インドネシア
農業開発リモートセンシング計画
帰国専門家報告書Ⅳ

（短期専門家　昭和58年度）

昭和59年8月

国際協力事業団

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はじめに

インドネシア農業開発リモートセンシング計画は，農業開発の適地選定に，リモートセンシング技術を応用したシステムの確立を目差したもので，昭和55年4月から5カ年の計画で技術協力が開始された。

本計画は，先方政府によるセンター施設建設の遅れにより，活動開始に多少の遅れが見られたものの，今日までの関係機関及び関係各位の御協力と御尽力により，アナログ画像解析から評価図作成までを全体システムPRESS(Productive Remote Sensing System)としてとりまとめられた。

本年度は，本計画の最終年度としてこれまでの技術協力を総括することになるが，システムの現地検証等の残された問題点を踏まえ，協力期間の延長についても検討が行われる。

この報告書は，これまでの技術協力の総括として，これまでの専門家の成果を総合報告書の形にまとめたものであり，さらに今後のプロジェクトの発展の為の一助として活用されることを期待するものである。

最後に，これまで御協力頂いた専門家各位，各関係機関に対し心から感謝の意を表する次第である。

昭和59年8月

国際協力事業団
農業開発協力部長
田内　　堯

インドネシア農業開発リモートセンシング計画 帰国専門家報告書 IV
（短期専門家昭和58年度）

対象専門家氏名

分野	氏名	派遣期間	所属
農村計画 (Agrarian Forming)	松尾芳雄 (Yoshio MATSUO)	S 58. 8. 5 ～ 58. 8. 4 ('83. 8. 5 ～'83. 8. 4)	京都大学農学部 (Kyoto Univ.)
地域計画 (Reginal Planning)	若林秀介 (Shusuke WAKABAYASHI)	S 58. 9. 9 ～ 58. 11. 7 ('83. 9. 9 ～'83. 11. 7)	アジア航測株式会社 (AAS)
ソフトウェア開発 (Software)	秋山侃 (Tsuyoshi AKIYAMA)	S 59. 1. 5 ～ 59. 3. 4 ('84. 1. 5 ～'84. 3. 4)	農林水産省農業環境技術研究所(MAFF)
データ処理 (Date Processing)	深山一弥 (Kazuya MIYAMA)	S 59. 1. 5 ～ 59. 3. 4 ('84. 1. 5 ～'84. 3. 4)	農林水産省北海道農業試験場 (MAFF)
生産予測 (Production)	星仰 (Takashi HOSHI)	S 59. 3. 2 ～ 59. 3. 31 ('84. 3. 2 ～'84. 3. 31)	筑波大学電子情報工学系 (Tsukuba Univ.)
生産予測 (Production)	北村貞太郎 (Teitaro KITAMURA)	S 59. 3. 21 ～ 59. 4. 3 ('84. 3. 21 ～'84. 4. 3)	京都大学農学部 (Kyoto Univ.)

農　村　計　画

京都大学農学部
松　尾　芳　雄
（Yoshio MATSUO）

目　　次

1. 派遣概要

1.1, 担当者

松　尾　芳　雄　　　　　京都大学農学部

熱帯農学専攻　　助手

1.2 期　間

自　　昭和58年　8月　6日

至　　　同　　10月　3日　　（59日間）

1.3 目　的

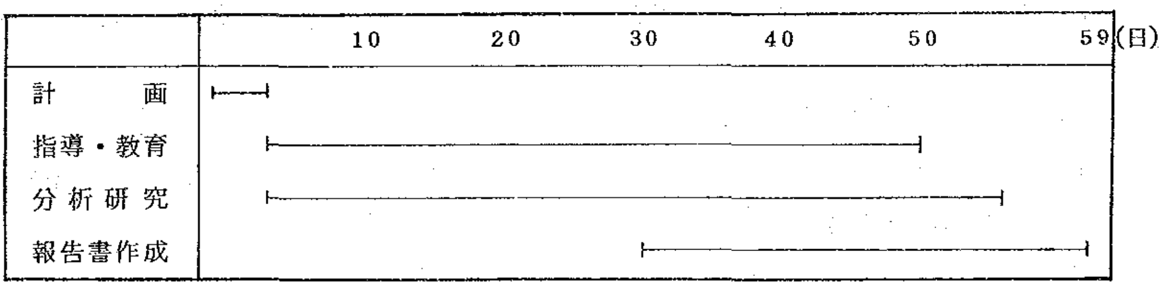
農村計画等に係る研究・指導

農村計画等に係る計算機利用技術の指導・教育を実施するとともに，農業開発適地と現況自然条件との関連分析を行ない各要因の重みを評価する。

2. 計　　画

2.1 スケジュール

着任期間が59日間と短かかったため，日本側長期専門家等との相談のうえで研究内容を定め，またカウンターパートの希望等を考慮し指導内容を決定した。全体のスケジュールは凡そ下記のように余裕を持たせて設定した。



2.2 指導・教育

今回担当したカウンターパートは地理の専門家であり，計算機利用による農村計画についての関心は非常に高いものの，必要となる計算機利用技術について充分な基礎が出きていないと判断された。したがって，計算機による情報処理の方法ならびにその実習に指導・教育のウエイトを置くこととした。これは農村計画については日本での研修が予定されていることを考慮したものである。

2.3 分析対象地域

農業適地関連分析の対象地域として北バンテンのケース・スタディ・エリアが日本人長期専門家より提示された。その理由としてランドサット・データを始めとして各種の主題図の蓄積があること，更に日本人長期専門家の現地調査による土地分級図があることなど

があげられる。そこで，本地域を分析対象地域として設定することとした。

3. 業務内容および成果等

3.1 指導・教育

① 内容

Ⅰ) 地域情報処理のための計算機利用技術としての計算機言語（FORTRAN）教育

Ⅱ) 主題情報の応用処理課題によるFORTRAN実習

Ⅲ) 開発プログラムに対するドキュメンテーションとその作成要領の指導

② 成果

Ⅰ) FORTRAN基本サブルーチン・ライブラリ構想の作成およびその開発およびその使用マニュアルの作成

Ⅱ) マニュアル，ドキュメンテーション作成のための簡易文書処理プログラムの作成

Ⅲ) カウンターパートによる試作プログラム・マニュアル

③ 所感

計算機利用に関しては，一部の情報処理専門のカウンターパートを除き，計算機言語（FORTRAN等）の習熟が前提となる。これは，完成されたソフトウェアの稼動手順のみを知りその操作に従事するオペレーション・レベルにとどまらず，既存ソフトウェアの機能拡充・改良あるいは新規開発への需要が認められる以上，是非とも必要と思われる。この件に関連する項目をまとめると以下のようである。

Ⅰ) システムおよび既存ソフトウェアの平易なオペーレーション・マニュアル

Ⅱ) 基本サブルーチン・ライブラリの早急な充実（特に科学技術計算用のもの，画像処理に固有のもの等）

Ⅲ) 徹底した計算機言語教育

Ⅳ) マニュアルあるいはレポート等の作成のための専用文書処理機の必要性

3.2 分析研究

① 内容容

Ⅰ) 既存主題情報の収集と検討

Ⅱ) 回帰分析プログラムの作成・テストならびに関連プログラムの作成（サンプリング，表集計，回帰推定，図化等）

Ⅲ) 回帰分析の実施（サンプル，変数の組合せによる12ケース）

Ⅳ) 分析結果の考察

② 成果

日本人長期専門家の水田適地分級図を外的基準とし，総数16種の主導図等を説明変数とした重回帰分析の結果から，各主題情報について以下のような知見が事例的に求められた。

Ⅰ）標高，傾斜，降雨

これらの要因はすべて関連性が強く説明力が大きいことが，すべてのケースについて認められた。標高と傾斜の寄与の大きいことは，妥当であり従来の位置付けとも矛盾しない。

しかし，降雨分布については，その寄与の大きさおよびその効き方に必ずしも妥当ではない。これは対象領域の地形的な特性が反映されたものと考えられるが検討の余地が残されている。しかしながら，この要因は，その寄与が大きいため，妥当な理由なくして無視することはできないと考えられる。

Ⅱ）有効土層深

この要因はそれ程説明力を持たないようである。特にオリジナル・ランドサット・データ（73）を含む場合には，寄与が希薄として除外される。恐らくこの要因は標高あるいは傾斜の要因と相関が高く，ここでのような500 *m* メッシュという小縮尺なスケールでは前述の要因との情報的なオーバラップのため冗長なものとなっていると考えられる。

Ⅲ）土壌水分

土壌水分情報はランドサット・データ等を用いて得られた加工処理フェイズ１の情報である。この情報はランドサット・データの比演算に基づく異種情報を含んでいる。しかしながら，その効果は明瞭に表われていない，もしくは他に比べてわずかである。従ってこの要因はこの対象領域にとってそれ程重要ではないと考えられる。

Ⅲ）水資源ポテンシャル・洪水被害

ランドサット・データ（73）を含めなければ，これらの要因の貢献は，わずかではあるが認められる。しかし，ランドサット・デートを含めると，水資源要因の寄与は減少する。このことは，その加工処理の程度は比較的高くまた推定誤差等を含んでいる可能性があることなどの理由によると思われる。

Ⅴ）ランドサット・データ（73）

1973年の4種のランドサット・データはすべて寄与力が大きく，他の要因の相対的価値を落とすことが認められる。しかし，地形条件に関する要因については依然として貢献程度は高く維持される。更に重相関係数は他のケースより高く，回帰モデルとしての説明力も最大である。

このことは，ランドサット・データは何らかの処理を施こさず，直接応用するほうが良いことを示唆していると考えられる。

Ⅵ）ランドサット・データ（76）

この情報のみが他時期のものであり，試験的に投入された。しかし，年度は異なるもののデータ取得時期はほぼ同じであり，3年の間の自然的土地条件の変化の可能性はほとんどないと考えられる（土地被覆は変化する）。それ故この情報を付加することによ

る顕著な寄与はみられなかったと考えられる。

③　所感

ここでの関連分析遂行上の所感を次に記す。

Ⅰ）データ：既存の主題情報等の管理が，個々人の関心のあるもののみ個人的に行なわれているため，またデータ自身が加工されていたりするため，更に領域的にも整合性を欠く場合もあり，データ管理に今後の課題が残されている。

Ⅱ）システム：システムの障害が多く，業務遂行の阻害となる。小は30分程度から大は3日程度の中断を延べ数回余儀なくされた。

Ⅲ）分析：Ⅰ)，Ⅱ)，に関連するが，分析そのものについての時間が充分ではなく，結果の考察を含めて検討の余地が残されている（大学において詰める必要がある）。

以上

4. REPORT ON THE ASSIGNMENT OF REGIONAL DEVELOPMENT AT THE REMOTE SENSING ENGINEERING PROJECT FOR DEVELOPMENT OF AGRICULTURAL INFRASTRUCTURE

Yoshio Matsuo

By Dr. Yoshio MATSUO
JICA expert short term
assigned for Agrarian Forming

I. PERFACE.

With the completion of the assignment to the Remote Sensing Project, I would like to submit a brief report of my activities at the project. The main activities accomplished have been as follows :

(1) Instructions of the computer techniques on the agrarian forming.

1) Instruction of the FORTRAN language for using a computer in order to be able to process regional informations.

2) Programming practice by an applicable process of a thematical informations.

3) Explanation on the necessety of the manual on a developed program and the guidance of a manual making.

4) Construction of a simple word processing program for supporting a manual or documentation making.

(2) An analysis on the interrelation between the agricultural land suitability and current natural conditions.

1) Gathering the existing thematical informations and preconsideration of them and their treatment.

2) Implementation of a step wise regression analysis on the basis of the above results.

3) Evaluation of standard regression coefficients from the results of the analysis.

It is my great pleasure to say that the assignment has been completed successfully as planned at the beginning. Special cooperation and encouragement rendered by many people in the project, in particular the assigned counterpart Drs.Muh.Dimyati is greatly acknowledged.

2. Details on the activities.

(1) Instruction of computer techniques.

1) On FORTRAN language

Using the FORTRAN IV language published by IBM, the basic grammer has been educated to the assigned counterpart. And the procedure for a problem solving by a computer has been also instructed by a simple exercise.

2) Programming practice by FORTRAN.

As a applicable exercise, the problem of mapping a thematical information is given to the counterpart, and the procedures on its processing program making has been taught as a practical lesson. Moreover, the general usage of it is instructed.

3) Program manual.

The necessety of a program manual is explained. Through making the manual on usage of the above program, the method of making a manual is instructed.

On the other hand, a frame work for a basic subroutine library is introduced and developed partially and its manual is proposed.

4) Making of a simple word processing program.

A simple word processing program is made, which can support a manual, documentation, and report making. the above mentioned manual etc has been processed by this program.

(2) An analysis on the interrelation between the agricultural land suitability and current natural conditions.

1) Existing thematical informations and preconditions.

The existing thematical informations are gathered with a same form. The processed degree and the contents of them are checked. Then, the candidate sample for processing are selected and the variable to be used are devided in groups.

2) Regression analysis.

The step wise regression analysis are implemented. Twelve kinds of processing results are obtained from the different combination of samples and explanatory variables.

3) Consideration.

The weights or importances of each thematical informations are considered by its standard partial regression coefficient and their effectiveness is evaluated.

It is thought that this case study will become a good references a s methodology to such a study like this.

3. Remark.

The assigned counterpart is a specialist of geology. He is much interested in a computer assisted agrarian forming and is to be trained on the agrarian forming in Japan. Therefore, the instructions are laid on the computer techniques through a text and practical exercises. On the usage of a computer, almost of all counterparts had better become proficient in the computer language, for example FORTRAN, and PL/1 for the purpose of its efficient use.

On the other hand, the results of regression analyzes shows high relations of the land suitability to the elevation from sea level, the slope gradient and so on from the case study data. But the reliatility of data are thought relatively low, and it is desired that the whole data will be checked and after checking such an analysis will be adapted again.

DEVELOPMENT OF THE BASIC SUBROUTINES FOR FORTRAN APPLICATION PROGRAMS

YOSHIO MATSUO

1. INTRODUCTION

THERE WAS NOT PREPARED A SUBROUTINE LIBRARY FOR THE FORTRAN APPLICATION PROGRAM. BECAUSE THE ALMOST OF ALL APPLICATION SOFTWARES FOR REMOTE SENSING DATA HANDLING, FOR EXAMPLE ARIS, HAS BEEN SUPPLIED AND MADE BY USING A PL/I LANGUAGE. UNTIL NOW, THE APPLICATION PROGRAMS HAS BEEN DEVELOPED MAINLY BY USING THE PL/I, HERE IN THE REMOTE SENSING PROJECT PROMOTED BY THE COOPERATION OF INDONESIA AND JAPAN.

THIS CIRCUMSTANCE IS NOT SO WORKABLE FOR A FORTRAN USER, ESPECIALLY AS THE AUTHOR WHO IS NOT SO FAMILIAR TO THE PL/I. THEREFORE, DURING THE DEVELOPMENT A PROCESSING PROGRAM WITH RESPECT TO THE AUTHOR'S NECESSITY, BASIC SUBROUTINES WERE MADE AS IN AN INDEPENDENT STYLE AS POSSIBLE, FOR THE SAKE OF THEIR GENERAL USE.

2.BASIC SUBROUTINES

SUBROUTINES INTRODUCED HERE ARE AS FOLLOWS.

1) CHRCON...CONVERTER OF A NUMERICAL VALUE TO A NUMERIC CHARACTER STRING
2) CLMHDR...GENERATOR OF A COLUMN HEADER/FOOTER OF A SYMBOL MAPPING
3) COMPRS...COMPRESSER OF TWO/FOUR BYTE INTEGER DATA TO ONE BYTE STARING DATA
4) DCMPRS...DECOMPRESSER OF ONE BYTE STRING DATA TO TWO/FOUR BYTE INTEGER DATA
5) FILESF...CHECKING OF THE EXISTENCE OF A SPECIFIED FILE
6) FLDCLR...CLAERING THE CRT TERMINAL AND SETTING A POINTER AT THE FIRST POSITION
7) FMTGEN...FORMAT GENERATOR FOR IMAGE DATA INPUT/OUTPUT
8) FRAMEP...SPECIFICATION OF A PROCESSING PARAMETERS ON FRAME
9) INIMGS...FILE DEFINITION FOR IMAGE-FILES INPUT
10) LINGET...ONE LINE DATA GET AND DECOMPRESSION OF IT
11) LNSEEK...SETTER AN INPUT POINTER AT AN ARBITRARY POSITION
12) RDARRY...DATA READ BY AN ARRAY WITH A HIGHER SPEED
13) SETFIL...SPECIFICATION AND DEFINITION OF AN INPUT/OUTPUT FILE
14) SMINVS...CALCULATION OF AN INVERSE MATRIX FOR A SINGLE

PRECISION TYPE

15) SMINVD...CALCULATION OF AN INVERSE MATRIX FOR A DOUBLE

PRECISION TYPE

16) WDCHK....EXTRACTION OF WORDS BETWEEN DELIMINATERS

17) WTARRY...DATA OUTPUT BY AN ARRAY WITH A HIGHER SPEED

3.DOCUMENTAION FOR THEIR USAGE

THE FUNCTION AND USAGE OF EACH SUBROUTINE ARE AS FOLLOWS.

3.1. CHRCON (NUMBER,MCHRS,STRING,NCHRS,&NNN)

FUNCTION... CONVERTS A NUMERICAL VALUE TO A NUMERIC CHARACTER STRING

ARGUMENTS...

-NUMBER ;NUMERICAL VALUE TO BE CONVERTED (I*4,IN)

-MCHRS ;THE MAXIMUM ORDER OF A NUMBER (I*4,IN)

-STRING ;CONVERTED NUMERIC CHARACTER STRING (C*MCHRS,OUT)

-NCHRS ;THE NUMBER OF CONVERTED CHARACTERS (I*4,OUT)

-NNN ;A STATEMENT NUMBER FOR THE CASE OF A NEGATIVE VALUE

NOTE....... "(I*4,IN)" MEANS RESPECTIVELY A FOUR BYTE INTEGER AND THE INPUT TO THIS SUBROUTINE AND (C*MCHRS,OUT), "MCHARS" CHARACTERS AND THE OUTPUT FROM THIS. IN ADDITION TO THESE, R*4 WILL MEANS A FOUR BYTE RAEL, TOO. THE METHOD OF SUCH REPRESENTAION IS ADAPTED IN THE LATER FROM THIS.

AN EXAMPLE...

```
CALLING PROGRAM

     INTEGER*4 NUMBER,MCHRS,NCHRS
     LOGICAL*1 STRING(8)
       .
       .
       .
     MCHRS=8
       .
     READ (5,*) NUMBER
       .
       .
       .
     CALL CHRCON (NUMBER,MCHRS,STRING,NCHRS,&100)
     WRITE (6,10) NUMBER,STRING,NCHRS
  10 FORMAT(1X,I8,1S,8A1,1X,I8)
       .
       .
       .
 100 STOP
```

3.2. CLMHDR (CSTART,CEND,CSKIP,UPDOWN)

FUNCTION... GENERATES THE COLUMN HEADER/FOOTER OF SYMBOL MAPPING AS A COLUMN SCALE

ARGUMENTS...

- -CSTART; THE VALUE FOR A START COLUMN (I*4,IN)
- -CEND ; THE VALUE FOR A END COLUMN (I*4,IN)
- -CSKIP ; THE VALUE FOR SKIPPING (I*4,IN)
- -UPDOWN; AN OPTION FOR A HEADER OR A FOOTER (I*4,IN)

  UPDOWN = 0 ; FOR A HEADER

  1 ; FOR A FOOTER

AN EXAMPLE...

```
CALLING PROGRAM

     INTEGER*4 CSTART,CEND,CSKIP
      .
      .
      .
     CALL CLMHDR (CSART,CEND,CSKIP,0)
      .
      .
      .
     CALL CLMHDR (CSART,CEND,CSKIP,1)
      .
      .
```

3.3. CMPRSS (OPT,BS,BE,BK,INDATA,OUTDAT)

FUNCTION... COMPRESSES TWO BYTE OR FOUR BYTE INTEGER DATA TO ONE BYTE CHARACTER DATA FOR OUTPUT IMAGE DATA

ARGUMENTS...

-OPT ; AN OPTION FOR INPUT DATA TYPE (I*4,IN)

OPT = 2 ; TWO BYTE INTEGER DATA

4 ; FOUR BYTE INTEGER DATA

-BS ; THE NUMBER OF THE START ELEMENT FOR PROCESSING OF INPUT DATA ARRAY (I*4,IN)

-BE ; THE NUMBER OF THE END ELEMENT FOR PROCESSING INPUT DATA ARRAY (I*4,IN)

-BK ; THE NUMBER OF ELEMENTS SKIPPED (I*4,IN)

-INDATA; THE INPUT DATA ARRAY (I*4,IN)

-OUTDAT; THE COMPRESSED DATA ARRAY (C*1,OUT)

AN EXAMPLE...

```
CALLING PROGRAM

     INTEGER*4 BS,BE,BK,INDATA(1000)
      .
      .
```

```
LOGICAL*1 OUTDAT(1000)
  .
  .
  .
READ (5,*) BS,BE,BK
  .
  .
  .
CALL COMPRS (4,BS,BE,BK,INDATA,OUTDAT)
  .
  .
```

3.4. DCMPRS (OPT,BS,BE,BK,INDATA,OUTDAT)

FUNCTION... DECOMPRESSES THE ONE BYTE IMAGE DATA TO TWO OR FOUR BYTE INTEGER DATA FOR MAKING IT POSSIBLE TO CALCULATE IMAGE DATA BY A FORTRAN

ARGUMENTS...

- -OPT ; AN OPTION FOR OUTPUT DATA TYPE (I*4,IN)
  - OPT = 2 ; TWO BYTE INTEGER DATA
  - 4 ; FOUR BYTE INTEGER DATA
- -BS ; THE NUMBER OF THE START ELEMENT FOR PROCESSING OF INPUT DATA ARRAY (I*4,IN)
- -BE ; THE NUMBER OF THE END ELEMENT FOR PROCESSING OF INPUT DATA ARRAY (I*4,IN)
- -BK ; THE NUMBER OF ELEMENTS SKIPPED (I*4,IN)
- -INDATA; THE INPUT DATA ARRAY (I*2/I*4,IN)
- -OUTDAT; THE DECOMPRESSED DATA ARRAY (C*1,OUT)

NOTE...... "INDATA" TYPE IS CHANGED WITH RESPECT TO THE VALUE OF "OPT".

AN EXAMPLE...

```
  CALLING PROGRAM

      INTEGER*4 BS,BE,BK

      INTEGER*2 OUTDAT(1000)

      LOGICAL*1 INDATA(1000)
        .
        .
        .
      READ (5,*) BS,BE,BK
        .
        .
        .
      CALL DCMPRS (2,BS,BE,BK,INDATA,OUTDAT)
        .
        .
```

3.5. FILESF (FN,FT,FM,IRC,LRECL,RECORD)

FUNCTION... CHECKS THE EXISTENCE OF A SPECIFIED FILE AND IN THE CASE OF EXISTING GETS THE FILE PARAMETERS

ARGUMENTS...

- -FN ; A FILE NAME (C*8,IN)
- -FT ; A FILE TYPE (C*8,IN)
- -FM ; A FILE MODE (C*8,IN)
- -IRC ; A RETURN CODE ON THE EXISTENCE (I*4,OUT)
- -LRECL ; THE LOGICAL RECORD LENGTH (I*4,OUT)
- -RECORD; THE NUMBER OF RECORDS (I*4,OUT)

NOTE...... IF THE FILE EXISTING, "IRC" IS SETTED TO ZERO.

EXAMPLE...

```
  CALLING PROGRAM

      REAL*8 FN,FT,FM

      INTEGER*4 IRC,LRECL,RECORD
        .
        .
```

```
      READ (5,50000) FN,FT,FM
50000 FORMAT(3A8)
        :
      CALL FILESF (FN,FT,FM,IRC,LRECL,RECORD)
      IF(IRC.NE.0) GOTO 100
        :
  100 CONTINUE
        .
```

3.6. FLDCLR

FUNCTION... CLEARS THE CRT TERMINAL AND SETS AN ALPHA CURSCOR AT A START OF THE FIST LINE

ARGUMENT... NONE

NOTE....... THIS SUBROUTINE IS CODED BY AN ASSEMBLER AND SUPPLIED BY KIMOTO CORPORATION. THIS ROUTINE IS INTRODUCED HERE FOR THE SAKE OF USERS.

3.7. FMTGEN (LRECL,FMT,&NNN)

FUNCTION... GENERATES THE FORMAT OF AN INPUT/OUTPUT OF IMAGE FILE AND SO ON, AS A CHARACTER STRING.

ARGUMENTS...

- -LRECL ;THE LOGICAL RECORD LENGTH (I*4,IN)
- -FMT ;A CHARACTER STRING STORING FORMAT DESCRIPTION (C*80,OUT)
- -NNN ;STATEMENT NUMBER IN THE CASE OF A WRONG LRECL

AN EXAMPLE...

CALLING PROGRAM

```
      LOGICAL*1 FMT(80)
      INTEGER*4 LRECL,PIXEL(1000)
      READ (5,*) LRECL
        .
        .
        .
      CALL FMTGEN (LRECL,FMT,&100)
        .
        .
        .
      READ (LUN,FMT) (PIXEL(I),I=1,LRECL)
        .
        .
```

3.8. FRAMEP (LSTART,LEND,LSKIP,CSTART,CEND,CSKIP)

FUNCTION... ACQUIRES A PROCESSING FRAME DATA, SIX PARAMETERS FROM USER'S SPECIFICATION

ARGUMENTS...

-LSTART; THE NUMBER SHOWING A START LINE (I*4,OUT)

-LEND ; THE NUMBER SHOWING A END LINE (I*4,IN/OUT)

-LSKIP ; THE NUMBER SHOWING LINE SKIPS (I*4,OUT)

-CSTART; THE NUMBER SHOWING A START COLUMN (I*4,OUT)

-CEND ; THE NUMBER SHOWING A END COLUMN (I*4,IN/OUT)

-CSKIP ; THE NUMBER SHOWING COLUMN SKIPS (I*4,OUT)

NOTE....... THE METHOD OF SPECIFICATION IS AS FOLLOWS.

' &FRAME CSKIP=3,LEND=1234,&END'

THE KEYED IN STRING MUST BEGIN FROM ONE SPACE ' ' AND PARAMETERS TO BE SPECIFIED MUST BE INTERLEAVED

BY '&FRAME' AND ',&END'. THESE PARAMETERS HAVE THE FOLLOWING DEFAULT VALUE.

CSTART & LSTART ... 1

CEND & LEND .... GIVEN BY AN IMAGE SIZE AS AN INPUT

CSKIP.............. GIVEN BY (CEND-1)/120+1

LSKIP.............. 1.6*CSKIP

IF THE USER ADAPTS A DEFAULT VALUE, ITS SPECIFICATION CAN BE OMITTED.

AN EXAMPLE...

CALLING PROGRAM

```
      INTEGER*4 CSTART,CEND,CSKIP,LSTART,LEND,LSKIP
        .
        .
        .
      CEND=148
      LEND=140
      CALL FRAMEP (LSTART,LEND,LSKIP,CSTART,CEND,CSKIP)
        .
        .
        .
```

3.9. INIMGS (IMAGES,LUNSTR,NLINE,NCOLM,&NNN)

FUNCTION... FILE DEFINITION FOR INPUT IMAGE FILES

ARGUMENTS...

-IMAGES; THE NUMBER OF INPUT IMAGES (I*4,IN)

-LUNSTR; THE STARTING LOGICAL UNIT NUMBER (I*4,IN)

-NLINE ; NO. OF LINES AS AN IMAGE SIZE PARAMETER (I*4,OUT)

-NCOLM ; NO. OF COLUMNS AS AN IMAGE SIZE PARAMETER

(I*4,OUT)

-NNN ;STATEMENT NO. IN CASE OF DISMATCH IMAGE SIZE

NOTE....... THIS SUBROUTINE REQUIRES THE SAME SIZE OF ALL IMAGES.

AN EXAMPLE...

```
  CALLING PROGRAM
        INTEGER*4 IMAGES,LUNSTR/50/
        READ (5,*) IMAGES
          .
          :
        CALL INIMGS (IMAGES,LUNSTR,NLINE,NCOLM,&10)
          .
          :
     10 STOP
          :
```

3.10. LINGET

(OPT,LUN,FMT,LRECL,INBUF2,INBUF4,CS,CE,CK,&NNN,&MMM)

FUNCTION... READS ONE LINE DATA AND DECOMPRESSES AS SPECIFIED.

ARGUMENTS...

-OPT :AN OPTION FOR OUTPUT DATA TYPE (I*4,IN)

OPT = 2 ; TWO BYTE INTEGER DATA STORED IN INBUF2

= 4 ; FOUR BYTE INTEGER DATA STORED IN INBUF4

-FMT :THE ARRAY STRING FOR THE FORMAT DATA (C*80,IN)

-LRECL :THE LOGICAL RECORD LENGTH (I*4,IN)

-INBUF2:THE ARRAY FOR TWO BYTE INTEGER DATA (I*2,OUT)

-INBUF4:THE ARRAY FOR FOUR BYTE INTEGER DATA (I*4,OUT)

-CS :THE COLUMN START FOR DECOMPRESSION (I*4,IN)

-CE :THE END COLUMN FOR DECOMPRESSION (I*4,IN)

-CK :THE SKIP COLUMN FOR DECOMPRESSION (I*4,IN)

```
     -NNN :STATEMENT NO. IN THE CASE OF DETECTING THE EOF
     -MMM :STATEMENT NO. IN THE CASE OF FINDING AN ERROR
NOTE...... THIS PROGRAM CONSISTS OF "RDARRY" AND "DCMPRS".
AN EXAMPLE...
  CALLING PROGRAM
      INTEGER*2 INBF2(10000)
      INTEGER*4 OPT/2/,CS,CE,CK,FMT(20),DUMMY(10000)
      READ (5,*) LRECL,CS,CE,CK
      CALL FMTGEN (LRECL,FMT)
       :
      CALL LINGET (OPT,50,FMT,LRECL,INBF2,DUMMY,CS,CE,CK,&3,&5)
       :
```

3.11. LNSEEK (LUN,CURRNT,TARGET,&NNN)

```
FUNCTION... MOVE THE POINTER OF INPUT RECORD BY SPACING
            FORWARD OR BACKWARD
ARGUMENTS...
     -LUN ;THE LOGICAL UNIT NUMBER ASSIGNED TO A INPUT FILE
            (I*4,IN)
     -CURRNT;THE CURRENTLY READED RECORD NUMBER (I*4,IN)
     -TARGET;THE NEXT RECORD NUMBER TO BE READ (I*4,IN)
     -NNN ;STATEMENT NUMBER IN THE CASE OF DETECTING THE EOF
AN EXAMPLE...
  CALLING PROGRAM
      INTEGER*4 LUN,CURRNT,TARGET
      CURRNT=0
      DO 100 LIN=1,LEND,LSKIP
```

```
      TARGET=LIN
      CALL LNSEEK (LUN,CURRNT,TARGET,&200)  CURRNT=TARGET
      READ (LUN,......
  100 CONTINUE
  200 STOP
```

3.12. RDARRY (LUN,FMT,CHARS,STRING,&NNN,&MMM)

FUNCTION... READ A STRING DATA BY AN ARRAY WITH A HIGHER SPEED

ARGUMENTS...

- -LUN ;THE LOGICAL UNIT NUMBER (I*4,IN)
- -FMT ;THE ARRAY STORING THE FORMAT DATA (C*80,IN)
- -CHARS ;THE NUMBER OF CHARACTERS TO BE INPUTTED (I*4,IN)
- -STRING;THE CHARACTER STRING STORING INPUT DATA (C*CHARS,OUT)
- -NNN ;STATEMENT NUMBER IN THE CASE OF DETECTING THE EOF
- -MMM ;STATEMENT NUMBER IN THE CASE OF DETECTING ERROR

AN EXAMPLE...

```
  CALLING PROGRAM
      LOGICAL*1 STRING(10000),FMT(80)
      INTEGER*4 LUN,CHARS
        .
        .
        .
      LUN=9
      CALL RDARRY (LUN,FMT,CHARS,STRING,&100,&200)
        .
        .
        .
  100 CONTINUE
        .
```

```
  200 CONTINUE
       .
       .
       .
```

3.13. SETFIL (LINES,COLMNS,OPT,LUN)

FUNCTION... DEFINES AN INPUT/OUTPUT FILE

ARGUMENTS...

-LINES ;THE NUMBER OF RECORDS (I*4,OUT)

-COLMNS;THE NUMBER OF LOGICAL RECORD LENGTH (I*4,IN/OUT)

-OPT ;OPTION FOR SPECIFYING AS AN INPUT/OUTPUT (I*4,IN)

OPT = 0 ; FOR OUTPUT

1 ; FOR INPUT

-LUN ;THE LOGICAL UNIT NUMBER ASSIGNED TO A FILE (I*4,IN)

NOTE....... THE ARGUMENT COLMNS IS AN INPUT WHEN OPT = 0, AND AN OUTPUT IN THE ELSE CASE

AN EXAMPLE...

CALLING PROGRAM

```
      INTEGER*4 LINES,COLMNS,OPT,LUN
        .
        .
        .
      CALL SETFIL (LINES,COLMNS,1,50)
      LUN=60
      CALL SETFIL (LINES,COLMNS,0,LUN)
        .
        .
        .
```

3.14. SMINVS (A,M,N,DET,IWK)

FUNCTION... CALCULATE THE INVERSE OF AN INPUTTED MATRIX

ARGUMENTS... -A :AN INPUTTED MATRIX GIVEN AS AN ARRAY A(M,N)
AND INVERSE MATRIX IS STORED IN (R*4,IN/OUT)

-M :SIZE FACTER OF AN INPUTTED MATRIX (I*4,IN)

-N :SIZE FACTER GIVEN BY M+1 (I*4,IN)

-DET:THE DETERMINANT OF INPUTTED MATRIX (R*4,OUT)

-IWK:WORK SPACE FOR CALCULATION AS AN ARRAY IWK(N) (I*2)

AN EXAMPLE...

CALLING PROGRAM

```
      DIMENSION A(50,51),IWK(40)
        :
        .
      CALL SMINVS (A,50,51,DET,IWK)
        .
        :
```

3.15. SMINVD (A,M,N,DET,IWK)

NOTE....... THIS SUBROUTINE HAS THE SAME FUNCTION AS "SMINVS".
THE DIFFERENCES ARE AS FOLLOWS.
MATRIX A AND A VARIABLE DET ARE GIVEN AS DOUBLE PRECISION
A AND DET ; (R*8)

3.16. WDCHK (STRNG,WORD,NW,ANNN)

FUNCTION... RECOGNIZES WORDS INTERLEAVED WITH DELIMINATERS,
WHICH IS GIVEN BY ' ' OR ','

ARGUMENTS...

-STRNG ;A CHARACTER STRING TO BE CHECKED (C*30,IN)

-WORD ;AN ARRAY STORING THE EXTRACTED WORDS(C*8*12,OUT)

-NW ;THE NUMBER OF WORDS EXTRACTED (I*4,OUT)

-NNN ;A STATEMENT NUMBER IN THE CASE OF DETECTING
    NO WORD

NOTE....... IF THE LENGTH OF A WORD EXCESS EIGHT CHARACTERS, THE EXCESS WILL BE NEGLECTED. AND C*8*12 APPEARED THE ABOVE MEANS TWO DIMENSIONAL ARRAY WITH EIGHT CHARACTERS AND TWELVE WORDS.

AN EXAMPLE...

```
  CALLING PROGRAM
      LOGICAL*1 STRING(30),WORD(8,12)
      INTEGER*4 NWORD
      CALL WDCHK (STRING,WORD,NWORD,&100)
        .
        .
        .
  100 CONTINUE
        .
        .
```

3.17. RDARRY (LUN,FMT,CHARS,STRING)

FUNCTION... WRITE A STRING DATA BY AN ARRAY WITH A HIGHER SPEED

ARGUMENTS...

-LUN ;THE LOGICAL UNIT NUMBER (I*4,IN)

-FMT ;THE ARRAY STORING THE FORMAT DATA (C*80,IN)

-CHARS ;THE NUMBER OF CHARACTERS TO BE INPUTTED (I*4,IN)

-STRING;THE CHARACTER STRING STORING INPUT DATA
    (C*CHARS,OUT)

AN EXAMPLE...

CALLING PROGRAM

```
LOGICAL*1 STRING(10000),FMT(80)
INTEGER*4 LUN,CHARS
  .
  .
  .
LUN=9
CALL WTARRY (LUN,FMT,CHARS,STRING)
  .
  .
  .
```

4. REMARKS

GENERALLY SPEAKING, SUBROUTINES CAN BE DIVIDED INTO THE TWO GROUPS IN AN APPLICATION SYSTEM THAT CONSISTS OF MAIN PROGRAMS SHARING A SPECIAL ROLE OR FUNCTION. ONE IS BASIC SUBROUTINES USED COMMONLY AS INTRODUCED HERE. THE OTHER IS APPLICATION SUBROUTINES THAT WILL HAVE A SPECILAL ROLE BUT BE USED ONLY IN A (FEW) APPLICATION MAIN PROGRAM.

THE ENVIRONMENT FOR DEVELOPING A CERTAIN APPLICATION SYSTEM CAN BE EVALUATED PARTIALLY IN ACCORDING TO THE DEGREE OF FULFILMENT OF SUCH A BASIC SUBROUTINE LIBRARY. THE AUTHER TRIED TO MAKE SUCH A LIBRARY FOR THE REMOTE SENSING PROJECT. BUT THE AUTHOR IS LIMITED ON THE PERIOD FOR STAYING HERE AND MUST BE STOPPED, HOWEVER THIS WORK IS NOT FINISHED.

THE AUTHOR HOPE THAT INDONESIAN COUNTER PARTS WILL CONTINUE, IMPROVE AND ADVANCE THIS WORK.

(OCT.30,'83)

5. APPENDIX (SOURCE LIST)

5.1

```
      SUBROUTINE CHRCON (NMBR,NCHR,CHARS,COL,*)
C     *************************************
C     *                                   *
C     *   CONVERT A NUMBER TO CHARACTERS  *
C     *                                   *
C     *************************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      LOGICAL*1 WK(2),CHARS(NCHR)
      INTEGER*2 L
      INTEGER*4 NMBR,COL
      EQUIVALENCE (L,WK)
C
      IF(NMBR) 600,100,200
  100 I=1
      GOTO 300
  200 I=ALOG10(NMBR+.1)+1
  300 L=64
      DO 400 J=1,NCHR
        CHARS(J)=WK(2)
  400 CONTINUE
      NNN=NMBR
      DO 500 J=1,I
        K=10**(I-J)
        L=NNN/K
        NNN=NNN-L*K
        L=L+240
        CHARS(J)=WK(2)
  500 CONTINUE
      COL=I
      RETURN
C
  600 RETURN 1
C
      END
```

5.2

```
      SUBROUTINE CLMHDR (CSTART,CEND,CSKIP,UPDWN)
C     *******************************
C     *                             *
C     *   HEADER/FOOTER OF COLUMN   *
C     *                             *
C     *******************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      INTEGER CSTART,CEND,CSKIP,UPDWN
      INTEGER*2 LP(120)
C
      NTCP=(CEND-CSTART+CSKIP)/CSKIP
```

```
      NPT=(NTCP-1)/120+1
      NO=ALOG10(CEND+1.0)+1
      DO 30 M=1,NPT
        KBN=M+6
        IF(UPDWN.NE.0) WRITE (KBN,60000)
        DO 20 I=1,NO
          JS=CSTART+(M-1)*CSKIP*120
          JE=JS+CSKIP*119
          IF(JE.GT.CEND)JE=CEND
          K=0
          JJ=10**(NO-I)
          DO 10 J=JS,JE,CSKIP
            K=K+1
            KK=J/JJ
            LP(K)=MOD(KK,10)
   10     CONTINUE
          WRITE(KBN,20000) (LP(J),J=1,K)
   20   CONTINUE
        IF(UPDWN.EQ.0) WRITE (KBN,60000)
   30 CONTINUE
      RETURN
C
20000 FORMAT(10X,120I1)
60000 FORMAT(1X)
C
      END
```

5.3

```
      SUBROUTINE COMPRS (OPT,BS,BE,BK,ISRG,OSRG)
C     *************************************
C     *                                   *
C     *   DATA COMPRESS ROUTINE BY A BYTE *
C     *                                   *
C     *       BS: START BYTE POSITION     *
C     *       BE: END   BYTE POSITION     *
C     *       BK: SKIP  BYTE NUMBER       *
C     *                                   *
C     *************************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      LOGICAL*1  ISRG(1), OSRG(1)
      INTEGER*4  OPT,BS,BE,BK
C
      I1=BS*OPT
      I2=BE*OPT
      I3=BK*OPT
      K=0
      DO 10 I=I1,I2,I3
         K=K+1
         OSRG(K)=ISRG(I)
   10 CONTINUE
      RETURN
C
      END
```

5.4

```
      SUBROUTINE DCMPRS (OPT,BS,BE,BK,ISTRNG,OSTRNG)
C     **************************************
C     *                                    *
C     *     BYTE DATA DECOMPRESS ROUTINE   *
C     *                                    *
C     *     OPT: 2: TO 2 BYTES             *
C     *          4: TO 4 BYTES             *
C     *       ELSE: NO COMPLETION          *
C     *                                    *
C     **************************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      LOGICAL*1 NULL/.FALSE./, ISTRNG(1), OSTRNG(1)
      INTEGER*4 OPT,BS,BE,BK
C
      IF(OPT.NE.2.AND.OPT.NE.4) RETURN
      L=0
      J=OPT-1
      DO 20 I=BS,BE,BK
        DO 10 K=1,J
          L=L+1
          OSTRNG(L)=NULL
 10     CONTINUE
        L=L+1
        OSTRNG(L)=ISTRNG(I)
  20  CONTINUE
      RETURN
C
      END
```

5.5

```
      SUBROUTINE FILESF (FNAME,FTYPE,FMD,IRET,XREC,XLEN)
C     **************************************
C     *                                    *
C     *   SEEK FOR IMAGE FRAME PARAMETERS  *
C     *                                    *
C     **************************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      COMMON /FILEID/FILN,FILT,FILM
      COMMON /FILEST/FILEN,FILET,FDT,FTI,WP,RP,FLM,NOR
     &               ,DA,RECFM,LRECL,L8,YE
      COMMON /ERCD/ ERROR
      REAL*8 FNAME,FTYPE,FILN,FILT,FILEN,FILET
      INTEGER*4 LRECL,ERROR,IRET,XREC,XLEN
      INTEGER*2 FMD(4),FILM,FDT,FTI,WP,RP,FLM,NOR,DA,L8,YE
     &                                 ,CF/'F '/,RF/'  '/
      LOGICAL*1 RECFM(2),RCFM1(2)
      EQUIVALENCE (RF,RCFM1)
C
      FILN=FNAME
```

```
      FILT=FTYPE
      FILM=FMD(1)
      IRET=0
      XREC=0
      XLEN=0
      CALL FSTATE
      IRET=ERROR
      IF(IRET.NE.0) GOTO 100
        RCFM1(1)=RECFM(1)
        IF(RF.NE.CF) IRET=100
        XREC=NOR
        XLEN=LRECL
        FMD(1)=FLM
  100 CONTINUE
      RETURN
C
      END
```

5.6 (OMITTED)

5.7

```
      SUBROUTINE FMTGEN (LRECL,FMT,*)
C     ************************
C     *                      *
C     *   FORMAT GENERATOR   *
C     *                      *
C     ************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      LOGICAL*1 CHR,WK(2),RPL/')'/,LPL/'('/,CAL/'A'/,BLL/.FALSE./
     &          ,CML/','/,C1L/'1'/,C2L/'2'/,C5L/'5'/,LENGTH
     &          ,CHECK(4)/'1','2','4','8'/,CCC,FMT(1)
      INTEGER*2 IWK,JWK
      EQUIVALENCE (CHR,WK,IWK),(CCC,JWK)
C
      IF(LRECL.LE.0) GOTO 50
C
      LENGTH=FMT(1)
      CHR=LENGTH
      DO 1  I=1,4
        CCC=CHECK(I)
        IF(IWK.EQ.JWK) GOTO 5
    1 CONTINUE
      LENGTH=C1L
    5 IP=1
      FMT(1)=LPL
      DO 10 I=2,80
        FMT(I)=BLL
   10 CONTINUE
      II=(LRECL-1)/255
      IF(II.EQ.0) GOTO 40
        IF(II.EQ.1) GOTO 20
          NCHR=4
```

```
        CALL CHRCON (II,NCHR,FMT(IP+1),NOCHR,&50)
        IP=IP+NOCHR+1
        FMT(IP)=LPL
 20   FMT(IP+1)=C2L
      FMT(IP+2)=C5L
      FMT(IP+3)=C5L
      FMT(IP+4)=CAL
      FMT(IP+5)=LENGTH
      IP=IP+6
      IF(II.EQ.1) GOTO 30
        FMT(IP)=RPL
        IP=IP+1
 30   FMT(IP)=CML
 40 II=LRECL-II*255
    NCHR=3
    CALL CHRCON (II,NCHR,FMT(IP+1),NOCHR,&50)
    IP=IP+NOCHR
    FMT(IP+1)=CAL
    FMT(IP+2)=LENGTH
    FMT(IP+3)=RPL
    IP=IP+3
    RETURN
C
 50 RETURN1
C
    END
```

5.8

```
      SUBROUTINE FRAMEP (LST,LED,LSP,CST,CED,CSP)
C     ************************************
C     *                                  *
C     *   PARAMETERS SPECICATION ROUTINE *
C     *                                  *
C     ************************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      NAMELIST /FRAME/LSTART,LEND,LSKIP,CSTART,CEND,CSKIP
      INTEGER CSTART,CEND,CSKIP,CST,CED,CSP
C
      CSTART=1
      LSTART=1
      CSKIP =(CED-1)/120+1
      LSKIP =CSKIP*1.6
      LEND=LED
      CEND=CED
      WRITE (6,60000)
      READ (5,FRAME,END=10)
   10 WRITE (6,FRAME)
      CST=CSTART
      LST=LSTART
      LSP=LSKIP
      CSP=CSKIP
      LED=LEND
      CED=CEND
```

```
      RETURN
C
60000 FORMAT(/' **ENTER FRAME PARAMETER WITH &FRAME ...,&END')
      END
```

5.9

```
      SUBROUTINE INIMGS (IMAGES,LUNSTR,NL,NC,*)
C     ***************************************
C     *                                     *
C     *   FILE DEFINITION FOR INPUT IMAGES  *
C     *                                     *
C     ***************************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      INTEGER*4 IMAGES,LUNSTR,NL,NC
C
      WRITE (6,60000) IMAGES
      I=1
      CALL SETFIL (NL,NC,1,LUNSTR)
      WRITE (6,60001) I
      IF(IMAGES.EQ.1) RETURN
      LUN=LUNSTR
      DO 10 I=2,IMAGES
        LUN=LUN+1
        CALL SETFIL (NLN,NCN,1,LUN)
        IF(NLN.NE.NL) RETURN 1
        IF(NCN.NE.NC) RETURN 1
        WRITE (6,60001) I
   10 CONTINUE
      RETURN
C
60000 FORMAT(/'    ASSIGNMENT OF ',I2,' IMAGES')
60001 FORMAT(/'    THE ',I2,'-TH IMAGE JUST ASSIGNED')
      END
```

5.10

```
      SUBROUTINE LINGET (OPT,LUN,FMT,LRECL,STRNG2,STRNG4,CS,CE,CK,*,*)
C     ********************************
C     *                              *
C     *   IMAGE DATA GET BY A LINE   *
C     *                              *
C     ********************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      INTEGER *4 OPT,FMT(20),STRNG4,CS,CE,CK
      INTEGER *2 STRNG2
C
      CALL RDARRY (LUN,FMT,LRECL,STRNG,&1,&2)
      CALL DCMPRS (OPT,CS,CE,CK,STRNG2),
      RETURN
C
  1   RETURN1
C
```

```
  2    RETURN2
C
     , END
```

5.11

```
      SUBROUTINE LNSEEK (LUN,CURRNT,TARGET,*)
C     ********************************
C     *                              *
C     *   TARGET LINE SEEK ROUTINE   *
C     *                              *
C     ********************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      INTEGER CURRNT,TARGET
C
      MOVPNT=TARGET-CURRNT-1
      IF(MOVPNT) 10,30,40
C                                         BACK SPACE
   10 MOVPNT=-MOVPNT
      DO 20 L=1,MOVPNT
        BACKSPACE LUN
   20 CONTINUE
C                                         NO COMPLETION
   30 RETURN
C                                         SPACE FORWARD
   40 DO 50 L=1,MOVPNT
        READ(LUN,50000,END=60)
   50 CONTINUE
      RETURN
C                                         EOF DETECTION
   60 RETURN 1
C
50000 FORMAT(1X)
C
      END
```

5.12

```
      SUBROUTINE RDARRY (KBN,FMT,LRECL,STRING,*,*)
C     ******************************
C     *                            *
C     *   INPUT STRING BY AN ARRAY *
C     *                            *
C     ******************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      LOGICAL*1 FMT(80),STRING(LRECL)
C
C     READ (KBN,FMT,END=10,ERR=20) STRING
      READ (KBN,FMT) STRING
      RETURN
C
C  10 RETURN 2
C
```

```
C   20 RETURN 1
C
       END
```

5.13

```
      SUBROUTINE SETFIL (NOLIN,NOCOL,IOC,KBN)
C     *************************************
C     *                                   *
C     *   FILE SET AND/OR GET FRAME INF.. *
C     *                                   *
C     *************************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      COMMON /PARMS/FID,LUN,UNT,FN,FT,FM,PAR,REC,FMT,BLK,SIZ,IEND(2)
      REAL*8 BLNK/'  '/,FID,LUN,UNT,FN,FT,FM,PAR,REC,FMT,BLK,SIZ,WORD(12)
      INTEGER*2 IODSG(3,2)/'OU','TP','UT',' I','NP','UT'/
     &          ,STRNG(15)/15*'  '/,NO/'NO'/,I
C
      JOC=IOC+1
  100 WRITE(6,60000) (IODSG(I,JOC),I=1,3)
      READ (5,50000,END=200) STRNG
  200 CALL WDCHK (STRNG,WORD,NW,&100)
      FN=WORD(1)
      FT=WORD(2)
      IF(WORD(3).NE.BLNK) FM=WORD(3)
      CALL FILESF (FN,FT,FM,IRET,NOL,NOC)
      IF(IRET.EQ.0) GOTO 300
      IF(IOC.NE.1) GOTO 500
      WRITE(6,60001)
      WRITE(6,60002) UNT,FN,FT,FM
      WRITE(6,60003)
      READ (5,50000) I
      CALL FLDCLR
      GOTO 100
  300 IF(IOC.EQ.1) GOTO 400
      WRITE (6,60004)
      READ (5,50000) I
      IF(I.EQ.NO) GOTO 100
      GOTO 500
  400 NOLIN=NOL
      NOCOL=NOC
      WRITE(6,60005) NOLIN,NOCOL
  500 CALL CHRCON (KBN,8,LUN,J)
      CALL CHRCON (NOCOL,8,SIZ,J)
      WRITE(6,60006) LUN,UNT,FN,FT,FM,PAR,REC,FMT,BLK,SIZ
      WRITE(7,70000) (IODSG(I,JOC),I=1,3),FN,FT,FM
      CALL CMSC
      RETURN
C
50000 FORMAT(15A2)
60000 FORMAT(/' **',3A2,' FILE ASSIGNMENT** / ENTER <FN> <FT> <FM> ...')
60001 FORMAT(' ***ERR / SPECIFIED FILE NOT FOUND / ERR***')
60002 FORMAT(' FILE: ',A5,2A8,A3)
60003 FORMAT(' FILE RE-ASSIGN AFTER STRIKE ANY KEY & ENTER  ')
```

```
60004 FORMAT(' ***SPECIFIED FILE ALREADY EXIST** REWRITE OK ?'
     &       ,' ANSWER WITH YES OR (NO)   ')
60005 FORMAT(' FRAME...',I5,' LINES *',I5,' COLUMNS')
60006 FORMAT(' FI ',A3,A5,2A8,A3,A2,A6,A2,2A6)
70000 FORMAT(/1X,3A2,' FILE ;',2A9,A3)
C
      END
C
      BLOCK DATA
      COMMON /PARMS/FID,LUN,UNT,FN,FT,FM,PAR,REC,FMT,BLK,SIZ,IEND
      INTEGER*4 FID(2)/'FILE','DEF '/
     &          ,LUN(2)/'0   ','    '/
     &          ,UNT(2)/'DISK','    '/
     &          ,FN (2)/'FILN','    '/
     &          ,FT (2)/'FILT','    '/
     &          ,FM (2)/'A1  ','    '/
     &          ,PAR(2)/'(   ','    '/
     &          ,REC(2)/'RECF','M   '/
     &          ,FMT(2)/'F   ','    '/
     &          ,BLK(2)/'BLOC','K   '/
     &          ,SIZ(2)/'1000','0   '/
     &          ,IEND(2)/2*-1/
      END
```

5.14

```
      SUBROUTINE SMINVS (A,M,N,T,INDEX)
C     ********************************
C     *                              *
C     *   INVERSE MATRIX CALCULATION *
C     *                              *
C     ********************************
C     CODED BY Y.MATSUO
C
      INTEGER M,N,PIVR
      INTEGER*2 INDEX(1)
      REAL*4 A(M,N),W,DET,PIV
C
C  INITIALIZATION
      DET=1.0
      DO 70 K=1,M
C  SEACH FOR PIVOT ELEMENT
         PIV=0.
         PIVR=0
         DO 10 I=K,M
           W=ABS(A(I,K))
           IF(PIV.GE.W) GOTO 10
           PIV=W
           PIVR=I
   10    CONTINUE
         INDEX(K)=PIVR
         IF(PIVR.EQ.0) GOTO 100
         IF(PIVR.EQ.K) GOTO 30
C  INTERCHANGE ROWS TO PIVOT ELEMENT ON DIAGONAL
         DO 20 J=1,N
```

```
          W=A(PIVR,J)
          A(PIVR,J)=A(K,J)
          A(K,J)=W
   20   CONTINUE
        DET=-DET
   30   PIV=A(K,K)
        DET=DET*PIV
C   DIVIDE PIVOT ROW BY PIVOT ELEMENT
        A(K,K)=1.0
        DO 40 J=1,N
          A(K,J)=A(K,J)/PIV
   40   CONTINUE
C   REDUCE NON-PIVOT ROWS
        DO 60 I=1,M
          IF(I.EQ.K) GOTO 60
          W=A(I,K)
          A(I,K)=0.
          DO 50 J=1,N
            A(I,J)=A(I,J)-A(K,J)*W
   50     CONTINUE
   60   CONTINUE
   70 CONTINUE
C   INTERCHANGE COLUMNS
      DO 90 KK=2,M
        K=M-KK+1
        INDEXK=INDEX(K)
        IF(INDEXK.EQ.K) GOTO 90
        DO 80 I=1,M
          W=A(I,INDEXK)
          A(I,INDEXK)=A(I,K)
          A(I,K)=W
   80   CONTINUE
   90 CONTINUE
  100 RETURN
C
      END
```

5.15 (OMITTED)

5.16

```
      SUBROUTINE WDCHK (STRNG,WORD,NW,*)
C     *******************************************
C     *                                         *
C     *   DIVIDE THE STRING DATA INTO WORD DATA *
C     *                                         *
C     *******************************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      LOGICAL*1 WK(2),STRNG(30),WORD(8,12)
      INTEGER*2 IWK/'  '/,BLNK/'  '/,CMMA/', '/,PRR
      EQUIVALENCE (WK,IWK)
C
      DO 20 I=1,12
```

```
      DO 10 J=1,8
         WORD(J,I)=WK(1)
   10   CONTINUE
   20 CONTINUE
      NW=1
      NCHR=0
      PRR=CMMA
      DO 60 I=1,30
        IF(NW.GT.12) GOTO 60
        WK(1)=STRNG(I)
        IF(IWK.EQ.BLNK) GOTO 30
        IF(IWK.EQ.CMMA) GOTO 30
        NCHR=NCHR+1
        WORD(NCHR,NW)=STRNG(I)
        GOTO 60
   30   IF(I.EQ.1) GOTO 40
        WK(1)=STRNG(I-1)
        PRR=IWK
   40   IF(PRR.NE.CMMA.AND.PRR.NE.BLNK) GOTO 50
        NW=NW+1
        NCHR=0
        GOTO 60
   50   NW=NW+1
        NCHR=0
   60 CONTINUE
      NW=NW-1
      IF(NW.EQ.0) RETURN 1
      RETURN
C
      END
```

5.17

```
      SUBROUTINE WTARRY (KBN,FMT,LRECL,STRING)
C     ********************************
C     *                              *
C     *   OUTPUT STRING BY AN ARRAY  *
C     *                              *
C     ********************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      LOGICAL*1 FMT(80),STRING(LRECL)
C
      WRITE (KBN,FMT) STRING
      RETURN
C
      END
```

DEVELOPMENT OF A SIMPLE WORD PROCESSER "DPRINT"

YOSHIO MATSUO

1. INTRODUCTION

A SIMPLE WORD PROCESSER HAS BEEN DEVELOPED IN IN THE IBM/370 CMS SYSTEM TAKING ADVANTAGE OF ITS EDITING FACILITY. THIS WORD PROCESSING IS SUPPORTED BY THE FORTRAN PROGRAM "DPRINT", WHICH IS NAMED BY SHORTENING THE 'DOCUMENT PRINT'. THE "DPRINT" PROGRAM MAKES IT POSSIBLE TO REARRANGE A USER'S MANUSCRIPT, FOR EXAMPLE A CERTAIN PROGRAM MANUAL WRITTEN BY ENGLISH, WHICH IS CHARACTER STRING DATA AND MADE BY USING THE CMS EDITER.

THE MAIN FUNCTIONS OF THIS PROGRAM ARE AS FOLLOWS.

1) REARRANGEMENT IN ACCORDING TO USER'S SPECIFIED PAGE SIZE

2) CENTERING PROCESSING

3) RIGHT MARGIN JUSTIFICATION

4) PAGENATING AND GENERATING A FOOTER AUTOMATICALLY

5) PERMITTING FREE FORMATTED MANUSCRIPT EXCEPT FOR WITH A FEW CONTROL CHARACTERS

2. STRUCTURE OF "DPRINT"

THIS PROGRAM CONSISTS OF ONE MAIN AND SEVERAL SUBPROGRAMS WHICH ARE ALL PROGRAMMED BY USING A FORTRAN LANGUAGE. THE MAIN PROGRAM IS NAMED "DPRINT" AS MENTIONED ABOVE, WHICH PLAYS THE ROLE AS THE CONTROLER OF A WHOLE WORD PROCESSING AND HAS A MAIN FUNCTION OF HANDLING THE CHARACTER STRING. ON THE OTHER HAND, THESE SUBPROGRAMS ARE DIVIDED INTO THE TWO GROUPS. ONE IS COMPOSED OF SIX SUBROUTINES, EACH OF WHICH HAS A SHARED FUNCTION

OF WORD PROCESSING AND EXPLAINED LATER. THE OTHER IS FROM BASIC SUBROUTINES THAT ARE DEVELOPED FOR THE PURPOSE OF A GENERAL USE. BUT THESE BASIC SUBROUTINES ARE NOT MENTIONED HERE.

THE STRUCTURE OF THIS PROGRAM IS ILLUSTRATED IN THE NEXT FIGURE.

```
"DPRINT"
    |
    |------DPRS00.....USER'S PARAMETER SPECIFICATION
    |------DPRS01.....PREPROCESSER OF INPUT LINE
    |------DPRS02.....CENTERING PROCESS
    |------DPRS03.....RIGHT MARGIN JUSTIFICATION
    |------DPRS04.....FOOTER GENERATOR
    |------DPRS05.....POSTPROCESS FOR ENDING
    |------FORTRAN BASIC SUBROUTINES
```

FIGURE.1 THE STRUCTURE OF "DPRINT"

THE "DPRS00" SUBROUTINE DEFINES FILES FOR AN INPUT MANUSCRIPT AND AN OUTPUT REARRANGED, AND THE USER'S SPECIFIED OPTION VALUES, WHICH ARE FOR A SPACING PARAMETER AND ON THE PAGE SIZE OF THE OUTPUT. AND THE NEXT "DPRS01" IS A PREPROCESSER OF CHARACTER STRINGS OF A READED LINE AND ELIMINATES A REDUNDANT DELIMINATER(SPACE). THE THIRD "DPRS02" HAS A CENTERING FUNCTION, WHICH DISCRIMINATES THE STRING TO BE LOCATED IN THE MIDDLE OF A LINE AND MOVE IT TO THE CENTER POSITION. THE "DPRS03" JUSTIFIES

APPROXIMATELY THE RIGHT MARGIN OF OUTPUT LINE WITH SUPPLEMENTING ADDITIONAL SPACES BETWEEN WORDS. THE "DPRS04" GENERATES THE FOOTER SHOWING THE PAGE NUMBER. THIS NUMBER IS CALCULATED AUTOMATICALLY AND PRINTED IN THE CENTER POSITION BY USING "DPRS02". AND AT LAST THE "DPRS05" COMPLETES THE POSTPROCESS FOR INSERTING DUMMY LINES AND PRINTING THE LAST PAGE NUMBER. THEREFOR THIS USES "DPRS02" AND "DPRS03".

3. ON THE CONTROL CHARACTERS

THERE ARE A FEW CONTROL CHARACTERS USED IN THE "DPRINT", SHOWING A CHARACTER STRING TO BE CENTERED, OR A TERMINATER OF THE END OF PARAGRAPH .

3.1. CENTERING CONTROL

THE CHARACTER '¬' HAS SUCH A MEANING THAT A STRING INTERLEAVED BY THIS WILL BE MOVE TO THE CENTER PART OF AN OUTPUT LINE. FOR EXAMPLE, IF A STRING 'XXX YYYY ZZ' IS TO BE CENTERED, THEN THIS CHARACTER SHULD BE ADDED BOTH IN FRONT OF AND BEHIND OF THIS STRING, AS '¬XXX YYYY ZZ¬|'. THE LAST CHARACTER '|' IS A TERMINATER, WHICH FUNCTION IS EXPLAINED NEXT.

3.2. TERMINATER

THE TERMINATER CHARACTER IS GIVEN BY '|' AS APPEARS IN THE ABOVE EXAMPLE. ORDINALY THIS CHARACTER HAS THE MEANING OF ENDING A PARAGRAPH. MOREOVER THIS HAS THE SUPPLEMENTARY FUNCTION OF PREPARING A NEW LINE FOR OUTPUT TOO. IN THE ABOVE CASE, THE CHARACTER STRING TO BE CENTERED IS NOT A PARAGRAPH, BUT REQUIRES TO PREPARE A NEW LINE FOR THE SAKE OF A NEXT OUTPUT.

4. ON THE USAGE OF "DPRINT"

A USER OF "DPRINT" MUST PREPARE THE INPUT MANUSCRIPT INCLUDING ABOVE CONTROL CHARCTERS IN HIS FILE BY USING THE CMS EDITER.

HERE IS ASSUMED THAT THE FILE NAME, THE FILE TYPE, AND THE FILE MODE OF SUCH A FILE ARE GIVEN RESPECTIVELY AS FN, FM, AND FT.

4.1. "DPRINT" LOADING AND INPUT PARAMETERS

THE USER STARTS FROM LOADING "DPRINT" PROGRAM BY USING THE CMS COMMAND AS FOLLOWS.

'LOAD DPRINT (START'

AFTER THIS COMMAND IS KEYED IN, THEN "DPRINT" REQUIRES THE INPUT FILE ASSIGNMENT WITH THE NEXT FORM.

'***DOCUMENT PRINTING***'

'** INPUT FILE ASSIGNMENT**'

'ENTER <FN> <FT> <FM> ...'

THE USER MUST INPUT OR KEY IN THE FILE NAME, FILE TYPE AND FILE MODE USING THE DELIMINATER SPACE ' ' OR COMMA ','. IN THIS CASE, THESE ARE AS FOLLOWS.

'FN,FT,FM'

THEN "DPRINT" CHECKS THE EXISTENCE OF THE SPECIFIED FILE. AND IF THE SPECIFIED FILE IS NOT FOUND, THEN THE NEXT MESSAGE WILL BE TYPED.

'**ERR / SPECIFIED FILE NOT FOUND / ERR***'

'FILE: FN FT FM'

'FILE RE-ASSIGN AFTER STRIKE ANY KEY & ENTER'

AFTER TYPING ANY KEY, THEN THE SAME POCEDURE FOR FILE ASSIGNMENT IS ITERATED, UNTIL THE SPECIFIED FILE WILL BE FOUND. IF THE

SPECIFIED FILE IS EXISTED, THE FILE SIZE IS INFORMED AS FOLLOWS.

'FRAME... LLL LINES * CCC COLUMNS'

WHERE, LLL AND CCC ARE RESPECTIVELY SHOWING THE TOTAL LINES AND THE TOTAL COLUMNS. AND THEN THE NEXT MESSAGE, WHICH IS THE CMS COMMAND FOR THE FILE DEFINMENT, IS TYPED OUT.

'FI 50 DISK FN FT FM (RECFM F BLOCK CCC'

THE ABOVE PROCEDURE IS FOR INPUT FILE ASSIGNMENT. AND, BEFORE ASSIGNMENT FOR THE OUTPUT, THE PARAMETERS FOR AN OUTPUT FORM, WHICH REGULATE THE OTPUT FILE, WILL BE SPECIFIEDAS FOLLOWS.|

' ENTER SPACING CONTROL & PAGE SIZE'

' SINGLE SPACE...1/DOUBLE SPACE...(2)'

' ??? SPACING CONTROL ??'

THE MEANING OF THE ABOVE QUESTION IS SIMPLE. IF THE USER WANTS TO OMAKE AN OUTPUT WITH A SINGLE SPACE, THEN HIS ANSWER MUST BE '1'. IN ANOTHER CASE, HIS ANSWER WILL BE '2'. IN THE MESSAGE BEFORE QUESTIONING, THE VALUE '2' WITH PARENTHESE SHOWS THE "DPRINT"'S DEFAULT VALUE WHICH IS PREPARED AS THE INITIALLY SET. IF THE USER ADAPTS THIS VALUE, THEN HE ONLY SPECIFIES A CHARACTER ','.

AS WELL AS IN ABOVE QUESTION, THE NEXT HAS THE SAME RULE FOR THE USER'S SPECIFICATION.

' PAGE SIZE BY LINES & COLUMNS (50 & SAME AS ORIGINAL)'

' ?? LINES & COLUMNS ??'

THIS QUESTION IS FOR THE PAGE SIZE OF AN OUTPUT. THE VALUES ENCLOSED WITH ARE DEFAULT VALUES, TOO.

AT LAST, THE OUTPUT FILE ASSIGNMENT IS REQUIRED AS FOLLOWS.

'**OUTPUT FILE ASSIGNMENT**'

'ENTER <FN> <FT> <FM> ...'

THE METHOD OF THE USER'S ANSWER IS QUITE SAME AS WELL AS IN THE INPUT FILE. BUT, "DPRINT" DOES NOT CHECK WHETHER THE SPECIFIED FILE HAS ALREADY EXISTED OR NOT. THEREFOR, IF EXISTED, THAT FILE WILL BE REWRITED. THE USER MUST PAY ATTENTION TO REWRITING OF THE SPECIFIED FILE.

4.2. AN EXAMPLE

THIS REPORT IS PARTIALLY MADE BY USING "DPRINT". AS A CONCRETE EXAMPLE, THE BEGINNING OF THE INPUT MANUSCRIPT OF THIS REPRT IS SHOWN HERE. THE COMPARISON OF BOTH THE NEXT MANUSCRIPT AND THE FIRST PART OF THIS REPORT WILL GIVE A GOOD COMPREHENSION FOR THE FUNCTION OF "DPRINT".

```
¬DEVELOPMENT OF A SIMPLE WORD PROCESSER "DPRINT"¬|
¬YOSHIO MATSUO¬|
|
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IN THE IBM/370 CMS SYSTEM TAKING ADVANTAGE OF ITS
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BY THE FORTRAN PROGRAM "DPRINT", WHICH IS NAMED BY
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   MAKES IT POSSIBLE TO REARRANGE A USER'S MANUSCRIPT,
FOR EXAMPLE A CERTAIN PROGRAM MANUAL WRITTEN BY ENGLISH,
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     THE MAIN FUNCTIONS OF THIS PROGRAM ARE AS FOLLOWS.|
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     3) RIGHT MARGIN JUSTIFICATION|
     4) PAGENATING AND GENERATING A FOOTER AUTOMATICALLY|
     5) PERMITTING FREE FORMATTED MANUSCRIPT
        EXCEPT FOR WITH A FEW CONTROL CHARACTERS|
|
2. STRUCTURE OF "DPRINT"|
```

INPUT MANUSCRIPT FOR THIS REPORT (PART).

4.3. CONSTRAINTS

HOWEVER "DPRINT" THIS PROGRAM IS LESS CONDITIONED AS MENTIONED AT FIRST, BUT THERE ARE A FEW CONSTRAINTS FOR THE USAGE AS FOLLOWS.

1) PROHIBITING THE USE OF CONTROL CHARACTERS ITSELF IN THE ORIGINAL MANUSCRIPT (NOT THE INPUT MANUSCRIPT)

2) NEGLECTING THE STRING AFTER THE TERMINATER

3) PRINTING AN OUTPUT FILE BY USING THE CMS COMMAND THAT 'PRINT FN FT FM (CC'

AT LAST, THESE LIMITATIONS ARE NOT SO TROUBLESOME. THE AUTHOR HOPES THIS "DPRINT" WILL BE FREQUENTLY USED BY THE STAFF OF REMOTE SENSING PROJECT. THE "DPRINT" COMPOSED OF THE ONE MAIN AND SIX SUBROUTINES IS OPEND FOR THE SAKE OF RELEASING THE FIRST CONSTRAINT. THE WHOLE SOURCE PROGRAM LIST ARE IN THE APPENDIX.

APPENDIX. SOURCE LIST

```
C       ***********************
C       *                     *
C       *   PRINT DOCUMENT    *
C       *                     *
C       ***********************
C       ORIGINALLY CODED BY Y.MATSUO
C
        LOGICAL*1 CHR,BLK,ISRG(400),OSRG(256),ASA,CA(3)/' ','0','1'/
       &    ,SSW/.FALSE./,SW,ILS/.FALSE./,LWK(255),CTRML/'|'/,OORG(255)
        INTEGER*2 OLIN,IWK/' '/,BLNK/' '/,CHCK/'¬'/,CTRM/'|'/
        INTEGER*4 OEND,OLINE,OCOLMN,SPCP,IFMT(20),OFMT(20),CPNTR
        EQUIVALENCE (CHR,IWK),(BLK,BLNK),(ASA,OSRG(1)),(OSRG(2),OORG(1))
C
        JEND=0
        ILIN=0
        OLIN=0
        NP=0
        CALL DPRS00 (ICOLMN,ILINE,OCOLMN,OLINE,SPCP,IFMT,OFMT)
        IEND=ICOLMN-1
        OEND=OCOLMN-1
        OLINE=OLINE/SPCP
        ASA=CA(SPCP)
   10   IF(JEND.GE.OEND) GOTO 30
```

```
      JENDP=JEND+1
      CALL RDARRY (50,IFMT,ICOLMN,ISRG(JENDP))
      CALL DPRS01 (IEND,ISRG(JENDP),JEND,SSW,LWK)
      ILIN=ILIN+1
      IF(ILIN.NE.ILINE) GOTO 10
      ILS=.TRUE.
   20 IF(JEND.LE.1) GOTO 120
   30 SW=.FALSE.
      NCHR=0
      CPNTR=0
      K=JEND-OEND
      DO 40 I=1,OEND
        CHR=ISRG(I)
        NCHR=NCHR+1
        OORG(NCHR)=CHR
        IF(IWK.EQ.CHCK) SW=.TRUE.
        IF(IWK.EQ.BLNK) CPNTR=NCHR
        IF(IWK.EQ.CTRM) GOTO 50
   40 CONTINUE
      GOTO 60
   50 CPNTR=NCHR
   60 J=CPNTR+1
      IF(CPNTR.EQ.OEND) GOTO 75
      DO 70 I=CPNTR,OEND
        OORG(I)=BLK
   70 CONTINUE
      I=CPNTR-1
      IF(.NOT.SW.OR.IWK.NE.CTRM) CALL DPRS03 (OEND,OORG,I,LWK)
   75 IF(J.EQ.JEND) GOTO 90
      K=0
      DO 80 I=J,JEND
        K=K+1
        ISRG(K)=ISRG(I)
   80 CONTINUE
   90 JEND=K
      OLIN=OLIN+1
      IF(SW) CALL DPRS02 (OEND,OORG,LWK)
      IF(OLIN.NE.OLINE) GOTO 100
      NP=NP+1
      CALL WTARRY (60,OFMT,OCOLMN,OSRG)
      ASA=CA(2)
      CALL DPRS04 (NP,OEND,OORG,LWK)
      WRITE (60,OFMT) ASA
      CALL WTARRY (60,OFMT,OCOLMN,OSRG)
      ASA=CA(3)
      OLIN=0
      GOTO 110
  100 CALL WTARRY (60,OFMT,OCOLMN,OSRG)
      IF(OLIN.EQ.1) ASA=CA(SPCP)
  110 IF(ILS) GOTO 20
      GOTO 10
  120 I=OLINE-OLIN
      NP=NP+1
      IF(I.GT.0) CALL DPRS05 (NP,I,OCOLMN,OSRG,OFMT,LWK)
      STOP
C
      END
```

```
      SUBROUTINE DPRS00 (ICOLMN,ILINE,OCOLMN,OLINE,SPCP,IFMT,OFMT)
C     ***************************************
C     *                                     *
C     *           PRINT DOCUMENT            *
C     *                                     *
C     *  PARAMETER SPECIFICATION ROUTINE    *
C     *                                     *
C     ***************************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      INTEGER*4 OCOLMN,OLINE,SPCP,IFMT(20),OFMT(20)
C
      CALL FLDCLR
      WRITE(6,60000)
      CALL SETFIL (ILINE,ICOLMN,1,50)
      CALL FMTGEN (ICOLMN,IFMT)
      WRITE(6,60001)
      READ (5,*,END=10) SPCP
   10 IF(SPCP.EQ.0) SPCP=2
      WRITE(6,60002)
      READ (5,*,END=20) OLINE,OCOLMN
   20 IF(OLINE.EQ.0) OLINE=50
      IF(OCOLMN.EQ.0) OCOLMN=ICOLMN
      CALL SETFIL (OLINE,OCOLMN,0,60)
      CALL FMTGEN (OCOLMN,OFMT)
      RETURN
C
60000 FORMAT(' ***DOCUMENT PRINTING***')
60001 FORMAT(3X,'ENTER SPACING CONTROL & PAGE SIZE  '/5X,'SINGLE SPACE..
     &.1/DOUBLE SPACE...(2)'/5X,'?? SPACING CONTROL ??')
60002 FORMAT(5X,'PAGE SIZE BY LINES & COLUMNS (50 & SAME AS ORIGINAL)'/
     &5X,'?? LINES & COLUMNS ??')
C
      END

      SUBROUTINE DPRS01 (NCHR,STRNG,CEND,SW,WK)
C     ********************************
C     *                              *
C     *        PRINT DOCUMENT        *
C     *                              *
C     *  REDUNDANT DELIMINATER CHECK *
C     *                              *
C     ********************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      INTEGER*4 CEND
      INTEGER*2 IWK/'  '/,IWO/'  '/,CHCK/'  '/,CTRM/'|'/
      LOGICAL*1 CHR,CHRO,SW,STRNG(NCHR),WK(1)
      EQUIVALENCE (CHR,IWK),(CHRO,IWO)
C
      ICNT=0
      CHR=.TRUE.
      DO 40 J=1,NCHR
        CHRO=CHR
        CHR=STRNG(J)
        IF(IWK.NE.CHCK) GOTO 10
        IF(IWO.NE.CHCK) GOTO 20
```

```
      IF(.NOT.SW) GOTO 40
      GOTO 20
   10 SW=.FALSE.
   20 ICNT=ICNT+1
      STRNG(ICNT)=CHR
      IF(IWK.EQ.CTRM) GOTO 30
      GOTO 40
   30 SW=.TRUE.
      GOTO 50
   40 CONTINUE
   50 CEND=CEND+ICNT
      RETURN
C
      END
      SUBROUTINE DPRS02 (OCOL,STRNG,WK)
C     ********************************
C     *                              *
C     *        PRINT DOCUMENT        *
C     *                              *
C     *  CENTERING PROCESS ROUTINE   *
C     *                              *
C     ********************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      INTEGER*4 OCOL
      INTEGER*2 IWK,CHCK/'¬'/,BLNK/' '/
      LOGICAL*1 CHR,BLK,STRNG(OCOL),WK(200)
      EQUIVALENCE (CHR,IWK),(BLK,BLNK)
C
      IWK=BLNK
      K=0
      J=0
      DO 20 I=1,OCOL
        CHR=STRNG(I)
        IF(J.NE.1) GOTO 10
        K=K+1
        WK(K)=CHR
   10   IF(IWK.NE.CHCK) GOTO 20
        J=J+1
        IF(J.EQ.2) GOTO 30
   20 CONTINUE
      RETURN
   30 K=K-1
      J=(OCOL-K)/2
      DO 40 I=1,J
        STRNG(I)=BLK
   40 CONTINUE
      DO 50 I=1,K
        J=J+1
        STRNG(J)=WK(I)
   50 CONTINUE
      J=J+1
      DO 60 I=J,OCOL
        STRNG(I)=BLK
   60 CONTINUE
      RETURN
C
      END
```

```
      SUBROUTINE DPRS03 (OCOL,STRNG,CEND,WK)
C     ********************************
C     *                              *
C     *        PRINT DOCUMENT        *
C     *                              *
C     *  RIGHT MARGIN JUSTIFICATION  *
C     *                              *
C     ********************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      INTEGER*4 OCOL,CEND
      INTEGER*2 IWK/' '/,IWKO/' '/,CMM/','/,PRD/'.'/,SPC/' '/
     &          ,CCNT,PCNT,SCNT
      LOGICAL*1 CHR,CHRO,SP,STRNG(OCOL),WK(1)
      EQUIVALENCE (CHR,IWK),(CHRO,IWKO),(SP,SPC)
C
      IF(OCOL.GT.2.5*CEND) RETURN
      PCNT=0
      CCNT=0
      SCNT=0
      CHR=SP
      DO 20 I=1,CEND
        CHRO=CHR
        CHR=STRNG(I)
        IF(IWK.NE.SPC) GOTO 20
        IF(IWKO.EQ.SPC) GOTO 20
        IF(IWKO.NE.PRD) GOTO 10
        PCNT=PCNT+1
        GOTO 20
   10   IF(IWKO.NE.CMM) GOTO 15
        CCNT=CCNT+1
        GOTO 20
   15   SCNT=SCNT+1
   20 CONTINUE
      IF(PCNT+CCNT+SCNT.EQ.0) RETURN
      PINC=0.
      CINC=0.
      SINC=0.
      REST=OCOL-CEND
      IF(REST.GT.CEND) REST=REST-OCOL/2
      IF(PCNT.EQ.0) GOTO 30
      PINC=REST/PCNT
      IF(PINC.GT.2.0) PINC=2.0
      REST=REST-PINC*PCNT
   30 IF(CCNT.EQ.0) GOTO 40
      CINC=REST/CCNT
      IF(CINC.GT.1.0) CINC=1.0
      REST=REST-CINC*CCNT
   40 IF(SCNT.EQ.0) GOTO 50
      SINC=REST/SCNT
      IF(SINC.GT.0.5) SINC=0.5
   50 IF(PCNT+CCNT+SCNT.EQ.0) RETURN
      J=0
      X=0.0
      CHR=SP
      DO 90 I=1,CEND
        CHRO=CHR
        CHR=STRNG(I)
        J=J+1
```

```
      WK(J)=CHR
      XINC=0.
      IF(IWK.NE.SPC) GOTO 90
      IF(IWKO.EQ.SPC) GOTO 90
      IF(IWKO.NE.PRD) GOTO 60
      XINC=PINC
      GOTO 70
 60   IF(IWKO.NE.CMM) GOTO 65
      XINC=CINC
      GOTO 70
 65   XINC=SINC
 70   X=X+XINC
      IF(X.LT.1.0) GOTO 90
      K=X
      X=X-K
      DO 80 L=1,K
        J=J+1
        WK(J)=SP
 80   CONTINUE
 90 CONTINUE
    DO 100 I=1,J
      STRNG(I)=WK(I)
100 CONTINUE
    RETURN
    END

      SUBROUTINE DPRS04 (NP,OCOL,STRNG,WK)
C     ************************
C     *                      *
C     *    PRINT DOCUMENT    *
C     *                      *
C     *   FOOTER GENERATOR   *
C     *                      *
C     ************************
C     ORIGINALLY CODED BY Y.MATSUO
C
      INTEGER*4 OCOL
      LOGICAL*1 CHR,MN/'-'/,CT/'¬'/,BL/' '/,STRNG(OCOL),WK(200)
C
      STRNG(1)=CT
      STRNG(2)=MN
      STRNG(3)=BL
      CALL CHRCON (NP,4,STRNG(4),ICHR)
      STRNG(4+ICHR)=BL
      STRNG(5+ICHR)=MN
      STRNG(6+ICHR)=CT
      CALL DPRS02 (OCOL,STRNG,WK)
      RETURN
      END
```

```
      SUBROUTINE DPRS05 (NP,LINE,OCOL,STRNG,FMT,WK)
C     ***********************
C     *                     *
C     *   PRINT DOCUMENT    *
C     *                     *
C     *   POST-PROCESSING   *
C     *                     *
C     ***********************
C     ORIGINALLY CODED BY Y.MATSUO
C
      INTEGER*4 OCOL,FMT(20)
      LOGICAL*1 CHR,CA/'0'/,STRNG(OCOL),WK(200)
C
      DO 10 I=1,LINE
        WRITE (60,FMT) STRNG(1)
   10 CONTINUE
      STRNG(1)=CA
      CALL DPRS04 (NP,OCOL-1,STRNG(2),WK)
      WRITE (60,FMT) CA
      WRITE (60,FMT) STRNG
      RETURN
C
      END
```

5. On the evaluation factors of a suitable land for the development of agricultural infrastructure

Yoshio Matsuo

1. Introduction

A practical application of remote sensing data has been tried by the remote sensing project, which is being promoted by the international cooperation of the two organizations, the center for processing and statistics (in the ministry of public works of Indonesia) and JICA (Japan International Cooperation Agency). This project aims the development of the method of finding a candidate area for the development of an agricultural infrastructure by using remotely sensing data.

Until now, several kinds of thematical informations were extracted and mapped through computer processing of a landsat data and existing informations on a case study district. Moreover, on the other hand, the evaluation methods of a suitable land for such object were also realized in the meaning of computer algorithms. Those methods are the PATTERN method (Planning Assistance Through Technical Evaluation of Relevance Numbers method) and the method of using the PCA (Principal Component Analysis).

This project has just entered in the final stage of a suitable land mapping by using such methods integrating those thematical informations. But these two methods have such limitations as empirical techniques or evaluation weights are required, or data handling is only for quantitative measurements. Therefore it had better be considered that in the application of these methods their direct use may not give so promising results unless those limitations are taken care of.

It follows that the theme of this report is to clarify the next question.

1) Which profile has a suitable land for the development of agricultural infrastructure currently ?

2) Which factors are the key for characterizing such land, in other words ? Concretely, in this report are considered and discussed the weights or intensity of relations between the suitable land and the thematical informations from an analytical viewpoint.

Later from here, a suitable land means the one for development of agricultural land for the sake of simplicity.

2. A case study area and existing data

The north "Banten" area was selected as a case study area. Because there can be seen the various kinds of natural conditions in it. Moreover it locates comparatively near the site of the remote sensing project in Jakarta city and the ground survey can be made relatively easy taking the advantage of its neighborhood.

2.1. Profiles of the case study area

This area is situated in the north western part of Java island, strictly speaking in the latitude of the south from 5°52'14" to 6°29'42" and in the longitude of the east from 105°47'20" to 160°27' 5", as it can be seen in the figure 1.

Governmentally, this area is partially belonging to the three "Kabupaten"s, which means a regency and consists of some "Kecamatan"s (sub-regency). They are the whole "Serang" (26 kecamatans), the northern part of both "Pandegerang" (11 kecamatans of the 16) and "Lebek" (5 kecamatans of the 15). These areas occupy respectively about 1,900 km^2, 900 km^2 and 1,100 km^2. The whole area is approximately 3,900 km^2 except for a sea.

The study area is divided into the three areas topographically and they show their characteristics as follows.

1) Low land : The low lands less than 25 m elevation occupy about 25 % of the whole area, and are located near the Java sea. Almost of these low lands are alluvial, and caused from three big rivers, "Ci Ujung", "Ci Durian", and "Ci Banten". The main landuse is paddy field, Occasionally a fish pond can be seen near the sea shore.

2) Upland : The uplands between from 25 m elevation to 100 m are located in the surroundings of "Maja" town as a plateau, or in the skirts of volcanic mountains. These areas are geologically partitioned into two subareas, miocene sedimentary around "Maja" town and pliocene sedimemtary in the other. The soils of these areas are gray humus, gray alluvial, planosol, and so on. These areas are used as an orchard of coconut palm or banana, and as a plantation for cassaba, oil palm, clove and so forth, except for the western part of a mountain covered with a secondary forest.

3) Mountainous area : Mountainous area, higher than 100 m, are seen in the western part of the study area or in the peninsula "Ujut", which is in the north western corner of the Java island. The western mountainous area includes three volcanic mountains, "Gunung Karang" (1,778 m), "Gunung Pulosari" (1,346 m), and "Gunung Aseupan" (1,179 m). These are mainly covered with latosol and used for shrub on the lower site. These forest area decreased to 19,000 ha (including the north and south Banten area).

The climate of the study area is such as follows.

A rainy season usually is from november to march, and a dry season from april to october. In the rainy season, the precipitation is about 380 mm/month but in the dry about 190 mm/month. The rainfall is remarkably varied due to the geographical condition. In the southern part, it rains more than in the northern

(3,000 - 4,000 mm/year near the Indonesian sea, while 1,500 mm/year near the Java sea). The most rainfall recorded 4,000 - 5,000 mm/year in the mountainous area.

The social or economic situation is described in the next.

The densely populated areas (500 - 2,000 peoples/ha) are concentrated in the irrigated paddy field such as in the basin of "Ci Ujung", "Ci Durian" and "Ci Banten" near the Java sea. The population density in the uplands near "Maja" town and the mountainous areas are less than 500 peoples/ha.

In "Banten" area, big towns are "Serang", "Cilegon", "Rangkasbitung" and "Pandeglang", whose population densities are more than 2,000 peoples/ha. Finally, the total population of "Serang kabupaten" is about 983,000 peoples (580 peoples/km^2), "Pandeglang kabupaten" about 167,000 peoples (260 peoples/km^2) and "Lebek kabupaten" about 610,000 peoples/km^2).

On the other hand, from viewpoint of landuse, in the case of "Banten" area the approximate one third of a whole area is used for mixed crops, another one third for both irrigated and rainfed paddy fields, and the rest for forests or towns.

Most irrigated paddy fields are located in the low altitude area near the Java sea and the southern part of "Genung Karang". These areas are possible to yield 2,000 - 4,000 kg/ha. Whereas, peoples in the non-irrigated are considered rather poor economically.

Upper river basin are used for rainfed paddy fields or crop fields. It can be said that uplands are for orchards of mixed fruits or plantation and mountainous areas for forest mainly. But the "Alan Alan" can be seen partially in these area too.

2.2 Existing data

As the products until now, several kinds of thematic maps are existing.

Some of these are digitized manually from published maps. And some are made by computer assisted classifications using landsat CCT (see 2.3) and ground truth data. All of these are listed in a table,1.

This table shows the kind of each data and its role in this study. Among of these data, the suitability data is made on the basis of roughly surveyed data by a long term assigned expert for agricultural development. The abstract of this data as in the followings.

2.2.1 land suitability

The ground survey for land suitability was implemented as the one for rice production and from the viewpoint of natural conditions. Here the survey results are considered showing the agricultural land suitability because the suitable land for rice production could be regarded as an agricultural land suitability.

The evaluation for land suitability is categorized as follows, and each category of it is considered to represent the suitability index for an agricultural land use.

1) Suitable ; All land property on natural conditions show suitable.

2) Poor workability ; Natural conditions prevent workability and show the improvement of workability.

3) Poor drainage ; Natural conditions lack in drainage and show the improvement of drainage.

4) Poor irrigation ; Natural conditions lack in irrigation and show the improvement of irrigation.

5) Poor condition ; Natural conditions are not so good.

6) Unsuitable ; Natural conditions are unsuitable.

These suitability indices are considered on the rank order scale. Without the artificial improvement of natural conditions, above categories' sequence will give directly the magnitude of agricultural possibility. Therefore the category's number could be regarded as such a score for an agricultural land possibility as if the score is higher then its possibility is lower. This paper will be based on such assumption or prerequisite as mentioned above.

On the reliability of this information, it is said that the survey was done mainly from a moving car and there were not so many check points on the details and therefore the reliability of this data is neither so high nor uniform by its location. Specially the southern parts of the study area and the boundary parts of categories of distribution are not so reliable. This requires a preprocess for adequate sampling later.

2.2 thematic informations

The altitude from a sea level and the slope gradient is coded by a 500 m mesh grid from a geomorphology map (scale 1/250,000), manually. These codes are shown in table.2.2 and 2.3.

Also, the geology and soil map are converted to a digital code by a mesh. In addition to these, an effective soil depth and an annual precipitation distribution map are done so.

The legend of these all are such as in table2.4 to 2.7. On the geology and soil types, its categories are rearranged from a desirable type to an unsuitable for an agricultural land use.

2.3 Thematic informations by landsat data application

A soil moisture classification map, a biomass estimation map, and a land cover classification map has already been made by using landsat data analysis.

A soil moisture classification map is given by the application of Fukuhara's proposed model which will compensate the vegetation cover influences and extract the soil information only. A biomass estimation map is given by using ratioing and regression techniques of landsat data. In a land cover classification map, its categories are classified in 88.6 % precision by the maximum likelihood method as a supervised technique. the legends of these maps are seen in table.2.8, 2.9, and 2.10.

In addition to these three kinds of thematic maps, maps showing a flood damage estimation and a water resource potential evaluation are made as a further application of landsat data. These are using thematic informations acquired already, such as the land cover map, and so on, besides of landsat data. The legends of these two are given in table.2.11 and 2.12.

It is thought that the degree of data manipulation could be rather higher, and therefore these two thematic informations will not be used as possible. In the case of absence of these informations, the original landsat data had better be used directly as a reference. In this report, such a case will also be checked.

2.3 Landsat data

Two temporal landsat data are existing. One is acquired from the landsat 1 on August 21th 1973 (scene ID 81394023150), and the other from the landsat 2 on June 21th 1976 (scene ID 825160214150). These are compensated both geometrically and radiometrically. Both scenes includes a little cloud in the moutainous area of the study area, but not so vital for their use. The former landsat data only are applied in making the thematic informations in the processing phase one.

All kinds of thematic informations are mapped using alpha-numeric characters and they can be seen in the appendix.

3. Method of case study

In order to clarify the interrelations between the land suitability (2.2.1) and thematical informations (2.2.2) with its reference (2.3), the regression analysis can be adapted in such a way that suitability score may be used as a criterion and thematical informations as explanatory variables. But before starting the analysis the treatment of qualitative informations must be considered.

3.1 Treatment of qualitative informations

As seen in tables showing legends, thematical informations are divided into four types, a rank order, a numerical rank order, a nominal, and a quantitative type. The rank order type shows a qualitative rank, for example, 1.good, 2.moderate, 3.bad. The numerical rank order type is such that 1.from 100 to 200, 2.from 200 to 300, and so on. This type can be regarded as transformed by a monotonously increasing function and used as a quantitative variable. The nominal type appears such as in land cover categories or soil type categories, and is quite qualitative. At last the quantitative type appears in original landsat data only.

The value of a rank order variable is given by such as 1.good, 2.moderate, 3.bad in the above explanation. These values represents a relation between values of its variable. As well as the consideration on a suitability score to land suitability, it is assumed that such a rank will give approximately a score for the criterion, that is, the suitability score.

The nominal type cannot be used with the rest types in a regression analysis. Only this type is used for the analysis by a cross table in order to checking the requisite for data partitioning. If the data consists of some groups, then the following regression analysis must be adapted differently by such a group.

The table.3 gives three cross tables among the nominal scaled informations, geology, soil, and land cover categories. These categories are rearranged such a sequence as desirable for land suitability, which is decided by a discussion of indonesian counter parts and a Japanese expert.

From these tables, it can be recognized that the existence of four groups given by from 1 to 6 and from 7 to 10 of the land cover category and from 1 to 3 and from 4 to 7 of the soil category. But there is no remarkable difference found from the geology one. The first group is given by land cover category 1 to 6 and soil category 1 to 3, and the second by land cover 7 to 10 and soil 1 to 3, the third by land cover 1 to 6 and soil 4 to 7, and the last by land cover 7 to 10 and soil 4 to 7.

In this case study, these four groups is fused to the two, one of which, consisting of the first, second and third group, will be analyzed by the regression and the other be neglected as ineffective. It is the reason of this that the soil condition is not so good and the current land cover in the latter group is not desirable for the suitability, too, in the meaning of potentiality.

The former group is prepared as a training samples' map shown in the figure.2. The word training means confirming and refining the model for describing the interrelation between a land suitability and thematical informations.

3.2 regression analysis

The regression analysis used here is called a stepwise regression analysis. This has the function of selecting the effective variables among the prepared, which is thematic informations in this case. The regression analysis applied is as follows.

The suitability score : Y is given as an objective or a criterion variable, and eight kinds of thematical informations and eight kinds of landsat data : $X_1, X_2, \ldots, X_8, X_9, \ldots, X_{16}$ play the role of explanatory variables. And the relation between Y and $X_1, \ldots, X_{16}$ may be represented by the next equation.

$$Y = F(X_1, X_2, \ldots, X_{16}) + dX \qquad \ldots(1)$$

Where, a function:F is unknown and the last term:dX represents the residual between Y and F $(X_1,X_2,...,X_{16})$.

This function can be replaced to the next linear equation in a certain situation.

$$Y = B_1X_1 + B_2X_2 + \dots + B_{16}X_{16} + e \qquad \dots(2)$$

The linear coefficients:B are called partial regression coefficients and e is an error term.

In the stepwise regression analysis, effective variables are selected. The general criteria for variable selection are in the followings.

1) The partial coefficient must be significantly enough high.

2) The variable must be given or controlable easily.

3) the correlation among explanatory variables must be lower.

Among above criteria, the first and the third are regarded in the stepwise regression analysis. And the second criterion is checked by an analysist.

3.3 Processing procedure

The case study is implemented with the next procedure.

(1) Sample gathering

Samples are gathered from a training map with a coarse grid sampling method. the samples as a training are counted 440 and stored in a training sample file.

(2) Four cases adaptation

The four cases are extracted as a subset of explanatory variables. The regression analysis is adapted in each case independently. In addition, the candidates from training samples are iteratively selected for the purpose of refining the regression model.

There are differences of the processing phases or the roles in the explanatory variables as mentioned in 2.2 and 2.3. Therefore, all the variables are checked by dividing into the four cases, which are subset of all variables.

i) Case 1 : Six thematical informations, that is, an altitude, a slope gradient, a precipitation, an effective soil depth, a soil moisture and a biomass map, are used as explanatory variables.

ii) Case 2 : Eight thematic informations, that is , a water resources, and a flood area map in addition to the ones of the case 1, are used for the purpose of checking the degree of contribution of the phase two informations.

iii) Case 3 : Twelve thematic informations, four kinds of spectral data of a landsat in 1973 besides of the case 2's, are used. The possibility of using the landsat data as alternatives of the phase one or two thematic informations, which are made by applying these landsat data, is to be checked.

iv) Case 4 : All informations are used. This case adds the another temporal data of a landsat to the case 3's. It is checked whether another temporal data can contribute to explaining the suitability score or not.

The selection of candidates for training a regression model is done as follows.

At first, using the all samples, a regression model is made. Then they are estimated or predicted by the regression model acquired. Among of them, such samples are eliminated as not proper, whose predicted score is asfar from its actual score as excessing a threshold value 1.5. And the second model is built by using the first selected samples. The similar process as the above is done by the next threshold value 1.0. The final regression model is given by the secondarily selected samples.

The appreciation of this process of sample selection is that the first training samples are including an unreliable as mentioned in 2.2.1.

(3) Regression estimation

For checking the adaptation of the regression model, a land suitability score is estimated in a map form by using the acquired regression model. A result pattern will be checked and evaluated by the distribution of suitability scores.

4. Results of regression analysis

The results of regression analysis are summarized in the table.4 and 5.

4.1 Standard partial regression coefficients

The table 4.1 shows the number of samples used, the multiple correlation coefficient, and the standard regression coefficient in each iteration and case. In this table, a variable marked with '*' is not selected because it is not so effective.

When a partial regression coefficient is standardized, the magnitude of its value does not reflect the scaling factor in which it is measured, and shows directly the intensity of a relationship to the objective variables that is suitability score.

On the other hand the iteration effect can be seen in each case. As mentioned already, the training samples are selected by the criterion for a regression model refinement. This effect is appeared in improvements of a multiple correlation coefficient of all cases. But, in the prediction or estimation by such a refined model as in this case, it must be noted that a stability of the model will decrease usually and the range of its adaptation will become narrower.

4.2 Regression equations and estimations

The table.5 shows the regression equation in each case, which is given as linear coefficients called partial regression coefficients. These four regression equations are given from the last selection of samples.

The significance of them are confirmed with a significance level 5 %. The F values of respective cases are 150.8, 153.3 113.6, and 154.2. Therefore, the four kinds of regression estimation are done on the basis of these equations. The results of estimation are arranged in a map form respectively as seen in the figures 3.1, 3.2, 3.3, and 3.4.

5. Considerations

Here are some considerations and discussions on the explanatory factors from the results of regression analysis.

5.1 Altitude, slope and rainfall

Theses factors are all recognized effective through all the model refining processes and cases. The contributions of the altitude and the slope factor are very appreciative and not conflicts to a common sense.

But the large contribution and negative correlation of the rainfall factor are not so appreciative. It is considered that the geomorphological characteristics in the study area reflects on this factor, but there remains the rest on this reason to be investigated. However, this factor cannot be neglected on behalf of its large contribution unless there is a rational reason.

5.2 Effective soil depth

The effective soil depth factor seems not so effective. Especially when including the original landsat data at '73, this factor is eliminated. Perhaps this factor correlates closely others such as the altitude or the slope factor and is regarded as a redundant information in such a scale as 500 m mesh of this study.

5.3 Soil moisture

This factor is the data of the manipilated phase 1 given by using landsat data and so on. But this has another information originating the ratioing of the landsat data. Effects of it do not appears so clearly or else relatively a little through cases. Therefore this factor is considered not to be so important in this area.

5.4 Water resource and flooded area

Without the landsat data at '73, these factors contribute, but a little. Once the landsat data included, the contribution of water resource factor decreases. This may be from the reason that the manipilation degree of it is comparatively higher and might include the estimation error or a runding error.

On the other hand the flood area factor is considered to have an independent contribution as well as the altitude, the slope factor and so on.

5.5 Landsat data at '73

All landsat data at '73 have large contributions and devaluates other factors. But the factors from a geomorphological condition still remain in a relatively high level of contribution. Moreover the multiple correlation coefficient of the case including this is larger than any case. This suppose that the landsat data had better be applied directly with geomorphological informations without any treatment.

5.6 Landsat data at '76

This is only another temporal data and included tentatively. The date of data acquisition of this is in the almost same season of the former one and there may be little possibility of a change of land condition during the three years between both data observations. Therefore it is considered that there is not remarkable contributions found by adding this data.

5.7 estimation of suitability scores

There are prepared four kinds of estimation maps generated. But, from the above considerations, if the decision for selection might be required, the third case is to be recommended as a land suitability map among of all. Because the multiple correlation coefficient is highest. however this map should not be used as a suitable land map, because the check of estimation is not finished.

6. Figures and tables

6.1 Tables

6.2 Figures

3.1 A land suitability map of the case 1

3.2 A land suitability map of the case 2

3.3 A land suitability map of the case 3

3.4 A land suitability map of the case 4

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Table.1 The existing data and their profile

Where, the phase shows the degree of processing and the type R, RN, C and Q mean respectively rank order, numerical rank order, nominal and quantitative type.

No.	Data	Phase	Type	Role
0	Suitability	0	R	Criterion
1	Altitude	0	RN	Explanation
2	Slope	0	RN	Explanation
3	Geology	0	C	Explanation
4	Rain fall	0	RN	Explanation
5	Soil depth	0	RN	Explanation
6	Soil type	0	C	Explanation
11	MSS band 4 (73)	0	Q	Reference
12	MSS band 5 (73)	0	Q	Reference
13	MSS band 6 (73)	0	Q	Reference
14	MSS band 7 (73)	0	Q	Reference
21	MSS band 4 (76)	0	Q	Reference
22	MSS band 5 (76)	0	Q	Reference
23	MSS band 6 (76)	0	Q	Reference
24	MSS band 7 (76)	0	Q	Reference
101	Soil moisture	1	R	Explanation
102	Biomass	1	RN	Explanation
103	Landcover type	1	C	Explanation
201	Water resource	2	R	Explanation
202	Flood damage	2	R	Explanation

Table.2.1. Legend of the suitability score

Value	Description
0	Excluded area
1	Suitable
2	Requirement for workability improvement
3	Requirement for drainage improvement
4	Requirement for irrigation improvement
5	Poor condition
6	Unsuitable

Table.2.2. Legend of an altitude map

Value	Description
0	Excluded area
1	0 - 25
2	25 - 100
3	100 - 200
4	200 - 500
5	500 - 700
6	700 - 1000
7	1000 - 1500
8	1500 - (m)

Table.2.3. Legend of a slope gradient

Value	Description
0	Excluded area
1	- 0
2	2 - 15
3	15 - 40
4	40 - (%)

Table.2.4. Legend of geological categories

Value	Description
0	Excluded area
1	Alluvium
2	Undifferentiated volcanic product
3	Plicene sedimentary
4	Miocene sedimentary
5	Miocene limestone
6	Andesite basalt diabase

Table.2.5. Legend of precipitation

Value	Description
0	Excluded area
1	- 1500
2	1500 - 2000
3	2000 - 3000
4	3000 - 4000
5	4000 - (mm/year)

Table.2.6. Legend of effective soil depth

Value	Description
0	Excluded area
1	90 -
2	60 - 90
3	30 - 60
4	- 30 (cm)

Table.2.7.Legend of soiltype

Value	Description
0	Excluded area
1	Latosol
2	Alluvial
3	Regosol
4	Complex renzima
5	Padosolic
6	Association gray hums
7	Association grumsol, Gray yellow or Gray regosol

Table.2.8. Legend of soil moisture

Value	Description
0	Excluded or Unknown area
1	Very wet
2	Wet
3	Moderate
4	Dry
5	Very dry

Table.2.9. Legend of Biomass weight

Value	Description
0	Excluded area
1	0 - 2
2	2 - 6
3	6 - 14
4	14 - 31
5	31 - (kg/m^2)

Table.2.10. Legend of landcover type

Value	Description
0	Excluded area
1	Wet paddy field
2	Dry paddy field
3	Bush
4	Grass land
5	Rural settlement
6	Wetland
7	Fish pond
8	Low density forest
9	High density forest
10	Clouded area

Table.2.11. Legend of Water resource potential

Value	Description
0	Excluded area
1	Plenty
2	More
3	Moderate
4	Less
5	Lack

Table.2.12. Legend of flood dangerous area

Value	Description
0	Excluded area
1	Safety area
2	Flooded once during last 6 years
3	Flooded more than twice during last 6 years

Landcover type	Geology type 1	2	3	4	5	6
1	1	1	0			
2	4	1	2	0		0
3	8	4	9	2		0
4	1	2	2	0		0
5	1	6	3	0	0	
6	1	1	1	0		
7	1	0	0			
8	0	4	2	1	0	
9	0	6	0	0		
10	0	1	0			

Landcover type	Soil type 1	2	3	4	5	6	7
1	0	1	0	0	0	0	
2	1	3	0	0	2	1	
3	3	6	1	1	12	1	
4	2	1	1	1	2	0	
5	5	1	0	1	3	0	
6	1	1	0	0	1	0	
7	0	1	0		0	0	
8	3	0	0	1	2	0	
9	5	0			0	0	0
10	1	0			0		0

Soil type	Geology type 1	2	3	4	5	6
1	0	20	1			0
2	10	0	3	0		
3	1	0	1			0
4	0	3	1			
5	4	1	13	3		
6	2	1	1			0
7		0				

Table.3 Three kinds of cross tables showing the interrelations among nominal scaled thematic informations. Where, the value shows percent and blank no sample responsed, but except for samples of the excluded area.

Table.5 Regression equations of four cases by the last selected samples. Where, '*' shows a variable unselected by the regression analysis.

Variable label	Multiplied constants Case 1	Case 2	Case 3	Case 4
1 Altitude	0.345	0.368	0.207	0.271
2 Slope	0.982	0.857	0.818	0.702
3 Precipitation	-0.805	-1.000	-0.897	-0.959
4 Soil depth	-0.128	-0.085	*	*
5 Soil moisture	0.309	0.100	0.143	*
6 Biomass	*	*	-0.176	*
7 Water resource		0.188	0.145	0.062
8 Flooded area		-0.538	-0.550	-0.614
9 MSS band4 (73)			0.032	*
10 MSS band5 (73)			-0.025	*
11 MSS band6 (73)			-0.035	-0.019
12 MSS band7 (73)			0.036	0.029
13 MSS band4 (76)				*
14 MSS band5 (76)				*
15 MSS band6 (76)				*
16 MSS band7 (76)				-0.007
Additive constant	3.100	4.066	3.949	4.615

Table.4 Standard regression coefficients in each iteration step and case.
Where, '*' shows a variable unselected by the regression analysis

	Case 1			Case 2			Case 3			Case 4		
Iteration	1	2	3	1	2	3	1	2	3	1	2	3
No. of samples	440	309	225	440	303	223	440	313	222	440	305	218
Mult.Correlation	.617	.824	.881	.632	.823	.913	.661	.897	.925	.664	.839	.925
1 Altitude	.275	.277	.338	.221	.292	.362	.164	.196	.183	.173	.216	.239
2 Slope	.423	.722	.779	.440	.614	.679	.424	.546	.607	.424	.519	.534
3 Precipitation	-.503	-.517	-.527	-.484	-.602	-.671	-.468	-.493	-.547	-.464	-.531	-.588
4 Soil depth	*	-.078	-.077	*	-.071	-.050	*	*	*	*	*	*
5 Soil moisture	*	.125	.226	*	.070	.129	*	.066	.098	*	*	*
6 Biomass	.076	*	*	*	*	*	*	-.115	-.164	*	*	*
7 Water resource				*	.070	.129	*	.052	.091	*	*	.039
8 Flood area				-.161	-.230	-.322	-.149	-.229	-.317	-.147	-.222	-.357
9 MSS band4 (73)							.812	.848	.702	.732	.726	*
10 MSS band5 (73)							-.514	-.630	-.607	-.470	-.515	*
11 MSS band6 (73)							-.749	-.800	-.713	-.690	-.661	-.342
12 MSS band7 (73)							.583	.731	.789	.570	.655	.580
13 MSS band4 (76)										*	*	*
14 MSS band4 (76)										*	*	*
15 MSS band4 (76)										-.076	*	*
16 MSS band4 (76)										*	-.077	-.087

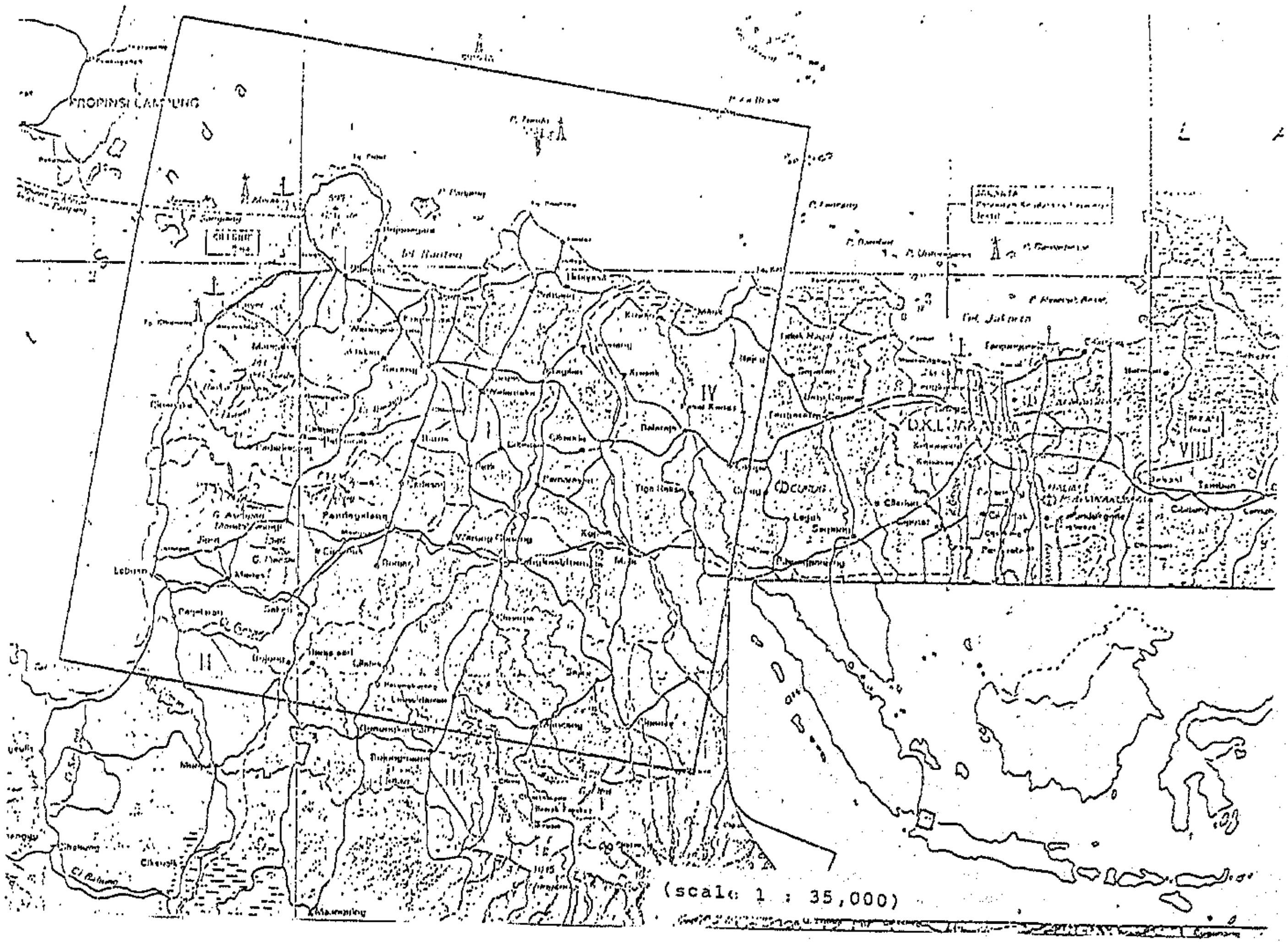


Fig.1. A study area and its location

```
***************************
*                         *
*     SYMBOL  MAPPING     *
*                         *
***************************


FRAME LINE (START,END,SKIP)...   1, 140,   3
     COLUMN(START,END,SKIP)...   1, 148,   2
PROCESS BY USING MIN. & MAX...   0  &      6
            NO. OF LEVELS......            7


        ****  L E G E N D  ****

RANGE      LEVEL    SYMBOL    COUNT  PERCENT
------     -----    ------    -----  -------
  0-  0      1      '    '    1263.   37.10
  1-  1      2      '))))'     238.    6.99
  2-  2      3      '2222'     493.   14.48
  3-  3      4      'TTTT'      62.    1.82
  4-  4      5      'HHHH'     204.    5.99
  5-  5      6      'AAAA'     630.   18.51
  6-255      7      'MMMM'     514.   15.10

                   (TOTAL     3404)
```

Fig.2.1 The Legend of a training map

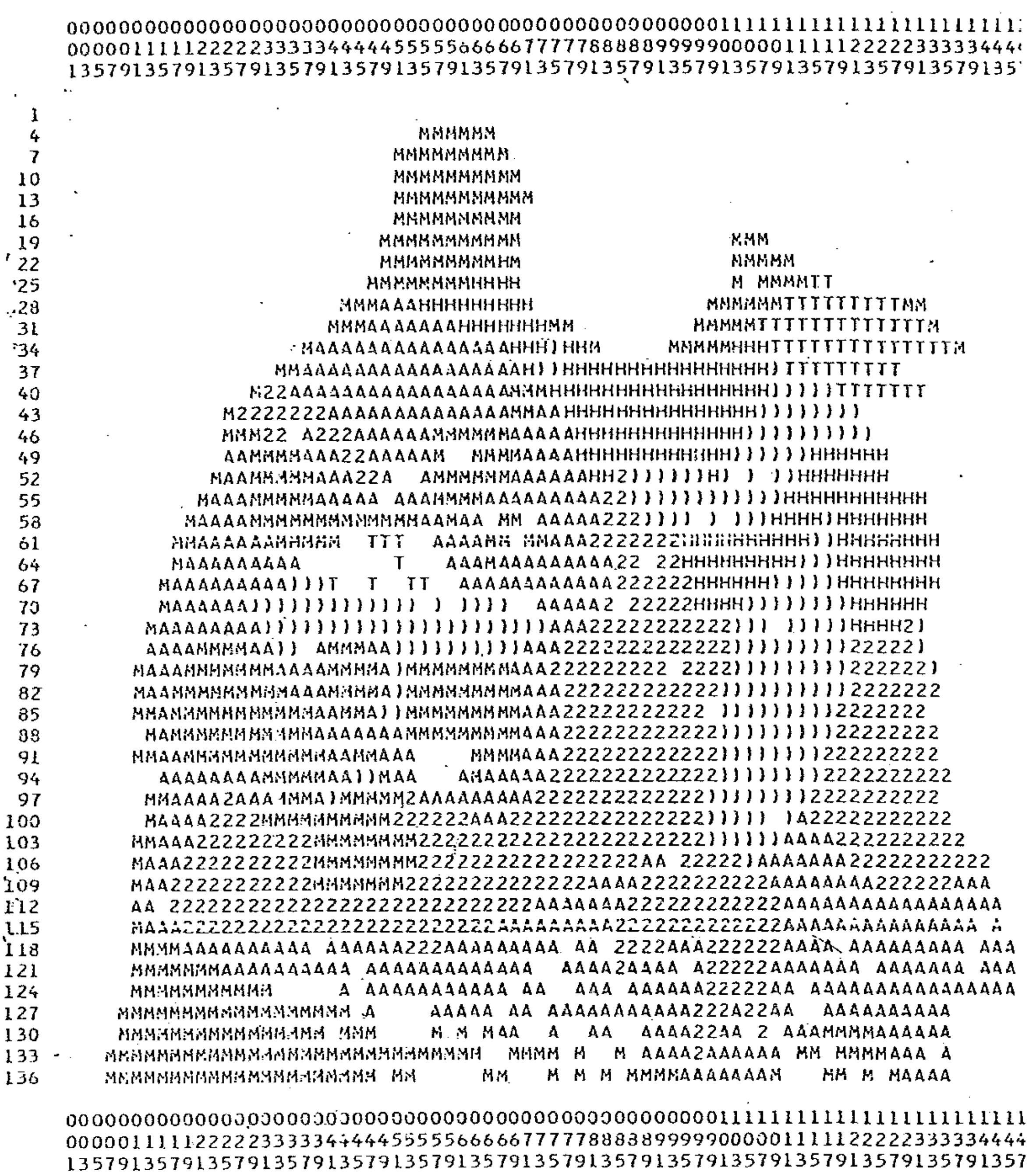
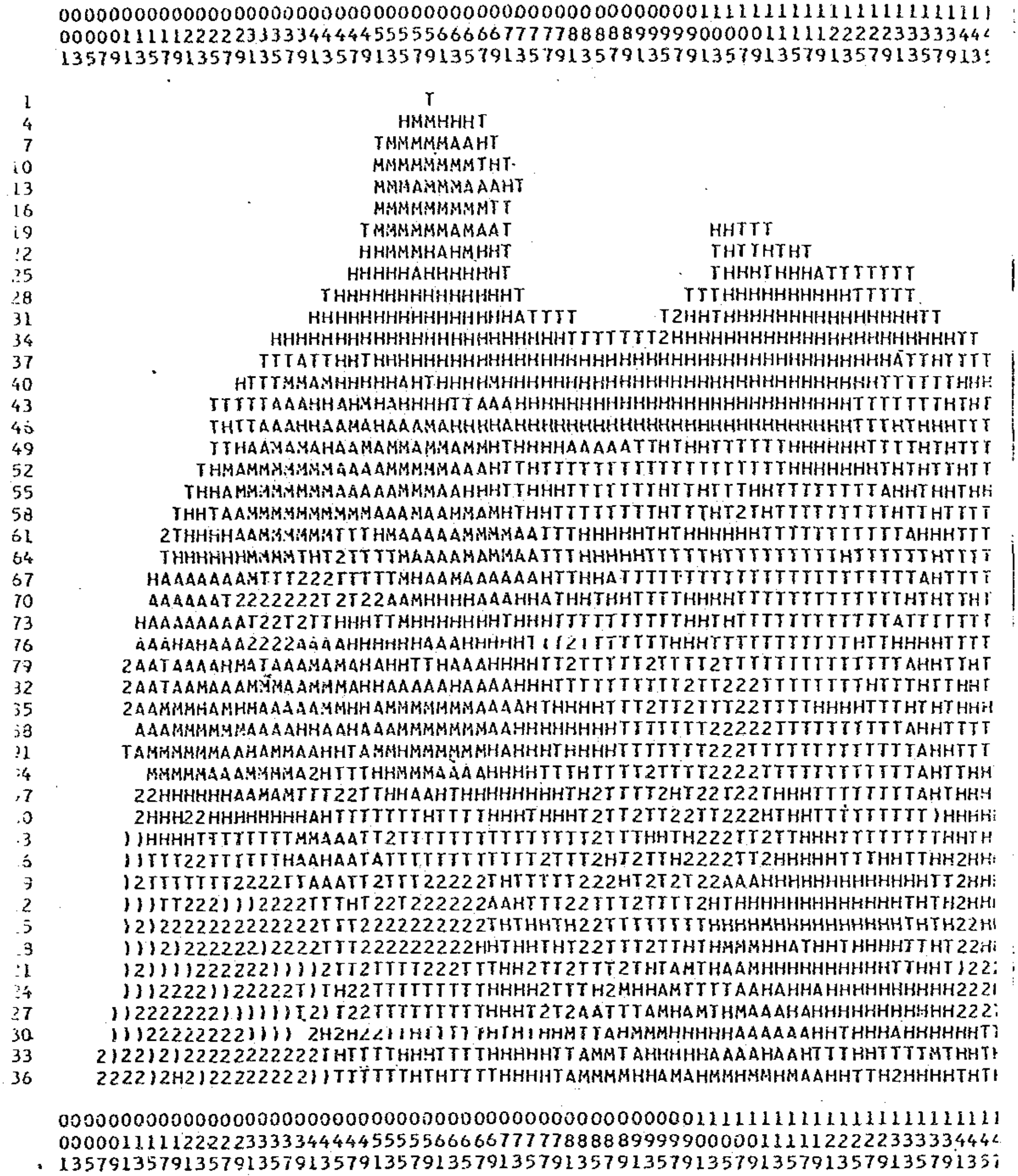
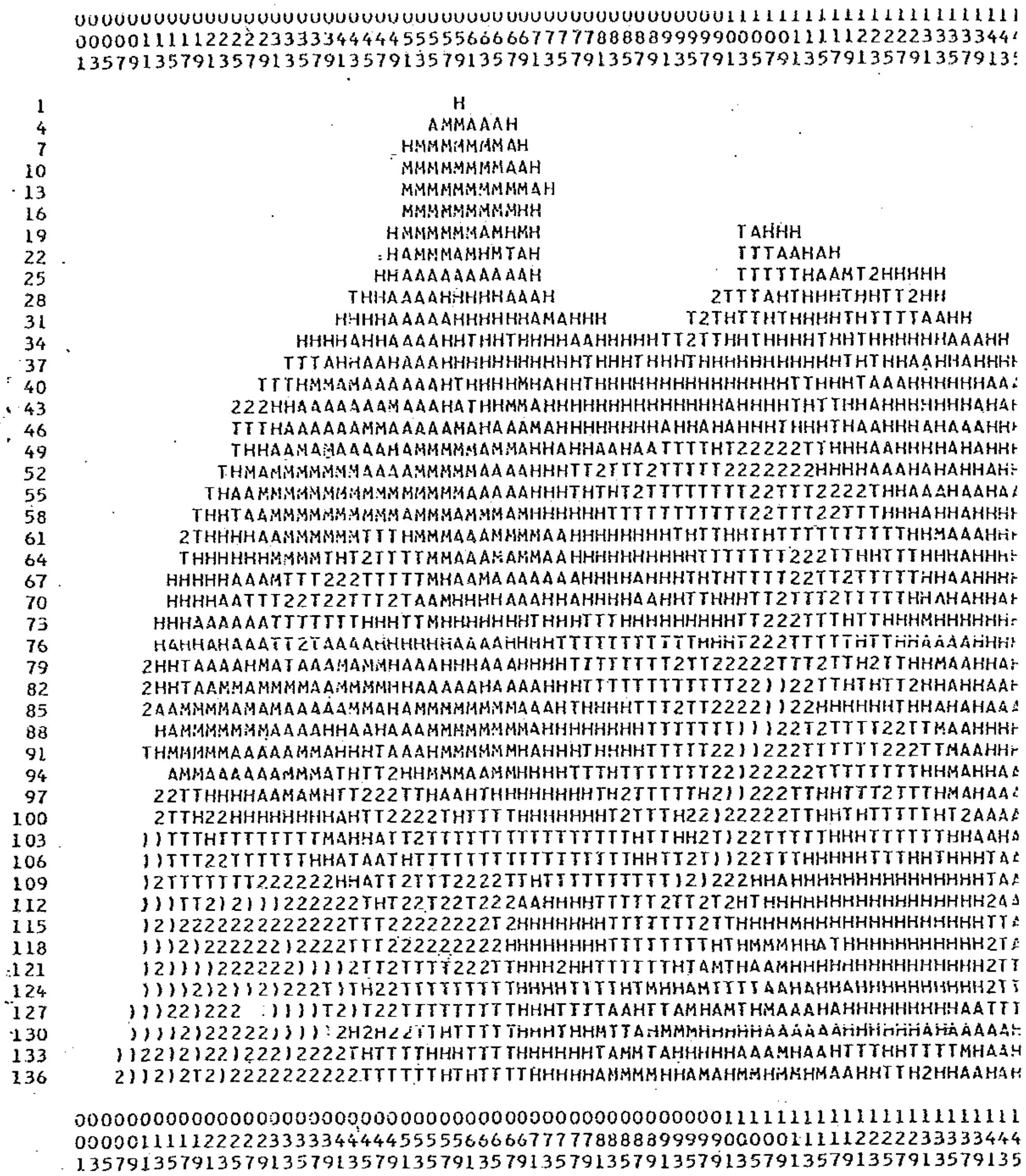


Fig.2.2 A map showing training samples



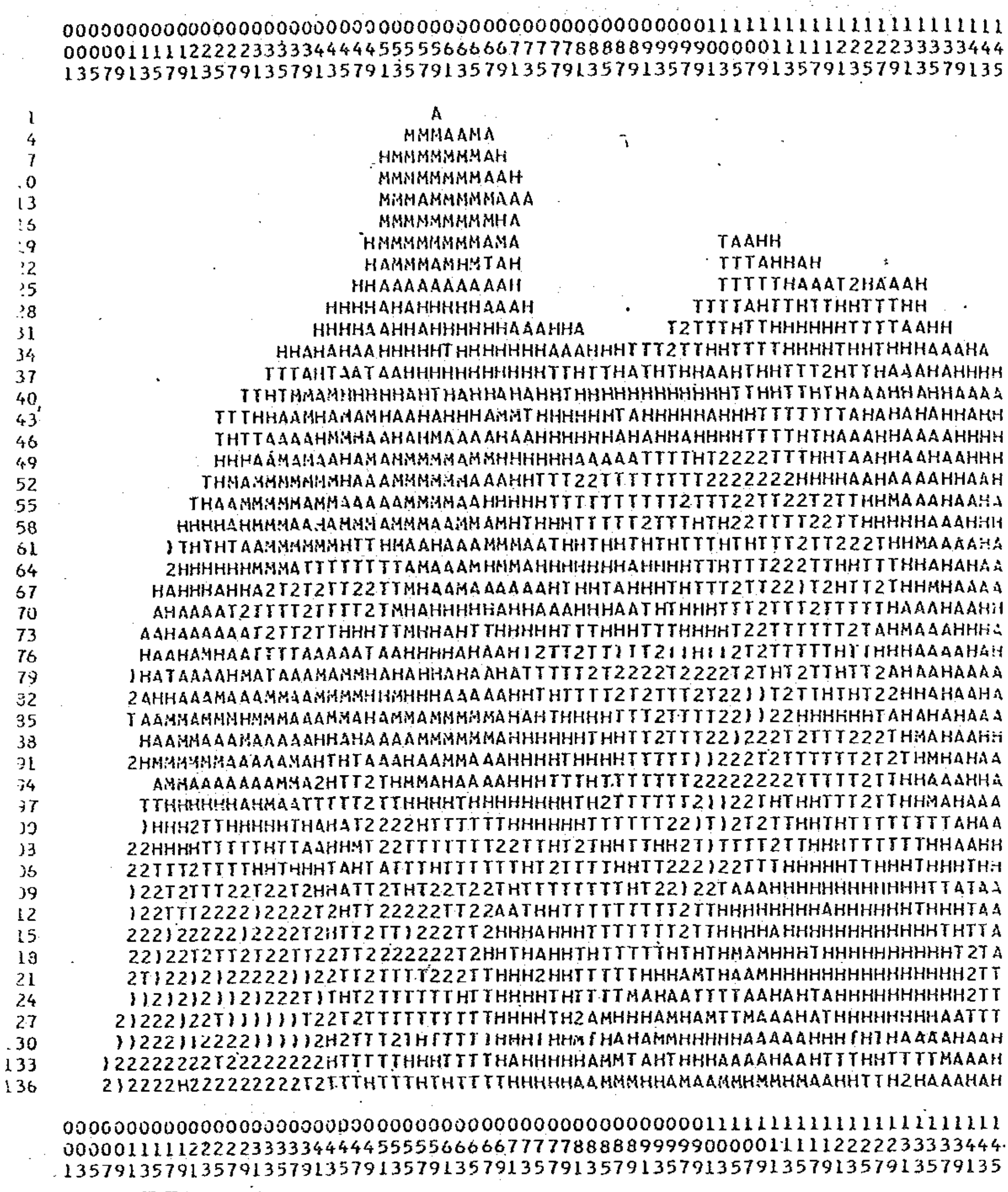
RANGE	LEVEL	SYMBOL	COUNT	PERCENT
0– 0	1	' '	876.	25.73
1– 1	2	')))))'	58.	1.70
2– 2	3	'2222'	274.	8.05
3– 3	4	'TTTT'	874.	25.68
4– 4	5	'HHHH'	817.	24.00
5– 5	6	'AAAA'	287.	8.43
6–255	7	'MMMM'	218.	6.40

Fig.3.1 A land suitability map of the case 1



RANGE	LEVEL	SYMBOL	COUNT	PERCENT
0– 0	1	' '	878.	25.79
1– 1	2	'))))'	83.	2.44
2– 2	3	'2222'	286.	8.40
3– 3	4	'TTTT'	630.	18.51
4– 4	5	'HHHH'	842.	24.74
5– 5	6	'AAAA'	433.	12.72
6–255	7	'MMMM'	252.	7.40

Fig.3.2 A land suitability map of the case 2



RANGE	LEVEL	SYMBOL	COUNT	PERCENT
0– 0	1	' '	875.	25.71
1– 1	2	'))))'	56.	1.65
2– 2	3	'2222'	300.	8.81
3– 3	4	'TTTT'	677.	19.89
4– 4	5	'HHHH'	776.	22.80
5– 5	6	'AAAA'	502.	14.75
6–255	7	'MMMM'	218.	6.40

Fig.3.3 A land suitability map of the case 3

```
     0000000000000000000000000000000000000000000000000000000000000011111111111111111111111
     0000011111222223333344444555556666677777888889999900000111112222233333444
     1357913579135791357913579135791357913579135791357913579135791357913579135

   1                                           A
   4                                       MMMAMMH
   7                                     HMMMMMMMMH
  10                                     MMMMMMMMAMH
  13                                     MMMAMMMMMMAA
  16                                     MMMMMMMMMHA
  19                                    AMMMMMMMMAMH                          TAAHH
  22                                    AAMMMAAHMTAH                          TTTAAHAA
  25                                  HHAAAMAAAAAAH                          TTTTTHAHATTHAAAH
  28                               HHHHAHHHHHTHAAMH                        TTHTAHTTTTTTHTTTHH
  31                              HHHAAAHHHHHHHHHAHAAAA                 T2TTTTHTHTHHTHTTTTAAAH
  34                          HHAHAHAAAAHHHTHHTHHHTAAAHHAHTT2TTHHTTTTHTTHTHTTTHTAAMAA
  37                        TTTMHTAAHAAHHHHHHHHAHHTTHTTTHTHTHHHHHTHHTTHTTTTHAAAAAAAAA
  40                     TTHHHMAHHAHHHAHTHAHAMHAHHTHHHHHHHHHHHAHTHHTTHTTAAMHHAHHAAAA.
  43                  TT2HTAAMAAAAMHAAHAHHHMMMTHHHHHHHHHHHHHAHHTTTT2TTTAAAHAAAAHAAA
  46                  TTTHAAAAHMMHAAHAHMAAAAHAAHHHHHHHHHAHHAHHHTTTTTHTHAAAHAAAAAAAHH.
  49                  THHMAMAMAAHAMAMMMMMAAMHHHHHHHAAAAATTTTTT22222TTHTHAAAAAAAAAAAHA.
  52                 THMAMMMMMMMAAAAMMMMMMAAAHHTTT2T2TTTTTTT2222)22HHTHAAHAAAAAAAAAH.
  55               THAAMAMAMAMMAAAAAAMMMMAAHHHHHTTTHTTTTTTTTT2T222222T222HTMAAAHAAAA
  58              HHHHAAMMMAAMAMMMAAMMMAMMAMHTHHHHTTTT2TTTHTT2222T222TTAHHAAMAAAAA.
  61            )THHHTAAMMMMMMHTTHMAAAAAAMMMAAHHHTHHTHTTT2TH2T222222222HHMAAAAAA.
  64            THHHHHHMAAATTTTTTTTMAAAAMAMMAAHHHHHHHHHHHHTTTTTT22TTTHTT2THHAAAAAA.
  67           HAHHAAHHATT2TTTT2TTTMHAAMAAAAAAHHHHAHHHTHTTT22T222T2TT222HHMAAMAA.
  70           AHAAAATTTTTTTTTTT2TAHAHHHHAAAHAAAHHHAATTTHTHTT222T22TTTT2AAAAAAAAA.
  73         AAHAAAAAAT2TT2TTHHHTTAHHHHTHHHHHHTTTHHHHHHHHTHT22TTTHTT2THHMAAAAAHA
  76         HAHHAMHAATTTTAAAAHTHAHHAAAHAAHT2TT2TTTTT2THHTT222TTT2THT2HHAAAAAAAA
  79        )HATAAAAHMATHAAMAMAHAAAHHMHAAAATTTHTTT2TT2T222222TTT2TTT22THHMAAAAAA
  82        2AHHAAAMMAAMHAAMMMAHAHAAAAAAAHHTHTTTT2T2TTT2T22))22TTHHHT22HHAAAAAA
  85        2AAMAAMMMHMMAAAAMMAAMMMMMMMAAAHHTHHHHTTT2TT2222)))2HHHHTTTHHMAAAAAA
  88         AAAMMAAAMAAHHAHTAHAAAAMMMMMAHHHHHHHHHHTTTTTT222))222TTT222TTMAAAAAA
  91        2HMAMMMMAAAAAMHHTTTAAAAAMMMMAAHHHHHHHHHHTTTTT))222T2T2TTTT2T2TTMAAAAA
  94           AMMAAAAAAAAMMA2HTT2HHAAAAAAAAHAHHTTHTTTTTTT2222)222TTTTT2TTHHMAAAAA
  97         TTTHHHHHAHAMATTT2T22TTAHHHHHAHHAHHTHTTTTTTT)))22TTTHTTTT2TTTHMAHAAA
 100         2TTT2TTHHHHHHHAHA22T22TTTTHTHHHHHHHHHTTTTT22)2)2T2TTHHTTTTTTTTTT2AAAA
 103       22HHHT2TTTTTTTTAAHHA222TTTTTTHTTHTHTTTTTHTTHH22)T2TTTTTTHHHTTTTTTTHHAAAAA
 106       22TTT22TTTTTTTHHATHHTATTTTTTTTHTHTTTTTTTHHTT)2))22TTTTTHHHTTTHHTHHHTAAA
 109       222T2TTT22T222THHHTT22HTT2TT2THTHHTTTTTTTT22)22TAHAHHHTHHHHHHHHHTTATHAA
 112       )22TTT22)22222222HTT222222T22AHTHHHTTTTTTTTT2TTHTHHHHHHHHHHTHHTHHHTHAA
 115       22222222)222222TTT2TT22T2TT2HHHAHHHTTTTTTT2T2HHHHAHHHHHHHHHHHHHHHTTAA
 118       22)22T222222)2T22TT22T2222T2HHTHAHHTHTTTTTTHTTTHAAAHHHTHHHHHHHHHHTT2TMM
 121       )2)2222)2222))))2TT2TTTT222TTHHH2HHTTTTTTHHHAATHAAAHHHHHTTHHHHHHHH2TTT
 124       ))))2)2))2))2)T)TH22TTTTHTTTTHHHHTHTTHTAHHAATTTTHHHHHTAHHHHHHHHHH2TTA
 127      2)))2)222))))))222T22TTTTTTTTTTHHHHTHTAAHHHAAHHATTAHAAHAHHHHHHHHHHHATTTA
 130      ))2)2)222)2)))))2H2T22TTTTTTTTTHHHTHHAHHHHAAAHHHHHAAHAHHHHHHHHHHAHAAAAMAA
 133     )2222222222222222222TTTTT2HHHTTTTHHTHAHHAAAHAHTHHHAAAAHAAHTTTHHTTTTMAMAAA
 136     2))222T22222222)2222TTTTTTTTTHTTTTHHHTHAAMMAHHHAAHAAHAAHAAAHHT2H2HHAAAAAA

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     1357913579135791357913579135791357913579135791357913579135791357913579135791357
```

RANGE	LEVEL	SYMBOL	COUNT	PERCENT
0– 0	1	' '	878.	25.79
1– 1	2	'))))'	~~67.~~	~~1.97~~
2– 2	3	'2222'	329.	9.67
3– 3	4	'TTTT'	665.	19.54
4– 4	5	'HHHH'	673.	19.77
5– 5	6	'AAAA'	582.	17.10
6–255	7	'MMMM'	210.	6.17

Fig.3.4 A land suitability map of the case 4

地　域　計　画

アジア航測株式会社
若　林　秀　介
(Shusuke WAKABAYASHI)

目　　次

1. はじめに

本リモートセンシングプロジェクトでは，すでに農業開発適地の選定にあたり，各種の主題図が作成され，各種の評価がなされている。しかし，植生図は現段階では作成されていない。

未開発地域では，空中から得られる情報の中では植生の情報が最も多く，またこの植生はその生育環境をとおして立地条件を把握できる可能性を有している。したがって，植生は農業開発地の選定に対し有効な手段の一つになり得ると思われる。

本報告は，赤外カラー航空写真（1：30,000）およびLANDSAT IMAGE（1：250,000）を直接判読する方法により植生図を作成し，現況の植生と自然条件（標高，傾斜）の解析を行い，農業開発適地に関する検討を行ったものである。

2. 赤外カラー航空写真の判読

2.1 概要

航空写真は，地表面の情報を的確に反映してあり，地形，植生など土地に関連するものにとって非常に有効なものである。したがって，現在では，調査や計画の分野にとっては欠かせないものとなっている。

航空写真判読は一般に，像の大きさ，形，色調，きめ，パターンなどの識別によって行うものである。

赤外カラー写真は，ナチュラルカラー写真と異なり，赤外線の部分にも感じ，植物が赤く発色するというような自然界とまったく異った発色をしている。赤外カラーフィルムは緑，赤および赤外線に感光する三層の乳剤からなり，これらをそれぞれ青，緑，赤に発色させている。したがって，赤外カラー写真は主に赤外線の部分での反射光量の多い植生の判読用に最も多く利用されている。

2.1.1

色調は，色のあざやかさ，明るさ，濃さなどを示す度合である。赤外カラー写真は，植物の反射率の差で何段階にも表現されており，そのちがいが植物の種類のちがいを表現している。常緑広葉樹林は濃赤色，低木は赤色，草地は淡赤色にそれぞれ発色している。水田および畑地は，耕作の状態により，淡赤色，白色または濃緑色に発色している。また，水は近赤外線を吸収する性質をもっているので，土壌水分の程度により，白色から黒色の各階層に分かれる。

2.1.2 きめ

きめとは，写真画像の中にみられる色調の配列またはその変化の度合のことである。それは，一般に写真画像の中でなめらかな，ゴツゴツした，なだらかな，一様な，などに区分され表現されている。

2.1.3　パターン

パターンは，航空写真から読みとることのできる最も代表的なものである。特に森林の判読には有効であり，樹冠の形，色調，きめ，密度などにより森林のパターンが判読できる。水田や畑地は，比較的よくにた単調なパターンを示していることが多く，さらに畦などのパターンを加えて判読する。しかし，この場合，収穫の前後でパターンが変化し，また季節によっても差がでることに注意しなければならない。プランテーションは，一般に規則的に並んだ樹冠がみられるため，容易に判読できる。

その他，水系のパターンやリニアメントなども比較的容易に判読できる。

2.2　航空写真判読の実際

航空写真判読は，すでに撮影済のＣＪＣ地区およびASAHAN地区の赤外カラー航空写真を使用し行った。

表2.1は使用した赤外カラー航空写真の内容を示している。

表2.1　　赤外カラー航空写真の内容

地　区　名	撮影年月	スケール	使用写真
ＣＪＣ地区	1981.8	1：20,000	C−255,　16.17.18 C−241,　19.20.21
ＡＳＡＨＡＮ地区	1983.3	1：30,000	C−1,　18.19.20

2.2.1　尾根および谷の判読

尾根および谷の判読は，航空写真の立体感を得るために行うものであり，ＣＪＣ地区のＴＯＭＯ周辺の丘陵で行った。

この地域は，沖積平野の背後に位置する丘陵地区であるが，比較的細かい尾根や谷が複雑に入りくみ，地形判読には好都合の地域である。

写真判読は，航空写真を立体視し，細かい尾根や谷を注意深く記入する形で行った。

2.2.2　樹高の判読

樹高の判読は，航空写真の高さの感覚を得るために行うものである。具体的には，ASAHAN地域にあるプランテーションおよび常緑広葉樹林の地域を対象に，異なる高さの樹林を判読し，その高さを比較した。

また，樹林の中で樹冠の占める割合を示す樹冠疎密度の判読もあわせて行った。

2.2.3　パターンの判読

パターンの判読は，比較的植生が変化に富むＣＪＣ地区Bambuknning川の河口部の，Swamp地域で行った。

この地域は，大部分が湿地により占められており，その湿地内の生育環境のちがいにより様々な植生パターンがみられる。海岸の前面にはマングローブが多数分布し，海岸より

はなれるにしたがって除々に減少している。その背後には，湿地や湿地林が分布している。また，海岸の汀線付近は広範囲に養魚池が分布している。

湿地の背後は，広く水田が分布し，収穫前後のちがいによりそのパターンも異っている。集落は，道路に沿って帯状に散在している程度である。

図 2. 1 は，パターン判読の結果の植生図である。

2. 3　植生と立地環境

赤外カラー航空写真の判読により地表を覆う植生の状態がわかり，さらにその生育環境を把握することが可能であれば，赤外カラー写真は農業開発の適地の選定に対して非常に有効な手段になると思われる。

今回，Swamp 地域の写真判読の結果，Swam p 地域に生育する樹木や草地の広がり，高さ，密度などが正確に判読でき，その種類の生育環境のちがいによりある程度の立地環境の把握も可能であることがわかった。また，すでに農地として利用されている土地に対しても，その生育パターンにより，一年間を通じ水田として利用されて土地と水田および畑地として利用されている土地に大きく分けることも可能であることがわかった。以下に，航空写真により判読した植生の種類毎の生育環境の概略を述べる。

(1)　マングローブ林

マングローブは主に河口部の塩水地に生育する樹木であり，その樹林の密度により塩水化の程度がわかる。塩分濃度が高いため，農業開発には適さない。

(2)　湿地林

マングローブ林の背後に立地する樹林である。樹木の高さおよび密度により，土壌水分の程度がわかる。樹高が高い程土壌水位が低く，樹高が低い程土壌水位が高い。土壌水分の状態により，ある程度の水田に利用は可能である。

(3)　湿原

常に水が冠水しているため，泥炭層が発達している。農業開発には適さない。

(4)　草地

土壌水分のちがいにより，高さおよび密度が変化する。以前何かに利用されていた土地であり，農業開発には適している。

(5)　水田

土壌水分の状態（Wet，Dry）により，年 1 回の収穫を行っているか，または年 2 回の収穫を行っている水田に分れる。

以上のように，植生はそれぞれ固有の環境に適応する形で生育しており，その生育環境を把握することにより，その地域の地形の状態や土壌の状態をある程度推測することも可能である。したがって，航空写真による植生の判読は，一般に現地調査がほとんど不可能な未開発地に対しては非常に有効な手段であり，また欠くことのできないものと

言える。

3. LANDSAT IMAGEの判読による植生図の作成

3.1 概要

LANDSAT IMAGEは，現地侵入が不可能な多くの未開発地をもつインドネシアにおいては極めて有効な情報を提供してくれる。また，これらの未開発地域は一般に高温と豊富な雨量に恵まれ，地表は一年中植生に覆われていることが多い。したがって，農業開発の適地選定に当っては，LANDSAT IMAGEからいかに植生を判読し，その立地環境を把握することができるかが重要なポイントの一つと思われる。

現在，本プロジェクトでもLANDSAT DATAから各種の主題図が作成されているが，植生図は作成されていない状況である。これは，LANDSAT DATAからでは植生分類の識別が極めて困難なことに起因していると思われる。そこで今回は，LANDSAT IMAGEを直接判読する方法により植生図を作成した。

図3.1及び図3.2は対象地域に設定した北バンテン地域を示している。

図3.3は植生図の作成フローを示している。以下にその概要を述べる。

(1) LANDSAT IMAGEの作成

最も植生のパターンが表現され，判読しやすいLANDSAT IMAGEを作成する。今回は，対象とした北バンテン地域ですでに作成されているLANDSAT IMAGE のなかから，最も原データが忠実に反映されているものを選んだ。

(2) 植生分類

既存資料および現地の状況を考慮し，北バンテン地区に適合した植生分類を行う。

(3) 第1次写真判読

収集したLANDSAT IMAGEにオーバーレイをかけ(2)の植生分類にしたがって第1次判読を行う。

(4) 現地調査

第1次写真判読で得られた結果をもとに，判読が困難または不明瞭な場所を中心に現地調査を行い，判読結果の点検と修正を行う。

(5) 第2次写真判読

現地調査の結果に基づいて，不明瞭な場所や誤って判読した場所について再判読を行い，修正する。

(6) 植生図の作成

以上の調査および写真判読で得られたデータをもとに最終的な植生図を作成する。

表3.1　熱帯東アジア主要森林群系と立地
（van Steenis 1950にもとづいて，Whitmore 1975がまとめたもの）

気候	土壌水分	地域	土壌	海抜高など	森林群系*
年中多湿	乾地	内陸	成帯土壌	低地～1200m	1．熱帯低地常緑降雨林
				山地（750）1200～1500m	2．熱帯低山地降雨林
				（600）1500～3000m（3350m）	3．熱帯上部山地降雨林
				3000（3350m）～樹木限界	4．熱帯亜高山林
			ポドゾル化砂土	主として低地	5．ヒース林
			石灰岩	主として低地	6．石灰岩地林
			超塩基性岩	主として低地	7．超塩基性岩地林
		海岸			8．海岸植生
	高水位地（少なくとも周期的に）	塩水地			9．マングローブ林
		汽水地			10．汽水林
		淡水地	貧養泥炭		11．泥炭湿地林
			富養（有機的，無機的）土壌	ほとんど常に多湿	12a．淡水湿地林
				同期的に多湿	12b．季節的湿地林
季節的に乾燥	季節的にやや水分不足				13．熱帯半常緑降雨林
	季節的に著しく水分不足				14．熱帯湿生落葉林
					15．乾季の増大に応じたその他の群系

＊1～13：熱帯降雨林，14～15：モンスーン林。

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表 3.2 MAIN FOREST TYPES AND CORRESPONDING PHOTO TYPES

Forest Type	Photo Type	Photo Aspect
Lowland Dipterocarp Forests	2e	High forest. Medium to large crowns. Irregular canopy with tall emergents. Coarse texture. Typically on low undulating land and low hills.
Hill Dipterocarp Forests	H2e	Similar to 2e but appears more open. On gentle slopes of high hills and on isolated low hills.
Upper Dipterocarp Forests	H1b/e/d	High forest but lower than H2e. Small to medium crowns. Compact or broken irregular canopy sometimes with frequent large trees. Medium to coarse texture. On very high hills and steep slopes.
Montane Oak Forests	M1b/d	Medium forest. Small to medium crowns. Dense slightly irregular canopy sometimes with scattered large trees. On mountain slopes and ridges above the Upper Dipterocarp Forests.
Montane Ericaceous Forests	M1c	Low forest. Small crowns. Dense, regular canopy. On mountain tops and exposed ridges.
Mangrove Swamp Forests	Lm	Low to medium forest. Small crowns. Compact, regular canopy. Fine texture. Dark tone.
Freshwater Alluvial and Peat Swamp Forests	S1b/c/d	Low forest. Small crowns. Irregular or regular, open or close canopy sometimes with scattered taller trees. Fine texture. In lowlying areas.
	S2b/d	Higher forest with larger crowns than S1b/c/d. Coarse texture.
Riverine Forests	R1b/c/d	Low forest, Small crowns. Compact or broken irregular canopy sometimes with scattered large trees. Fine to medium texture. Associated with rivers and flood plains.
	R2b/d	Higher forest with larger crowns than R1b/d. Coarse texture.

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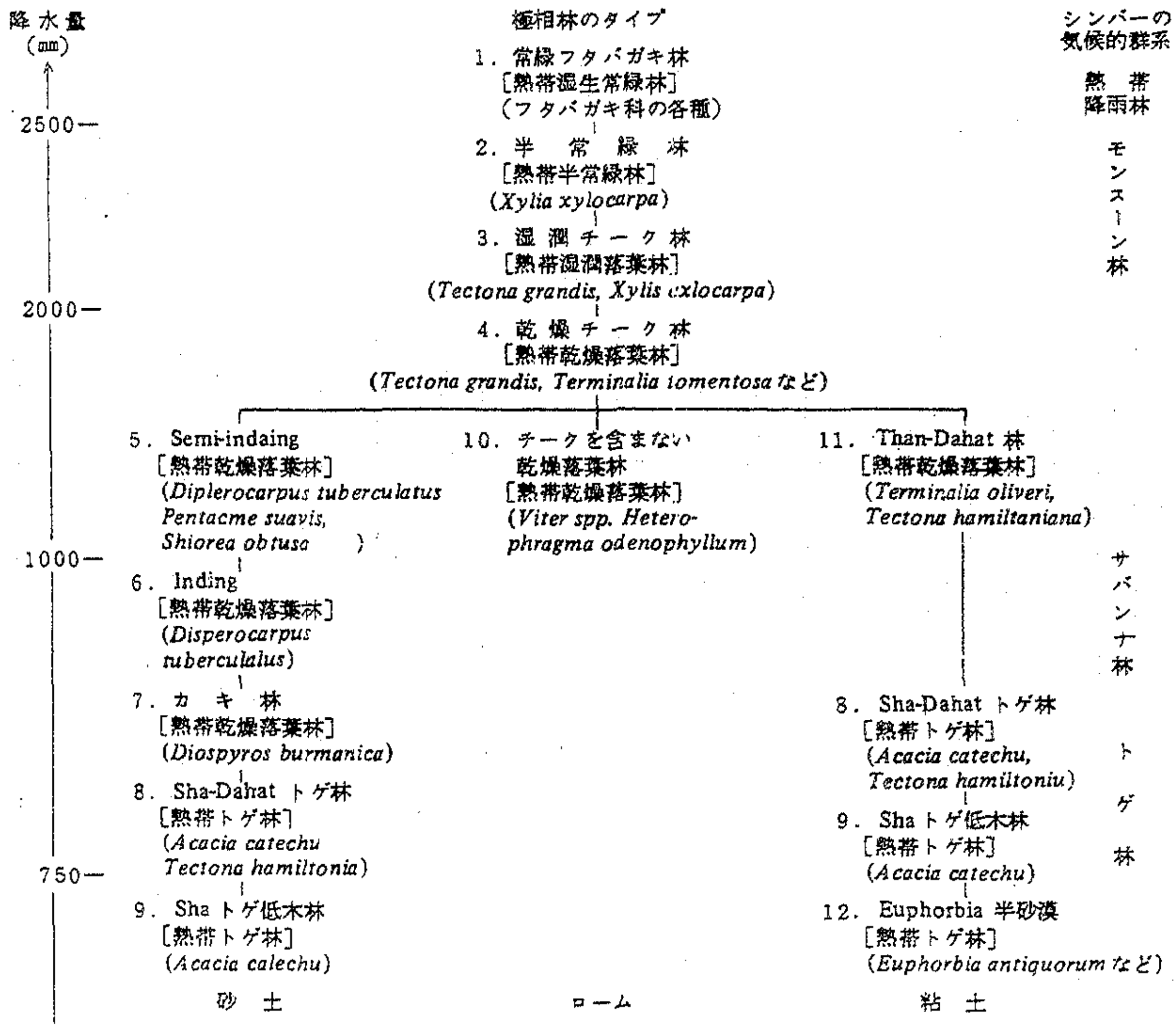


図3・4　ビルマの主な低地極相林（Stamp 19?5 を Richard 1952 より引用）
[　] 内の森林名は Champion-1936 による。（　）内は優占種を示す。

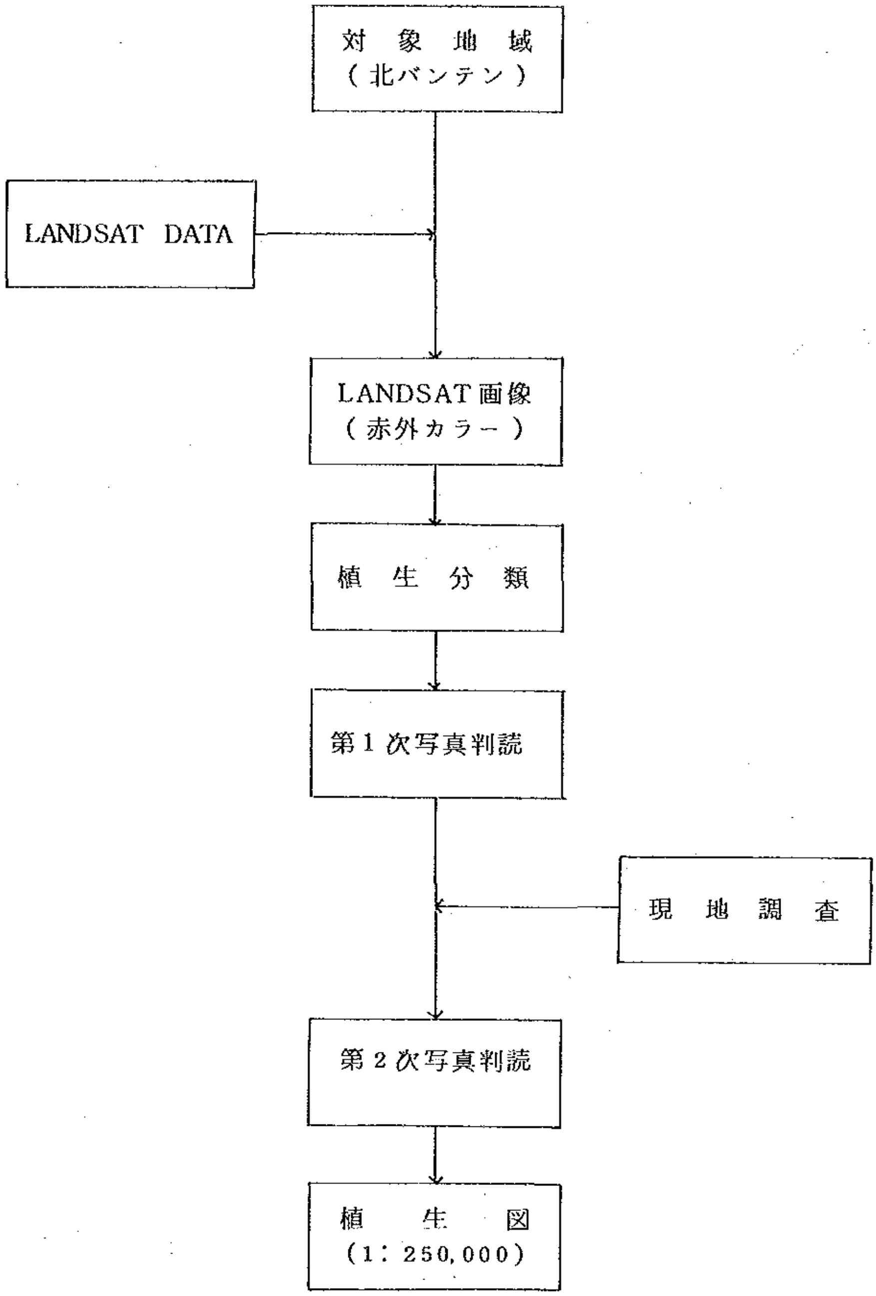


図 3. 3　LANDSATによる植生図作成フロアー

3. 2　植生分類

熱帯地域の植生については，林学や生態学の分野で古くから研究がなされてきた。

表 3. 1 ，表 3. 2 および図 3. 1 は熱帯東アジア，マレーシア，ビルマの各森林についての分類例である。これらはすべて未開発地域での開発を目的としたものであり，主として森林群系と立地環境要因の関係からまとめられている。

今回は，以上の例を参考にインドネシア全域の植生の現況を考慮し，分類を行い表 3. 3 のようにまとめた。この植生分類は，未開発地域に重点をおき森林を中心とした内容とな

っている。

また，この植生分類は，赤外カラー航空写真の判読では十分に可能な内容であり，場合によってはLANDSAT IMAGEでも可能と思われる内容となっている。

表 3.3 インドネシアにおける植生分類

植生タイプ	植生分類
森林	1. 亜熱帯高山林（3000 m以上） 2. 熱帯上部山地降雨林（1500～3000 m） 3. 熱帯低山地降雨林（1200～1500 m） 4. 熱帯低地常緑降雨林（1200 m以下） 5. 二次林 6. 低木林 7. 湿地林 8. マングローブ林 9. ココヤシ林 10. ゴム園
草地	11. 草地（高茎草木） 12. 草地（低茎草木） 13. 湿原
農地	14. 畑地 15. 水田（乾田） 16. 水田（湿田）
その他	17. 伐採跡地 18. 焼畑 19. その他

3.3 現地調査

3.3.1 現地調査ルート

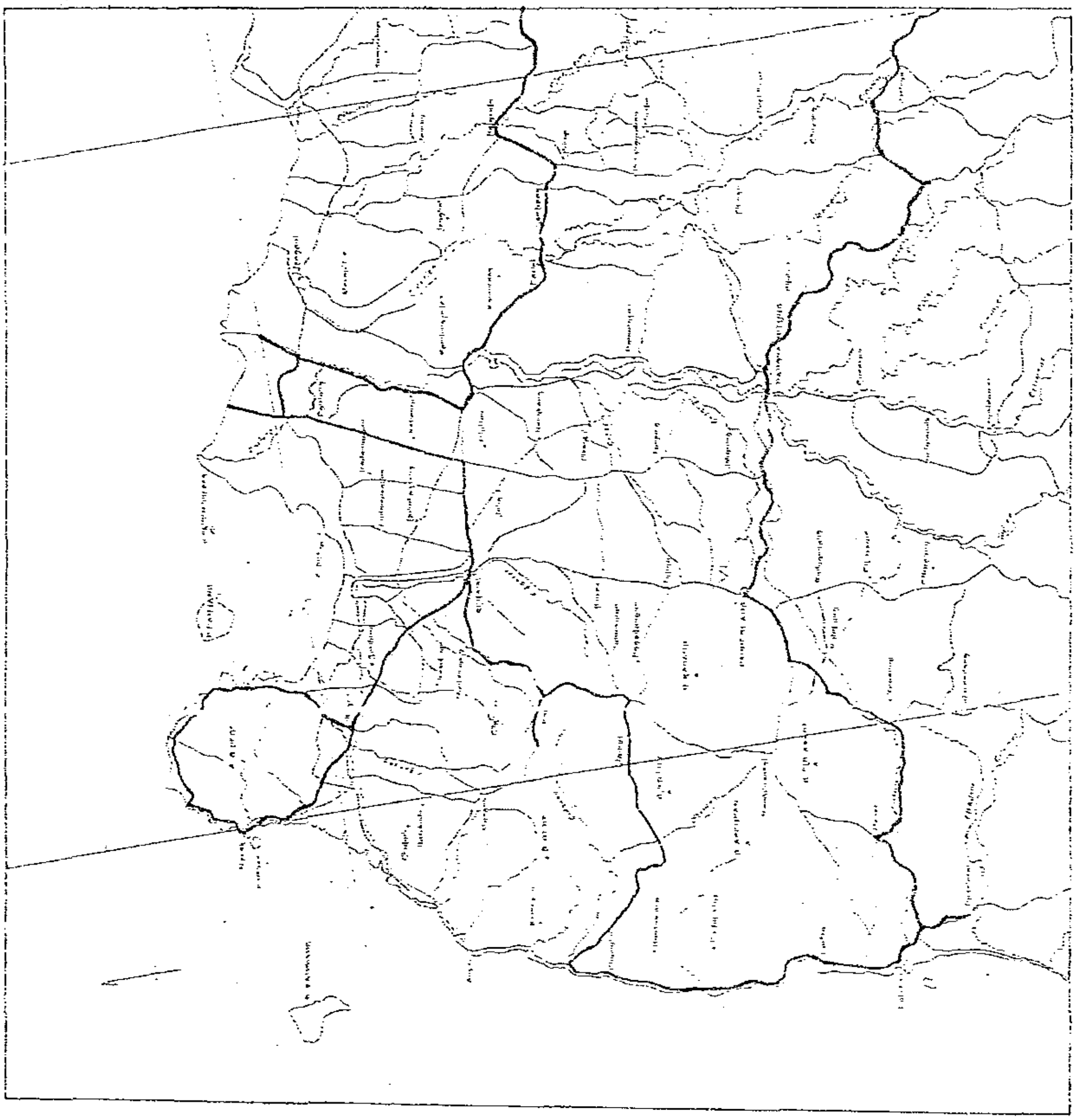
現地調査は，1983年10月4日～6日の3日間にわたって実施した。現地調査ルートは図3.5に示すとおりである。

調査は，第1次写真判読の検証と，対象地域内に分布する様々な植生パターンの確認を中心に行った。

3.3.2 現地調査結果

(1) 原生林

対象地域内では，Mt. KARANGやMt. ASEUPENなどの山々の山頂周辺や斜面にわずかに残存している程度である。原生林は一般に樹高25～30 mのフタバガキ科の巨木



により構成されている。今回の調査では，直接現地侵入が困難だったため正確に判断することはできなかったが，その規模から判断し原生林とした。

(2) 二次林は原生林をとり囲むように形成される森林であり，樹高は 10 ～ 20 ｍ程度である。この森林は，人為的に破壊された原生林の跡地で，植生遷移途上の群落である。

（写真－１）

(3) 二次林，ココヤシ林

二次林よりさらに低標高の地域に分布する森林であり，二次林とココヤシが混生している。（写真－２）

(4) ココヤシ林

低山地域から海岸部にかけて多く分布する森林であり，対象地域内では比較的多く分布している。この森林は，樹高 5 ～ 10 ｍで樹冠層はほぼ均一である。

(5) 湿地林

雨水や細い川から流入する水が貯留されている湿原に分布する森林である。対象地域内ではCidananの上流部にのみみられる。（写真－３）

(6) マングローブ林

主として河川の河口部の塩水化した湿地に分布する森林である。対象地域内ではCiujung川の河口部にみられ，塩水化の程度により樹木の大ききや密度が異っている。

(7) 低木林，草地

原生林が伐採された後に出現するものであり，伐採後の経過年数により，樹高が5～10ｍの低木林やAlang—Alang が優先する草地になっている。対象区域内では丘陵地に多く分布している。

(8) 畑　地

対象地域内では大規模な畑地はほとんどみられず，乾季に水田として利用できない場所に小規模なものがみられる程度である。それらの畑地には豆，トウモロコシ，サツマイモなどが作られている。（写真－４）

(9) 水　田

対象地域内の沖積地を中心に大規模に分布している。これらの水田は，利水条件のちがいにより雨季，乾季を通して水田として利用されているケースと雨季のみ水田として利用されているケースに分がある。前者は，河川沿いの比較的利水条件のよい地域に分布し，後者は河川からはなれたやや乾燥した地域に分布している。（写真－５）

(10) ゴム園

対象地域内では，ランカスピトン周辺で行われているが，その規模は小さい。このプランテーションはほとんど樹高 10 ～ 15 ｍの比較的若いものである。

(11) 養魚池

Ciujung川の河口周辺に広く分布している。淡水性の魚を養殖している。

3.4 植生図の作成

北バンテン地域の植生分類は，写真判読および現地調査の結果を統合し，表3.4に示すようにまとめた。

植生図は表3.4に示した植生分類に基づき再判読を行い修正し作成した。その結果は図3.6に示すとおりである。

対象地域は，比較的古くから人手が入っているため原生林は高山の山頂周辺や斜面に一部残存してる程度である。二次林は標高のやや高い場所やココヤシと混在し，分布している。また，一部，昔焼畑をしたと思われる地域もみられる。丘陵地は，二次林，ココヤシ，水田および畑地の混在地域であり，利水条件のちがいにより細分化され複雑なパターンを示している。沖積地は，大部分が水田に利用されており，かんがいの程度により，二期作や二毛作を行っている。

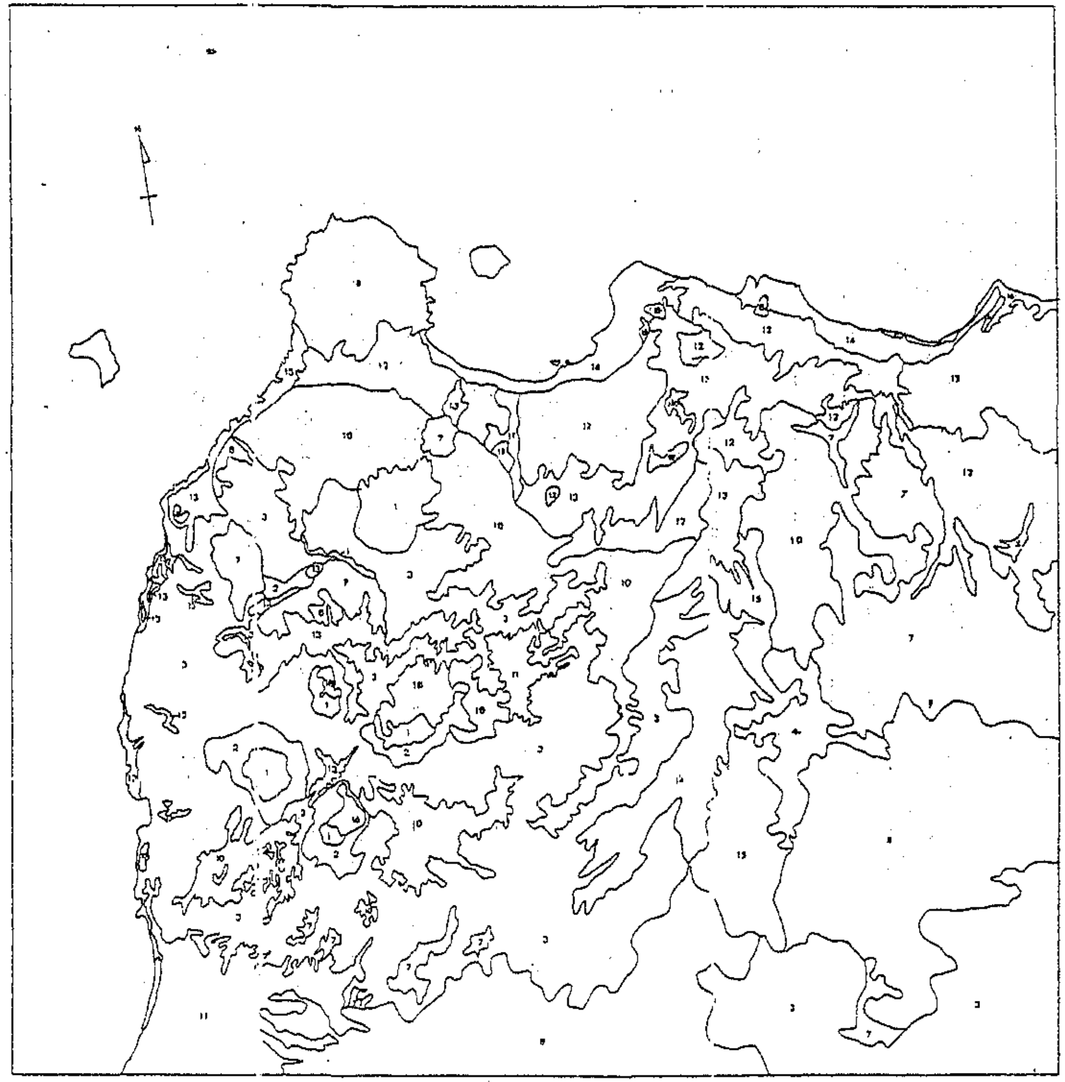
表3.4 北バンテンにおける植生分類

番号	植生分類
1	原生林
2	二次林
3	二次林，ココヤシ林（混在）
4	ココヤシ林
5	湿地林
6	マングローブ林
7	低木林，草地
8	低木林，ココヤシ林
9	湿原
10	水田，ココヤシ林
11	水田，ココヤシ林（雨季のみ水田として利用）
12	水田（雨季のみ水田として利用）
13	水田（雨季，乾季とも水田として利用）
14	養魚池
15	ラバープランテーション
16	その他

4. 植生と自然条件の解析

4.1 概要

農業開発適地と自然条件の関係は，すでに何例か専門家により報告されている。そのなかで，松尾氏レポート（農村計画短期専門家）では，農業適地と自然条件の関連分析の結



LEGEND

1 Primary Forest
2 Secondary Forest
3 Secondary Forest, Coconut Palm
4 Coconut Palm
5 Swamp Forest
6 Mangrove Forest
7 Bush, Grassland, Alang-Alang
8 Bush and Coconut Palm
9 Swamp Grassland
10 Paddy Field, Coconut Palm
11 Paddy Field, Coconut Palm; Wet Season Only
12 Paddy Field, Wet Season Only
13 Paddy Field, Either Wet or Dry Season
14 Fishpond
15 Rubber Plantation
16 Others

1 : 500,000

果，標高と傾斜に関連性が強いと報告されている。

ここでは，その結果を踏まえ，現況植生と標高および傾斜との関連性について具体的に重ね合せ法により解析を試み，農業開発適地について検討した。重ね合せ法は，メッシュによる方法，アナログによる方法などがあるが，今回は植生と標高および傾斜との関係が比較的はっきりしているのでアナログによる方法を採用した。

なお，標高および傾斜のデータは，すでに本プロジェクトで作成されている標高区分図および傾斜区分図を使用した。

4.2　植生と標高

植生と標高との関係は，図4.1に示すように主題図を重ね合せ，植生分類毎に各標高が占める割合を調べ，表4.1に示す結果を得た。

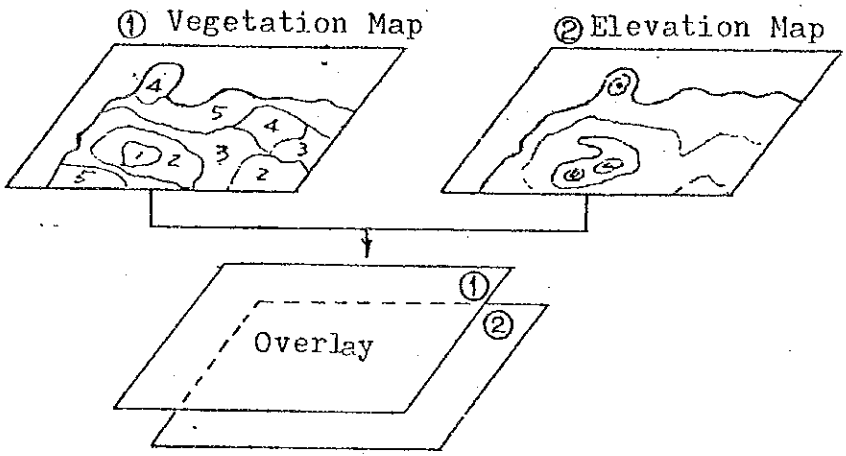


図4.1　植生と標高

その結果，北バンテン地域では植生と標高の間には一定の関係がみられた。

この地域の植生は，低標高から高標高に向い，水田，水田・ココヤシ，ココヤシ，二次林，原生林の順序に分布する傾向がみられる。つまり，水田は0〜25 *m*，水田・ココヤシは25〜100 *m*，ココヤシは100〜200 *m*の範囲に多く分布している。また，二次林および原生林は700 *m* 以上の標高の地域に分布している。このように，北バンテン地域では農地としては，標高700まで利用されており，したがって農業適地は標高700 *m* 以下の地域と判断できる。

表 4. 1　　Vegetation — Elevation

Vegetation, cover classification	Elevation 0～25m	25～100m	100～200m	200～500m	500～700m	700～1000m	1000～1500m	1500m～
1 Primary Forest				∘	∘	○	◎	○
2 Secondry Forest			∘	◎	○	○	∘	
3 Secondry Forest Coconut Palm	○	◎	◎	○	∘			
4 Coconut Palm	○	○						
5 Swamp Forest		∘						
6 Mangreve Forest	∘							
7 Bush Grassland	∘	◎	○	∘				
8 Bush, Coconut Palm	○	◎						
9 Swamp Grassland		∘						
10 Paddy Field Coconut Palm	∘	◎	○	○	∘			
11 Paddy Field(wet) Coconut Palm	◎	○	∘					
12 Paddy Field(wet)	◎							
13 Paddy Field(wet, Dry)	◎	○						
14 Fish Pond	○							
15 Rubber plantation	∘	○						
16 Others					∘	∘	∘	∘

◎ Much

○ Middle

∘ Least

4. 3　植生と傾斜

植生と傾斜の関係は，標高の場合と同様に図 4. 2 に示すような形式で行い，表 4. 2 に示す結果を得た。

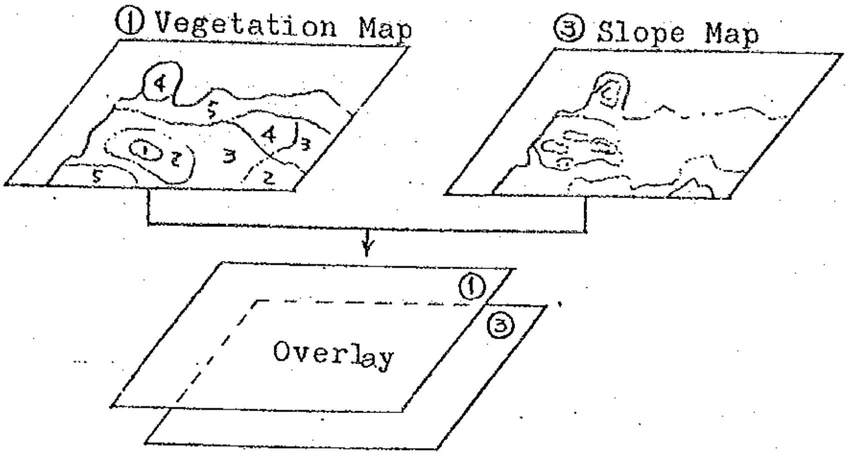


図 4. 2　　植生と傾斜

植生と傾斜の関係は，標高と同様に低標高から高標高に向い，水田，水田・ココヤシ，ココヤシ，二次林，原生林の順序に分布する傾向がみられる。水田は 0 ～ 2 %，水田・ココヤシは 2～15%，ココヤシは 15 ～ 40 %の範囲に多く分布している。また，二次林および原生林は40%以上の傾斜の地域に多く分布している。したがって，農業開発適地は，傾斜 40 %以下の地域と判断できる。

表 4. 2　　Vegetation − Slope

Vegetation cover Classification	Slope			
	0 ～ 2 %	2 ～ 15 %	15 ～ 40 %	40 % ～
1 Primany Forest		○	◯	◎
2 Secondry Forest		○	◯	◎
3 Secondry Forest Coconut Palm	○	◯	◎	○
4 Coconut Palm	○	◯		
5 Swamp Forest	○			
6 Mangrove Forest	○			
7 Bush , Grassland	○	◎	◯	○
8 Bush , Coconut Palm	◯	◎	○	
9 Swamp Grassland	○			
10 Paddy Field Coconut Palm	◎	◯	○	
11 Paddy Field(wet) Coconut Palm	◎	◯		
12 Paddy Field(wet)	◎			
13 Paddy Field(wet, Dry)	◎	◯		
14 Fish Pond	◯			
15 Rubber Plantation	◎	◯	○	
16 Others			◯	◎

◎ Much

◯ Middle

○ Least

4. 3　農業開発適地の検討

農業開発適地は，北バンテン地域の農地の現況と標高および傾斜の関係から，標高と傾斜の組み合せにより，表4. 3に示すような適地を評価した。また，図4. 3は，その結果を抽出したものである。

表4. 3　農業開発適地の評価

Elevation ＼ Slope	0〜2%	2〜15%	15〜40%	40%〜
0 〜 25 m	I	II	III	IIII
25 〜 100 m	II	II	III	IIII
100 〜 200 m	III	III	III	IIII
200 〜 500 m	III	III	III	IIII
500 〜 700 m	III	III	III	IIII
700 〜 1000 m	IIII	IIII	IIII	IIII
1000 〜 1500 m	IIII	IIII	IIII	IIII
1500 m〜	IIII	IIII	IIII	IIII

I ：水田，畑地，果樹園の適地

II ：畑地，果樹園の適地

III ：果樹園の適地

IIII ：農業開発不適地

I　水田，畑地，果樹園の適地

標高0〜25 m，傾斜0 〜 2 %の地域である。この地域は現在既に大部分が水田と利用され，水利条件の差により，年1回または年2回の収穫が行われている。かんがいを十分に行えば理想的な水田の適地である。

II　畑地，果樹園の適地

標高 0 〜 100 m，傾斜0〜15 %の地域である。IIの地域は現在主に水田，ココヤシに利用されているが，本来は地形条件からみて畑地として利用するのが好ましいと判断し，ここでは畑地の適地とした。この地域は主に丘陵地であり，土壌もやや乾燥していると思われる。しかし，かんがいの如何によっては十分に水田としても利用できる地域である。

III　果樹園の適地

標高 0 〜 700 m，傾斜 0〜40 %の地域である。IIIの地域は標高および傾斜からみて農地造成が難しく，造成しても土壌侵食の危険性が大きい。したがって果樹園として利用するののが好ましい地域である。現在はココヤシが主に植栽されている。

IIII　農業不適地

標高 700 m以上，傾斜40%以上の地域である。この地域は高標高でしかも傾斜が急峻であり，農業には全く適していないため，土壌侵食の防止，保水機能の維持の両面からみて森林として保全すべきである。

5. 北スマトラ地域の植生

北スマトラは，本プロジェクトの農業開発適地選定の対象となっている地域である。ここでは，北スマトラ地域の現地調査の結果に基づき，前述した北バンテン地域を比較して述べる。

北スマトラ地域（メダン周辺）の植生は，山地の原生林および二次林，丘陵地の畑作地帯，低地のプランテーション地帯が主なものである。山地では，標高 1,000 m 以上はほぼ森林に覆われ，地形の状態により原生林（写真－7），二次林に分かれるが一部マツの植林地もみられる。丘陵地は，大規模な畑作地帯（写真－8）となっており，トウモロコシ，カカオ，その他野菜類がうえられている。また，低地は大規模な油ヤシ（写真－9）やゴムのプランテーションが行われている。水田は谷底平野に小規模なものがみられる程度である。（写真－10）

以上の結果，北スマトラ地域の植生は，北バンテン地域の植生と比較すると以下の特徴がみられる。

(1) 高標高地域に原生林がかなり残存している。

(2) 丘陵地は大規模な畑作地帯になっている。

(3) 低地は大規模な油ヤシ，ゴムのプランテーションである。

(4) 水田は谷底平野に小規模なものがある程度である。

このように，インドネシアの農地は地域により利用形態が異っている。したがって，農業開発適地を選定する場合には，北バンテン地域の結果に加え，北スマトラ地域等の他領域の農地の利用状況も把握する必要があると思われる。

6. まとめ

6.1 赤外カラー航空写真（1：30,000）は，Swamp 地域の写真判読の結果，樹木の種類，高さや密度，草地の高さや広がりなどを正確に判読でき，種類の生育環境のちがいによりある程度の立地環境の把握も可能なことがわかった。

したがって赤外カラー航空写真は現地調査が不可能な未開発地域に対しては現地調査に代わる手段として利用できる可能性が高いと思われる。

6.2 LANDSAT IMAGE の判読による植生図の作成

LANDSAT IMAGE（1：250,000）の判読により植生図を作成した結果，北バンテン地域における植生の状況は十分に把握することができた。しかし，今回使用した LANDSAT IMAGE は植生のパターンがあまり表現されておらず現地調査にかかるウエイトが高い結果となった。したがって，今後，植生判読に有効な LANDSAT IMAGE の作成が必要と思われる。

6.3 植生と自然条件の解析

北バンテン地域における植生と自然条件（標高，傾斜）の解析の結果，農地は標高 700 m 以下，傾斜40％以下の地域に分布し，それぞれの標高，傾斜に適応して利用されている

ことがわかった。その結果，北バンテン地域における農地の適地は，水田が標高0～25 m，傾斜0～2％，畑地が標高0～100 m，傾斜0～15％，果樹が標高0～700 m，傾斜0～40％と推定することができた。

今後，標高，傾斜以外の自然条件との解析や他地域で同様の解析を行うことがのぞまれる。

VEGETATION MAP MAKING BY PHOTO INTERPRETATION AND SITE SELECTION OF SUITABLE AREA FOR AGRICULTURAL DEVELOPMENT ON NORTH BANTEN

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MR. Shusuke WAKABAYASHI
JICA Expert for Regional planning
Remote Sensing Engineering Project
Ministry of Public Works INDONESIA

C O N T E N T S

1. Foreword

In this remote sensing project, for the selection of suitable land for agricultural development, various thematic maps had been composed and various evaluation had been made. However, in this stage no vegetation map has been composed yet.

Among the many informations gathered from aerial pictures of undeveloped land the majority is about vegetation. And by this vegetation it is possible to grasp the conditions of location from the life environment of the area.
Therefore, it is considered that the situation of the vegetation can be used as one of the methods in the site selection of suitable area for agricultural development.

This report contains the study of suitable area for agricultural development by the analysis of the present situation of vegetation and natural condition (elevation, slope) from vegetation maps composed from direct interpretation method of aerial color infrared photographs (1 : 30,000) and LANDSAT IMAGE (1 : 250,000),

2. Interpretation of aerial color infrared photographs.

2.1. Concept

Aerial photograph perfectly reflect the land surface condition and is very useful for matters concerning land such as toporaphy, vegetation etc. Therefore, at present it is indispensable in the field of land survey and planning.

In general the photo interpretation is made for each mean such as the size of image, form color tone, texture, pattern etc. The infrared photograph is different from the natural color photograph. It is also exposed infrared and the plants are seen in color which is different from its natural color.
The color infrared film is composed of three layers of light sensitive emulsions. They are exposed green, red and infrared and developed blue, green and red color.
Therefore the color infrared photographs are mainly used in the field of interpretation of vegetation that produces a lot of reflection in the infrared.

2.1.1. Color tone

Color tone represents the brightness, vividness, density etc. The color infrared photographs can express the difference of reflectance of plants in several stages. The difference expresses the difference of the type of plant. Evergreen leaves forest will be shown in dark red color, bush in red color and grass in light red color. The paddy field and the upland field depending on the situation will show different colors such as dark red, white or dark green. Since water absorbs the infrared color, depending on the degree of moisture content, the soil will be shown in several stages of colors from white to black.

2.1.2. Texture

Texture is the condition of distribution or change of the color tone which can be seen in the image of the photographs. In general texture is classified and expressed in smooth, rough, spots, uniform etc.

2.1.3. Pattern

Pattern is the most typical item that can be obtained from the aerial photograph. It is most useful in the interpretation of forest and from the pattern of the forest the form the tree tops, the color tone, the texture and density can be interpreted. In many cases the paddy field and the farmland show comparatively similar simple pattern, and is further interpreted by adding the pattern of ridges. However, in this case it must be noted that the pattern changes prior and after harvest and there will be differences according to the seasons. Plantation can be easily identified since it shows regular rows of tree tops. Further the drainage pattern and liniament can be relatively easy to interprate.

2.2. Practice of aerial photograph interpretation

Aerial photograph interpretation has been conducted using aerial color infrared photographs taken for the CJC area and Asahan area Table2.1 shows the content of the used aerial color infrared photographs.

Table2.1 Content of aerial color infrared photographs.

Area name	Date of photographing	S c a l e	Used photographs
CJC area	August 1982	1 : 30,000	C-255, 16, 17, 18 C-241, 19, 20, 21
Asahan area	March 1983	1 : 30,000	C-1, 18, 19, 20

2.2.1. Interpretation of ridge and valley

The interpretation of ridge and valley is conducted to obtained the stereoscopic feeling of the aerial photographs, and the hilly area near Tomo in the CJC area was sellected as model. This spot is located in the hilly area behind alluvial land formed by comparatively delicate ridges and valleys complicatedly mixed. This kind of land is very ideal for interpretation of topography. In the photo interpretation the aerial photographs were viewed in three dimension and the line of ridges and valleys were traced out on the overlay.

2.2.2. Interpretation of tree height

The interpretation of tree height is conducted to obtain the height feeling of the aerial photographs, In practice, the tree height was interpreted by the use of aerial photographs taken for plantation and evergreen leave forest in Asahan area. At the same time, interpretation of tree top density which shows the ratio of tree tops in the forest was also done.

2.2.3. Interpretation of pattern

The interpretation of pattern was conducted at the swampy area of Bambukuning River estuary within the CJC area where the vegetation has a lot of variety. This area is mostly swampy and according to the vironment the various vegetation pattern can be observed. The beach area is mostly covered with mangrove becoming less and less toward the land.

The background was covered with swampy forest and swampy field. Near the beach a lot of fish pond are found.

At the back of the swapy area is found paddy fields where the pattern changes according to the harvesting. Here and there along the roads housing can be seen.

Fig.2.1 shows the vegetation map produced from the result of pattern interpretation.

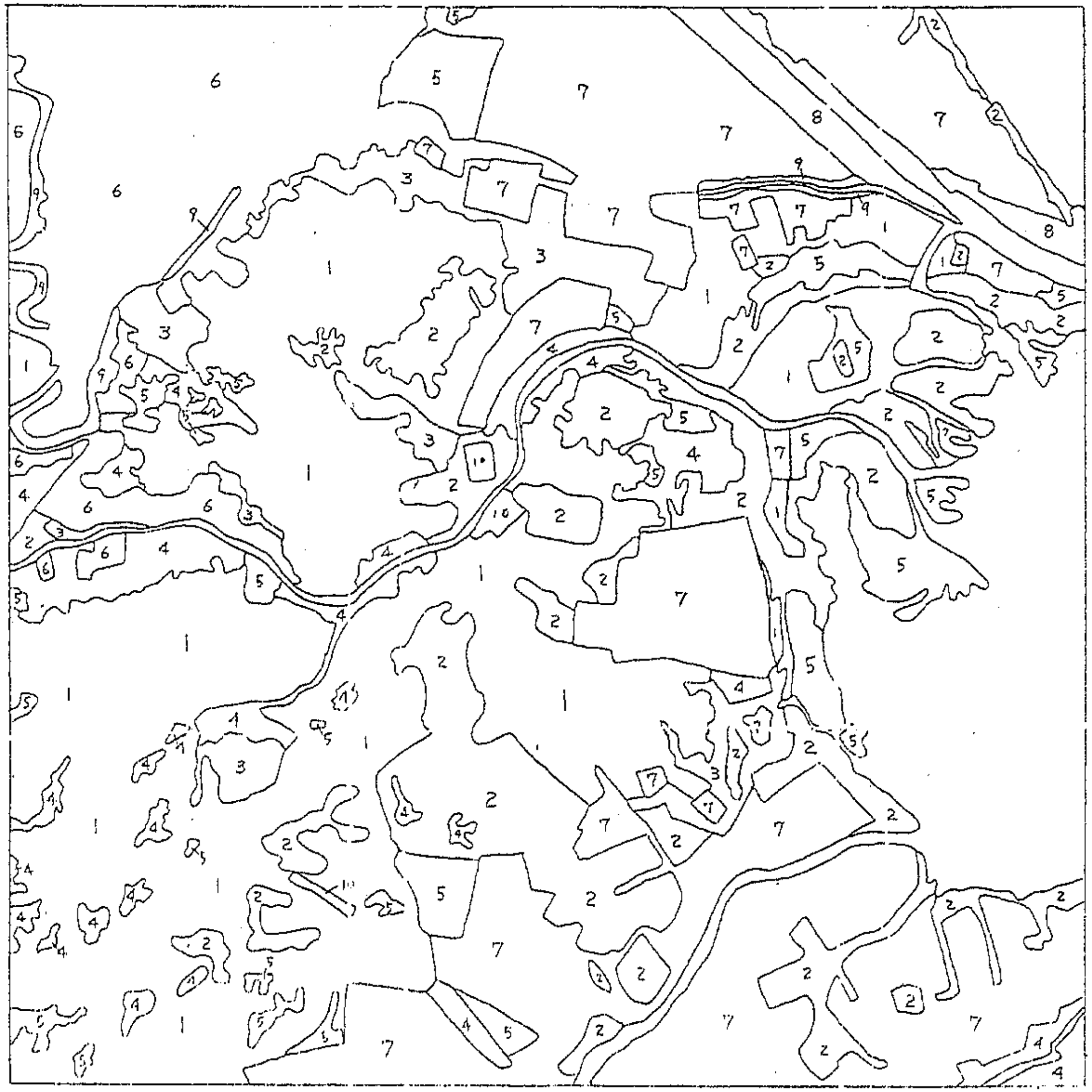

FIG.2.1. VEGETATION MAP

LEGEND

(1) Swampy forest
(2) Mangrove forest
(3) Grassland (high)
(4) Grassland (low)
(5) Swampy grassland
(6) Paddy field
(7) Fish pond
(8) Salt farm
(9) Village
(10) Others.

1 : 30,000

2.3. Vegetation and the Conditions of location.

From the interpretation of aerial color infrared photographs the condition of vegetation covering the land surface can be known and if from this it is possible to grasp the environment of the area, then the aerial color infrared photographs can be regarded as a highly useful method for the selection of suitable land for agricultural development.
This time from the result of photo interpretation in the swampy area, the height, the distribution and the density of the forest or grass land in the area can be correctly interpreted. And it was observed that from the difference of the environment upto a certain extent, it was possible to grasp the conditions of location. Further, even for land that had been used for agriculture, it was known that it was possible to classify from the pattern, land which was used as paddy field the whole year or used as paddy field and farm land alternately. The outline of environment for each variety of vegetation interpreted from aerial photographs will be described below.

(1) Mangrove forest

Mangrove trees grow mainly in the salty water near the river estuary and the forest density depends on the salt content of the water. Since the salt content is high it is not suitable for agricultural development.

(2) Swampy forest

This is the forest at the rear of the mangrove forest area. The water content degree of the soil can be known from the height and density of the forest. In general the higher the trees the lower is the soil water level and vice versa.

The use for paddy field depends on the condition of the soil water content.

(3) Swampy field

This area is always under water and peat deposits are developped. This area was not suitable for agricultural development.

(4) Grass land

The height and density varies according to the soil water content. In the past this land used for some purpose and is suitable for agricultural development.

(5) Paddy field

Depending on the soil water content (wet or dry) condition, the paddy fields were divided into two types. The one is once a year harvest type and the other is twice a year type. As mentioned above, the vegetation grwoth is adjusted to the type of environment and by grasping the environment, upto a certain extent, it is possible to estimate the topography and soil condition of the land. Therefore the interpretation of vegetation from aerial photographs in general, is a very useful and indispensable method for unopened areas where field survey is almost impossible.

3. The making of vegetation map from interpretation of LANDSAT IMAGE

3.1. Concept

For almost unaccessble and unopened lands in Indonesia, the Landsat image can provide a highly effective information. In general this unopened lands are blessed with high temperature and much rainfall and most of the land is covered with vegetataion all year round.

Therefore for the site selection of suitable area for agricultural development, one of the important points are how to interprete the vegetation and from this to be able to grasp the land condition.

At present, in this project, various thematic maps have been produced from Landsat data, but no vegetation map has been composed. It was thought that it was difficult to identify and classify the vegetation from the Landsat data.

Therefore, this time, vegetation map was made by direct interpretation method from Landsat Image. Fig. 3.1 . and 3.2. shows the North Banten area as target area.

Fig.3.3. shows the flow in making the vegetation map.

The outline will be described below.

(1) Production of Landsat Image

The purpose is to make Landsat image which is easy to interprete and expresses vegetation pattern. In this study, we select from the Landsat Image taken for the targeted North Banten area, data which were reliably expressed were picked from the original data.

(2) Vegetation cover classification

Taking into consideration existing data and field condition, vegetation cover classification suitable for North Banten area are made.

(3) The first photo interpretation

Putting an overlay on gathered Landsat Image and complying with vegetation cover classification the first photo interpretation are conducted.

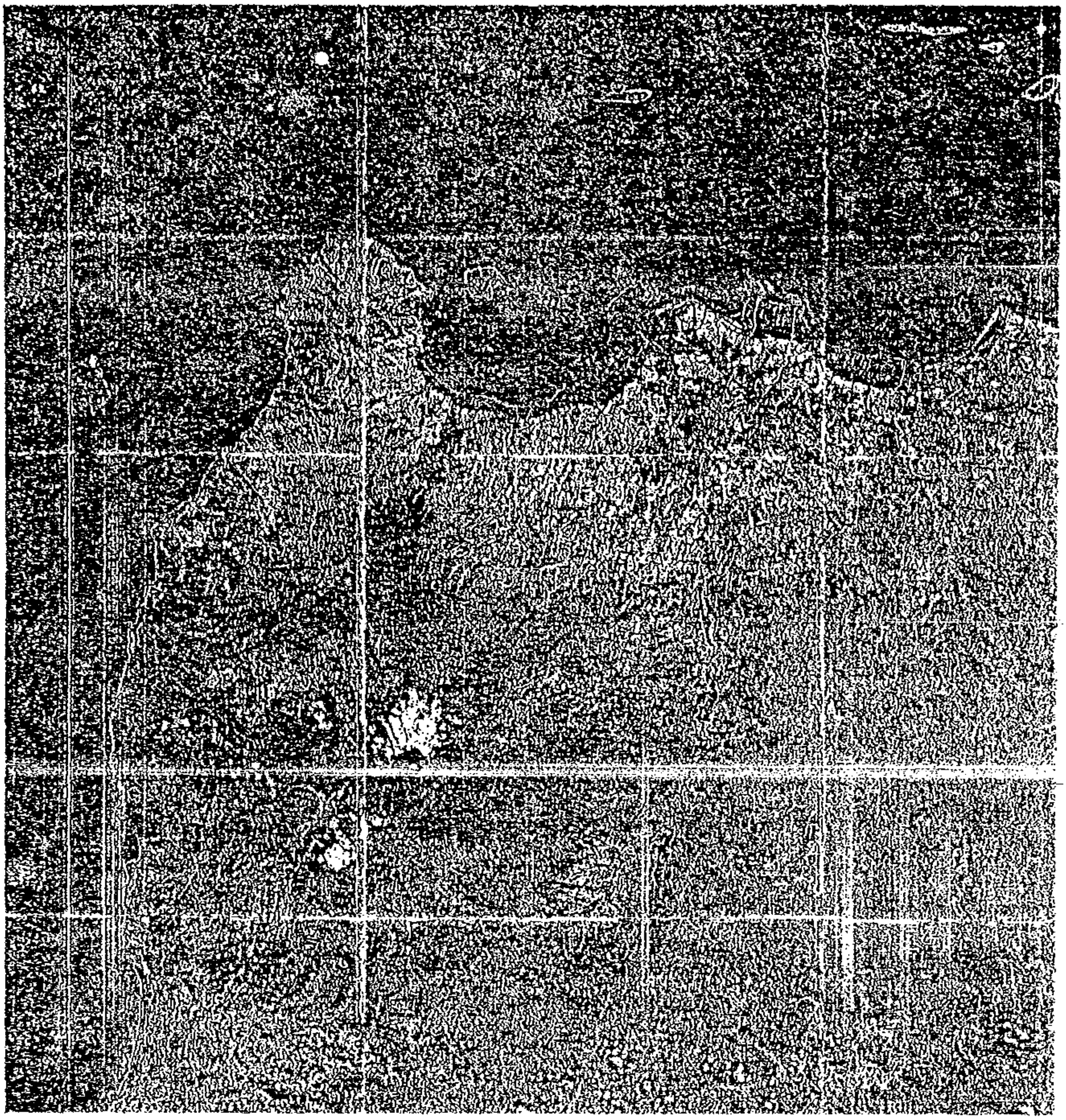

FIG.3.2. LANDSAT COLOR COMPOSITE IMAGE ON NORTH BANTEN AREA

SCALE 1 : 500.000

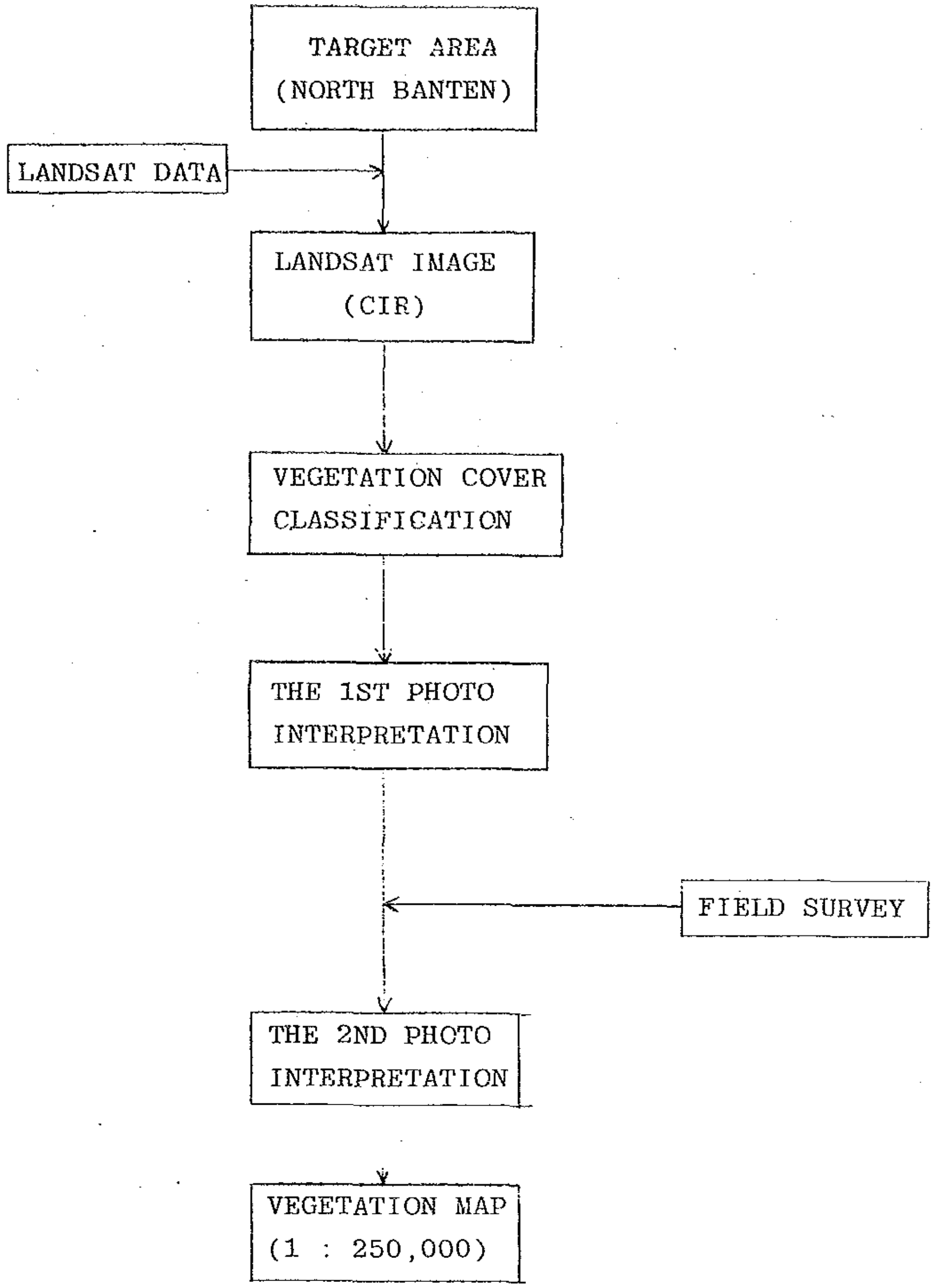

FIG. 3.3. Making of vegetation map by LANDSAT DATA

(4) Field survey

Based on the result of the first photo interpretation and for places where interpretation is difficult or not clear, field survey is conducted. And the interpretation result is inspected and corrected.

(5) The second photo interpretation

Based on the field survey findings, for places where interpretation is not clear or mistaken, re-interpretation and correction are conducted.

(6) Making of vegetation map

Based on data obtained from above mentioned survey and photo interpretations, the final vegetation map was completed.

3.2. Vegetation cover classification

From long ago, researchers in the field of forestry or ecology has been made for the vegetation in tropical areas. Table 3.1. and 3.2. and Fig. 3.1. show examples of classifications of forest in tropical areas such as Tropical East Asia, Malaysia and Burma. The classifications are made for the development of undevelopped areas and are mainly compiled from the relation between forest groups and the conditions of location. In this report, using above examples as references and taking into consideration vegetation condition in the whole Indonesian country, classification are made and the result can be seen in Table 3.3. The content of this vegetation classification are centered on forests and stressed an undevelopped area. Further, this vegetation classification is sufficiently possible by interpretation of aerial color infrared photographs and in some cases are also possible with Landsat image.

Table3.1 Main forest types in the tropical east Asia in connection with site factors

(Whitmore, 1975)

Climate	Soil moisture	Location	Soils	Altitude		Forest formation type*
High moisture in all seasons	Dry land	Inland	Zonal soil	Lowland -1200 m	1	Tropical lowland evergreen rain forest
				Hilly (750) 1200-1500 m	2	Tropical low-mountain rain forest
				(600) 1500-3000 m	3	Tropical upper-mountain rain forest
				(3000) 3500 m to forest limit	4	Tropical sub-alpine forest
			Podzolic sand	Mainly lowland	5	Heath forest
			Limestone	Mainly lowland	6	Limestone forest
			Ultrabasic rock	Mainly lowland	7	Serpentin forest
		Coast			8	Coastal forest
		Salt water swamp			9	Mangrove forest
		Brackish water swamp			10	Brackish water swamp forest
		Fresh water swamp	Poor fertile peat		11	Peat swamp forest
			Fertile soil (organic and inorganic)	Wet	12a	Fresh water swamp forest
				Periodically wet	12b	Seasonal swamp forest
Seasonally dry	Causes moderate water deficit seasonally				13	Tropical semi-evergreen rain forest
	Causes severe water deficit seasonally				14	Tropical moist deciduous forest
					15	Other formation types according with the increment of dry season

*1-13: Tropical rain forests, 14-15: Monsoon forests.

Table3.2 MAIN FOREST TYPES AND CORRESPONDING PHOTO TYPES

Forest Type	Photo Type	Photo Aspect
Lowland Dipterocarp Forests	2e	High forest. Medium to large crowns. Irregular canopy with tall emergents. Coarse texture. Typically on low undulating land and low hills.
Hill Dipterocarp Forests	H2e	Similar to 2e but appears more open. On gentle slopes of high hills and on isolated low hills.
Upper Dipterocarp Forests	H1b/c/d	High forest but lower than H2e. Small to medium crowns. Compact or broken irregular canopy sometimes with frequent large trees. Medium to coarse texture. On very high hills and steep slopes.
Montane Oak Forests	M1b/d	Medium forest. Small to medium crowns. Dense slightly irregular canopy sometimes with scattered large trees. On mountain slopes and ridges above the Upper Dipterocarp Forests.
Montane Ericaceous Forests	M1c	Low forest. Small crowns. Dense, regular canopy. On mountain tops and exposed ridges.
Mangrove Swamp Forests	1m	Low to medium forest. Small crowns. Compact, regular canopy. Fine texture. Dark tone.
Freshwater Alluvial and Peat Swamp Forests	S1b/c/d	Low forest. Small crowns. Irregular or regular, open or close canopy sometimes with scattered taller trees. Fine texture. In lowlying areas.
	S2b/d	Higher forest with larger crowns than S1b/c/d. Coarse texture.
Riverine Forests	R1b/c/d	Low forest. Small crowns. Compact or broken irregular canopy sometimes with scattered large trees. Fine to medium texture. Associated with rivers and flood plains.
	R2b/d	Higher forest with larger crowns than R1b/d. Coarse texture.

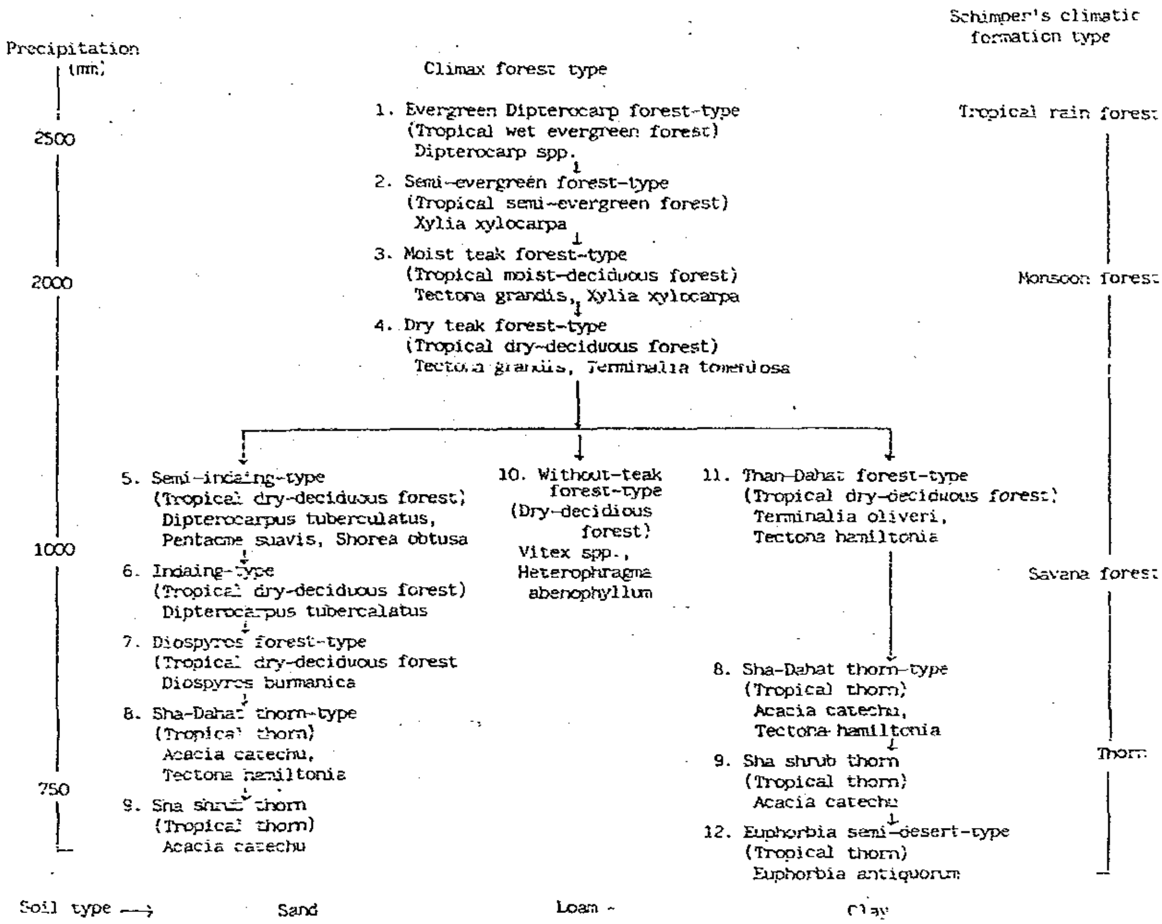

Fig.3.4 Lowland Climax Forest Types in Burma in Relation to Precipitation and Soil Type(Okutomi,1977)

Table 3.3. VEGETATION COVER CLASSIFICATION IN INDONESIA

VEGETATION TYPE	VEGETATION COVER CLASSIFICATION
FOREST	1. Tropical sub-alpine forest (3500 m -) 2. Tropical upper-mountain rain forest (1500-3000 m) 3. Tropical low-mountain rain forest (1200-1500 m) 4. Tropical lowland ever green rain forest (-1200 m) 5. Secondary forest (Old) 6. Secondary forest (Young) 7. Swampy forest 8. Mangrove forest 9. Coconut palm 10. Rubber forest
GRASSLAND	11. Grassland (High) 12. Grassland (Low) 13. Swampy grassland
AGRICULTURAL LAND	14. Farm land 15. Paddy field (Dry) 16. Paddy field (Wet)
OTHERS	17. Clearcutting forest 18. Shifting cultivated field 19. Others

3.3. Field survey

3.3.1. Field survey route

The field survey was conducted for three days from October 4 to October 6, 1983 and the route is shown in Fig. 3..5. The field survey was done for the purpose of checking the result of the first photo interpretation and confirming the vegetation pattern covering the target area

(1) Primary forest

In the target area, primary forest is scarely found in the crest and slope of Mt.Karang and Mt.Aseupan. In general the primary forest consists of huge trees 25-30 m in height (mainly DIPTEROCARPACEOUS) (In this survey it was difficult to enter the location, so evaluation was not correctly judged. How ever this area be called primary forest).

(2) Secondary forest

In this target area, the secondary forest surrounds the primary forest.
The trees area about 10-20 meters in height. Once there had been promary forest and destroyed by man. The forest living at present is in the process of succession (photo 1).

(3) Secondary forest and coconut palm

The forest found in areas away from secondary forest toward the low elevation area consists of mix of secondary forest and coconut palm (photo 2)

(4) Coconut palm

The coconut palm is widely distributed in the area between the low elevation land and the beach. It is relatively found in the target area.

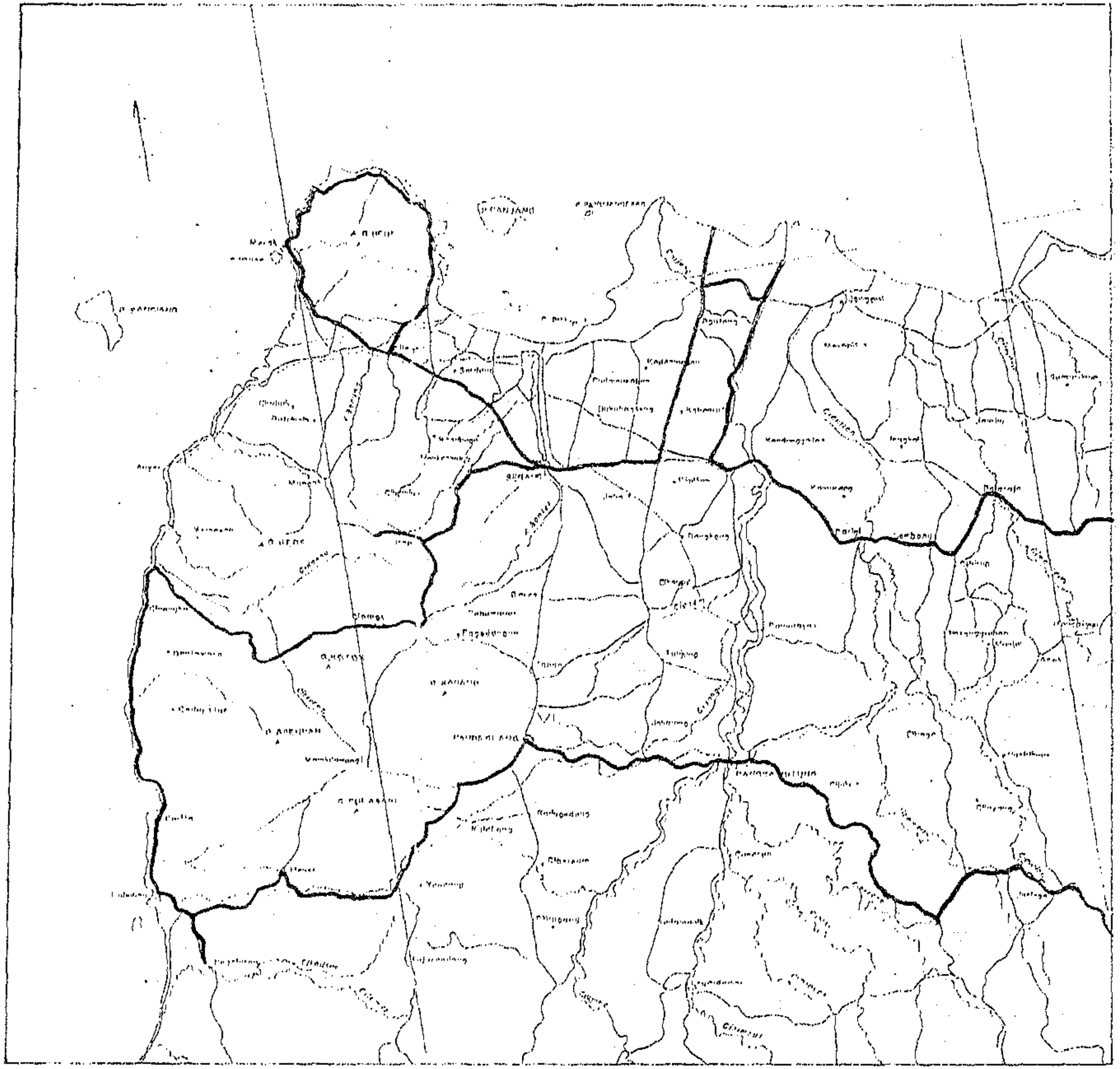

FIG. 3.5. COURSE SCHEDULE

LEGEND :

——— SURVEYING ROUTE

1 : 500,000

The height of the trees in this forest is 5-10 meters with almost uniform density.

(5) Swampy forest

This is the forest found in areas filled with water from rainfall or small rivers. In the targeted area the swampy forest is found only in the up stream area of Cidanan River (photo 3).

(6) Mangrove forest

This kind of forest ismainly found in the swampy areas at the rives estuary where the water is salty. In the target area the mangrove forest is found in the estuary of Ci Ujung River and the density and tree size depends on the degree of salt in the water.

(7) Bush, Grassland

The bush and grassland appears after the primary forest has been cut. Depending on the lapse after cutting of the primary forest, the land is covered mainly with bush of 5 - 10 meter in height or alang-alang. In this target area this type of forest is found in the mountainous area.

(8) Farmland

In the target area, large scale farmland is almost non existent. Only small scale farmland which can not be used as paddy field during the dry season is found. This famland is used to plant peanuts, corn and sweet potaoes (photo 4).

(9) Paddy field

Many paddy fields are found in the target area centering in the alluvial areas.

There are two kinds of paddy fields : rainy and dry season type and rainy season only type. The former type is found in areas along the fiver where irrigation is comparatively good while the latter is found in dry areas away from the river. (photo 5)

(10) Rubber plantation

Within the target area, rubber plantation is found in the civinity of Rangkasbitung, though of small scale. The tree height in this plantation is 10-15 meters and are relatively young.

(11) Fish pond

Many fish ponds are found in the estuary area of Ci Ujung River. (photo 6) And a fresh water fish is raised there.

PHOTO -1 SECONDARY FOREST

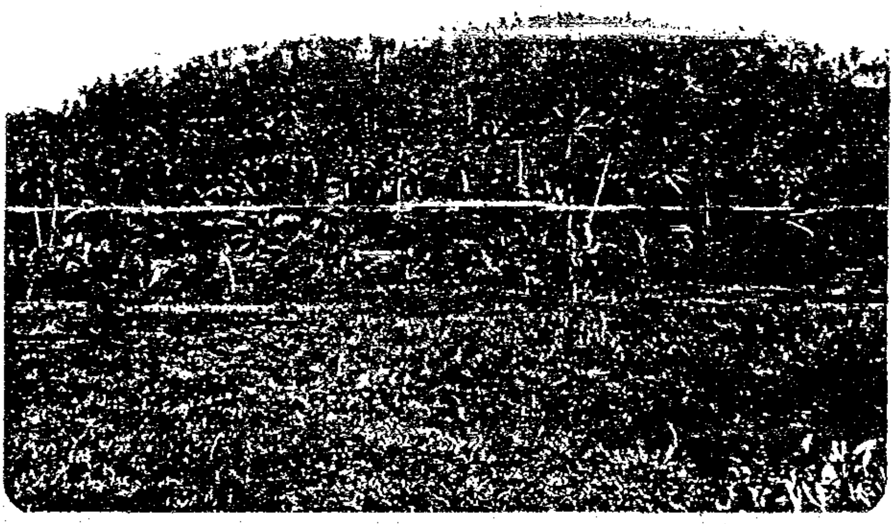

PHOTO -2 SECONDARY FOREST, COCONUT PALM

PHOTO -3 SWAMP

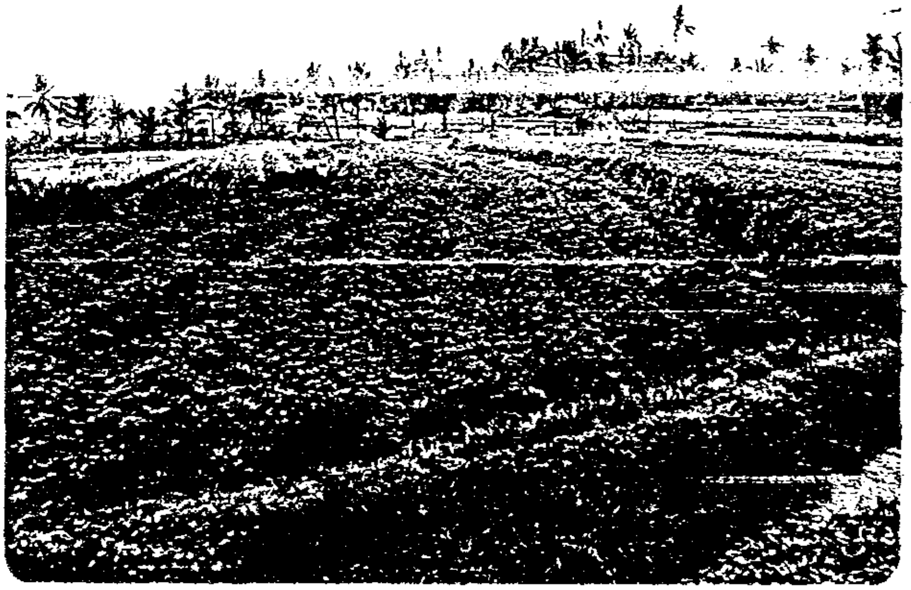

PHOTO -4 FARMLAND

PHOTO -5 PADDY FIELD

PHOTO -6 FISH POND