AVHRR has five radiometer channels, namely :

channel 1 : 0.55 - 0.68 um (visible)
measure albedo, defines snow and ice features, terrain features, vegetative cover, and meteorological (cloud) features.

channel 2 : 0.725 - 1.1 um (near infrared)
defines snow and ice condition and melt, allows vegetation assessment (highly sensitive to the presence of chlorophyll), and meteorological (cloud) monitoring.

channel 3 : 3.33 - 3.93 um (medium infrared)
sensitive to extreme heat sources, forest fire detection, sea surface temperature analysis, and nighttime cloud mapping.

Operational Earth Observation Satellites

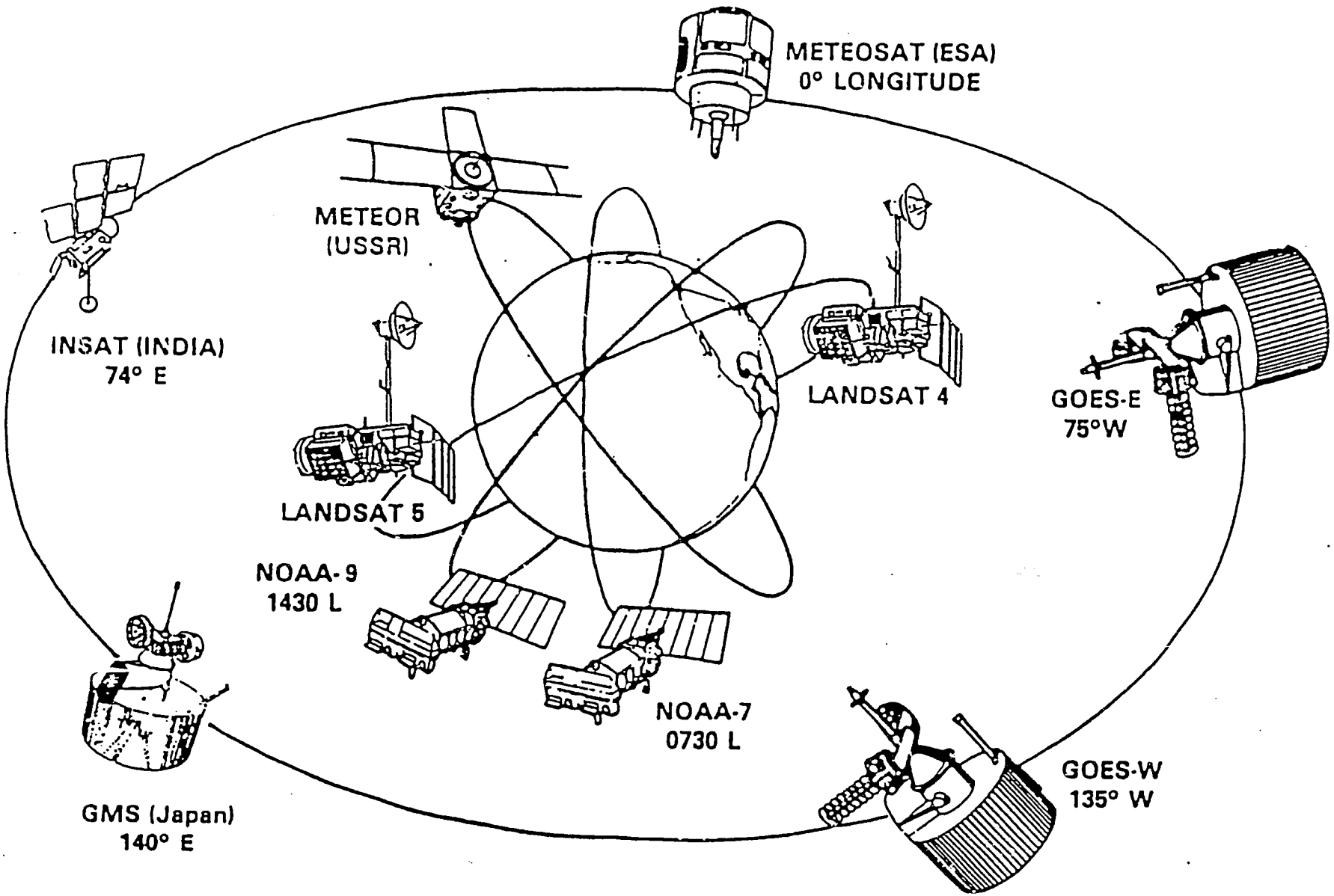


FIGURE 1.

Table 1 : Satellite characteristics

Satellite	Inst.	Mode	Alt.	IFOV	S W	R C	Band
			km	m	km	days	
NOAA	AVHRR	multispectral	833	1100	2400	0.5	5
Landsat	MSS	multispectral	705	80	185	16	4
Landsat	TM	multispectral	705	30	185	16	7
SPOT	HRV	multispectral	832	20	60	26	3
SPOT	HRV	panchromatic	832	10	60	26	1

Note: Inst = Instrument
Alt = Altitude
S W = Swath width
R C = Repeat cycle

channel 4 : 10.5 - 11.5 um (far infrared)
defines day and night land temperature, volcanic plumes, meteorological cloud features, and river, lake and ocean surface temperatures.
channel 5 : 11.5 - 12.5 um (far infrared)
same as channel 4
The characteristics of NOAA/AVHRR data as shown in table 2.

2. Imagery Product and their use in Assessment

Imageries used in assessment process are derived from the NOAA-9 and NOAA-11 satellites. Imageries are acquired from the satellite and sensor system at two spatial resolution. The finest resolution known as High Resolution Picture Transmission (HRPT) are transmitted to ground receiving stastions in real-time. Selected imagery sets of the same spatial resolution are recorded aboard the satellite for later play back to ground station. Recorder limitations dictate that maximum of ten minute of this imagery may be recorded on any single orbit. This data are subsequently processed as Local Area Coverage (LAC) imagery. A reduced spatial resolution imagery, known as Global Area Coverage (GAC), provide world-wide coverage. GAC imagery are created by the processor aboard the satellite by sampling the full resolution imagery and recording it at GAC resolution. The sampling of full resolution imagery is accomplished by averaging for every five adjacent pixel along the scan line and then processing only every third line. LAC and HRPT imagery are nominaly 1.1 km spatial resolution at the satellite subpoint. GAC data at the satellite sub point are generally treated as 4 km spatial resolution imagery. A third spatial resolution AVHRR imagery is known as Global Vegetation index (GVI). The spatial resolution of GVI imagery are 16 km at the satellite subpoint (figure 2).

Three types of imagery are considered for the image interpretation product,namely: GVI, GAC and LAC. GVI resolution represented the most economical data source and the least quantity of data to handel. Conversely LAC imagery provided the hihgest spatial resolution, but requared more handling requarements and cost. LAC imagery give more reliable information, due to the heterogenity of vegetations.

3. NDVI product and their use in Assessment

The Normalized Difference Vegetation Index (NDVI), a ratio of near infrared (NIR) and visible (VIS) radiances, has been found to be indicative of the quantity and quality of photosynthetically active biomass. Figure 3 shows the spectral response of green vegetation over the NOAA/AVHRR reflective channels. Reflectance for vegetation, both stressed and well-watered, is higher in channel 2 (NIR) then in channel 1 (VIS). The general formula for NDVI may be expressed as :

TABLE 2

Selected Characteristics of the NOAA-9 Satellite and AVHRR Sensor System

Characteristic	NOAA/AVHRR
Inclination of orbit	99.092°
Height above surface	833 km
Number of orbits/day	14.1
Times of coverage at equator	02:30 descending 14:30 ascending
Orbital period	102 min.
Latitudinal coverage	90°N-90°S
Cycle duration	1 day
Ground coverage	3000 km
Field of view (FOV)	+ 55.4°
Instantaneous field of view (IFOV)	1.39 - 1.51 mrad
Ground resolution (nadir)	1.1 km
Ground resolution (maximum off-nadir)	2.4 km along track 6.9 km across track
Number of channels	One visible One near infrared One middle infrared Two thermal infrared

Source: Adapted from Kidwell 1986

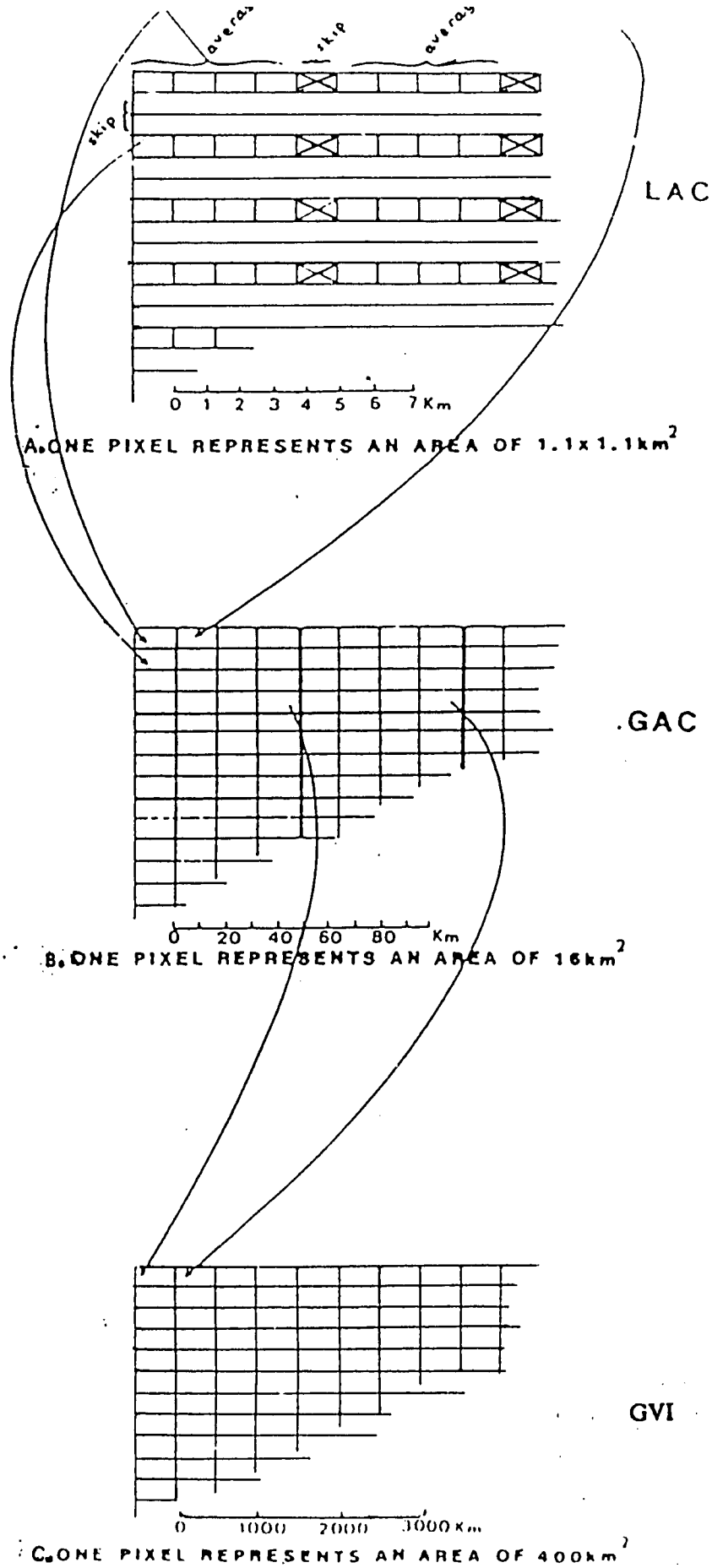


Figure 2. Spatial relationships between pixels in different AVHRR formats (all dimensions are nominal): A: large area coverage (LAC) pixel; B: global area coverage (GAC) pixel; C: global vegetation index (GVI) pixel. The sampling used to derive pixel values for the GAC and GVI products is as follows: GAC: four out of five LAC pixels in one out of three lines are averaged to represent the value of a 4 km GAC pixel (B). GVI: one GAC pixel is selected (see text) to represent the value of a nominal 15 km (equator) GVI pixel

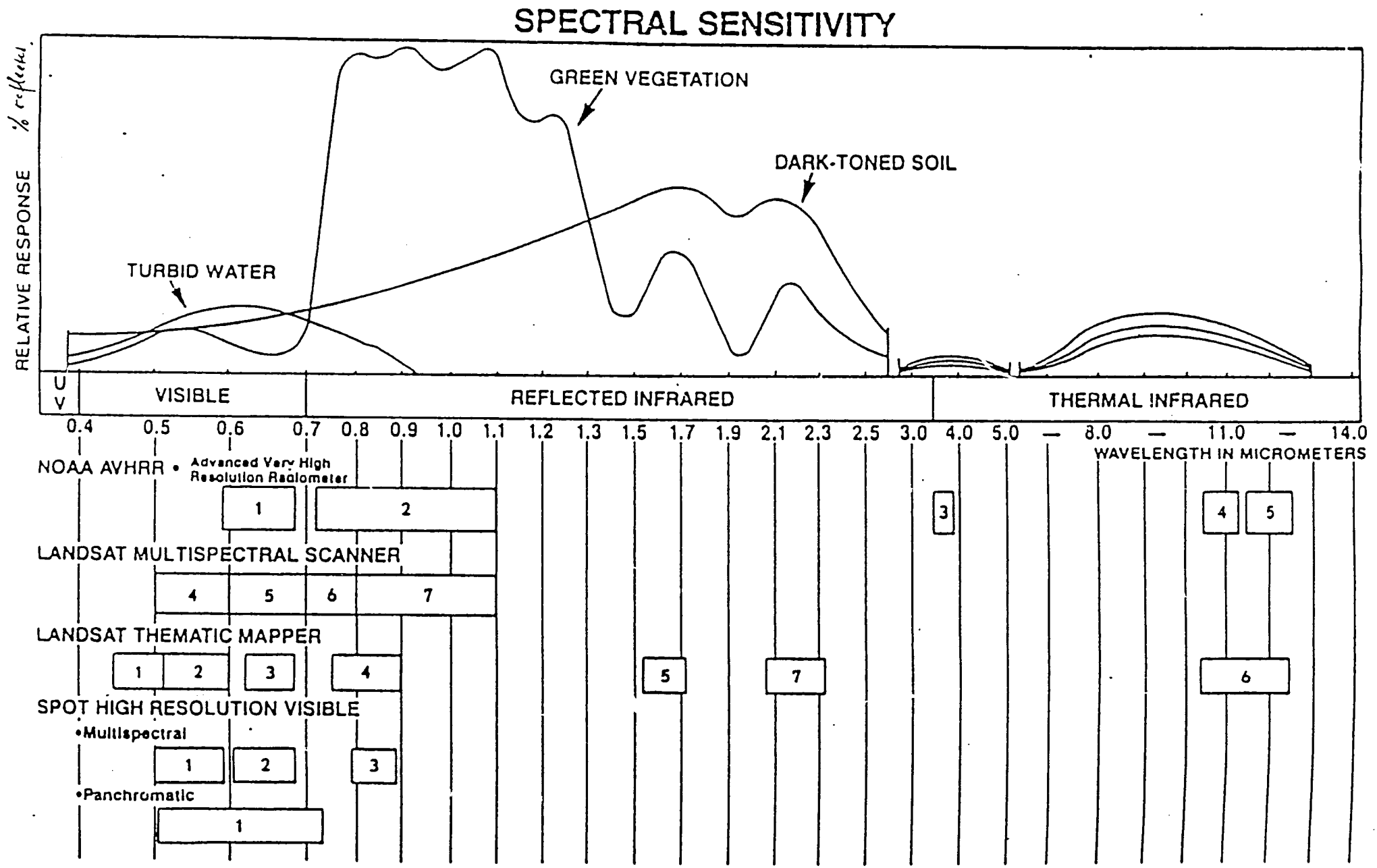

SPECTRAL SENSITIVITY
RELATIVE RESPONSE
% reflect.
GREEN VEGETATION
DARK-TONED SOIL
TURBID WATER
U V
VISIBLE
REFLECTED INFRARED
THERMAL INFRARED
0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.5 1.7 1.9 2.1 2.3 2.5 3.0 4.0 5.0 — 8.0 — 11.0 — 14.0
WAVELENGTH IN MICROMETERS
NOAA AVHRR • Advanced Very High Resolution Radiometer
LANDSAT MULTISPECTRAL SCANNER
LANDSAT THEMATIC MAPPER
SPOT HIGH RESOLUTION VISIBLE
•Multispectral
•Panchromatic

FIGURE 3

$$NDVI = (CH2 - CH1) / (CH2 + CH1)$$

where : CH1 = Channel 1 reflectance
CH2 = Channel 2 reflectance

The NDVI analysis discussed in the training workshop is derived from the NOAA/AVHRR satellite data, namely: channel 1, channel 2 and channel 4 in the form of GVI format. Channel 1 and channel 2 data is used for NDVI analyzing and channel 4 data is utilized for cloud filtering. There are several software used in the training workshop such as MICVEGI (for providing NDVI time series data), XYCOMP (for compositing NDVI imagery), DRAGON (for displaying imagery composite) etc.

III. PROPOSED DATA PRODUCTS, FLOW AND INTEGRATION FOR INDONESIA

1. Data Requirement for Assessment

1.1. Meteorological data

Rainfall is the most important variable affecting the agricultural production in Indonesia. Other meteorological elements such as temperature, sunshine duration, air humidity, etc., are of lesser importance to agriculture than rainfall. The monthly mean rainfall data are determined from at least 28 daily observations. Quality control of the monthly rainfall data was undertaken to delete erroneous cases. Observations were compared to their normal and with other meteorological elements. This rainfall data were used to provide cumulative rainfall analysis/crop condition indices. Historical time series are needed to compute the climatic normal.

One of the limitations in using monthly instead of daily data is that monthly data do not indicate the distribution of rainfall during the month. The assumption for using monthly data is that rains are evenly distributed during the period. The assumption may not always be valid. The rainfall data is gathered from the Meteorological and Geophysical Agency.

1.2. Crop data

The source of crop data (time series of area, production and yield statistics for selected crops) is the Central Bureau of Statistics. Data were collected by CBS through surveys and from other sources. Fluctuations in the yield and production data occured due to both weather and non weather impact. Overtime, variations in yield are usually associated with drought, flooding and pests. Changes in technology also lead to changes in yield. Phenological data (planting,

vegetation, flowering, grainfilling, physiological maturuty and harvesting dates) are needed to formulate crop calendars and monitor crop development during the growing season.

1.3. NOAA/AVHRR Level 1b daily data

The NOAA/AVHRR Level 1b daily data consisting of individual channel data (CH-1, CH-2, CH-4) and GVI tapes should be processed. A normalized difference vegetation index combining channel 1 and channel 2 of the AVHRR reading is routinely calculated using the global area coverage (GAC) format. The NDVI indicates vegetation dynamics since the variation in the NDVI is strongly related to the intercepted photosynthetically active radiation (Malingreau, 1986), therefore to some extent it reflects the growth history of the crop. The source of NDVI data is the National Institute of Aeronatics and Space (LAPAN).

There are some software which can be used for processing NDVI data, namely :

1.3.1. XYCOMP

This program allows the user to composite a specific number of days of Plate Carre XY projection image data in order to select those pixels which are cloud-free or most nearly cloud-free eliminating missing data whenever posible. The XYCOMP program composites on basis of maximum NDVI.

1.3.2. FCONVERT

This program can be used to convert the NDVI data to NDVI image.

1.3.3. DRAGON

This software allow the user to display the NDVI image at the computer monitor with some variation of picture, by adjusting of some variable which are availabled in the dragon software.

1.3.4. MICVEGI

This program allows the user to defining and maintaining satellite NDVI time-series data.

2. Data integration

The key element of success in publishing the Assessment Bulletin is the smooth interagency coordination, because each agency have important role in providing a specific data for assessing crop conditions. LAPAN is the main source of satellite data, BMG as source of the meteorological data, Directorate of Food Crop Protection as source of crop data, and Bulog as source of food information. All data will be put together for making an assessment. These activities will

be conducted in the last week of every month, to publish the Assessment Bulletin during the first week of the following month. The flow chart of the Assessment procedure shown in figure 4.

IV. THE ASSESSMENT BULLETIN

1. The Climatic Impact Assessment Bulletin

The current bulletin consists of two main information, namely :

1.1. Meteorological condition.

Describe weather situation during the observed month, on the rainfall, temperature, wind speed and direction, humidity etc. How well the meteorological conditon from the mormal, which are stated in above normal, normal and bellow normal, and extreme weather occurences.

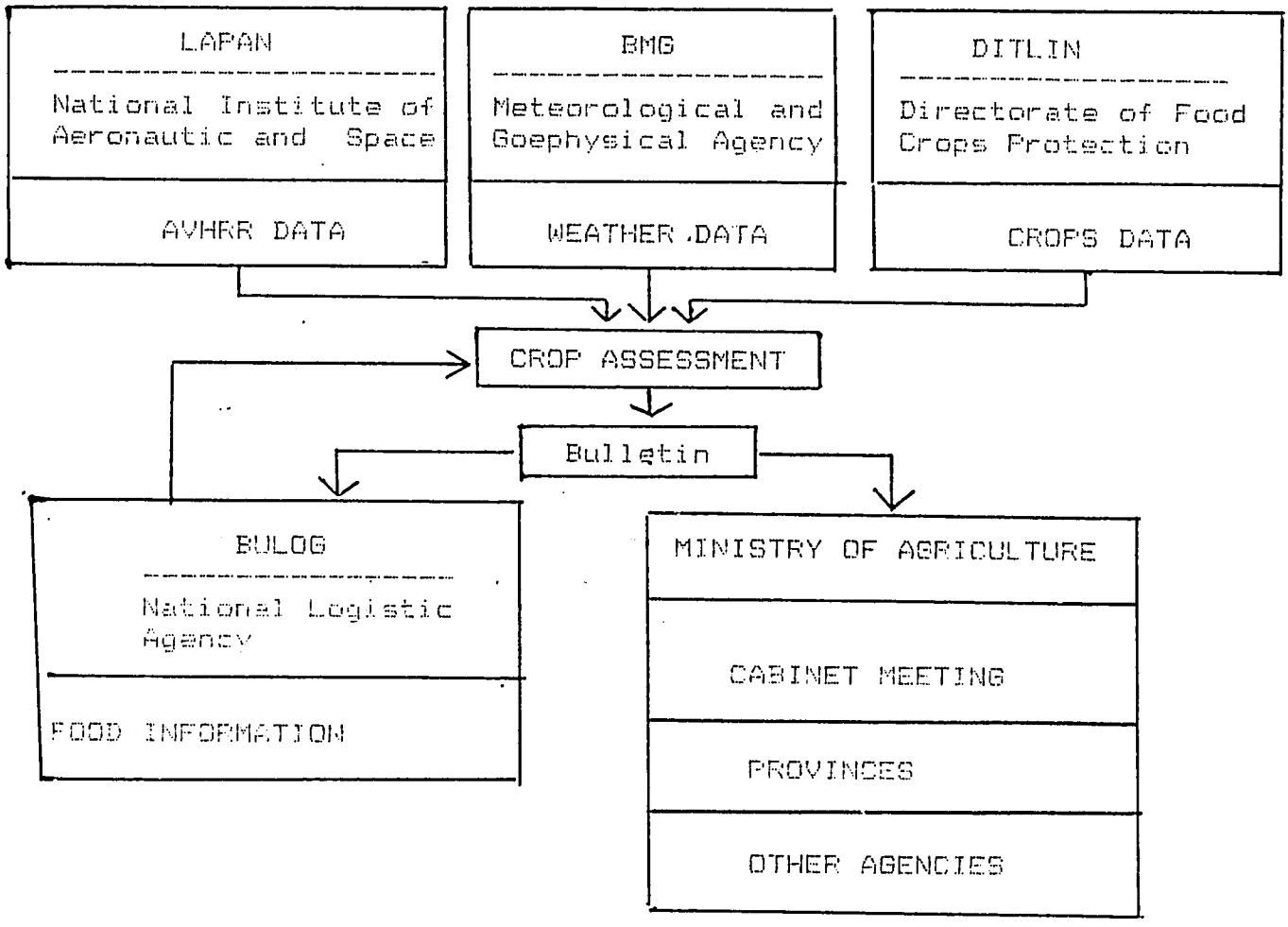
1.2. Describe field and crop conditions.

The field crop conditions are divided into two catagories, namely favourable and unfavourable for land preparation, crop growth and harvesting activities. In the bigining of rainy season information were stressed on the weather conditions during land preparation, planting activities, and early crop growth stages, for rice, maize, soybean and cassava. In the mid rainy season information were stressed on the impact of excessive rainfall, strong wind on crop growth. In the end of rainy season information were focused on dryspells. If the dry season started earlier, when the crop was still in the growing state, crop damages could not be avoided.

The bulletin was issued on a monthly basis. The first issue was in October 1994. Meteorological data were collected from synoptic stations, including rainfall, temperature, humidity, wind speed and direction, cloudiness, and sunshine data. During the last week of each month, rainfall data were analyzed on the Apple IIe for the Yield Moisture Index (YMI) and A Single Level Water Balance Model. The latter model brought the best results in indicating field crop condition, especially for drought condition, while YMI good to indicate excesive rainfall for crops. During the peak of mosoon in January to February, wind speed and cloudiness become impotant meteorological elements in indicating posibility crop dameges due to the strong wind. Low radiation or extensive cloudiness could intensify the pests and diseases infestation.

Crop data crop calendar information and crop distribution were input together with weather analysis into a data base for making an assessment.

Figure 4 : SATELLTTE CROP MONITORING ASSESSMENT PROCESS



2. The format of Assessment Bulletin

The most important thing provided by the workshop is the ability of participant to formulate an assessment was strengthened by using the software which are provided during the workshop to improve the current assessmnet bulletin.

The improvement of bulletin in the future will include modifications to the format and the content of the assessment bulletin. The format of bulletin will consist of:

2.1. Overview

In this area will contain the meteorological information in brief, as well as in the current bulletin.

2.2. Satellite image information

The field situation based on the time series NDVI data, can be used to compare the crop condition from week-to-week, and between previous years with current year. While images will be interpreted briefly in the simple map, to indicate the locations which are experiencing problems (Apendix 1, shows several images of crop vegetation dynamics over Indonesia)

2.3 The crop yield forecasting

The yield forecasts will be based on the analysis of relationship between yield and NDVI data. The NDVI time series for select locations will be included as an appendix to the bulletin. The yield forcast will scheduled at the end of first and second growing period, around mid rainy and late rainy season (an example of yield estimation analysis is shown in appendix 2).

V. PLAN OF FOLLOW UP ACTION IN INDONESIA

1. Installation of equipment and establishment of analysis

In September 1989, the hardware inventory of the agencies cooperating in the phase II will be upgraded with sufficient additions to facilitate the imagery analysis. The Climate Impact Assessment on Crop Production bulletin, which is published monthly since 1984, will incorporate NOAA/AVHRR satellite data products in the form of 1) imagery, and 2) normalized difference vegetation index (NDVI) analysis, in strengthening the existing Early Warning Program.

2. Technical training mission

During mid November-early December 1989, a week long follow-up technical training mission will be conducted in each participating country in order to help ensure that the improved system is operational and self-sustaining.

3. Regional evaluation seminar

A regional evaluation seminar, attended by decision makers from participating countries, will be held at ESCAP. The seminar will 1)evaluate the suitability of the technology, 2)discuss difficulties and successes in implementing the system , and 3)introduce the technology to other interested countries of the region. The meeting will also identify countries to join the phase III replication program.

VI. SUMMARY AND CONCLUSIONS

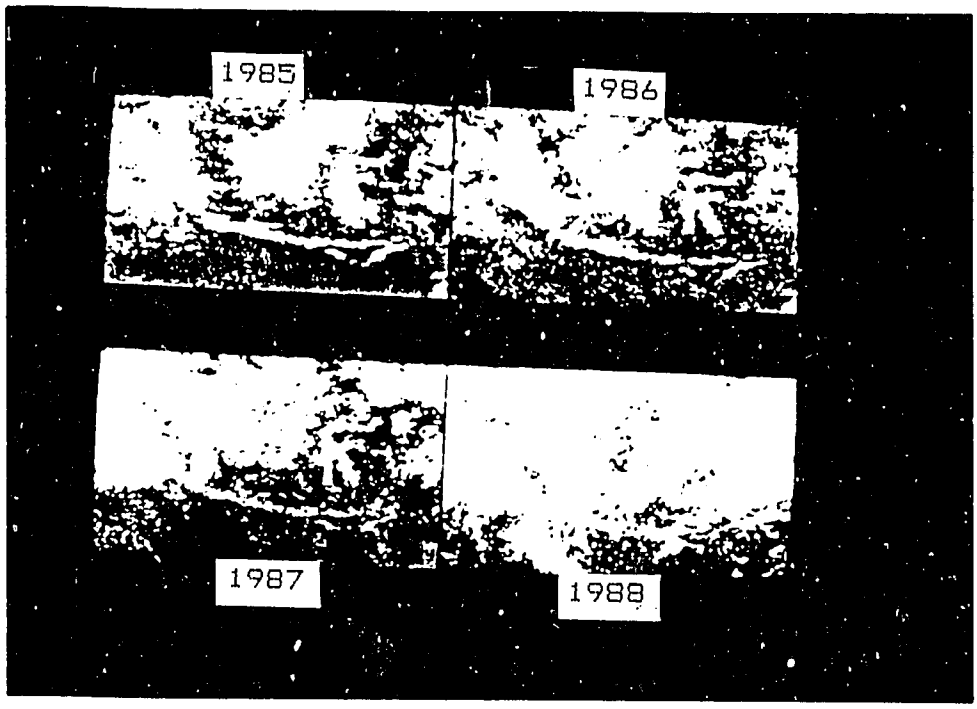
The Satellite Crop Monitorong Technology is designed to compliment the rainfall analysis and move the user one step closer to reliable and timely quantitative crop yield estimates. The imagery analysis, introduced in the second phase training workshop, will be incorporated into monthly drought early warring bulletins already provided in each country as a result of the phase I activities.

This workshop utilized NOAA/AVHRR satellite data which can provide the assessor with timely qualitative estimates of crop and pasture conditions over large areas. The software provided was designed to provide image display capabilities and analytical procedures. One of the main advantages of satellite data is the econamical repetitive coverage which can show a time series of vegetation indices which con indicate the dynamics of vegetation in an area. The utilization of satellite data can provide operational satellite imagery and vegetative index analysis. This technology will move the recipient country one step closer to the end goal of a reliable and timely tool for assessing crop conditions.

By establishing the early warning system, food security program can be significantly improved. several key government agencies responsible for planning and implementing national agricultural and food policies meet at regular intervals during the year and review the overall situation (meteorologiscal, agricultural, and food policies). The key to success of the early warning system is the smooth coordination between the participating agencies (BMG, LAPAN, BULOG and Ministry of Agriculture). It is hoped that technology introduced during Phase II will contribute to successful agricultural and food security program in Indonesia.

Appendix 1

Figure 5 : The images of crop dynamics over Indonesia, 1985-1988



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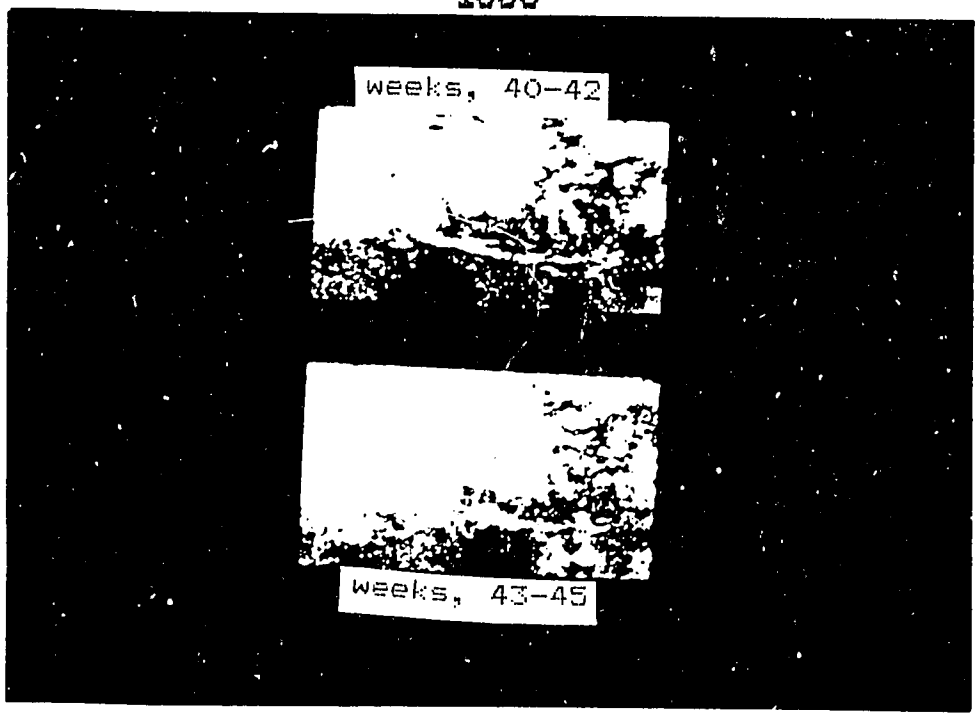


Appendix 2a

Table 3 : Regression result on the NDVI value related to the rice yield and corn yield in East Java, Indonesia (January-April), 1985-1987

I t e m	Explanatory variable	
	Rice	Corn
Dependent variable	NDVI	NDVI
Constant	50.92	23.21
Std. Err. of Y est	3.20	1.82
R squared	0.03	0.04
Number of obs.	15	15
Degrees of freedom	13	13
Regression coef.	0.01	- 0.01
Std. Err. of Coef.	0.02	0.01

Table 4 : Regression result on the NDVI value related to rice yield and corn yield in East Java, Indonesia (May-August), 1985-1987.

I t e m	Explanatory variables	
	Rice	Corn
Dependent variables	NDVI	NDVI
Constant	49.79	26.31
Std. Err. of Y est	2.86	2.82
R squared	0.00	0.14
Number of obs.	15	15
Degrees of freedom	13	13
Regression coef.	0.00	-0.03
Std. Err. of coef.	0.02	0.02

Appendix 2b

Table 5 : Yield, Rainfall and NDVI Data in East Java, Indonesia, 1985-1987.

Observation	RY(5-8) (qt/ha)	CY(5-8) (qt/ha)	R(4-7) (mm)	NDVI(5-8) x 1000
1	50.11	18.02	635	165.80
2	50.00	19.92	536	170.90
3	49.25	22.48	442	177.10
4	51.49	24.84	72	150.00
5	51.45	26.02	240	132.20
6	51.42	26.79	67	159.90
7	49.74	24.27	72	206.90
8	49.39	19.70	240	192.60
9	49.28	20.18	67	209.60
10	51.69	23.48	72	86.00
11	51.89	25.01	240	89.30
12	51.75	26.00	67	77.70
13	45.51	18.53	342	135.40
14	44.57	20.18	626	121.20
15	43.26	22.70	412	119.30

Note: RY(5-8): Rice yield in the period of May-August (qt/ha)
CY(5-8): Corn yield in the period of May-August (qt/ha)
R(4-7) : Rainfall in the period of April-July (mm)
NDVI(5-8): Maximum NDVI in the period of May-August (x1000)

Figure 6

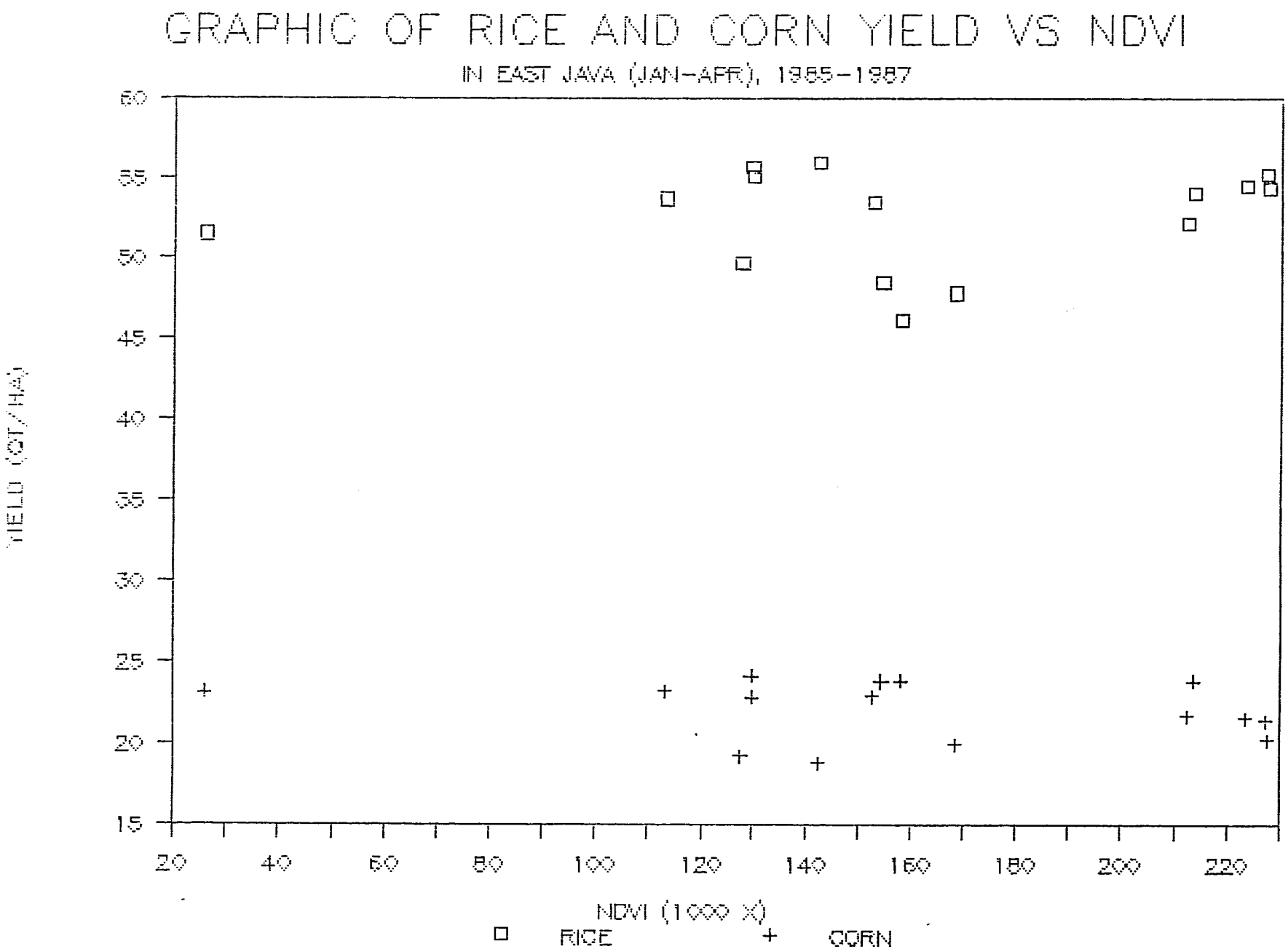
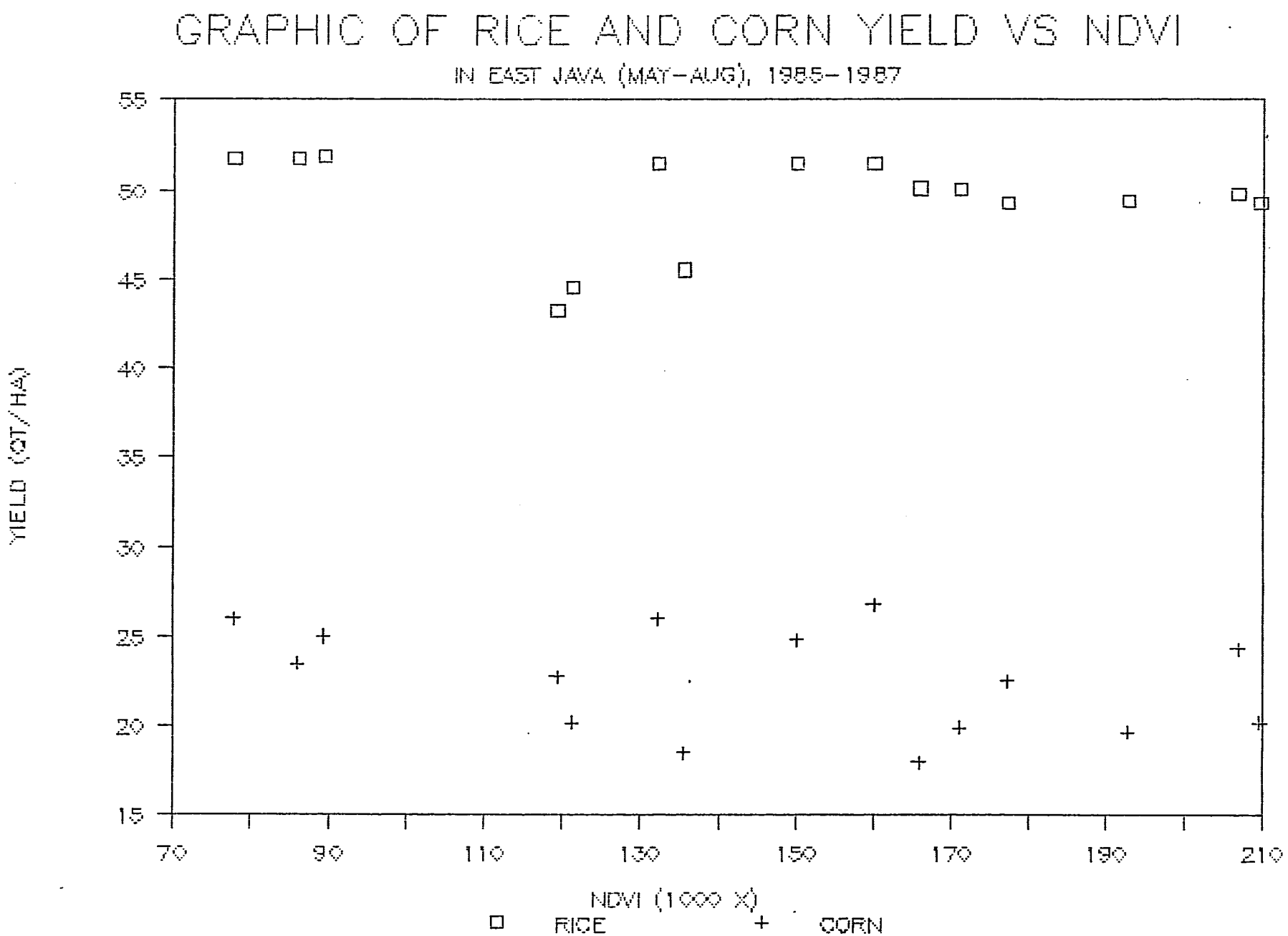

GRAPHIC OF RICE AND CORN YIELD VS NDVI
IN EAST JAVA (JAN-APR), 1985-1987
YIELD (QT/HA)
60
55
50
45
40
35
30
25
20
15
20
40
60
80
100
120
140
160
180
200
220
NDVI (1000 X)
RICE
CORN

Figure 7


GRAPHIC OF RICE AND CORN YIELD VS NDVI
IN EAST JAVA (MAY-AUG), 1985-1987
YIELD (QT/HA)
55
50
45
40
35
30
25
20
15
70
90
110
130
150
170
190
210
NDVI (1000 X)
RICE
CORN

Appendix 3

ORGANIZATIONAL CHART OF PARTICIPATING AGENCIES IN IDONESIA

1. Meteorological and Geophysical Agency (BMG)

Azwar Anas	Minister of Transportation
Karjoto	Director General of Meteorological and Geophysical Agency
Sujadi	Director of Analysis and Processing Center
Sutardjo	Head of Analysis Division
Sutrisno	Head of Climatological Analysis Subdivision
Staff members	

2. National Logistics Agency (BULOG)

Bustanil Arifin	Chairman of BULOG, which is also Minister for Cooperatives
Sukriyaatmadja	Vice Chairman
Dr. Beddu Amang	Deputy Chairman of Procurement and Distribution
Mr. Ibrahim Wiradisastra	Head od Domestic Procurement Bureau
Mr. Johardi Johan	Head of Non Rice Procurement Division
Mohd. Ismet	Head of Non Rice Procurement Sub-division
Staff members	

3. Directorate of Food Crop Protection (DITLIN)

Wardojo	Minister of Agriculture
Dr. Muin Pabinru	Director General of Food Crops
Dr. M. Satta Wigenasantana	Director of Food Crop Protection
M. Rais	Head of Observation and Forecasting Subdirectorate
Zainita	Head of Climatological Section
Erly Tapisari Harahap	Staff of Climatological Section

4. National Institute of Aeronautics and Space

Ibnu Subroto	Chairman of National Institute of Aeronautics and Space
---------	Deputy Chairman for Remote Sensing
Mahsun Irsyam	Head of Center for Remote Sensing Technology
Zalbawi Suyuti	Head of Center for Remote Sensing Application and Head of Remote Sensing Data Bank Division
Bambang Untoro	Head of User Services of Remote Sensing Data Section, and also Research staff NOAA Data Processing

Staff members

Appendix 4

Mailing Addreses and Phone of the Participating Agencies in the Crop Assessment Team :

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3. Meteorological and Geophysical Agency
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   b. Jl. LAPAN Pekayon, Pasar Rebo
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      Jakarta 13710
      Indonesia

Appendix 5

Listing of Equipment and Data Provided Through the Workshop

1. Software

a.	MICVEGI	for	NDVI Time Series Analysis
b.	DRAGON	for	Satellite Image Analysis
c.	XYTOP	for	GVI data and variation of thermal threshold values.
d.	XYCOMP	for	Variation of compositing period with GVI, GAC and LAS data.
e.	XYFILL	for	Variation of Color Tables with the Dragon software and "Filling" AVHRR data.
f.	XYSHIFT	for	Variation of AVHRR data resolution with LAC, GAC and GVI.

2. D a t a

2.1. Global Vegetation Index (GVI) Data
   a. Scaled NDVI data files (53 diskettes)
      (week 15,1985 - week 13, 1989)
   b. Channel data files (24 diskettes)
      (week 40,1985 - week 45, 1988)

2.2. Global Area Coverage (GAC) data
   (channel data files (43 diskettes)

2.3. Local Area Coverage (LAC) data
   (channel data files (1 diskette)

2.4. Boundary data (6 diskettes)

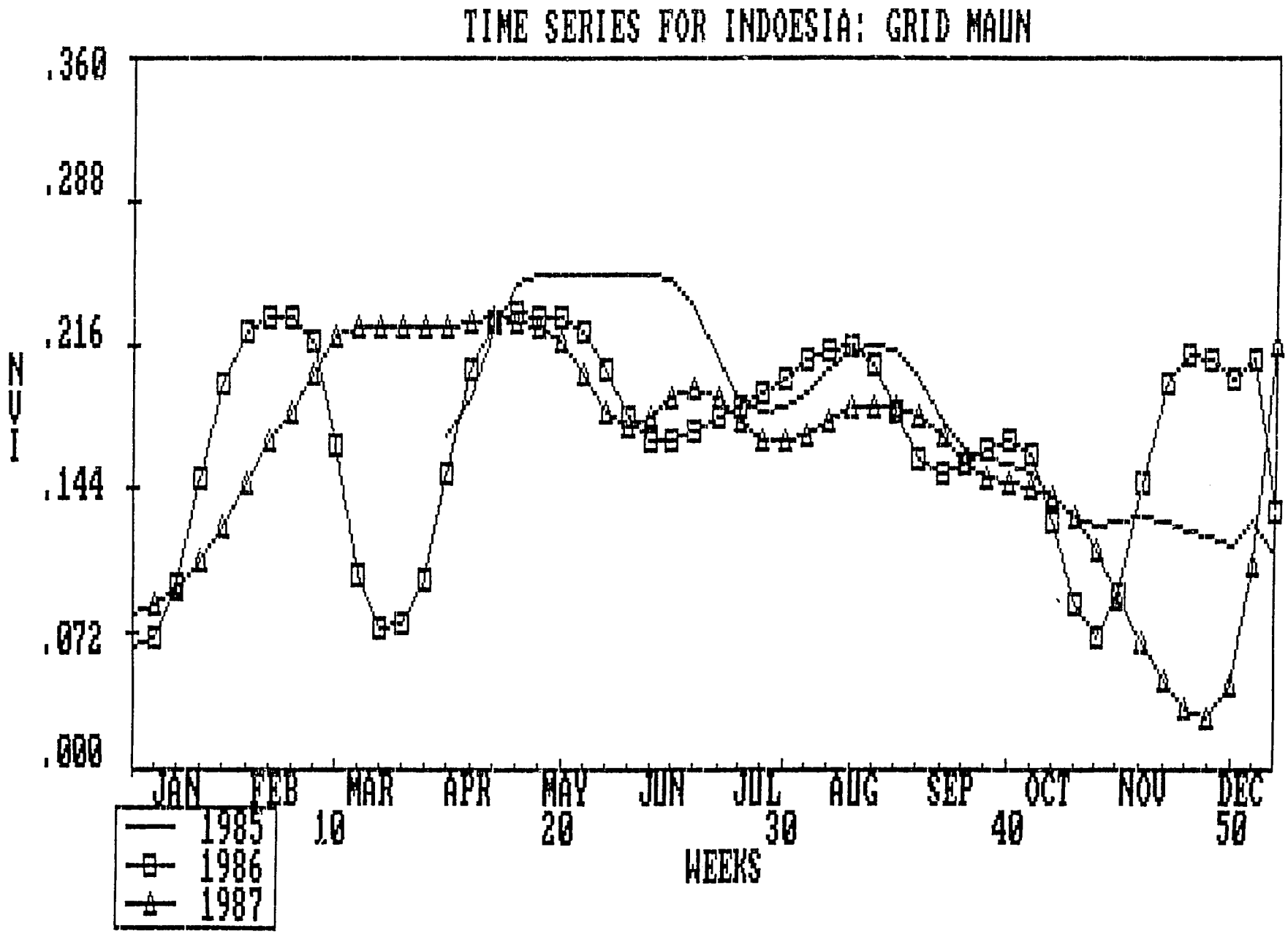

Figure 8a : Time series of NDVI in Madiun, East Java in the period of 1985-1987 (longitude : 111.25 - 111.75 ; latitude : -7.25 - -7.75)

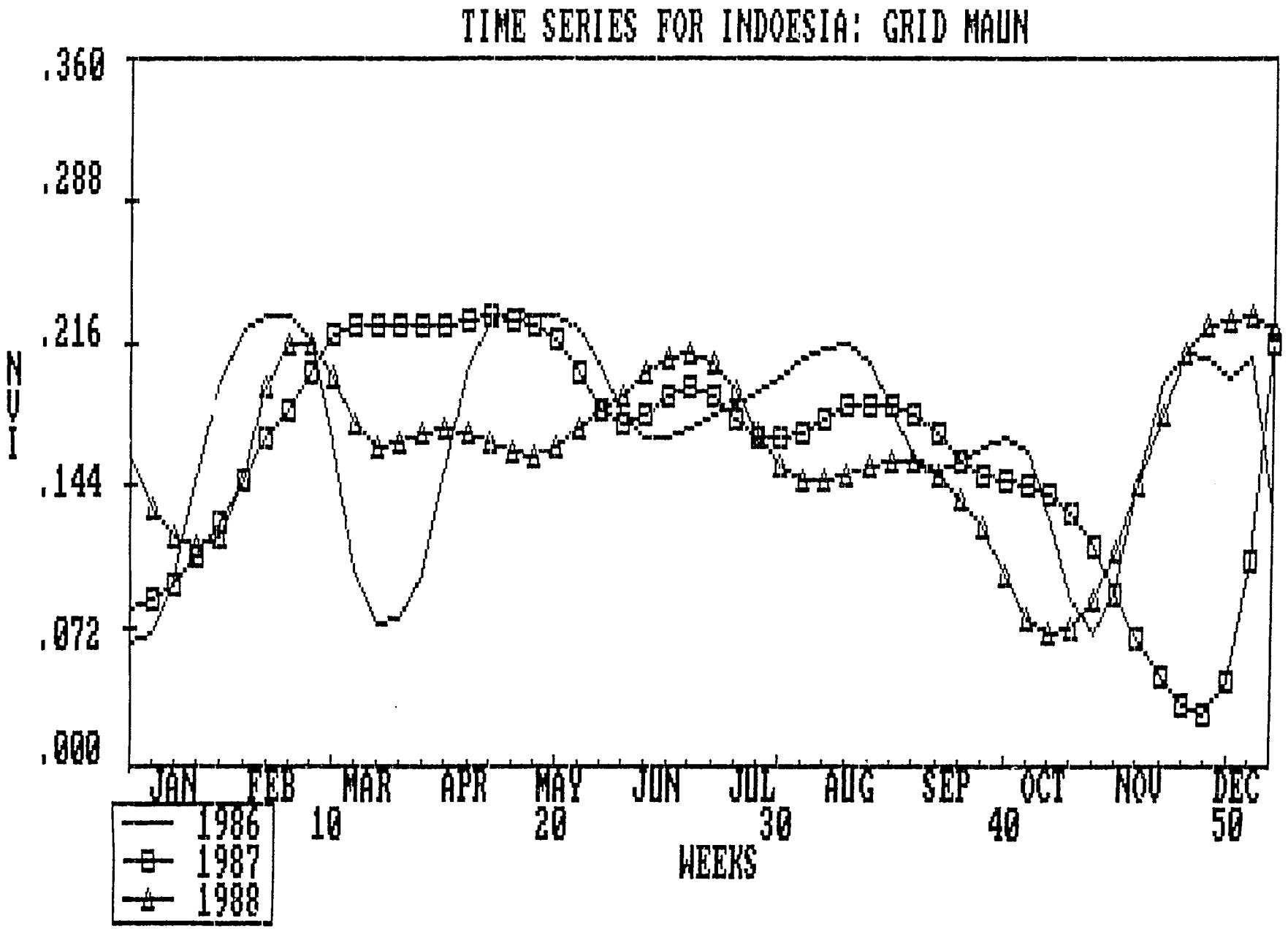

Figure 5b : Time series of NDVI in Madiun, East Java in the period of 1986-1988 (longitude : 111.25 - 111.75 ; latitude : -7.25 - -7.75)

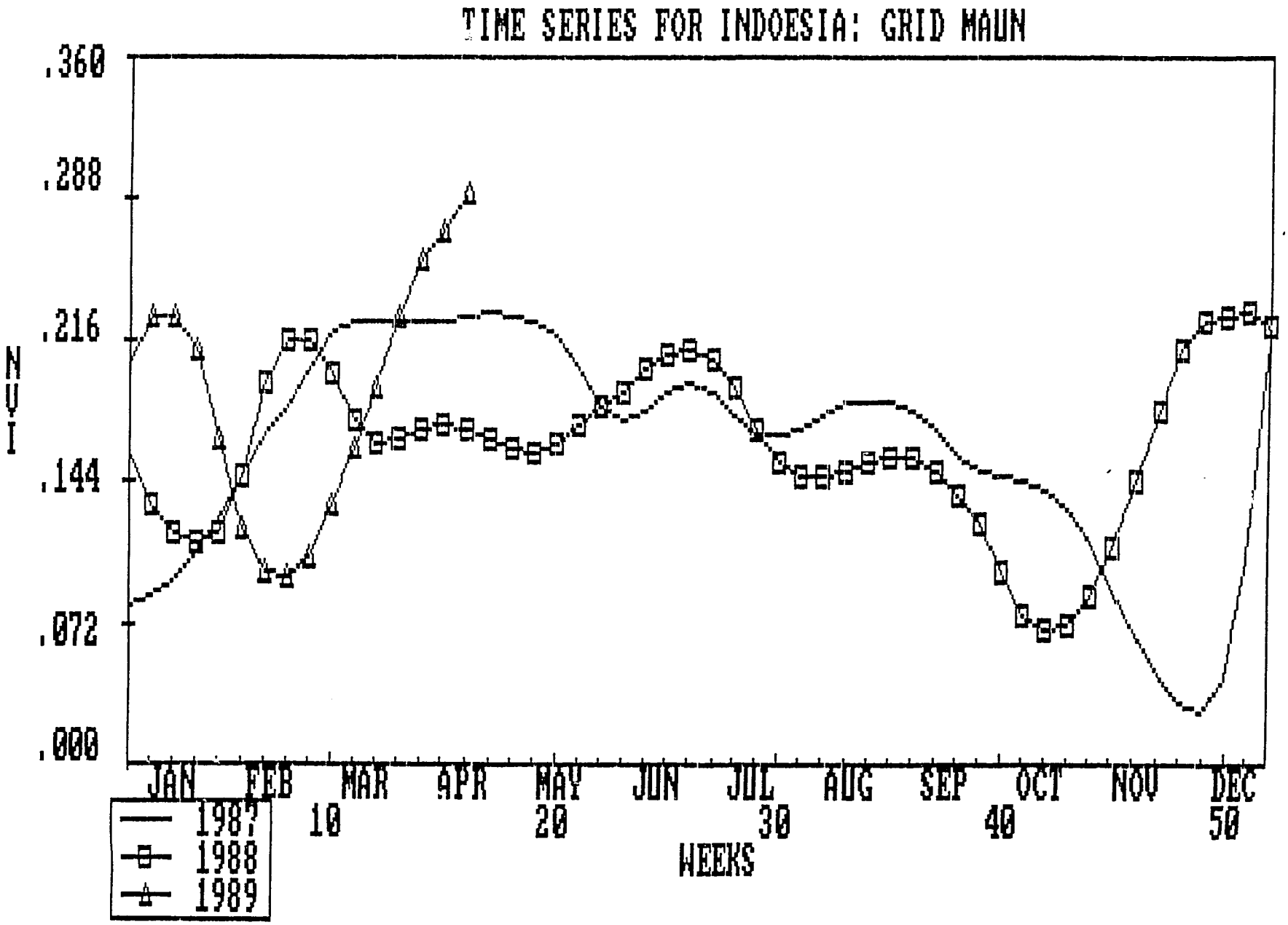

Figure 8c : Time series of NDVI in Madiun, East Java in the period of 1987-1989 (longitude : 111.25 - 111.75 ; latitude : -7.25 - -7.75)

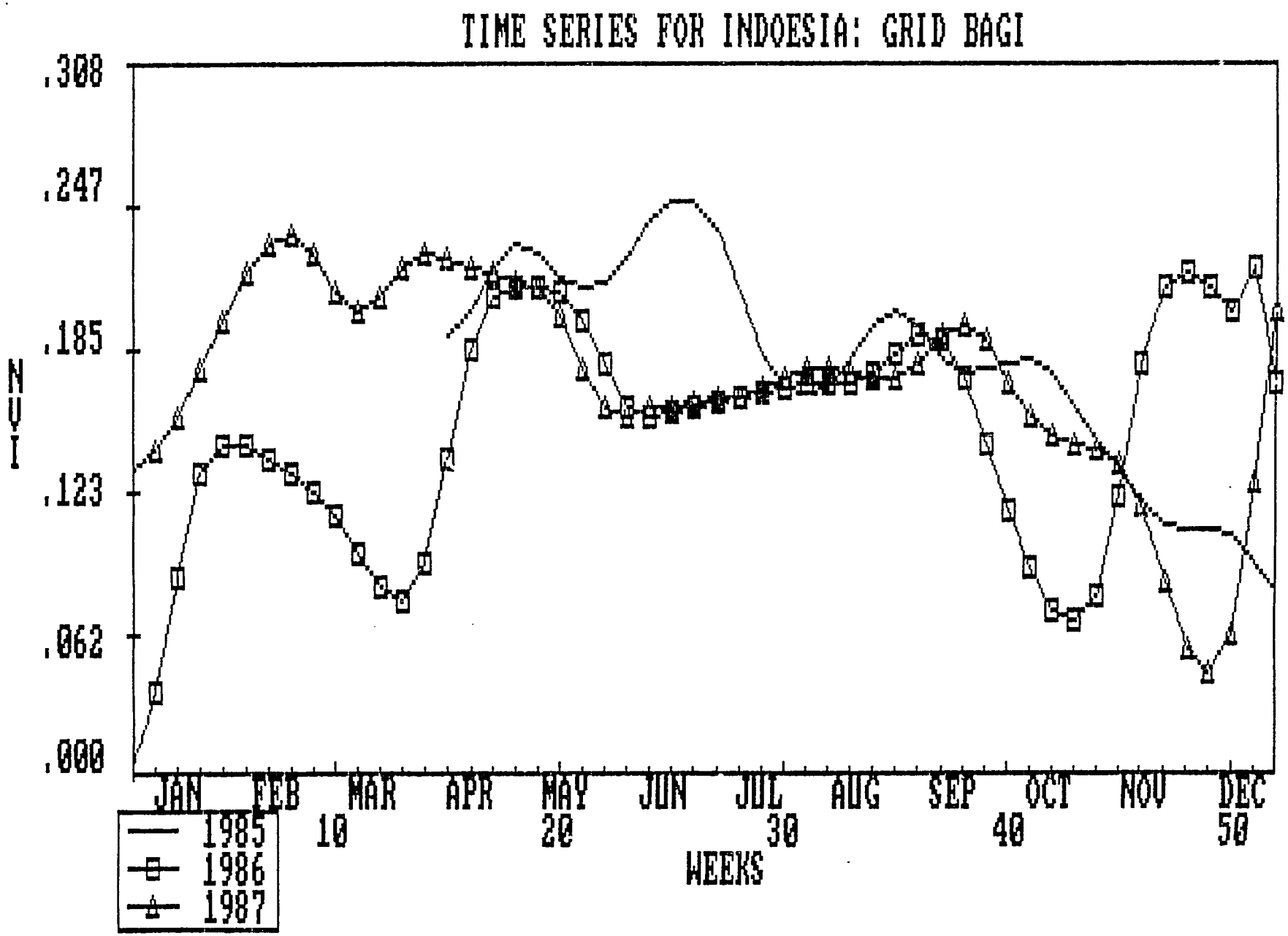

Figure 9a : Time series NDVI in Banyuwangi, East Java in the period of 1985-1987 (longitude : 113.50 - 114.00 ; latitude : -7.75 - -8.25)

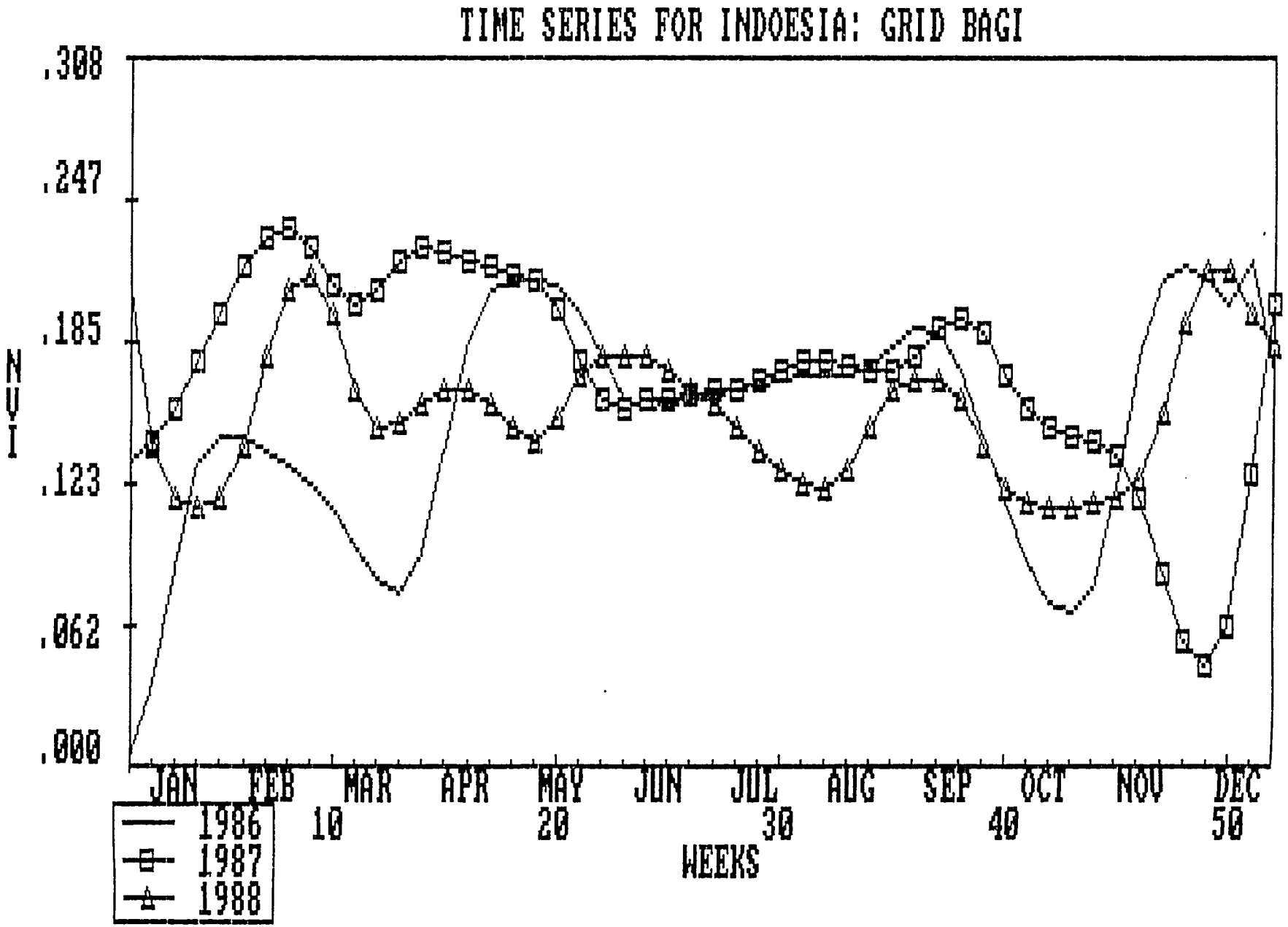

Figure 9b : Time series of NDVI in Banyuwangi, East Java in the period of 1986-1988 (longitude : 113.50 - 114.00 ; latitude : -7.75 - -8.25)

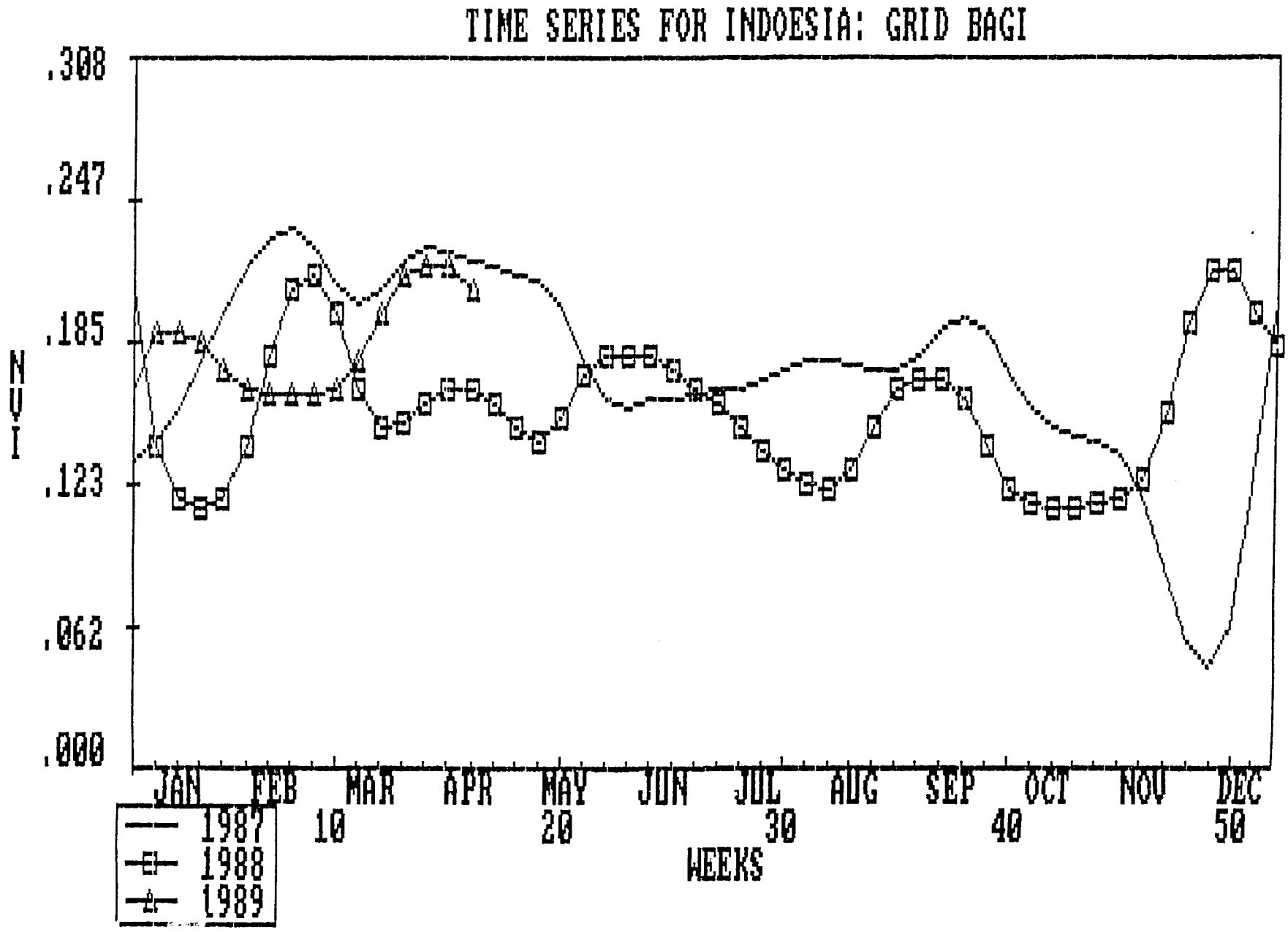

Figure 9c : Time series of NDNI in Banyuwangi, East Java in the period of 1987-1989 (longitude : 113.50 - 114.00 ; latitude : -7.75 - -8.25)