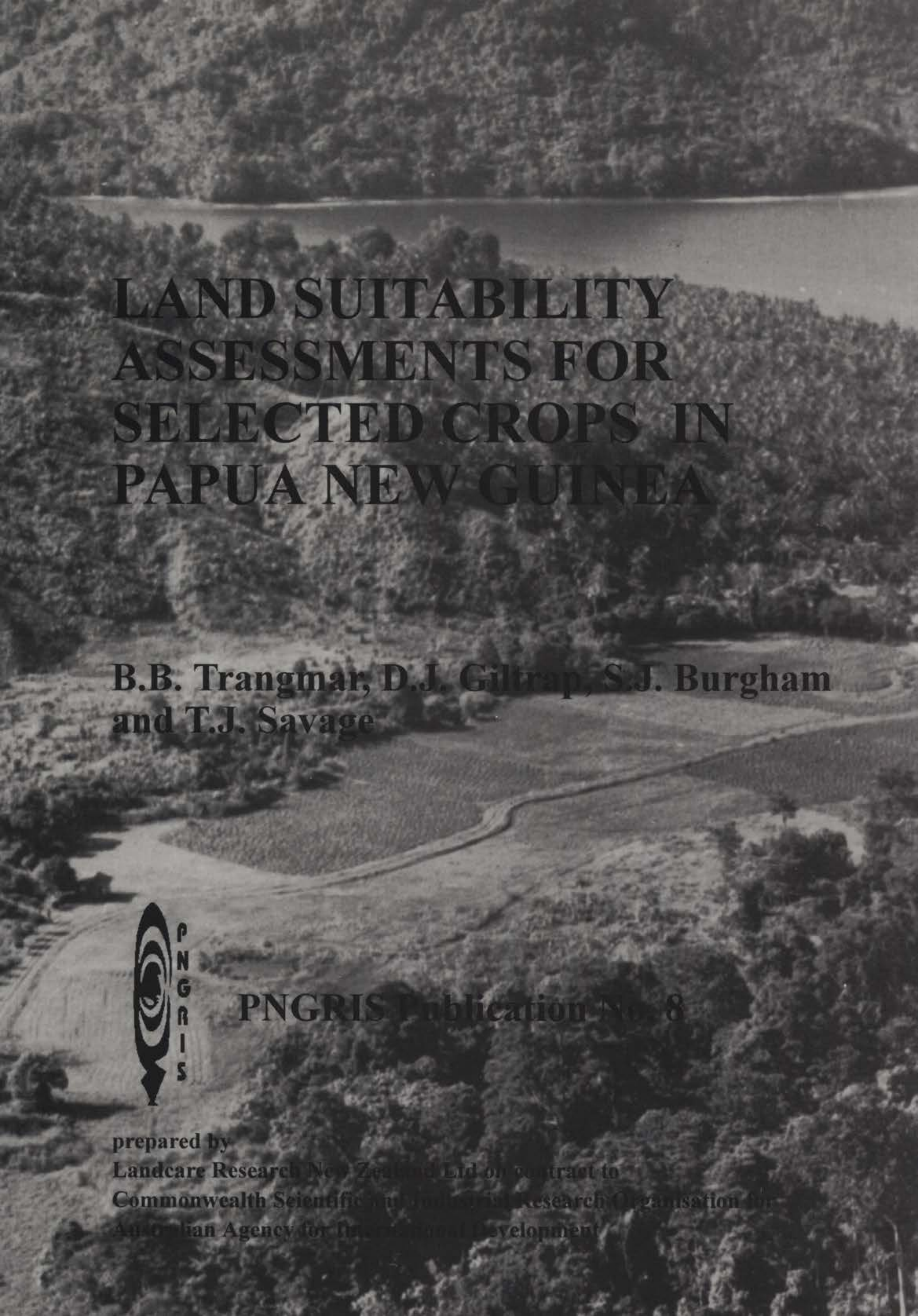

LAND SUITABILITY ASSESSMENTS FOR SELECTED CROPS IN PAPUA NEW GUINEA

B.B. Trangmar, D.J. Giltrap, S.J. Burgham
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ABSTRACT

Methodology for the application of computerized land suitability assessment systems with the Papua New Guinea Resource Information System (PNGRIS) is presented. These systems comprise a land suitability model for arabica coffee production (Harding *et al.* 1986), tree and cash crops described in the Papua New Guinea Land Evaluation System (PNGLES) (Venema and Daink 1992). The methodology is tested for arabica coffee production and oil palm in Papua New Guinea for the major environment classes in Papua New Guinea (PNG) and for resource mapping units defined in PNGRIS. Land suitability for arabica coffee and oil palm production in PNG is mapped. The computerized land evaluation system for arabica coffee production is described. Results of the land suitability assessments for arabica coffee production based on the Harding *et al.* (1986) and PNGLES systems are compared. Recommendations are made for further development and validation of the land evaluation systems used. Procedures for data transfer between PNGRIS and the land evaluation systems are described.

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ABBREVIATIONS

ALES	Automated Land Evaluation System
AusAID	Australian Agency for International Development
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DAL	Department of Agriculture and Livestock (PNG)
FAO	Food and Agriculture Organization
LRU	land resource unit
LUR	land use requirements
LUT	land utilisation type
PNG	Papua New Guinea
PNGLES	Papua New Guinea Land Evaluation System
PNGRIS	Papua New Guinea Resource Information System
RMU	resource mapping unit

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1. INTRODUCTION

1.1 Background and objectives

The Papua New Guinea Resource Information System (PNGRIS) is a micro-computer-based geo-referenced database containing information on natural resources, population distribution, rural land use, small-holder economic activity and land use potential (Bellamy 1986). It is compiled at 1:500 000 scale for approximately 5000 Resource Mapping Units (RMUs) covering the entire land area of Papua New Guinea (PNG).

Two potential applications of PNGRIS are:

1) identification of areas of PNG which, given certain criteria, would be suitable for particular types of land use, and
2) determination of the most suitable type(s) of land use for specific land areas.

The land resource data in PNGRIS is appropriate for broad-scale agricultural land use suitability assessment at national and provincial level. A number of studies have conducted general (Haantjens *et al.* 1967, Bleeker 1975, Hackett 1988) and crop-specific (Bleeker and Freyne 1981, Venema and Daink 1992) agricultural land suitability assessments for PNG. Of these studies, only Venema and Daink (1992) have applied PNGRIS for such purposes. Venema and Daink (1992) computed suitability ratings for 22 crops for all PNGRIS RMUs but the results were stored in a database and not mapped. As a result, no spatial assessment of crop suitability was presented.

The structure of most land evaluation systems partition land on the basis of physical and climatic characteristics. A similar partitioning of PNG's physical environment was done by McAlpine (unpub.) in 1987. McAlpine identified 235 discrete environmental combinations in PNG differentiated on the basis of landform, altitude, rainfall, slope, rock type, and inundation. Ideally, physical land suitability for specific crops should be broadly similar within the same environment class when considering land use suitability for different crops on a nation-wide scale. As a result, the environment classes defined by McAlpine should be useful in partitioning the physical environment of PNG for broad-scale agricultural development planning.

The objectives of this study were to:

1) Develop procedures for application of land resource data from PNGRIS with computerized land evaluation systems to assess crop suitability for PNGRIS RMUs and the major environmental types of PNG;
2) Compute land use suitability ratings for a range of crops using coffee as a detailed test crop;
3) Prepare sample maps on suitability of major environments and PNGRIS RMUs for selected cash crops.

This report describes the:

- land evaluation systems used in the study;
- procedures used in applying PNGRIS data with these systems;
- development and application of a computerized land evaluation system for arabica coffee production;
- results of the crop suitability analyses.

2. LAND EVALUATION SYSTEMS

2.1 Review of land evaluation in PNG

Land evaluation systems have been used with land resource survey data in PNG since the 1960's to assess land suitability for agricultural development. Haantjens (1963, 1969) developed the "Agricultural Land Classification" for arable crops, tree crops, improved pastures and paddy rice. This system was developed during the CSIRO regional land resource surveys of the 1950's and early 1960's. It is based largely on physical properties of the land. Hartley *et al.* (1967) defined five potential land use classes for horticulture in a survey in West New Britain. Bleeker (1975) used the main elements of Haantjens' system to produce national 1:1 000 000 scale maps of physical land limitations (9 classes) and agricultural land use potential for the four major land use types defined by Haantjens.

These early land evaluation systems were developed for the major groups of agricultural crops and were not crop-specific. As the amount of resource data for PNG has increased and agricultural development has proceeded, a number of crop-specific land evaluation systems were developed. These included systems for cocoa production (Bleeker and Freyne 1981, Wayi 1987), sweet potato (Radcliffe 1983), and coffee (Harding *et al.* 1986). A crop eco-physical land evaluation system (ECOPHYS) (Hackett 1988) was also introduced as part of PNGRIS. However, ECOPHYS has not been widely used by staff of the Department of Agriculture and Livestock (DAL) Land Use Section and has not been widely tested in PNG.

The system currently used most widely by DAL staff is the Papua New Guinea Land Evaluation System (PNGLES) developed by Venema and Daink (1992). This system is based on the FAO Framework for Land Evaluation (FAO 1976). It provides a systematic land evaluation method for the production of 18 crops at two levels of management input. Decision trees for each of the 18 crops have been developed within the computerized framework provided by the Automated Land Evaluation System (ALES) (Rossiter and Van Wambeke 1991). Crop suitability ratings for the above crops have been computed for each province in PNG using the land resource data in PNGRIS (1:500 000 scale). PNGLES is currently being tested in soil and land resource surveys at more detailed scale by DAL Land Use Section staff. The PNGLES decision tree models for citrus, potato and pineapple were used as part of the land evaluation process in the Upper Ramu land resource survey (Trangmar *et al.* 1995a).

A crop physiological evaluation system (PLANTGRO) (Hackett 1991) is also currently being evaluated in PNG. PLANTGRO places more emphasis on crop physiological response to climate and soil factors. It is more appropriate for site-specific crop suitability assessments than the other systems listed above. The other systems have less rigorous climatic parameters and are easier to use with land resource survey data in which climatic variation is described in only a general way. As such PLANTGRO complements the other systems for site-specific application.

In this study the arabica coffee model of Harding *et al.* (1986) was computerized using the ALES package and suitability ratings generated for each environment subclass and PNGRIS RMU. Ratings for all PNGLES models were computed for each environment subclass and PNGRIS RMUs. Procedures for applying PLANTGRO with PNGRIS were developed and tested in a pilot study area.

2.2 Arabica coffee land evaluation model

2.2.1 Introduction

Harding *et al.* (1986) developed a comprehensive system of land evaluation for rainfed arabica coffee production in PNG. The system is also based on the FAO (1976) framework and is a qualitative classification for two land utilization types (LUT). These are a high input system (coffee estates and managed blocks) and a low input system (small-holders).

Seven diagnostic criteria are recommended for evaluating the land suitability of individual sites, namely drainage/effective soil depth, air temperature, mean annual rainfall, erosion hazard, soil chemical fertility, site accessibility and present land use. Land resource data required to derive these criteria are:

Soil drainage class
Effective rooting depth
Altitude (surrogate for temperature)
Mean annual rainfall
Erosion hazard (rainfall erosivity, soil erodibility, slope)
Fertility (total N, P retention, Exch. K, Mg, CEC, pH)

The methodology enables evaluations to be made of individual (uniform) sites and also large areas of variable land, such as provinces or catchments. However, evaluations of large areas of variable land depend on the ability to map the land resource data used to derive the diagnostic criteria to run the model. The system has been validated at provincial scale using Western Highlands as a test area (Harding *et al.* 1987) and also applied in the Upper Ramu Catchment for land resource data collected at 1:50 000 scale (Trangmar *et al.* 1995a). In the latter study the classification system was computerized using the ALES framework (Rossiter and Van Wambeke 1991). The computerized version of the model has been installed on computers in DAL Land Use Section, Port Moresby.

Procedures for extracting the relevant land resource data for each resource mapping unit and transferring it into ALES to run the coffee model were similar to those used in the Upper Ramu study (Trangmar *et al.* 1995a). These procedures were adapted for use with PNGRIS in this study to generate coffee suitability ratings for PNGRIS RMUs and environment subclasses.

2.2.2 Diagnostic Criteria

The key land characteristics and their suitability classes required to run the Harding *et al.* (1986) coffee model are described briefly below.

Drainage/effective soil depth

The rating for this diagnostic criterion is determined from the effective soil depth, the soil depth after drainage. The depth of free-draining soil, the presence or absence of limiting layers, and the presence/absence of slowly permeable horizons are all used to determine the effective soil depth (Tables 1 and 2). These are modified versions of the respective tables in Harding *et al* (1986), and do not consider the possible limitation of the absence of drainage outlets, because this attribute cannot be compiled on a map unit basis.

In the evaluation for arabica coffee production, the soil is regarded as being unsuitable if the depth to which plant roots can readily penetrate is less than 50 cm (Harding *et al.* 1986). All soils with an impenetrable layer (e.g. rock, concretionary layer) at depths of less than 50 cm, are rated as unsuitable (R4). Soils with a depth of free-draining soil of less than 20 cm cannot be drained to attain an effective soil depth of more than 50 cm, and are also rated as unsuitable.

Soils without an impenetrable layer at depths of less than 50 cm, but with 20-50 cm of free-draining soil, are rated as suitable (R3), provided the soil can be drained to achieve an effective soil depth exceeding 50 cm. In most cases, this can be achieved by installing closely-spaced drains to a depth of 1 m. Drainage is possible in both low- and high-input production systems, so the soils are rated as suitable (Rating R3). However, if the soils have either low vertical- or low horizontal drainage, deep ploughing or mole draining respectively will be required. In high-input production systems, such amelioration techniques are possible. As a result, slowly permeable soils with 20-50 cm of free-draining soil are rated as suitable (R3). In low-input systems mechanized drainage techniques are too costly, and such soils are rated as unsuitable (R4).

Table 1: Drainage/effective soil depth suitability classes for high input coffee production (after Harding *et al.* 1986)

Suitability rating	Depth of free draining soil (cm)
R1	> 120
R2	50-120
R3	20-49
R4	< 50 over limiting layer
	< 20

Table 2: Drainage/effective soil depth suitability classes for low input coffee production (Source: Harding *et al.* 1986)

Suitability rating	Depth of free draining soil (cm)	Presence of horizons with low vertical[1] or horizontal[2] permeability
R1	> 120	N/A
R2	50-120	N/A
R3	20-49	absent
R4	20-49	present
	< 50 over limiting layer	N/A
	< 20	N/A

[1] Low vertical permeability in any one horizon indicates that deep ploughing is necessary
[2] Low horizontal permeability indicates that mole draining will be necessary

Altitude

Arabica coffee production is directly related to temperature - both very low and very high temperatures can seriously affect production. In PNG a strong correlation exists between temperature and altitude. Altitude is therefore used as a diagnostic criterion (Table 3) for evaluation of suitability for coffee production (Harding *et al.* 1986).

Table 3: Altitude/temperature suitability classes for coffee production (after Harding *et al.* 1986)

Suitability rating	Altitude range (metres a.s.l.)		Maximum annual temp. range (°C)		Minimum annual temp. range (°C)	
	High input LUT	Low input LUT	High input	Low input	High input	Low input
R1	1300-1699	1300-1699	26-24	26-24	15-13	15-13
R2	1100-1299 1700-1899	1100-1299 1700-1899	28-26 24-22	28-26 24-22	16-15 13-12	16-15 13-12
R3	1000-1099 1900-2000	600-1099 1900-2100	28-27 24-21	31-27 22-21	17-16 12-11	19-16 12-11
R4	<1000 >2000	<600 >2100	>28 <21	>22 <21	>16 <11	>19 <11

Mean annual rainfall

Mean annual rainfall is an important climatic characteristic for arabica coffee production. Suitability ratings for rainfall classes are given in Table 4.

Table 4: Mean annual rainfall suitability classes for coffee production (Source: Harding *et al.* 1986)

Suitability rating	Mean annual rainfall (mm)
R1	2000-2999
R3	1500-1999 3000-4000
R4	<1500 >4000

Erosion hazard

In the humid tropics, rates of natural soil erosion are generally low due to the formation of a protective cover of vegetation. However if the vegetation is removed, accelerated soil erosion occurs, particularly in areas which receive high intensity rainfall (Harding *et al.* 1986).

In this evaluation, three factors that contribute to soil erosion by water: rainfall erosivity, soil erodibility, and slope, are all used to derive an erosion hazard index, by adding together the index points for each factor (Table 5). The suitability rating is determined from the numerical value of the erosion hazard index (Table 6). The critical values for each suitability rating are different for high-input and low-input coffee production.

Table 5: Factors and classes comprising the erosion hazard index (Source: Harding *et al.* 1986)

Factor and units	Critical values and index points			
	1	2	3	4
Rainfall Erosivity (erosivity class[1])	Low	Moderate	High	Very High
Soil erodibility (erodibility class[2])	Very Low	Low	Moderate	High
Slope (°)	0-8	9-16	17-32	>32

1 Rainfall erosivity is a function of maximum monthly precipitation and annual rainfall. Calculations of rainfall erosivity, using data from a network of existing rainfall stations across PNG have been made by Bleeker (1983). A map of rainfall erosivity classes for PNG is given in Harding *et al.* (1986).

2 Soil erodibility describes the susceptibility of the soil to erosion, and has been shown to be dependent on the texture, organic matter content, structure, and permeability of the soil. Erodibility classes for PNG soils are given in Table 12.

Table 6: Erosion hazard index suitability classes (after Harding *et al.* 1986)

Suitability rating	Erosion hazard index	
	High input LUT	Low input LUT
R1	3-4	3-5
R2	5-7	6-8
R3	8-10	9-11
R4	11-12[1]	12

1 Or any land with slope > 32°

Soil fertility

The inherent soil fertility is an important parameter for crop growth, particularly in low input management systems. Such systems are largely dependent on the soil for the supply of plant nutrients. In the arabica coffee model, total nitrogen, phosphate retention, exchangeable K, exchangeable Mg, cation exchange capacity, and pH are used to derive a chemical fertility index (Table 7). The importance of each of the above chemical properties to arabica coffee production, and their preferred range is given in Harding *et al.* (1986). The numerical value of the chemical fertility is used to determine the suitability ratings, the critical values being different for low-input and high-input production systems (Table 8).

Table 7: Soil fertility index factors, critical values and index points (Source: Harding *et al.* 1986)

Factor and units	Critical values and index points			
	1	2	3	4
Total N (%)	<0.10	0.10-0.19	0.20-0.50	>0.50
P retention (%)	>95	85-95	60-84	>60
Exch. K (meq %)	<0.10	0.10-0.19	0.20-0.60	>0.60
Exch. Mg (meq %)	<0.30	0.30-0.59	0.60-1.00	>1.00
ECEC (meq %)	<2	2-5	6-10	>10
or CEC (meq %)	<5	5-10	11-25	>25
pH	<4.5 >7.5	4.5-4.9 7.1-7.5	5.0-5.4 6.6-7.0	5.5-6.5

Table 8: Soil fertility index suitability classes (Source: Harding *et al.* 1986)

Suitability rating	Soil fertility index points	
	High input LUT	Low input LUT
R1	>18	>20
R2	13-18	15-20
R3	8-12	10-14
R4	<8	<10

2.2.3 Land Suitability Class

For each of the diagnostic criteria described above, suitability points are assigned to each of suitability ratings, according to the relative importance of each (Table 9). The suitability points of a particular land unit are then added together to determine the suitability class (Table 10).

Table 9: Suitability classes and points allocated to each diagnostic factor (Source: Harding *et al.* 1986)

Diagnostic factor	Suitability rating and points			
	R1	R2	R3	R4
Drainage/effective soil depth	12	9	6	0
Altitude	8	6	4	0
Mean annual rainfall	4	n/a	2	0
Erosion hazard	4	3	2	0
Soil fertility	4	3	2	1

Table 10: Conversion of suitability points into a land suitability classification (after Harding *et al.* 1986)

Suitability points	Land suitability class
>27	1 (Highly Suitable)
23-27	2 (Moderately Suitable)
17-22	3 (Marginally Suitable)
<17 or any suitability rating scoring zero	4 (Not Suitable)

2.2.4 Development of the model for arabica coffee production in ALES

A computerized decision tree model of the Harding *et al.* (1986) arabica coffee land evaluation system was developed using the ALES framework.

The land and soil attributes required to determine the suitability ratings for the diagnostic criteria, and thus the Land Suitability Class of the Harding *et al.* (1986) coffee model, were set up as Land Characteristics in ALES. However, the corresponding data in the PNGRIS/Upper Ramu databases did not always have the same number of classes and/or the same critical limits as those required by the Harding *et al.* (1986) model. Intermediate Land Characteristics corresponding exactly to those in the PNGRIS/Upper Ramu databases were set up. Decision trees were also set up that would translate the classes of these Land Characteristics to those of the Land Characteristics required by the ALES model. This was done using "Lc -> Lc" decision trees, where decision trees are set up for the each Land Characteristic required by the Harding model that did not have matching classes in the PNGRIS/Upper Ramu databases.

The classes of attributes in the PNGRIS/RAMU data set that required translation are shown in Table 11 below.

Table 11: Land characteristic classes which required translation from the PNGRIS/RAMU databases for use in the Harding *et al.* (1986) coffee model

Land characteristic	Land characteristic class in PNGRIS/Upper Ramu databases	Land characteristic class of Harding *et al.* coffee model
ECEC (meq/100g)	<10	2-5
Altitude (m)	600-1200	600-999
	1200-1800	1300-1699
	1800-2400	2000-2099
	1800-2100	1900-1999
Slope (°)	5-10	0-8
	10-20	9-16
	20-30	17-32
	>30	>32
Total Nitrogen (%)	<0.2	0.10-0.19
P Retention (%)	60-90	60-84
	>90	>95
Exchangeable K (meq/100g)	<0.2	0.10-0.19
pH	6-7	6.6-7.0
	5-6	5.0-5.4
	<5	<4.5
	7-8	7.1-7.5
	>8	>7.5

The Land Characteristic "depth of free draining soil" was derived from the data attribute "drainage class" in the PNGRIS/Upper Ramu database as follows:

Drainage Class (PNGRIS/Upper Ramu)	Depth of free draining soil
well drained	>120cm
imperfectly drained	50-120cm
poorly to very poorly drained	20-49cm
waterlogged (swampy)	<29cm

Soil erodibility was determined from the Soil Taxonomy great group, using Table A6.1 of Harding *et al.* (1986). A number of additional correlations were made (Table 12) where the great groups of PNGRIS were not listed by Harding *et al.* (1986).

Table 12: Erodibility classes of Soil Taxonomy great groups in PNG (after Bleeker 1983)

Code	Class	Soil Taxonomy great group		Description
1	Very low	Histosols Andisols	Humitropepts	Soils with high to very high organic matter content and moderate to rapid permeabilities. Granular to fine crumby surface horizons.
2	Low	Argiudolls Hapludolls Rendolls Argiaquolls Endoaquolls Epiaquolls Argiustolls Calciustolls Haplustolls	Cryumbrepts Rhodudalfs Rhodustalfs Psammaquents Tropopsamments Ustipsamments Haplohumults Palehumults Plinthohumults	Soils with moderate organic matter content and moderate permeabilities.
3	Moderate	Cryaquepts Tropaquepts Cryochrepts Dystropepts Eutropepts Ustropepts Cryaquents Endoaquents Epiaquents Fluvaquents Hydraquents	Sulfaquents Tropofluvents Ustifluvents Cryorthents Troporthents Ustorthents Endoaqualfs Epiaqualfs Hapludalfs Haplustalfs Rhodudults	Generally slowly permeable soils with moderate organic matter content; the alluvial Entisols have low to moderate organic matter content, are massive and may have moderate very fine sand and silt content.
4	High	Endoaquerts Hapluderts Haplusterts Halaquepts Plinthaquepts Albaqualfs Natrudalfs Natrustalfs Plinthaqualfs Natrustolls	Albaquults Endoaquults Epiaquults Paleaquults Plinthaquults Hapludults Paleudults Plinthudults Acrudox Hapludox	Endoaquerts: Very slowly permeable, often subject to surface scaling and have prismatic or coarse blocky structures, but moderate organic matter content. Hapludults and Epiaqualfs: generally relatively low organic matter content and relatively high very fine sand and silt content. Poorly structured topsoils.

2.2.5 Land use requirements

The diagnostic criteria (rainfall, altitude, erosion hazard index, chemical fertility index, and drainage/effective soil depth) were established in ALES as Land Use Requirements (LUR) for coffee. The decision trees to determine suitability ratings (severity levels in ALES) followed the tables of Harding *et al.* (1986) described above. The soil chemical fertility index LUR required multiple land characteristics to be set up as Lc -> Lc decision trees to avoid complex decision trees for the LURs.

In the Upper Ramu study, the severity levels for erosion hazard index of Harding *et al.* (1986) were adjusted so that slopes exceeding 16 degrees were unsuitable for coffee production in the low input model, and slopes greater than 8 degrees were unsuitable in the high input model (D.F. Freyne *pers. comm.*). In the present study the severity levels for erosion hazard were those described in Harding *et al.* (1986)

2.2.6 Physical suitability subclass

The physical suitability class (1-4) and subclass (abbreviations of the LURs/diagnostic criteria) were derived by means of a decision tree, using all the possible permutations of the five LURs/diagnostic criteria, in combination with the "maximum limitation" method. The suitability classes 1-4 corresponded to the classes S1 (Highly Suitable), S2 (Moderately Suitable), S3 (Marginally Suitable), and S4 (Unsuitable) respectively of Harding *et al.* (1986).

In the decision tree, a suitability class was allocated to each permutation of the five LURs, using the suitability points defined in Tables 9 and 10. Branching of the decision tree was stopped when any one of the diagnostic criteria was maximally limiting (i.e. had a R4 rating and zero suitability points). This was done to reduce the number of possible permutations and the size of the decision tree. When any one of the diagnostic criteria had a R4 rating, the suitability class allocated was "4", and the subclass corresponded to the abbreviation of the maximally limiting LUR. Where more than one LUR was maximally limiting, the subclass only included the first maximally limiting LUR and would not include all the correct abbreviations. As a result, the "decision tree" method was combined with the "maximum limitation" method. This was done so that all the LURs which are potentially maximally limiting (i.e. drainage/effective soil depth, erosion hazard, altitude, and rainfall) were identified in the final physical suitability class allocated to each RMU.

2.2.7 Suitability ratings for compound RMUs

Many of the land units of both PNGRIS and the Upper Ramu catchment contain more than one soil great group. Each soil great group is unique, having a discrete set of attributes. This can result in different suitability ratings amongst soil great groups in the same RMU. Each soil great group is estimated to occupy a certain area percentage of the RMU in which it occurs. In RMUs containing three different soil great groups it was assumed that the percentage area of the RMU occupied by each great group was 40, 30, 30, respectively. This assumption was made to simplify the decision tree calculations in ALES. Similarly for those land units with only two soil great groups, great groups were assumed to occupy 60% and 40% of the total area respectively. In each case it was assumed that the dominant great group was listed first in the PNGRIS database.

Once the arabica coffee decision tree models were set up in ALES appropriate data for each land characteristic for each RMU was extracted from PNGRIS (Upper Ramu database in the case of the Upper Ramu study). A number of additional attributes required by the model (e.g. exchangeable Mg) were added. This database was then transferred to FoxPro, whereupon ASCII files of RMU definitions and resource attributes required by the ALES system were compiled. In the ALES framework, evaluations of suitability for arabica coffee production in both low-input and high-input production systems were generated. The resultant suitability classes for each land unit were transferred to a spatial database in MapInfo from which maps of suitability for arabica coffee production were generated.

The computerized Harding *et al.* (1986) arabica coffee model was originally developed for the Upper Ramu study (Trangmar *et al.* 1995a). It was then applied in this study to PNGRIS and used to generate the ratings shown in Maps 1-5.

2.3 Papua New Guinea Land Evaluation System (PNGLES)

DAL Land Use Section currently uses the Papua New Guinea Land Evaluation System (PNGLES) either manually or through the Automated Land Evaluation System (ALES) package to assess land suitability for crop production. The main concepts of PNGLES are summarized here. Full details of PNGLES are given in Venema and Daink (1992).

2.3.1 PNGLES concepts

PNGLES is based on the FAO concepts of matching land qualities with land use requirements of a specific land utilization type (LUT) (FAO 1976) to derive suitability ratings. The matching process is conducted using a decision tree framework established for each LUT within the Automated Land Evaluation System (ALES) of Rossiter and Van Wambeke (1991). Decision trees are given for small-holder production of 18 crops (cardamom, cashew, chillies, citrus, cocoa, coconut, coffee arabica and robusta, maize, mango, oil palm, pepper, pineapple, potato, pyrethrum, rubber, upland rice, and vanilla) under low input conditions and 8 crops (cocoa, coffee arabica and robusta, maize, oil palm, potato, upland rice, rubber) under medium to high input, smallholder production conditions. Suitability ratings of each land quality in relation to that required for optimum production of each crop are determined using the decision trees. The suitability rating for most limiting land quality is used to determine the overall suitability of the mapping unit for the specified land utilization type. All land utilization types, crop requirements, and decision trees are given in Venema and Daink (1992).

PNGLES was initially set up to utilize the land resources data stored in PNGRIS, but can be applied at more detailed scales (Trangmar *et al.* 1995a). It currently uses eight land qualities derived from 26 land characteristics (Table 13).

2.3.2 Automated Land Evaluation System (ALES)

The ALES framework provides a systematic structure and process through which to derive the land evaluation ratings for each LUT. A particular strength of ALES is that provides a user-friendly query system through which the user can ask questions about why particular ratings were derived. ALES also has the potential capability to determine gross margins for crop production if production costs, prices, and yield data are known or can be derived for each LRU. Full details of using ALES are given in the user manual (Rossiter and Van Wambeke 1991) and are not explained here. The yield and gross margins components of ALES and PNGLES have yet to be tested in PNG.

Table 13: PNGLES land qualities and land characteristics

Land qualities	Land characteristics/attributes
Temperature	Mean max. temperature Mean min. temperature
Erosion hazard	Slope Soil erodibility
Moisture conditions	Mean annual rainfall Rainfall seasonality Soil texture (topsoil, subsoil) Landform
Nutrient availability	pH Mineral reserve Anion fixation
Potential for mechanization	Stoniness/rockiness Slope Topsoil texture
Rooting conditions	Effective soil depth Soil texture (topsoil, subsoil) Stoniness/rockiness
Nutrient availability/ retention capacity	pH CEC Topsoil texture Anion fixation
Oxygen availability	Soil drainage
Soil toxicities	Acid sulphate Calcium carbonate
Excess of salts	Salinity Sodicity

In addition to the existing decision tree models for the crops developed in PNGLES by Venema and Daink (1992) ALES provides the framework to develop such models for other crops not presently included in PNGLES.

2.3.3 Data transfer between land resource databases and ALES/PNGLES Models

The relevant land characteristics for each RMU can be readily extracted from PNGRIS database and exported to ALES to conduct the crop suitability ratings using the PNGLES models. The crop suitability ratings were computed for each RMU in PNGRIS (Venema and Daink 1992). The ratings can then be reimported back to FoxPro and MapInfo for map plotting or spatial analyses with the other land resource attributes recorded.

2.4 PLANTGRO

2.4.1 Concepts

PLANTGRO is crop physiology-based computerized system of assessing land suitability for crop growth (Hackett 1991). It operates by matching the environmental requirements for optimum growth of specific crops with the climatic and soil conditions of the site being evaluated. It uses empirical qualitative crop growth response curves for each climatic and soil factor and matches them with the climatic and soils conditions for the site being evaluated. Limitations of each climatic and soil parameter of the site is assessed for the crop on a 0-9 scale (0 representing optimum growth, 9 causing plant death). In assessing the overall rating for the site PLANTGRO uses the maximum limitation method in which crop growth is constrained to the level or rating imposed by the most limiting factor. The overall ratings are presented in terms of maximum limitation rating tables or graphs.

2.4.2 Crop growth response functions in PLANTGRO

PLANTGRO contains crop growth response functions for the following climate and soil/site parameters:

Climate:	Soils/Site:
Daylength, solar radiation	Aeration
Tolerance to brief and extended cold	Base saturation
Tolerance to heat damage	Cation exchange capacity
Thermal units	Effective rooting depth
Crop development units	pH
Water availability	N, P, K
Seasonal water logging	Salinity
Flooding	Slope
Proneness to wind damage	Soil texture

PLANTGRO currently contains these growth functions for over 100 crops. The crop growth response files have been developed using documented information and expert consultation throughout the world. Growth functions can be developed for additional crops quite easily once their response to each climate and soil factor is known. Existing functions can be easily edited to take into account cultivar or varietal differences.

2.4.3 Soil data input to PLANTGRO

Soils data can be entered directly to PLANTGRO or existing generalized soil files for particular types of soils (e.g. sandy, clay soils) can be used if the soil type at a particular site or area is not known. It is recommended that actual soil data be used wherever possible. Soil data required by PLANTGRO is given in Table 14. Soil chemical properties listed in Table 14 apply to the topsoil layer. All of the soils data can be derived from PNGRIS using the procedures given in Annex 1.

Table 14: Soil data inputs required for PLANTGRO

Soil chemical properties (Topsoil)	Soil physical/site properties
Base saturation (%)	Aeration (Drainage Class)
Cation exchange capacity (meq/100g)	Effective rooting depth (cm)
Nitrogen (%)	Slope (degrees)
Available phosphorus (ppm)	Depth (Layers A, B, C) (cm)
Exchangeable potassium (meq/100g)	Texture (Layers A, B, C) (8 classes)
Salinity (dS/m)	Available water holding capacity (Layers A, B) (cm/m)
	Drainable water holding capacity (Layers A, B, C) (cm/m)

2.4.4 Climatic data inputs to PLANTGRO

Climatic data used in PLANTGRO (Table 15) should be derived from weather stations with more than 15 years of established record. Climatic data can be entered and crop growth analyses conducted for monthly, 10-daily, or weekly periods. Monthly data is most commonly used and is most relevant to crop suitability assessments for land resource surveys. 10-daily or weekly data may be used where particular crop physiological responses to specific weather conditions are to be assessed. Average data over the years of record or actual data for specific monthly, 10-daily or weekly periods can be entered.

Climatic data for PNG stations can be obtained from McAlpine *et al.* (1975) and entered to PLANTGRO. In running PLANTGRO for a particular survey area, data for the nearest or most relevant climate station is selected from the climate data menu.

Table 15: Climatic data inputs required for PLANTGRO

Data Type	Data Type
Rainfall (mm)	Evaporation (mm)
Irrigation water applied (mm)	Flooding risk value (1 or 0)
Daylength - average daily (hrs)	Solar radiation - average daily (Mj/m^2/day)
Temperature - mean daily max (°C)	Temperature - mean daily min. (°C)
Temperature - Brief cold - (e.g. min. less 6°C)	Wind - average (km/hr)
Wind - extreme (km/hr)	

2.4.5 Making crop growth predictions using PLANTGRO

Single or multiple crop suitability predictions can be computed at any one time for any combinations of crops, soils and climates. As a result, PLANTGRO is versatile in that many different crops can be compared at the same time for a particular soil and climate combination; the suitability of a particular crop can be evaluated for several different climate zones at the same time; it can also be used to assess appropriate planting times for particular crops during the year and assess crop rotation sequences for different crops under a given set of soil and climate data. PLANTGRO can also be used to assess development stages of the crop growth in response to environmental conditions. It also enables crop suitability assessments to be made for several soils and crops within a land unit.

PLANTGRO output is in the form of tables of limitation ratings for each soil and climate factor for each crop, and an overall limitation rating based on the maximum limiting rating for the individual factors. This can also be displayed graphically onscreen and results saved to a file for hard copy output. PLANTGRO also has a capability for output files to be converted to GIS format although this has not been attempted in PNG as yet.

Full details of operating PLANTGRO are given in the manual by Hackett (1991).

At the present time in PNG, PLANTGRO is best used for making crop growth predictions for particular sites or for land resource surveys with a small number of LRUs. As a result, it is quite complementary to the PNGLES suite of land evaluation models which were designed to be used with large land resource survey data sets through use of the ALES framework.

In contrast to ALES and PNGLES, PLANTGRO does not readily take management conditions into account although these can be simulated by adjusting the soil input data to match different management input levels (e.g. fertilizer, drainage, irrigation). It does not contain economic analysis modules.

PLANTGRO is not well structured to access a large land resource survey database. Its current output formats require much editing before it can be directly incorporated with a relational database for subsequent plotting with a GIS package.

2.5 Other land evaluation systems used in PNG

Land evaluation systems for a number of specific crops (including cocoa, sweet potato, coconuts) have been developed for use with land resource data in PNG. Several of these are briefly described below. Full details of each system are given in the cited references which the reader is encouraged to consult.

2.5.1 Cocoa

Bleeker and Freyne (1981) developed a land evaluation system for cocoa based on the relative severity of nine types of physical limitations. They used this system to map areas of PNG which are suitable for cocoa production. Wayi (1987) also proposed a system of land evaluation for cocoa production at three levels of management based on the FAO (1976) framework.

2.5.2 Sweet Potato

Radcliffe (1983) also applied the FAO framework for land evaluation to assess contrasting land types in Southern Highlands Province for sweet potato production under the traditional Mendi cultivation system. Radcliffe's sweet potato evaluation system could probably adapted for application in other parts of PNG.

2.5.3 Coconuts

Marques (1994) developed a land evaluation system for small-holder coconut production in PNG using the FAO framework. ALES was used as the framework within which to develop the system. The system was applied to Madang, Gulf and North Solomons Provinces as test areas using land resource data from PNGRIS. Maps of coconut suitability classes were plotted using MapInfo and areas of different suitability classes calculated (Marques 1994). The ALES model for coconut production has been installed on computers in DAL Land Use Section in Port Moresby.

2.5.4 Other Crops

Description of environmental requirements for specific crops is beyond the scope of this handbook. A bibliography of information on 26 crops is given in Venema and Daink (1992). This and the plant growth response functions given in PLANTGRO (Hackett 1991) should be consulted if new land evaluation systems for particular crops are to be developed or existing ones improved on.

3. METHODOLOGY

3.1 Classification of physical environments of PNG

The RMUs of the PNGRIS database were classified into the major environment subclasses based on the criteria defined by McAlpine (unpub.).

The classification includes 14 major environment types separated initially on the basis of major landform type (Table 16). These environment types were then subdivided according to altitude and rainfall classes. These subtypes are:

Altitude class:		Rainfall class:	
low	(0-600m)	dry	(1000-2000mm)
mid	(600-1200m)	wet	(2000-4000mm)
high	(1200-2400m)	very wet	(>4000mm)
very high	(>2400m)		

It should be noted that not all environment types contain subtypes of each altitude and/or rainfall class. For example, mangrove swamp environments only occur in the low altitude class, but occur in all three rainfall classes. As a result, there are three environment subtypes:

Mangrove Swamps:
Low altitude (0-600 m), dry (1000-2000 mm)
Low altitude (0-600 m), wet (2000-4000 mm)
Low altitude (0-600 m), very wet (> 4000 mm).

Each environment subtype has been further subdivided into a number of environment subclasses, based either on inundation type, slope, rock type, or dominant rock type grouping (Table 16). The environment subclasses are defined according to the PNGRIS classes for each of these land resource factors (Annex 2).

Table 16: Environment types, subtypes and subclasses

Environment type	Subtypes		Subclasses	Maximum number of subclasses[1] per subtype
	Altitude	Rainfall		
Mangrove Swamps	Low	Dry Wet Very wet	-	-
Estuaries and Coastal Plains	Low	Dry Wet Very wet	Inundation type	4
Beach Ridges and Plains	Low	Dry Wet	-	-
Raised Coral Reefs	Low	Dry Wet Very wet	Slope	3
Recent Alluvial Plains	Low High Very high	Dry (L,H alt.) Wet (L,H,VH alt.) Very wet (L alt.)	Inundation type	4
Relict Alluvial Plains	Low	Dry Wet Very wet	Inundation type	3
Alluvial Floodplains	Low	Dry Wet Very wet	Inundation type	3
Swamps	Low Mid High Very high	Dry (L alt.) Wet (L,H,VH alt.) Very wet (L,M alt.)	Inundation type	4
Alluvial Fans	Low Mid High Very high	Dry (L,M,H alt.) Wet (L,M,H,VH alt.) Very wet (L,M,H alt.)	Rock type	3
Volcanic Plains and Fans	Low Mid High Very high	Dry (L alt.) Wet (L,M,H,VH alt.) Very wet (L,M,H alt.)	Slope	3
Volcanic Plateaux and Cones	Low Mid High Very high	Wet (L,M,H,VH alt.) Very wet (L,M,H alt.)	Slope	3

(continued)

Environment type	Subtypes		Subclasses	Maximum number of subclasses[1] per subtype
	Altitude	Rainfall		
Steeplands - Karst	Low Mid High Very high	Wet (L,M,H alt.) Very wet (L,M,H,VH alt.)	Slope	3
Hills	Low Mid High Very high	Dry (L,M,H alt.) Wet (L,M,H,VH alt.) Very wet (L,M,H alt.)	Dominant rock type grouping	6[2]
Mountains	Low Mid High Very high	Dry (L,M,H,VH alt.) Wet (L,M,H,VH alt.) Very wet (L,M,H,VH alt.)	Dominant rock type grouping	5

1 Not all possible subclasses occur within each subtype.

2 Includes additional subclass not previously defined, for those RMUs which did not fit any of the subclass criteria

A FoxPro database file (RMUENV.DBF) containing all the RMUs from the PNGRIS database classified to environment subclass level has been installed on computers in the Land Use Section, Department of Agriculture and Livestock (DAL).

3.2 Land evaluation procedures

3.2.1 Evaluation models

Crop suitability ratings for all PNGRIS RMUs and the environment subclasses of McAlpine (unpub.) were evaluated using the PNGLES models (Venema and Daink 1992), except for arabica coffee for which the Harding *et al.* (1986) model was used.

The decision trees of the PNGLES models were used without modification, except for the vanilla model (low input). This model produced nil ratings for three RMUs in Central Province. The decision tree for the 'rooting conditions' LUR caused the nil ratings for the particular combination of soils for these RMUs. The particular combination in question was soils with an effective soil depth of 50-100 cm, and a subsoil texture of class 6 (rock). The decision tree was altered such that this combination gave a class 2 rating for 'rooting conditions', the lowest rating elsewhere in the decision tree for all other subsoil textures and an effective soil depth of 50-100 cm.

For the Harding *et al.* (1986) coffee model only the decision tree for erosion hazard index (for low input production) was altered from that of the original model. In the decision tree of the original model an R4 rating is achieved only when a land unit has slopes >32 degrees, high rainfall erosivity and high soil erodibility. The model was adjusted such that all units with slopes >32 degrees were given a R4 rating, including those with a higher rating for rainfall erosivity and soil erodibility.

3.2.2 Missing data from PNGRIS

Data for the rainfall erosivity (a required PNGLES land characteristic) is not part of the PNGRIS data set. Rainfall erosivity for each RMU was derived by overlaying the rainfall erosivity map given in Harding *et al.* (1986) onto an RMU map of each province. MapInfo and FOXPRO were then used to compile rainfall erosivity classes for each RMU into a database which was then linked to the PNGRIS database.

3.2.3 Suitability determinations for RMUs containing more than one soil great group

For crops evaluated using the PNGLES models, suitability ratings for RMUs containing more than one soil great group were derived using the method described in Venema and Daink (1992). For the arabica coffee evaluation, the final rating of RMUs with more than one soil great group was based on the dominant soil in the RMU.

3.2.4 Calculation of median environment subclass ratings

All RMUs were classified according to the 'Natural Resource Classification from PNGRIS' (McAlpine unpub.) down to environment subclass, altitude subclass and rainfall subclass level. The median crop suitability rating for all RMUs occurring in a particular environment subclass within a particular province was then calculated for each of a set of unique classification identifiers that occurred in each province. The median rating was then attached back to the RMUs using the unique classification identifier.

3.2.5 Data transfer and crop evaluations

The Harding *et al.* (1986) arabica coffee model required land unit definitions to be set up in the ALES database. These were created in FoxPro and exported to ALES using ASCII comma-delimited files. The attributes from PNGRIS required by the Harding arabica coffee model were also transferred from PNGRIS (FoxPro database files) to ALES using ASCII comma-delimited text files. The evaluations for all crops were then run and the results exported to an ASCII file, using the commands "File Evaluation Results", "Suitabilities" in the "Evaluations" sub-menu (Rossiter and Van Wambeke 1991).

The PNGLES models already contained a complete attribute database for all RMUs, and so did not require attributes to be transferred from PNGRIS. The crop evaluations were run for these models, and results exported as above.

The files containing the evaluation results for the Harding arabica coffee model and the PNGLES models, were imported into FoxPro and database files created. The database files for the Harding arabica coffee model and the PNGLES models were processed differently to attach individual ratings to each of the provincial RMUs. The database files for the Harding model were filtered to remove the results for RMU constituents. The ALES evaluation results file contains an evaluation rating (integer physical suitability subclass) for each RMU that corresponds to that of the first-named soil constituent (which by PNGRIS definitions occupies 40% of each RMU). It is this rating which was then attached to each provincial RMU, in individual database files for each province/crop combination.

In the case of the results files from the PNGLES models the evaluation ratings for the individual soil constituents were used in combination to derive the rating for the RMU. This was done according to the method of Venema and Daink (1992). A macro was written in FoxPro to do this. The resultant whole-RMU rating was stored as a single field in individual database files for each province/crop combination.

The individual files containing evaluation ratings for each province were then combined to create a single file containing all the RMUs for each province in PNG for each crop. These files were then transferred to MapInfo for map plotting.

3.3 Data transfer from PNGRIS to PLANTGRO

The PLANTGRO crop evaluation package (Hackett 1991) has not been evaluated for use with PNGRIS to date. The data input structures for PLANTGRO are not readily suited for application with large resource survey databases. These difficulties largely relate to extracting soils data from multi-factor resource databases and adapting them to PLANTGRO's input formats. Procedures were developed to extract soils data from PNGRIS for application with PLANTGRO. These procedures are described in full in Annex 1. The procedures were tested for 19 PNGRIS RMUs in the Upper Ramu catchment in Eastern Highlands Province. PLANTGRO analyses for these RMUs were conducted for arabica coffee, sweet orange, pineapple, Irish potato and yam. Climate data from Aiyura (McAlpine *et al.* 1975) was used for the climatic parameters required by PLANTGRO for the 19 test RMUs.

4. RESULTS

4.1 Physical environments of PNG

The distribution of the 14 major physical environment types in PNG are shown in Map 1. The environment types were further subdivided into a total of 235 subclasses (McAlpine unpub.) whose distribution is too complex to be shown at the map scale (1:2 000 000) used in Map 1. A data file classifying each PNGRIS RMU into one of the 235 environment subclasses has been installed on the computers in the Land Use Section, DAL.

The areas of major environment types and subtypes are summarized in Table 17. Results indicate that mountains (41%), relict alluvial plains (13%), swamps (8%) and hills (7%) are the most common environment types in PNG.

Table 17: Environment types, subtypes, areas and number of RMUs

Environment	Total area (km^2)	Number of RMUs
Mangrove swamps		
Low altitude (0-600m), dry (1000-2000mm)	1861	35
Low altitude (0-600m), wet (2000-4000mm)	2326	53
Low altitude (0-600m), very wet (>4000mm)	1511	10
Total - Mangrove swamps	5698	98
Estuaries and Coastal Plains		
Low altitude (0-600 m), dry (1000-2000mm)	1001	16
Low altitude (0-600 m), wet (2000-4000mm)	1059	42
Low altitude (0-600 m), very wet (>4000mm)	384	9
Total - Estuaries and coastal plains	2444	67
Beach Ridges and Plains		
Low altitude (0-600m), dry (1000-2000mm)	768	17
Low altitude (0-600m), wet (2000-4000mm)	1123	52
Total - Beach ridges and plains	1891	69
Raised Coral Reefs		
Low altitude (0-600m), dry (1000-2000mm)	95	7
Low altitude (0-600m), wet (2000-4000mm)	5312	156
Low altitude (0-600m), very wet (>4000mm)	2163	36
Total - Raised coral reefs	7570	199
Recent Alluvial Plains		
Low altitude (0-600 m), dry (1000-2000mm)	3217	44
Low altitude (0-600 m), wet (2000-4000mm)	14191	150
Low altitude (0-600 m), very wet (>4000mm)	2676	45
High altitude (1200-2400 m), dry (1000-2000mm)	102	9
High altitude (1200-2400 m), wet (2000-4000mm)	665	11
Very high altitude (>2400 m), wet (2000-4000mm)	131	9
Total - Recent alluvial plains	20928	268
Relict Alluvial Plains		
Low altitude (0-600 m), dry (1000-2000mm)	22960	28
Low altitude (0-600 m), wet (2000-4000mm)	21491	20
Low altitude (0-600 m), very wet (>4000mm)	15363	11
Total - Relict alluvial plains	59814	59

(continued)

Environment	Total area (km^2)	Number of RMUs
Alluvial Floodplains		
Low altitude (0-600 m), dry (1000-2000mm)	3364	27
Low altitude (0-600 m), wet (2000-4000mm)	19582	89
Low altitude (0-600 m), very wet (>4000mm)	4499	24
Total - Alluvial floodplains	27445	140
Swamps		
Low altitude (0-600 m), dry (1000-2000mm)	4569	33
Low altitude (0-600 m), wet (2000-4000mm)	25995	168
Low altitude (0-600 m), very wet (>4000mm)	4529	21
Mid altitude (600-1200 m), very wet (>4000mm)	128	5
High altitude (1200-2400 m), wet (2000-4000mm)	13	1
Very high altitude (>2400 m), wet (2000-4000mm)	14	1
Total - Swamps	35248	229
Alluvial Fans		
Low altitude (0-600 m), dry (1000-2000mm)	4458	41
Low altitude (0-600 m), wet (2000-4000mm)	7964	111
Low altitude (0-600 m), very wet (>4000mm)	907	11
Mid altitude (600-1200 m), dry (1000-2000mm)	89	3
Mid altitude (600-1200 m), wet (2000-4000mm)	539	14
Mid altitude (600-1200 m), very wet (>4000mm)	86	3
High altitude (1200-2400 m), dry (1000-2000mm)	181	6
High altitude (1200-2400 m), wet (2000-4000mm)	1542	39
High altitude (1200-2400 m), very wet (>4000mm)	114	3
Very high altitude (>2400 m), wet (2000-4000mm)	76	3
Total - Alluvial fans	15956	234
Volcanic Plains and Fans		
Low altitude (0-600m), dry (1000-2000mm)	47	1
Low altitude (0-600m), wet (2000-4000mm)	10197	88
Low altitude (0-600m), very wet (>4000mm)	7761	29
Mid altitude (600-1200 m), wet (2000-4000mm)	1167	19
Mid altitude (600-1200 m), very wet (>4000mm)	1710	18
High altitude (1200-2400 m), wet (2000-4000mm)	3286	38
High altitude (1200-2400 m), very wet (>4000mm)	452	8
Very high altitude (>2400 m), wet (2000-4000mm)	711	9
Total - Volcanic plains and fans	25331	212
Volcanic Plateaux and Cones		
Low altitude (0-600m), wet (2000-4000mm)	3618	77
Low altitude (0-600m), very wet (>4000mm)	404	18
Mid altitude (600-1200 m), wet (2000-4000mm)	2665	36
Mid altitude (600-1200 m), very wet (>4000mm)	802	11
High altitude (1200-2400 m), wet (2000-4000mm)	2084	36
High altitude (1200-2400 m), very wet (>4000mm)	836	16
Very high altitude (>2400 m), wet (2000-4000mm)	994	17
Total - Volcanic plateaux and cones	11403	211

(continued)

Environment	Total area (km^2)	Number of RMUs
Steeplands, Karst		
Low altitude (0-600m), wet (2000-4000mm)	169	28
Low altitude (0-600m), very wet (>4000mm)	7518	25
Mid altitude (600-1200 m), wet (2000-4000mm)	4076	21
Mid altitude (600-1200 m), very wet (>4000mm)	3897	21
High altitude (1200-2400 m), wet (2000-4000mm)	3697	26
High altitude (1200-2400 m), very wet (>4000mm)	1524	21
Very high altitude (>2400 m), wet (2000-4000mm)	1447	14
Very high altitude (>2400 m), wet (2000-4000mm)	573	13
Total - Steeplands, karst 2731	25463	169
Hills		
Low altitude (0-600 m), dry (1000-2000mm)	5796	58
Low altitude (0-600 m), wet (2000-4000mm)	17929	192
Low altitude (0-600 m), very wet (>4000mm)	4308	30
Mid altitude (600-1200 m), dry (1000-2000mm)	323	3
Mid altitude (600-1200 m), wet (2000-4000mm)	499	16
Mid altitude (600-1200 m), very wet (>4000mm)	470	10
High altitude (1200-2400 m), dry (1000-2000mm)	264	5
High altitude (1200-2400 m), wet (2000-4000mm)	2334	44
High altitude (1200-2400 m), very wet (>4000mm)	2633	1
Very high altitude (>2400 m), wet (2000-4000mm)	425	10
Total - Hills	32383	269
Mountains		
Low altitude (0-600 m), dry (1000-2000mm)	4787	36
Low altitude (0-600 m), wet (2000-4000mm)	43911	365
Low altitude (0-600 m), very wet (>4000mm)	19886	157
Mid altitude (600-1200 m), dry (1000-2000mm)	567	11
Mid altitude (600-1200 m), wet (2000-4000mm)	36433	302
Mid altitude (600-1200 m), very wet (>4000mm)	11657	123
High altitude (1200-2400 m), dry (1000-2000mm)	2180	24
High altitude (1200-2400 m), wet (2000-4000mm)	47972	482
High altitude (1200-2400 m), very wet (>4000mm)	6725	121
Very high altitude (>2400 m), dry (1000-2000mm)	99	2
Very high altitude (>2400 m), wet (2000-4000mm)	12311	187
Very high altitude (>2400 m), very wet (>4000mm)	479	17
Total - Mountains	187007	1828

4.2 Land suitability for arabica coffee by environment subclass and RMU

4.2.1 Suitability for arabica coffee based on environment subclass

The suitability of arabica coffee production (Harding *et al.* 1986) based on analysis of median ratings for each environment subclass are shown in Maps 2 (low input) and 3 (high input). Map 2 indicates that small areas of highly suitable land occur near Goroka in Eastern Highlands Province, Mt Hagen in Western Highlands Province and in Southern Highlands Province. Large areas with moderate suitability occur along the main axial ranges of the PNG mainland with small areas at higher elevations in East New Britain, New Ireland and the islands in Milne Bay Province.

Map 3 also indicates that the same areas which are highly suited for low input coffee production are also well suited for high input production. However, a much smaller area is moderately suited and is restricted to parts of the Southern Highlands, Enga, Western Highlands, Eastern Highlands and Morobe Provinces with small areas in Central and Northern Provinces. The total areas of suitability class based on analysis of environment subclasses are given in Table 18.

Table 18: Areas of suitability classes for arabica coffee production based on environment subclasses

Input level	Suitability class				Total
	High	Moderate	Marginal	Not suitable	
Low (km^2)	2909	61370	22068	372288	458635
Low (%)	0.6	13.4	4.8	81.2	100
High (km^2)	3131	10316	732	444456	458635
High (%)	0.7	2.2	0.2	96.9	100

4.2.2 Suitability for arabica coffee based on RMUs

The suitability of arabica coffee production based on application of the Harding *et al.* (1986) model for each of the PNGRIS RMUs is shown in Maps 4 (low input) and 5 (high input). The suitability ratings determined on analysis of each RMU are summarized in Tables 19 (low input) and 20 (high input) for each province. About 4% of PNG has high physical suitability under either low or high input management (Tables 19, 20). These areas occur mainly in the 1300-1700 altitude range in rolling terrain in West Sepik, Southern Highlands, Enga, Western Highlands, parts of Chimbu, Eastern Highlands, Morobe, Central and Milne Bay Provinces with small areas in Madang and Northern Provinces (Maps 4 and 5).

About 8% of PNG is moderately suited for low input arabica coffee production compared to about 1% under high input levels. Areas of moderate suitability for low input production are generally adjacent to the highly suitable areas listed above (Map 4). These are generally areas which are less suitable because of soil constraints (effective rooting depth, soil fertility), steeper slopes, suboptimal altitude/temperature range, or soil erodibility. Areas which are marginal for low input production occur on higher parts of New Britain, New Ireland and Bougainville with constraints largely caused by warmer temperatures and moist climate.

Results indicate a wider distribution of areas of high suitability based on RMU analysis compared to the values determined using the median rating for each environment subclass (Maps 2 and 3). In the environment subclass approach, values of land attributes are averaged across RMUs within each contiguous environment subclass. This may result in the relatively lower suitability ratings of many areas using the environment subclass median values compared to analysis based on each RMU.

Soil factors were not used as criteria for separating environment subclasses. They were not used because of the complexity of the soil pattern and difficulties of delineating homogeneous units at 1:500 000 scale in PNGRIS.

Table 19: Areas of suitability classes for low input arabica coffee production based on PNGRIS RMUs

Province	Suitability class and area								Total area
	High		Moderate		Marginal		Unsuitable		
	(km²)	(%)	(km²)	(%)	(km²)	(%)	(km²)	(%)	(km²)
Western	16	<0.1	10	<0.1	0	0	96260	99.9	96286
Gulf	0	0	60	0.2	0	0	33787	99.8	33847
Central	2233	7.5	4899	16.4	39	0.1	22747	76.0	29918
Milne Bay	587	4.2	1513	10.7	4	<0.1	12021	85.1	14125
Northern	694	3.1	3071	13.6	0	0	18745	83.3	22510
Southern Highlands	2444	9.5	3796	14.8	0	0	19400	75.7	25640
Enga	1392	11.8	2119	17.9	81	0.7	82470	69.6	11839
Western Highlands	2080	23.4	3183	35.7	0	0	3634	40.9	8897
Chimbu	373	6.2	996	16.5	0	0	4653	77.3	6022
Eastern Highlands	3607	32.8	3340	30.4	292	2.6	3767	34.2	11006
Morobe	3693	11.0	6413	19.1	331	1.0	23074	68.9	33511
Madang	371	1.3	851	3.0	84	0.3	27355	95.4	28661
East Sepik	19	<0.1	378	0.9	99	0.2	43020	98.9	43516
West Sepik	1527	4.2	3419	9.5	11	<0.1	31053	86.2	36010
Manus	0	0	0	0	0	0	2098	100	2098
New Ireland	0	0	458	4.8	1922	20.0	7235	75.2	9615
East New Britain	0	0	427	2.8	2357	15.6	12325	81.6	15109
West New Britain	0	0	29	0.1	1800	8.7	18867	91.2	20696
North Solomons	0	0	100	1.1	1045	11.2	8184	87.7	9329
TOTAL	19036	4.2	35062	7.6	8065	1.8	396472	86.4	458635

Table 20: Areas of suitability classes for high input arabica coffee production based on PNGRIS RMUs

Province	Suitability class and area								Total area
	High		Moderate		Marginal		Unsuitable		
	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	(km^2)	(%)	(km^2)
Western	16	<0.1	10	<0.1	0	0	96260	99.9	96286
Gulf	0	0	0	0	0	0	33847	100	33847
Central	2179	7.3	162	0.5	39	0.1	27538	92.1	29918
Milne Bay	587	4.2	25	0.2	4	<0.1	13509	96.8	14125
Northern	694	3.1	14	0.1	0	0	21802	96.8	22510
Southern Highlands	2549	9.9	867	3.4	0	0	22224	86.7	25640
Enga	1392	11.8	337	2.8	0	0	10110	85.4	11839
Western Highlands	2226	25.0	777	8.7	0	0	5894	66.3	8897
Chimbu	491	8.2	113	1.9	0	0	5418	89.9	6022
Eastern Highlands	3607	32.8	650	5.9	93	0.8	6656	60.5	11006
Morobe	3719	11.1	135	0.4	0	0	29657	88.5	33511
Madang	251	0.9	203	0.7	0	0	28207	98.4	28661
East Sepik	19	<0.1	0	0	0	0	43497	99.9	43516
West Sepik	1544	4.3	220	0.6	11	<0.1	34235	95.1	36010
Manus	0	0	0	0	0	0	2098	100	2098
New Ireland	0	0	0	0	483	5.0	9132	95.0	9615
East New Britain	0	0	433	2.9	42	0.3	14634	96.8	15109
West New Britain	0	0	39	0.2	0	0	20657	99.8	20696
North Solomons	0	0	100	1.1	0	0	9229	98.9	9329
TOTAL	19274	4.2	4085	0.9	672	0.2	434604	94.7	458635

4.2.3 Comparison of PNGLES and Harding *et al.* (1986) arabica coffee models

Suitability ratings determined by the PNGLES (Venema and Daink 1992) and Harding *et al.* (1986) low input arabica coffee land evaluation models were compared at two different spatial scales:

- 1: 500 000 scale based on the PNGRIS RMUs, and
- 1: 50 000 scale for 598 Land Resource Units (LRUs) mapped in the Upper Ramu catchment (Trangmar *et al.* 1995a) in Eastern Highlands Province.

Results for the comparison between models (Table 21) show that the Harding *et al.* (1986) model rates about 11% of PNG as being of high or moderate suitability for low input arabica coffee production. In contrast, the PNGLES model rates only about 4% as being moderately suitable, with none being highly suited.

Table 21: Comparison of suitability ratings for PNGRIS RMUs using the PNGLES and Harding *et al.* (1986) low input arabica coffee models

Rating class	PNGLES		Harding *et al.* (1986)	
	Area (km^2)	%	Area (km^2)	%
1	0	0	19036	4.2
2	17325	3.8	35062	7.6
3	281339	61.3	8065	1.8
4	150642	32.8	396472	86.4
	458635	100	458635	100

In the comparison made at 1:50 000 scale, the Harding *et al.* (1986) model for high input arabica coffee production produced a more severe rating than the PNGLES model for 31% of LRUs (Table 22). In 18% of LRUs the Harding *et al.* (1986) model produced a less severe rating than the PNGLES model. The remaining 50% of LRUs had the same rating in each system. For low input production, the Harding *et al.* (1986) model produced a more severe rating than the PNGLES model (Table 23) for 48% of the LRUs. In 21% of LRUs the Harding *et al.* (1986) model produced a more severe rating the PNGLES. The remaining 31% of LRUs had the same rating in each system.

Many of the discrepancies between the two systems are caused by differences in the decision trees and class boundaries for altitude (temperature) and rainfall land use requirements. The Harding *et al.* (1986) model treats variation in altitude outside the optimal range of 1300-1699 m more severely than the PNGLES model. Similarly, the Harding *et al.* (1986) model downgrades variation in rainfall outside the 2000-2999 mm optimal range more severely than the PNGLES models.

For example, in the Harding *et al.* (1986) model, a rainfall of less than 1500 mm yields a severity level for the rainfall land use requirement of "4". The suitability class is therefore Class 4, indicating that this LRU is unsuitable for both high and low input arabica coffee production. However in the PNGLES model, the land use requirement decision tree yields a severity level of "2", because it also considers the texture of the subsoil in this decision tree.

Therefore rainfall is rated more severely in the Harding model. In the case of the Upper Ramu, this has a significant effect on the ratings produced with 276 LRUs in the low input model, and 186 LRUs in the high input model being affected by the more severe rainfall rating.

In cases where the PNGLES models produced more severe ratings, this was largely due to differences in assessment of soil aeration or wetness. In PNGLES aeration status is solely derived from soil drainage class. For poorly or very poorly drained soils, the land use requirement rating is '4' (i.e. unsuitable for coffee production). However, for the corresponding land use requirement (drainage/effective soil depth) in Harding *et al.* (1986) such soils are rated as 3. Where drainage is mitigated by other land use requirements the final rating for such soils in Harding *et al.* (1986) may be 2.

4.2.4 Interpretation of land evaluation results

The differences in evaluation results of the two models for both the PNGRIS RMUs and the Upper Ramu study indicate the need for users of the land evaluation systems to be fully aware of which models and criteria were used. They should also be aware of the limitations of the models used.

The results also indicate that the PNGLES and Harding *et al.* (1986) models require further validation before they are widely applied in PNG.

Table 22: Comparison of suitability classes for high input arabica coffee production using models of PNGLES and Harding *et al.* (1986)

Rating class, Harding model	Rating class, PNGLES model	No. of LRUs	Example Harding model subclass[1]	Example PNGLES model subclass[2]
Harding model more severe:				
4	3	46	4r/e	3e
4	2	137	4r	2m/t
3	2	3	3a/r	2c/m/w
3	1	-	-	-
2	1	-	-	-
Total LRUs		186 (31.1%)		
Venema model more severe:				
3	4	7	3d/a/r	4w
2	4	42	2d/r	4w
2	3	-	-	-
1	3	-	-	-
1	2	63	1	2m/t
Total LRUs		112 (18.7%)		
No difference:				
4	4	260	4r/e	4e
3	3	-	-	-
2	2	40	2r	2m/w
1	1	-	-	-
Total LRUs		300 (50.2%)		

[1] Subclass abbreviations for the Harding models as follows:
a altitude
d drainage/effective soil depth
e erosion hazard
r rainfall

[2] Subclass abbreviations for the Venema models as follows:
c temperature
m moisture conditions
t nutrient availability/retention capacity
w oxygen availability (wetness)

Table 23: Comparison of suitability classes for low input arabica coffee production using models of PNGLES and Harding *et al.* (1986)

Rating class, Harding model	Rating class, PNGLES model	No. of LRUs	Example Harding model subclass[1]	Example PNGLES model subclass[2]
Harding model more severe:				
4	3	226	4r/e	3e
4	2	50	4r	2m/n
3	2	8	3a/r	2c/e/m/w
3	1	-	-	-
2	1	-	-	-
Total LRUs		284 (47.5%)		
Venema model more severe:				
3	4	28	3d/r	4w
2	4	-	-	-
2	3	-	-	-
1	3	-	-	-
1	2	99	1	2e/m
Total LRUs		127 (21.2%)		
No difference:				
4	4	101	4r/e	4e
3	3	-	-	-
2	2	86	2r	2e/m/r/w
1	1	-	-	-
Total LRUs		187 (31.3%)		

[1] Subclass abbreviations for the Harding models as follows:
a altitude
d drainage/effective soil depth
e erosion hazard
r rainfall

[2] Subclass abbreviations for the Venema models as follows:
c temperature
m moisture conditions
t nutrient availability/retention capacity
w oxygen availability (wetness)

4.3 Land suitability for oil palm

The suitability of land for high input oil palm production based on application of the PNGLES model (Venema and Daink 1992) for each of the PNGRIS RMUs is shown in Map 6. The suitability ratings determined on analysis of each RMU are summarized in Table 27 for each province. Results indicate that about 4% of PNG has high physical suitability for oil palm. These areas occur mainly in Madang, Morobe, Northern, Central, Milne Bay, West New Britain, New Ireland and North Solomons Provinces. About 6% of PNG is moderately suited, 24% is marginal and 66% is unsuitable (Table 24, Map 6).

Areas of moderate suitability occur in East and West Sepik, the Gogol Valley in Madang, parts of Western Province, Gulf, Central, Northern, New Britain, and small areas in Morobe, Milne Bay, North Solomons, and New Ireland.

4.4 Land suitability for other crops

Land suitability assessments were conducted using the PNGLES models for low input, small-holder production of 14 other crops (cardamom, cashew, chillies, citrus, cocoa, coconut, coffee robusta, maize, mango, oil palm, pepper, pineapple, potato, pyrethrum, rubber, upland rice, and vanilla) under low input conditions and 6 other crops (cocoa, coffee robusta, maize, potato, upland rice, rubber) under medium to high input, smallholder production conditions.

For each of the above crops, land suitability ratings for each PNGRIS RMU were transferred from ALES and linked to the PNGRIS database for mapping using MapInfo. These crop suitability map files have been installed on the computers in the DAL Land Use Section, Port Moresby from which hard copy maps can be readily produced. The maps are too numerous to be presented in this report. The example of oil palm is given in Map 6.

In addition, suitability ratings were computed for each median environment subclass for all 18 of the PNGLES crops (Venema and Daink 1992). Results for each province have been installed on the DAL Land Use Section computers. Area summaries (km^2 and per cent of total province area) of suitability ratings by crop and province are given in Annex 3 for the PNGLES models calculated on an RMU basis and by median environment subclass.

Table 24: Areas of suitability classes for oil palm production based on PNGRIS RMUs

Province	Suitability class and area								Total area
	High		Moderate		Marginal		Unsuitable		
	(km²)	(%)	(km²)	(%)	(km²)	(%)	(km²)	(%)	(km²)
Western	0	0	5384	5.6	51457	53.4	39445	41.0	96286
Gulf	698	2.1	3333	9.9	1115	3.3	28701	84.7	33847
Central	1127	3.8	1816	6.1	5297	17.7	21678	72.4	29918
Milne Bay	1975	14.0	1207	8.6	1727	12.2	9216	65.2	14125
Northern	2925	13.0	1927	8.6	3827	17.0	13831	61.4	22510
Southern Highlands	0	0	529	2.1	145	0.6	24966	97.3	25640
Enga	68	0.6	54	0.5	0	0	11717	98.9	11839
Western Highlands	257	2.9	172	1.9	726	8.2	7742	87.0	8897
Chimbu	0	0	40	0.7	1081	18.0	4901	81.3	6022
Eastern Highlands	0	0	116	1.0	98	0.9	10792	98.1	11006
Morobe	1107	3.3	1021	3.1	4541	13.6	26842	80.0	33511
Madang	4069	14.2	2132	7.4	3607	12.6	18853	65.8	28661
East Sepik	0	0	981	2.2	10524	24.2	32011	73.6	43516
West Sepik	0	0	2676	7.4	13254	36.8	20080	55.8	36010
Manus	193	9.2	662	31.6	260	12.4	983	46.8	2098
New Ireland	1448	15.1	1319	13.7	2384	24.8	4464	46.4	9615
East New Britain	816	5.4	1737	11.5	0	0	12556	83.1	15109
West New Britain	2551	12.3	3782	18.3	3871	18.7	10492	50.7	20696
North Solomons	2185	23.4	685	7.3	4305	46.2	2154	23.1	9329
TOTAL	19419	4.2	29573	6.5	108219	23.6	301424	65.7	458635

4.5 PLANTGRO ratings for Upper Ramu test area

Crop suitability ratings and dominant constraints for selected PNGRIS RMUs from the Upper Ramu test application of PLANTGRO are summarized in Table 25. PLANTGRO uses growth limitation ratings (GLRs) imposed by soil or climatic constraints to assess potential crop performance. GLRs are rated (Hackett 1991) as:

0-2 High potential crop performance (Minimal physical limitations to crop growth)
3-4 Moderate potential crop performance (Moderate limitations to crop growth)
5-6 Low potential crop performance (Significant limitations to crop growth)
7-8 Nil potential (Severe limitations to crop growth)
9 Rapid death (Very severe limitations to crop growth).

The PLANTGRO ratings correspond to the high, moderate, marginal and unsuitable classes used in this report for ratings derived from PNGLES and Harding *et al.* (1986)

Table 25: PLANTGRO ratings and main limitations for selected crops and PNGRIS RMUs, Upper Ramu catchment, Eastern Highlands Province. Comparative ratings for Harding *et al.* (1986) for arabica coffee and PNGLES for other crops (except yam) in parentheses.

RMU No.	PLANTGRO crop performance ratings and main limitations				
	Arabica coffee	Sweet orange	Pineapple	Irish potato	Yam
171	9 (4) Slope	6 (3) Soil texture	5 (3) Fertility	5 (3) Slope	6 Temp.
441	3 (2) Fertility	3 (2) Temperature	4 (2) Solar radiation	3 (2) Fertility	6 Temp.
442	4 (2) Aeration	6 (3) Aeration, texture	5 (3) Fertility	5 (3) Fertility	6 (3) Temp.
452	6 (3) Aeration	7 (4) Aeration	7 (4) Aeration	7 (4) Aeration	6 (3) Temp.
60	4 (2) Slope	4 (2) Temperature	5 (3) Fertility	5 (3) Fertility	6 (3) Temp.
64	2 (1) Nil	4 (2) Temperature	4 (2) Solar radiation	2 (1) Nil	6 (3) Temp.

For the RMUs listed in Table 25 ratings based on PLANTGRO correlated closely with those for the other evaluation systems used. As with the ALES-based systems (PNGLES and Harding *et al.* (1986), the limitation ratings of each land characteristic are given in the PLANTGRO output. An additional advantage of the PLANTGRO output is that climatic limitations at various parts of the growing season can be identified for each crop. This capability is not present in PNGLES or the Harding *et al.* (1986) coffee models.

The land use requirements in PLANTGRO are more physiologically-based than PNGLES or the Harding *et al.* (1986) coffee model. As a result, PLANTGRO is more sensitive to climatic parameters than the other two models. For example, Table 25 indicates that while there are basically no soil constraints to growth of pineapple in RMUs 441 and 64, solar radiation is the major limiting factor to achieving optimum growth. Factors such as solar radiation are not included in the other models.

The structure of PLANTGRO enables rapid comparison of site suitability for a range of crops, comparison of sites (different soils, and/or climates) for a specific crop(s), crop rotations, and assessment of the phasic development of some crops. It is also flexible in climate data entry which can include weekly or mean monthly records, or actual monthly records for a specific year. As a result, it complements the relatively inflexible decision tree structure of the ALES-based models. However, PLANTGRO's current input/output formats are not easily linked with relational databases or computer mapping packages. This constraint limits its widespread application with large resource databases.

5. DISCUSSION

5.1 Model validation requirements

The analysis has indicated a need for wider validation of the PNGLES models (Venema and Daink 1992) and the Harding *et al.* (1986) arabica coffee models. The PNGLES models have been applied for several small areas by DAL Land Use Section staff (F. Daink *pers comm.*). They were also used to assess land suitability for citrus and Irish potato at 1:50 000 scale in the Upper Ramu catchment (Trangmar *et al.* 1995a). In the latter study, the suitability ratings produced by the models for specific areas were compared with local experience of crop production as a reliability check. However, no systematic quantitative testing of models in relation to yield and specific management inputs in different locations has been conducted to date.

The arabica coffee models of Harding *et al.* (1986) have been applied and tested in the Western Highlands (Harding *et al.* 1987). They were also applied at 1:50 000 scale in the Upper Ramu catchment (Trangmar *et al.* 1995a). Results were generally consistent with local experience.

Both the PNGLES and Harding *et al.* (1986) arabica coffee models require further field testing in areas with different land characteristics and management regimes. Validation should include comparison of model ratings with crop yield results under known management inputs. This should be done in a range of environments that cover a range of rating classes so that the boundaries between rating classes can be more reliably defined.

As the systems become used and tested in different areas, they should be refined and updated by DAL Land Use Section staff. This should be an ongoing activity as DAL experience in application of the various systems increases.

In addition, comparisons of different land evaluation systems which exist in PNG for some crops (e.g. cocoa) should be systematically compared so DAL staff can select the most appropriate model for each crop. For example, the results produced by the cocoa model of Bleeker and Freyne (1981) should be compared with those of PNGLES (Venema and Daink 1992) and PLANTGRO (Hackett 1991) to assess which best match local experience.

5.2 Scale factors in land use suitability assessment

The land evaluation systems discussed in this report can be readily applied at different map scales. However, it is essential that interpretation of the results is done in context of the map scale at which the land characteristics used in the land evaluation systems are collated and delineated.

Land suitability assessments made using data from PNGRIS are only relevant for planning at national or provincial level. The land resource data in PNGRIS was compiled at 1:500 000 scale and is of insufficient detail for planning agricultural development at district, subdistrict or catchment levels. Land evaluation for planning at these levels should be based on resource data mapped at scales of 1:50 000 or 1:25 000, respectively (Basher *et al.* 1995). Land suitability assessment for village development or site-specific agricultural projects requires land resource data mapped at scales of 1:10 000 or larger.

5.3 Adjustment of rating criteria in relation to management conditions

Adaptations to the models may be required at different spatial scales and under different input management systems. At increasing levels of spatial detail, the assumed management inputs levels (or Land Utilization Type in the PNGLES models) will require increasing refinement for local crop production systems and management inputs. In applying the land evaluation systems, care should be taken in defining the management systems to which the systems are applied to ensure relevance of the suitability ratings generated.

5.4 Application of land evaluation models

The ALES-based models (PNGLES, Harding *et al.* (1986)) should be used in conjunction with appropriate land resource data to initially screen land suitability at national and provincial level using PNGRIS. They should then be used in conjunction with more detailed land resource data (e.g. 1:50 000) collected in areas of high potential to identify specific areas of development potential. Once such areas have been identified detailed site investigations of land suitability should be done in conjunction with other relevant factors such as availability of markets, investment, infrastructure, and transport. PLANTGRO is perhaps best used to complement the ALES-based models at this detailed, site-specific stage of the agricultural development process to assess specific soils, crop species and combinations under a particular set of well documented climatic conditions.

5.5 Future model development

Once the existing models have been more widely validated and applied, additional parameters of importance for production of specific crops could be added to improve their predictive ability. For example, climatic criteria (e.g. rainfall, rainfall seasonality, humidity, temperature) could be used to predict general likelihood of pest and disease occurrence for specific crops.

Addition of new parameters and their testing should be done in conjunction with agronomists and crop specialists with experience of specific crops in different parts of PNG.

6. CONCLUSIONS

The framework for computerized land evaluation systems in PNG have been established by the development of PNGLES (Venema and Daink 1986), the arabica coffee model of Harding *et al.* (1986), and the test application of PLANTGRO (Hackett 1991) in conjunction with PNGRIS. However, the systems applied during this study require ongoing validation in different parts of PNG. This should be done by comparison of crop yield data with suitability ratings generated by the land evaluation systems. This should be done in collaboration with local agronomists and crop production specialists.

Results of the analyses for arabica coffee production indicate that use of median ratings for environment subclasses downgrade suitability ratings compared to analysis on an RMU-by-RMU basis. This is caused by use of the median rating for each environment subclass whose value reflects the generally more common lower suitability classes in an environment unit and downgrades the RMUs which (on an individual basis) have higher suitability ratings.

The aggregation of ratings using the environment class approach are useful for very broad scale analysis of crop suitability. However, calculation of ratings on an RMU basis provide a more reliable estimate of crop suitability because the ratings are directly related to the land resource data in each RMU rather than averaged for all RMUs in a particular environment subclass.

Wider correlation of the PNGLES and Harding *et al.* (1986) arabica coffee models should be conducted. Appropriate adjustments should be made to each model to ensure improved consistency between the ratings produced by each model.

The development of PNGLES and the Harding *et al.* (1986) coffee model in the ALES framework makes them well suited to land evaluation in association with computerized land resource databases such as PNGRIS and the Upper Ramu database (Trangmar *et al.* 1995b). The work done in this study of developing procedures to extract soil data from PNGRIS for use in PLANTGRO should be expanded on to make PLANTGRO more widely applicable with PNGRIS. This will require revision of data input/output formats in PLANTGRO to make it more compatible with relational databases and applicable with land resource survey data.

The crop suitability ratings based on PNGRIS in this study should only be used for agricultural development planning at national scale. Investigations for agricultural development at provincial, district, subdistrict and site-specific levels should be conducted at more detailed scales.

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ANNEX 1: Procedures for extracting soils data from PNGRIS for entry to PLANTGRO

1. Introduction

PLANTGRO (Hackett 1991) is a computer program which generates semi-quantitative predictions of plant performance based on soil, climate and plant characteristic files. Linking PLANTGRO to PNGRIS data should allow prediction of physical crop suitabilities for many crops across many RMUs. However, constraints to doing this are:

- limitations in PLANTGRO input and output formats
- PNGRIS does not contain all the data required to run PLANTGRO
- inconsistencies in data definitions between PNGRIS and PLANTGRO

Any omissions from the PNGRIS database or the accuracy of the PLANTGRO models are not considered here. Such factors impact on the reliability of predictions obtained by linking PLANTGRO and PNGRIS, but not on the procedures of generating such predictions.

2. PLANTGRO input and output

PLANTGRO reads input data from ASCII text files in a strict format and writes data as text reports to a printer or text file. There is no facility for reading data from or writing predictions to databases in standard formats. A computer program (SOILOUT.EXE) was written to take data from a standard database (Paradox) table and write this out to a series of PLANTGRO soil files (one soil per record). The following fields are read from the Paradox table:

Name	Name of PLANTGRO soil file
Fullname	Soil (site) name stored in PLANTGRO file
Aeration	PLANTGRO aeration code
BS	Base saturation (%)
CEC	CEC (meq/100g)
PRD	Potential rooting depth (cm)
P	Olsen Phosphate (ppm)
K	Exchangeable K (meq/100g)
Sal	Salinity (dS/m)
Slope	Slope (degrees)
DEPTHA	Thickness of "A" horizon (cm)
DEPTHB	Thickness of "B" horizon (DEPTHA+DEPTHB=Potential rooting depth)
DEPTHC	Thickness of "infiltration zone" (cm)
AWCA	Available water in A horizon (%)
AWCB	Available water in B horizon (%)
DRWA	Drainable water capacity in A horizon (%)
DRWB	Drainable water capacity in B horizon (%)
DRWC	Drainable water capacity in C horizon (%)
TEXTA	Texture of A horizon (PLANTGRO code)
TEXTB	Texture of B horizon (PLANTGRO code)
TEXTC	Texture of infiltration zone (PLANTGRO code)

Writing a computer program to convert PLANTGRO output to a standard database table for use with PNGRIS requires the computer program to interpret the PLANTGRO text output in a format suitable for input to a relational database and use with computer mapping software.

3. PNGRIS data

PNGRIS stores soil data for the three main soils within each RMU. Most of the soil data required by PLANTGRO is included in PNGRIS (subject to translation) or could be reasonably inferred from PNGRIS data. The main exceptions are:

Slope — PNGRIS records two slopes and three soils per RMU but does not indicate which slopes apply to which soils. This must be inferred from user knowledge of soils and their likely slope class.

Layers — PNGRIS stores an overall depth rating rather than the thicknesses of individual layers as required by PLANTGRO. This overall thickness must be arbitrarily split between the soil A and B horizons for input to PLANTGRO.

AWC — Available water capacity (AWC) is required for the A and B layers in PLANTGRO. PNGRIS stores a rating for the cumulative AWC for three different rooting depths. The ratings are too coarsely stepped to allow estimation of the individual layer AWCs by difference. As a result, AWC must be estimated from texture.

DRWC — Drainable water capacity was not included in the PNGRIS data. This was estimated from the texture.

Infiltration Zone — PNGRIS does not include any data about the 'infiltration zone' parameter used in PLANTGRO. The infiltration zone is an area below the rooting zone which may impede soil drainage and lead to seasonal water-logging if its drainable water capacity or total thickness is sufficiently low. A constant infiltration zone of 1 m can generally be assumed with texture, AWC and DRWC the same as the B horizon.

4. Data inconsistencies between systems

The PNGRIS and PLANTGRO data formats differ in several ways. PLANTGRO uses numeric estimates for most properties while PNGRIS stores ratings. The PLANTGRO models are not particularly sensitive to the precise value of each input parameter. The level of precision in the PNGRIS data is probably adequate for most PLANTGRO applications.

A series of lookup tables were created converting the PNGRIS data code to one or more PLANTGRO soil parameters. Each lookup table was given fields named CODE giving the PNGRIS code, DESC giving the corresponding description, and one or more other fields giving the corresponding PLANTGRO soil characteristic(s).

The lookup tables are:

Table 1–1: Summary of lookup tables for converting PNGRIS soil data to PLANTGRO soil input parameters

Lookup table	PNGRIS field (CODE)	Corresponding PLANTGRO field(s)
AVAILP	AVAILP	PGOLSEN Olsen Phosphate
BS	BS	PGBS Base Saturation
CEC	CEC	PGCEC Cation Exchange Capacity
DEPTH	DEPTH	PGDEPTH Potential rooting depth PGDEPTHA A horizon thickness PGDEPTHB B horizon thickness
DRAINAGE	DRAINAGE	PGAERAT PLANTGRO Aeration code
EXK	EXCHK	PGKX Exchangeable K
NITROGEN	NITROGEN	PGNIT Available Nitrogen
PH	PH	PGPH Soil pH
SALINITY	SALINITY	PGSAL Soil salinity
SLOPE	SLOPE1 or SLOPE2	PGSLOPE Slope
TEXTURE	TEXTURE1 or TEXTURE2	PGTEXT Texture (PLANTGRO code) PGAWC Available water capacity PGDRWC Drainable water capacity

5. Procedure for generating PLANTGRO Predictions

The following procedure was used to generate PLANTGRO predictions for arabica coffee, sweet orange, pineapple, Irish potato and lesser yam for each of the 57 soils within the 19 RMUs in the Upper Ramu catchment. Climate data was taken from the Aiyura climate station in all cases.

The main steps were:

1. Data for the 57 soils in the 19 RMUs were extracted from the PNGRIS data file

2. The SLOPE1 and SLOPE2 values from the PNGRIS data file were inserted into the extracted soil file and one of these was manually selected for each soil. This selection was a "best guess" taking account of the erodibility ratings of the soils and the presumed relative frequencies (soil1 > soil2 > soil3). Only one RMU had SLOPE1 and SLOPE2 values differing by more than one class so errors in this allocation were probably not critical.

3. The lookup tables were used to generate a new (Paradox) table with the PLANTGRO codes in the format required by the SOILOUT program. The name fields were generated from the RMU and soil numbers.

4. The SOILOUT.EXE program was run to produce PLANTGRO soil files for each of the 57 soils.

5. PLANTGRO program was run (using the multiple predictions option) to generate the 285 predictions (57 soils, 5 plants).

Results of the test application of PLANTGRO on PNGRIS RMUs is summarized in Section 4.4 of the main report.

6. Limitations to using PLANTGRO with a large dataset

Steps 1, 3 and 4 in the above procedure can be readily performed on a much larger number of soils. However, step 2 requires manual inspection of each soil and therefore requires more effort if a large number of soils were involved. The effort was relatively minor (at least for the 57 soils tested). Many plant files may not be markedly dependent on slope (erosion hazard should be considered separately) and it may, in fact, be acceptable to simply use the dominant (or mean) slope for all soils in an RMU.

The main limitation to running a much larger (e.g. 1000 soils) data set would be running PLANTGRO and interpreting the results. Even in the multiple prediction model PLANTGRO requires each soil, crop and climate file to be specified and has a limit of 7 soil files per run. Future developments of PLANTGRO should provide output formats which are compatible with data input and output formats which are readily compatible with relational databases for using with computer mapping packages.

7. Computer programmes

The computer programmes developed to extract PLANTGRO data from PNGRIS (SOILOUT.EXE, lookup tables) have been installed on computers in DAL Land Use Section.

ANNEX 2: Definitions of PNGRIS attributes used to define environment subclasses

Definitions of the 'Inundation type' environment subclasses

Inundation type	PNGRIS code
Little or no inundation	0,1,2
Seasonal	3,4
Permanent	5,6
Tidal	7,8

Definitions of the 'Slope' environment subclasses

Slope class	PNGRIS code
Low (<10°)	1,2,3
Moderate (10-20°)	4
High (<20°)	5,6

Definitions of the 'Rock type' environment subclasses

Rock type	PNGRIS code
Alluvial deposits	41,45
Older sediments	40,12
Pyroclastics	46

Definitions of the 'Dominant rock type' environment subclasses

Dominant rock type	PNGRIS code
Non-calcareous sedimentary	11,12,13
Calcareous sedimentary	14,15
Metamorphic	21,22,23
Acid to intermediate igneous	30,32-35,38,46
Basic igneous	31,36,37

ANNEX 3: Summary of crop suitability ratings for PNGRIS RMUs and median environment subclasses according to PNGLES

Key to Abbreviations:

Province:

WES	Western	MOR	Morobe
GUL	Gulf	MAD	Madang
CEN	Central	ESK	East Sepik
MIL	Milne Bay	WSK	West Sepik
NTH	Northern	MAN	Manus
SHY	Southern Highlands	NIR	New Ireland
ENG	Enga	ENB	East New Britain
WHY	Western Highlands	WNB	West New Britain
SIM	Simbu	NSL	North Solomons
EHY	Eastern Highlands	ALLPNG	Totals for the whole of PNG

Crop:

card	Cardamom	cash	Cashew
chil	Chillie	citr	Citrus
coco	Cocoa	cocn	Coconut
h2cof	Harding *et al.* (1986) arabica coffee model		
rcof	Robusta coffee	maiz	Maize
mango	Mango	oilp	Oil palm
pepp	Pepper	pine	Pineapple
pota	Irish potato	pyre	Pyrethrum
rice	Rice	rubb	Rubber
vani	Vanilla		

Suffixes:

lo	Low input management
hi	High input management

Suitability ratings:

1	High
2	Moderate
3	Marginal
4	Unsuitable

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
WES	card_lo	1	0	0.0	0	0.0
WES	card_lo	2	16	0.0	0	0.0
WES	card_lo	3	62668	65.1	46884	48.7
WES	card_lo	4	33602	34.9	48812	50.7
WES	cash_lo	1	225	0.2	0	0.0
WES	cash_lo	2	22404	23.3	810	0.8
WES	cash_lo	3	40055	41.6	46100	47.9
WES	cash_lo	4	33602	34.9	48812	50.7
WES	chil_lo	1	0	0.0	0	0.0
WES	chil_lo	2	37338	38.8	21218	22.0
WES	chil_lo	3	25221	26.2	26127	27.1
WES	chil_lo	4	33727	35.0	48915	50.8
WES	citr_lo	1	0	0.0	0	0.0
WES	citr_lo	2	19329	20.1	20589	21.4
WES	citr_lo	3	43402	45.1	26457	27.5
WES	citr_lo	4	33555	34.8	48677	50.6
WES	coco_hi	1	0	0.0	0	0.0
WES	coco_hi	2	37378	38.8	37707	39.2
WES	coco_hi	3	20930	21.7	3032	3.1
WES	coco_hi	4	37978	39.4	53631	55.7
WES	coco_lo	1	0	0.0	0	0.0
WES	coco_lo	2	37378	38.8	37707	39.2
WES	coco_lo	3	23221	24.1	7061	7.3
WES	coco_lo	4	35687	37.1	50955	52.9
WES	cocn_lo	1	220	0.2	0	0.0
WES	cocn_lo	2	54154	56.2	38270	39.7
WES	cocn_lo	3	6225	6.5	6506	6.8
WES	cocn_lo	4	35687	37.1	50955	52.9
WES	h2cof_hi	1	16	0.0	0	0.0
WES	h2cof_hi	2	10	0.0	0	0.0
WES	h2cof_hi	3	0	0.0	0	0.0
WES	h2cof_hi	4	96260	100.0	96260	100.0
WES	h2cof_lo	1	16	0.0	0	0.0
WES	h2cof_lo	2	10	0.0	0	0.0
WES	h2cof_lo	3	0	0.0	0	0.0
WES	h2cof_lo	4	96260	100.0	96260	100.0
WES	rcof_hi	1	0	0.0	0	0.0
WES	rcof_hi	2	36325	37.7	21152	22.0

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
MOR	card_lo	1	0	0.0	0	0.0
MOR	card_lo	2	2637	7.9	178	0.5
MOR	card_lo	3	21341	63.7	25291	75.5
MOR	card_lo	4	9533	28.4	6952	20.7
MOR	cash_lo	1	26	0.1	0	0.0
MOR	cash_lo	2	2393	7.1	1087	3.2
MOR	cash_lo	3	22279	66.5	24555	73.3
MOR	cash_lo	4	8813	26.3	6952	20.7
MOR	chil_lo	1	241	0.7	31	0.1
MOR	chil_lo	2	2672	8.0	1225	3.7
MOR	chil_lo	3	19003	56.7	24025	71.7
MOR	chil_lo	4	11595	34.6	6968	20.8
MOR	citr_lo	1	434	1.3	408	1.2
MOR	citr_lo	2	4461	13.3	1720	5.1
MOR	citr_lo	3	19810	59.1	23315	69.6
MOR	citr_lo	4	8806	26.3	6952	20.7
MOR	coco_hi	1	184	0.5	157	0.5
MOR	coco_hi	2	1904	5.7	1547	4.6
MOR	coco_hi	3	5369	16.0	5380	16.1
MOR	coco_hi	4	26054	77.7	26026	77.7
MOR	coco_lo	1	78	0.2	0	0.0
MOR	coco_lo	2	2679	8.0	2426	7.2
MOR	coco_lo	3	11301	33.7	12573	37.5
MOR	coco_lo	4	19453	58.0	18248	54.5
MOR	cocn_lo	1	110	0.3	31	0.1
MOR	cocn_lo	2	2665	8.0	2395	7.1
MOR	cocn_lo	3	11118	33.2	12573	37.5
MOR	cocn_lo	4	19618	58.5	18248	54.5
MOR	h2cof_hi	1	3719	11.1	2296	6.9
MOR	h2cof_hi	2	135	0.4	0	0.0
MOR	h2cof_hi	3	0	0.0	18	0.1
MOR	h2cof_hi	4	29657	88.5	31197	93.1
MOR	h2cof_lo	1	3693	11.0	2150	6.4
MOR	h2cof_lo	2	6413	19.1	10360	30.9
MOR	h2cof_lo	3	331	1.0	320	1.0
MOR	h2cof_lo	4	23074	68.9	20447	61.0
MOR	rcof_hi	1	156	0.5	0	0.0
MOR	rcof_hi	2	2655	7.9	1737	5.2

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
WES	rcof_hi	3	23177	24.1	21085	21.9
WES	rcof_hi	4	36784	38.2	52670	54.7
WES	rcof_lo	1	0	0.0	0	0.0
WES	rcof_lo	2	37322	38.8	21218	22.0
WES	rcof_lo	3	24633	25.6	25151	26.1
WES	rcof_lo	4	34331	35.7	48812	50.7
WES	maiz_hi	1	349	0.4	129	0.1
WES	maiz_hi	2	67	0.1	0	0.0
WES	maiz_hi	3	53582	55.6	36966	38.4
WES	maiz_hi	4	42288	43.9	58064	60.3
WES	mang_lo	1	225	0.2	0	0.0
WES	mang_lo	2	22404	23.3	810	0.8
WES	mang_lo	3	40055	41.6	46100	47.9
WES	mang_lo	4	33602	34.9	48812	50.7
WES	oilp_hi	1	0	0.0	16051	16.7
WES	oilp_hi	2	5384	5.6	44616	46.3
WES	oilp_hi	3	51457	53.4	14012	14.6
WES	oilp_hi	4	39445	41.0	18731	19.5
WES	oilp_lo	1	0	0.0	0	0.0
WES	oilp_lo	2	39649	41.2	37578	39.0
WES	oilp_lo	3	38220	39.7	38424	39.9
WES	oilp_lo	4	18417	19.1	16055	16.7
WES	pepp_lo	1	0	0.0	0	0.0
WES	pepp_lo	2	37561	39.0	38141	39.6
WES	pepp_lo	3	6225	6.5	6497	6.7
WES	pepp_lo	4	52500	54.5	51648	53.6
WES	pine_lo	1	220	0.2	0	0.0
WES	pine_lo	2	37128	38.6	21244	22.1
WES	pine_lo	3	25248	26.2	25707	26.7
WES	pine_lo	4	33690	35.0	48780	50.7
WES	pota_hi	1	0	0.0	0	0.0
WES	pota_hi	2	0	0.0	0	0.0
WES	pota_hi	3	59676	62.0	41834	43.4
WES	pota_hi	4	36610	38.0	52535	54.6
WES	pyre_lo	1	0	0.0	0	0.0
WES	pyre_lo	2	10	0.0	0	0.0
WES	pyre_lo	3	2472	2.6	400	0.4
WES	pyre_lo	4	93804	97.4	95457	99.1

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
MOR	rcof_hi	3	8507	25.4	7686	22.9
MOR	rcof_hi	4	22193	66.2	23730	70.8
MOR	rcof_lo	1	298	0.9	194	0.6
MOR	rcof_lo	2	2692	8.0	1713	5.1
MOR	rcof_lo	3	17092	51.0	17512	52.3
MOR	rcof_lo	4	13429	40.1	12550	37.5
MOR	maiz_hi	1	171	0.5	0	0.0
MOR	maiz_hi	2	1945	5.8	2470	7.4
MOR	maiz_hi	3	3469	10.4	2250	6.7
MOR	maiz_hi	4	27926	83.3	28703	85.7
MOR	mang_lo	1	197	0.6	40	0.1
MOR	mang_lo	2	2222	6.6	1047	3.1
MOR	mang_lo	3	22279	66.5	24555	73.3
MOR	mang_lo	4	8813	26.3	6952	20.7
MOR	oilp_hi	1	1107	3.3	1011	3.0
MOR	oilp_hi	2	1021	3.0	723	2.2
MOR	oilp_hi	3	4541	13.6	5565	16.6
MOR	oilp_hi	4	26842	80.1	25841	77.1
MOR	oilp_lo	1	884	2.6	854	2.5
MOR	oilp_lo	2	1485	4.4	1121	3.3
MOR	oilp_lo	3	11609	34.6	13210	39.4
MOR	oilp_lo	4	19533	58.3	18063	53.9
MOR	pepp_lo	1	79	0.2	0	0.0
MOR	pepp_lo	2	2150	6.4	1945	5.8
MOR	pepp_lo	3	10561	31.5	11285	33.7
MOR	pepp_lo	4	20721	61.8	20017	59.7
MOR	pine_lo	1	334	1.0	412	1.2
MOR	pine_lo	2	5413	16.2	3109	9.3
MOR	pine_lo	3	17305	51.6	24304	72.5
MOR	pine_lo	4	10459	31.2	4641	13.8
MOR	pota_hi	1	16	0.0	0	0.0
MOR	pota_hi	2	954	2.8	314	0.9
MOR	pota_hi	3	13682	40.8	13376	39.9
MOR	pota_hi	4	18859	56.3	17772	53.0
MOR	pyre_lo	1	0	0.0	0	0.0
MOR	pyre_lo	2	156	0.5	0	0.0
MOR	pyre_lo	3	14623	43.6	18268	54.5
MOR	pyre_lo	4	18732	55.9	14342	42.8

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
WES	rice_hi	1	349	0.4	129	0.1
WES	rice_hi	2	19937	20.7	21041	21.9
WES	rice_hi	3	56660	58.8	53807	55.9
WES	rice_hi	4	19340	20.1	17635	18.3
WES	rubb_hi	1	0	0.0	0	0.0
WES	rubb_hi	2	54374	56.5	38270	39.7
WES	rubb_hi	3	5128	5.3	3967	4.1
WES	rubb_hi	4	36784	38.2	52670	54.7
WES	rubb_lo	1	0	0.0	0	0.0
WES	rubb_lo	2	54374	56.5	38270	39.7
WES	rubb_lo	3	7581	7.9	8099	8.4
WES	rubb_lo	4	34331	35.7	48812	50.7
WES	vani_lo	1	0	0.0	0	0.0
WES	vani_lo	2	37561	39.0	38141	39.6
WES	vani_lo	3	23038	23.9	6626	6.9
WES	vani_lo	4	35687	37.1	50955	52.9
GUL	card_lo	1	0	0.0	0	0.0
GUL	card_lo	2	47	0.1	0	0.0
GUL	card_lo	3	17409	51.4	18267	54.0
GUL	card_lo	4	16391	48.4	13484	39.8
GUL	cash_lo	1	9	0.0	9	0.0
GUL	cash_lo	2	135	0.4	37	0.1
GUL	cash_lo	3	17369	51.3	17652	52.2
GUL	cash_lo	4	16334	48.3	13427	39.7
GUL	chil_lo	1	90	0.3	0	0.0
GUL	chil_lo	2	1295	3.8	1018	3.0
GUL	chil_lo	3	15095	44.6	16202	47.9
GUL	chil_lo	4	17367	51.3	14531	42.9
GUL	citr_lo	1	90	0.3	0	0.0
GUL	citr_lo	2	893	2.6	880	2.6
GUL	citr_lo	3	16530	48.8	17444	51.5
GUL	citr_lo	4	16334	48.3	13427	39.7
GUL	coco_hi	1	201	0.6	217	0.6
GUL	coco_hi	2	2948	8.7	1919	5.7
GUL	coco_hi	3	7734	22.8	5876	17.4
GUL	coco_hi	4	22964	67.8	22712	67.1
GUL	coco_lo	1	201	0.6	217	0.6

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
MOR	rice_hi	1	613	1.8	585	1.7
MOR	rice_hi	2	1731	5.2	1121	3.3
MOR	rice_hi	3	12002	35.8	12257	36.6
MOR	rice_hi	4	19165	57.2	18792	56.1
MOR	rubb_hi	1	1	0.0	0	0.0
MOR	rubb_hi	2	3749	11.2	2571	7.7
MOR	rubb_hi	3	7403	22.1	7035	21.0
MOR	rubb_hi	4	22358	66.7	23730	70.8
MOR	rubb_lo	1	1	0.0	0	0.0
MOR	rubb_lo	2	4038	12.0	2935	8.8
MOR	rubb_lo	3	15878	47.4	16361	48.8
MOR	rubb_lo	4	13594	40.6	12550	37.5
MOR	vani_lo	1	289	0.9	389	1.2
MOR	vani_lo	2	2102	6.3	1556	4.6
MOR	vani_lo	3	10947	32.7	13054	39.0
MOR	vani_lo	4	20173	60.2	18248	54.5
MAD	card_lo	1	84	0.3	84	0.3
MAD	card_lo	2	78	0.3	23	0.1
MAD	card_lo	3	18755	65.4	18709	65.3
MAD	card_lo	4	9744	34.0	7983	27.9
MAD	cash_lo	1	13	0.0	0	0.0
MAD	cash_lo	2	489	1.7	296	1.0
MAD	cash_lo	3	18541	64.7	18580	64.8
MAD	cash_lo	4	9618	33.6	7983	27.9
MAD	chil_lo	1	927	3.2	944	3.3
MAD	chil_lo	2	4847	16.9	3184	11.1
MAD	chil_lo	3	11624	40.6	12873	44.9
MAD	chil_lo	4	11263	39.3	10681	37.3
MAD	citr_lo	1	1333	4.7	1397	4.9
MAD	citr_lo	2	4426	15.4	2967	10.4
MAD	citr_lo	3	13352	46.6	14452	50.4
MAD	citr_lo	4	9550	33.3	7983	27.9
MAD	coco_hi	1	1058	3.7	1328	4.6
MAD	coco_hi	2	4690	16.4	2739	9.6
MAD	coco_hi	3	2013	7.0	1437	5.0
MAD	coco_hi	4	20900	72.9	23097	80.6
MAD	coco_lo	1	914	3.2	944	3.3

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area	province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
GUL	coco_lo	2	2961	8.7	1919	5.7	MAD	coco_lo	2	4758	16.6	3313	11.6
GUL	coco_lo	3	13278	39.2	14223	42.0	MAD	coco_lo	3	11211	39.1	12440	43.4
GUL	coco_lo	4	17407	51.4	14500	42.8	MAD	coco_lo	4	11778	41.1	11045	38.5
GUL	cocn_lo	1	375	1.1	247	0.7	MAD	cocn_lo	1	2549	8.9	2573	9.0
GUL	cocn_lo	2	2817	8.3	1919	5.7	MAD	cocn_lo	2	3322	11.6	1684	5.9
GUL	cocn_lo	3	13248	39.1	14193	41.9	MAD	cocn_lo	3	11012	38.4	12440	43.4
GUL	cocn_lo	4	17407	51.4	14500	42.8	MAD	cocn_lo	4	11778	41.1	11045	38.5
GUL	h2cof_hi	1	0	0.0	0	0.0	MAD	h2cof_hi	1	251	0.9	23	0.1
GUL	h2cof_hi	2	0	0.0	0	0.0	MAD	h2cof_hi	2	203	0.7	414	1.4
GUL	h2cof_hi	3	0	0.0	0	0.0	MAD	h2cof_hi	3	0	0.0	0	0.0
GUL	h2cof_hi	4	33847	100.0	33847	100.0	MAD	h2cof_hi	4	28207	98.4	28224	98.5
GUL	h2cof_lo	1	0	0.0	0	0.0	MAD	h2cof_lo	1	371	1.3	23	0.1
GUL	h2cof_lo	2	60	0.2	0	0.0	MAD	h2cof_lo	2	851	3.0	498	1.7
GUL	h2cof_lo	3	0	0.0	93	0.3	MAD	h2cof_lo	3	84	0.3	680	2.4
GUL	h2cof_lo	4	33787	99.8	33754	99.7	MAD	h2cof_lo	4	27355	95.4	27460	95.8
GUL	rcof_hi	1	71	0.2	37	0.1	MAD	rcof_hi	1	1189	4.1	969	3.4
GUL	rcof_hi	2	774	2.3	843	2.5	MAD	rcof_hi	2	4608	16.1	3182	11.1
GUL	rcof_hi	3	10110	29.9	8045	23.8	MAD	rcof_hi	3	2434	8.5	1376	4.8
GUL	rcof_hi	4	22892	67.6	22691	67.0	MAD	rcof_hi	4	20430	71.3	23074	80.5
GUL	rcof_lo	1	71	0.2	37	0.1	MAD	rcof_lo	1	1189	4.1	969	3.4
GUL	rcof_lo	2	1314	3.9	981	2.9	MAD	rcof_lo	2	4845	16.9	3372	11.8
GUL	rcof_lo	3	15966	47.2	17306	51.1	MAD	rcof_lo	3	12158	42.4	13399	46.7
GUL	rcof_lo	4	16496	48.7	13427	39.7	MAD	rcof_lo	4	10469	36.5	7983	27.9
GUL	maiz_hi	1	43	0.1	9	0.0	MAD	maiz_hi	1	891	3.1	944	3.3
GUL	maiz_hi	2	433	1.3	258	0.8	MAD	maiz_hi	2	2781	9.7	2309	8.1
GUL	maiz_hi	3	2422	7.2	2083	6.2	MAD	maiz_hi	3	1286	4.5	943	3.3
GUL	maiz_hi	4	30949	91.4	30010	88.7	MAD	maiz_hi	4	23703	82.7	24465	85.4
GUL	mang_lo	1	9	0.0	9	0.0	MAD	mang_lo	1	284	1.0	0	0.0
GUL	mang_lo	2	135	0.4	37	0.1	MAD	mang_lo	2	218	0.8	296	1.0
GUL	mang_lo	3	17369	51.3	17652	52.2	MAD	mang_lo	3	18541	64.7	18580	64.8
GUL	mang_lo	4	16334	48.3	13427	39.7	MAD	mang_lo	4	9618	33.6	7983	27.9
GUL	oilp_hi	1	698	2.1	292	0.9	MAD	oilp_hi	1	4069	14.2	3090	10.8
GUL	oilp_hi	2	3333	9.8	5193	15.3	MAD	oilp_hi	2	2132	7.4	1389	4.8
GUL	oilp_hi	3	1115	3.3	11529	34.1	MAD	oilp_hi	3	3607	12.6	3087	10.8
GUL	oilp_hi	4	28701	84.8	14456	42.7	MAD	oilp_hi	4	18853	65.8	21035	73.4
GUL	oilp_lo	1	1176	3.5	258	0.8	MAD	oilp_lo	1	2915	10.2	2681	9.4
GUL	oilp_lo	2	3970	11.7	5227	15.4	MAD	oilp_lo	2	3508	12.2	1988	6.9
GUL	oilp_lo	3	18594	54.9	19824	58.6	MAD	oilp_lo	3	12421	43.3	13957	48.7

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
GUL	oilp_lo	4	10107	29.9	6296	18.6
GUL	pepp_lo	1	302	0.9	208	0.6
GUL	pepp_lo	2	2851	8.4	1919	5.7
GUL	pepp_lo	3	13230	39.1	14175	41.9
GUL	pepp_lo	4	17464	51.6	14557	43.0
GUL	pine_lo	1	80	0.2	46	0.1
GUL	pine_lo	2	1322	3.9	972	2.9
GUL	pine_lo	3	16821	49.7	17875	52.8
GUL	pine_lo	4	15624	46.2	14345	42.4
GUL	pota_hi	1	0	0.0	0	0.0
GUL	pota_hi	2	0	0.0	0	0.0
GUL	pota_hi	3	10967	32.4	8925	26.4
GUL	pota_hi	4	22880	67.6	22691	67.0
GUL	pyre_lo	1	0	0.0	0	0.0
GUL	pyre_lo	2	0	0.0	0	0.0
GUL	pyre_lo	3	2722	8.0	3473	10.3
GUL	pyre_lo	4	31125	92.0	29765	87.9
GUL	rice_hi	1	80	0.2	46	0.1
GUL	rice_hi	2	667	2.0	251	0.7
GUL	rice_hi	3	17594	52.0	16768	49.5
GUL	rice_hi	4	15506	45.8	14405	42.6
GUL	rubb_hi	1	0	0.0	0	0.0
GUL	rubb_hi	2	3172	9.4	2136	6.3
GUL	rubb_hi	3	7783	23.0	5897	17.4
GUL	rubb_hi	4	22892	67.6	22691	67.0
GUL	rubb_lo	1	0	0.0	0	0.0
GUL	rubb_lo	2	3172	9.4	2136	6.3
GUL	rubb_lo	3	14179	41.9	15296	45.2
GUL	rubb_lo	4	16496	48.7	13427	39.7
GUL	vani_lo	1	56	0.2	0	0.0
GUL	vani_lo	2	3106	9.2	2136	6.3
GUL	vani_lo	3	13221	39.1	14166	41.9
GUL	vani_lo	4	17464	51.6	14557	43.0
CEN	card_lo	1	0	0.0	0	0.0
CEN	card_lo	2	924	3.1	13	0.0
CEN	card_lo	3	18199	60.8	20933	70.0
CEN	card_lo	4	10795	36.1	8749	29.2

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
MAD	oilp_lo	4	9817	34.3	9056	31.6
MAD	pepp_lo	1	2276	7.9	2573	9.0
MAD	pepp_lo	2	3560	12.4	1388	4.8
MAD	pepp_lo	3	10683	37.3	12372	43.2
MAD	pepp_lo	4	12142	42.4	11409	39.8
MAD	pine_lo	1	1236	4.3	1219	4.3
MAD	pine_lo	2	4768	16.6	2955	10.3
MAD	pine_lo	3	11943	41.7	12827	44.8
MAD	pine_lo	4	10714	37.4	10681	37.3
MAD	pota_hi	1	0	0.0	0	0.0
MAD	pota_hi	2	107	0.4	107	0.4
MAD	pota_hi	3	8433	29.4	5886	20.5
MAD	pota_hi	4	20121	70.2	22608	78.9
MAD	pyre_lo	1	0	0.0	0	0.0
MAD	pyre_lo	2	0	0.0	0	0.0
MAD	pyre_lo	3	2628	9.2	1713	6.0
MAD	pyre_lo	4	26033	90.8	25969	90.6
MAD	rice_hi	1	1969	6.9	1348	4.7
MAD	rice_hi	2	2471	8.6	2214	7.7
MAD	rice_hi	3	6084	21.2	4441	15.5
MAD	rice_hi	4	18137	63.3	20598	71.9
MAD	rubb_hi	1	0	0.0	0	0.0
MAD	rubb_hi	2	6012	21.0	4510	15.7
MAD	rubb_hi	3	2219	7.7	1017	3.5
MAD	rubb_hi	4	20430	71.3	23074	80.5
MAD	rubb_lo	1	0	0.0	0	0.0
MAD	rubb_lo	2	6249	21.8	4700	16.4
MAD	rubb_lo	3	11943	41.7	13040	45.5
MAD	rubb_lo	4	10469	36.5	7983	27.9
MAD	vani_lo	1	2294	8.0	2573	9.0
MAD	vani_lo	2	3540	12.4	1388	4.8
MAD	vani_lo	3	11049	38.6	12736	44.4
MAD	vani_lo	4	11778	41.1	11045	38.5
ESK	card_lo	1	0	0.0	0	0.0
ESK	card_lo	2	67	0.2	0	0.0
ESK	card_lo	3	15493	35.6	17026	39.1
ESK	card_lo	4	27956	64.2	25764	59.2

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
CEN	cash_lo	1	282	0.9	205	0.7
CEN	cash_lo	2	3419	11.4	1266	4.2
CEN	cash_lo	3	16975	56.7	19847	66.3
CEN	cash_lo	4	9242	30.9	8566	28.6
CEN	chil_lo	1	431	1.4	264	0.9
CEN	chil_lo	2	4119	13.8	1503	5.0
CEN	chil_lo	3	14820	49.5	19108	63.9
CEN	chil_lo	4	10548	35.3	8566	28.6
CEN	citr_lo	1	482	1.6	264	0.9
CEN	citr_lo	2	3752	12.5	1469	4.9
CEN	citr_lo	3	16645	55.6	19491	65.1
CEN	citr_lo	4	9039	30.2	8566	28.6
CEN	coco_hi	1	203	0.7	59	0.2
CEN	coco_hi	2	4202	14.0	1490	5.0
CEN	coco_hi	3	2363	7.9	1457	4.9
CEN	coco_hi	4	23150	77.4	26878	89.8
CEN	coco_lo	1	278	0.9	264	0.9
CEN	coco_lo	2	4209	14.1	1490	5.0
CEN	coco_lo	3	11558	38.6	14298	47.8
CEN	coco_lo	4	13873	46.4	13832	46.2
CEN	cocn_lo	1	795	2.7	447	1.5
CEN	cocn_lo	2	3574	11.9	1490	5.0
CEN	cocn_lo	3	11676	39.0	14115	47.2
CEN	cocn_lo	4	13873	46.4	13832	46.2
CEN	h2cof_hi	1	2179	7.3	129	0.4
CEN	h2cof_hi	2	162	0.5	3480	11.6
CEN	h2cof_hi	3	39	0.1	39	0.1
CEN	h2cof_hi	4	27538	92.0	26270	87.8
CEN	h2cof_lo	1	2233	7.5	183	0.6
CEN	h2cof_lo	2	4899	16.4	9998	33.4
CEN	h2cof_lo	3	39	0.1	482	1.6
CEN	h2cof_lo	4	22747	76.0	19255	64.4
CEN	rcof_hi	1	1083	3.6	563	1.9
CEN	rcof_hi	2	3061	10.2	1204	4.0
CEN	rcof_hi	3	4769	15.9	1239	4.1
CEN	rcof_hi	4	21005	70.2	26749	89.4
CEN	rcof_lo	1	1288	4.3	768	2.6
CEN	rcof_lo	2	2856	9.5	999	3.3

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
ESK	cash_lo	1	973	2.2	1548	3.6
ESK	cash_lo	2	3239	7.4	2567	5.9
ESK	cash_lo	3	11348	26.1	12798	29.4
ESK	cash_lo	4	27956	64.2	25764	59.2
ESK	chil_lo	1	162	0.4	0	0.0
ESK	chil_lo	2	4995	11.5	4963	11.4
ESK	chil_lo	3	9098	20.9	10438	24.0
ESK	chil_lo	4	29261	67.2	27219	62.5
ESK	citr_lo	1	162	0.4	0	0.0
ESK	citr_lo	2	4304	9.9	4266	9.8
ESK	citr_lo	3	11094	25.5	12590	28.9
ESK	citr_lo	4	27956	64.2	25764	59.2
ESK	coco_hi	1	1025	2.4	1551	3.6
ESK	coco_hi	2	4299	9.9	3442	7.9
ESK	coco_hi	3	577	1.3	487	1.1
ESK	coco_hi	4	37615	86.4	37681	86.6
ESK	coco_lo	1	1022	2.3	1548	3.6
ESK	coco_lo	2	3611	8.3	2748	6.3
ESK	coco_lo	3	9273	21.3	10938	25.1
ESK	coco_lo	4	29610	68.0	27418	63.0
ESK	cocn_lo	1	1022	2.3	1548	3.6
ESK	cocn_lo	2	4308	9.9	3445	7.9
ESK	cocn_lo	3	8576	19.7	10241	23.5
ESK	cocn_lo	4	29610	68.0	27418	63.0
ESK	h2cof_hi	1	19	0.0	19	0.0
ESK	h2cof_hi	2	0	0.0	0	0.0
ESK	h2cof_hi	3	0	0.0	0	0.0
ESK	h2cof_hi	4	43497	100.0	43497	100.0
ESK	h2cof_lo	1	19	0.0	19	0.0
ESK	h2cof_lo	2	378	0.9	246	0.6
ESK	h2cof_lo	3	99	0.2	92	0.2
ESK	h2cof_lo	4	43020	98.9	42974	98.8
ESK	rcof_hi	1	241	0.6	0	0.0
ESK	rcof_hi	2	4916	11.3	4963	11.4
ESK	rcof_hi	3	922	2.1	676	1.6
ESK	rcof_hi	4	37437	86.0	37662	86.5
ESK	rcof_lo	1	175	0.4	0	0.0
ESK	rcof_lo	2	4988	11.5	4963	11.4

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
CEN	rcof_lo	3	14873	49.7	19491	65.1
CEN	rcof_lo	4	10901	36.4	8626	28.8
CEN	maiz_hi	1	75	0.3	59	0.2
CEN	maiz_hi	2	2848	9.5	1045	3.5
CEN	maiz_hi	3	1336	4.5	732	2.4
CEN	maiz_hi	4	25659	85.8	28048	93.7
CEN	mang_lo	1	580	1.9	205	0.7
CEN	mang_lo	2	3121	10.4	1266	4.2
CEN	mang_lo	3	16975	56.7	19847	66.3
CEN	mang_lo	4	9242	30.9	8566	28.6
CEN	oilp_hi	1	1127	3.8	597	2.0
CEN	oilp_hi	2	1816	6.1	1097	3.7
CEN	oilp_hi	3	5297	17.7	5280	17.6
CEN	oilp_hi	4	21678	72.5	22850	76.4
CEN	oilp_lo	1	835	2.8	191	0.6
CEN	oilp_lo	2	1985	6.6	1503	5.0
CEN	oilp_lo	3	14697	49.1	18326	61.3
CEN	oilp_lo	4	12401	41.4	9804	32.8
CEN	pepp_lo	1	0	0.0	0	0.0
CEN	pepp_lo	2	3214	10.7	1487	5.0
CEN	pepp_lo	3	11017	36.8	14320	47.9
CEN	pepp_lo	4	15687	52.4	14015	46.8
CEN	pine_lo	1	1802	6.0	768	2.6
CEN	pine_lo	2	3589	12.0	1760	5.9
CEN	pine_lo	3	15826	52.9	20663	69.1
CEN	pine_lo	4	8701	29.1	6248	20.9
CEN	pota_hi	1	0	0.0	0	0.0
CEN	pota_hi	2	179	0.6	39	0.1
CEN	pota_hi	3	10105	33.8	7787	26.0
CEN	pota_hi	4	19634	65.6	21649	72.4
CEN	pyre_lo	1	0	0.0	0	0.0
CEN	pyre_lo	2	118	0.4	39	0.1
CEN	pyre_lo	3	7866	26.3	10198	34.1
CEN	pyre_lo	4	21934	73.3	19238	64.3
CEN	rice_hi	1	1170	3.9	362	1.2
CEN	rice_hi	2	1379	4.6	1712	5.7
CEN	rice_hi	3	9259	30.9	9912	33.1
CEN	rice_hi	4	18110	60.5	17455	58.3

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
ESK	rcof_lo	3	9768	22.4	11382	26.2
ESK	rcof_lo	4	28585	65.7	26275	60.4
ESK	maiz_hi	1	1015	2.3	1548	3.6
ESK	maiz_hi	2	793	1.8	727	1.7
ESK	maiz_hi	3	1000	2.3	322	0.7
ESK	maiz_hi	4	40708	93.5	40731	93.6
ESK	mang_lo	1	973	2.2	1548	3.6
ESK	mang_lo	2	3239	7.4	2567	5.9
ESK	mang_lo	3	11348	26.1	12798	29.4
ESK	mang_lo	4	27956	64.2	25764	59.2
ESK	oilp_hi	1	0	0.0	780	1.8
ESK	oilp_hi	2	981	2.3	7029	16.2
ESK	oilp_hi	3	10524	24.2	2258	5.2
ESK	oilp_hi	4	32011	73.6	32647	75.0
ESK	oilp_lo	1	215	0.5	80	0.2
ESK	oilp_lo	2	5532	12.7	5203	12.0
ESK	oilp_lo	3	13729	31.5	15066	34.6
ESK	oilp_lo	4	24040	55.2	22384	51.4
ESK	pepp_lo	1	7	0.0	0	0.0
ESK	pepp_lo	2	1335	3.1	878	2.0
ESK	pepp_lo	3	12215	28.1	13116	30.1
ESK	pepp_lo	4	29959	68.8	28508	65.5
ESK	pine_lo	1	1050	2.4	1548	3.6
ESK	pine_lo	2	4333	10.0	3642	8.4
ESK	pine_lo	3	8872	20.4	10211	23.5
ESK	pine_lo	4	29261	67.2	27219	62.5
ESK	pota_hi	1	0	0.0	0	0.0
ESK	pota_hi	2	0	0.0	0	0.0
ESK	pota_hi	3	6284	14.4	5703	13.1
ESK	pota_hi	4	37232	85.6	37482	86.1
ESK	pyre_lo	1	0	0.0	0	0.0
ESK	pyre_lo	2	0	0.0	0	0.0
ESK	pyre_lo	3	1811	4.2	861	2.0
ESK	pyre_lo	4	41705	95.8	42563	97.8
ESK	rice_hi	1	3485	8.0	4127	9.5
ESK	rice_hi	2	1249	2.9	700	1.6
ESK	rice_hi	3	7154	16.4	6071	14.0
ESK	rice_hi	4	31628	72.7	32448	74.6

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
CEN	rubb_hi	1	292	1.0	406	1.4
CEN	rubb_hi	2	4175	14.0	1393	4.7
CEN	rubb_hi	3	4446	14.9	1239	4.1
CEN	rubb_hi	4	21005	70.2	26749	89.4
CEN	rubb_lo	1	292	1.0	406	1.4
CEN	rubb_lo	2	4175	14.0	1393	4.7
CEN	rubb_lo	3	14550	48.6	19491	65.1
CEN	rubb_lo	4	10901	36.4	8626	28.8
CEN	vani_lo	1	0	0.0	0	0.0
CEN	vani_lo	2	3575	11.9	1692	5.7
CEN	vani_lo	3	10917	36.5	14209	47.5
CEN	vani_lo	4	15426	51.6	14015	46.8
MIL	card_lo	1	0	0.0	0	0.0
MIL	card_lo	2	360	2.5	285	2.0
MIL	card_lo	3	11522	81.6	12171	86.2
MIL	card_lo	4	2243	15.9	1258	8.9
MIL	cash_lo	1	21	0.1	0	0.0
MIL	cash_lo	2	1583	11.2	1320	9.3
MIL	cash_lo	3	10278	72.8	11094	78.5
MIL	cash_lo	4	2243	15.9	1258	8.9
MIL	chil_lo	1	443	3.1	56	0.4
MIL	chil_lo	2	2235	15.8	2318	16.4
MIL	chil_lo	3	8991	63.7	10082	71.4
MIL	chil_lo	4	2456	17.4	1258	8.9
MIL	citr_lo	1	695	4.9	222	1.6
MIL	citr_lo	2	1668	11.8	1839	13.0
MIL	citr_lo	3	9519	67.4	10263	72.7
MIL	citr_lo	4	2243	15.9	1258	8.9
MIL	coco_hi	1	465	3.3	7	0.0
MIL	coco_hi	2	2251	15.9	2481	17.6
MIL	coco_hi	3	1636	11.6	1645	11.6
MIL	coco_hi	4	9773	69.2	9812	69.5
MIL	coco_lo	1	300	2.1	43	0.3
MIL	coco_lo	2	2417	17.1	2576	18.2
MIL	coco_lo	3	8118	57.5	8591	60.8
MIL	coco_lo	4	3290	23.3	2367	16.8
MIL	cocn_lo	1	495	3.5	43	0.3

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
ESK	rubb_hi	1	0	0.0	0	0.0
ESK	rubb_hi	2	5351	12.3	5020	11.5
ESK	rubb_hi	3	728	1.7	592	1.4
ESK	rubb_hi	4	37437	86.0	37662	86.5
ESK	rubb_lo	1	0	0.0	0	0.0
ESK	rubb_lo	2	5357	12.3	5020	11.5
ESK	rubb_lo	3	9574	22.0	11298	26.0
ESK	rubb_lo	4	28585	65.7	26275	60.4
ESK	vani_lo	1	162	0.4	0	0.0
ESK	vani_lo	2	4876	11.2	3903	9.0
ESK	vani_lo	3	8868	20.4	11331	26.0
ESK	vani_lo	4	29610	68.0	27418	63.0
WSK	card_lo	1	0	0.0	0	0.0
WSK	card_lo	2	1874	5.2	267	0.7
WSK	card_lo	3	21499	59.7	27926	77.6
WSK	card_lo	4	12637	35.1	4260	11.8
WSK	cash_lo	1	60	0.2	0	0.0
WSK	cash_lo	2	3168	8.8	3155	8.8
WSK	cash_lo	3	20145	55.9	26428	73.4
WSK	cash_lo	4	12637	35.1	4260	11.8
WSK	chil_lo	1	1650	4.6	596	1.7
WSK	chil_lo	2	6932	19.3	6099	16.9
WSK	chil_lo	3	13595	37.8	21195	58.9
WSK	chil_lo	4	13833	38.4	5298	14.7
WSK	citr_lo	1	1534	4.3	596	1.7
WSK	citr_lo	2	6713	18.6	5892	16.4
WSK	citr_lo	3	15183	42.2	22594	62.7
WSK	citr_lo	4	12580	34.9	4260	11.8
WSK	coco_hi	1	674	1.9	430	1.2
WSK	coco_hi	2	6797	18.9	11033	30.6
WSK	coco_hi	3	1794	5.0	1074	3.0
WSK	coco_hi	4	26745	74.3	21071	58.5
WSK	coco_lo	1	507	1.4	430	1.2
WSK	coco_lo	2	6964	19.3	11033	30.6
WSK	coco_lo	3	11295	31.4	12965	36.0
WSK	coco_lo	4	17244	47.9	8914	24.8
WSK	cocn_lo	1	1584	4.4	430	1.2

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
MIL	cocn_lo	2	2383	16.9	1996	14.1
MIL	cocn_lo	3	7957	56.3	8591	60.8
MIL	cocn_lo	4	3290	23.3	2367	16.8
MIL	h2cof_hi	1	587	4.2	278	2.0
MIL	h2cof_hi	2	25	0.2	0	0.0
MIL	h2cof_hi	3	4	0.0	4	0.0
MIL	h2cof_hi	4	13509	95.6	13843	98.0
MIL	h2cof_lo	1	587	4.2	278	2.0
MIL	h2cof_lo	2	1513	10.7	2466	17.5
MIL	h2cof_lo	3	4	0.0	4	0.0
MIL	h2cof_lo	4	12021	85.1	11377	80.5
MIL	rcof_hi	1	877	6.2	408	2.9
MIL	rcof_hi	2	1305	9.2	1485	10.5
MIL	rcof_hi	3	2408	17.0	2170	15.4
MIL	rcof_hi	4	9535	67.5	9803	69.4
MIL	rcof_lo	1	1269	9.0	630	4.5
MIL	rcof_lo	2	1480	10.5	1253	8.9
MIL	rcof_lo	3	8793	62.3	9887	70.0
MIL	rcof_lo	4	2583	18.3	1316	9.3
MIL	maiz_hi	1	303	2.1	0	0.0
MIL	maiz_hi	2	1260	8.9	1640	11.6
MIL	maiz_hi	3	1697	12.0	1617	11.4
MIL	maiz_hi	4	10865	76.9	10694	75.7
MIL	mang_lo	1	50	0.4	0	0.0
MIL	mang_lo	2	1554	11.0	1320	9.3
MIL	mang_lo	3	10278	72.8	11094	78.5
MIL	mang_lo	4	2243	15.9	1258	8.9
MIL	oilp_hi	1	1975	14.0	1736	12.3
MIL	oilp_hi	2	1207	8.5	737	5.2
MIL	oilp_hi	3	1727	12.2	1995	14.1
MIL	oilp_hi	4	9216	65.2	9340	66.1
MIL	oilp_lo	1	741	5.2	553	3.9
MIL	oilp_lo	2	2333	16.5	2066	14.6
MIL	oilp_lo	3	8318	58.9	9063	64.2
MIL	oilp_lo	4	2733	19.3	1895	13.4
MIL	pepp_lo	1	406	2.9	0	0.0
MIL	pepp_lo	2	2379	16.8	2635	18.7
MIL	pepp_lo	3	7803	55.2	8431	59.7

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
WSK	cocn_lo	2	5896	16.4	5998	16.7
WSK	cocn_lo	3	11286	31.3	18000	50.0
WSK	cocn_lo	4	17244	47.9	8914	24.8
WSK	h2cof_hi	1	1544	4.3	2725	7.6
WSK	h2cof_hi	2	220	0.6	170	0.5
WSK	h2cof_hi	3	11	0.0	0	0.0
WSK	h2cof_hi	4	34235	95.1	32961	91.5
WSK	h2cof_lo	1	1527	4.2	1447	4.0
WSK	h2cof_lo	2	3419	9.5	4165	11.6
WSK	h2cof_lo	3	11	0.0	0	0.0
WSK	h2cof_lo	4	31053	86.2	30244	84.0
WSK	rcof_hi	1	1269	3.5	430	1.2
WSK	rcof_hi	2	6987	19.4	11073	30.7
WSK	rcof_hi	3	2993	8.3	3872	10.8
WSK	rcof_hi	4	24761	68.8	18176	50.5
WSK	rcof_lo	1	942	2.6	430	1.2
WSK	rcof_lo	2	7358	20.4	11073	30.7
WSK	rcof_lo	3	13330	37.0	16999	47.2
WSK	rcof_lo	4	14380	39.9	4783	13.3
WSK	maiz_hi	1	1476	4.1	430	1.2
WSK	maiz_hi	2	1040	2.9	223	0.6
WSK	maiz_hi	3	1747	4.9	7750	21.5
WSK	maiz_hi	4	31747	88.2	25038	69.5
WSK	mang_lo	1	60	0.2	0	0.0
WSK	mang_lo	2	3168	8.8	3155	8.8
WSK	mang_lo	3	20145	55.9	26428	73.4
WSK	mang_lo	4	12637	35.1	4260	11.8
WSK	oilp_hi	1	0	0.0	3160	8.8
WSK	oilp_hi	2	2676	7.4	3321	9.2
WSK	oilp_hi	3	13254	36.8	9360	26.0
WSK	oilp_hi	4	20080	55.8	19454	54.0
WSK	oilp_lo	1	541	1.5	467	1.3
WSK	oilp_lo	2	7882	21.9	6014	16.7
WSK	oilp_lo	3	17008	47.2	21251	59.0
WSK	oilp_lo	4	10579	29.4	7297	20.3
WSK	pepp_lo	1	535	1.5	6	0.0
WSK	pepp_lo	2	6936	19.3	11457	31.8
WSK	pepp_lo	3	11295	31.4	12965	36.0

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
MIL	pepp_lo	4	3537	25.0	2527	17.9
MIL	pine_lo	1	897	6.4	458	3.2
MIL	pine_lo	2	2949	20.9	3239	22.9
MIL	pine_lo	3	7977	56.5	8955	63.4
MIL	pine_lo	4	2302	16.3	1057	7.5
MIL	pota_hi	1	0	0.0	0	0.0
MIL	pota_hi	2	27	0.2	7	0.0
MIL	pota_hi	3	4735	33.5	4383	31.0
MIL	pota_hi	4	9363	66.3	9476	67.1
MIL	pyre_lo	1	0	0.0	0	0.0
MIL	pyre_lo	2	13	0.1	0	0.0
MIL	pyre_lo	3	2155	15.3	2777	19.7
MIL	pyre_lo	4	11957	84.7	11216	79.4
MIL	rice_hi	1	1004	7.1	1054	7.5
MIL	rice_hi	2	1267	9.0	800	5.7
MIL	rice_hi	3	3100	21.9	2922	20.7
MIL	rice_hi	4	8754	62.0	9000	63.7
MIL	rubb_hi	1	90	0.6	0	0.0
MIL	rubb_hi	2	2811	19.9	2538	18.0
MIL	rubb_hi	3	1689	12.0	1604	11.4
MIL	rubb_hi	4	9535	67.5	9803	69.4
MIL	rubb_lo	1	90	0.6	0	0.0
MIL	rubb_lo	2	2891	20.5	2684	19.0
MIL	rubb_lo	3	8561	60.6	9635	68.2
MIL	rubb_lo	4	2583	18.3	1316	9.3
MIL	vani_lo	1	396	2.8	56	0.4
MIL	vani_lo	2	2389	16.9	2621	18.6
MIL	vani_lo	3	8050	57.0	8591	60.8
MIL	vani_lo	4	3290	23.3	2367	16.8
NTH	card_lo	1	150	0.7	150	0.7
NTH	card_lo	2	1221	5.4	462	2.1
NTH	card_lo	3	13840	61.5	16915	75.1
NTH	card_lo	4	7299	32.4	4627	20.6
NTH	cash_lo	1	369	1.6	161	0.7
NTH	cash_lo	2	2315	10.3	2517	11.2
NTH	cash_lo	3	12527	55.7	14281	63.4
NTH	cash_lo	4	7299	32.4	4627	20.6

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
WSK	pepp_lo	4	17244	47.9	8914	24.8
WSK	pine_lo	1	828	2.3	430	1.2
WSK	pine_lo	2	7777	21.6	11858	32.9
WSK	pine_lo	3	13736	38.1	16314	45.3
WSK	pine_lo	4	13669	38.0	5298	14.7
WSK	pota_hi	1	0	0.0	0	0.0
WSK	pota_hi	2	185	0.5	170	0.5
WSK	pota_hi	3	12762	35.4	16387	45.5
WSK	pota_hi	4	23063	64.0	17257	47.9
WSK	pyre_lo	1	0	0.0	0	0.0
WSK	pyre_lo	2	11	0.0	0	0.0
WSK	pyre_lo	3	7111	19.7	7241	20.1
WSK	pyre_lo	4	28888	80.2	28192	78.3
WSK	rice_hi	1	1637	4.5	520	1.4
WSK	rice_hi	2	2667	7.4	2753	7.6
WSK	rice_hi	3	15023	41.7	16685	46.3
WSK	rice_hi	4	16683	46.3	15838	44.0
WSK	rubb_hi	1	116	0.3	0	0.0
WSK	rubb_hi	2	8540	23.7	11618	32.3
WSK	rubb_hi	3	2593	7.2	5501	15.3
WSK	rubb_hi	4	24761	68.8	18176	50.5
WSK	rubb_lo	1	116	0.3	0	0.0
WSK	rubb_lo	2	8540	23.7	11618	32.3
WSK	rubb_lo	3	12974	36.0	18628	51.7
WSK	rubb_lo	4	14380	39.9	4783	13.3
WSK	vani_lo	1	614	1.7	430	1.2
WSK	vani_lo	2	6857	19.0	11033	30.6
WSK	vani_lo	3	11295	31.4	12965	36.0
WSK	vani_lo	4	17244	47.9	8914	24.8
MAN	card_lo	1	0	0.0	0	0.0
MAN	card_lo	2	0	0.0	0	0.0
MAN	card_lo	3	1795	85.6	1802	85.9
MAN	card_lo	4	303	14.4	296	14.1
MAN	cash_lo	1	0	0.0	0	0.0
MAN	cash_lo	2	0	0.0	0	0.0
MAN	cash_lo	3	1795	85.6	1802	85.9
MAN	cash_lo	4	303	14.4	296	14.1

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
NTH	chil_lo	1	1216	5.4	159	0.7
NTH	chil_lo	2	3670	16.3	4524	20.1
NTH	chil_lo	3	8073	35.9	10030	44.6
NTH	chil_lo	4	9551	42.4	7441	33.1
NTH	citr_lo	1	2109	9.4	2098	9.3
NTH	citr_lo	2	4455	19.8	3812	16.9
NTH	citr_lo	3	8653	38.4	11617	51.6
NTH	citr_lo	4	7293	32.4	4627	20.6
NTH	coco_hi	1	1632	7.3	2164	9.6
NTH	coco_hi	2	2863	12.7	2093	9.3
NTH	coco_hi	3	2120	9.4	2337	10.4
NTH	coco_hi	4	15895	70.6	15437	68.6
NTH	coco_lo	1	506	2.2	213	0.9
NTH	coco_lo	2	4688	20.8	5078	22.6
NTH	coco_lo	3	7183	31.9	9359	41.6
NTH	coco_lo	4	10133	45.0	7821	34.7
NTH	cocn_lo	1	1220	5.4	213	0.9
NTH	cocn_lo	2	3967	17.6	5078	22.6
NTH	cocn_lo	3	7190	31.9	9359	41.6
NTH	cocn_lo	4	10133	45.0	7821	34.7
NTH	h2cof_hi	1	694	3.1	960	4.3
NTH	h2cof_hi	2	14	0.1	7	0.0
NTH	h2cof_hi	3	0	0.0	0	0.0
NTH	h2cof_hi	4	21802	96.9	21543	95.7
NTH	h2cof_lo	1	694	3.1	960	4.3
NTH	h2cof_lo	2	3071	13.6	4020	17.9
NTH	h2cof_lo	3	0	0.0	0	0.0
NTH	h2cof_lo	4	18745	83.3	17530	77.9
NTH	rcof_hi	1	243	1.1	0	0.0
NTH	rcof_hi	2	4643	20.6	4683	20.8
NTH	rcof_hi	3	2381	10.6	2495	11.1
NTH	rcof_hi	4	15243	67.7	14499	64.4
NTH	rcof_lo	1	1249	5.5	52	0.2
NTH	rcof_lo	2	4835	21.5	5746	25.5
NTH	rcof_lo	3	7817	34.7	9495	42.2
NTH	rcof_lo	4	8609	38.2	6861	30.5
NTH	maiz_hi	1	964	4.3	170	0.8
NTH	maiz_hi	2	3241	14.4	3401	15.1

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
MAN	chil_lo	1	0	0.0	0	0.0
MAN	chil_lo	2	799	38.1	676	32.2
MAN	chil_lo	3	996	47.5	701	33.4
MAN	chil_lo	4	303	14.4	296	14.1
MAN	citr_lo	1	0	0.0	0	0.0
MAN	citr_lo	2	75	3.6	0	0.0
MAN	citr_lo	3	1720	82.0	1781	84.9
MAN	citr_lo	4	303	14.4	296	14.1
MAN	coco_hi	1	0	0.0	0	0.0
MAN	coco_hi	2	799	38.1	676	32.2
MAN	coco_hi	3	84	4.0	425	20.3
MAN	coco_hi	4	1215	57.9	997	47.5
MAN	coco_lo	1	0	0.0	0	0.0
MAN	coco_lo	2	799	38.1	676	32.2
MAN	coco_lo	3	996	47.5	701	33.4
MAN	coco_lo	4	303	14.4	296	14.1
MAN	cocn_lo	1	0	0.0	0	0.0
MAN	cocn_lo	2	799	38.1	676	32.2
MAN	cocn_lo	3	996	47.5	701	33.4
MAN	cocn_lo	4	303	14.4	296	14.1
MAN	h2cof_hi	1	0	0.0	0	0.0
MAN	h2cof_hi	2	0	0.0	0	0.0
MAN	h2cof_hi	3	0	0.0	0	0.0
MAN	h2cof_hi	4	2098	100.0	2098	100.0
MAN	h2cof_lo	1	0	0.0	0	0.0
MAN	h2cof_lo	2	0	0.0	0	0.0
MAN	h2cof_lo	3	0	0.0	0	0.0
MAN	h2cof_lo	4	2098	100.0	2098	100.0
MAN	rcof_hi	1	0	0.0	0	0.0
MAN	rcof_hi	2	75	3.6	0	0.0
MAN	rcof_hi	3	808	38.5	655	31.2
MAN	rcof_hi	4	1215	57.9	997	47.5
MAN	rcof_lo	1	0	0.0	0	0.0
MAN	rcof_lo	2	799	38.1	676	32.2
MAN	rcof_lo	3	996	47.5	701	33.4
MAN	rcof_lo	4	303	14.4	296	14.1
MAN	maiz_hi	1	0	0.0	0	0.0
MAN	maiz_hi	2	118	5.6	189	9.0

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
NTH	maiz_hi	3	435	1.9	1260	5.6
NTH	maiz_hi	4	17870	79.4	16973	75.4
NTH	mang_lo	1	1505	6.7	310	1.4
NTH	mang_lo	2	1179	5.2	2206	9.8
NTH	mang_lo	3	12527	55.7	14281	63.4
NTH	mang_lo	4	7299	32.4	4627	20.6
NTH	oilp_hi	1	2925	13.0	2988	13.3
NTH	oilp_hi	2	1927	8.6	1610	7.2
NTH	oilp_hi	3	3827	17.0	3748	16.7
NTH	oilp_hi	4	13831	61.4	12650	56.2
NTH	oilp_lo	1	1245	5.5	52	0.2
NTH	oilp_lo	2	4086	18.2	5751	25.5
NTH	oilp_lo	3	8676	38.5	10183	45.2
NTH	oilp_lo	4	8503	37.8	5621	25.0
NTH	pepp_lo	1	209	0.9	0	0.0
NTH	pepp_lo	2	4422	19.6	4757	21.1
NTH	pepp_lo	3	7746	34.4	9831	43.7
NTH	pepp_lo	4	10133	45.0	7821	34.7
NTH	pine_lo	1	580	2.6	213	0.9
NTH	pine_lo	2	4313	19.2	4477	19.9
NTH	pine_lo	3	8079	35.9	12250	54.4
NTH	pine_lo	4	9538	42.4	5214	23.2
NTH	pota_hi	1	9	0.0	9	0.0
NTH	pota_hi	2	247	1.1	148	0.7
NTH	pota_hi	3	7371	32.7	7861	34.9
NTH	pota_hi	4	14883	66.1	14492	64.4
NTH	pyre_lo	1	0	0.0	0	0.0
NTH	pyre_lo	2	7	0.0	7	0.0
NTH	pyre_lo	3	4587	20.4	5851	26.0
NTH	pyre_lo	4	17916	79.6	16652	74.0
NTH	rice_hi	1	1069	4.7	170	0.8
NTH	rice_hi	2	3784	16.8	3993	17.7
NTH	rice_hi	3	4882	21.7	6052	26.9
NTH	rice_hi	4	12775	56.8	11493	51.1
NTH	rubb_hi	1	121	0.5	0	0.0
NTH	rubb_hi	2	4851	21.6	5600	24.9
NTH	rubb_hi	3	2295	10.2	1578	7.0
NTH	rubb_hi	4	15243	67.7	14499	64.4

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
MAN	maiz_hi	3	103	4.9	0	0.0
MAN	maiz_hi	4	1877	89.5	1888	90.0
MAN	mang_lo	1	0	0.0	0	0.0
MAN	mang_lo	2	0	0.0	0	0.0
MAN	mang_lo	3	1795	85.6	1802	85.9
MAN	mang_lo	4	303	14.4	296	14.1
MAN	oilp_hi	1	193	9.2	210	10.0
MAN	oilp_hi	2	662	31.6	466	22.2
MAN	oilp_hi	3	260	12.4	698	33.3
MAN	oilp_hi	4	983	46.9	724	34.5
MAN	oilp_lo	1	35	1.7	0	0.0
MAN	oilp_lo	2	820	39.1	676	32.2
MAN	oilp_lo	3	1172	55.9	974	46.4
MAN	oilp_lo	4	71	3.4	23	1.1
MAN	pepp_lo	1	0	0.0	0	0.0
MAN	pepp_lo	2	799	38.1	676	32.2
MAN	pepp_lo	3	996	47.5	701	33.4
MAN	pepp_lo	4	303	14.4	296	14.1
MAN	pine_lo	1	0	0.0	0	0.0
MAN	pine_lo	2	883	42.1	676	32.2
MAN	pine_lo	3	912	43.5	701	33.4
MAN	pine_lo	4	303	14.4	296	14.1
MAN	pota_hi	1	0	0.0	0	0.0
MAN	pota_hi	2	0	0.0	0	0.0
MAN	pota_hi	3	883	42.1	676	32.2
MAN	pota_hi	4	1215	57.9	997	47.5
MAN	pyre_lo	1	0	0.0	0	0.0
MAN	pyre_lo	2	0	0.0	0	0.0
MAN	pyre_lo	3	0	0.0	0	0.0
MAN	pyre_lo	4	2098	100.0	2098	100.0
MAN	rice_hi	1	0	0.0	0	0.0
MAN	rice_hi	2	242	11.5	443	21.1
MAN	rice_hi	3	873	41.6	506	24.1
MAN	rice_hi	4	983	46.9	724	34.5
MAN	rubb_hi	1	0	0.0	0	0.0
MAN	rubb_hi	2	799	38.1	676	32.2
MAN	rubb_hi	3	84	4.0	425	20.3
MAN	rubb_hi	4	1215	57.9	997	47.5

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
NTH	rubb_lo	1	0	0.0	0	0.0
NTH	rubb_lo	2	6170	27.4	6715	29.8
NTH	rubb_lo	3	7731	34.3	8578	38.1
NTH	rubb_lo	4	8609	38.2	6861	30.5
NTH	vani_lo	1	319	1.4	0	0.0
NTH	vani_lo	2	4961	22.0	6146	27.3
NTH	vani_lo	3	7097	31.5	8442	37.5
NTH	vani_lo	4	10133	45.0	7821	34.7
SHY	card_lo	1	51	0.2	51	0.2
SHY	card_lo	2	3767	14.7	4391	17.1
SHY	card_lo	3	13778	53.7	13985	54.5
SHY	card_lo	4	8044	31.4	6406	25.0
SHY	cash_lo	1	0	0.0	0	0.0
SHY	cash_lo	2	0	0.0	0	0.0
SHY	cash_lo	3	17596	68.6	18524	72.2
SHY	cash_lo	4	8044	31.4	6406	25.0
SHY	chil_lo	1	0	0.0	0	0.0
SHY	chil_lo	2	1688	6.6	2642	10.3
SHY	chil_lo	3	14149	55.2	14241	55.5
SHY	chil_lo	4	9803	38.2	8033	31.3
SHY	citr_lo	1	0	0.0	0	0.0
SHY	citr_lo	2	2212	8.6	2924	11.4
SHY	citr_lo	3	16209	63.2	15428	60.2
SHY	citr_lo	4	7219	28.2	6406	25.0
SHY	coco_hi	1	0	0.0	0	0.0
SHY	coco_hi	2	674	2.6	674	2.6
SHY	coco_hi	3	3993	15.6	2431	9.5
SHY	coco_hi	4	20973	81.8	20429	79.7
SHY	coco_lo	1	0	0.0	0	0.0
SHY	coco_lo	2	674	2.6	674	2.6
SHY	coco_lo	3	6942	27.1	7660	29.9
SHY	coco_lo	4	18024	70.3	16657	65.0
SHY	cocn_lo	1	0	0.0	0	0.0
SHY	cocn_lo	2	674	2.6	674	2.6
SHY	cocn_lo	3	6942	27.1	7660	29.9
SHY	cocn_lo	4	18024	70.3	16657	65.0
SHY	h2cof_hi	1	2549	9.9	3265	12.7

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
MAN	rubb_lo	1	0	0.0	0	0.0
MAN	rubb_lo	2	799	38.1	676	32.2
MAN	rubb_lo	3	996	47.5	701	33.4
MAN	rubb_lo	4	303	14.4	296	14.1
MAN	vani_lo	1	0	0.0	0	0.0
MAN	vani_lo	2	799	38.1	676	32.2
MAN	vani_lo	3	996	47.5	701	33.4
MAN	vani_lo	4	303	14.4	296	14.1
NIR	card_lo	1	0	0.0	0	0.0
NIR	card_lo	2	764	7.9	501	5.2
NIR	card_lo	3	7939	82.6	8023	83.4
NIR	card_lo	4	912	9.5	1046	10.9
NIR	cash_lo	1	0	0.0	0	0.0
NIR	cash_lo	2	0	0.0	0	0.0
NIR	cash_lo	3	8703	90.5	8524	88.7
NIR	cash_lo	4	912	9.5	1046	10.9
NIR	chil_lo	1	1062	11.0	244	2.5
NIR	chil_lo	2	1938	20.2	1767	18.4
NIR	chil_lo	3	5703	59.3	6033	62.7
NIR	chil_lo	4	912	9.5	1046	10.9
NIR	citr_lo	1	599	6.2	33	0.3
NIR	citr_lo	2	2754	28.6	2222	23.1
NIR	citr_lo	3	5350	55.6	5550	57.7
NIR	citr_lo	4	912	9.5	1046	10.9
NIR	coco_hi	1	998	10.4	208	2.2
NIR	coco_hi	2	1764	18.3	1853	19.3
NIR	coco_hi	3	2113	22.0	1357	14.1
NIR	coco_hi	4	4740	49.3	5717	59.5
NIR	coco_lo	1	734	7.6	33	0.3
NIR	coco_lo	2	2402	25.0	2490	25.9
NIR	coco_lo	3	5056	52.6	5038	52.4
NIR	coco_lo	4	1423	14.8	1574	16.4
NIR	cocn_lo	1	1017	10.6	208	2.2
NIR	cocn_lo	2	2097	21.8	2315	24.1
NIR	cocn_lo	3	5078	52.8	5038	52.4
NIR	cocn_lo	4	1423	14.8	1574	16.4
NIR	h2cof_hi	1	0	0.0	0	0.0

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
SHY	h2cof_hi	2	867	3.4	209	0.8
SHY	h2cof_hi	3	0	0.0	77	0.3
SHY	h2cof_hi	4	22224	86.7	22089	86.2
SHY	h2cof_lo	1	2444	9.5	3265	12.7
SHY	h2cof_lo	2	3796	14.8	3528	13.8
SHY	h2cof_lo	3	0	0.0	639	2.5
SHY	h2cof_lo	4	19400	75.7	18208	71.0
SHY	rcof_hi	1	0	0.0	0	0.0
SHY	rcof_hi	2	72	0.3	51	0.2
SHY	rcof_hi	3	8599	33.5	6640	25.9
SHY	rcof_hi	4	16969	66.2	16768	65.4
SHY	rcof_lo	1	0	0.0	0	0.0
SHY	rcof_lo	2	451	1.8	408	1.6
SHY	rcof_lo	3	13429	52.4	14657	57.2
SHY	rcof_lo	4	11760	45.9	9748	38.0
SHY	maiz_hi	1	0	0.0	0	0.0
SHY	maiz_hi	2	744	2.9	628	2.4
SHY	maiz_hi	3	3336	13.0	3535	13.8
SHY	maiz_hi	4	21560	84.1	21477	83.8
SHY	mang_lo	1	0	0.0	0	0.0
SHY	mang_lo	2	0	0.0	0	0.0
SHY	mang_lo	3	17596	68.6	18524	72.2
SHY	mang_lo	4	8044	31.4	6406	25.0
SHY	oilp_hi	1	0	0.0	529	2.1
SHY	oilp_hi	2	529	2.1	145	0.6
SHY	oilp_hi	3	145	0.6	2838	11.1
SHY	oilp_hi	4	24966	97.4	19997	78.0
SHY	oilp_lo	1	0	0.0	0	0.0
SHY	oilp_lo	2	674	2.6	674	2.6
SHY	oilp_lo	3	7333	28.6	8042	31.4
SHY	oilp_lo	4	17633	68.8	16250	63.4
SHY	pepp_lo	1	0	0.0	0	0.0
SHY	pepp_lo	2	674	2.6	674	2.6
SHY	pepp_lo	3	6942	27.1	7660	29.9
SHY	pepp_lo	4	18024	70.3	16657	65.0
SHY	pine_lo	1	0	0.0	0	0.0
SHY	pine_lo	2	2360	9.2	3357	13.1
SHY	pine_lo	3	14302	55.8	13526	52.8

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
NIR	h2cof_hi	2	0	0.0	483	5.0
NIR	h2cof_hi	3	483	5.0	0	0.0
NIR	h2cof_hi	4	9132	95.0	9132	95.0
NIR	h2cof_lo	1	0	0.0	483	5.0
NIR	h2cof_lo	2	458	4.8	1138	11.8
NIR	h2cof_lo	3	1922	20.0	0	0.0
NIR	h2cof_lo	4	7235	75.2	7994	83.1
NIR	rcof_hi	1	0	0.0	0	0.0
NIR	rcof_hi	2	2722	28.3	2252	23.4
NIR	rcof_hi	3	2181	22.7	1407	14.6
NIR	rcof_hi	4	4712	49.0	5672	59.0
NIR	rcof_lo	1	0	0.0	0	0.0
NIR	rcof_lo	2	3339	34.7	2918	30.3
NIR	rcof_lo	3	5339	55.5	5606	58.3
NIR	rcof_lo	4	937	9.7	1046	10.9
NIR	maiz_hi	1	0	0.0	0	0.0
NIR	maiz_hi	2	1322	13.7	1754	18.2
NIR	maiz_hi	3	1019	10.6	276	2.9
NIR	maiz_hi	4	7274	75.7	7105	73.9
NIR	mang_lo	1	0	0.0	0	0.0
NIR	mang_lo	2	0	0.0	0	0.0
NIR	mang_lo	3	8703	90.5	8524	88.7
NIR	mang_lo	4	912	9.5	1046	10.9
NIR	oilp_hi	1	1448	15.1	1777	18.5
NIR	oilp_hi	2	1319	13.7	284	3.0
NIR	oilp_hi	3	2384	24.8	1992	20.7
NIR	oilp_hi	4	4464	46.4	5082	52.9
NIR	oilp_lo	1	0	0.0	0	0.0
NIR	oilp_lo	2	3389	35.2	3003	31.2
NIR	oilp_lo	3	5079	52.8	5673	59.0
NIR	oilp_lo	4	1147	11.9	939	9.8
NIR	pepp_lo	1	1002	10.4	208	2.2
NIR	pepp_lo	2	2112	22.0	2315	24.1
NIR	pepp_lo	3	5078	52.8	5038	52.4
NIR	pepp_lo	4	1423	14.8	1574	16.4
NIR	pine_lo	1	0	0.0	0	0.0
NIR	pine_lo	2	3410	35.5	2505	26.1
NIR	pine_lo	3	5318	55.3	5780	60.1

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
SHY	pine_lo	4	8978	35.0	8033	31.3
SHY	pota_hi	1	0	0.0	0	0.0
SHY	pota_hi	2	3321	13.0	3293	12.8
SHY	pota_hi	3	8865	34.6	5667	22.1
SHY	pota_hi	4	13454	52.5	14574	56.8
SHY	pyre_lo	1	0	0.0	0	0.0
SHY	pyre_lo	2	1946	7.6	369	1.4
SHY	pyre_lo	3	13125	51.2	14472	56.4
SHY	pyre_lo	4	10569	41.2	9523	37.1
SHY	rice_hi	1	0	0.0	0	0.0
SHY	rice_hi	2	1887	7.4	2924	11.4
SHY	rice_hi	3	10418	40.6	6435	25.1
SHY	rice_hi	4	13335	52.0	14150	55.2
SHY	rubb_hi	1	0	0.0	0	0.0
SHY	rubb_hi	2	1628	6.3	1531	6.0
SHY	rubb_hi	3	7043	27.5	5160	20.1
SHY	rubb_hi	4	16969	66.2	16768	65.4
SHY	rubb_lo	1	0	0.0	0	0.0
SHY	rubb_lo	2	1745	6.8	1606	6.3
SHY	rubb_lo	3	12135	47.3	13459	52.5
SHY	rubb_lo	4	11760	45.9	9748	38.0
SHY	vani_lo	1	0	0.0	0	0.0
SHY	vani_lo	2	674	2.6	674	2.6
SHY	vani_lo	3	6942	27.1	7660	29.9
SHY	vani_lo	4	18024	70.3	16657	65.0
ENG	card_lo	1	0	0.0	0	0.0
ENG	card_lo	2	1342	11.3	386	3.3
ENG	card_lo	3	3743	31.6	4095	34.6
ENG	card_lo	4	6754	57.0	6167	52.1
ENG	cash_lo	1	0	0.0	0	0.0
ENG	cash_lo	2	119	1.0	0	0.0
ENG	cash_lo	3	4966	41.9	4646	39.2
ENG	cash_lo	4	6754	57.0	6167	52.1
ENG	chil_lo	1	0	0.0	0	0.0
ENG	chil_lo	2	177	1.5	122	1.0
ENG	chil_lo	3	3639	30.7	3964	33.5
ENG	chil_lo	4	8023	67.8	6727	56.8

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
NIR	pine_lo	4	887	9.2	1046	10.9
NIR	pota_hi	1	0	0.0	0	0.0
NIR	pota_hi	2	288	3.0	0	0.0
NIR	pota_hi	3	4640	48.3	3898	40.5
NIR	pota_hi	4	4687	48.7	5672	59.0
NIR	pyre_lo	1	0	0.0	0	0.0
NIR	pyre_lo	2	0	0.0	0	0.0
NIR	pyre_lo	3	2669	27.8	2695	28.0
NIR	pyre_lo	4	6946	72.2	6875	71.5
NIR	rice_hi	1	0	0.0	0	0.0
NIR	rice_hi	2	2343	24.4	2234	23.2
NIR	rice_hi	3	2861	29.8	2299	23.9
NIR	rice_hi	4	4411	45.9	5037	52.4
NIR	rubb_hi	1	254	2.6	175	1.8
NIR	rubb_hi	2	2814	29.3	2384	24.8
NIR	rubb_hi	3	1835	19.1	1339	13.9
NIR	rubb_hi	4	4712	49.0	5672	59.0
NIR	rubb_lo	1	268	2.8	175	1.8
NIR	rubb_lo	2	3174	33.0	2846	29.6
NIR	rubb_lo	3	5236	54.5	5503	57.2
NIR	rubb_lo	4	937	9.7	1046	10.9
NIR	vani_lo	1	1062	11.0	244	2.5
NIR	vani_lo	2	2040	21.2	1852	19.3
NIR	vani_lo	3	5090	52.9	5465	56.8
NIR	vani_lo	4	1423	14.8	1574	16.4
ENB	card_lo	1	0	0.0	0	0.0
ENB	card_lo	2	264	1.7	52	0.3
ENB	card_lo	3	14054	93.0	14392	95.3
ENB	card_lo	4	791	5.2	614	4.1
ENB	cash_lo	1	0	0.0	0	0.0
ENB	cash_lo	2	772	5.1	349	2.3
ENB	cash_lo	3	13546	89.7	13552	89.7
ENB	cash_lo	4	791	5.2	614	4.1
ENB	chil_lo	1	215	1.4	30	0.2
ENB	chil_lo	2	2071	13.7	2301	15.2
ENB	chil_lo	3	12021	79.6	12113	80.2
ENB	chil_lo	4	802	5.3	614	4.1

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
ENG	citr_lo	1	0	0.0	0	0.0
ENG	citr_lo	2	1517	12.8	283	2.4
ENG	citr_lo	3	4081	34.5	5037	42.5
ENG	citr_lo	4	6241	52.7	5878	49.6
ENG	coco_hi	1	68	0.6	68	0.6
ENG	coco_hi	2	54	0.5	54	0.5
ENG	coco_hi	3	0	0.0	0	0.0
ENG	coco_hi	4	11717	99.0	11717	99.0
ENG	coco_lo	1	0	0.0	0	0.0
ENG	coco_lo	2	122	1.0	122	1.0
ENG	coco_lo	3	886	7.5	994	8.4
ENG	coco_lo	4	10831	91.5	10723	90.6
ENG	cocn_lo	1	0	0.0	0	0.0
ENG	cocn_lo	2	122	1.0	122	1.0
ENG	cocn_lo	3	886	7.5	994	8.4
ENG	cocn_lo	4	10831	91.5	10723	90.6
ENG	h2cof_hi	1	1392	11.8	386	3.3
ENG	h2cof_hi	2	337	2.8	764	6.5
ENG	h2cof_hi	3	0	0.0	120	1.0
ENG	h2cof_hi	4	10110	85.4	10569	89.3
ENG	h2cof_lo	1	1392	11.8	386	3.3
ENG	h2cof_lo	2	2119	17.9	3445	29.1
ENG	h2cof_lo	3	81	0.7	0	0.0
ENG	h2cof_lo	4	8247	69.7	7888	66.6
ENG	rcof_hi	1	0	0.0	0	0.0
ENG	rcof_hi	2	122	1.0	122	1.0
ENG	rcof_hi	3	1392	11.8	386	3.3
ENG	rcof_hi	4	10325	87.2	11331	95.7
ENG	rcof_lo	1	0	0.0	0	0.0
ENG	rcof_lo	2	258	2.2	122	1.0
ENG	rcof_lo	3	2808	23.7	3555	30.0
ENG	rcof_lo	4	8773	74.1	7394	62.5
ENG	maiz_hi	1	0	0.0	0	0.0
ENG	maiz_hi	2	229	1.9	229	1.9
ENG	maiz_hi	3	472	4.0	289	2.4
ENG	maiz_hi	4	11138	94.1	11321	95.6
ENG	mang_lo	1	0	0.0	0	0.0
ENG	mang_lo	2	119	1.0	0	0.0

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
ENB	citr_lo	1	755	5.0	602	4.0
ENB	citr_lo	2	2613	17.3	2408	15.9
ENB	citr_lo	3	10950	72.5	11485	76.0
ENB	citr_lo	4	791	5.2	614	4.1
ENB	coco_hi	1	178	1.2	25	0.2
ENB	coco_hi	2	2078	13.8	2276	15.1
ENB	coco_hi	3	5958	39.4	5930	39.2
ENB	coco_hi	4	6895	45.6	6827	45.2
ENB	coco_lo	1	183	1.2	30	0.2
ENB	coco_lo	2	2861	18.9	2928	19.4
ENB	coco_lo	3	10598	70.1	10816	71.6
ENB	coco_lo	4	1467	9.7	1284	8.5
ENB	cocn_lo	1	373	2.5	30	0.2
ENB	cocn_lo	2	2671	17.7	2928	19.4
ENB	cocn_lo	3	10598	70.1	10816	71.6
ENB	cocn_lo	4	1467	9.7	1284	8.5
ENB	h2cof_hi	1	0	0.0	480	3.2
ENB	h2cof_hi	2	433	2.9	0	0.0
ENB	h2cof_hi	3	42	0.3	0	0.0
ENB	h2cof_hi	4	14634	96.9	14629	96.8
ENB	h2cof_lo	1	0	0.0	480	3.2
ENB	h2cof_lo	2	427	2.8	2309	15.3
ENB	h2cof_lo	3	2357	15.6	0	0.0
ENB	h2cof_lo	4	12325	81.6	12320	81.5
ENB	rcof_hi	1	262	1.7	0	0.0
ENB	rcof_hi	2	2024	13.4	2331	15.4
ENB	rcof_hi	3	6551	43.4	6570	43.5
ENB	rcof_hi	4	6272	41.5	6157	40.8
ENB	rcof_lo	1	799	5.3	55	0.4
ENB	rcof_lo	2	2351	15.6	2103	13.9
ENB	rcof_lo	3	11115	73.6	11434	75.7
ENB	rcof_lo	4	844	5.6	614	4.1
ENB	maiz_hi	1	79	0.5	0	0.0
ENB	maiz_hi	2	415	2.7	437	2.9
ENB	maiz_hi	3	1467	9.7	929	6.1
ENB	maiz_hi	4	13148	87.0	13383	88.6
ENB	mang_lo	1	70	0.5	70	0.5
ENB	mang_lo	2	702	4.6	279	1.8

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
ENG	mang_lo	3	4966	41.9	4646	39.2
ENG	mang_lo	4	6754	57.0	6167	52.1
ENG	oilp_hi	1	68	0.6	68	0.6
ENG	oilp_hi	2	54	0.5	54	0.5
ENG	oilp_hi	3	0	0.0	0	0.0
ENG	oilp_hi	4	11717	99.0	11717	99.0
ENG	oilp_lo	1	0	0.0	0	0.0
ENG	oilp_lo	2	122	1.0	122	1.0
ENG	oilp_lo	3	839	7.1	947	8.0
ENG	oilp_lo	4	10878	91.9	10770	91.0
ENG	pepp_lo	1	0	0.0	0	0.0
ENG	pepp_lo	2	122	1.0	122	1.0
ENG	pepp_lo	3	886	7.5	994	8.4
ENG	pepp_lo	4	10831	91.5	10723	90.6
ENG	pine_lo	1	0	0.0	0	0.0
ENG	pine_lo	2	283	2.4	283	2.4
ENG	pine_lo	3	4002	33.8	5107	43.1
ENG	pine_lo	4	7554	63.8	6359	53.7
ENG	pota_hi	1	15	0.1	0	0.0
ENG	pota_hi	2	912	7.7	481	4.1
ENG	pota_hi	3	3872	32.7	4013	33.9
ENG	pota_hi	4	7040	59.5	7255	61.3
ENG	pyre_lo	1	0	0.0	0	0.0
ENG	pyre_lo	2	872	7.4	481	4.1
ENG	pyre_lo	3	6881	58.1	8894	75.1
ENG	pyre_lo	4	4086	34.5	1752	14.8
ENG	rice_hi	1	0	0.0	0	0.0
ENG	rice_hi	2	229	1.9	229	1.9
ENG	rice_hi	3	3530	29.8	4515	38.1
ENG	rice_hi	4	8080	68.2	7005	59.2
ENG	rubb_hi	1	0	0.0	0	0.0
ENG	rubb_hi	2	122	1.0	122	1.0
ENG	rubb_hi	3	1392	11.8	386	3.3
ENG	rubb_hi	4	10325	87.2	11331	95.7
ENG	rubb_lo	1	0	0.0	0	0.0
ENG	rubb_lo	2	258	2.2	122	1.0
ENG	rubb_lo	3	2808	23.7	3555	30.0
ENG	rubb_lo	4	8773	74.1	7394	62.5

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
ENB	mang_lo	3	13546	89.7	13552	89.7
ENB	mang_lo	4	791	5.2	614	4.1
ENB	oilp_hi	1	816	5.4	723	4.8
ENB	oilp_hi	2	1737	11.5	1888	12.5
ENB	oilp_hi	3	0	0.0	6140	40.6
ENB	oilp_hi	4	12556	83.1	6307	41.7
ENB	oilp_lo	1	382	2.5	389	2.6
ENB	oilp_lo	2	2952	19.5	2849	18.9
ENB	oilp_lo	3	10874	72.0	11056	73.2
ENB	oilp_lo	4	901	6.0	764	5.1
ENB	pepp_lo	1	373	2.5	30	0.2
ENB	pepp_lo	2	2601	17.2	2858	18.9
ENB	pepp_lo	3	10668	70.6	10886	72.0
ENB	pepp_lo	4	1467	9.7	1284	8.5
ENB	pine_lo	1	324	2.1	30	0.2
ENB	pine_lo	2	2103	13.9	2419	16.0
ENB	pine_lo	3	11888	78.7	12009	79.5
ENB	pine_lo	4	794	5.3	600	4.0
ENB	pota_hi	1	0	0.0	0	0.0
ENB	pota_hi	2	0	0.0	0	0.0
ENB	pota_hi	3	8879	58.8	8901	58.9
ENB	pota_hi	4	6230	41.2	6157	40.8
ENB	pyre_lo	1	0	0.0	0	0.0
ENB	pyre_lo	2	0	0.0	0	0.0
ENB	pyre_lo	3	5871	38.9	5876	38.9
ENB	pyre_lo	4	9238	61.1	9233	61.1
ENB	rice_hi	1	292	1.9	30	0.2
ENB	rice_hi	2	1692	11.2	1365	9.0
ENB	rice_hi	3	7461	49.4	7141	47.3
ENB	rice_hi	4	5664	37.5	5637	37.3
ENB	rubb_hi	1	0	0.0	0	0.0
ENB	rubb_hi	2	2286	15.1	2331	15.4
ENB	rubb_hi	3	6551	43.4	6570	43.5
ENB	rubb_hi	4	6272	41.5	6157	40.8
ENB	rubb_lo	1	0	0.0	0	0.0
ENB	rubb_lo	2	3150	20.8	3010	19.9
ENB	rubb_lo	3	11115	73.6	11434	75.7
ENB	rubb_lo	4	844	5.6	614	4.1

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
ENG	vani_lo	1	0	0.0	0	0.0
ENG	vani_lo	2	122	1.0	122	1.0
ENG	vani_lo	3	886	7.5	994	8.4
ENG	vani_lo	4	10831	91.5	10723	90.6
WHY	card_lo	1	41	0.5	18	0.2
WHY	card_lo	2	2680	30.1	319	3.6
WHY	card_lo	3	4207	47.3	5847	65.7
WHY	card_lo	4	1969	22.1	1481	16.6
WHY	cash_lo	1	0	0.0	0	0.0
WHY	cash_lo	2	154	1.7	0	0.0
WHY	cash_lo	3	6774	76.1	6652	74.8
WHY	cash_lo	4	1969	22.1	1481	16.6
WHY	chil_lo	1	0	0.0	0	0.0
WHY	chil_lo	2	1256	14.1	657	7.4
WHY	chil_lo	3	3889	43.7	3145	35.3
WHY	chil_lo	4	3752	42.2	3014	33.9
WHY	citr_lo	1	0	0.0	0	0.0
WHY	citr_lo	2	3230	36.3	1849	20.8
WHY	citr_lo	3	3832	43.1	4305	48.4
WHY	citr_lo	4	1835	20.6	1426	16.0
WHY	coco_hi	1	192	2.2	192	2.2
WHY	coco_hi	2	172	1.9	128	1.4
WHY	coco_hi	3	791	8.9	273	3.1
WHY	coco_hi	4	7742	87.0	7398	83.2
WHY	coco_lo	1	0	0.0	0	0.0
WHY	coco_lo	2	364	4.1	320	3.6
WHY	coco_lo	3	1496	16.8	1549	17.4
WHY	coco_lo	4	7037	79.1	6943	78.0
WHY	cocn_lo	1	0	0.0	0	0.0
WHY	cocn_lo	2	364	4.1	320	3.6
WHY	cocn_lo	3	1496	16.8	1549	17.4
WHY	cocn_lo	4	7037	79.1	6943	78.0
WHY	h2cof_hi	1	2226	25.0	1406	15.8
WHY	h2cof_hi	2	777	8.7	870	9.8
WHY	h2cof_hi	3	0	0.0	0	0.0
WHY	h2cof_hi	4	5894	66.2	6265	70.4
WHY	h2cof_lo	1	2080	23.4	1351	15.2

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
ENB	vani_lo	1	405	2.7	30	0.2
ENB	vani_lo	2	2639	17.5	2619	17.3
ENB	vani_lo	3	10598	70.1	10816	71.6
ENB	vani_lo	4	1467	9.7	1284	8.5
WNB	card_lo	1	0	0.0	0	0.0
WNB	card_lo	2	391	1.9	0	0.0
WNB	card_lo	3	17176	83.0	17031	82.3
WNB	card_lo	4	3129	15.1	3162	15.3
WNB	cash_lo	1	0	0.0	0	0.0
WNB	cash_lo	2	102	0.5	0	0.0
WNB	cash_lo	3	17465	84.4	17031	82.3
WNB	cash_lo	4	3129	15.1	3162	15.3
WNB	chil_lo	1	46	0.2	0	0.0
WNB	chil_lo	2	3403	16.4	3377	16.3
WNB	chil_lo	3	13853	66.9	13796	66.7
WNB	chil_lo	4	3394	16.4	3162	15.3
WNB	citr_lo	1	1038	5.0	2453	11.9
WNB	citr_lo	2	8336	40.3	7068	34.2
WNB	citr_lo	3	8193	39.6	8007	38.7
WNB	citr_lo	4	3129	15.1	3162	15.3
WNB	coco_hi	1	554	2.7	724	3.5
WNB	coco_hi	2	5611	27.1	3922	19.0
WNB	coco_hi	3	2642	12.8	2640	12.8
WNB	coco_hi	4	11889	57.4	11367	54.9
WNB	coco_lo	1	37	0.2	0	0.0
WNB	coco_lo	2	8772	42.4	7839	37.9
WNB	coco_lo	3	8590	41.5	7849	37.9
WNB	coco_lo	4	3297	15.9	3320	16.0
WNB	cocn_lo	1	144	0.7	0	0.0
WNB	cocn_lo	2	8665	41.9	7839	37.9
WNB	cocn_lo	3	8590	41.5	7849	37.9
WNB	cocn_lo	4	3297	15.9	3320	16.0
WNB	h2cof_hi	1	0	0.0	29	0.1
WNB	h2cof_hi	2	39	0.2	0	0.0
WNB	h2cof_hi	3	0	0.0	0	0.0
WNB	h2cof_hi	4	20657	99.8	20667	99.9
WNB	h2cof_lo	1	0	0.0	29	0.1

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
WHY	h2cof_lo	2	3183	35.8	2899	32.6
WHY	h2cof_lo	3	0	0.0	1080	12.1
WHY	h2cof_lo	4	3634	40.8	3211	36.1
WHY	rcof_hi	1	0	0.0	0	0.0
WHY	rcof_hi	2	510	5.7	443	5.0
WHY	rcof_hi	3	2871	32.3	1556	17.5
WHY	rcof_hi	4	5516	62.0	5636	63.3
WHY	rcof_lo	1	0	0.0	0	0.0
WHY	rcof_lo	2	1075	12.1	443	5.0
WHY	rcof_lo	3	3572	40.1	4924	55.3
WHY	rcof_lo	4	4250	47.8	2884	32.4
WHY	maiz_hi	1	0	0.0	0	0.0
WHY	maiz_hi	2	451	5.1	451	5.1
WHY	maiz_hi	3	1073	12.1	772	8.7
WHY	maiz_hi	4	7373	82.9	7674	86.3
WHY	mang_lo	1	0	0.0	0	0.0
WHY	mang_lo	2	154	1.7	0	0.0
WHY	mang_lo	3	6774	76.1	6652	74.8
WHY	mang_lo	4	1969	22.1	1481	16.6
WHY	oilp_hi	1	257	2.9	257	2.9
WHY	oilp_hi	2	172	1.9	128	1.4
WHY	oilp_hi	3	726	8.2	208	2.3
WHY	oilp_hi	4	7742	87.0	7398	83.2
WHY	oilp_lo	1	0	0.0	0	0.0
WHY	oilp_lo	2	429	4.8	385	4.3
WHY	oilp_lo	3	1308	14.7	1382	15.5
WHY	oilp_lo	4	7160	80.5	7045	79.2
WHY	pepp_lo	1	0	0.0	0	0.0
WHY	pepp_lo	2	364	4.1	320	3.6
WHY	pepp_lo	3	1496	16.8	1549	17.4
WHY	pepp_lo	4	7037	79.1	6943	78.0
WHY	pine_lo	1	0	0.0	0	0.0
WHY	pine_lo	2	1266	14.2	667	7.5
WHY	pine_lo	3	4013	45.1	3750	42.1
WHY	pine_lo	4	3618	40.7	2959	33.3
WHY	pota_hi	1	0	0.0	0	0.0
WHY	pota_hi	2	1378	15.5	966	10.9
WHY	pota_hi	3	3438	38.6	2289	25.7

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
WNB	h2cof_lo	2	29	0.1	1810	8.7
WNB	h2cof_lo	3	1800	8.7	0	0.0
WNB	h2cof_lo	4	18867	91.2	18857	91.1
WNB	rcof_hi	1	0	0.0	0	0.0
WNB	rcof_hi	2	3449	16.7	3377	16.3
WNB	rcof_hi	3	5397	26.1	5620	27.2
WNB	rcof_hi	4	11850	57.3	11338	54.8
WNB	rcof_lo	1	49	0.2	0	0.0
WNB	rcof_lo	2	6253	30.2	6330	30.6
WNB	rcof_lo	3	11237	54.3	11069	53.5
WNB	rcof_lo	4	3157	15.3	3162	15.3
WNB	maiz_hi	1	0	0.0	0	0.0
WNB	maiz_hi	2	3236	15.6	1656	8.0
WNB	maiz_hi	3	2240	10.8	2860	13.8
WNB	maiz_hi	4	15220	73.5	14498	70.1
WNB	mang_lo	1	0	0.0	0	0.0
WNB	mang_lo	2	102	0.5	0	0.0
WNB	mang_lo	3	17465	84.4	17031	82.3
WNB	mang_lo	4	3129	15.1	3162	15.3
WNB	oilp_hi	1	2551	12.3	1703	8.2
WNB	oilp_hi	2	3782	18.3	3019	14.6
WNB	oilp_hi	3	3871	18.7	4878	23.6
WNB	oilp_hi	4	10492	50.7	10263	49.6
WNB	oilp_lo	1	74	0.4	0	0.0
WNB	oilp_lo	2	8927	43.1	7900	38.2
WNB	oilp_lo	3	9535	46.1	10078	48.7
WNB	oilp_lo	4	2160	10.4	2211	10.7
WNB	pepp_lo	1	144	0.7	0	0.0
WNB	pepp_lo	2	8665	41.9	7839	37.9
WNB	pepp_lo	3	8590	41.5	7849	37.9
WNB	pepp_lo	4	3297	15.9	3320	16.0
WNB	pine_lo	1	0	0.0	0	0.0
WNB	pine_lo	2	3475	16.8	3391	16.4
WNB	pine_lo	3	14094	68.1	14823	71.6
WNB	pine_lo	4	3127	15.1	2127	10.3
WNB	pota_hi	1	0	0.0	0	0.0
WNB	pota_hi	2	0	0.0	0	0.0
WNB	pota_hi	3	8874	42.9	8855	42.8

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
WHY	pota_hi	4	4081	45.9	3160	35.5
WHY	pyre_lo	1	0	0.0	0	0.0
WHY	pyre_lo	2	486	5.5	629	7.1
WHY	pyre_lo	3	4776	53.7	3788	42.6
WHY	pyre_lo	4	3635	40.9	2892	32.5
WHY	rice_hi	1	0	0.0	0	0.0
WHY	rice_hi	2	1435	16.1	565	6.4
WHY	rice_hi	3	3867	43.5	2288	25.7
WHY	rice_hi	4	3595	40.4	3002	33.7
WHY	rubb_hi	1	0	0.0	0	0.0
WHY	rubb_hi	2	510	5.7	443	5.0
WHY	rubb_hi	3	2871	32.3	1556	17.5
WHY	rubb_hi	4	5516	62.0	5636	63.3
WHY	rubb_lo	1	0	0.0	0	0.0
WHY	rubb_lo	2	1075	12.1	443	5.0
WHY	rubb_lo	3	3572	40.1	4924	55.3
WHY	rubb_lo	4	4250	47.8	2884	32.4
WHY	vani_lo	1	0	0.0	0	0.0
WHY	vani_lo	2	364	4.1	320	3.6
WHY	vani_lo	3	1496	16.8	1549	17.4
WHY	vani_lo	4	7037	79.1	6943	78.0
SIM	card_lo	1	131	2.2	131	2.2
SIM	card_lo	2	2080	34.5	1258	20.9
SIM	card_lo	3	2790	46.3	3323	55.2
SIM	card_lo	4	1021	17.0	1011	16.8
SIM	cash_lo	1	0	0.0	0	0.0
SIM	cash_lo	2	325	5.4	86	1.4
SIM	cash_lo	3	4676	77.6	4925	81.8
SIM	cash_lo	4	1021	17.0	1011	16.8
SIM	chil_lo	1	0	0.0	0	0.0
SIM	chil_lo	2	310	5.1	184	3.1
SIM	chil_lo	3	3186	52.9	4184	69.5
SIM	chil_lo	4	2526	41.9	1355	22.5
SIM	citr_lo	1	0	0.0	0	0.0
SIM	citr_lo	2	764	12.7	600	10.0
SIM	citr_lo	3	4237	70.4	4411	73.2
SIM	citr_lo	4	1021	17.0	1011	16.8

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
WNB	pota_hi	4	11822	57.1	11209	54.2
WNB	pyre_lo	1	0	0.0	0	0.0
WNB	pyre_lo	2	0	0.0	0	0.0
WNB	pyre_lo	3	2168	10.5	2178	10.5
WNB	pyre_lo	4	18528	89.5	18518	89.5
WNB	rice_hi	1	0	0.0	0	0.0
WNB	rice_hi	2	5439	26.3	3598	17.4
WNB	rice_hi	3	4837	23.4	5883	28.4
WNB	rice_hi	4	10420	50.3	10095	48.8
WNB	rubb_hi	1	0	0.0	0	0.0
WNB	rubb_hi	2	6165	29.8	4646	22.4
WNB	rubb_hi	3	2681	13.0	2669	12.9
WNB	rubb_hi	4	11850	57.3	11338	54.8
WNB	rubb_lo	1	0	0.0	0	0.0
WNB	rubb_lo	2	9190	44.4	7839	37.9
WNB	rubb_lo	3	8349	40.3	7878	38.1
WNB	rubb_lo	4	3157	15.3	3162	15.3
WNB	vani_lo	1	144	0.7	0	0.0
WNB	vani_lo	2	8665	41.9	7839	37.9
WNB	vani_lo	3	8590	41.5	7849	37.9
WNB	vani_lo	4	3297	15.9	3320	16.0
NSL	card_lo	1	0	0.0	0	0.0
NSL	card_lo	2	1015	10.9	267	2.9
NSL	card_lo	3	6782	72.7	7292	78.2
NSL	card_lo	4	1532	16.4	744	8.0
NSL	cash_lo	1	0	0.0	0	0.0
NSL	cash_lo	2	0	0.0	0	0.0
NSL	cash_lo	3	7797	83.6	7991	85.7
NSL	cash_lo	4	1532	16.4	744	8.0
NSL	chil_lo	1	494	5.3	0	0.0
NSL	chil_lo	2	1619	17.4	2789	29.9
NSL	chil_lo	3	5484	58.8	5092	54.6
NSL	chil_lo	4	1732	18.6	1226	13.1
NSL	citr_lo	1	792	8.5	0	0.0
NSL	citr_lo	2	4137	44.3	4874	52.2
NSL	citr_lo	3	2868	30.7	2376	25.5
NSL	citr_lo	4	1532	16.4	744	8.0

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
SIM	coco_hi	1	0	0.0	0	0.0
SIM	coco_hi	2	40	0.7	40	0.7
SIM	coco_hi	3	1081	18.0	1081	18.0
SIM	coco_hi	4	4901	81.4	4901	81.4
SIM	coco_lo	1	0	0.0	0	0.0
SIM	coco_lo	2	122	2.0	87	1.4
SIM	coco_lo	3	1730	28.7	1907	31.7
SIM	coco_lo	4	4170	69.2	3987	66.2
SIM	cocn_lo	1	0	0.0	0	0.0
SIM	cocn_lo	2	122	2.0	87	1.4
SIM	cocn_lo	3	1730	28.7	1907	31.7
SIM	cocn_lo	4	4170	69.2	3987	66.2
SIM	h2cof_hi	1	491	8.2	136	2.3
SIM	h2cof_hi	2	113	1.9	0	0.0
SIM	h2cof_hi	3	0	0.0	0	0.0
SIM	h2cof_hi	4	5418	90.0	5587	92.8
SIM	h2cof_lo	1	373	6.2	76	1.3
SIM	h2cof_lo	2	996	16.5	2268	37.7
SIM	h2cof_lo	3	0	0.0	0	0.0
SIM	h2cof_lo	4	4653	77.3	3678	61.1
SIM	rcof_hi	1	0	0.0	0	0.0
SIM	rcof_hi	2	165	2.7	165	2.7
SIM	rcof_hi	3	1884	31.3	1305	21.7
SIM	rcof_hi	4	3973	66.0	4000	66.4
SIM	rcof_lo	1	0	0.0	0	0.0
SIM	rcof_lo	2	165	2.7	165	2.7
SIM	rcof_lo	3	3504	58.2	4085	67.8
SIM	rcof_lo	4	2353	39.1	1158	19.2
SIM	maiz_hi	1	0	0.0	0	0.0
SIM	maiz_hi	2	24	0.4	24	0.4
SIM	maiz_hi	3	677	11.2	677	11.2
SIM	maiz_hi	4	5321	88.4	5321	88.4
SIM	mang_lo	1	0	0.0	0	0.0
SIM	mang_lo	2	325	5.4	86	1.4
SIM	mang_lo	3	4676	77.6	4925	81.8
SIM	mang_lo	4	1021	17.0	1011	16.8
SIM	oilp_hi	1	0	0.0	0	0.0
SIM	oilp_hi	2	40	0.7	40	0.7

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
NSL	coco_hi	1	1153	12.4	0	0.0
NSL	coco_hi	2	1344	14.4	2567	27.5
NSL	coco_hi	3	4098	43.9	3102	33.3
NSL	coco_hi	4	2734	29.3	2027	21.7
NSL	coco_lo	1	494	5.3	0	0.0
NSL	coco_lo	2	4514	48.4	4700	50.4
NSL	coco_lo	3	2413	25.9	2312	24.8
NSL	coco_lo	4	1908	20.5	1238	13.3
NSL	cocn_lo	1	501	5.4	0	0.0
NSL	cocn_lo	2	4335	46.5	0	0.0
NSL	cocn_lo	3	2585	27.7	0	0.0
NSL	cocn_lo	4	1908	20.5	9207	98.7
NSL	h2cof_hi	1	0	0.0	0	0.0
NSL	h2cof_hi	2	100	1.1	4700	50.4
NSL	h2cof_hi	3	0	0.0	2312	24.8
NSL	h2cof_hi	4	9229	98.9	1238	13.3
NSL	h2cof_lo	1	0	0.0	0	0.0
NSL	h2cof_lo	2	100	1.1	0	0.0
NSL	h2cof_lo	3	1045	11.2	0	0.0
NSL	h2cof_lo	4	8184	87.7	9207	98.7
NSL	rcof_hi	1	595	6.4	0	0.0
NSL	rcof_hi	2	1366	14.6	821	8.8
NSL	rcof_hi	3	4734	50.7	0	0.0
NSL	rcof_hi	4	2634	28.2	8386	89.9
NSL	rcof_lo	1	923	9.9	0	0.0
NSL	rcof_lo	2	4054	43.5	2480	26.6
NSL	rcof_lo	3	2820	30.2	1322	14.2
NSL	rcof_lo	4	1532	16.4	5527	59.2
NSL	maiz_hi	1	492	5.3	0	0.0
NSL	maiz_hi	2	1305	14.0	0	0.0
NSL	maiz_hi	3	1443	15.5	7991	85.7
NSL	maiz_hi	4	6089	65.3	744	8.0
NSL	mang_lo	1	0	0.0	0	0.0
NSL	mang_lo	2	0	0.0	2480	26.6
NSL	mang_lo	3	7797	83.6	1322	14.2
NSL	mang_lo	4	1532	16.4	5527	59.2
NSL	oilp_hi	1	2185	23.4	0	0.0
NSL	oilp_hi	2	685	7.3	0	0.0

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
SIM	oilp_hi	3	1081	18.0	1081	18.0
SIM	oilp_hi	4	4901	81.4	4901	81.4
SIM	oilp_lo	1	0	0.0	0	0.0
SIM	oilp_lo	2	122	2.0	87	1.4
SIM	oilp_lo	3	1717	28.5	1894	31.5
SIM	oilp_lo	4	4183	69.5	4000	66.4
SIM	pepp_lo	1	0	0.0	0	0.0
SIM	pepp_lo	2	122	2.0	87	1.4
SIM	pepp_lo	3	1730	28.7	1907	31.7
SIM	pepp_lo	4	4170	69.2	3987	66.2
SIM	pine_lo	1	0	0.0	0	0.0
SIM	pine_lo	2	346	5.7	473	7.9
SIM	pine_lo	3	3150	52.3	4194	69.6
SIM	pine_lo	4	2526	41.9	1355	22.5
SIM	pota_hi	1	0	0.0	0	0.0
SIM	pota_hi	2	150	2.5	150	2.5
SIM	pota_hi	3	2659	44.2	2003	33.3
SIM	pota_hi	4	3213	53.4	2103	34.9
SIM	pyre_lo	1	0	0.0	0	0.0
SIM	pyre_lo	2	188	3.1	0	0.0
SIM	pyre_lo	3	3333	55.3	4393	72.9
SIM	pyre_lo	4	2501	41.5	1330	22.1
SIM	rice_hi	1	0	0.0	0	0.0
SIM	rice_hi	2	312	5.2	439	7.3
SIM	rice_hi	3	2461	40.9	1714	28.5
SIM	rice_hi	4	3249	54.0	2256	37.5
SIM	rubb_hi	1	0	0.0	0	0.0
SIM	rubb_hi	2	582	9.7	582	9.7
SIM	rubb_hi	3	1467	24.4	888	14.7
SIM	rubb_hi	4	3973	66.0	4000	66.4
SIM	rubb_lo	1	0	0.0	0	0.0
SIM	rubb_lo	2	1589	26.4	1127	18.7
SIM	rubb_lo	3	2080	34.5	3082	51.2
SIM	rubb_lo	4	2353	39.1	1158	19.2
SIM	vani_lo	1	0	0.0	0	0.0
SIM	vani_lo	2	122	2.0	87	1.4
SIM	vani_lo	3	1730	28.7	1907	31.7
SIM	vani_lo	4	4170	69.2	3987	66.2

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
NSL	oilp_hi	3	4305	46.1	7991	85.7
NSL	oilp_hi	4	2154	23.1	744	8.0
NSL	oilp_lo	1	619	6.6	2258	24.2
NSL	oilp_lo	2	5145	55.2	309	3.3
NSL	oilp_lo	3	2109	22.6	3102	33.3
NSL	oilp_lo	4	1456	15.6	2027	21.7
NSL	pepp_lo	1	494	5.3	0	0.0
NSL	pepp_lo	2	4335	46.5	5679	60.9
NSL	pepp_lo	3	2592	27.8	2202	23.6
NSL	pepp_lo	4	1908	20.5	1348	14.4
NSL	pine_lo	1	543	5.8	0	0.0
NSL	pine_lo	2	1677	18.0	4700	50.4
NSL	pine_lo	3	5509	59.1	2312	24.8
NSL	pine_lo	4	1600	17.2	1238	13.3
NSL	pota_hi	1	0	0.0	0	0.0
NSL	pota_hi	2	0	0.0	2789	29.9
NSL	pota_hi	3	6695	71.8	5474	58.7
NSL	pota_hi	4	2634	28.2	966	10.4
NSL	pyre_lo	1	0	0.0	0	0.0
NSL	pyre_lo	2	0	0.0	0	0.0
NSL	pyre_lo	3	1814	19.4	6648	71.3
NSL	pyre_lo	4	7515	80.6	1905	20.4
NSL	rice_hi	1	595	6.4	0	0.0
NSL	rice_hi	2	1299	13.9	0	0.0
NSL	rice_hi	3	5429	58.2	1518	16.3
NSL	rice_hi	4	2006	21.5	7589	81.3
NSL	rubb_hi	1	53	0.6	0	0.0
NSL	rubb_hi	2	2656	28.5	2570	27.5
NSL	rubb_hi	3	3986	42.7	4102	44.0
NSL	rubb_hi	4	2634	28.2	1881	20.2
NSL	rubb_lo	1	53	0.6	0	0.0
NSL	rubb_lo	2	5897	63.2	2789	29.9
NSL	rubb_lo	3	1847	19.8	2880	30.9
NSL	rubb_lo	4	1532	16.4	1905	20.4
NSL	vani_lo	1	494	5.3	0	0.0
NSL	vani_lo	2	4458	47.8	5186	55.6
NSL	vani_lo	3	2469	26.5	1272	13.6
NSL	vani_lo	4	1908	20.5	744	8.0

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
EHY	card_lo	1	0	0.0	0	0.0
EHY	card_lo	2	1312	11.9	227	2.1
EHY	card_lo	3	7834	71.2	8921	81.1
EHY	card_lo	4	1860	16.9	1823	16.6
EHY	cash_lo	1	0	0.0	0	0.0
EHY	cash_lo	2	1807	16.4	509	4.6
EHY	cash_lo	3	7339	66.7	8639	78.5
EHY	cash_lo	4	1860	16.9	1823	16.6
EHY	chil_lo	1	111	1.0	111	1.0
EHY	chil_lo	2	1057	9.6	398	3.6
EHY	chil_lo	3	5973	54.3	7342	66.7
EHY	chil_lo	4	3865	35.1	2511	22.8
EHY	citr_lo	1	0	0.0	0	0.0
EHY	citr_lo	2	1968	17.9	509	4.6
EHY	citr_lo	3	7203	65.4	8639	78.5
EHY	citr_lo	4	1835	16.7	1823	16.6
EHY	coco_hi	1	5	0.0	5	0.0
EHY	coco_hi	2	111	1.0	111	1.0
EHY	coco_hi	3	98	0.9	4	0.0
EHY	coco_hi	4	10792	98.1	10886	98.9
EHY	coco_lo	1	0	0.0	0	0.0
EHY	coco_lo	2	116	1.1	116	1.1
EHY	coco_lo	3	1008	9.2	1017	9.2
EHY	coco_lo	4	9882	89.8	9873	89.7
EHY	cocn_lo	1	0	0.0	0	0.0
EHY	cocn_lo	2	116	1.1	116	1.1
EHY	cocn_lo	3	1008	9.2	1017	9.2
EHY	cocn_lo	4	9882	89.8	9873	89.7
EHY	h2cof_hi	1	3607	32.8	3446	31.3
EHY	h2cof_hi	2	650	5.9	1963	17.8
EHY	h2cof_hi	3	93	0.8	0	0.0
EHY	h2cof_hi	4	6656	60.5	3694	33.6
EHY	h2cof_lo	1	3607	32.8	3446	31.3
EHY	h2cof_lo	2	3340	30.3	2784	25.3
EHY	h2cof_lo	3	292	2.7	279	2.5
EHY	h2cof_lo	4	3767	34.2	2765	25.1
EHY	rcof_hi	1	0	0.0	0	0.0

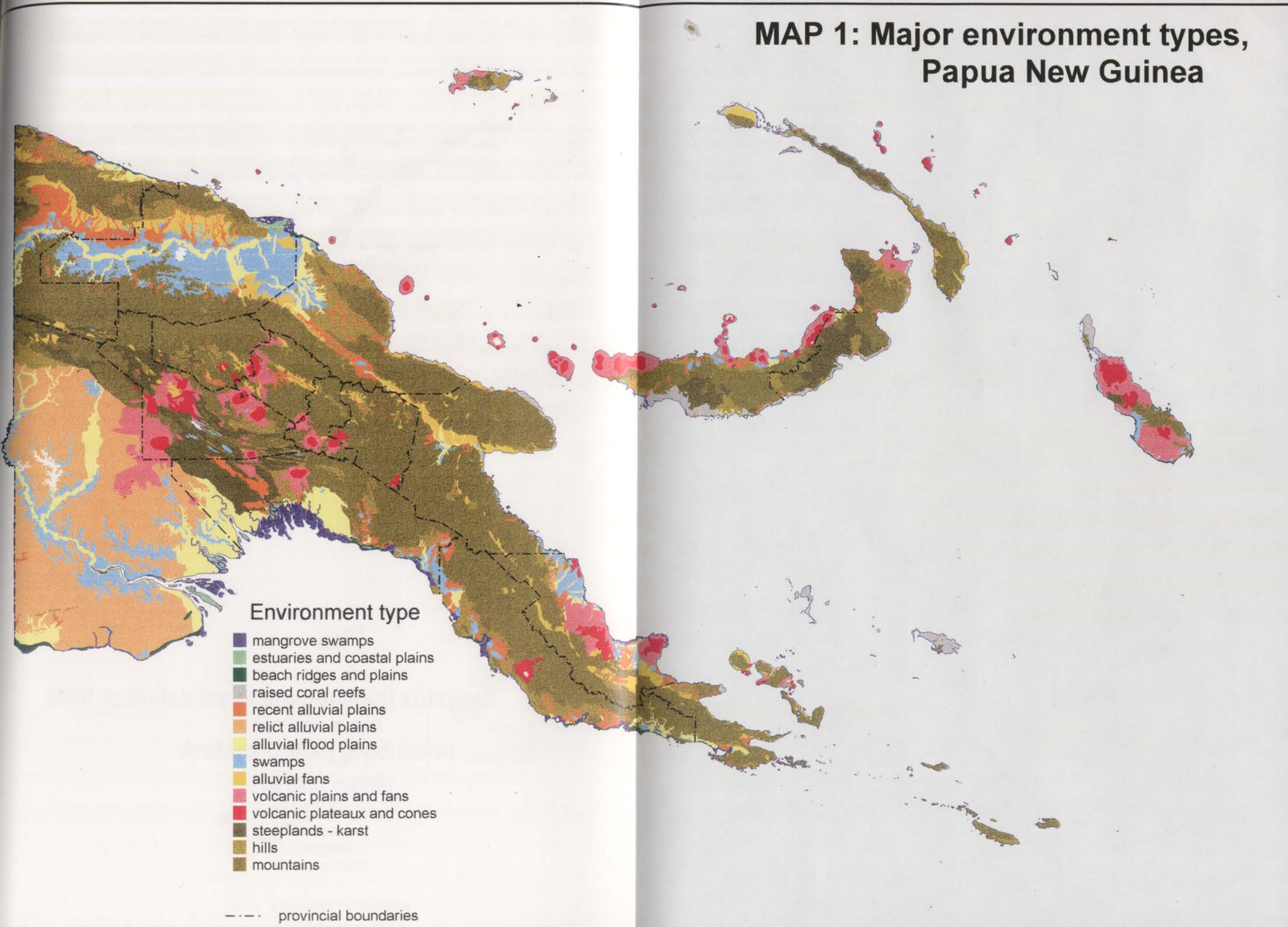
province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
ALLPNG	card_lo	1	457	0.1	434	0.1
ALLPNG	card_lo	2	20839	4.5	8629	1.9
ALLPNG	card_lo	3	280824	61.2	288833	63.0
ALLPNG	card_lo	4	156515	34.1	144639	31.5
ALLPNG	cash_lo	1	1978	0.4	1923	0.4
ALLPNG	cash_lo	2	42424	9.3	13999	3.1
ALLPNG	cash_lo	3	260174	56.7	283621	61.8
ALLPNG	cash_lo	4	154059	33.6	144399	31.5
ALLPNG	chil_lo	1	7088	1.5	2435	0.5
ALLPNG	chil_lo	2	82421	18.0	60965	13.3
ALLPNG	chil_lo	3	194413	42.4	220691	48.1
ALLPNG	chil_lo	4	174713	38.1	158861	34.6
ALLPNG	citr_lo	1	10023	2.2	8073	1.8
ALLPNG	citr_lo	2	77607	16.9	66171	14.4
ALLPNG	citr_lo	3	218831	47.7	225242	49.1
ALLPNG	citr_lo	4	152174	33.2	143920	31.4
ALLPNG	coco_hi	1	8590	1.9	7135	1.6
ALLPNG	coco_hi	2	79979	17.4	76752	16.7
ALLPNG	coco_hi	3	65394	14.3	39968	8.7
ALLPNG	coco_hi	4	304672	66.4	318611	69.5
ALLPNG	coco_lo	1	5254	1.1	3722	0.8
ALLPNG	coco_lo	2	90411	19.7	88242	19.2
ALLPNG	coco_lo	3	146153	31.9	142291	31.0
ALLPNG	coco_lo	4	216817	47.3	210995	46.0
ALLPNG	cocn_lo	1	10405	2.3	5770	1.3
ALLPNG	cocn_lo	2	103051	22.5	77352	16.9
ALLPNG	cocn_lo	3	128197	28.0	143549	31.3
ALLPNG	cocn_lo	4	216982	47.3	218964	47.7
ALLPNG	h2cof_hi	1	19274	4.2	15578	3.4
ALLPNG	h2cof_hi	2	4085	0.9	13060	2.8
ALLPNG	h2cof_hi	3	672	0.1	2570	0.6
ALLPNG	h2cof_hi	4	434604	94.8	423610	92.4
ALLPNG	h2cof_lo	1	19036	4.2	14576	3.2
ALLPNG	h2cof_lo	2	35062	7.6	51934	11.3
ALLPNG	h2cof_lo	3	8065	1.8	3669	0.8
ALLPNG	h2cof_lo	4	396472	86.4	385527	84.1
ALLPNG	rcof_hi	1	5986	1.3	2407	0.5

province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
EHY	rcof_hi	2	214	1.9	120	1.1
EHY	rcof_hi	3	3365	30.6	3121	28.4
EHY	rcof_hi	4	7427	67.5	6033	54.8
EHY	rcof_lo	1	0	0.0	0	0.0
EHY	rcof_lo	2	214	1.9	120	1.1
EHY	rcof_lo	3	5295	48.1	5490	49.9
EHY	rcof_lo	4	5497	49.9	3664	33.3
EHY	maiz_hi	1	226	2.1	233	2.1
EHY	maiz_hi	2	162	1.5	158	1.4
EHY	maiz_hi	3	827	7.5	149	1.4
EHY	maiz_hi	4	9791	89.0	10466	95.1
EHY	mang_lo	1	0	0.0	0	0.0
EHY	mang_lo	2	1807	16.4	509	4.6
EHY	mang_lo	3	7339	66.7	8639	78.5
EHY	mang_lo	4	1860	16.9	1823	16.6
EHY	oilp_hi	1	0	0.0	0	0.0
EHY	oilp_hi	2	116	1.1	116	1.1
EHY	oilp_hi	3	98	0.9	4	0.0
EHY	oilp_hi	4	10792	98.1	10886	98.9
EHY	oilp_lo	1	0	0.0	0	0.0
EHY	oilp_lo	2	116	1.1	116	1.1
EHY	oilp_lo	3	1008	9.2	1017	9.2
EHY	oilp_lo	4	9882	89.8	9873	89.7
EHY	pepp_lo	1	0	0.0	0	0.0
EHY	pepp_lo	2	111	1.0	111	1.0
EHY	pepp_lo	3	1013	9.2	1022	9.3
EHY	pepp_lo	4	9882	89.8	9873	89.7
EHY	pine_lo	1	111	1.0	111	1.0
EHY	pine_lo	2	1057	9.6	398	3.6
EHY	pine_lo	3	5998	54.5	7342	66.7
EHY	pine_lo	4	3840	34.9	2511	22.8
EHY	pota_hi	1	226	2.1	233	2.1
EHY	pota_hi	2	582	5.3	191	1.7
EHY	pota_hi	3	5246	47.7	6479	58.9
EHY	pota_hi	4	4952	45.0	4103	37.3
EHY	pyre_lo	1	0	0.0	0	0.0
EHY	pyre_lo	2	281	2.6	0	0.0
EHY	pyre_lo	3	6999	63.6	7885	71.6

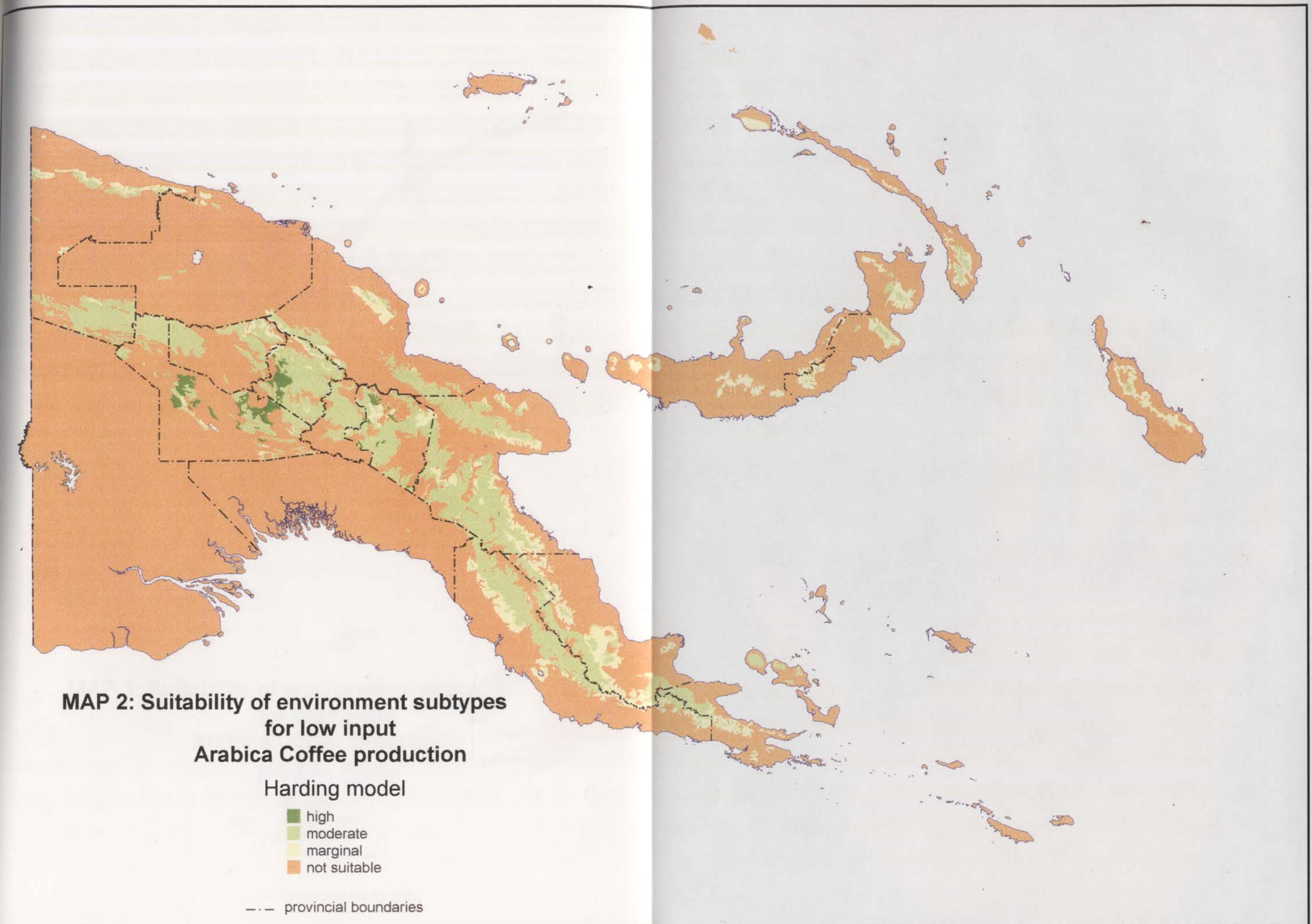
province	crop	suitability rating	RATINGS BY RMU area (km2)	RATINGS BY RMU %area	RATINGS BY MED. ENV. TYPE area (km2)	RATINGS BY MED. ENV. TYPE % area
ALLPNG	rcof_hi	2	75993	16.6	60004	13.1
ALLPNG	rcof_hi	3	95483	20.8	75904	16.5
ALLPNG	rcof_hi	4	281173	61.3	305372	66.6
ALLPNG	rcof_lo	1	8252	1.8	3135	0.7
ALLPNG	rcof_lo	2	86649	18.9	67083	14.6
ALLPNG	rcof_lo	3	184545	40.2	203465	44.4
ALLPNG	rcof_lo	4	179189	39.1	166126	36.2
ALLPNG	maiz_hi	1	6084	1.3	3522	0.8
ALLPNG	maiz_hi	2	22414	4.9	17599	3.8
ALLPNG	maiz_hi	3	79631	17.4	71401	15.6
ALLPNG	maiz_hi	4	350506	76.4	356603	77.8
ALLPNG	mang_lo	1	3953	0.9	2182	0.5
ALLPNG	mang_lo	2	40449	8.8	16058	3.5
ALLPNG	mang_lo	3	260174	56.7	276952	60.4
ALLPNG	mang_lo	4	154059	33.6	149182	32.5
ALLPNG	oilp_hi	1	19419	4.2	34972	7.6
ALLPNG	oilp_hi	2	29573	6.4	71855	15.7
ALLPNG	oilp_hi	3	108219	23.6	82664	18.0
ALLPNG	oilp_hi	4	301424	65.7	255023	55.6
ALLPNG	oilp_lo	1	9662	2.1	7783	1.7
ALLPNG	oilp_lo	2	93126	20.3	82572	18.0
ALLPNG	oilp_lo	3	184246	40.2	203469	44.4
ALLPNG	oilp_lo	4	171601	37.4	150373	32.8
ALLPNG	pepp_lo	1	5827	1.3	3025	0.7
ALLPNG	pepp_lo	2	84313	18.4	85288	18.6
ALLPNG	pepp_lo	3	130766	28.5	142800	31.1
ALLPNG	pepp_lo	4	237729	51.8	215421	47.0
ALLPNG	pine_lo	1	8005	1.7	5235	1.1
ALLPNG	pine_lo	2	88452	19.3	72125	15.7
ALLPNG	pine_lo	3	194993	42.5	218650	47.7
ALLPNG	pine_lo	4	167185	36.5	150007	32.7
ALLPNG	pota_hi	1	266	0.1	242	0.1
ALLPNG	pota_hi	2	8330	1.8	8655	1.9
ALLPNG	pota_hi	3	188066	41.0	160397	35.0
ALLPNG	pota_hi	4	261973	57.1	272158	59.3
ALLPNG	pyre_lo	1	0	0.0	0	0.0
ALLPNG	pyre_lo	2	4088	0.9	1525	0.3
ALLPNG	pyre_lo	3	93611	20.4	107611	23.5

province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
EHY	pyre_lo	4	3726	33.9	2415	21.9
EHY	rice_hi	1	5	0.0	5	0.0
EHY	rice_hi	2	1110	10.1	634	5.8
EHY	rice_hi	3	5319	48.3	6758	61.4
EHY	rice_hi	4	4572	41.5	3574	32.5
EHY	rubb_hi	1	0	0.0	0	0.0
EHY	rubb_hi	2	214	1.9	120	1.1
EHY	rubb_hi	3	3365	30.6	3121	28.4
EHY	rubb_hi	4	7427	67.5	6033	54.8
EHY	rubb_lo	1	0	0.0	0	0.0
EHY	rubb_lo	2	214	1.9	120	1.1
EHY	rubb_lo	3	5295	48.1	5490	49.9
EHY	rubb_lo	4	5497	49.9	3664	33.3
EHY	vani_lo	1	0	0.0	0	0.0
EHY	vani_lo	2	116	1.1	116	1.1
EHY	vani_lo	3	1008	9.2	1017	9.2
EHY	vani_lo	4	9882	89.8	9873	89.7

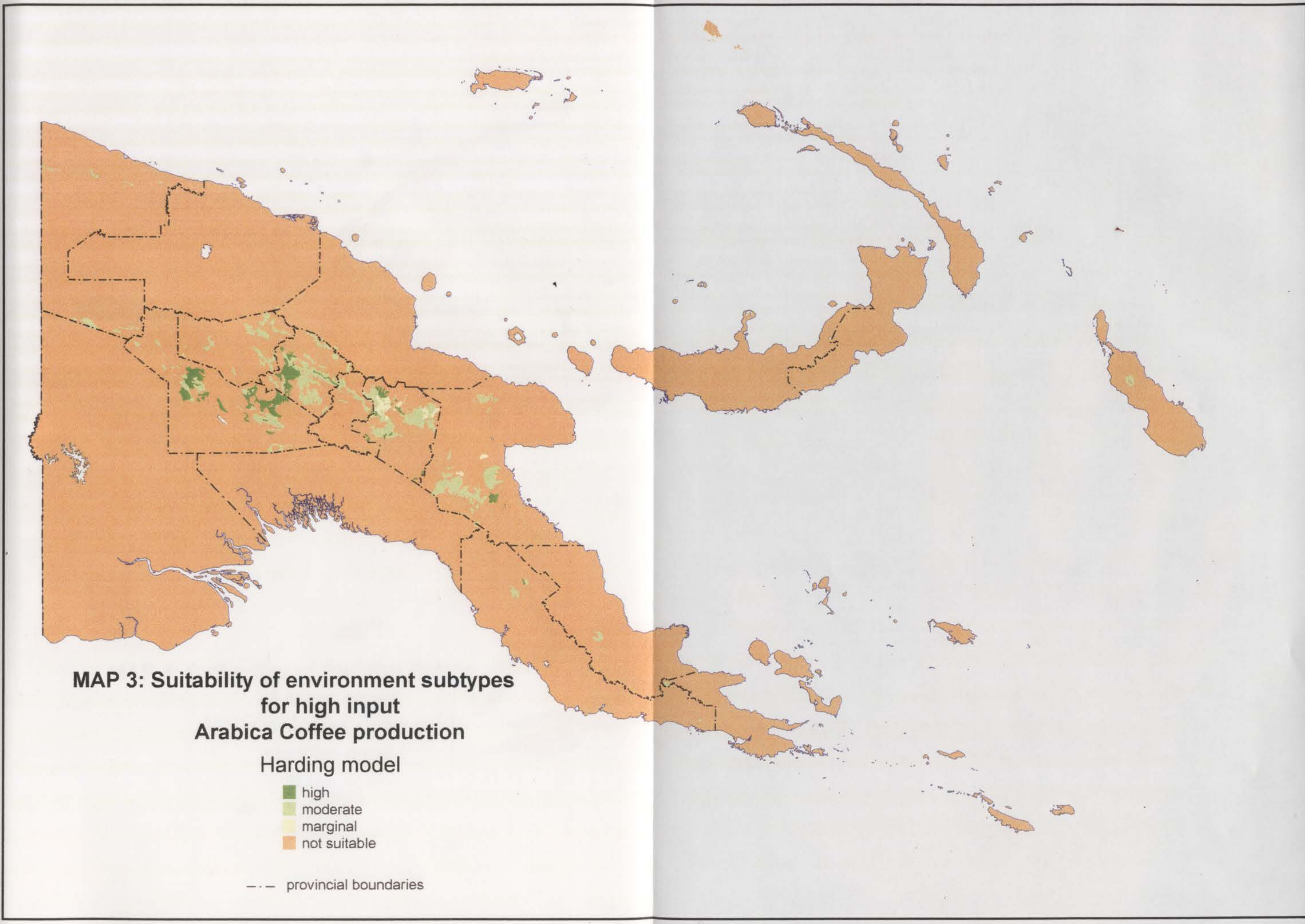
province	crop	suitability rating	RATINGS BY RMU area (km2)	%area	RATINGS BY MED. ENV. TYPE area (km2)	% area
ALLPNG	pyre_lo	4	360936	78.7	339935	74.1
ALLPNG	rice_hi	1	12268	2.7	8376	1.8
ALLPNG	rice_hi	2	51140	11.2	47016	10.3
ALLPNG	rice_hi	3	178814	39.0	167972	36.6
ALLPNG	rice_hi	4	216413	47.2	216733	47.3
ALLPNG	rubb_hi	1	927	0.2	581	0.1
ALLPNG	rubb_hi	2	110811	24.2	89061	19.4
ALLPNG	rubb_hi	3	65559	14.3	54646	11.9
ALLPNG	rubb_hi	4	281338	61.3	298867	65.2
ALLPNG	rubb_lo	1	820	0.2	581	0.1
ALLPNG	rubb_lo	2	122057	26.6	96049	20.9
ALLPNG	rubb_lo	3	156404	34.1	179332	39.1
ALLPNG	rubb_lo	4	179354	39.1	162504	35.4
ALLPNG	vani_lo	1	6235	1.4	3722	0.8
ALLPNG	vani_lo	2	88966	19.4	88107	19.2
ALLPNG	vani_lo	3	144287	31.5	141350	30.8
ALLPNG	vani_lo	4	219147	47.8	210741	45.9



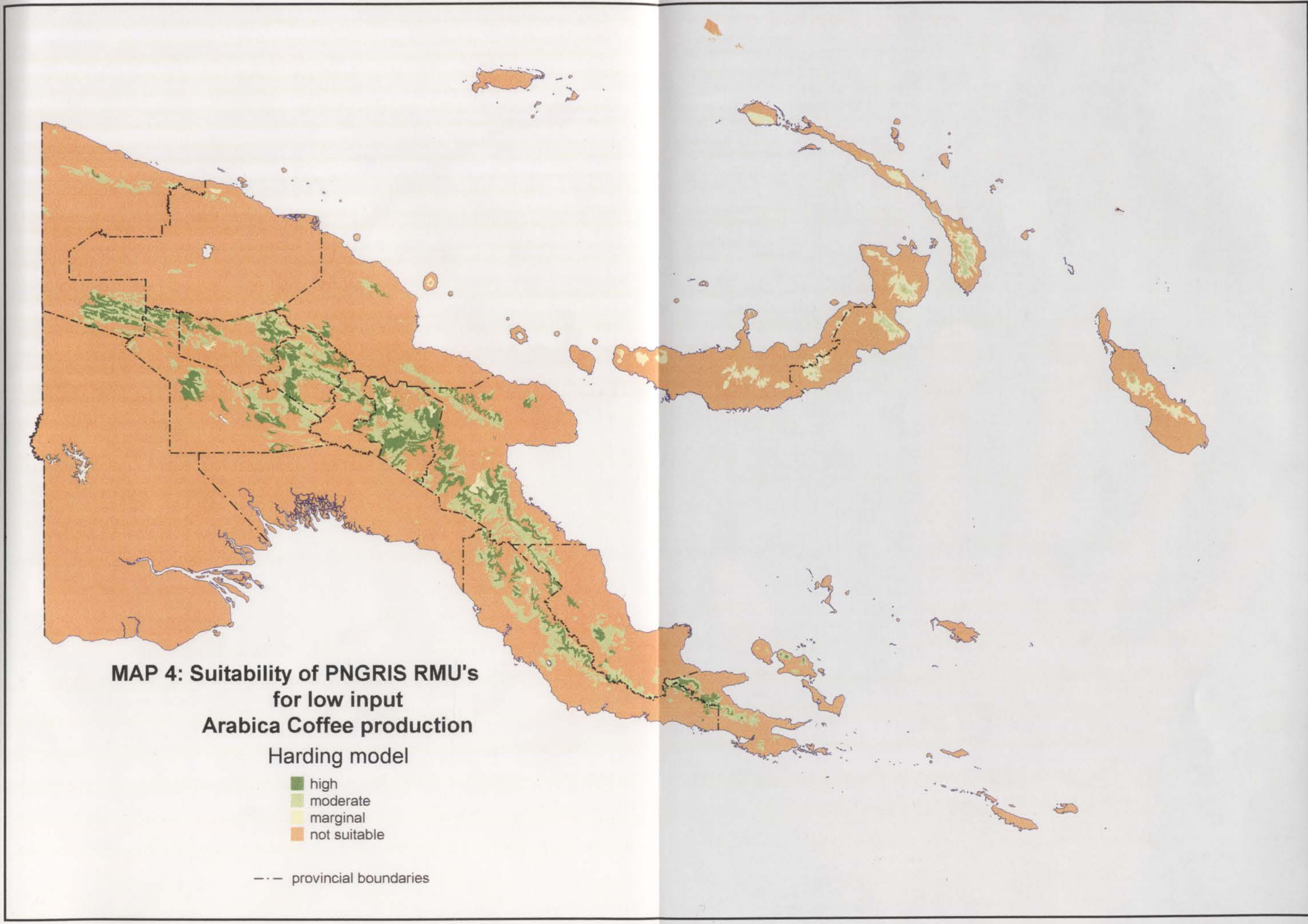
MAP 1: Major environment types, Papua New Guinea



MAP 2: Suitability of environment subtypes for low input Arabica Coffee production

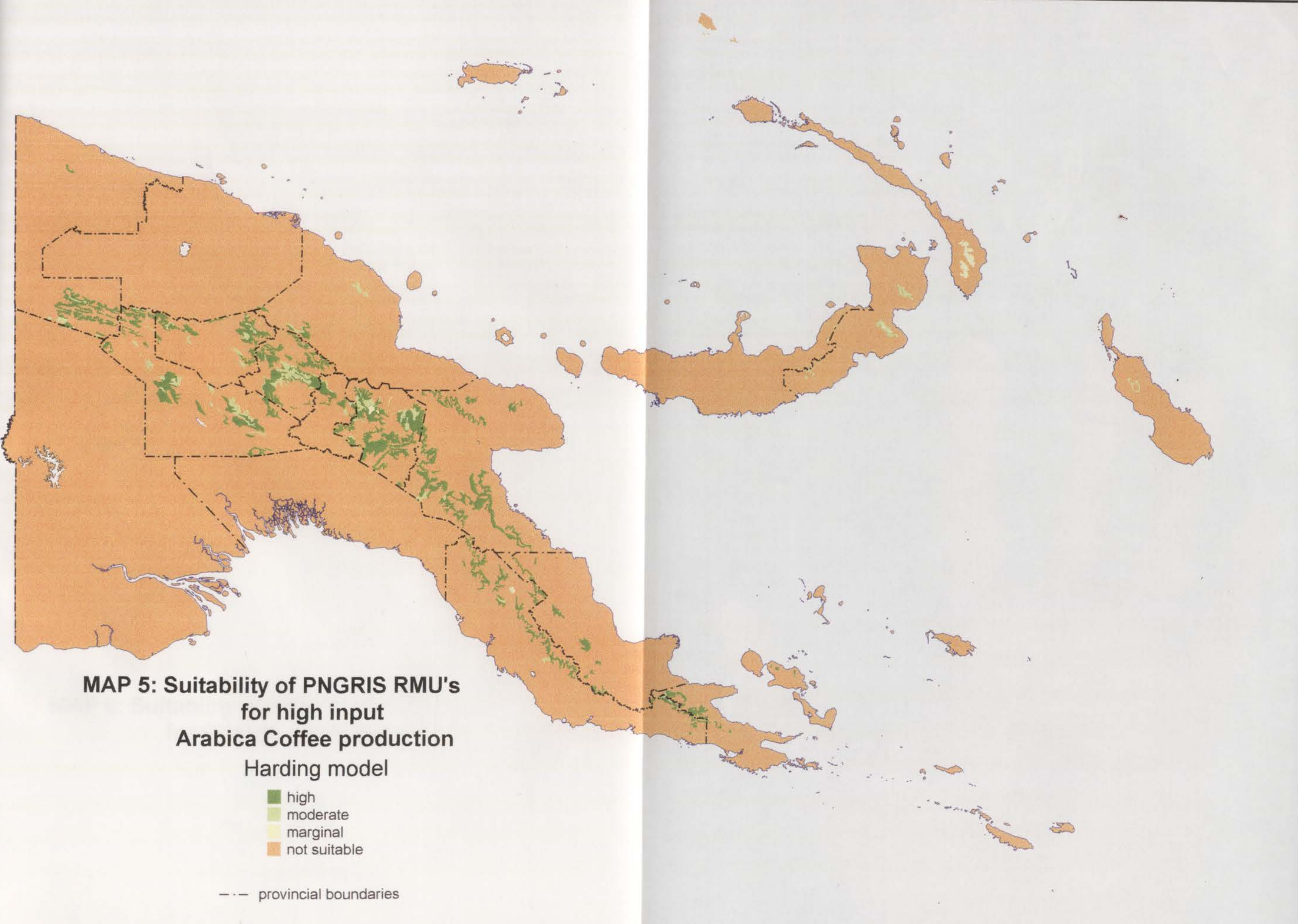


MAP 3: Suitability of environment subtypes for high input Arabica Coffee production



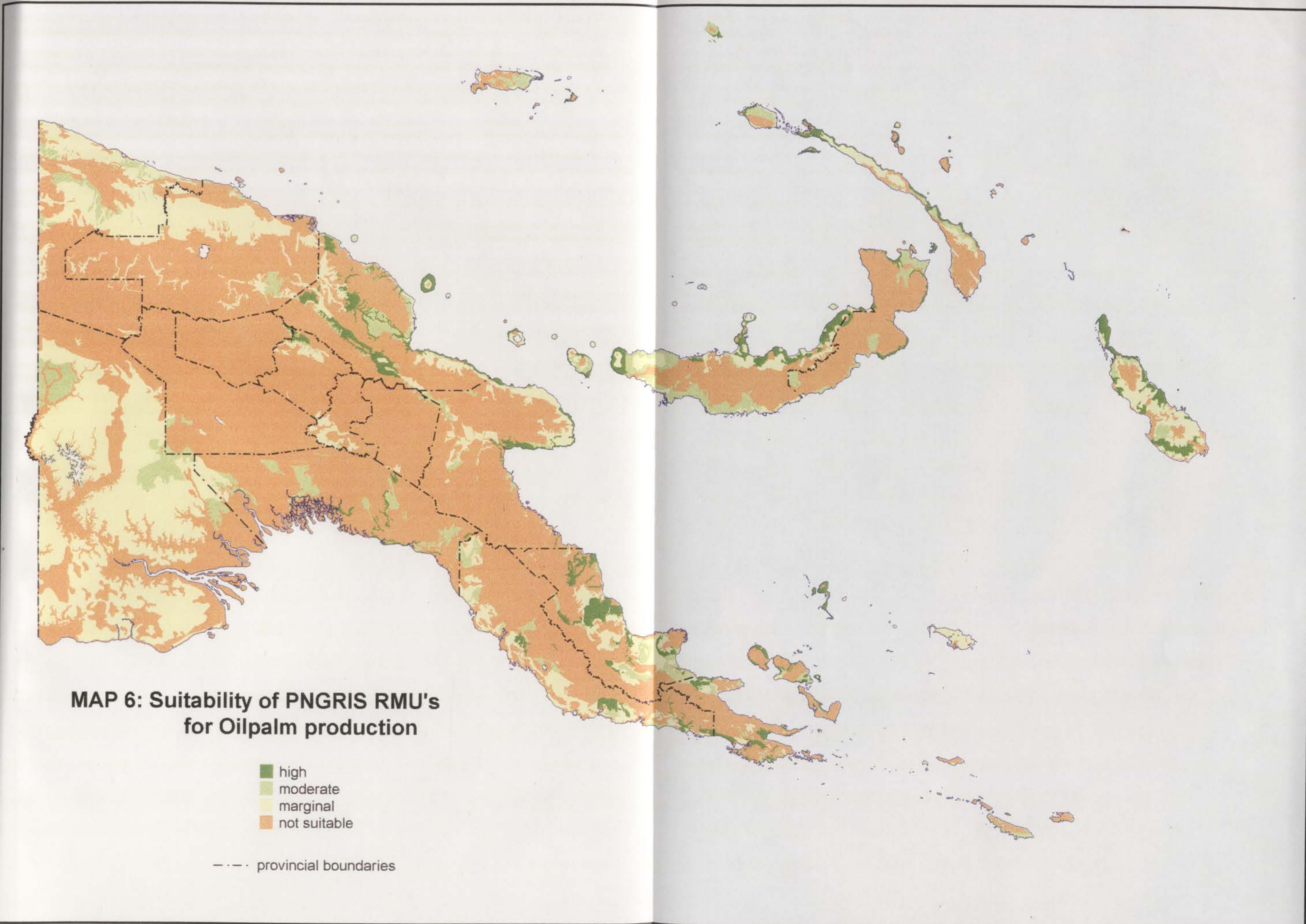
MAP 4: Suitability of PNGRIS RMU's for low input Arabica Coffee production

Harding model



MAP 5: Suitability of PNGRIS RMU's for high input Arabica Coffee production

Harding model



MAP 6: Suitability of PNGRIS RMU's for Oilpalm production

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