THE RELATIVE IMPORTANCE OF LAND QUALITY TO THE SUCCESS OF THREE COLONISATION PROJECTS IN BRAZIL

BY

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DECLARATION

This thesis has been composed by myself and it has not been submitted in any previous application for a degree. The work reported within was executed by myself unless otherwise stated.

ABSTRACT

This study assesses the importance of land quality to the success of three colonisation projects in Brazil. Two of the Projects studied are situated in the cerrado region and the other is located in the western part of the Amazon Basin. In each Project farm plots were grouped into categories based on land quality. From each category a number of farm plots were chosen with the purpose of interviewing and measuring the success of their occupants. A total of 155 colonists were interviewed and their success was assessed through indicators including material possessions, farm improvements and main forms of utilisation of their farming plots. It was not possible to detect any correlation between land quality and settlers' success or failure within any of these projects. A comparison between the three case studies (Ouro Preto, Sagarana, and Gusmão projects) indicates that the better performance of the colonists at Gusmão is due to non-land factors, particularly proximity and ease of accessibility to markets. A subjective evaluation of the achievement of the objectives of the projects led to the conclusion that the Projects have fallen short of their expectations. The major constraints to the development of the Projects appears to be related to the interacting effects of non-land factors such as inadequate road network, lack of finance and technical assistance.

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CHAPTER 1

INTRODUCTION

The Amazon and cerrado (tropical savanna) regions of Brazil cover an area of approximately 6,500,000 square kilometres (Figure 2.1). These regions comprise over 70 % of the country's total area yet, in 1970, they housed only 10 % of the total population and their contribution to the economy as a whole was relatively small (IBGE, 1975). However, in recent years, higher priority has been given to establish policies to foster the development of the Amazon and cerrado regions. The setting up of agricultural settlement schemes is one of the strategies being used.

Between 1970 and 1979 the Government official colonisation agency, the National Institute for Colonisation and Land Reform (INCRA) settled 47,736 families. In 1980 however, INCRA's target was to settle 40,000 families (INCRA, 1980). Therefore, in one single year INCRA's goal was to settle as many families as they had settled in the previous nine years.

Lewis (1964) argues that settlement schemes must fail if the areas chosen for their establishment are unsuitable, whether because of poor soil, or uncertain rainfall or their unhealthiness or for other such reason. Lewis also points out that in under-developed countries it is almost universal practice to settle the land first and to find out later what can be grown economically.

The establishment of agricultural settlement schemes involves selection of places. In the process of choosing sites the suitability of land, involving the assessment of land quality, for agricultural development has to be considered.

Land quality is defined in the framework for land evaluation (FAO, 1976) as a complex attribute of land which acts in a manner distinct from the action of other land qualities in its influence in the suitability of land for specified kind of use. The expression of each land quality is determined by a set of interacting single or compound land characteristics, having different weight in different environments depending on the values of all characteristics in the set. The land characteristic texture, soil depth, precipitation and natural vegetation are frequently used to assess the land quality 'water availability'.

The land quality referred to as soil fertility is frequently inferred from measurements in laboratory of the amount of exchangeable bases, phosphorus, potassium and other plant nutrients present in soil samples.

Beek (1978) suggests that land qualities can provide a link between land resource inventories and land use planning by identifying the properties that merit observations, measurements and classification, and by suggesting the detail of investigation needed. Authors such as Dent & Young (1981), Wambeke (1978) consider that given specific social and economic conditions, land qualities indicate whether a particular area has the potential to produce sufficiently to provide a satisfactory standard of living for those people who choose, or have no other alternative than to select that location as a place for permanent settlement, agricultural or livestock production.

The main objective of this thesis is to assess the relative importance of land quality to the success of settlers in official colonisation schemes in the Amazon and cerrado region of Brazil. The thesis comprises eight chapters. The next chapter deals with the criteria and rationale employed in the selection of the case studies. Chapter 3 comprises a physical characterisation of the areas of the case studies, including a description of the climate, soil and vegetation. The assessment of the agricultural potential of the environments studied is also included in Chapter three. In Chapter four the methodology of the case studies, including research design, definition of criteria of success stratification and sampling procedures are outlined and discussed together with data collection and analysis.

Chapters 5, 6 and 7 deal respectively with the Ouro Preto, Sagarana and Gusmão schemes which were the subject of this research. Each chapter is divided into five main sections. The first section describes the history and development of the project, the second one deals with the definition of specific land qualities used in the stratification of farming plots, the third section assesses the relationships between land quality and settlers success. In section four the achievement of the objectives of the project is evaluated and the last section summarises the conclusions.

Finally, Chapter eight is devoted to a comparative evaluation of the three case studies, and to a summary of the main conclusions.

CHAPTER 2

SELECTION OF THE CASE STUDIES

The projects were selected with a view to obtaining information on the performance of colonisation projects from as wide range of land qualities as possible in two major environments: tropical forest and tropical savanna (known in Brazil as cerrado) (Figure 2.1). The criteria employed and the rationale for the selection of the projects were the following:

1. That the project represents the work of the colonisation department of the Federal Government, i.e., the National Institute for Colonisation and Land Reform (INCRA) or its predecessor, abolished in 1970, the Brazilian Institute for Land Reform (IBRA). This was to ensure that projects were established on the basis of similar policies and resources (financial, administrative).

2. That the project is located either in the tropical forest region or in the cerrado area for two main reasons:
   a) because of the supposed differences in land quality for agriculture between the cerrado and the tropical forest regions (Chapter 3) and b) because these areas represent the current agricultural frontier. Future colonisation projects are likely to be located in these areas.

3. That the project has been in existence for at least seven years. This was considered the minimum time required to bring the land into production which a settler could work with family labour alone.

4. That the project has had its land resources surveyed. This was necessary to allow any form of interpretation of the importance of different land qualities.

In the 1970's with the tropical forest region covering approximately 4,990,000 square kilometres, 15 colonisation projects were set up by INCRA (Figure 2.2). Seven of these projects were established in the Territory of Rondonia which is located in the south western part of the Amazon Basin. Within the

tropical forest environment the Territory of Rondônia with its 243,000 square kilometres was selected to be studied for two main reasons :

a) It has large areas of relatively high fertile soils. These soils have been rated as having the highest potential for agricultural development amongst the non-alluvial soils of the entire Amazon Basin (Radam, 1978; Wambeke, 1978; Sombroek, 1966).

b) It is the region where the official government colonisation agency (INCRA) has set up the largest number of colonists on 100-hectare plots.

Furthermore, in 1977/78 a team from the University of Brasília (UnB), studying the potential of Rondônia for agricultural development, recommended the continuation of the setting up of colonisation projects to accommodate settlers on small plots (100 - 200 hectares) (Versiani, 1979). The UnB team concluded that the development of the region through the implantation of small farms, instead of large estates, was the better strategy for using the resources available.

Only one colonisation project out of the seven set up in Rondônia complied with the four criteria outlined above. This was the Ouro Preto Integrated Colonisation Project (PIC-Ouro Preto) (Figure 2.1). Five of the projects were discarded because they had been in operation for less than seven years. The Sidney-Girão Project was not selected because it had not had its land resources surveyed at an adequate scale (for interpretation of the significance of different land qualities, at the farm level).

In the cerrado region covering an area of approximately 1,500,000 square kilometres (Eiten, 1972), three projects complied with the criteria outlined above (Figure 2.2). The Sagarana and the Gusmão Projects were selected because they presented distinct contrast including:

a) natural fertility of the soils, b) size of farming plots, c) form of agriculture practised and d) distance from the main consumer centres.

The Ouro Preto, Sagarana and Gusmão Projects which complied with the criteria were selected for the study of the relative

importance of land qualities to the success of colonisation projects (Figures 2.2, 5.1, 6.1, 7.1).

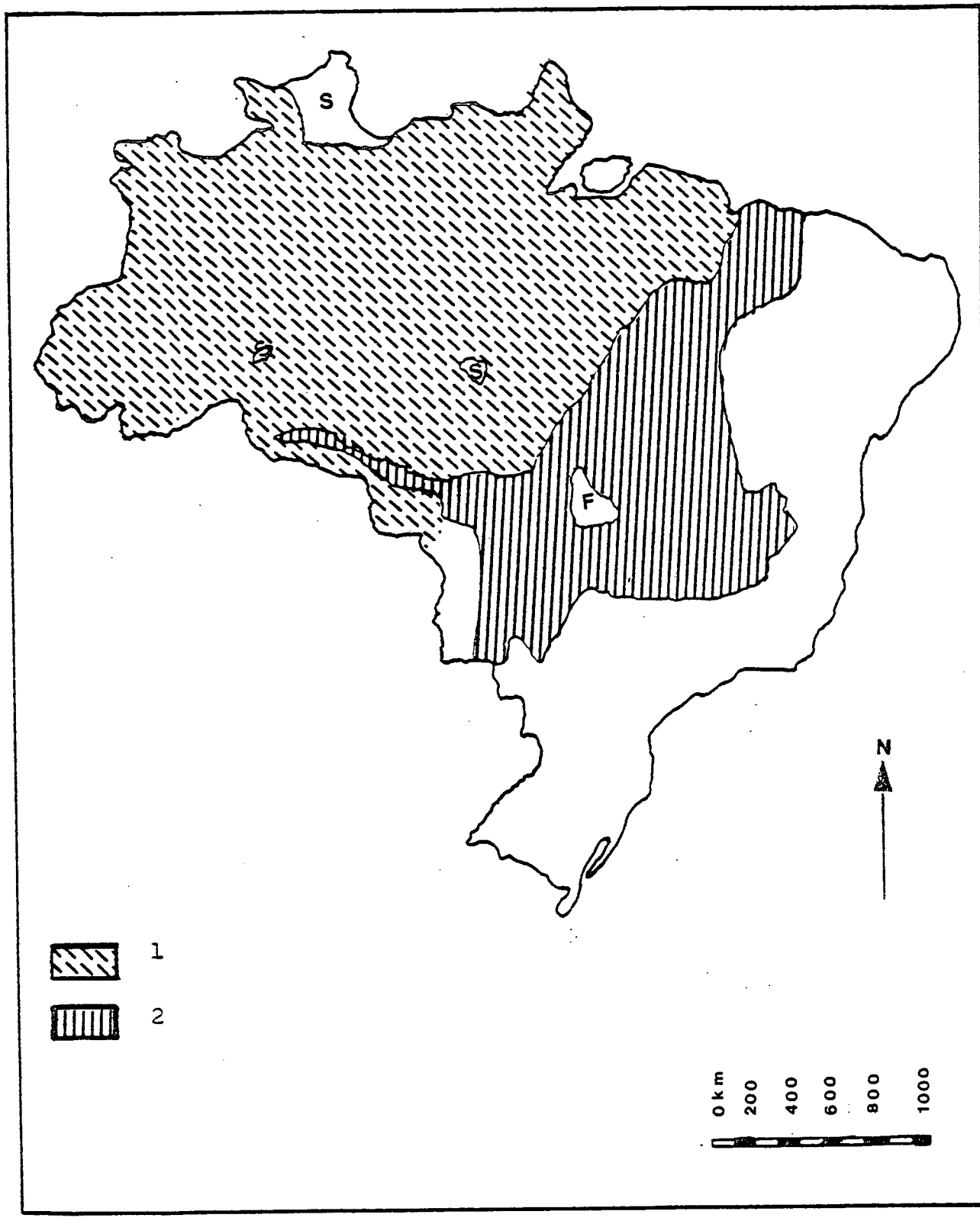


Figure 2.1: Distribution of vegetation types in the Amazon Basin and Cerrado region of Brazil (After Eiten, 1979).

1 = Rain forest; 2 = Cerrado, F = upland forest;
S = Amazon savanna

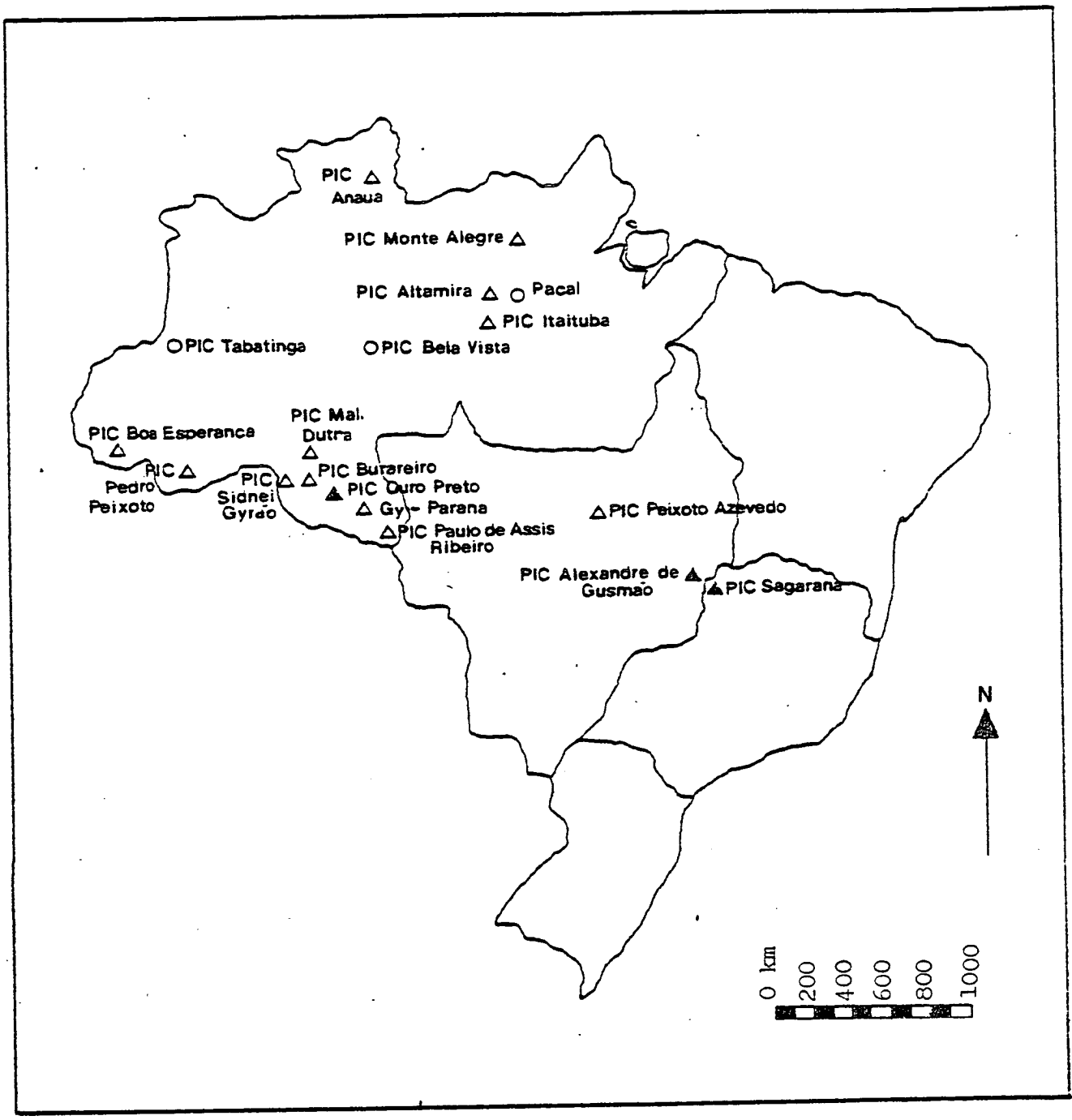


Figure 2.2: INCRA colonisation projects in the rain forest and cerrado regions of Brazil.

▲ = case studies; Δ = projects in the implementation phase;
O = projects in the consolidation phase.

CHAPTER 3

PHYSICAL CHARACTERIZATION AND AGRICULTURAL POTENTIAL OF THE AREAS STUDIED

This chapter is divided into two sections: in 3.1, climate, soil and vegetation will be described; in 3.2 the land capability methodologies which have been used to assess the agricultural potential will be outlined. This will be followed by a brief comparison of the agricultural potential of the areas studied.

3.1 Physical characterization of the areas

3.1.1 Climate

Climate plays an important role in agricultural production. It determines to some extent the crops that can be grown and the intensity and nature of erosion. Climatic variables such as precipitation, temperature, insolation, wind-velocity, evaporation all have considerable impact on agricultural activities (Whyte, 1976; Vink, 1975).

Silva's work (1973) based on the Köppen climatic classification, referred to the climate of the Ouro Preto region as being of a transitional type between the humid and warm (Af) and the periodically dry savanna climate with dry winter (Aw).

The climatic zone A in Köppen's classification refers to areas with average monthly temperatures which never fall below 18 ^{o}C. The sub-type Af characterizes areas with at least 60 mm of precipitation in the driest month (rainforest climate). The sub-type Aw characterizes areas with less than 60 mm of precipitation in the driest winter month (tropical savanna climate). The Gusmão and Sagarana projects are located in areas with the tropical savanna climate type.

The Köppen climatic classification broadly indicates that the temperature regime is unlikely to restrict the growth of crops commonly cultivated in the areas studied. However, when precipitation is less than 60 mm a soil water deficit could arise restricting the growth of crops if irrigation is not used.

Since irrigation is not a common practice on the three colonisation projects studied (except for the Gusmão project where it is employed by a small number of colonists), the total amount and distribution of rainfall becomes one of the most important climatic factors for crop growth. Therefore, rainfall will be considered here in a greater detail. Mention will be made about the temperature regime and evapotranspiration.

Only the Ouro Preto project has a climatological station within its boundaries. It was established in 1974 by the Executive Commission for Cocoa Development (CEPLAC) and has been in operation since. This is, however, a very short time in which to gather adequate data to characterize the climate. The climatological data which will be presented here for the three case studies were recorded in the nearest climatological stations.

3.1.1.1 The Ouro Preto area

In the Territory of Rondonia with its 243,044 square kilometres there have only been two climatological stations in operation for over 20 years. These are the Porto Velho station on the flat land to the north and the Vilhena stations sited on the plateau to the south.

Rainfall in the Territory of Rondônia tends to decrease as one moves southwards. In the north (Porto Velho) annual rainfall averages 2,277 mm while in the south (Vilhena) it is 2,086 mm. Monthly rainfall of Porto Velho and Vilhena are illustrated in Table 3.1.

The data in Table 3.1 show that a very wet season is followed by a relatively dry period (May - September). About 78 % of the rain falls in 6 months, from November to April. From May to October, both in Porto Velho or Vilhena, the potential evapotranspiration is higher than the rainfall (Radam, 1978). Water deficiency in this period is likely to occur in both places, as the moisture holding capacity of the majority of the Rondonia's soils is low to very low.

The annual mean temperatures recorded for Porto Velho and Vilhena are 26.5 ^{o}C and 25 ^{o}C respectively. The highest

Table 3.1 Monthly rainfall of Porto Velho and Vilhena (mm)(after RADAM,1978).

Months	Climatological station	
	Porto Velho	Vilhena
January	338	342
February	305	303
March	317	351
April	230	165
May	110	73
June	34	26
July	15	19
August	30	28
September	121	97
October	193	186
November	223	213
December	361	283
TOTAL YEAR	2277	2086

Table 3.2 Monthly rainfall of the Gusmão and Sagarana areas (mm) (after EMBRAPA,1978 and PINHEIRO,1974).

Months	Climatological station	
	Brasília (Gusmão area)	Arinos (Sagarana area)
January	231	196
February	239	151
March	195	91
April	122	59
May	46	5
June	4	1
July	5	0
August	2	2
September	43	14
October	152	89
November	2279	184
December	260	275
TOTAL YEAR	1578	1067

monthly temperature recorded at Porto Velho was 34.7 °C in August, while the lowest monthly mean temperature was 18.6 °C recorded in July (Radam, 1978).

The significance of the rainfall regime and other climatic elements for the establishment of a successful agriculture in the Ouro Preto project area will be considered in more detail in Chapter 5.

3.1.1.2 The Sagarana and Gusmão projects areas

Data on rainfall presented in Table 3.2 were recorded in the Brasília and Arinos climatological stations. They cover a 10-year period. The Brasília station is sited 30 km from the Gusmão project boundary. The landscape where the station is sited resembles that of the Gusmão project and the altitude of the climatological station site (1140 m) is in the range of the altitude variation in the Project area (1000 - 1340 m). Thus it is reasonable to assume that the weather in both sites is similar.

The Arinos climatological station is sited roughly 60 km from the Sagarana project boundary (Figure 6.1). Although the station is sited in a landscape which resembles the Sagarana area, the altitude of the climatological station (496 m) is slightly less than the altitudinal range in the Sagarana area (500 - 850 m). Therefore, the Arinos data may not be as representative for the Sagarana area as the Brasília data for the Gusmão area. However, the data from the Arinos station are useful in confirming the rainfall distribution in the cerrado region.

In Brasília the annual rainfall averages 1578 mm, while in Arinos it is 1067 mm. Both areas present two distinct seasons. The wet season starts in October and extends up to March/April and over 90 % of the total annual rainfall falls in this 7-month period. The dry season starts in April/May and extends up to October. This five-month period accounts for less than 10 % of the total rainfall. The length of dry season is illustrated in Figure 3.1.

Unless irrigation is used and/or crops resistant to moisture deficiency are planted, the growth of crops in the cerrado area

is severely restricted by the length and extent of the dry season.

Even in the wet season, when the monthly rainfall is greater than the potential evapotranspiration, crops could suffer from moisture deficiency. This results from the characteristics of the rainfall pattern in the areas. It is not uncommon to register nearly all the monthly rainfall in a few consecutive days, which are then followed by a relative long dry period named 'veranico'.

The temperature regime of the Gusmão area is affected by the high altitude of the region (1000 - 1300 m). The mean maximum temperature is fairly uniform throughout the year. It ranges from 25 ^{o}C to 28 ^{o}C. The mean minimum temperatures range from 12 ^{o}C in the winter to 18 ^{o}C in the summer. The annual mean temperature is 20.4 ^{o}C. The temperatures in the Sagarama area are slightly higher, due mainly to its lower altitude.

Colonists agricultural activities, both in the tropical forest and cerrado areas are very much dependent upon the rainfall regime. Farming operations such as land clearing, ploughing, sowing amongst others are basically determined by the rainfall distributions. Other implications of the rainfall characteristics, for example,upon soil erosion, leaching, road building and maintenance, are considered in the subsequent sections.

3.1.2 Soil resources

Beek (1978) stressed that soils differ in behaviour when certain physical and chemical inputs (fertiliser, lime, etc.) are applied for their improvement. There are very different responses to inputs, sometimes referred to as "input application efficiencies". Therefore, it is important to assess the properties of soils and their response to management in order to establish sound agricultural land use plans in any given region. The main soils which occur in the areas studied will be described here. The assessment of their agricultural potential will be dealt with in 3.2.

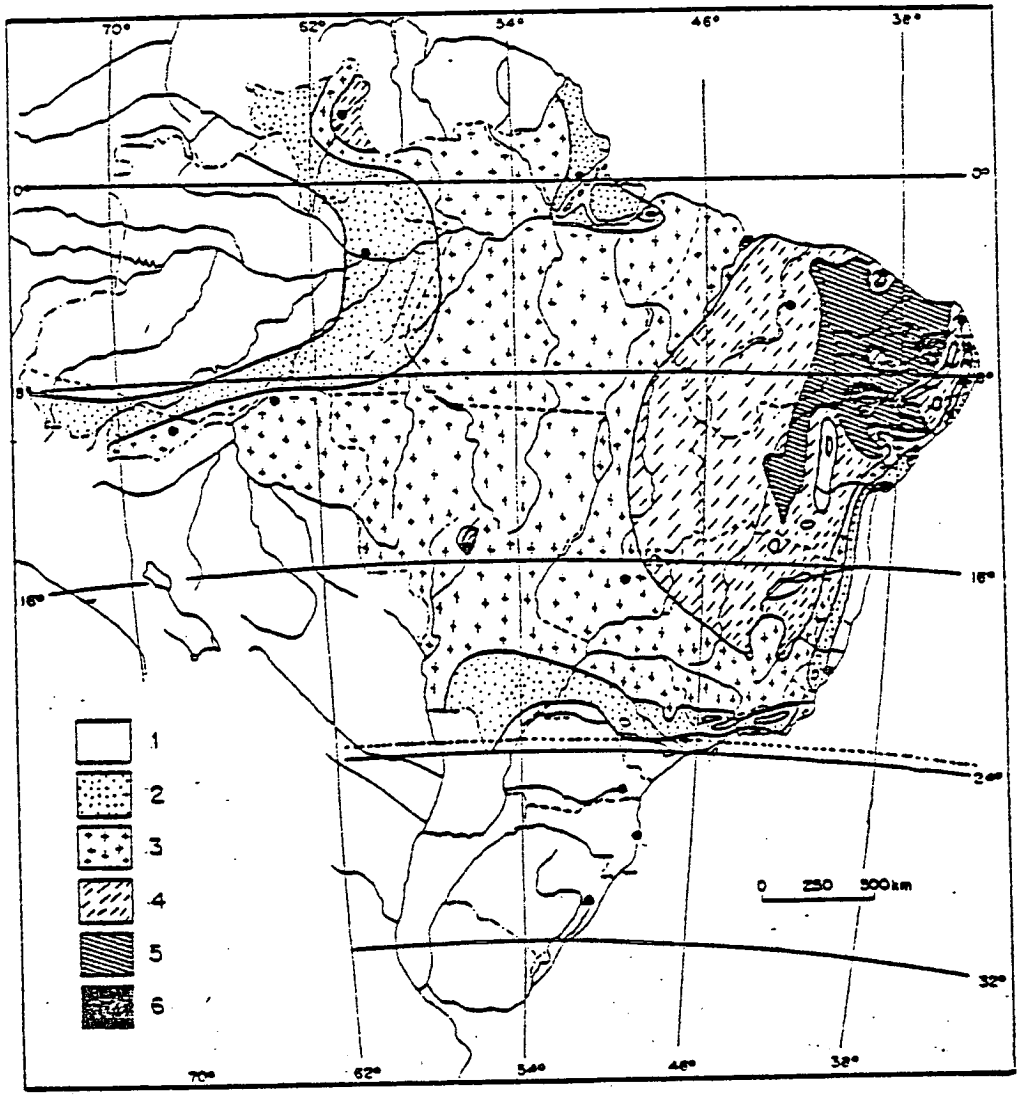


Figure 3.1: Map showing dry season length (After Prance, 1978):

1 = without dry season
2 = very short dry season (1 - 2 months)
3 = short dry season (3 - 4 months)
4 = medium dry season (5 - 6 months)
5 = long dry season (7 - 8 months)
6 = extended dry season (8 months or more).

3.1.2.1 Soils of the Ouro Preto project

Soils of the Ouro Preto region were mapped for the first time in 1965, at a scale of 1:5,000,000. This survey was conducted jointly by FAO and the Pedology/Fertility teams of the Ministry of Agriculture of Brazil (IBGE, 1977). Between 1973 and 1976 the soils of the Ouro Preto area were mapped at a scale of 1:125,000 by soil surveyors of CEPLAC (Silva, 1973; Dias, 1976; Carvalho, 1976a,b). In 1978 the soils of the Ouro Preto region were included in the Radam (1978) report. The Radam's maps were published at 1:1,000,000, from field and radar surveys at 1:250,000.

In this section the results reported by the CEPLAC's soil surveyors will be used in the characterization of the soils because they are the most detailed soil surveys available for the area. They also contain the sort of information needed for the characterization of the soils.

According to Silva (1973), Dias (1976) and Carvalho (1976a,b), the majority of the soils of the Ouro Preto project area fall within two orders (Alfisols and Ultisols), based on the soil classification system of the USDA soil taxonomy 1975 (USDA, 1975).

Nearly 84 % (192,280 ha) of the total area (230,000 ha), mapped by the CEPLAC's surveyors, are occupied by four soil mapping units (Ouro Preto, Xibiu, Rondônia and Anari) (Figures 3.2, 3.3, 3.4). The remaining 16 % comprise seven mapping units. The latter will not be described here, for the sake of brevity, except to say that the soils were classified by the CEPLAC's surveyors as class IV or unsuitable for the cultivation of cocoa. A brief description of the main soil units follows:

A - The Ouro Preto soil unit (Oxic Tropudalf)

Soils of this unit account for 10 % of the total area surveyed. They are derived from basic rocks of the crystalline basement and are usually associated with broken relief. They present an A/B/C horizon sequence, with little morphological differentiation between horizons.

Soils of this unit contain a relatively high content of plant nutrients. The sum of exchangeable bases (S), defined by $S = Ca^{++} + Mg^{++} + K^{+} + Na^{+}$, ranges from 8.5 to 5.5 meg/100 g of

soil in the A and B horizons. The cation exchangeable capacity (T), defined by $T = S + Al^{+3} + H^{+}$, ranged from 11.0 to 7.5 meq/100 g of soil. The saturation with bases (V), defined by $V = 100\ S/T$, is about 70 % in the whole profile.

Soils of this unit do not have problems with exchangeable aluminum toxicity. They are relatively deep (effective depth $\pm$ 120 cm) and well drained. They are highly susceptible to erosion, mainly due to their frequent occurrence on steep slopes.

A.2 The 'Rondônia' soil unit (Oxic Tropudalf)

Soils of this unit account for 8 % of the total area surveyed. They are derived from gneiss rocks and usually occur on broken relief with very steep slopes. They present an A/B/C horizon sequence, with horizons well defferentiated.

The plant nutrient content of soils of this unit is slightly lower than the previous one. However, the saturation with bases (V) is still high, greater than 50 % throughout the profile. Exchangeable aluminum is evident in the B horizon (0.3 meq/100 g of soils).

Soils of this unit are also relatively deep (effective depth, 100 - 150 cm), and well drained. They are highly susceptible to erosion and present serious limitation to mechanization because of the relief and/or the presence of rocks.

A.3 The 'Xibiu' and 'Anari' units (Oxic Tropudult)

Soils of these units cover 66 % of the total area surveyed. They are formed from intermediate rocks of the crystalline basement. They usually occur on gentle undulating terrain and present a discernible A/B/C horizons sequence. There is a thick B horizon (Argillic) and an effective total depth of the A and B horizons greater than 200 cm.

Soils of these units contain a medium level of inherent fertility; with the sum of exchangeable bases around 3.0 meq/100 g of soil. The cation exchangeable capacity (T) ranges from 7.0 to 4.0 meq/100 g of soil in the A and B horizons. The saturation with bases is rather high in the sub-horizon A (80 %), but it decreases considerably in the other sub-horizons to values around 40 %. Exchangeable aluminum is present

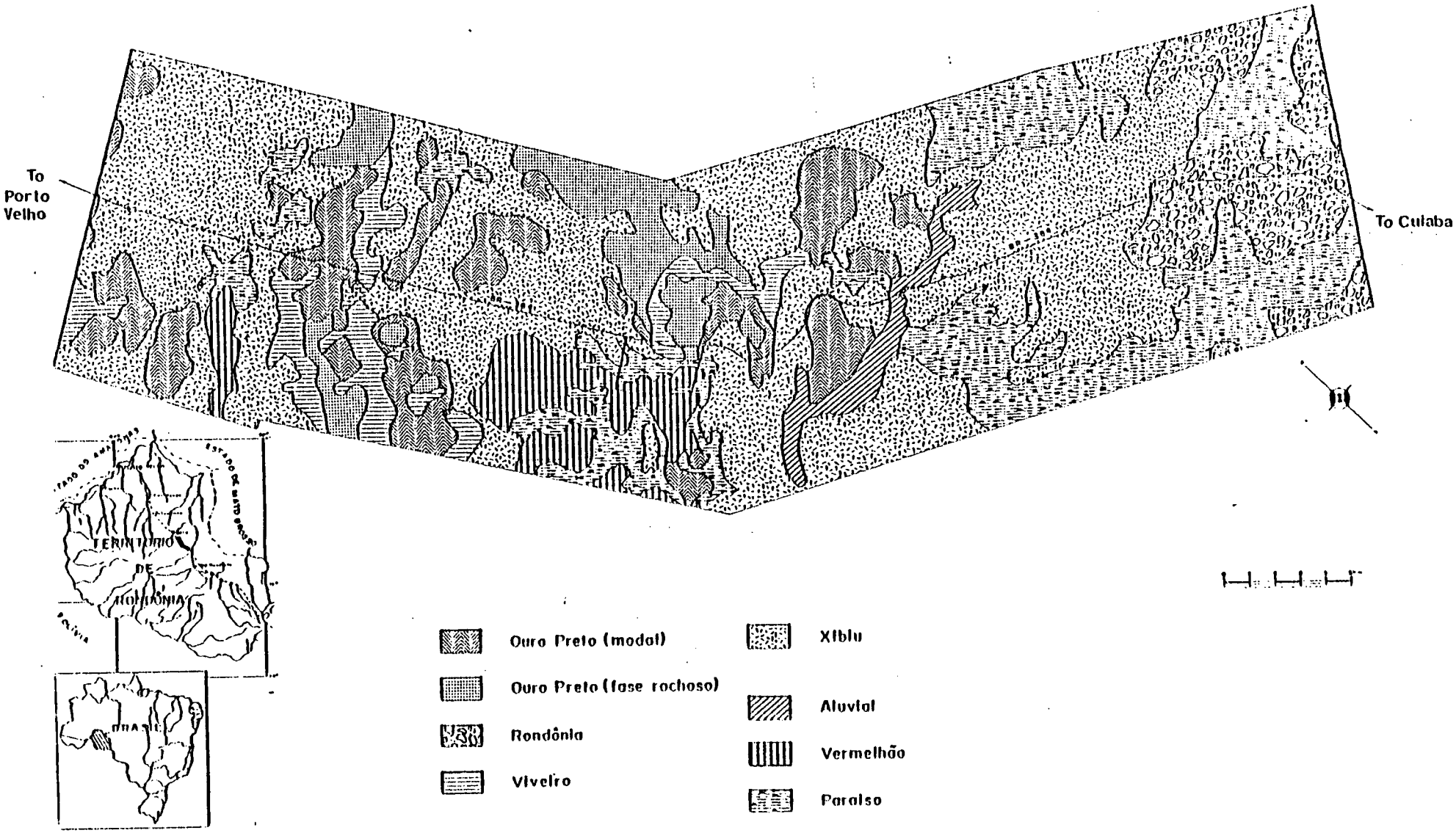


Figure 3.2: Map of soils of part of the Ouro Preto project (soil units as defined in 3.1.2). (After Silva, 1973).

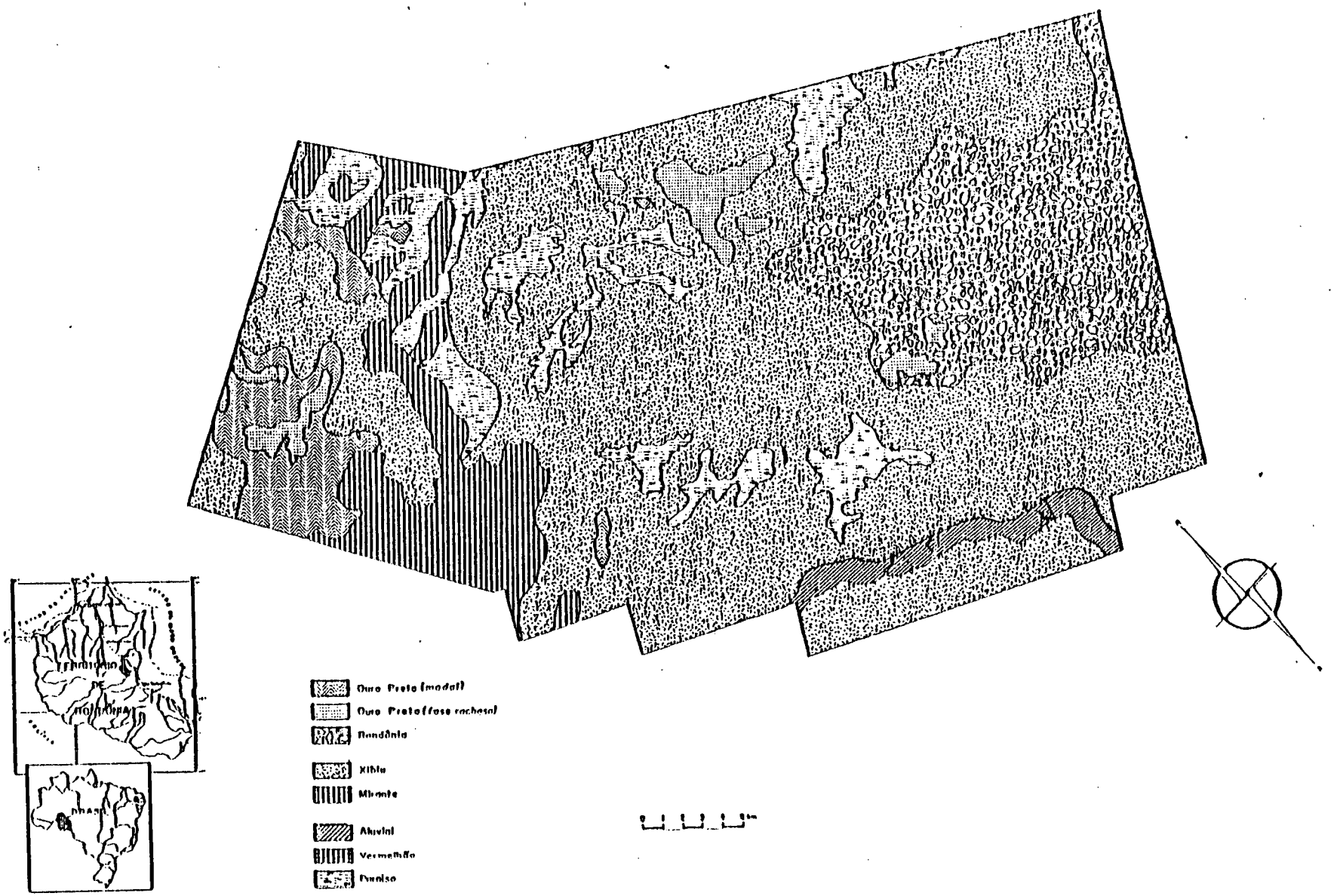


Figure 3.3: Map of soils of the OUro Preto project, the expansion area II (soil units as defined in 3.1.2) (After Dias, 1976).

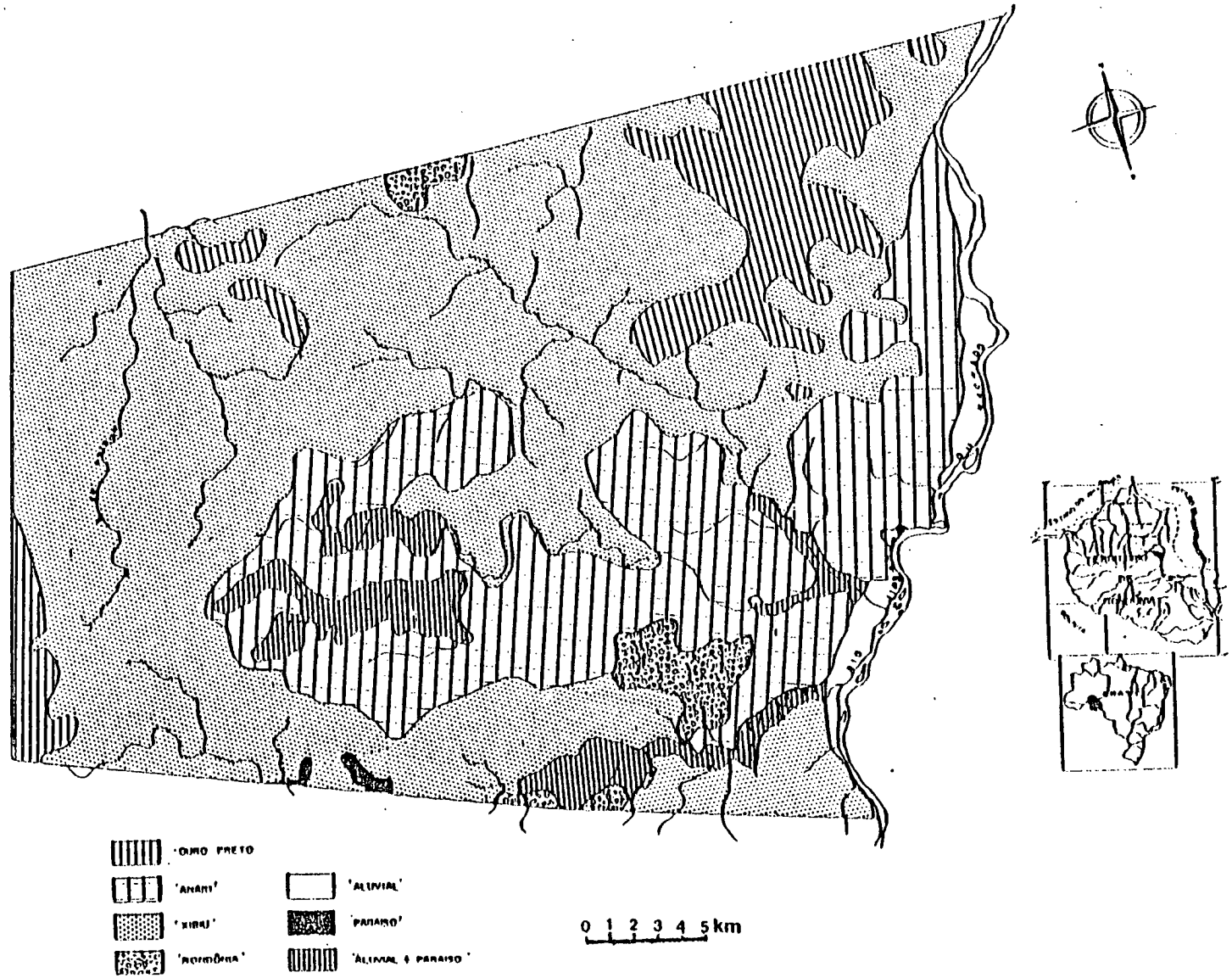


Figure 3.4: Map of soils of the Ouro Preto project, the expansion area III (soil units as defined in 3.1.2). (After Carvalho[a], 1977).

throughout the profile (0.1 - 0.2 meq/100 g of soils).

Soils of these units are well drained, and very deep. Risks of erosion are lower than in the previously described units, mainly because the soils occur on gentle undulating terrain. In addition, they do not present any serious impediment to the utilization of agricultural machinery.

The remaining soils which occur in the are surveyed with the exception of the hydromorphic soils (2 % of the total area), are well developed and well drained. They are also usually associated with gentle undulating terrain. Their main constraints to agriculture are a) low plant nutrient contents, and b) low moisture holding capacity. The levels of exchangeable aluminum are much higher in these soils than in the other soil units described earlier.

3.1.2.2 Soils of the Gusmão project

According to Embrapa (1978) the majority of the soils of the Gusmão project fall within the Oxisol order of the USDA soil classification system; Soil taxonomy 1975. Oxisols are the most highly weathered soils in the USDA classification. Their most important diagnostic feature is the presence of a deep B horizon generally containing a very high proportion of clay-size particles dominated by oxides of iron and aluminum.

Soils of the Gusmão project can be grouped into four categories upon the Embrapa (1978) soil survey. These are:

A - Latosols (soils with a latosolic B horizon)
B - Cambisols (soils with an incipient B horizon)
C - Hydromorphic laterite
D - Hydromorphic soils (not discriminated)

The first two will be characterized here because they account for 9 0 % of the total Project area.

A Latosols

Latosols occupy about 75 % of the total area (Figure 3.5). They are usually associated with flat land or land with gently undulating slopes. They present a discernible A/B/C horizons

sequence with little morphological differences between horizons and sub-horizons. The B latosolic horizon is very deep, with an effective depth of the A and B horizons greater than 200 cm.

These soils are rich in oxides (Si, Al, Fe) and have low plant nutrient status. The sum of exchangeable bases (S) is small (0.5 meq per 100 g); the cation exchangeable capacity ranges from 5.0 to 15.0 m eq/100 g. The percentage of saturation with bases is around 5 % throughout the soil profile. The percentage of saturation with aluminum, defined by 100 $Al^{+3}/Al^{+3} + S$, is greater than 7 0 % in the top 100 cm of the soil profile.

These soils are well drained and have little susceptibility to erosion due to a combination of good physical properties (structure, texture, porosity) and an occurrence on flat land.

B. Cambisols

Cambisols cover 15 % of the total area of the Gusmão project (Figure 3.5). These are shallow mineral soils, non hydromorphic, with a (B) incipient horizon in which some easily mineralized primary minerals are still found. They show an A/B/C horizons sequence with clear and abrupt transitions between them. These profiles are normally gravelly throughout.

Compared with latosols the cambisols are less acid and have higher nutrient status, particularly exchangeable bases. The percentage of saturation with bases is greater than 30 % throughout the profile. The exchangeable aluminum is higher than in the latosols. It increases from 2.9 meq per 100 g of soil in the A horizon to an average of 5.0 meq in the sub-superficial horizons.

The inherent infertility of the cambisols, like latosols, imposes serious restrictions on their use, particularly for cultivation. In addition, cambisols are very susceptible to erosion, mainly because they occur in areas with very steep slopes. The overall agricultural potential of these soils will be considered in 3.2.

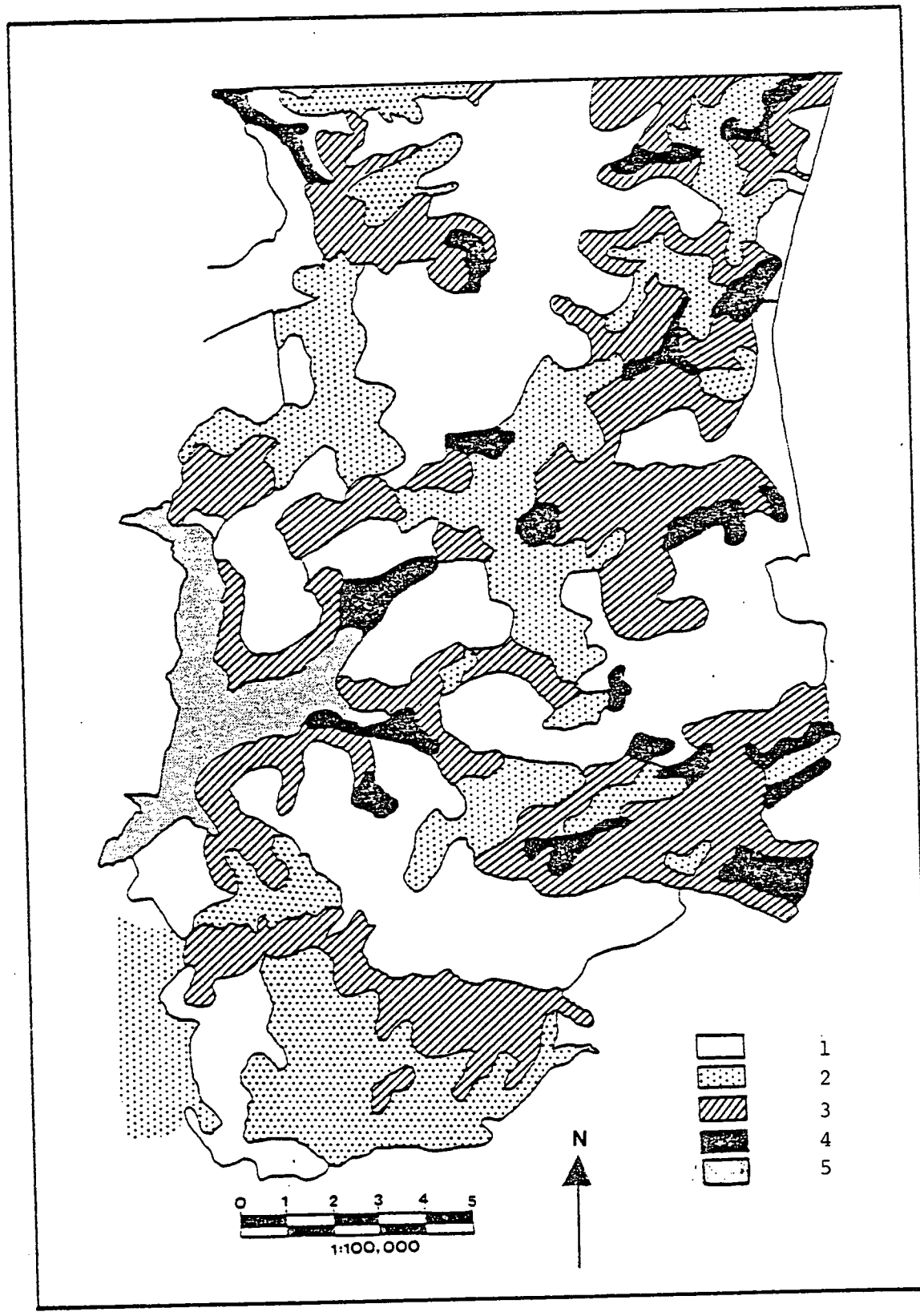


Figure 3.5: Map of soils of the Gusmão project (After Embrapa, 1978).
1 = Dark-red latosol, 2 = Red-yellow latosol,
3 = cambisols, 4 = Hydromorphic,
5 = lake

3.1.2.3 Soils of the Sagarana project

The majority of the soils of the Sagarana project are latosols with similar properties to the soils of the Gusmão project. However, soils with high contents of plant nutrients do occur in the area derived from limestone rocks (Pinheiro, 1974).

The Sagarana soils with high inherent fertility are covered by either deciduous or semi-deciduous forest. In the implementation of the Project the areas under forest were kept as forest reserve. Since forest land was not allocated to colonists, it can be said that colonists in the Sagarana and Gusmão Projects were farming soils with similar agricultural properties. Therefore, if differences in degree of success were to be found between colonists in these Projects, they cannot be attributed to the land quality factor. Comparisons. between the performance of settlers in the three case studies will be dealt with in Chapter 8.

3.1.3 Vegetation

The predominant type of natural vegetation of the Ouro Preto project is tropical forest. Radam (1978) refers to two forms of forest (in the Ouro Preto area): dense tropical forest and open tropical forest. These two types of forests differ in their physiognomic form and in standing timber volume. In the open tropical forest communities of palm trees and large numbers of lianes are very frequent. The standing timber volume of an open forest is frequently less than 100 m^3/ha, whilst for a dense forest it could reach 200 m^3/ha (Radam, 1978).

The relationships between these two forms of forest and soil types have not been defined in the surveys referred to earlier. In the Ouro Preto project open and dense forests appear associated with soils having high, medium and low bases contents.

In Chapter 5, the wasteful method of deforestation which is taking place in the area will be discussed.

In the Gusmão and Sagarana projects tropical savanna, or 'cerrado', is the main type of natural vegetation. The cerrado contains several distinctive sub-units and a physiognomic gradient can be distinguished in the vegetation. Eiten (1963, 1968) has divided cerrado vegetation into four types which range from almost pure grassland with essentially no woody plants to medium tall (7 - 15 m) arboreal forms overlying grass. This gradient was quantitatively codified by Goodland (1971) in terms of basal area of trunks per hectare and divided into four intergrading categories with the following characteristics:

- 'Campo sujo' (herbaceous vegetation with very scattered and small trees): general height of taller woody plants 3 m, trees less than 1000 per hectare, with a total basal area of 30,000 square cm per hectare.
- 'Campo cerrado' (sparse 'orchard' vegetation): general height 4 m, trees 1400 per hectare, total basal area of 76,000 square cm per ha.
- 'Cerrado sensu stricto' (dense 'orchard' vegetation): general height 6 m, trees of 2000 per ha, total basal area of 168,000 sq. cm per ha.
- 'Cerradão' (woodland with a canopy of nearly 50 %): general height 6 m, trees over 3000 per ha, total basal area of over 300,000 sq. cm per ha.

This physiognomic gradient has been found to parallel a soil fertility gradient (Lopes, 1977; Ratter, 1978; Goodland 1971). In other words, as density and height of the woody natural vegetation increases a number of soil parameters also increase, such as pH(H_2O), pH(KCl), exchangeable Ca, Mg and K and extractable P, Zn, Cu and Mn.

This fertility gradient is recognized by colonists in both Projects in their allocation of land uses within plots. This reduces the chances of colonists cultivating land with lower potential for crop growth.

3.2 The agricultural potential of the areas.

One of the objectives of the colonisation policies in Brazil is to promote the utilization of the land resources on a sustainable basis. The setting up of a colonisation project in one area usually envisages changes in the way that the land resources are being used. The degree of change varies from case to case.

In the case of the Ouro Preto project, the tropical forest was to be replaced by crops, pasture, and the infra-structure necessary to support the establishment of a successful agricultural settlement. In the case of the Sagarana project, the degree of change envisaged was less substantial because the area was already colonised. However, the anticipated changes involved in the setting up of the Sagarana project, were still of a considerable scale. This included, for example, the introduction of new farming practices, increases in the productivity of crops already cultivated and introduction of new crops. Dent (1981) argues that land evaluation becomes necessary where changes in land use are contemplated. Evaluation is required in order to predict the suitability of the land to various forms of production, the inputs and management practices needed, and the consequences of such changes upon the environment. A knowledge of the different land qualities is therefore important in the process of setting up colonisation projects.

The criteria used by the colonisation agency to choose the sites of the projects and the methodologies employed to assess the agricultural potential of the areas, at the time of the establishment of the projects, are considered separately for each case study in chapters 5, 6 and 7. Here, land qualities and the agricultural potential of the areas where the projects are located will be assessed on the basis of the land resources evaluation carried out by Pinheiro (1974), Embrapa (1978), and Radam (1978). In order to compare the different forms of assessment a brief outline of the land capability systems employed by those organisations is required.

A - Embrapa's Land Capability System

Embrapa evaluates the suitability of the land resources for six forms of land use under three management systems. The six agricultural land uses are:

- annual crops (or short cycle crops)
- perennial crops (or long cycle crops)
- planted grasses
- natural grasses
- silviculture
- unsuitable for the previous uses. Recommended for the conservation of the flora and fauna.

The Embrapa's methdology places greater emphasis on the land suited to annual crops for two reasons:

a) the high demand for annual crops (food and cash crops) both at national and international markets (socio-political and economic consideration), and

b) they assume that annual crops are more demanding in terms of land requirements than the other forms of land uses. This means that a tract of land suitable for annual crops should also be suitable for the other agricultural users considered.

When an area suitable for annual crops is unsuitable for perennial crops or other uses, special symbols are used in the land capability maps to show the unsuitability. This is the case for example, with low land areas suitable for annual crops and unsuited to perennial crops because of water excess during part of the year. In other instances, the effective depth of the soil renders an area suitable for annual crops (usually shallow rooted) but unsuitable for other crops such as tree crops which are characterized by deeper root systems.

The three management systems (A, B, C) are defined in terms of farming practices, level of technical knowledge, intensity of capital application, intensity of land-labour utilization and traction of agricultural implements (Suplan, 1978). The management systems are defined as follows:

- Management system A -
  Farming practices relying upon traditional knowledge

No capital is used for maintenance and improvement of the agricultural land conditions. Draft-power is usually manpower. If animals are used, only simple agricultural implements are available.

- Management system B -

Farming practices reflect a medium level of technical knowledge. Some use is made of capital for maintenance and improvement of the agricultural land conditions. Cultivation of crops relies on hand-labour and animal traction. Some use is made of power-operated machinery for transport and processing of agricultural produce.

- Management system C -

Farming practices depend upon a high level of technical knowledge. Intensive use is made of capital for both maintenance and improvement of agricultural land conditions. Intensive use is made of power-operated machinery. Farming practices make full use of the results of agricultural research.

In the management system A, the land classification is based upon its natural condition, as no use of capital is made for improvement of the agricultural land condition. On the other hand, in the management systems B and C, land is classified according to the persistent limitations after the use of capital and technical means for improvement of the agricultural land conditions have been made. Irrigation and large scale drainage is not considered in Embrapa's current Land Capability System

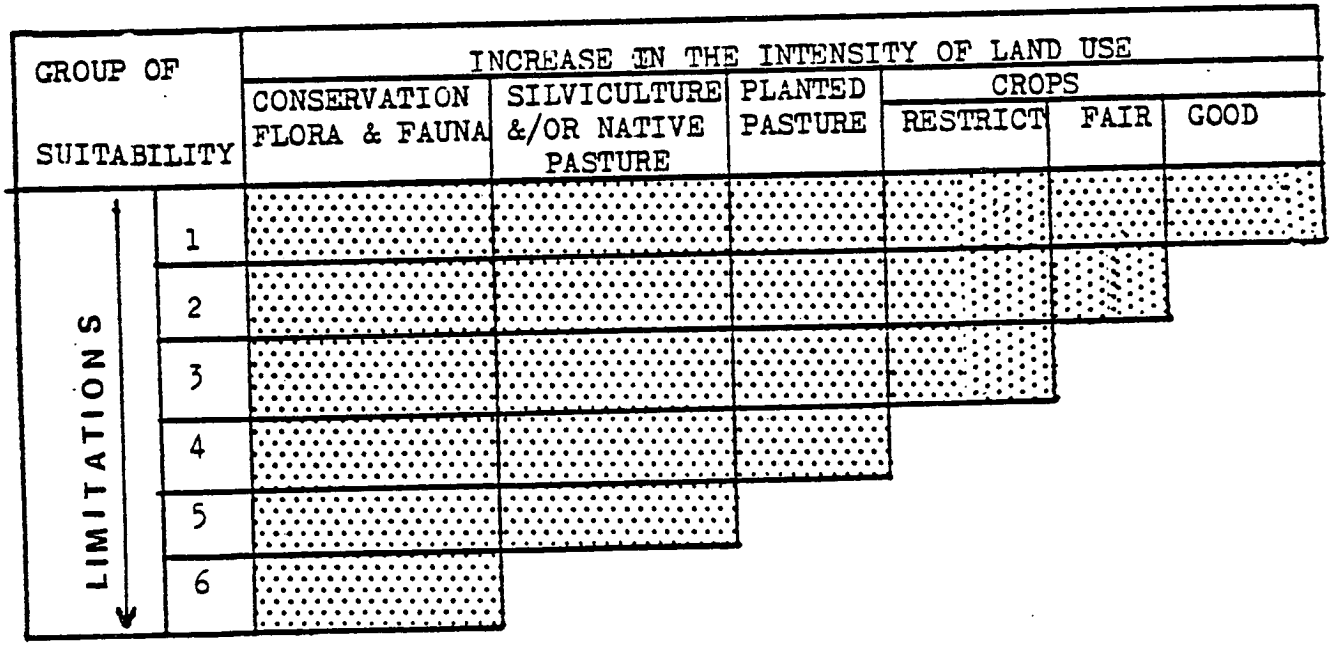
Embrapa's system distinguishes four "classes of suitability" (good, fair, restricted and unsuitable) and six "groups of suitability" (1, 2, 3, 4, 5 and 6), which are essentially comparable to the eight capability classes of the Land Capability System of the Soil Conservation Service of the USDA (Klingebiel, 1960). The symbols employed by Embrapa are illustrated in Tables 3.3 and 3.4.

The suitability groups 1, 2, and 3 refer to land suitable for 'crops' and groups 4, 5 and 6 refer to suitability for "planted pasture", "silviculture and/or native pasture" , and "preservation of fauna and flora", respectively. The

Table 3.3 Symbols used to represent the land capability classes of the EMBRAPA 's Land Capability System (After SUPLAN,1978).

CLASSES OF SUITABILITY	AGRICULTURAL LAND USES					
	CROPS MANAG. SYSTEM			PLANTED PASTURE	SILVICULTURE	NATIVE PASTURE
	A	B	C	MANAG. SYSTEM B	MANAG. SYSTEM B	MANAG.SYSTEM A
GOOD	A	B	C	P	S	N
FAIR	a	b	c	p	s	n
RESTRICTED	(a)	(b)	(c)	(p)	(s)	(n)
UNSUITABLE	-	-	-	-	-	-

Table 3.4 Diagram showing the land suitability groups of the EMBRAPA' s Land Capability System (After SUPLAN, 1978).



limitations which affect the six "Groups of Suitability" increase from "Group 1" to "Group 6". Consequently, the land use alternatives and the intensity with which the land can be utilized decreases from "Group 1" to "Group 6", as illustrated in the diagram in Table 3.4.

Thus, a land mapping unit 1(a) b C means that:

1 = land suitable for crops
C = 'Good' suitability in the management system C
b = 'Fair" suitability in the management system B
(a) = 'Restricted' suitability in the management system A.

B - The "João Pinheiro" Foundation land capability system.

The Pinheiro Foundation assessed the land resources of the Sagarana Project in 1973 (Pinheiro, 1974). They used an eight class land classification system, similar to the USDA land capability classification. They assumed that a high level of management similar to the Embrapa's Management System C would be adopted by colonists. The Pinheiro Foundation capability classification will not be outlined here, for two reasons:

a) the capability classification adopted by them is similar to the USDA capability classification which is widely known, and
b) the eight classes of the Pinheiro land capability classification can be broadly related to the six 'Groups of Suitability' of the Embrapa's system. Thus, the assessment of the agricultural potential of the Sagarana area would not be impaired by omitting the description of the Pinheiro's land capability classification.

The results of the Pinheiro's land capability studies are presented in Table 3.5. The figures in Table 3.5 show that 48 % of the total area falls within the category of non-arable land (classes V, VI, VII and VIII), and nearly half of the area considered as arable (classes I, II, III, IV) belongs to class IV. These figures illustrate the low agricultural potential

Table 3.5 Areas and percentages of the land capability classes of the Sagarana project (after PINHEIRO,1974).

Land capability classes	Area in hectares	% of the total area
II	3330	9.0
III	6962	19.0
IV	8954	24.0
V	5756	16.0
VI	9705	26.0
VII	1286	4.0
VIII	765	2.0
TOTAL AREA	36758	100.0

Table 3.6 Main limiting factors of the land resources of the Sagarana project (after PINHEIRO,1974).

Factor	Percentage of the total area
Lack of fertility (f)	44
Risk to inundation (i)	14
Inundation plus drainage problems (di)	13
Relief (steep slopes) (t)	10
Drainage (d)	7
Others	12
TOTAL	100

of the Sagarana project area. They also indicate the high management level needed to farm part of the area successfully. The major limitation to crop growth in the Sagarana project is the inherent infertility of the soils which is the dominant limitation over about half of the total area, but it is also a constraint in the remainder of the area. The next major limiting factor is risk of unundation and/or drainage problems (Table 3.6).

The different land capability classes and the main limiting factors in one farming plot in the Sagarana project is illustrated in Figure 3.6. The variability in the quality of land within a single plot of 122 hectares is considerable. As a matter of interest the colonists interviewed were able to distinguish the principal differences in land capability within their farming plots, particularly drainage and plant indicators of fertility. The colonist usually consider the land quality factor in their own allocation of land to farming activities. Sometimes, they take calculated risks, such as planting in areas subject to inundation because of the higher inherent fertility of the soils.

The agricultural potential of the Gusmão Project is fairly similar to that of the Sagarana Project. These two areas have basically the same soil types, vegetation and climate, as indicated in 3.1. According to the Embrapa land capability system 68 % of the total area of the Gusmão project falls within the suitability group 2(b)c; 17 % is of 5(n) suitability and 5 % is of the suitability group 6 as illustrated in Table 3.7, and Figure 3.7.

The agricultural potential of the Gusmão project is very low in the management system A, or the traditional system without application of capital for maintenance and improvement of the land conditions. Only 1 % of the total area has the suitability class "Restricted" referring to cultivation in the Management system A (= the suitability group 2(a)b c). The rest of the area is unsuitable for cultivation of crops in the Management system A. In the Project area the highest 'suitability group' is "Fair"

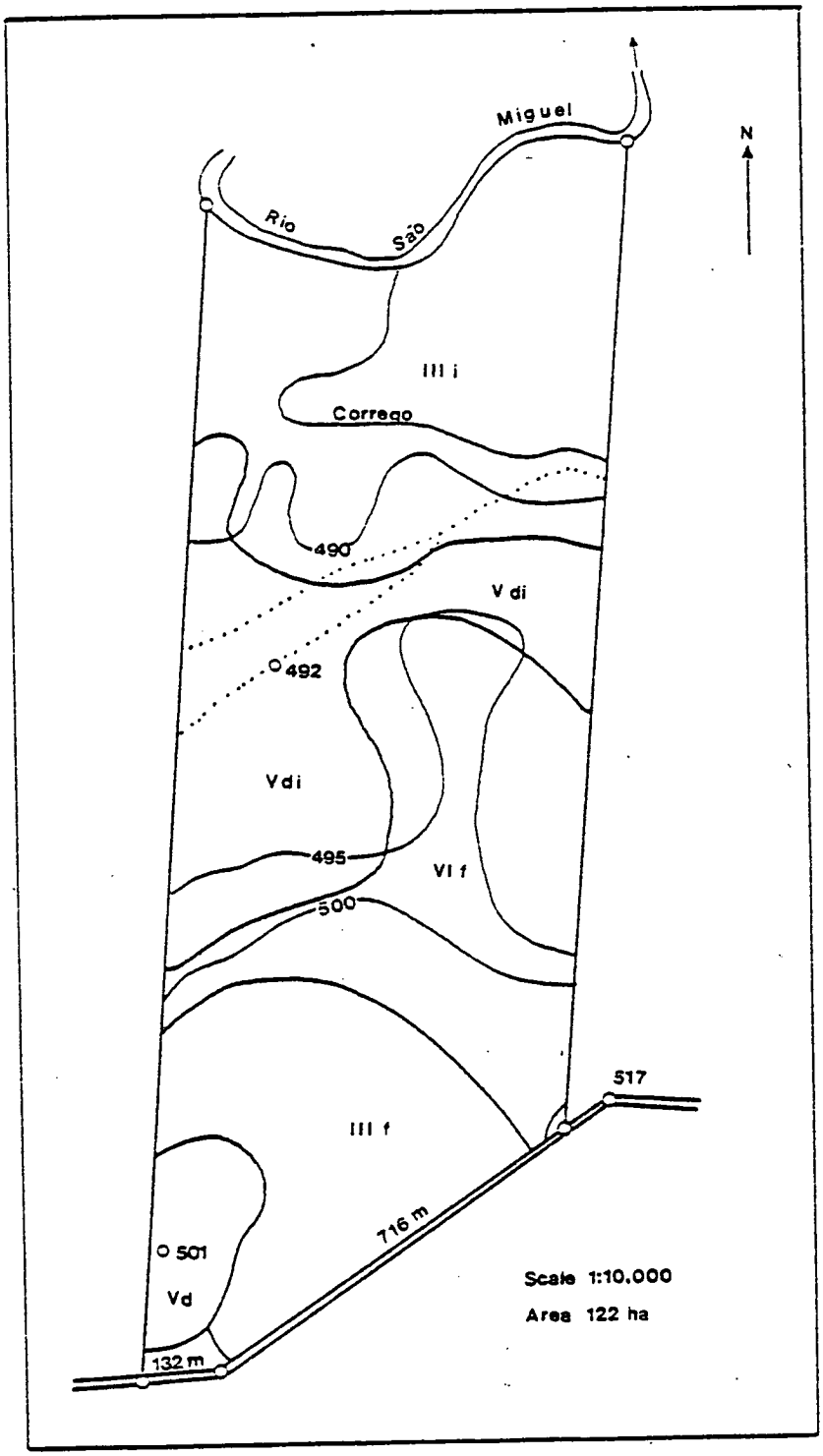


Figure 3.6: Map showing the distribution of land capability classes of a farming plot in the Sagarana project (capability classes as defined in 3.2). (After Pinheiro, 1974).

Table 3.7 Land "suitability groups" of the Gusmão project area (after EMBRAPA,1978).

Suitability groups	% of the total area
2(b)c	67
5n	17
2(b)c III	8
6	5
4(p)	2
2(a)bc	1
TOTAL	100

Table 3.8 Key for the interpretation of the land 'suitability groups'.

Suitability group	Potential use	Management systems		
		A	B	C
2(b)c	Crops (A & P)	Uns.	Restr.	Fair
2(b)c III	Crops (A)	Uns.	Restr.	Fair
2(a)bc	Crops (A & P)	Restr.	Fair	Fair
4(p)	Planted pasture	Uns.	Restr.	-
5n	Native pasture	Uns.	Restr.	-
6	Conservation of flora and fauna.			

A(Annual crops)
P(Perennial crops)
Uns.(Unsuitable)
Restr.(Restricted)

in the most advanced management system (C) where farming practices depend upon a high level of technical knowledge and intensive use of capital for improvement and maintenance of land conditions. A key for interpretation of the land suitability of the Gusmão project is presented in Table 3.8.

The main limiting factor for cultivation of crops in the Gusmão project is the low inherent fertility. As already stated in the characterization of the soils of the area, the Gusmão project's soils have low contents of exchangeable bases, high levels of exchangeable aluminum and they are also very deficient in phosphorus. A high level of management and capital application are needed to overcome these deficiencies. On the other hand, soils possess excellent physical properties which facilitate tillage and reduce the erosion hazard.

The agricultural potential of the Ouro Preto project is relatively high. As stated earlier, the soils of the Ouro Preto project are basically derived from basaltic materials giving high levels of plant nutrients. These soils are amongst the most fertile non-alluvial soils in the whole Amazon Basin (Radam, 1978; Wambeke, 1978; Sombroek, 1966).

Radam (1978) has classified the soils of the Ouro Preto project as having suitability "GOOD" for cultivation of crops in all management systems (A/B/C). The chemical properties of the Ouro Preto soils enable colonists to obtain relatively high crop yields without making use of chemical fertilizers, at least in the first few years.

Since the Radam surveys were at a reconnaissance level, based largely on the interpretation of radar imageries, it would be wrong, therefore, to conclude that the totality of the soils of the Project have "GOOD" suitability for cultivation of crops. In fact, in a survey of 60,000 hectares of land, Silva (1973) found that about 20 % of the area was not suited to cocoa-15 % was of "moderate suitability" (classes II/III), and 65 % of "GOOD suitability" for the cultivation of cocoa, as illustrated in the land capability map in Figure 3.8.

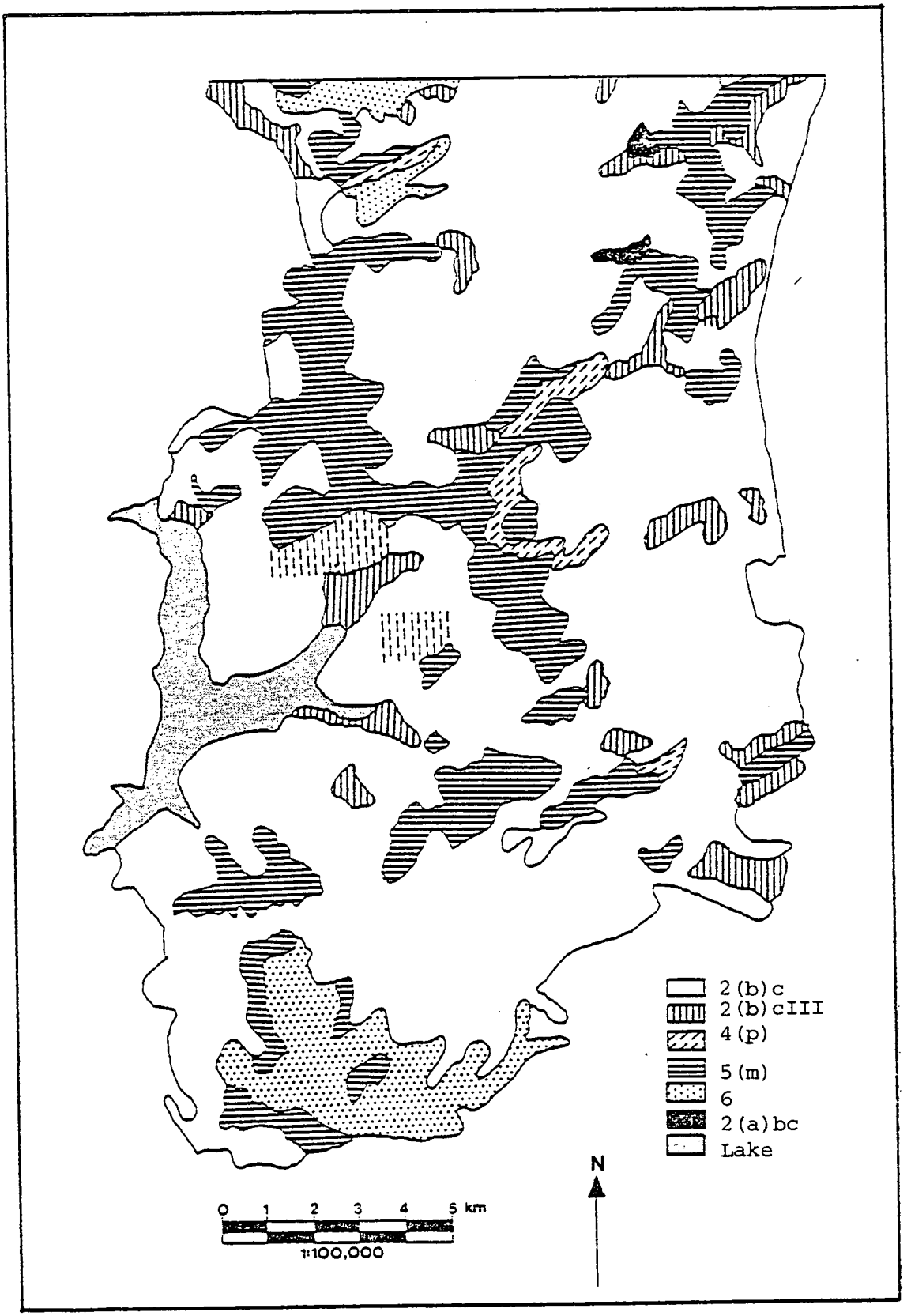


Figure 3.7 Land suitability map of the Gusmão Project (suitability groups as defined in Table 3.8).

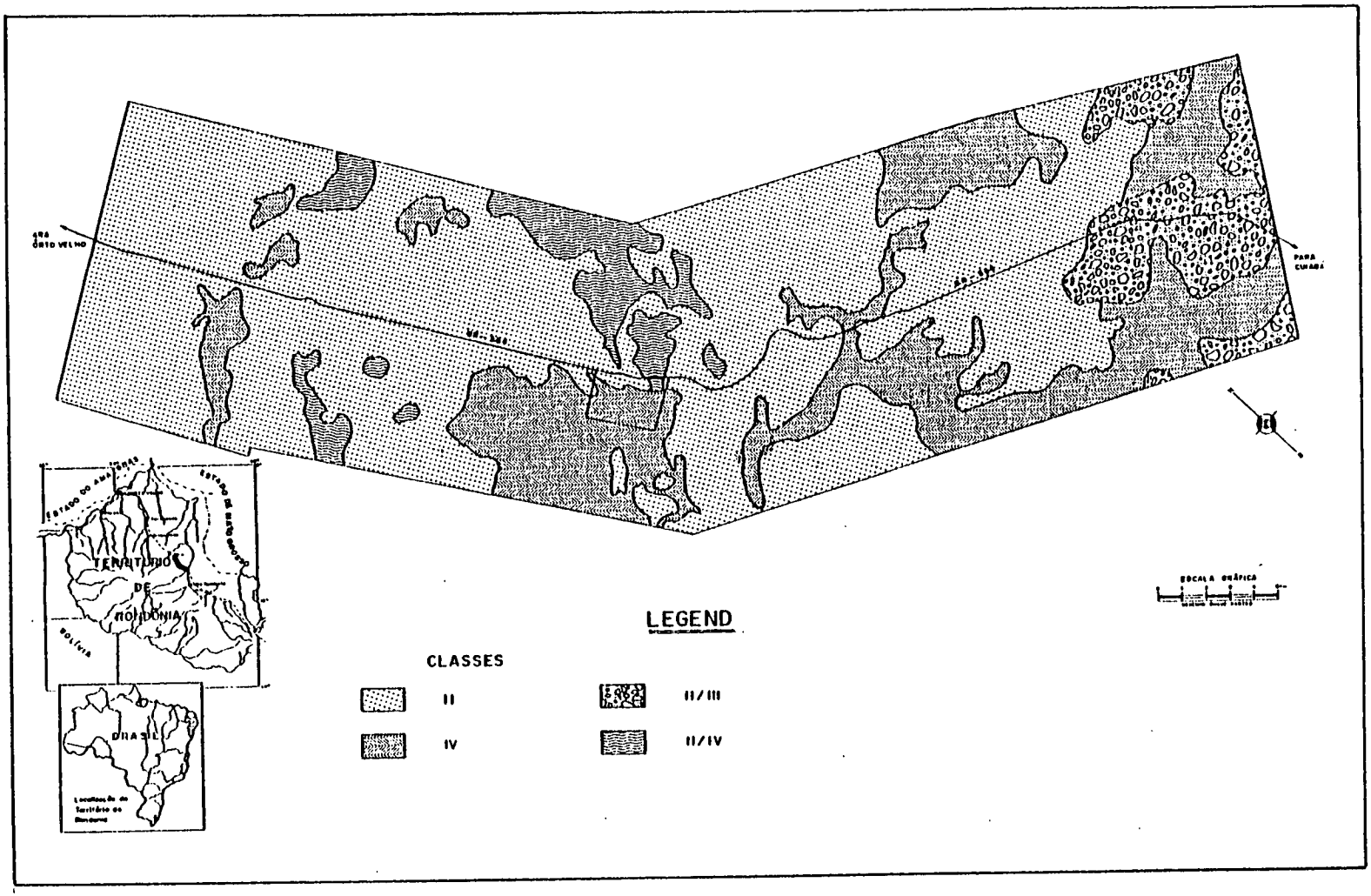


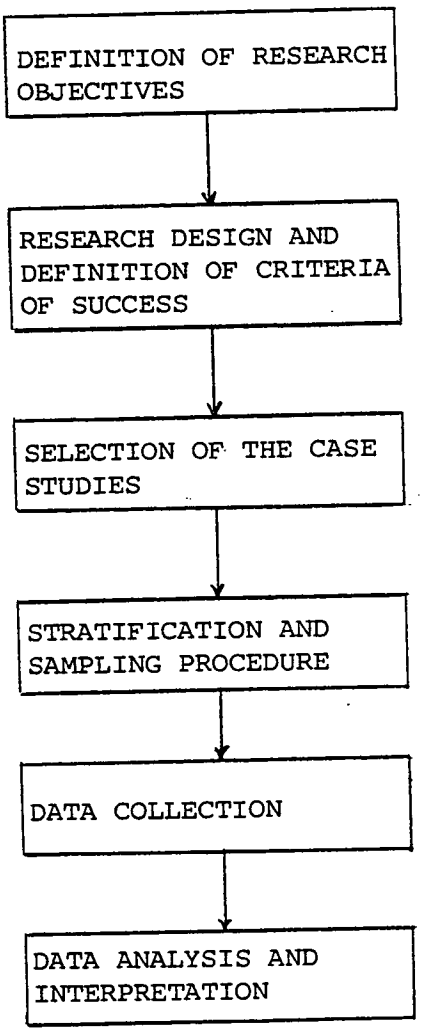
Figure 3.8 Land suitability map for cultivation of cocoa in the Ouro Preto project. II = 'Good suitability', III = 'Moderate suitability', IV = 'Unsuitable'. (After Silva, 1973).

In summary, as a generalization based on land quality, we can conclude that the agricultural potential of the Sagarana and Gusmão Projects is similar and very much lower than the agricultural potential of the Ouro Preto Project.

CHAPTER 4

METHODOLOGY OF THE CASE STUDIES

The steps involved in the methodology of this study are summarized in the flow diagram below. A detailed account of these steps with the exception of the definition of objectives (Chapter 1) and the selection of case studies (Chapter 2), is presented in the subsequent sections.



4.1 Research design

The overall method of investigation evaluates the effect of land quality on farming success by comparing the benefits obtained from farms with different land assets. The research included colonisation projects sited in areas covering a wide range of land qualities in two major environments: the tropical forest and the tropical savanna (cerrado).

However, in the establishment of any colonisation project, socio-economic and political factors also influence success. These non-land factors were also considered in the methodology. Inevitably, in the design of this research, a number of assumptions have had to be made. As the validity of the conclusions relies on these assumptions (in other words, the extent to which assumptions represent reality), they will be outlined before the other steps involved in the methodology.

It was assumed:

1. That colonisation projects carried out by the same settlement agency were established on the basis of similar policies, and also that the resources (finance, staff) available for the implementation of the projects were similar.
2. That people settled in the colonisation projects comprised, at the beginning of the projects, a fairly homogeneous group in terms of level of education, agricultural experience, family labour force and financial resources.
3. That in the implementation of the projects, colonists were provided with similar opportunities to obtain finance and advice on farming practices, to acquire inputs (fertilisers, lime, seeds, pesticides, agricultural machinery) and to sell produce.

These assumptions were based on five facts:

1. That the establishment of colonisation projects were governed by the same laws and decrees, such as: the Land Statute: Law No. 4504 (BRASIL, 1964); the Decree No. 56795 (BRASIL, 1965a) and the Decree No. 54428 (BRASIL, 1966);
2. That the projects were set up to achieve common objectives. The objectives can be broadly summarized as following:

2.1 To improve the standard of living, health and education of the colonist and his family and to provide the opportunities and conditions necessary for such progress.

2.2 To attach man firmly to the land.

2.3 To promote the rational exploitation of land resources.

2.4 To contribute to regional economic growth through:

- the taxes paid by colonists,
- the increased consumer buying power of settlers,
- the contribution to the food supply of urban centres and the reduction of regional food deficits for those agricultural products which can be locally produced.

3. that the colonisation agency assigned the responsibility for the implementation of the projects to one Department (the Department of Projects and Operations - DP). This effectively prevents duplication between departments;

4. that the implementation plans, known as P.O.'s, available for all projects, show that the guidelines laid out for the establishment of projects were rigidly followed, and

5. that Federal Agencies laid out rules which affected colonists in a similar manner. These rules govern the concession of agricultural loans and advisory services, and the establishment of subsidies for acquisition of fertilisers, lime, seeds, pesticides and other inputs.

Furthermore, colonists are obliged to live on their farms and to follow the guidance given by the project managers. Failure to do so could be penalized with expulsion from the settlement projects.

With these assumptions established, the next step was to define criteria to assess each settler's success. A settler's income from farming activities is spent in the provision of food, clothing, health care and travel for him and his family, and also in investment. Clearly, expenditure to meet demand of basic needs takes priority over investment (in other words no investment will take place unless the basic needs are met).

In general, colonists do not keep income as cash in banks or at home. Instead, they invest whatever they can save in acquiring possessions (cattle, horses, pigs, tractors, ploughs, cars, refrigerators, television sets) or making improvements to their farms (building of store houses, grain stores, water-holes, dams, corrals, pig-sties, fences etc). Therefore, the basic criteria used in this study to assess a settler's success were measurements of possessions and farm improvements. The items measured were grouped under the following categories:

1. livestock,
2. agricultural machinery,
3. farm buildings,
4. house, housing appliances, and
5. mechanized means of transportation.

By this approach, the greater the number of material possessions, both personal and agricultural, that a settler owns, the higher the economic success attained.

Hereafter, the term "indicator" will be used to refer to any of the five groups of possessions.

With farms stratified according to land quality and with the aid of the indicators outlined above, relationships between land quality and success were then investigated. The stratification of farms is dealt with in 4.2.

Statistical analyses of the data were carried out within projects. The purpose of the statistical analysis was to find out whether differences in land quality were causing differences in the success rate. Standard statistical methods such as analysis of variance, F-tests, and t-tests were employed.

The following example relating to the Gusmão case study will clarify the statistical procedure. Farms which comprise the Gusmão project were stratified based on land quality into two strata (A and B) (see 4.2 and 7.3). Following this 9 farms from each stratum were randomly chosen for their owners to be interviewed. The indicators of success outlined previously were then measured.

The success achieved by each settler in the "agricultural machinery" indicator was assessed by the compilation of scores in "agricultural machinery" (a.m.). Scores in a.m. were compiled through the following weighted formula:

a.m. = Σ 2(tractors) + ploughs + harrows + cultivators + spraying machines + threshing machines + sowing machines + diesel engines

The 18 scores in "agricultural machinery" are illustrated in Table 4.1.

TABLE 4.1 Scores for the "agricultural machinery" indicator on the Gusmão Project.

	LAND QUALITY STRATUM	
	A	B
	2	3
	3	5
	6	6
	7	6
	7	6
	7	8
	7	9
	8	9
	10	10
$\bar{X}$	6.3	6.8

To test whether the means 6.3 and 6.8 were significantly different two steps were followed :

1. analysis of variance was computed, and
2. an F-test was performed.

The results of the analysis of variance of data on agricultural machinery in the Gusmão project are shown in Table 4.2.

TABLE 4.2 Analysis of the variance for the indicator "agricultural machinery".

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares
Between categories of Plots (A,B)	2	8.53	8.53
Within categories	16	81.75	5.10
TOTAL	17	90.28	—

The next step was to carry out the F-test. The F-test involves the execution of four steps:

1. the establishment of the null hypothesis,
2. the compilation of the F-ratio,
3. the comparison of the F ratio observed with the F-table obtained in standard statistical tables for the distribution of F, at a given level of significance, and
4. the rejection or acceptance of the null hypothesis.

The null hypothesis for the indicator "agricultural machinery" is that the means A(6.3) and B(6.8) are identical, at the 5 % level of significance. This hypothesis will hold if the F ratio observed is smaller than the F-table for the distribution of F. Otherwise, the null hypothesis will be rejected.

By definition the F observed is the result of the division of the mean square between categories of plots (8.53) by the mean square within categories (5.10). Hence, the F observed =

$$\frac{8.53}{5.10} = 1.67.$$

The F-table for the distribution of F with one and sixteen degrees of freedom, at the 5 % level of significance is 4.49.

Since the F observed (1.67) is smaller than the F-table (4.49), the null hypothesis that the means (A = 6.3) and (B = 6.8) are identical cannot be rejected. Thus, the conclusion is that there is no difference in the degree of success measured through the indicator "agricultural machinery" for colonists farming plots with different land assets.

The procedure applied for this example was applied in turn to the other indicators. The scores on the other indicators :- "domestic animals", "farm buildings" and "material possessions" achieved by each settler were arrived at by the following formulas:

- "Domestic animals" (D.a) =

  D.a = Σ cattle + horses + pigs

- "Farm buildings" (F.b) =

  F.b. = Σ store houses + grain stores + maize stores + corrals + pig-sties.

- "Possessions" (P)

  P = Σ 2(cars + vans) + refrigerators + television sets + radios + gas cookers + electricity + piped water + water filter.

Apart from analysis of variance and F tests, other statistical analysis relevant to the data available were also carried out including cross-tabulations and correlations (see 4.3).

Furthermore, the overall degree of success attained by a colonisation project was appraised subjectively by comparing the development to date of a project against the objectives it was established to fulfil. For example, the number of settlers who have left a project was used as an indicator of the objective 'to attach man firmly to the land.' Another example was the adoption of up-to-date farming practices and analyses of the areas farmed, as indicators of the fulfilment of the objective 'to promote the rational exploitation of land resources'.

4.2 Stratification and sampling procedure

As pointed out in Chapters 2 and 3, the rain forest - where the Ouro Preto project is sited - and the cerrado, where the other two case studies are sited, can be distinguished by the quality of their land for agricultural development.

Furthermore, variations in land quality also occur within the area of each project. Because of these variations relationships between land quality and success could be appraised at the individual project level.

Stratification of a project area was based on maps and descriptions of land resources available for the area. The scale of the maps determined the detail of the stratification. For the Sagarana project, maps were available at a scale of 1:50,000; for the Gusmão project 1:100,000 and for the Ouro Preto project 1:125,000.

The overall methodology employed in the stratification of farms consisted of:

1. superimposing the farm allotment map on land capability or soil maps,
2. estimating, for each farm, the areas occupied by different land capability classes or soil types, and
3. grouping farms into categories.

Farms were then randomly selected from each category for the purpose of interviewing the owners. The percentage of farms selected from each category varied according to the total number of farms per category. A detailed account of the stratification is presented for each project in the relevant chapters dealing with individual projects (5.3, 6.3, 7.3).

4.3 Data collection

The collection of data occupied a period of 16 months (October 1979 - February 1981). Half of this time was spent in a review of literature, in making contacts, in planning the field work and in writing reports. The other half was spent on the site of the colonisation projects themselves.

Data were obtained at the project level and at the farm level. At the project level information was sought about:

- the objectives of the project,
- its history and development,
- its present administration,
- the services provided to settlers,
- regulations governing the selection and organisation of colonists,
- economic activities, agricultural production, productivity, marketing and farming practices.

At the project level, information was collected by means of informal interviews with the staff of organisations involved in the agricultural development of the region. Further information was obtained from records depending upon their availability.

Information at the farm level was obtained through interviews of 155 colonists: 105 colonists in the Ouro Preto Project, 32 in the Sagarana Project and 18 in the Gusmão Project. Interviews were conducted personally using a standard questionnaire, a copy of which is included (Appendix 2).

The questionnaire was designed to provide data on possessions (the indicators of success outlined in 4.1) and general information necessary to acquire an understanding of the project as a whole. The former included questions on:

- livestock (cattle, horses, pigs and poultry),
- agricultural machinery (tractors, harrows, ploughs, threshing machines, cultivators, spraying machines),
- farm buildings (store houses, grain stores, maize stores, corrals, pig-sties, water holes, dams),
- housing appliances (television sets, radios,refrigerators, gas cookers, water filters),
- mechanized means of transport (car, vans, trucks).

While the latter included questions on:

- settler's family size, province born, migration, agricultural experience and financial resources before becoming a colonist, and
- land use, crops cultivated, areas farmed, productivity, farming patterns and marketing.

The data are summarized in Tables which are presented in the chapters dealing with individual case studies. The raw data for the 155 colonists interviewed is presented in Appendix 1.

4.4 Data analysis

Data obtained from questionnaires were organized into forty-five quantiative variables and thirty qualitative variables. Quantitative variables such as settler's family size, cattle, horses, pigs, tractors required only simple tabulation. However, some conversions were necessary. Measurements of weight used by

settlers such as: 'alqueire', 'balaio', 'carro', 'lata' were converted into kilograms. Figures of seed planted were converted into hectares of area farmed.

All qualitative data such as farming practices, settler's origin, agricultural experience and house conditions were coded according to the ranges of response provided by settlers. Most of the qualitative questions required only simple answers: 'yes', 'no' or 'unknown'.

All the coded data were fed into the computer of the University of Edinburgh Regional Computing Centre; for the preparation of simple summary tables and conduct of statistical analysis.

The Statistical Package for Social Science (SPSS) by Nie (1975), version H of June 1979 was used. It offers the facilities necessary for the conduct of the analyses needed in the assessment of criteria of success defined in (4.1). The subprograms "ONE-WAY' and "ANOVA' were used for performance of analysis of variance and F test. The subprograms "CROSSTABULATION', "FREQUENCY" and "BREAKDOWN" were employed to estimate statistics such as: mean, median, mode, and measures of association (Cramer's Somers, Kendall's Tau b coefficients).

CHAPTER 5

THE OURO PRETO INTEGRATED COLONISATION PROJECT.

The Ouro Preto project is located in the western part of the Amazon Basin in the Federal Territory of Rondônia (RO) (Figure 5.1). It is the oldest and largest official colonisation project in the region administered by the National Institute for Colonisation and Land Reform (INCRA). It was created in 1969 through the Decree number 63104 of 15/08/69, occupies an area of 512,585 hectares including the four subdivisions referred to as POP1, POP2, POP3 and POP4 (Figure 5.2). At the end of 1979, it was housing 5050 families officially settled by INCRA. In addition to the four socio-economic objectives of colonisation already mentioned (4.1), the Ouro Preto project was established as part of the efforts of the Federal Government in setting up colonisation projects in the Amazon Basin for political reasons (establishment of political presence).

5.1 Geographical Location.

The Ouro Preto Project lies in the centre of Rondônia latitudes 10°07 and 11° 07'S; longitudes 61° 39' and 62° 41' W, between the kilometres 250 and 368 of the unpaved BR-364 road (Figure 5.1). This road (1500 km long), links Porto Velho, the capital of the Territory, and Cuiabá, the capital of the Mato Grosso do Norte State.

In the rainy season, traffic along the BR-364 road, the only terrestrial link with the centre-south of Brazil, nearly comes to a halt with serious consequences to trading. The economy of the Territory is heavily dependent on the importation of industrial goods from the Centre-south and the export of agricultural and forest products. The remote geographical location, together with the costly and inadequate means of transport present severe disadvantage to settlers in the Ouro Preto project compared with settlers in the Sagarana and Gusmão projects (Chapters 6, 7) which are closer to consumer centres.

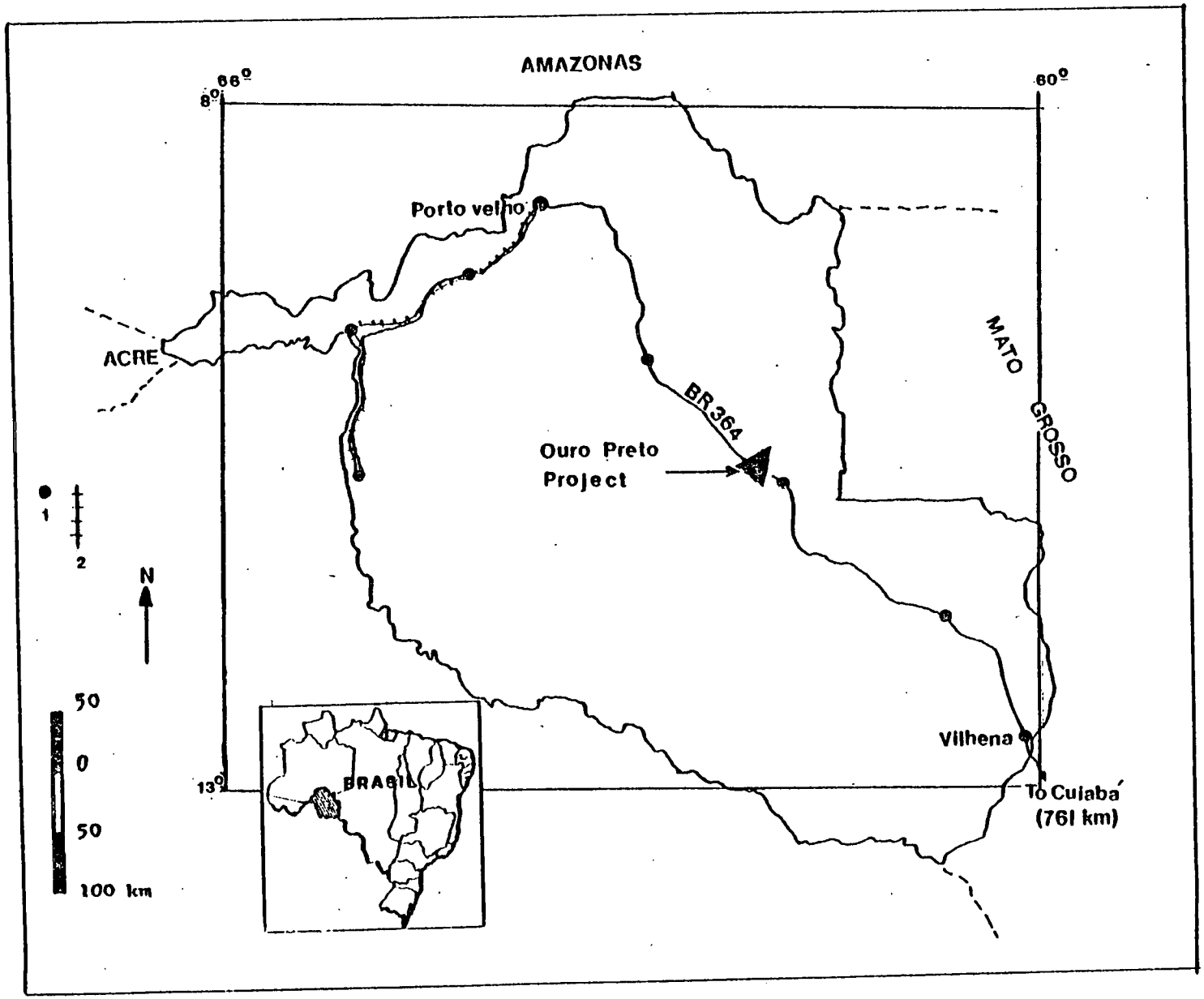


Figure 5.1 Location of the Ouro Preto Project in the Territory of Rondonia. 1 = Urban centres
2 = former rail roads.

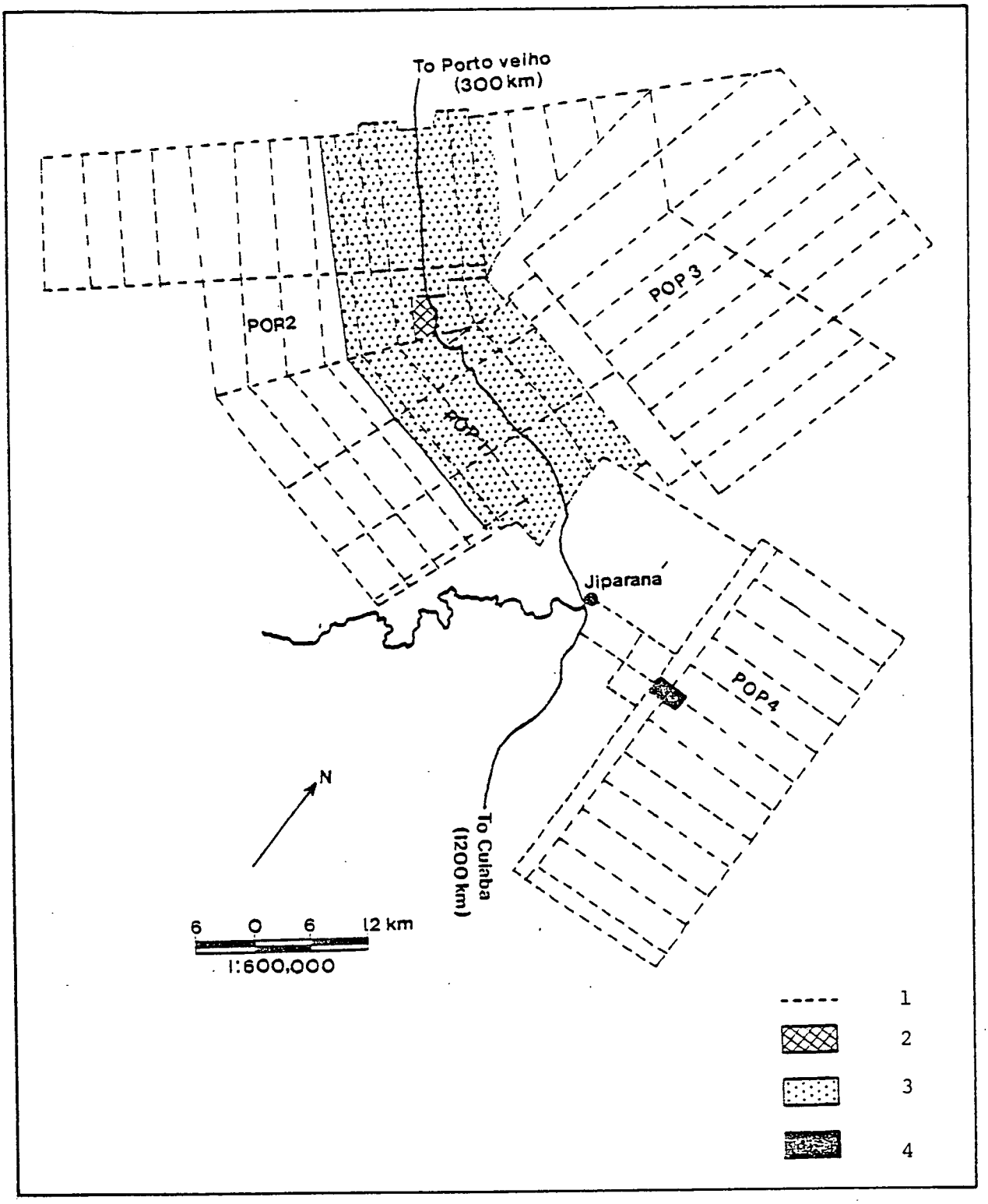


Figure 5.2 Ouro Preto Project and its four sectors (POP 1, POP 2, POP3, POP 4). Feeder roads (1), main administrative site (2), studied area (3); secondary administrative site (4).

5.2 Establishment of the Project

5.2.1 Historic aspects of the colonisation of the region.

Until the middle 40's nearly all migrants to the Territory came from the north and the drought-stricken north east of the country. They settled along the main navigable rivers (Madeira, Mamoré) in the north west. Their principal economic activity was the gathering of forest products mainly rubber and the cultivation of subsistence crops (rice, beans, cassava, maize).

The decline of the demand for Brazilian rubber in the 40's, coincident with the end of World War II and normalisation of rubber production by Asian countries, the lack of private enterprise, and the growing demand for food, contributed to the setting up of colonisation projects by the Territory authorities. In the following two decades seven colonisation projects were set up along the "Madeira-Mamore' railroad linking Porto Velho to Guajará-Mirin, 350 kilometres away. These projects made very little progress. Their failure is attributed to a combination of factors such as: poor soil fertility, lack of government technical and financial support, inadequate management, remoteness and the settlers background as gatherers of forest products (Wesche, 1978). With these deficiencies, the establishment of commercial agriculture did not materialize, settlers continued to practice subsistence agriculture.

In 1970 the Territory was still one of the least populated regions of the country. It had a population of 111,064 inhabitants living in an area of 243,044 sq. kilometres (IBGE, 1977). Half of the population was living in the two main towns of Porto Velho and Guajará-Mirin. In addition to the low density (0.45 persons/ sq. km), the other striking feature of the population was its irregular spatial distribution concentrating mainly in the north-west.

The construction of the BR-364 road, opened to traffic in 1967, marks the beginning of an intense migration to the Territory. Most of the migrants were former agricultural labourers and smallholding farmers in the southern states.

These people were being pushed out of the region by the intensification of mechanisation and substitution of coffee plantations by soya-bean and wheat. This fact, and the prospects of becoming owners of a 100-hectares farm of fertile land according to government publicity accounts for the high migration to the Territory. Eighty-one per cent out of 2820 settlers of the Ouro Preto Project migrated to the region to acquire land (Pacheco, 1979).

Between 1970 and 1978 the annual rate of population growth of the Territory averaged 21 %. The population passed from 111,064 to 518,900. This population increase occurred mainly along the BR-364 road, in or near the seven official colonisation projects set up by INCRA in the period 1970-1975 (Figure 2.1). The central region where the Ouro Preto project is sited has the fastest rate of population growth in the Territory. Against this simplified historic background the Ouro Preto project was set up.

5.2.2 Site selection

The decision to establish the Ouro Preto Project came in 1968 after a visit to the Ouro Preto region by officials from the former Brazilian Institute for Agrarian Reform (IBRA). They went there to study the private colonisation project which was being set up by 'CALAMA', in the Ji-Parana county. They were impressed by the relatively high fertility of the soils and the rate of immigration to the region (Wesche, 1978). Shortly after this visit the Ouro Preto project was created. The primary aims were to avoid illegal appropriation of land by private firms and individuals and to conduct the settling of migrants in small farm units.

The selection of the site for the establishment of the Ouro Preto Project was not preceded by a detailed assessment of the suitability of the land resources for agriculture. However, the relatively good crop performance observed in the CALAMA project was taken as an indication of the agricultural suitability of the area. Three main aspects were observed in the selection of site.

There were:

a) availability of a large tract of unoccupied public land,

b) accessibility by the BR-364 road and,

c) nearness to areas already settled.

Speed and pragmatism in the choice of site was needed to avoid the occupation of the area by squatters. The first families of migrants were settled by INCRA, shortly after the selection of the site in 1970.

5.2.3 Implementation of the Project

The implementation of the Project followed INCRA's general methodology for setting up colonisation projects 'Metodologia para programação operacional dos projetos de assentamento de agricultores' (INCRA, 1971). The methodology deals solely with the executive aspects of colonisation projects. In other words, it is only applicable when a decision to set up a project has been made, the site has been chosen and the size of plots already been established. The importance of these factors upon the development of the Project will be assessed in the evaluating sections.

INCRA's methodology consists of the execution of 12 basic 'programmes' referred to in the annual plans 'Programação Operacional' (P. O. as 'Atividades'). Each programme is treated as an autonomous activity, since in its execution specific procedures are followed aimed at achieving specific goals. Half of the 12 basic programmes are executed directly by INCRA, i.e., their execution is entirely within INCRA's power. These programmes are called the "Determined Execution". The other half is called the "Promotional and/or Integrational Execution". The latter are supposed to be executed by other government organisations or even by the settlers themselves. INCRA should only deal with them in the role of a co-ordinator. Briefly, the basic programmes and their specific objectives are:

A - Programmes of the "Determined Execution".

- *Programme 1 - 'Land acquisition and re-allocation settlers'*

This programme aims firstly, at acquiring legal possession of the land and secondly at issuing land title to settlers.

- *Programme 2 - 'Agrarian organisation'*

This programme aims at defining the agrarian structure of the project. It deals with the demarcation of plots, the lay-out of roads, the allocation of land for the administration, industries, and for the establishment of community services (education, health, etc.).

- *Programme 3 - 'Organisation of the Project administration'*

This programme aims at setting up an 'effective administration capable of making the best use of the resources at its disposal'. It includes the definition of the technical and non-technical staff needed and the financial and material means for executing the other programmes.

- *Programme 4 - 'Settling of immigrants'*

This programme aims at accommodating settlers in the plots. It includes the selection of colonists, allocation of plots and initially, a 6 month non-repayable grant to cover living expenses during the settling in period.

- *Programme 5 - 'Organisation of the farming units and the agricultural development plan'*

This programme aims at promoting the 'rational utilisation of land, labour, capital and technological resources'. It includes the design, at the farm level, of the agricultural land use plan, and to provide the technical assistance for its implementation.

- *Programme 6 - 'Physical infra-structure'*

This programme aims at providing the Project with the basic infra-structure necessary for its development. It includes the construction of farm access roads, bridges, irrigation channels, drainage works, to support the rational utilisation of the farm units.

B - Programmes of the "Promotional and/or Integrational Execution".

- *Programme 7 - 'Education';*
- *Programme 8 - 'Health and Social Welfare';*
- *Programme 9 - 'Housing'.*

These programmes are of "promotional execution" and aim respectively, at:

a) establishing an adequate educational system;
b) a medical, dental and social welfare assistance, compatible with settlers needs, and
c) a housing system within the standards defined by the competent housing authorities.

INCRA's role is to make contact with the regional authorities, providing them with information and logistic support for the implementation of the programmes. INCRA may also provide incentives (such as exemption from taxes), to attract private individuals (doctors, dentists, etc.) to settle in the area.

- *Programme 10 - 'Co-operation'*

This programme aims at establishing a settlers' co-operative, to organise crop production, to provide mechanisation and to acquire necessary inputs (such as fertilisers, seeds and pesticides).

- *Programme 11 - 'Agricultural credit'*

This programme aims at securing the financial resources necessary for settlers to implement the recommended agricultural plan. Credit was to be obtained from banks and other credit institutions. The ultimate responsibility for repaying loans lies with settlers. INCRA's role was to provide settlers with land titles, to determine the amount of credit needed and to help in the establishment of contacts between settlers and bank managers.

- *Programme 12 - 'Marketing'*

This programme aims at promoting the establishment of an adequate system of marketing for agricultural produce. To help, the construction of grain storage facilities and the establishment of industries are envisaged in this programme.

In the implementation of each programme three phases are distinguished. These are:

a) "implantation",
b) "consolidation", and
c) "emancipation".

By the end of each phase, a number of stages would have been reached. For instance, in Programme 5 - (Organisation of the farming units and the agricultural development plan), these phases are characterised as follows:

a) *'Implantation':*

a.1 design of the provisional agricultural land use plan for individual plots;

a.2 establishment of agricultural experimentation trials;

a.3 definition of a system of technical assistance and,

a.4 assessment of the first results.

b) *'Consolidation'*

b.1 design and establishment of a definite land use plan including perennial cash crops based on land capability studies;

b.2 assessment of the results (crop yields, land deterioration, etc.) and,

b.3 achievement by settlers of a minimum annual income.

c) *'Emancipation' (Transfer of authority from INCRA)*

c.1 transfer of the co-ordination of crop production to the settler's co-operative, and

c.2 transfer of the administration of the plots to the settlers.

At any one time different programmes are found at different phases of implementation. In large projects such as the Ouro Preto project, for example some colonists received land titles back in 1974/1975, whilst others were still being settled in 1980.

These 12 programmes attempt to cover all aspects necessary to support the establishment of a permanent settlement in the area with agriculture as the main economic activity. Since agricultural success depends largely on the land resources, one of INCRA's first steps was to make arrangement for the survey of the resources. In this respect, in 1971, INCRA signed an agreement with the Executive Commission for the Cocoa Development Plan (CEPLAC). This Commission had been operating successfully since 1957. Under the agreement, CEPLAC was responsible for investigating the potential of the area for agriculture in general, and cocoa plantations in particular.

The first results of CEPLAC's studies were published in 1973 (Silva, 1973). Their report referred to an area of 60,000 hectares and led to the conclusion that both pedologically and climatically, the area was more suitable for tree crops than

for subsistence crops (such as rice, maize, beans). Sixty five per cent of it was classified as class II ("Good suitability"), 15 % as class II/III ("Moderate suitability") and the rest as unsuitable for cocoa. With the expansion of the Project more land was surveyed. By 1977 a total of 230,000 hectares of land had been surveyed (Dias, 1976; Carvalho, 1976a; Silva, 1973). Reports of these surveys accompanied by maps of soil and capability classes for cocoa, at a scale of 1:125,000 confirmed the results of the first survey in 1973. Some of these maps are presented in Figures 3.2, 3.3, 3.4 and 3.8.

CEPLAC not only conducted land capability studies but it also set up the Ouro Preto Experimental Station to study cocoa. An advisory service for cocoa growers to support the establishment of plantations was also established by CEPLAC in the region. In 1980, CEPLAC's technical staff in the Project consisted of 6 agronomists, 3 tree-crop specialists and 10 middle-level technicians working as extension agents.

Despite the suitability of the area and the technical support provided by CEPLAC, only a small proportion of settlers became cocoa growers. This will be shown in sections 5.4 and 5.5. However, cocoa growers are amongst the most successful settlers in the Project.

While land capability studies were being carried out by CEPLAC, migrants were being settled by INCRA in 100-hectare plots. By regulation, 50 % of the area of each plot had to be kept as 'forest reserve' for conservation. The 100-hectare plot size was established arbitrarily. It was not based on specific studies of land capability, labour availability or the type of agriculture to be practised. The physical lay-out of plots followed a geometric grid pattern as illustrated in Figure 5.2. The main road which runs through the Project is the BR-364 and there are plots to either side. Every 9 kilometres a secondary road was constructed, perpendicular to the BR-364. These 'feeder roads' give access to the "Glebas". Every 4 kilometres there is a road perpendicular to the secondary road which gives access to the plots. Plots are rectangles of approximately

500 by 2000 metres and are again located on both sides of the farming plot-access roads.

There are in the Project 46 plots of 200 hectares where livestock was to be the main economic activity. In addition. since 1980 migrants are being settled in 50 hectares plots. The reduction of the size of plots was a political decision based on a number of reasons. The main one was that in the 70's there was an overdemand for plots. As a consequence, many migrants were not settled by INCRA. With the reduction in the size of plots, INCRA will double the number of families settled in a given area. This will help to reduce the number of immigrants seeking farming plots.

The Ouro Preto Project has achieved a great deal in relation to the number of families settled. The original target of families to be settled (500) was exceeded in 1972 only two years after its creation. By the end of 1976, 4670 families had been settled. In the following three years (1977/1979), the number of families settled was relatively small. By the end of 1979, there were 5050 families officially settled (Table 5.1). In 1980, settling of migrants was still going on. Between January/June, 2165 families applied for a plot in the Project and 1655 of them were chosen to become settlers.

The high demand for plots in the early days of the Project caught its administration unprepared. From 1974 to 1979 the majority of families settled in the Project area without INCRA's approval. Most of them settled on the fringe of the Project as squatters. They demarcated plots following the same INCRA's geometric pattern. Later INCRA recognised them as settlers.

Up to July 1980, 4060 settlers (i.e. 80 % of the official number) had already received land titles. The rest had already received the "Autorização de ocupação" (A.O.) or provisional land title. With the former, settlers have access to long-term credit for farm improvements, while the latter only entitles settlers to receive seasonal credit.

TABLE 5.1: Cumulative number of colonists settled in the Ouro Preto Project (1970-1979)

Year	Total No. of Colonists
1971	496
1972	579
1973	2952
1974	3200
1975	3700
1976	4670
1977	4750
1978	4800
1979	5050

In addition to the families settled by INCRA there are many families living in the Project area as sharecroppers, salaried workers or simply as residents. The system of sharecropping takes many forms. The simplest one is when the sharecropper hands over to the land owner a part of the crop production. In some cases the sharecropper keeps the whole production of subsistence crops which are intercropped with coffee, in exchange for looking after the coffee plantation in its first three years.

During the field sampling of 105 plots, it was found that there were, in fact, 212 families. In other words, there were 105 official settlers together with 107 unofficial settlers. However, for the Project as a whole the ratio unofficial settler/official settler should be smaller because only plots which had officially been allocated to settlers for at least seven years were considered in this study (Chapter 2, 5.3). It is common for a migrant family arriving in the Project to stay with a settler, often a relative or friend, until a plot is allocated to him by INCRA. Alternatively, he becomes a squatter on the fringe of the Project area and waits for INCRA to recognise him as a settler. A squatter acquires land ownership rights if he has been occupying

less than 100 hectares of public land for at least one year, have cultivated the land using family labour, and have no other farm land in his name.

One third of the settlers interviewed came from the southern state of Parana (PR), 39 % came from the south-eastern states (ES, MG, SP, RJ) and 22 % from the former "Mato Grosso" state (MT) (Table 5.2). The settlers came from regions where agriculture is relatively well developed. They usually have experience with more advanced practices of crop management employed in commercial plantations in the southern states. Their agricultural background will be shown to be an asset for the development of the Project.

Table 5.2: Number of colonists born in each state and last place of residence.

Abbreviation of States	Number of colonists born in each State	Last place of residence before moving to the Project
MG	37	12
ES	28	24
SP	06	03
RJ	02	01
RS	03	00
SC	03	00
PR	03	35
GO	01	01
MT	00	24
CE	08	02
BA	06	01
PE	04	00
PB	02	00
AL	01	00
SE	01	00
RO	00	01
TOTAL	105	105

It was not possible to obtain data on the cost per family settled. The revenue for selling plots to colonists only covers part of the total costs because the price charged was set at a very low level, about CR $ 10.00 per/hectare i.e. U.S. $ 70 cents (in December 1972).

Despite treating each of the 12 programmes as an autonomous activity, it is clear that they are inter-related and mutually dependent. The division into programmes was only done for planning reasons.

Some programmes were implemented successfully, some fell short of their targets and others were never implemented. Targets for the demarcation of plots, number of migrants settled and issuing of land titles were satisfactorily achieved. On the other hand, the building of feeder roads fell short of its targets and the design of agricultural land-use plan, at the farm level, was not executed at all. The implications of the role of the management in the success of the Project, will be assessed in 5.5.

5.3 Definition of categories of farms based on land quality and sampling procedure.

The study of the relationships between land quality and success of settlers in the Ouro Preto project included colonists settled in an area of approximately 60,000 hectares. This area is roughly the area referred to as the Ouro Preto project, sector 1 (POP1).

The Ouro Preto project was originally confined to the POP1 area. However, as mentioned in the previous sections, the project has grown enormously. In 1980 it comprised four sectors (POP1, POP2, POP3 and POP4); it occupied an area of 512,585 hectares and housed 5050 families of colonists (Figure 5.2).

The investigation was confined to the POP1 area for two main reasons:

1 - an adequate length of time during which colonists have lived in the area as official settlers. By 1980, they had already been living in the POP1 area for at least seven years. I assumed that this period of time was long enough for a colonist to develop most of his plot.

2 - The opportunities the colonists have had in the POP1 area to develop their plots were assumed to be very similar. They should have had the same chances to obtain credit and technical advice. They should also have had the same opportunities to sell their produce, and to benefit from the overall guidance provided by the management of the Project.

Colonists outside the POP1 area have occupied plots within the area for shorter lengths of time. It is clear that a colonist who has been in the area for over seven years should have had more opportunities to develop his plot than the one who settled in the area four years or more later. Therefore, in order to study the most homogeneous group of settlers, the colonists outside the POP1 area were excluded from the investigation of the relationships between land quality and settler's success (Figure 5.2).

5.3.1 Definition of the land quality (soil fertility) employed in the stratification of farms.

As stated in Chapter 3, the majority of the soils of the Ouro Preto project have medium to high inherent fertility indicated by the relatively high sum of exchangeable bases and low contents of exchangeable aluminum. Silva (1973) grouped the soils of the POP1 area into 3 categories based on the value/saturation with bases (V). These categories are :

- Eutrophic soils (soils with more than 50 % of saturation with bases throughout the soil profile). The "Ouro Preto", "Rondônia" and "Viveiro" soil mapping units fall within this category. The first two were described in Chapter 3.
- Mesotrophic soils (soils presenting between 30 and 50 % of saturation with bases throughout the soil profile). The "Xibiu" soil mapping unit described in Chapter 3, belongs to this group of soils.
- Dystrophic soils (soils with less than 30 % of the saturation with bases). The "Paraiso", "Vermelhão" and "Alluvial" mapping units belong to this category of soils. (Figure 3.2).

As illustrated in Table 5.3 the nutrient status of the mesotrophic soils and the eutrophic soils do not differ very much. On

TABLE 5.3: Chemical properties of the soils of the Ouro Preto project POP1 sector (After Silva, 1973).

Soil Horizons	EUTROPHIC SOILS												MESOTROPHIC SOIL				DYSTROPHIC SOILS							
	"OURO PRETO"				"RONDONIA"				"VIVEIRO"				"XIBIU"				"PARAISO"				"VERMELHAO"			
	meg/100g soil		%	pH in H_2O	meg/100g soil		%	pH in H_2O	meg/100g soil		%	pH in H_2O	meg/100g soil		%	pH in H_2O	meg/100g soil		%	pH in H_2O	Meg/100g soil		%	pH in H_2O
	S*	T**	V***		S	T	V		S	T	V		S	T	V		S	T	V		S	T	V	
A	5.9	8.6	66	6.4	3.6	4.6	77	5.9	3.6	4.6	77	6.0	3.8	6.2	59	6.3	1.1	3.5	31	5.2	1.3	4.5	25	5.0
B	5.8	7.8	74	5.9	2.6	3.7	70	5.1	2.2	3.6	61	5.4	2.2	4.6	48	5.2	0.6	3.8	16	4.7	0.9	3.7	27	4.7

*S = Ca + Mg + Na + K

**T = S + Al + H

***V = 100 x S/T

the other hand, the nutrient status, indicated by the parameters S, T, V, and pH, of the dystrophic soils are very much lower than the other two categories of soils.

The total amount of eutrophic, mesotrophic and dystrophic soils making up the areas of the farming plots of the POP1 area were used in the stratification of farms into two categories of plots (A and B) which are defined next.

5.3.2 Stratification of farms

Farms were stratified using the overall methodology outlined in 4.2, consisting of:

a) superimposing the farm allotment map on the soil map. The 1:125,000 soil map of the Silva's (1973) soil survey was used;

b) estimating for each farm the areas occupied by each soil type. Areas were estimated by means of a dot grid with 25 dots per square centimetre;

c) grouping farming plots into plots "A" or "B".

The two categories of plots were defined as follows:

"PLOT A" (medium to high nutrient status). This category included farming plots with more than 50 % of soils with medium to high fertility. The 401 farming plots which fell within this category have on average 92 % of their areas made up of soils with medium to high inherent fertility, and

"PLOT B" (low nutrient status). This category included farming plots with more than 50 % of their areas made up of soils with low nutrient status (the dystrophic soils). The 179 plots which comprised this category have on average 80 % of their areas made up of soils with low nutrient status, as illustrated below:

	Soil nutrient status (%)	
Category of plots	Medium to High	Low nutrient status
A	92	8
B	20	80

Forty and twenty-one plots from categories A and B, respectively, were then chosen for the purpose of interviewing the settlers.

In addition to the 61 settlers interviewed in the POP1 area, 44 colonists who settled on the fringe of the POP1 area (POP2 and POP3)

without authorisation from INCRA were also interviewed. At the beginning, as stated in 5.2, most of the migrants who settled outside the POP1 area were considered as squatters. Being squatters, they were not entitled to receive credit nor technical assistance. Therefore, their opportunities to develop their plots were lower in addition to the shorter length of time they have been settled in the area. Hereafter the colonists outside the POP1 area will be referred to as non-pioneer settlers.

The success of colonists farming plots A and B will be used to assess the effects of land quality upon settlers success. The success of the non-pioneer colonists will then be compared with the success of the pioneer colonists in the POP1 area. These assessments appear in 5.4.

5.4 Relationships between land quality and settlers success

In this section the effects of land quality upon the success of colonists will be assessed following the overall methodology outlined in Chapter 4. As previously stated success will be appraised through possessions grouped into four main categories "domestic animals" (5.4.1), "agricultural machinery" (5.4.2), "farming buildings" (5.4.3) and "possessions" (5.4.4). In addition to these four indicators of success the relationships between land quality and areas farmed with crops and farming practices adopted will be considered in 5.4.5.

In addition to the assessment of the effects of land quality upon success, the effects of length of time as official settlers on the success rate will also be considered in this section. The latter involves the comparison of the success of colonists farming plots (A, B) in the POP1 area with the success of non-pioneer settlers farming plots (C) outside the POP1.

5.4.1 "Domestic animals"

The indicator of success "domestic animals" comprises cattle, swine, horses and other animals (such as buffalo, mule). It does not include poultry. Scores in "domestic animals" (d.a.) were compiled through the following formula:

$$d.a. = \Sigma \text{ cattle} + \text{swine} + \text{horses} + \text{others}.$$

The original data used in the compilation of scores are in the appendix 1 including farm codes 019 to 123. For instance, the score in d.a. for the farm code 030 is 126, i.e. 75 (cattle) + 40 (pigs) + 5 (horses) + 6 (others).

Scores in "domestic animals" range from zero to 164 with a large proportion of low scores and with only 18 % of scores above 60. The overall mean is 32.1 ± 5.8 (95 % confidence interval for the mean). However, the median (22.8) gives a better indication of the distribution of scores. The data also show that nearly 50 % of the domestic animals are owned by less than 20 % of settlers while 16 % of the domestic animals belong to half of the settlers interviewed (Table 5.5). This indicates that possession of domestic animals varies considerably amongst the 105 settlers interviewed.

Despite the large variation in the number of domestic animals owned by colonists, there is no clear indication that the possession of domestic animals is being affected by land qualities. The means, 34.0 for colonists in category A and 34.8 for colonists in category B, are close (Table 5.4). The null hypothesis that $\bar{x}A = \bar{x}B$ cannot be rejected at the 5 % level of significance, as the F ratio (0.008) calculated in Table 5.6 is smaller than the F distribution (4.00 found in standard statistical tables for the distribution of F. Consequently we cannot conclude that the number of domestic animals owned by settlers varies with land quality.

The second comparison involves pioneer and non-pioneer colonists. The mean (34.3) in "domestic animals" for the pioneer colonists is greater than the mean (29.1) for the non-pioneer colonists (category C). However, the null hypothesis that these two means are similar cannot be rejected at the 5 % level of significance. Because the F ratio (0.76) calculated in Table 5.7 is smaller than the F (3.94) for the F distribution found in statistical tables. Therefore, we conclude that on average the number of domestic animals owned by the pioneer settlers is not significantly greater than the number of domestic animals owned by the non-pioneer colonists.

The non-significance in the number of domestic animals owned by the two groups of colonists could be because :-

a) that little support was given to the pioneer settler, in the initial stage of the Project and alternatively,

b) that adequate support was given to the non-pioneer colonist after he was recognised as 'official settler', enabling him to catch up with the pioneer settler.

The role played by the administrators of the Project upon the success of settlers will be considered in the next section (5.5).

Cattle account for 57 % of the number of domestic animals and swine account for 40 %. Cattle are a better indicator of success of colonists than pigs. Not only is the number of cattle greater than the number of pigs but cattle are also more important in economic terms.

The striking feature of the data in Table 5.8 is that 30 % of settlers do not have cattle while 30 % of cattle belong to 7 % of settlers. The data also show that 28 % of settlers have between one and 15 head of cattle, 33 % have between 16 - 45 head, and 9 % have more than 46 head of cattle. These figures show that possession of cattle varies considerably among the 105 colonists studied.

In relation to the area in pasture (Table 5.32) the number of cattle is still small, which indicates that pasture is under stocked. Another indication that livestock activities are not well developed in the area is the absence of industries to process animal products. Most of the milk is consumed fresh at the farm and/or used in the production of home-made cheese.

Swine account for 40 % of the "domestic animals" indicator. The number of pigs reared by settlers range from zero to 50. Only 10 % of the settlers do not rear pigs while 45 % have more than 10 animals, as shown in Table 5.8. Most of the pigs are reared for the settler's own consumption. However, the number of animals suggests that pigs are being reared in excess of the colonists own needs. Therefore, it can be concluded that part of settler's income comes from the sale of pigs.

In summary, the indicator "domestic animals" showed that the possession of livestock varies considerably among the settlers interviewed. However, the variation could not be explained by the factor 'land quality' nor by the status of the colonists in the early days of the implementation of the Project.

Table 5.4 Scores for the 'domestic animals' indicator.

Land quality stratum					Non-pioneers	
A			B		C	
	Colonist	Score	Colonist	Score	Colonist	Score
	1	0	1	0	2	0
	1	1	1	4	2	2
	1	3	2	5	1	3
	1	4	1	9	1	4
	3	6	2	10	1	5
	1	9	1	14	2	8
	1	10	1	17	1	9
	2	12	1	25	2	10
	2	15	1	26	2	11
	1	16	1	30	1	12
	2	17	1	31	1	14
	2	18	1	32	3	15
	1	19	1	48	1	16
	2	20	2	62	1	18
	1	23	1	72	1	19
	1	24	1	81	1	23
	1	27	1	84	1	25
	1	28	1	104	1	28
	1	35	-	-	1	30
	1	36	-	-	2	31
	1	40	-	-	1	32
	1	41	-	-	1	33
	1	42	-	-	2	36
	1	45	-	-	1	43
	1	63	-	-	1	46
	2	66	-	-	1	52
	1	67	-	-	1	53
	1	75	-	-	1	56
	1	77	-	-	1	57
	1	96	-	-	1	63
	1	102	-	-	1	74
	1	164	-	-	1	92
	-	-	-	-	1	126
Total	40	-	21	-	44	-
Mean	-	34.0	-	34.8	-	29.1

TABLE 5.5: Frequency distribution and statistics for the indicator 'domestic animals

Classes of Domestic Animals	Number of Domestic Animals	% of the total	Number of Settlers	% of the total	Statistics
0 - 20	525	15.6	52	49.5	Median = 22.8
21 - 40	662	19.6	22	20.9	Mean = 32.1
41 - 60	589	17.5	12	11.4	Mode = 10.0
61 - 80	747	22.1	11	10.5	Range = 164.0
⩾ 81	849	25.2	8	7.7	
TOTAL	3372	100.0	105	100.0	

Table 5.6. Analysis of variance and variance ratio (F) for the "domestic animals" indicator in the investigation of the effects of land quality on settlers's success.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	
Between categories of plots	1	8.47	8.47	$F=\frac{8.47}{1085.05}$
Within categories of plots	59	64018.13	1085.05	F = 0.008
Total	60	64026.60	-	F prob. = 0.92

Table 5.7 Analysis of variance and variance ratio (F) for the "domestic animals " indicator for the comparison between pioneer and non-pioneer colonists.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	-
Between categories of plots	1	692.31	692.31	$F=\frac{692.31}{914.43}$
Within categories of plots	103	94186.16	914.43	F = 0.76
Total	104	94878.47	-	Fprob.= 0.38

TABLE 5.8: Statistics for Cattle and Swine

a) Cattle

Classes of Cattle	Number of Cattle per class	% of the Total	Number of Settlers	% of the Total
0	0	0.0	31	29.5
1 - 15	200	10.4	29	27.6
16 - 30	448	23.2	20	19.0
31 - 45	558	28.9	15	14.3
46 - 60	162	8.4	3	2.9
> 61	559	29.1	7	6.7
TOTAL	1927	100.0	105	100.0

Median = 9; Mean = 18; Range = 130

b) Swine

Classes of Swine	Number of Pigs per class	% of the Total	Number of Settlers	% of the Total
0	0	0.0	11	10.5
1 - 5	53	3.9	16	15.2
6 - 10	245	18.3	30	28.7
11 - 15	222	16.5	16	15.2
16 - 20	312	23.2	16	15.2
> 21	510	38.1	16	15.2
TOTAL	1342	100.0	105	100.0

Median = 10; Mean = 13; Range = 50

5.4.2 "Agricultural machinery"

An indication of the degree of development of agriculture in any region can be obtained by studying the number and type of agricultural machines present in the area. The indicator of success "agricultural machinery"comprises basic equipment found in areas where agriculture is being practised on a permanent basis.

A score in "agricultural machinery"(a.m.), for each settler interviewed, was compiled through the following weighted formula.

a.m. = Σ 2 (tractors) + plough + harrow + cultivator + planting machines + threshing machines + spraying machines + diesel engines + chain-saw.

Thus, a score 10 would be achieved by a settler who has one of each of the nine equipments listed above. Clearly, scores greater than ten were possible because settlers could have more than one piece of equipment in each category of implement, such as two ploughs or three cultivators, and so on.

Scores in "agricultural machinery" range from zero to eight, averaging 1.7. Twenty-five per cent of settlers scored zero, 63 % scored less than four, and scores four or higher were achieved by only 12 % of settlers (Table 5.10).

The means in "agricultural machinery" for categories A, B and C, are 2.0, 1.6, 1.5, respectively (Table 5.9). The mean for A, seems to differ from the means for B and C which are fairly similar. However, the null hypothesis that the means A and B are similar cannot be rejected, at the 5 % level, because the F ratio (0.85) calculated in Table 5.11, is smaller than the F ratio (4.00) found in standard statistical tables for the distribution of F, at the 5 % level. Therefore, we cannot conclude that the number of agricultural implements owned by colonists is being affected by the factor 'land quality'.

In relation to the comparison between pioneer and non-pioneer settlers, the F value (1.1) calculated in Table 5.12 is smaller than the F table (3.94) for the distribution of F, at the 5 % level. Thus, the null hypothesis that the means in "agricultural machinery", for pioneer and non-pioneer colonists are similar cannot be rejected at the 5 % level of significance.

TABLE 5.9: Scores for the indicator 'agricultural machinery'.

CATEGORIES	A			B			C		
	Colonist	Score	Total	Colonist	Score	Total	Colonist	Score	Total
	10	0	0	3	0	0	13	0	0
	8	1	8	9	1	9	13	1	13
	10	2	20	4	2	8	7	2	14
	6	3	18	4	3	12	5	3	15
	1	4	4	-	-	-	5	4	20
	2	5	10	1	5	5	-	-	-
	1	6	6	-	-	-	1	6	6
	1	7	7	-	-	-	-	-	-
	1	8	8	-	-	-	-	-	-
TOTAL	40	-	81	21	-	34	44	-	68
MEAN	-	2.0	-	-	1.6	-	-	1.5	-

TABLE 5.10: Frequency distribution and statistics for the indicator 'agricultural machinery'

Classes of Agricultural machinery	Number of Agricultural machines	% of the total	Number of settlers	% of the total
0	0	0.0	26	24.7
1 - 3	117	63.9	66	62.9
4 - 6	51	27.9	11	10.5
7 - 8	15	8.2	2	1.9
TOTAL	183	100.0	105	100.0

Median = 1.4; Mean = 1.7; Range = 8.0

Table 5.11 Analysis of variance and variance ratio (F) for the "agricultural machinery" indicator in the investigation of the effects of land quality on settlers' success.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	
Between categories of plots	1	2.67	2.67	$F=\frac{2.67}{3.12}$
Within categories of plots	59	183.93	3.12	F = 0.85
Total	60	186.60	-	Fprob = 0.40

Table 5.12 Analysis of variance and variance ratio (F) for the "agricultural machinery" indicator for the comparison of success between pioneer and non-pioneer colonists.

Source of variation	Degrees of freedom	Sum of squares	Meam squares	
Between categories of plots	1	2.95	2.95	$F=\frac{2.95}{2.75}$
Within categories of plots	103	283.10	2.75	F = 1.10
Total	104	286.05	-	Fprob. = 0.30

Table 5.13 Statistics relating to the indicator "agricultural machinery".

NUMBER OF EQUIPMENTS / AGRICULTURAL IMPLEMENT	NIL		ONE	
	NUMBER OF SETTLER	% OF THE TOTAL	NUMBER OF SETTLERS	% OF THE TOTAL
Tractor	100	95	5	5
Plough	96	91	7	7
Harrow	105	100	-	-
Cultivator	98	93	7	7
Sowing machine	105	100	-	-
Threshing machine	99	94	6	6
Spraying machine	56	53	33	31
Diesel-engines	97	92	8	8
Chain-saw	42	40	59	56

The most common agricultural tool found amongst settlers is the chain-saw. Sixty per cent of settlers have at least one chain-saw. The use of chain-saw enables settlers to clear larger areas of forest than if they use more primitive tools (machete). Spraying machines are the second most common agricultural equipment found among settlers. Forty-seven per cent of settlers own at least one spraying machine, indicating that some sort of chemical control of diseases and pests is being practised.

Tractors, ploughs, cultivators and threshing machines are found amongst settlers in smaller proportion than the previous two (Table 7.13).

The small number of agricultural machines indicates that farming operations are labour intensive consequently, the amount of land farmed is determined by the availability of labour.

Despite the short length of time for colonisation in the area the agricultural implements (tractors, ploughs, threshing and spraying machines) indicate that a commercial agriculture is being established.

In summary, the investigation of the effects of land quality upon the indicator "agricultural machinery" showed that the number of implements owned by colonists are not being affected by the factor 'land quality'.

5.4.3 "Possessions"

The indicator of success referred to here as "possessions", includes household possessions, cars and vans. The answers given by settlers in the questionnaire were either "yes" or "no" and the replies were coded 'one' and 'zero', respectively.

Scores in "possessions" (p) were compiled for each settler interviewed through the following weighted formula :

$$p = \Sigma\ 2\ (\text{car} + \text{van}) + \text{refrigerator} + \text{television} + \text{radio} + \text{gas cooker} + \text{electricity} + \text{piped water} + \text{water filter}.$$

Thus, a score of nine would be achieved by a settler who had either a car or van plus the other seven items of possessions listed above.

The 105 scores in "possessions" in Table 5.14 show that scores are evenly distributed among the three categories (A, B, C). They range from 'zero' to 'six', averaging 2.0 with a large proportion of

small scores. Seventy per cent of settlers scored less than three, 25 % scored three or four, and only 4 % scored either five or six; as illustrated in Table 5.15.

The means 2.2 and 2.4 for colonists in categories A and B are fairly similar. They are not significantly different at the 5 % level of significance, because the F ratio (0.37) calculated in Table 5.16 is smaller than the F-table distribution (4.00). This means that no significant differences were recorded in the degree of success measured through "possessions" for settlers farming plots with different land assets.

On the other hand, the F ratio (5.92), for comparison between pioneer and non-pioneer colonists, is greater than the value (3.94) for the distribution of F (Table 5.17). This indicates that the level of "possessions" of pioneer settlers is significantly greater than the level of "possessions" of non-pioneer colonists. This suggests that non-pioneer colonists could still be using a larger proportion of their income in the development of their plots than the pioneer settlers. Consequently, non-pioneer colonists are spending less in non-essential household possessions than the pioneer settlers.

A radio is the most common household possession encountered in the Project with 83 % of settlers having one. Next comes 'water-filter' with 66 %, 'piped water' with 18 % and vans with 15 %. (Table 5.18). The household possessions 'radio' and 'water filter' are minor possessions in comparison with the other items considered here (car, van, television, etc.). However, the high number of radios can be of value to the agricultural extension agents in transmitting information to settlers, on farming practices, credit availability and marketing, to cite just a few.

In interpreting "possessions" as an indicator of success allowance has to be made for the short length of time elapsed since the colonisation of the region began; the mutual dependence between possessions and the remoteness of the area.

In connection with mutual dependence, it may be argued that colonists do not have refrigerators and television because electricity which is the most common form of energy to power them is not readily available. The other aspect, which can partially be related to location of the Project far from urban centres, is the attitude of the

TABLE 5.14 Scores for the indicator 'possessions'.

CATEGORIES	A			B			C		
	Colonist	Score	Total	Colonist	Score	Total	Colonist	Score	Total
	3	0	0	-	-	-	8	0	0
	10	1	10	1	1	1	11	1	11
	15	2	30	12	2	24	15	2	30
	3	3	9	6	3	18	7	3	21
	6	4	24	2	4	8	2	4	8
	2	5	10	-	-	-	1	5	5
	1	6	6	-	-	-	-	-	-
TOTAL	40	-	89	21	-	51	44	-	75
MEAN	-	2.2	-	-	2.4	-	-	1.7	-

TABLE 5.15 Frequency distribution and statistics for the indicator 'possessions'

Classes of Possessions	Total No. per class	% of the total	Number of settlers	% of the total
0	0	0.0	11	10.5
1 - 2	106	49.3	64	60.9
3 - 4	88	40.9	26	24.7
5 - 6	21	9.8	4	3.9
TOTAL	215	100.0	105	100.0

Median = 2.0; Mean = 2.0; Range = 6.0.

Table 5.16 Analysis of variance and variance ratio (F) for the "possessions" indicator in the investigation of the effects of land quality on settlers' success.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	
Between categories of plots	1	0.57	0.57	$F = \frac{0.57}{1.56}$
Within categories of plots	59	92.12	1.56	F = 0.37
Total	60	92.69	-	Fprob. = 0.55

Table 5.17 Analysis of variance and variance ratio (F) for the "possessions" indicator for the comparison of the success between pioneer and non-pioneer colonists.

Source of variation	Degrees of freedom	Sum of squares	Meam squares	
Between categories of plots	1	8.94	8.94	$F = \frac{8.94}{1.51}$
Within categories of plots	103	155.84	1.51	F = 5.92
Total	104	164.58	-	Fprob. = 0.01

TABLE 5.18: Statistics relating to the indicator "possessions"

Possessions	YES		NO	
	Number of Settlers	% of the Total	Number of Settlers	% of the Total
Cars	2	1.9	103	98.1
Vans	16	15.2	89	84.8
Refrigerator	1	1.0	104	99.0
Television	1	1.0	104	99.0
Radio	87	82.8	18	17.2
Gas-cooker	-	-	105	100.0
Electricity	2	1.9	103	98.1
Piped water	19	18.1	86	81.9
Water-filter	69	65.7	86	34.3

settlers towards household goods. It appears that settlers would rather invest in acquiring livestock than in buying household goods to improve their standard of living. The latter would require servicing and spare parts which are difficult and costly in more remote areas.

In summary, it can be concluded that :-

a) the level of material possessions is relatively low,

b) the level of possessions does not vary with the factor land quality and

c) that non-pioneer settlers have less possessions than the pioneer colonists.

5.4.4 "Farm buildings and the like"

The indicator of success referred to here as "farm buildings", comprises sheds, outhouses and store-houses which are commonly encountered in rural areas with a permanent agricultural settlement.

A score in "farm building" (f.b.) was compiled for each settler interviewed through the following formula:

$$f.b = \Sigma \text{ store house} + \text{maize store} + \text{grain store} + \text{corral} + \text{pig-sty}.$$

A maize-store is very distinct from either a store-house or a grain-store. A maize store (paiol) can be distinguished from the others by its architecture or by its function which is exclusively to store maize still on its cob. The differences between a store-house and a grain-store have to be made based on what and how crops are stored in them. A grain-store (tulha) is usually used to store 'unsacked' dried coffee berries, and sometimes other unsacked grain (such as rice and maize). Store-houses are used for all remaining items such as farming tools, pesticides and fertilisers. When grains are kept in store-houses, they are usually bagged before being stored.

Scores in "farm buildings" range from 'zero' to six, with an overall mean for the population studied of 2.7. The majority (66 %) of settlers scored between one to three, 29 % scored more than three, and 'zero' was scored by 6 % of settlers (Table 5.20).

The means 2.8 and 3.0 for categories A and B are fairly similar.

TABLE 5.19: Scores for the indicator 'farm buildings'

CATEGORIES OF PLOTS	A			B			C		
	Colonist	Score	Total	Colonist	Score	Total	Colonist	Score	Total
	3	0	0	-	-	-	3	0	0
	4	1	4	3	1	3	7	1	7
	7	2	14	4	2	8	14	2	28
	15	3	45	6	3	18	9	3	27
	6	4	24	5	4	20	9	4	36
	4	5	20	3	5	15	1	5	5
	1	6	6	-	-	-	1	6	6
TOTAL	40	-	113	21	-	64	44	-	109
MEAN	-	2.8	-	-	3.0	-	-	2.5	-

TABLE 5.20: Frequency distribution and statistics for the indicator 'farm buildings'.

Classes of Farm Buildings	Total No. per class	% of the total	Number of settlers	% of the total
0	0	0.0	6	5.7
1 - 3	154	53.8	69	65.7
4 - 6	132	46.2	30	28.6
TOTAL	286	100.0	105	100.0

Median = 2.8; Mean = 2.7; Range = 6.0

Table 5.21 Analysis of variance and variance ratio (F) for the "farm buildings" indicator in the investigation of the effects of land quality on settler 'success.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	
Between categories of plots	1	0.68	0.68	$F = \frac{0.68}{1.91}$
Within categories of plots	59	112.73	1.91	F = 0.36
Total	60	113.41	-	Fprob. = 0.55

Table 5.22 Analysis of variance and variance ratio (F) for the "farm buildings" indicator for the comparison of the success between pioneer and non-pioneer colonists.

Source of variation	Degrees of freedom	Sum of squares	Meam squares	
Between categories of plots	1	4.60	4.60	$F = \frac{4.60}{1.87}$
Within categories of plots	103	192.39	1.87	F = 2.46
Total	104	196.99	-	Fprob. = 0.12

TABLE 5.23: Statistics for the indicator 'farm buildings'

Farm Buildings	YES		NO	
	Number of Settlers	% of the Total	Number of Settlers	% of the Total
Grain-store	29	27.6	76	72.4
Store-house	48	45.7	57	54.3
Maize-store	61	58.0	44	42.0
Corral	67	63.8	38	36.2
Pig-sty	77	73.3	28	26.7

The F-test confirms that at the 5 % level of significance, the null hypothesis that $\bar{x}_A = \bar{x}_B$ cannot be rejected (Table 5.21). This means that there are no statistically significant differences in the degree of success between settlers farming plots with different land assets measured through the indicator "farm buildings".

The mean (2.9) for pioneer colonists is not significantly greater than the mean (2.5) for non-pioneer colonists. The F-ratio (2.5) calculated in Table 5.22, is smaller than the value for the F distribution (3.94). This indicates that, on average, the number of "farm buildings" on the farming plots is similar for the two groups of colonists.

Seventy-three per cent of settlers have pig-sties, 64 % have corrals and 58 % have maize-stores. The other buildings are also found amongst settlers however, they are less frequent than the previous three (Table 5.23).

Although the analysis did not show any statistically significant differences, the number and variety of farm buildings indicates that permanent agricultural settlement has been successfully established in the area.

5.4.5 "Areas farmed and farming practices"

For any given region land quality can restrict the amount of cultivation, crop productivity and pasture carrying capacity. To some extent it can also restrict the range of farming practices that can be adopted.

In order to assess the effects of land quality on area farmed with crops (a.f.), scores in "area farmed" were compiled for each settler interviewed through the following formula:

$$\text{a.f.} = \Sigma \text{ area in perennial crops} + \text{area in biennial crops} + \text{area in annual crops.}$$

Figures refer to the areas farmed in the 1979/1980 agricultural year. Perennial crops include cocoa, coffee, and rubber; bi-ennial crops include sugar-cane and cassava, and annual crops include rice, maize and beans. Since intercropping is a common practice amongst colonists, in compiling the figures presented in Tables 5.27, 5.28, 5.29, 5.30 the following conventions were observed :

a - In Table 5.27 "Areas farmed with perennial crops" refer to the total cultivated area where one of the three perennial crops (cocoa, coffee and rubber) is the main use. For example :-

a.1 10 hectares cultivated with both coffee and rubber were added once, i.e. 10 hectares for "perennial crops".

a.2 10 hectares cultivated with both coffee (main use) and rice was added once, i.e. 10 hectares for "perennial crops".

b - In Table 5.28 "Areas farmed with annual crops...", refer to the total cultivated area where one of the three annual crops (rice, maize and beans) is predominant. For example :

b.1 10 hectares cultivated with both rice and maize were added once, i.e. 10 hectares for "annual crops".

c - In Tables 5.29 "Areas farmed with cocoa, coffee and rubber ..." and in 5.30 "areas farmed with rice, maize and beans ..." cultivated area planted intercropped were added more than once, i.e. once for each crop. For example :

c.1 10 hectares cultivated with coffee, rubber and maize were added three times, i.e. 10 hectares for coffee, 10 hectares for rubber and 10 hectares for maize;

c.2 10 hectares cultivated with rice and beans were added twice, i.e. 10 hectares for rice and 10 hectares for maize.

Thus, the total amount of land cultivated with perennial crops (Table 5.27) and annual crops (Table 5.28) are not the total of the areas listed in Tables 5.29 and 5.30, respectively.

The 105 Scores in "areas farmed with crops" are presented in Table 5.24. Areas farmed per plot vary considerably. It ranges from 1.0 hectare to 86.0 hectares. However, the means for the categories A, B, and C are not very different. They are 18.6, 17.1 and 16.4 hectares, respectively.

The statistical analysis for the data in "area farmed with crops" shows that :

a) the amount of land farmed by settlers in category A ($\bar{x}$ = 18.6 ha) is not significantly greater than the amount of land farmed with crops by settlers in category B ($\bar{x}$ = 17.1 ha). Thus we cannot conclude that the amount of land cultivated with crops varies with the factor 'land quality' (Table 5.25).

Table 5.24 Scores for the 'areas farmed with crops' indicator

Land quality stratum					Non-pioneers	
A			B		C	
Colonist	Score		Colonist	Score	Colonist	Score
1	1.		1	6.	1	6.
2	5.		1	8.	1	7.
3	6.		2	10.	3	8.
3	7.		1	11.	1	9.
2	8.		1	12.	6	10.
2	9.		1	13.	4	11.
2	10.		2	14.	3	12.
1	11.		1	16.	1	13.
2	13.		1	17.	5	15.
1	14.		4	20.	2	16.
2	15.		2	21.	2	17.
2	16.		1	23.	1	18.
1	17.		1	25.	1	20.
1	18.		1	26.	4	21.
1	19.		1	31.	1	22.
1	20.		-	-	1	24.
1	22.		-	-	1	25.
1	24.		-	-	2	26.
1	25.		-	-	1	27.
1	26.		-	-	1	33.
2	27.		-	-	1	36.
1	28.		-	-	1	40.
1	29.		-	-	-	-
1	35.		-	-	-	-
1	37.		-	-	-	-
1	42.		-	-	-	-
1	44.		-	-	-	-
1	86.		-	-	-	-
Total	40	-	21	-	44	-
Mean	-	18.6	-	17.1	-	16.4

Table 5.25 Analysis of variance and variance ratio (F) for the "areas farmed with crops" indicator in the ivestigation of the effects of land quality on settlers 'success.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	
Between categories of plots	1	30.70	30.70	$F = \frac{30.70}{170.85}$
Within categories of plots	59	10080.15	170.85	F = 0.18
Total	60	10110.85	170.85	Fprob. = 0.18

Table 5.26 Analysis of variance and variance ratio (F) for the "areas farmed with crops" indicator for the comparison of the success between pioneer and non-pioneer colonists.

Source of variation	Degrees of freedom	Sum of squares	Meam squares	
Between categories of plots	1	71.96	71.96	$F = \frac{71.96}{124.52}$
Within categories of plots	103	12825.81	124.52	F = 0.58
Total	104	12897.77	-	Fprob. = 0.45

b) The amount of land farmed with crops by pioneer settlers ($\bar{x}$ = 18.0 ha) is not significantly greater than the amount of land farmed with crops by the non-pioneer colonists ($\bar{x}$ = 16.4 ha) (Table 5.26).

From 1970 to the agricultural year 1979-80, the system of agricultural development adopted by the colonists followed a fairly characteristic pattern. That is, the forest was cleared in the dry season (June/August); the timber of a few valuable species was extracted; and the remaining debris was burnt. This sequence was usually followed by the cultivation of one of the grain crops (rice or maize). Towards the end of the growing season grass seeds were sown for pasture formation, or perennial crops were planted. Sometimes the area was left to follow after a single crop. At other times, a grain crop was planted for two consecutive years before forming pasture, or planting a perennial crop or leaving the area to fallow. Then another tract of forest was cleared. This sequence is illustrated in the diagram in Figure 5.3.

None of the 105 settlers interviewed had cultivated the same tract of land with annual crops for three consecutive years, mainly because of weed invasion. Only a few colonists reported a decline in crop yields in the 2nd year of cultivation. The short cropping rotation led to a high rate of deforestation. In 10 years colonists cleared all the area they were entitled to clear under the existing legislation, i.e. 50 % of the total area allocated to them. By 1980, 5514.5 hectares of a total area of 11003.5 hectares, had already been cleared (Table 5.31).

The reasons which led to the high rate of deforestation will be considered in the next section in conjunction with the assessment of INCRA's objective of promoting the rational utilisation of the land resources.

Most of the deforested area was being used as pasture, i.e. 40 % of the total area (2.180 hectares) (Table 5.32). Perennial crops occupied 20 % of the deforested area, i.e. 1105.5 hectares (Table 5.27). The next major land use was 'capoeira', i.e. 18 % of the total deforested area (973.5 hectares), as illustrated in Table 5.33. 'Capoeira' is a piece of land which has been cultivated for one or two years then abandoned. The annual crops occupied 12 % of the

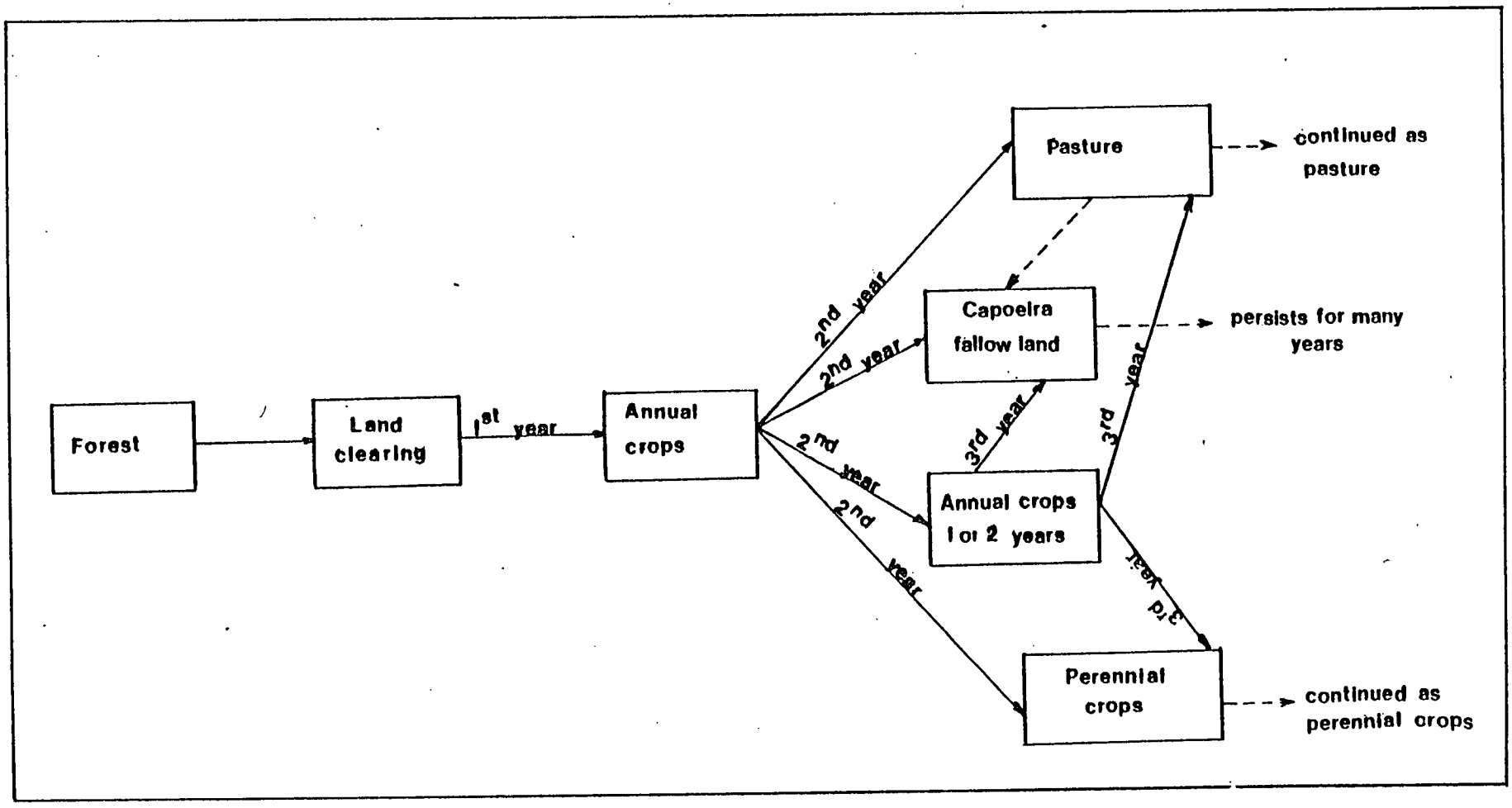


Figure 5.3 Diagram showing the sequence of agricultural development in the Ouro Preto Project.

TABLE 5.27: Areas farmed with perennial crops grouped into classes according to the area farmed and the number of settlers who cropped them.

Classes of Areas Farmed	Area farmed per class (ha)	% of the total	No. of Settlers	% of the Total
0.0 - 9.9	276.0	24.9	56	53.3
10.0 - 19.9	455.0	41.2	34	32.4
⩾ 20.0	374.5	33.9	15	14.3
TOTAL	1105.5	100.0	105	100.0

Median = 8.8 ha; Mean = 10.5 ha; Range = 66.0

TABLE 5.28: Areas farmed with annual crops grouped into classes according to the area farmed and the number of settlers who cropped them.

Classes of Areas Farmed	Area farmed per class (ha)	% of the Total	No. of Settlers	% of the Total
0.0 - 4.9	113.0	17.2	49	46.7
5.0 - 9.9	190.5	29.5	30	28.6
10.0 - 14.9	171.0	26.0	17	16.2
⩾ 15.0	179.0	27.3	9	8.5
TOTAL	653.5	100.0	105	100.0

Median = 4.9 ha; Mean = 6.2 ha; Range = 25.0

TABLE 5.29: Areas cultivated with cocoa, coffee and rubber grouped into classes according to the size of the area planted in each plot and the number of colonists who grow them.

Crops / Classes of area farmed (ha)	COCOA				COFFEE				RUBBER			
	Total area per class	% of the Total	No. of Settlers	% of the Total	Total area per class	% of the Total	No. of Settlers	% of the Total	Total area per class	% of the Total	No. of Settlers	% of the Total
0.0	-	-	71	67.6	-	-	19	18.1	-	-	85	81.0
1.0 - 9.9	59.0	18.3	14	13.3	289.5	51.0	68	64.8	34.5	19.2	6	5.7
10.0 - 19.9	270.0	81.7	20	19.1	165.5	29.2	15	14.3	145.5	80.8	14	13.3
⩾ 20.0	-	-	-	-	112.5	19.8	3	2.8	-	-	-	-
TOTAL	323.0	100.0	105	100.0	567.5	100.0	105	100.0	180.0	100.0	105	100.0

TABLE 5.30: Areas farmed with rice, maize and beans grouped into classes according to the size of the area planted in each plot and the number of colonists who farm them.

Crops / Classes of areas farmed (ha)	RICE				MAIZE				BEANS			
	Total area per class	% of Total	No. of Settlers	% of Total	Total area per class	% of Total	No. of Settlers	% of Total	Total area per class	% of Total	No. of Settlers	% of Total
0.0 - 4.9	134.0	28.7	63	60.0	125.0	28.6	65	61.9	143.5	43.2	78	74.2
5.0 - 9.9	153.5	32.9	28	26.7	124.0	28.3	22	20.9	120.0	36.1	21	20.0
10.0 - 14.9	120.5	25.8	11	10.5	173.5	39.6	17	16.2	49.0	14.7	5	4.8
⩾ 15.0	59.0	12.7	3	2.8	15.0	3.5	1	1.0	20.0	6.0	1	1.0
TOTAL	467.0	100.0	105	100.0	437.5	100.0	105	100.0	332.5	100.0	105	100.0

TABLE 5.31: Forest which had been cleared up to 1980, grouped into classes according to the size of area of forest cleared in each plot and the number of settlers.

Classes of Area Deforested in Hectares	Total Area per class	% of the Total	No. of Settlers	% of the Total
10.0 - 19.9	50.5	0.9	3	2.8
20.0 - 29.9	156.5	2.8	6	5.7
30.0 - 39.9	530.0	9.6	15	14.3
40.0 - 49.9	1083.0	19.6	24	22.8
50.0 - 59.9	1593.0	28.9	29	27.6
⩾ 60.0	2101.5	38.2	28	26.8
TOTAL	5514.5	100.0	105	100.0

Median = 50.3 ha; Mean = 52.5 ha; Range = 154.5 ha

TABLE 5.32 Pasture grouped into classes according to the size of the area occupied by pasture in each plot and the number of settlers.

Classes of Area in Pasture (ha)	Area per Class	% of the Total	Number of Settlers	% of the Total
0.0 - 14.9	303.5	13.9	37	35.2
15.0 - 29.9	1037.0	47.6	50	47.6
30.0 - 44.9	362.5	16.6	10	9.5
⩾ 45.0	477.5	21.9	8	7.7
TOTAL	2180.5	100.0	105	100.0

Median = 18.0 ha; Mean = 20.7 ha; Range = 100.0 ha

TABLE 5.33 Secondary growth 'Capoeira' with more than one year grouped into classes according to the size of the area occupied in each plot and the number of settlers.

Classes of Area in capoeira (ha)	Area per class	% of the Total	Number of Settlers	% of the Total
0.0 - 4.9	26.5	2.7	20	19.0
5.0 - 9.9	236.5	24.3	37	35.2
10.0 - 14.9	275.5	28.3	26	27.8
⩾ 15.0	435.0	44.7	22	20.9
TOTAL	973.5	100.0	105	100.0

Median = 8.1 ha; Mean = 9.2 ha; Range = 36.0 ha

TABLE 5.34: Farming practices adopted by colonists in the Ouro Preto Project.

Farming Practices	YES		NO	
	Number of Colonists	% of the Total	Number of Colonists	% of the Total
Irrigation	-	-	105	100
Contour planting	23	22	82	78
Terracing	-	-	105	100
Fertilizing	04	4	101	96
Liming	-	-	105	100
Improved seeds	16	15	89	85
Intercropping	61	58	44	42
Spraying	20	19	85	81
Ploughing	02	2	103	98
Harrowing	02	2	103	98

deforested area, i.e. 653.5 hectares (Table 5.28). The rest of the deforested area was occupied by other crops such as sugar-cane, cotton, banana, together with buildings and roads.

In passing it should be noted that coffee is the most widely planted perennial crop. Eighty two per cent of the colonists interviewed were coffee growers, 33 % were cocoa growers, and, 19 % were rubber growers. Coffee is usually cultivated in small holdings (less than 10 hectares) while cocoa and rubber are cultivated in large holdings (10 hectares or more), as illustrated in Table 5.29. As for the annual crops (rice, maize and beans) the majority of settlers were farming small holdings (less than 5 hectares), as illustrated in Table 5.30. Annual crops are usually planted intercropped with coffee or rubber.

The agricultural system adopted by settlers does not include the use of many of the farming practices employed in areas of more advanced agriculture. For instance, fertilising and spraying are adopted by only four and 19 % of the colonists respectively. Liming and terracing are not practiced at all, as illustrated in Table 5.34.

The implications of the present agriculture system for the long-term development of the Project will be dealt with in the next section.

5.5 Evaluation of the performance of the Project

In this section the performance of the Project will be evaluated against the objectives the Project was created to fulfil. However, the general nature of the objectives, which were not quantitatively defined, and the limited availability of reliable information determine the depth of the evaluation. The main objectives of the Project within the general INCRA aims were :

1 - to improve the standard of living of settlers
2 - to organise the occupation of the region, establishing a permanent settlement in the area based on medium size farms (100 - 200 hectares)
3 - to contribute to the regional economic growth
4 - to promote the national utilisation of the land resources.

The objective number four will be assessed in much more detail than the others for two main reasons :

a) the availability of data collected during the field survey and,

b) the importance of promoting the rational utilisation of land resources essential for the long term fulfilment of the other objectives.

5.5.1 Achievement of the objectives

- Objective one : To improve the standard of living of settlers:

In order to assess the degree of fulfilment of this objective it is necessary to compare the standard of living of colonists before settling in the Project area with their present standard of living. Precise quantitative information about the income, capital and the general social situation of individuals before they became settlers is, to the best of my knowledge, not available.

It is possible, therefore, to arrive at a conclusion that the standard of living of settlers is low. However, it does not necessarily mean that their standard of living has not improved.

None the less, during the interviews settlers were encouraged to compare their present situation with the one they were living in before moving to the Project area. However, specific questions in this topic were not included in the questionnaire. It was assumed that colonists were likely to supply biased answers because of the length of time they had been living in the Project. Although the replies of settlers were not systematically recorded, it was found that colonists tended to compare their situation in the early days of the Project, instead of the present situation, with their situations before becoming settlers. For this reason care had to be paid to the way that questions are phrased, otherwise replies are obtained which are not directly comparable.

The following remarks are not based on systematic records and consequently they lack precise figures to support them.

The majority of settlers appear to find it easier now to provide food for their family than before moving to the Project area. They also find that the educational facilities for their children are better now, or at least as good as before becoming settlers. However, the majority of settlers consider that the health service facilities in the Project are worse than in their region of origin.

Educational facilities relate to primary education. In the area studied one primary school was built to serve between 18 and

20 families of colonists. However, with the expansion of the Project, the ratio of school to settlers has decreased slightly. By 1978 there were 167 schools for 4800 families of settlers (INCRA, 1979).

The fact that settlers find the health service facilities worse than before is not surprising for two main reasons :
a) the short length of time of the colonisation of the area, and
b) the majority of settlers were originally from the centre-south, where health services are better developed. In 1980, in the Ouro Preto Village, there was only one Doctor and a hospital with 40 beds, to attend an estimated population of 50,000. These ratios are well below the ones recommended by World Health Organisation.

Housing is another major factor connected with the standard of living. Nineteen per cent of settlers live in very rustic houses, named "Tapiris". A tapiri has an earthen floor, walls made of round-thin timber or leaves of palm-trees and the roof is usually made of palm fronds. Sixteen per cent of colonists interviewed live in brick-built houses and the rest live in wooden houses with timber-floors.

It should be pointed out that the condition of a house in the Project does not reflect the economic performance of a settler. During the course of the field survey many settlers who were successful in economic terms were living in poor houses. The disregard for housing is mainly due to the low level of education of colonists. The adult illiteracy rate in the Project as a whole is over 50 % (World Bank, 1979). The administration of the Project has to share part of the responsibility for the poor housing conditions and for failing to convince settlers of the detrimental effects of bad housing conditions on health.

If improvements in the standard of living of settlers were assessed solely on the available housing and health service facilities the conclusion is that no improvements have been made. However, allowance has to be made for the remoteness of the Project, the initially daunting nature of the environment and the length of time that the colonisation of the area has proceeded. Ten years back there was nothing at the Project site but forest.

There is furthermore a widespread sense of satisfaction amongst

settlers resulting from the security of their tenure on the land, and the relatively good crop yields they are obtaining.

- Objective two : To control the occupation of the region

The need to control the occupation of the region played an important role in the decision to set up the Ouro Preto project. Implicit in this objective were :

a - the prevention of illegal appropriation of land;

b - the avoidance of conflicts over land tenure between migrants, and between migrants and the Amerindian population; and

c - the creation of an agrarian structure based on medium-size farms (100 - 200 hectares), large enough for migrants to obtain a reasonable income and to improve their standard of living.

INCRA was not successful in preventing unauthorised colonists in settling down on the fringe of the Project area. At the beginning, the administration could not cope with the high demand for plots. As a consequence, the majority of migrants settled down in the area before they had been selected as settlers. However, this fact did not lead to conflict over land ownership anywhere near the scale observed in other parts of the territory such as "Gleba Prosperidade" in the Munincipality of Cacoal, or "Imovel Aliança" in the Munincipality of Porto Velho (CETR, 1980), Bourne (1978) Gall (1977).

None the less, in 1980 the land tenure situation in the Project as a whole was satisfactory. Eighty per cent of the colonists had already received land titles. Amongst the 105 settlers interviewed 95 % of them had land titles.

The aim of creating an agrarian structure based on medium-size farms has been attained successfully. All 5050 plots allocated to settlers up to the end of 1979 were either of 100 hectares (99 %) or 200 hectares (1 %). The implications of allocating pre-determined standard-size plots in a grid pattern will be considered later.

The establishment of a permanent agricultural settlement can be considered fulfilled. This is supported by the number of families settled in the area, the insignificant turn-over of colonists, the amount of land occupied by perennial crops, the number of farm buildings and the installation of permanent facilities such as schools, shops, and clinics.

In the light of the evidence presented it is reasonable to conclude that the objective 'to control the occupation of the region promoting its permanent occupation' has been successfully fulfilled.

- Objective three : 'to contribute to the regional economic growth'.

The degree of fulfilment of this objective relies on the performance of settlers and on the capability of land resources to sustain agricultural production. In setting up a successful agricultural colonisation project, the region where the project is located benefits from :

a) the revenue generated by exporting agricultural products;
b) the enhancement of settlers income which would increase their ability to purchase goods, services and to reinvest in the improvement of their plots;
c) the taxes paid by settlers which can be used in funding of public projects; and
d) the establishment of agro-industries and other commercial enterprises.

Unfortunately, reliable information on the areas farmed, crop yields, livestock and timber production, taxes, growth of commercial enterprises, industries, and other factors necessary in carrying out a quantitative appraisal is not available.

However, as early as 1976, it was estimated that the Ouro Preto colonists were producing 60 % of Rondonia's rice needs and was self-sufficient on other food crops such as; beans, maize, cassava. (INCRA, 1976a). Since then areas of perennial cash crops (cocoa, coffee) planted in the previous years have come into production increasing the amount and variety of agriculture products exported from the Project.

For the 1979/1980 agricultural year, the data on areas farmed for the 105 settlers interviewed suggest that colonists are producing a surplus of agricultural products. On average colonists farmed 10.5 hectares with perennial crops; 6.2 hectares with annual crops; raised 18.0 head of cattle and reared 13.0 head of pigs (Tables 5.28; 5.27; 5.8).

The consumer-buying power of colonists is not very high as

indicated by the low level of material possessions but it cannot be dismissed as insignificant. The large number of small shops in the Ouro Preto Village and bigger enterprises in Jiparana city indicate this.

The fact that a) in 1969 the project area was virtually uninhabited and now it houses roughly 50,000 people; b) settlers are farming large areas and exporting agricultural products and c) that they are importing goods and services, are all indications of the positive contribution of the Project to regional economic growth.

- Objective four : 'To promote the rational utilisation of land resources'

The ultimate aim of this objective is to make the best use of the land resources compatible with the socio-economic and political goals of colonisation projects. This objective implies :

a) the cultivation of an appropriate percentage of the total area of the Project;
b) the diversification of crop and animal production;
c) the adoption of up-to-date farming practices;
d) the achievement of specified sustainable levels of productivity for agriculture and livestock.

The degree of fulfilment of this objective will be assessed based on the land use of plots and on the farming practices adopted by settlers.

By legislation, Law No. 4,771 of the 15/9/1965 (Brasil 1965b) 50 % of the total area allocated to a colonist in the Amazon Basin has to be kept as forest reserve. The enforcement of this legislation would secure the continuation of Forest as the major single-form of land use in the region and to allay the fuss of conservationists to some extent.

In the 105 plots studied, covering a total area of 11003,5 hectares, the major form of land uses, defined in 5.4.5, are :

a) Forest
b) Pasture
c) Perennial crops
d) 'Capoeira' (abandoned or fallow)
e) Annual crops

These land-use types account for 95 % of the total area of the 105-plots (Table 5.35). The figures in Table 5.35 refer to the land-use at the end of the 1979/1980 agricultural year.

TABLE 5.35 : Land-use in the 1979/1980 agricultural year of the 105 plots studied.

Land-use	Area in Hectares	% of the total area	% of the total area cleared
Forest	5489.0	49.8	-
Pasture	2180.5	19.8	39.5
Perennial Crops	1105.5	10.0	20.0
'Capoeira'	973.5	8.8	17.6
Annual-Crops	653.5	5.9	11.8
Others	601.5	5.7	11.3
TOTAL	11003.5	100.0	100.0

The data in Table 5.35 show that 50 % of the total area had already been deforested. On average the annual rate of deforestation was 5.2 hectares per plot. Most of the area deforested is being used as pasture (39.0 %), perennial crops (20 %), 'Capoeira' (18 %), and annual crops (12 %).

Although 50 % of the area was still occupied by forest in 1980, the legislation has not been observed. On 55 % of the farming plots more than 50 % of the area had already been deforested. There were settlers who had cleared nearly 100 % of the plot's total area.

The 50 % forest conservation rule has been criticised by several authors (Goodland, 1974; Sioli, 1973). The criticisms are on ecological grounds and on the difficulties of enforcing the legislation. Goodland argues that the chess-table pattern created by the discontinuous patches of forest interspersed with cultivated land would be detrimental both to wildlife and agriculture. As animals and plants have a minimum area they can survive, and as the forest provides a perpetual source of infection, particularly of pests, for the surrounding field crops. Goodland suggests that the forest reserve should

be set aside as a continuous 'block' of forest.

There are other implications of the 50 % rule. Where all the land is of prime agricultural quality, the law still prescribes the protection of half as forest, whilst where 100 % of the land should be totally protected for valid conservation reasons, the 50 % rule will still permit the clearance of half.

Nevertheless, even if one assumes that all the forest area cleared is of prime agricultural quality, and is being properly managed, it still can be argued that the high rate of deforestation was a wasteful process. This is because only a minor proportion of the forest resources was effectively used. The volume of standing timber has been estimated at 100 - 170 m^3 per hectare. As loggers often extract only the most valuable species, the effective yield per hectare is seldom more than 5 m^3 of timber (SEAC, 1980). The remaining timber is burnt or allowed to rot.

In addition to the wasteful forest clearance process the area is now under-utilised. The figures in Table 5.35 show that 17 % of the total deforested area was cultivated for one or two years and then abandoned. This is the land-use type named here 'Capoeira'. Furthermore, the area in pasture, i.e. 39 % of the total cleared area, was understocked. In the 2180 hectares of pasture there were 1927 head of cattle, i.e. 0.9 head/hectare. This is a low stocking rate, particularly considering that the figure quoted includes young animals. Near Paragominas in Para, also in the Amazon Basin region, Falesi (1976) states that the carrying capacity can reach 4 head/hectare/year. The sustainability of pasture as a major form of land use in the Amazon area has been questioned by Fearnside (1979).

The farming practices adopted by settlers are further indication that the land resources are not being properly managed. None of the 105 settlers interviewed use terracing and only 22 % of settlers adopt contour planting (Table 5.34). Since crops are often planted on steep slopes there is a considerable risk of soil erosion.

The scale of perennial crops plantations is the positive side of the utilisation of land resources. Perennial crops cover 20 % of the total deforested area. They are ecologically, socially and economically important for the long-term prospects of the Project.

Ecologically, perennial tree crops are more suited to the local

environment than annual crops (rice, maize, beans) because they give better soil protection against soil erosion (Sioli, 1973; Alvim, 1978). In the Ouro Preto project, many of the more fertile soils are associated with steep slopes (Chapter 3). According to Silva (1973) these soils are highly susceptible to erosion because of their association with steep slopes and because they present sub-horizons with low structural stability.

In comparison with annual crops, tree crops provide a better soil protection throughout the year. Thus, they reduce the risk of accelerated erosion, leaching and consequent soil degradation. They also reduce direct insolation to ground level, and maintain local and region humidity. Salati (1978) argues that about 5 % of the rainfall is derived from transpiration).

The social importance of the large scale perennial crops is that they enable a settler to make better use of his family labour, they also guarantee long term employment. Perennial crops require care throughout the year and are very demanding in labour. The labour requirements of the tree crops increase with the aging of the plantation, and maintain high once the plantation reaches maturity. For instance, with the present farming practices, to plant one hectare of rubber, cocoa and coffee, 62, 47 and 36 mandays are needed. However, as they come into production they require 131, 100 and 80 mandays/ha, respectively. The annual crops: rice, beans and maize require 32, 27 and 24 mandays/hectare respectively, (Seac, 1980).

In addition to the ecological and social aspects, perennial crop growers are economically more successful than non-growers. A significant association is found between the amount of cultivated land with perennial crops, material possessions, and housing conditions. Settlers with larger areas planted to perennial crops are better off in terms of material possessions and are living in better houses.

A significant association also exists between size of holdings planted to perennial crops and possession of cattle. Settlers farming larger holdings are more successful in terms of possession of cattle. Settlers cultivating more than 20 hectares of land have on average 27 head of cattle, whilst settlers cultivating less than 10 hectares of perennial crops have on average 14 head of cattle (Table 5.36).

Table 5.36 Diagram showing a positive association between areas planted to perennial crops and possession of cattle

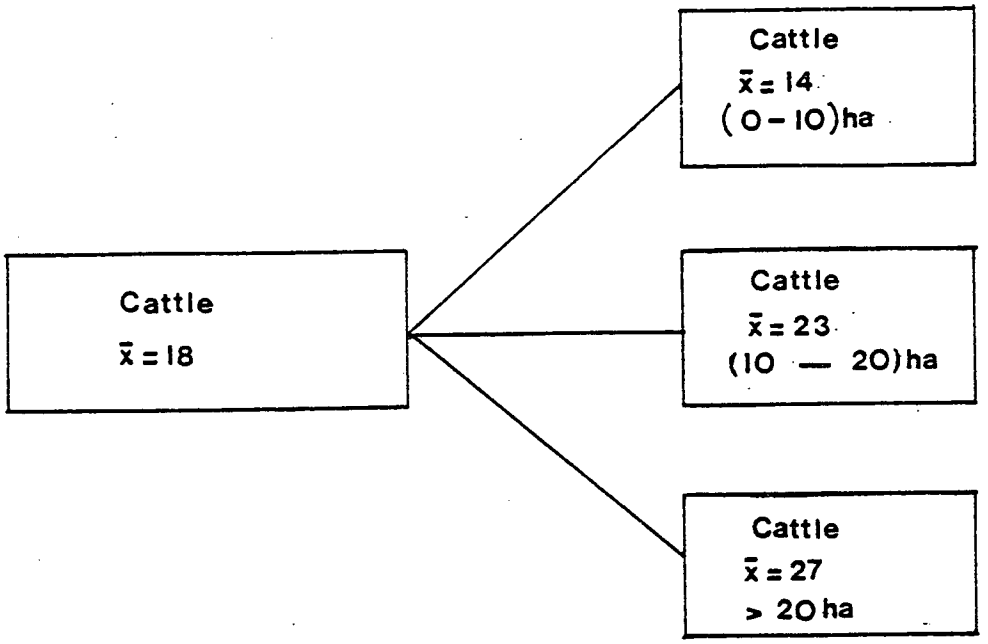
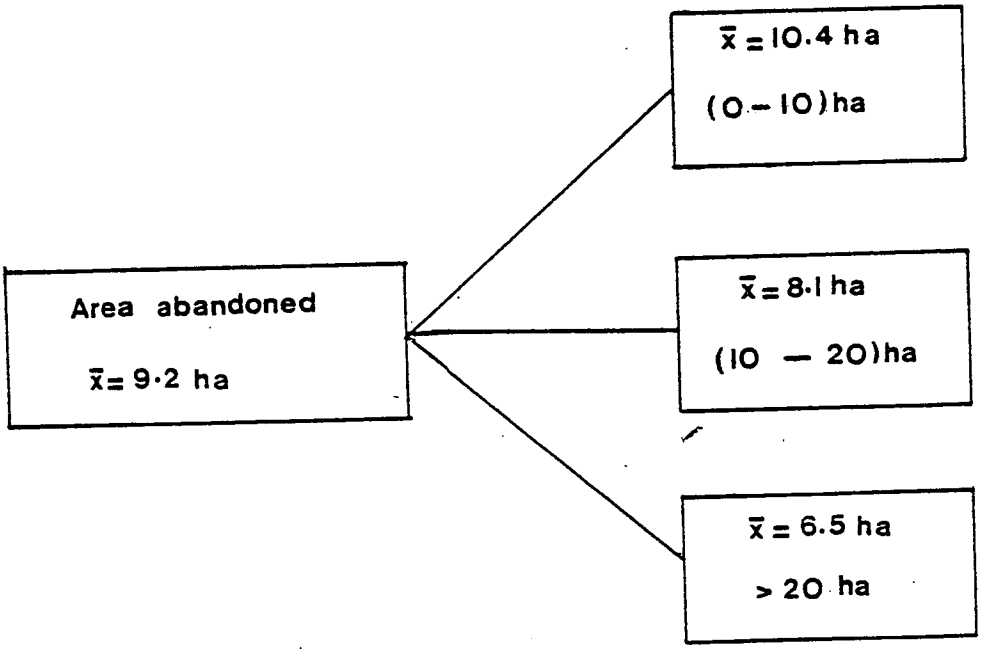


Table 5.37 Diagram showing a negative association between areas planted to perennial crops and amount of land abandoned (Capoeira).



These positive relationships, at this stage, when some of the tree crop plantations have only just come into production or are yet to reach it, indicate that settlers' income, and standard of living could increase substantially in the future.

Perennial crop growers are also making better use of the land resources. The amount of land abandoned is greater amongst colonists who cultivate less perennial crops. Settlers who cultivate less than 10 hectares of perennial crops have on average 10 hectares of abandoned land 'Capoeira', while settlers cultivating more than 20 hectares of perennial crops have on average 6.0 hectares of capoeira. (Table 5.37).

Despite the total cultivated area with perennial crops and their positive aspects the other evidence indicates that the objective of promoting the rational utilization of land resources has not been successfully fulfilled. This conclusion is supported by the high rate of deforestation, the wasteful process of land clearance, the under-utilization of pasture, the amount of land abandoned (Capoeira) and finally the inadequate farming practices.

5.5.2 Factors which limited the development of the Project

The provision of an adequate network of roads, storage facilities, credit and technical assistance is part of INCRA's responsibilities, outlined in 5.2.3. These factors will be considered in this section.

5.5.2.1 The road network

The difficulties in maintaining all-weather roads, associated with a somewhat inadequate network of feeder-roads affected settlers by restricting their access to the main service centres at critical periods of the year. Not only did settlers have difficulty in getting to the markets but agricultural extension agents also had difficulty in working in the field.

The major problem with feeder-roads was keeping them passable during the rainy season. The road building and maintenance problems were aggravated by the physical layout of plots, which is relatively high demanding in roads (0.4 km/settler). By 1972, 316 kilometres of feeder roads were already built. At that time, there were 579 colonists officially settled. Thus the ratio (0.54 km road/settler)

was satisfactory. However, since 1973, with the high migration to the Project area, the ratio road/settlers has worsened as illustrated below.

Year	Cumulative kilometres of road built	Cumulative number of colonists	Ratio (road/colonist) Kilometre
1971	100	496	0.20
1972	316	579	0.54
1973	399	2952	0.14
1974	567	3200	0.18
1975	660	3700	0.18
1976	1088	4670	0.23
1977	1119	4750	0.23

SOURCE: INCRA PO's (1)

During the rains, which coincide with maize and rice harvests access to the market was particularly difficult. As a consequence, the settlers' ability to market their output was severely restricted. This led to high post-harvesting losses of crops on the farming plot, as storage facilities was also inadequate. When they managed to sell their products, transportation was costly. As a result, the economic performance of colonists was negatively affected.

Whilst high on-farm losses of crops and high transportation to the local markets occurred because of the state of feeder roads, a far greater handicap to agricultural production was the condition of the main road (the BR-364). During the rainy season which lasts 4 - 5 months traffic on the unpaved BR-364 road was very difficult and often came to a halt, (see 3.1.1).

Even at present, traffic in the BR-364 road which is the only land link with the south, is still very difficult. The paving of the BR-364 road was not approved by the Federal Authorities until 1980. About 1400 kilometres of the 1500 kilometres are still to be paved. Considerable time will still be needed for the completion of the paving and the development of normal traffic in the BR-364 road

(1) Annual plans for the implementation of the Ouro Preto Project.

(Figure 5.1).

Until the paving of the main road is completed, agricultural production will continue to be affected by high transportation costs. The import of agricultural inputs such as fertilisers, pesticides and agricultural machinery and the marketing of agricultural products are likely to remain costly.

Thus, the constraints upon agricultural production imposed by poor road conditions are, at present, still considerable. At the early days of the Project they were even worse and must have severely affected the performance of settlers.

5.5.2.2 Credit and technical assistance

The importance of providing credit to colonists to develop their plots was always recognised by INCRA (INCRA, 1971; 1976a). However, the credit provision was not INCRA's direct responsibility. The colonisation agency role was to provide the legal means (the issuing of land titles) by which settlers could have access to credit.

Although there were delays in the issuing of land titles, the lack of credit institutions (the nearest Bank was in Porto Velho, 350 km away) and, the poor infra-structure of roads were more serious limitations to access to credit. As a result of the combination of these limitations agricultural credit, in the first five years, was insignificant. This seriously restricted the ability of settlers to develop their plots and, thus to increase income.

Credit for cocoa plantations began on a small scale in 1973. In the 1974/1975 agricultural year only a minority of settlers obtained credit. At that year, there were 3200 colonists settled in the Project and only 177 (5 %) of them received credit. The financing of rubber plantations began in 1975. Thirty-seven colonists received credit at that year. The financing of coffee plantations did not begin until 1976. In summary, from 1974 to the 1977/78 agricultural year, only 684 (14 %) of the 4750 colonists received credit to plant one of the three perennial crops (INCRA, 1979), as illustrated below :-

Agricultural Year	Crop	No. of settlers who received credit	Total No. of colonists
1974/1975	Cocoa	177	3200
1975/1976	Cocoa	124	3700
	rubber	37	
1976/1977	Cocoa	125	4670
	rubber	19	
	coffee	15	
1977/1978	Cocoa	42	4750
	rubber	-	
	coffee	145	
TOTAL (1974/1978)		684	4750

The size of holding financed per settler was 10 hectares for rubber and cocoa, and between 5 and 10 hectares for coffee. A settler planting cocoa could not get credit to plant the other two crops.

By 1978, for the Project as a whole, the number of settlers who had received credit was still small. Consequently, the majority of colonists were denied the means to progress from a form of subsistence farming to commercial farming.

Amongst the 105 settlers interviewd, the proportion of colonists who were planting tree crops with credit were higher than for the Project as a whole. In 1980, 77 % of the settlers interviewed were planting perennial crops with credit. Thirty-three per cent were cocoa growers, 25 % coffee growers and 19 % rubber growers. The reasons for this may be :-

a) The colonists have plots nearer to the BR-364 road. Thus access to urban centres are easier for them than for settlers farther away. For the same reason they can be approached by agricultural extension officers more easily, and

b) They were amongst the first colonists to settle in the area. Therefore, they received land titles first.

Although a relatively high proportion of settlers have planted perennial crops, the impact upon settlers' income of these plantations

is still to be realised. This is because a large proportion of plantations have not yet reached maturity. This partially explains the low level of material possession of colonists. However, the long-term prospects are very good.

The negative aspect related to the application of credit for plantations is that it has been used to finance larger holdings than a settler can farm on his own. Ten hectares of either cocoa or rubber are more than a colonist can farm with his own labour. The family labour force is around 600 mandays/year, estimates being based on family size, sex ratio and age structure (INCRA, 1974). This is considerably smaller than the labour requirements (1300 and 1000 mandays) necessary to cultivate 10 hectares of rubber and cocoa respectively (SEAC, 1980).

Because the family labour force is smaller than the labour requirements for cultivation of 10 hectares of rubber or cocoa, a settler has to rely on hired labour or sharecroppers. However, labour in the Project is already short and consequently costly. The shortage of labour is due to the fact that migrants arriving in the territory have as their first priority the acquisition of land, instead of working as hired labour or sharecroppers (Mueller, 1980; Pacheco, 1979). Despite the shortage of labour, the financing of large holdings was still going on in 1980. This is likely to make the problem of labour even worse in futute.

The question of labour shortage, aggravated by the decline in the price of cocoa and coffee in the international market has already produced some adverse effects upon the perennial crop plantations. In 1980, there were signals that some tree-growers had already abandoned part of their plantations because it was no longer economic to hire labour. Forty per cent of the cocoa growers were cultivating smaller areas than the 10 hectares they originally planted. As for rubber, 30 % of growers had abandoned part of their plantations (Table 5.28).

If five hectares instead of 10 hectares had been financed, the number of tree growers could have been doubled. Five hectares is about the size of plantation that a settler can look after with his family labour. He would still spare some labour to cultivate other crops and thus introduce a multiple cropping system which is

ecologically desirable. It is also probably desirable in the long-term, for sustainable cultivation.

Access to credit for cultivation of annual crops were affected by the same causes which restricted credit for perennial crops. In addition credit for annual crops is less attractive and is risky. The reasons are :-

a) short duration of the loan which lasts only during the planting season;
b) period of repayment of the loan which has to be made shortly after harvesting;
c) high on-farm losses due to the difficulties in getting the products to the market, and
d) official support for marketing is less for food crops than for the perennial cash crop for the foreign market.

The points listed above will be discussed in detail in the final chapter.

In summary, it can be concluded that credit was very restricted and not applied efficiently. Therefore, it can be argued that if credit had been allocated in accordance with labour availability, benefiting more settlers, the material position of colonists as a whole would probably be much better today.

5.5.2.3 The administration contribution to the development of the Project.

In assessing the contribution of the administration to the performance of the Project, allowance has to be made to a number of important factors :-

a) the Ouro Preto project was INCRA's first experience in colonisation in Rondônia,
b) the Project was implemented without knowledge of the best farming system to be introduced in the region, and
c) the administration had to cope with an unexpectedly high migration rate with very limited financial and human resources.

Furthermore, the help which was to come from other Government Departments (Health, Education, Housing, Agricultural Credit and Technical assistance, etc.) did not materialise as anticipated.

The effects of INCRA policies relating to the lay-out and size of

farms raise a number of important factors relating to the rational use of land resources.

The grid pattern of plot demarcation failed to consider the environmental differences. There are plots with 100 % of eutrophic soils while there are others with 100 % of dystrophic soils which have a much lower agricultural potential. Although, this study did not detect a statistically significant difference between the levels of possessions and land quality, it does not follow that in the future differences will not arise. This could easily occur once the other constraints to agricultural and livestock production are corrected.

The effects of the size of plot have to be assessed in the light of the legislation which recognises forest clearing as land improvement. Much land was cleared by settlers in the belief that by cutting down trees, they were improving the land thus securing its possession. This reasoning led to unnecessary forest clearance. The figures presented in 5.5.1 showed that over half of the deforested are is now under-utilised, either as 'pasture' or 'capoeira'.

In future colonisation projects measures aimed at correcting these deficiencies would improve the utilisation of the land resources. For instance, a) plot demarcation based on the agricultural capability of land, b) determination of size of plots based on the availability of labour, capital and the type of agriculture to be practiced, c) setting aside the forest reserve as a continuous block. These are some of the measures that can be applied.

Furthermore, land improvement should not be considered by the mere clearance of the forest but it should be measured by the subsequent utilisation of the area cleared.

A negative point in the implementation of the Project was that very young inexperienced middle level technicians were in charge of its implementation in the early stages. It is clear that senior project managers are likely to commit less mistakes than junior managers. Thus, efforts should be made to implement new projects with more experienced staff.

Nevertheless the relatively low economic performance of settlers cannot be solely attributed to the management of the Project. There was little the managers could have done to solve the problems of physical access, particularly the main road (BR-364), credit and

technical assistance discussed in the previous two sections.

5.5.2.4 The settlers

Mueller (1980) points out that the Rondônia colonists are a resource for the territory which is being misused. He goes on to say that if the colonists instead of having to struggle with all sorts of difficulties, could count on some greater orientation and backing, their effort would undoubtedly contribute handsomely to Rondônia's development'.

The most important difficulties faced by settlers relating to the inadequate road network and credit and technical assistance were discussed earlier. Under the unfavourable conditions for agricultural production which prevailed during the implementation of the Project, the statement that very little could have been done by the colonist to solve the problems which hindered his participation in the development of the project should not require any further elaboration.

It cannot be said that colonists contributed negatively for the development of the Project unless, one considers that a colonist who applied for credit to plant five hectares of tree crops, instead of 10 hectares, has made a negative contribution for the performance of the Project. By applying for credit to cultivate 5 hectares which he could look after with his labour force he had his application turned down. But, if he had planted ten hectares and later abandoned half of his plantation as many colonists did (5.5.2.2), he could still be better off than he is today. I do not consider this a fault of the settler.

Furthermore, well before the Government authorities started financing coffee plantations colonists were already cultivating coffee. This is surely a positive contribution to the development of the Project.

It is true that colonists have cleared forest along water courses, and over steep slopes. However, this occurred before agricultural extension agents pointed out the dangers of these practices. The responsibilities of colonists cannot be greater than those of the people who are supposed to demonstrate the correct farming practices. The colonists do not use fertiliser, lime and other inputs typical of modern commercial farming. But the costs of inputs are three times greater for the colonists, because of the high transportation costs, than for farmers in the industrialised south.

Before the problems hindering agricultural production are removed, the solution to which are beyond settlers' capability, the Ouro Preto colonists cannot be blamed for the relatively poor performance of the Project.

5.6 Conclusions

The main conclusions derived from this study are :

- Differences in land quality are not causing differences in the success of colonists. These have been measured through the indicators of success entitled "domestic animals", "agricultural machinery", "farm buildings" and "material possessions".
- The length of time required for colonists to become official settlers has produced significant differences in the level of the "possessions" indicator. The pioneer settlers have more possessions than the later immigrants. However, it was pointed out that the overall level of possessions is relatively low.
- The objective of promoting the rational utilisation of land resources has not been fulfilled. This is evidenced by :
  a) the high rate of deforestation,
  b) the wasteful method of forest clearance,
  c) the under-utlisation of the deforested area indicated by:
     1. the amount of abandoned land 'capoeira'
     2. the understocking of pasture , and
  d) the low level of adoption of advanced farming practices.

  Nevertheless, the extent of the farmed area under perennial crops was emphasised as a positive achievement on ecological and social grounds and probably long-term economic grounds. This is because perennial crops are well suited to the physical environment, demanding in labour, thus providing long-term employment.
- The objective of promoting the permanent occupation of the region and of creating an agrarian structure based on medium size farms (100 - 200 hectares) has been successfully fulfilled. This is supported by the low turn-over of colonists, the number of colonists settled in the area, and the lack of conflicts over land tenure.
- The objective of improving the standard of living of settlers was solely assessed on settlers material possessions, housing condi-

tions and health facilities. The conclusion must be that the standards have not been greatly increased at present. Howeyer, as the standard of living of the colonists before becoming settlers is unknown the comparison between standards of living past and present are unavailable.

- The objective of contributing to the regional economic growth has been satisfactorily fulfilled. This is indicated by the physical and social infra-structure created within the Project area and the production of a surplus of agricultural products.
- The main constraints to the development of the Project were found to be
  a) the inadequate network of roads (feeder and main roads) and
  b) the limited amount of credit for agricultural production and its inadequate application.
- The relatively low economic performance of the settlers cannot be solely attributed to the management of the Project because there was little the managers could have done to solve the problems imposed by the poor condition of the BR-364 road. In addition the help which was to come from other Government Agencies (Health, Education, Housing, Credit and Technical assistance) did not materialise as anticipated.
- The blame for the relatively low economic performance of the Project cannot be laid upon settlers. The main factors which hampered the development of the Project in the initial as well as later stages could not have been solved by the colonists on their own.

CHAPTER 6

THE SAGARANA AGRICULTURAL COLONISATION PROJECT

The Sagarana Project, located in the cerrado region, has been in operation for eight years. It comprises an area of 36758 hectares, consisting of 208 individual plots covering 29017 hectares (79 % of the total area), two major areas left as reserves covering 7420 hectares (20 %) and the remainder (1 %) is used for administrative purposes. In 1980, the Project was housing 198 settlers. This Project was set up in 1967 to fulfil INCRA's four main objectives outlined earlier (4.1). Later INCRA defined these objectives as follows:

a) to contribute to the occupation of the north west region of the State of Minas Gerais by attracting and settling new migrants;
b) to give access to land ownership to landless people with agricultural tradition;
c) to transform a subsistence economy into market orientated economy creating new jobs and increasing levels of income and standard of living of settlers;
c) to foster a micro-regional development pole in the Project area based on exportation of agricultural products to major regional market centres (Brasília and Belo Horizonte) (INCRA, 1973).

A description of the geographical location of the Project (6.1), its establishment (6.2), and relationships between land quality and settlers success (6.3, 6.4) will be dealt with in the subsequent sections as a background to the assessment of the relative importance of land quality to the success of the Project.

6.1 Geographical location

The Sagarana project lies in the Urucuia valley in the central plateau of Brazil, northwest of the Minas Gerais State, latitudes (16^{o} 00' to 16^{o} 10' S) and longitude (45^{o} 55' to 46^{o} 30' W) (Figure 6.1). The Project area, like the whole northwest of Minas Gerais, lacks a good road network. Only one unpaved road gives

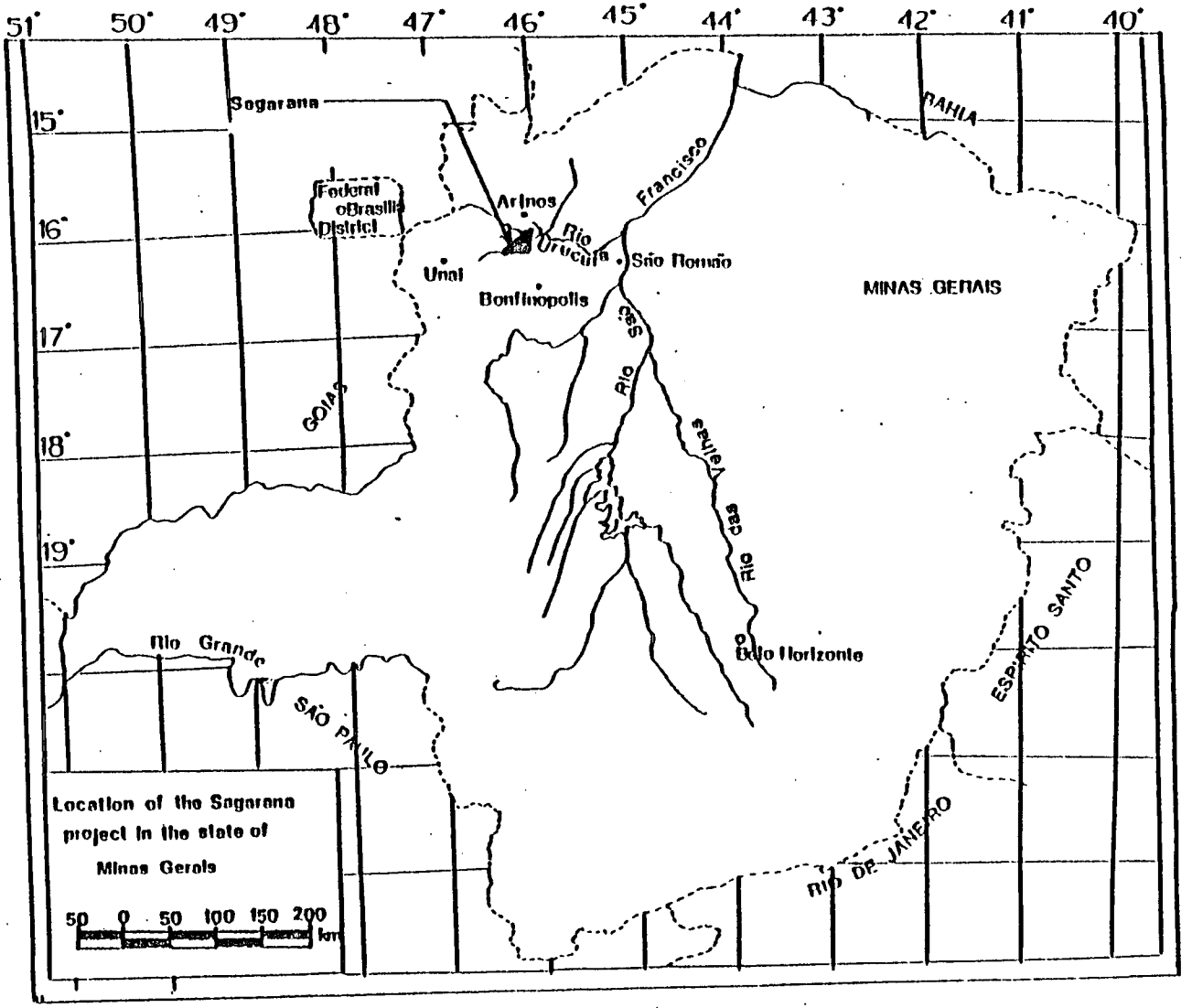


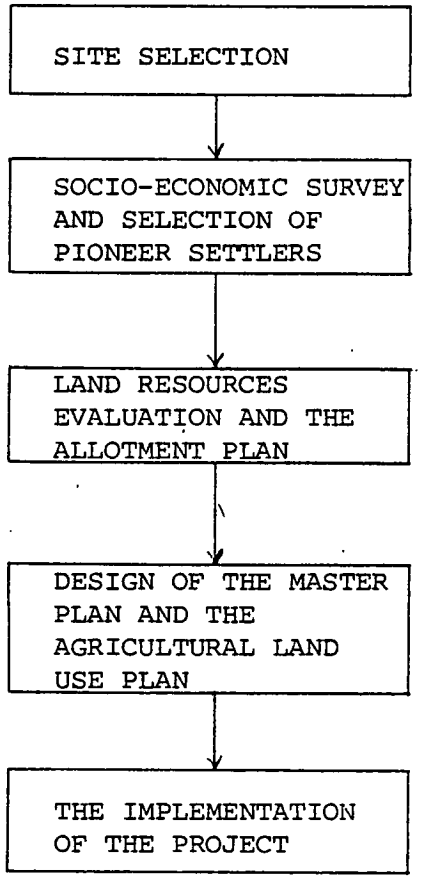
Figure 6.1 Location of the Sagarana Project.

access to the Project area. This is an alternative route that links the towns of Unaí and Bonfinópolis. Although this road is passable throughout the year traffic becomes difficult during the rainy season.

A high rainfall, an inappropriate road maintenance service and a traffic of heavy lorries carrying timber and charcoal are the main causes of deterioration in road conditions. In the rainy season the supply of services (agricultural extension, health care, public transport) and the transportation of goods and agricultural products in and out of the area are difficult and costly.

6.2 Establishment of the Project

The flow diagram below illustrates the five basic steps involved in the establishment of the Sagarana Project.



In assessing the success attained by settlers, it is important to know the criteria employed in the selection of site, the socio-

economic conditions of the people who later became settlers, the appraisal of land resources and how they were being used prior to the establishment of the Project as well as the way that the settlement project progressed over the years. The next section deals with each of these aspects.

6.2.1 Site selection

The site where the Sagarana Project lies, falls within the 'Brasília Priority Area for Land Reform (Figure 6.2). The priority area of Brasília was created through the Decrees no. 56795 (27/8/1965) and 58716 (24/6/1966) with a view to fostering the agricultural development of the region by changing the existing agrarian structure from large estates which were being used at a low intensity to a structure made up of more productive and labour intensive smallholder units.

The Brazilian Institute for Agrarian Reform (IBRA) was the Agency responsible for selecting the site and implementing the Project. The site selection process was carried out in two stages. The first stage was based on the interpretation of aerial photographs (1:60,000). This led to the selection of four sites potentially suitable for establishment of settlement projects. The second stage included only those sites previously chosen and consisted of surveys of land resources and consideration of non-land resources (farm sizes, economic activities, population density). The site number 2 was chosen because it presented:

a) more fertile soil resources (Chap. 3) than in the other three sites. There were also occurrence of limestone deposits;
b) better water resources;
c) larger areas covered by forest which was a desirable asset for the supply of the timber to meet the project demands;
d) a higher percentage of large under-used estates. The area was owned by 16 people but 60 % of the area belonged to one person.

In 1967 by the Decree no. 61607 the owners of the site 2 area, named Sagarana, covering 36758 hectares were dispossessed from their farms for the establishment of the Sagarana Project.

Figure 6.2: Priority areas for agrarian reform established by the Decree No. 56795 of 1965. Brasília agrarian priority area (1); other selected agrarian reform areas (2) and Capital of States (3).

6.2.2 Surveys conducted after site selection.

The selection of site was followed by an assessment of the socio-economic conditions of the population living in the area and the agricultural capability of its land resources. This assessment was based on two surveys:
a socio-economic and land resources carried out separately over a two-year period (October 1971 to October 1973). Data obtained in these surveys were used in the planning and implementation of the Project. Since the findings of these surveys played an important role in the establishment of the Project, they will be summarised in the subsequent sections.

a) *The socio-economic survey*

This survey was jointly carried out by the National Institute of Colonisation and Agrarian Reform (INCRA) and "Projeto Rondon" in 1971/1972. It was aimed at:

1) assessing the socio-economic conditions of the population already living in the area by collecting data on income, main economic activities, marketing, housing, level of education, age structure of the population, size of families, health problems and various other aspects, and
2) selecting the first families to take part in the Project as settlers (INCRA, 1972a).

According to this survey the population living in the area increased from 58 families (280 people) in 1966 to 109 families (525 people) in May of 1972. It means that about half of the population moved into the area despite the efforts by IBRA and later INCRA to prevent them from doing so, before the demarcation of plots and selection of settlers had taken place. Half of the population was under 15 years of age, 46 % between 16 - 59 and 4 % over 60. This was considered a good age structure, as a high demand for labour in 4 - 5 years time would coincide with the time that part of the population under 15 would be seeking some form of employment. Levels of education and income of the population were very low. Sixty three per cent of the population over 7-years old

was illiterate. The adult illiteracy rate was even higher. Among the 109 heads of families 72 % of them was unable both to read or write. This was recognised as being a serious handicap for the introduction of new forms of land management necessary to change the existing subsistence economy into a commercial economy.

Annual income per head of family was estimated at 6 minimum regional salaries (approx. U.S.$500/year at that time). Indicators of the effects of low income were poor housing conditions and an almost lack of material possessions (agricultural machinery, livestock, farm buildings, household possessions). This low income indicated that the capital necessary to finance the changes in the economy of the region had to come from outside and not from the settlers themselves.

The population was basically practising a subsistence agriculture. Rice, beans, maize and cassava were the principal crops. Crop productivity was low and smaller than the average for the State of Minas Gerais as a whole. Fertilisers, lime, improved seeds, pesticides, were not used and the areas cultivated were very small. This is illustrated by the fact that only 22 % of the 109 families were self-sufficient in terms of agricultural production (INCRA, 1972a). It was against this socio-economic background that the selection of the first settlers took place.

By legislation, heads of families over 60 years old could not be selected. This led to the disqualification of four heads of families. Two of them also failed on the grounds of poor health. Another 24 also failed because they did not reach the required minimum number of points (500) in the selection process. The criteria employed for selecting settlers favoured larger families. A childless couple or even couples with two young children was unable to reach the required minimum points even if they achieved top-score in the other criterion (agricultural experience).

Altogether 28 families failed which means that only 81 of the 109 original families were officially selected to take part in the colonisation Project. It seems, however, that most of the people who failed remained in the area living with relatives and working as share-croppers. By 1977 there were 103 families of share-croppers (INCRA, 1978).

Unlike the other two colonisation projects studied in this thesis,where settlers came from outside the region, in the Sagarana Scheme all but one settler was already living either within the Project area or in the vicinity. Thus, the settlers were already familiar with the environment.

b) *The land resources survey*

This survey was carried out by the Natural Resources Department of the João Pinheiro Foundation (JPF). Under the terms of the contract, signed on 28/6/1972, between INCRA and JPF, the latter was responsible for:

1) investigating climate, geomorphology, soil, vegetation, land use, water resources and the way these factors would affect agricultural activities,
2) devising a farm allotment plan for the division of the area into individual plots.

In the conduct of these studies, the JPF had to consider INCRA's objectives which consisted of:

a) accommodating 300 families of settlers, living and farming individual plots and,
b) enabling settlers to realise an annual income of at least 24 minimum, regional salaries (approx. U.S.$2000 at that time) (Pinheiro,1974).

JPF's studies were completed within one year and a report was submitted to INCRA. It contained (a) an evaluation of the agricultural potential of the area (3.2), (b) recommendations on land management practices to be observed in the implementation of the Project,and (c) a farm allotment proposal. Two sets of maps at 1:10,000 and 1:50,000 accompanied the report.

The farm allotment plan proposed by the JPF was approved on 5th June 1973, despite the low agricultural potential of the area (Chap. 3). As pointed out in 3.2, 48 % of the total area of the Project was classified as non-arable land (classes V, VI, VII and VIII), and class IV land accounted for nearly half of the total area classified as arable land (classes I, II, III and IV) (Table 3.5).

At that point the JPF was given the further task of demarcating plots in the field. Demarcation of plots finished four months later. This left the Project area (36,758 hectares) allocated as follows:

- 208 individual plots covering an area of 29,224 hectares (79 %) of the total area
- 2 clearly demarcated sites to be conserved as reserves covering an area of 7,420 hectares (20 %), and
- 2 sites for administrative purposes covering an area of 114 hectares (0.4 % of the total area (Figure 6.3).

The 208 plots range in size from 65 to 346 hectares, averaging 140 hectares. This large variation in size is directly related to the land capability class of each plot. Larger plots have a higher proportion of non-arable land (classes V, VI, VII, VIII) than smaller plots.

According to the JPF, variations in size of plots did not imply variations in productivity capacity, i.e., settlers would realise the same income whatever the size of a plot. Conversion factors were employed to estimate productivity capacity of different land classes. Land class I has the maximum productivity, i.e., 100 %. The others have progressively smaller productivity ratings as illustrated in Table 6.1

TABLE 6.1 Productivity capacity ratings of the land capability classes (After Pinheiro, 1974).

LAND CLASSES	PRODUCTIVITY CAPACITY FACTORS BASED ON SOIL FERTILITY AND TOPOGRAPHY
I	1.000
II	0.650
III	0.422
IV	0.275
V	0.178
VI	0.116
VII	0.075
VIII	0.049

According to the productivity factors, 100 hectares of land class I have the same productivity of 154 hectares of land class II and of 237 hectares of land class III. The JPF estimated that for a settler to realise the required annual income which was set at 2 minimun salaries per month he needed an area of 35.54 hectares of land class I.

It was necessary to combine the various land capability classes into plots giving equal productivity ratings. This accounts for the considerable range in size (65 - 346 hectares). Thus, by employing the conversion factors in Table 6.1 all plots were sized to have the same productivity of the 35.54 hectares of land class I (the Standard plot).

Size of individual holdings were kept as close to the Standard plot as shape, access to water and road permitted. In general plots have a rectangular format, are accessed by road and have either a river or a permanent stream or both running through them. (Figure 6.3).

It was assumed in the determination of the 35.54 hectares Standard plot that 10 % of the area would be farmed with crops (rice, maize and beans) and 90 % would be used for grazing. Furthermore, predictions were also made of crop yields, pasture carrying capacity, demand for crops, prices of crops and various agricultural inputs such as fertilisers, lime, pesticides and seeds.

A detailed analysis of the assumptions and predictions made by the JPF will not be carried out in this section. In passing it should be pointed out, however, that the approval by INCRA of the proposed plans is an indication of the realistic nature of assumptions. Furthermore, the team who carried out the studies were composed of experienced staff belonging to one organisation with a good reputation for land resources evaluation.

6.2.3 Design of Sagarana's "Projeto Técnico".

In 1973, following the assessment of land and non-land resources of the area, a "Projeto Técnico" (master plan) was devised by INCRA to govern the implementation of the Project. Targets to be achieved were set out in the Projeto Técnico (INCRA, 1974). These were:

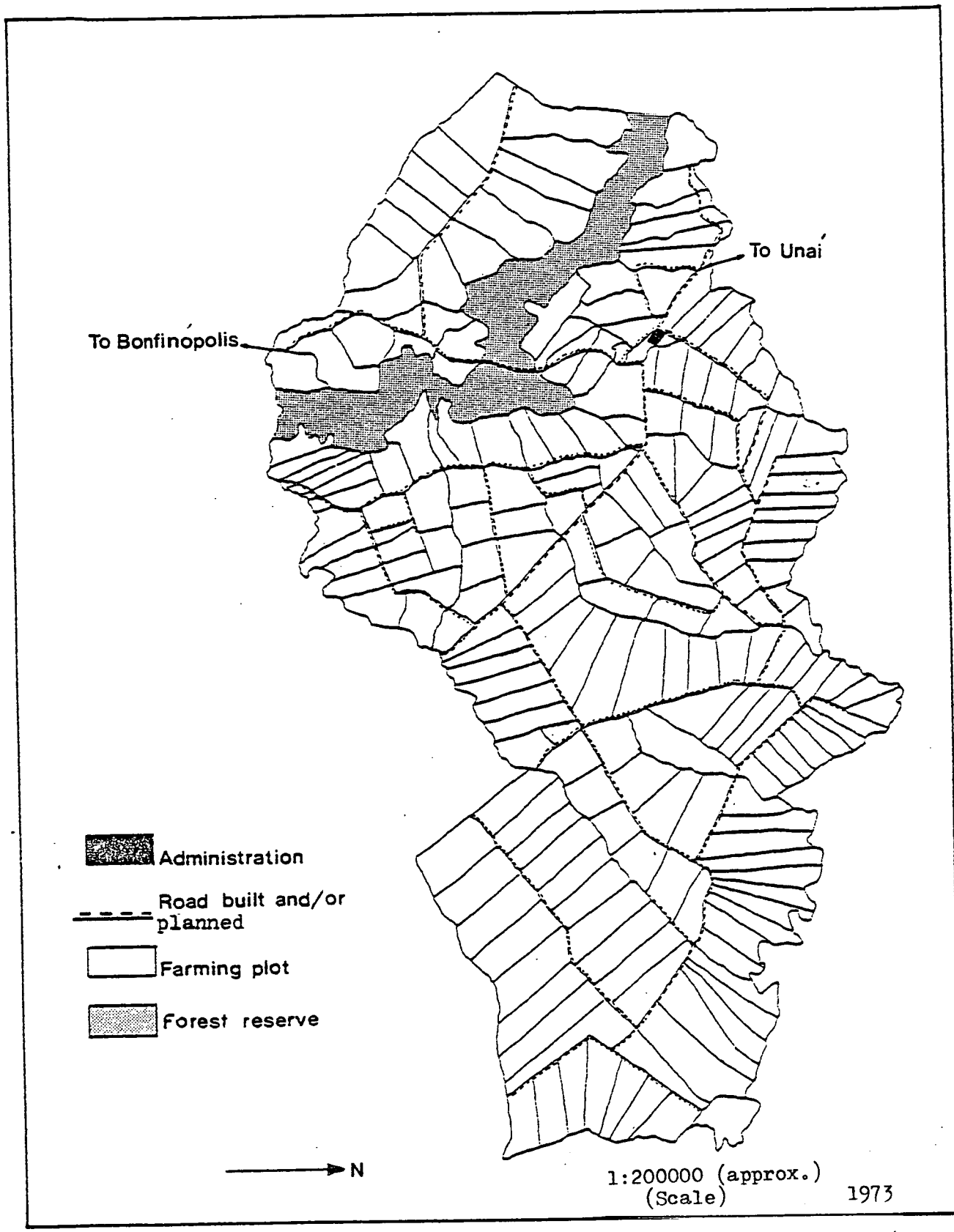


Figure 6.3: Lay-out of farming plots in the Sagarana Project.

1. to settle, by 1975, 208 families of settlers on individual plots,
2. to upgrade 200 kilometres of roads in 1973 and to construct, by 1975, 105 kilometres of farm access roads,
3. to build and equip, by 1975, a small hospital to provide settlers with medical and dental services,
4. to construct,by 1975, five school buildings for the provision of primary education to 320 children between 7 - 14 years old,
5. to reduce, by 1975, the percentage of illiteracy from 63 % to 10 %.
6. to obtain, by 1980, the following crop productivities in kg/ha; maize (2500), beans (900), rice, cotton, groundnuts, castor oil plant (1500), mango (14000), citrus (36000), guava (15000) and avocado (30,000);
7. to farm, by 1980, the following areas expressed in hectares: rice (1248), maize plus beans (2232), cotton (708), 'mamona' (312), groundnuts (396), fruit-trees (608), and pasture (10474).
8. to sell in 1979/1980 the following: (figures are expressed in tonnes) rice (936), beans (2008), maize (5580), cotton (1062), castor oil plant (468), groundnuts (594), fruits (14680), home-made cheese (130) and 1640 head of cattle,
9. to build store facilities for storing crop production and,
10. to issue at least 140 titles of land property to settlers before the withdrawal of INCRA's managers from the area.

Targets numbers 6, 7 and 8 show that agriculture and livestock were the main economic activities to be fostered in the Project area. These activities were planned to take place in individual plots farmed by single families.

As pointed out earlier (6.2.2), the 208 plots vary in size from 65 to 346 hectares. Smaller plots have higher percentages of arable land. In order to take account of the variability in the availability of arable and non-arable land, INCRA divided the 208 plots into four categories (A,B,C, D): Category A with 52 plots ranging from 65 to 96 hectares, averaging 83 ha; B with 66 plots

ranging from 97 to 136 hectares, averaging 115 ha, C with 54 plots ranging from 137 to 194 hectares, averaging 159 ha and D with 35 plots ranging from 197 to 346 hectares, averaging 234 ha (Table 6.3).

Figures in Table 6.3 are self-explanatory. However, it is important to observe that non-arable land accounts for 76 % of the area covered by plots D, but only 10 % of the area covered by A. On the other hand, plots B with 30 % of non-arable land do not differ very much from C (50 %). Following the definition of the categories of plots, plans were devised for their utilisation. The agricultural plan envisaged the growing of crops and pasture as economic activities to be fostered in the area.

Crops were grouped into three categories as follows:

- traditional crops comprising rice, maize and beans,
- non-traditional crops comprising cotton, groundnuts and castor oil plant (mamona), and
- fruit crops comprising citrus, mango, guava and avocado.

There were four reasons for choosing the crops listed above, i.e.,

- they were ecologically adapted to the environment, as they were found growing in the Project area,
- they were familiar to the settlers,
- they were profitable and marketable, i.e., a favourable demand for them was predicted, and
- they were the combination of crops which could make good use of labour throughout the year, reducing the length of time during which there was a low demand for labour.

Despite differences in size and in the percentages of different land capability units between categories of plots (Table 6.3), the areas to be farmed in A were equal to B and the areas to be farmed in C were equal to D. By the sixth year, each settler with plots A or B was to be farming 30 hectares with crops, and each settler with plots C or D were to be cultivating 26 hectares.

In the first four years the settlers' income was to come from traditional crops. The other crops were to be introduced later (2nd year) and non-traditional crops (3rd year). Areas farmed

were to increase over the years up to the 5th, then to be maintained at a constant level. From the second year onwards livestock were to be introduced for grazing in pastures formed in the previous year.

In the agricultural plan it was assumed that the same crop productivity would be obtained in all plots. It was predicted that by employing improved farming practices (liming,fertilising, contour planting, etc.) productivity of arable land (classes III and IV), would be upgraded to the level of land class II. On the other hand, carrying capacity of pasture was assumed to vary from 1.2 animal unit (A.U.) per hectare for category A plots to 0.6/A.U./ha for D. This variation reflects types of land which comprise each category of plot. Pasture was to be formed without utilisation of modern farming practices (as indicated above). This explains the low carrying capacity of pasture.

INCRA's agricultural plan predicted that by 1980 when the field work for this dissertation was conducted, some 6504 hectares were to be farmed with crops and 10474 hectares were to be put down to pasture.

6.2.4 Implementation of the Projeto Técnico

A land use plan, no matter how sound it may appear, is useless if it is not implemented. In this Project,while the socio-economic and land resources appraisal were being carried out, most of the infra-structure (roads, residential and administrative buildings, agricultural machinery, work shops) necessary to implement the Project were being dealt with by INCRA.

Shortly after the conclusion of the demarcation of plots, the process of settling the farmers was able to begin. It is clear that targets set for agriculture and livestock would not be realised unless the target set for the number of families to be settled was fulfilled. Thus, in this section, emphasis will be placed on the progress of the settlement and the increase in population.

In October 1973 the first 85 heads of families (6.2.2) selected as settlers, were asked by INCRA to choose plots and were officially given tenure. A priority criterion was observed in the process of choosing plots. It was based on the number of points that settlers

scored when they were selected in 1972 (6.2.2). Scores were arranged in a decreasing order, then settlers chose plots according to their classification on the list. In the following two years more families were settled and by the end of 1975, there were 201 families in the Project, which means that only seven plots were without settlers. However, for these seven plots there were 80 candidates.

In the following year (1976), 50 families gave up their plots. Despite settling new families, INCRA ended up the year with 6 families less than in 1975. INCRA says that settlers gave up because they realised they could not meet targets set out in the agricultural plan. Thus INCRA refers to this high rate of abandonment as a simple 'natural selection', i.e., the worst settlers left. However, the author interviewed settlers who were replacements for the settlers who gave up in 1976. They reported that some settlers were forced to give up their plots, because they opposed INCRA in matters concerning amount of land to be cleared, areas and crops to be planted. In addition there were problems over the acquisition and repayment of agricultural loans. In view of this evidence, therefore, it is hard to accept that settlers gave up voluntarily. It appears that they were persuaded to give up.

It is reported (INCRA, 1976[6]) that in the 1975/1976/1977 agricultural years droughts occurred and yields were low. As a consequence 74 % of settlers were unable to meet their financial commitments with banks. This made settlers more reluctant to take up large loans fearing the occurrence of another crop failure. However, it is very likely that most of the 50 settlers who gave up would have stayed on if they had not felt they were being forced to do things beyond their capabilities. This is particularly likely considering the desire that these people have in acquiring land.

In 1978 the number of families settled reached its maximum (203). From 1978 to 1980 the number of settlers decreased to 198, leaving 10 plots of the 208 demarcated still unoccupied. Thus, the objective of settling 208 settlers by 1975 had not been fulfilled five years later. From 1973 to 1980, 96 families gave

up, which is a high and undesirable turnover partly because of costs involved in settling farmers and partly in crop production lost.

All costs involved with administration and building of roads, schools and hospitals were paid by INCRA. INCRA (1978) estimated the total costs of the Project in the period (1972/1977) at Cr $ 15,260, 128.00 and the benefits were estimated at Cr $ 12 613 872.00 giving a cost/benefit ratio of 1.22. That is 0.83 benefits were generated from the capital invested.

The costs of acquiring land, demarcating plots and building houses for settlers were settlers' responsibility. These costs were financed by INCRA at very favourable annual rates (6 %) repayable over 20 years. Settlers were also responsible for the costs of implementing the agricultural plans by acquiring bank loans at annual rates ranging from 7 to 15 %.

Nearly all infra-structure made up of roads, schools and the hospital that INCRA proposed to supply in the Projecto Técnico was implemented. One exception was the construction of the 5 grain-storing facilities, none of which were built. However, targets for crop and livestock production did not materialise. The indicators used to assess the relationships between quality of land and success of settlers (6.4) will illustrate the level of development achieved.

In 1979 INCRA's personnel were withdrawn and settlers were left to make their own decision. This action taken against the advice of the Regional Director of INCRA in Minas Gerais, took place one year ahead of schedule, as a result of changes in policies at higher levels.

The opposition by the Regional Director was on the grounds that INCRA had not fulfilled their obligation relating to the issuing of land titles which are prerequisite for obtaining agricultural loans. By 1979 only 78 of the 198 settlers had received land titles.

Later in 1979 four INCRA officers returned to the Project to deal with the matter concerning the issuing of land titles. In March 1980 they were still in the Project but land titles had not been issued because the appeal of one of the former owners, against the Decree of disappropriation of the area, had not been settled yet. The effects of the role played by the management of the Project on the performance of settlers will be assessed in 6.5.

6.3 Definition of categories of farms based on land quality and sampling procedure.

As stated in the previous sections, the 208 plots which comprise the Sagarana project were grouped by INCRA (1974) into four categories of plots (A, B, C, D) based on the 1:10,000 land capability maps of the João Pinheiro Foundation (Pinheiro, 1974). Plots A, B, C and D are made up of 90, 68, 56 and 23 % arable land, respectively. These categories of plots (A, B, C and D) average 84, 116, 159 and 241 hectares, respectively, as illustrated in Table 6.3.

I considered the INCRA's four categories of plots adequate for the purpose of studying the relationships between land quality and settlers success. Therefore, I did not stratify the plots further but conducted the sampling on the basis of the four categories of plots defined by INCRA.

A sample of 15 % of plots (i.e., 32 plots: A = 8, B = 10, C = 9 and D = 5) was randomly chosen for their owners to be interviewed. The samples from categories A, B, C and D are made up of 93, 71, 55 and 25 % arable land, respectively. The average size of the plots sampled (A, B, C and D) is 85, 114, 160 and 221 hectares, respectively (Table 6.4). These figures show that the plots studied adequately represent the 208 plots which comprise the Sagarana Project. The comparison between settlers success and land assets will be carried out in the next section based on the four categories of plots outlined above.

6.4 Relationships between land quality and settlers success

The effects of land quality on the success of settlers will be assessed following the methodology outlined in Chapter 4. Success will be appraised through the four main groups of possession : "domestic animals" (6.4.1), "agricultural machinery" (6.4.2), "possessions" (6.4.3) and "farm buildings (6.4.4). The relationships between land assets and the amount of land farmed and farming practices will be considered in 6.4.5.

Plots A, B, C, and D characterised in the previous section will be used for the study of the relationships between land quality and settlers success.

Table 6.3 : Characterization of plots in categories A, B, C and D based on land capability and size of plots in the Sagarana Project.

Land cap. classes \ Category of plots	A	B	C	D
	%	%	%	%
II	24.2	6.3	2.3	0.1
III	53.1	36.9	14.7	2.6
IV	13.1	25.0	39.6	20.9
V	4.9	12.5	15.6	15.9
VI	4.7	16.7	26.9	59.1
VII	0.0	2.6	0.9	1.4
Total	100.0	100.0	100.0	100.0
Size of plots (ha)	83.8	115.6	159.3	240.7
Size range (ha) Min.	65.3	96.9	135.7	193.9
Size range (ha) Max.	96.8	135.5	193.5	346.9
No of plots	52	66	54	35

Table 6.4 : Characterization of the sample studied

Land cap. classes \ Category of plots	A	B	C	D
	%	%	%	%
II	28.1	10.2	6.8	0.3
III	44.9	37.6	14.1	2.3
IV	20.3	23.4	33.9	22.0
V	4.0	5.5	12.5	18.8
VI	2.7	23.3	32.7	56.6
Total	100.0	100.0	100.0	100.0
Size of plots (ha)	84.9	114.5	160.2	220.8

6.4.1 "Domestic animals"

The indicator of success "domestic animals" comprises cattle, swine and horses. Number of domestic animals owned by settlers was used in the compilation of scores in "domestic animals" (d.a.) for each settler. The following formula was used :

d.a. = Σ cattle + swine + horses + others

Scores for the indicator "domestic animals" range from one to seventy (Table 6.5), with a large proportion of low scores and with only 15 % of scores above 50. The frequency table for "domestic animals" and the statistics (mean = 26.3, standard error = ± 3.5 and median = 23.0) illustrated in Table 6.6, show that there is a large variation in possessions of domestic animals amongst settlers.

The number of "domestic animals" for settlers farming plots A, B, C and D averaged 23.4, 27.5, 32.8 and 19.2 respectively (Table 6.5). Comparisons among the 4 means show that the difference (13.6) between the highest mean for C (32.8) and the smallest one D (19.2) is relatively large. Although the means for the four categories differ, this does not necessarily indicate that they are significantly different at a specified level of significance. In order to claim that significant difference among means exist, at the 5 % level, the F-calculated (Fc) with three and twenty eight degrees of freedom has to be greater than the F distribution value found in statistical tables. Otherwise the four means are identical at the 5 % level of significance.

Table 6.7 summarizes the results of a standard analysis of variance and the variance ratio (Fc) of the data on domestic animals in Table 6.5. The Fc (0.59) is smaller than the F-table (Ft = 2.95). Thus, the four means are identical at the 5 % level of significance. It means that we cannot conclude that the number of domestic animals owned by settlers varies with land quality.

According to the data of the Pinheiro (1974) land resources surveys, on average 90 hectares of land per plot is suitable for pasture but the average number of cattle owned by settlers is only 17 (Table 6.8a). This indicates that livestock activities in the Project are relatively small. Nevertheless, livestock numbers are slowly building up acquired from the settlers' own resources realised mainly from cultivation of crops.

Table 6.5 Scores for the "domestic animals" indicator

Category of farm plots								
	A		B		C		D	
	Colonist	Score	Colonist	Score	Colonist	Score	Colonist	Score
	1	3	1	5	1	3	1	1
	1	6	1	6	1	5	1	2
	1	11	1	17	1	15	1	13
	1	17	1	19	1	35	1	36
	1	19	2	23	1	37	1	44
	1	30	1	27	1	46	-	-
	1	35	1	35	1	48	-	-
	1	66	1	50	1	51	-	-
	-	-	1	70	-	-	-	-
Total	8	-	10	-	9	-	5	-
Mean	-	23.4	-	27.5	-	32.8	-	19.2

Table 6.6 : Frequency distribution of domestic animals.

Classes of domestic animals	Number of domestic animals	% of the total	Number of settlers	% of the total
1 - 20	142	17	15	47
21 - 40	281	32	9	28
41 - 60	294	35	6	19
61 - 80	136	16	2	6
Total	853	100	32	100

Median = 23.0 ; mean = 26.3 ; st. error = 3.5 ; range = 69.0

Table 6.7 : Analysis of variance and variance ratio (F) for the domestic animals indicator.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio (F)
Between categories of plots	3	708.48	236.16	$F=\frac{236.16}{402.81}$
Within categories of plots	28	11278.73	402.81	
Total	31	11987.73	—	F= 0.59

Table 6.8 : Statistics for cattle, swine and horses.

a) Cattle

Classes of cattle	Number of cattle per class	% of the total	Number of settlers	% of the total	STATISTICS
0	0	0.0	2	6.0	Median = 10.5
1 - 15	124	22.0	18	57.0	Mode = 2.0
16 - 30	128	22.7	5	15.0	Mean = 17.3
31 - 45	158	28.0	4	13.0	St. er. = 2.9
46 - 60	154	27.3	3	9.0	Range = 60.0
Total	564	100.0	32	100.0	

b) Swine

Classes of swine	Number of pigs per class	% of the total	Number of settlers	% of the total	STATISTICS
0 -	0	0.0	5	16.0	Median = 6.5 Mode = 0.0 Mean = 7.3 St. error=1.1 Range = 22.0
1 - 5	20	8.5	8	25.0	
6 - 10	78	33.1	10	31.0	
11 - 15	78	33.1	6	19.0	
16 - 20	16	6.8	1	3.0	
⩾ 21	44	18.5	2	6.0	
Total	236	100.0	32	100.0	

c) Horses

Classes of horses	Number of horses per class	% of the total	Number of settlers	% of the total	STATISTICS
0	0	0.0	9	28.0	Median = 1.2 Mode = 0.0 Mean = 1.6 St. error=0.3 Range = 5.0
1 - 3	34	64.2	19	60.0	
4 - 6	19	35.8	4	12.0	
Total	53	100.0	32	100.0	

The major problems of animal rearing are pests and diseases but so far none have been reported which are sufficiently serious to hamper the expansion of livestock activities. Animals look in good health despite the low level of management. Husbandry practices such as supplementary feeding in the dry season, provision of minerals (calcium, phosphorus, iron, etc) and systematic vaccination are not practised by settlers.

One further indication of the small size of livestock activities is the lack of market for livestock produce. In the Project area there are no industries to process milk or any other livestock produce. The nearest industries are 120 kilometres away.

Cattle account for 66 % of the number of domestic animals. Fifty seven per cent of settlers have less than 15 animals and 6 % have none at all (Table 6.8a). Due to the low number of livestock and the type of cattle (non-specialised milk producers), the production of milk is very small. Most of it is consumed fresh, but some settlers do make home-produced cheese and butter for sale.

However, the production of milk is not the settlers' main concern. Their principal aim is to raise calves in order to increase the population of cattle. Female calves are usually kept for reproduction while male calves are the first ones sold when settlers need any extra cash.

The use of cattle to pull agricultural implements - desirable for its low cost and increase in farming efficiency - is not widely practiced. This is indicated by the small number of agricultural implements owned by settlers (6.4.2).

Swine account for 28 % of the number of domestic animals. Fifty-six per cent of settlers have less than 10 animals while 16 % do not rear pigs (Table 6.8b). Most of the pigs are reared for the settlers' own consumption. These pigs do not belong to specialised strains for production of fat or meat. However, they tend to produce more fat than meat and this is widely used as cooking oil. Pigs are usually reared in small earth-floored pig-sties with inadequate shelter.

Horses account for 6 % of the number of domestic animals. Sixty per cent of settlers have less than three horses and 28 % do not possess any horses (Table 6.8c). Horses like cattle are not widely used to pull agricultural implements. They are usually used by

settlers as a means of transportation within the Project area or in its yicinity.

In summary, livestock activities within the Project are of very small scale. The statistical analysis carried out shows that land quality is not causing significant differences in the number of domestic animals owned by settlers. In other words, settlers have achieved similar success in terms of possessions of livestock, independent of the quality of land or the size of plots.

6.4.2 "Agricultural machinery"

The type and number of agricultural machines in any region can be used as an indicator of the success of agriculture in the area. The indicator of success "agricultural machinery" comprises basic equipment which is commonly found in farms throughout the country. Scores in "agricultural machinery" (a.m.) for each settler were compiled through the following weighted formula:

a.m. = Σ 2 (tractor) + plough + harrow + cultivator + planting machines + threshing machines + spraying machines + diesel engines + chain-saw.

Thus, a score 'ten' would be achieved by a settler who has one of each of the nine implements listed above. Clearly, scores greater than ten were possible because settlers may have more than one of each type of implement, such as two ploughs, three cultivators and so on.

Scores in "agricultural machinery" were remarkably low. The number of "agricultural machines" for the whole population averaged 0.5, which indicates that many settlers have no agricultural aids at all. Six per cent of settlers own two agricultural implements, 35 % own one, and 59 % do not have any agricultural implements (Table 6.10).

The means A = 0.6, B = 0.6, C = 0.4 and C = 0.0, (Table 6.9), are not significantly different at the 5 % level because the F-calculated (1.32) is smaller than the F-table (2.95), as illustrated in Table 6.11. This means that possession of "agricultural machinery" by settlers is not being affected by the type of land they are farming.

In the population studied settlers do not have tractors, harrows, planting machines, or threshing machines pulled either by tractor or domestic animals. The other 5 types of agricultural implements are

found in very small numbers. Ploughs which are the most common kind of implement are only owned by 22 % of settlers (Table 6.12). Nevertheless, all settlers have simple agricultural tools (hoe, axe, etc.).

It may be argued that the main reason for the rather low number of agricultural machines was the role of the colonisation agency (INCRA). A further reason is the lack of capital for acquisition of agricultural implements. Since the creation of the Project up until 1978, INCRA was responsible for the provision of mechanisation. Major agricultural operations such as land clearance, ploughing, harrowing etc., were either conducted by INCRA or by other organisations directly employed by INCRA.

With the withdrawal of INCRA's personnel the provision of mechanisation to settlers ceased. Transference of INCRA's responsibilities to a settler's cooperative was predicted in the 'Projeto Técnico'. However, since the withdrawal of INCRA the cooperative has not provided mechanisation because it does not have agricultural machinery nor the means to contract the services of other organisations. In 1979/1980 most of the settlers reported a reduction in areas farmed in relation to the previous years.

Since plots are relatively large and labour already fully employed, the only way to increase the cultivated areas is by increasing the number of agricultural implements and with mechanisation. With current levels of mechanisation the cultivated area is unlikely to increase; settlers' income will, at best, be maintained and it may be reduced.

At present, the statistical analyses show that settlers own similar numbers of agricultural implements, independent of type of land they are farming.

6.4.3 "Possessions"

The indicator of success referred to here as "possessions" includes household possessions, cars and vans. The answers given by settlers in the questionnaire were either 'yes' or 'no' and the replies were coded 'one' and 'zero', respectively. Scores in "possessions" (p) were compiled for each settler through the following weighted formula:

Table 6.9 Scores for the "agricultural machinery" indicator

Category of farm plots								
	A		B		C		D	
	Colonist	Score	Colonist	Score	Colonist	Score	Colonist	Score
	4	0	5	0	5	0	5	0
	3	1	4	1	4	1	-	-
	1	2	1	2	-	-	-	-
Total	8	-	10	-	9	-	5	-
Mean	-	0.6	-	0.6	-	0.4	-	0.0

Table 6.10 : Frequency distribution for "agricultural machinery".

Classes of agricultural machinery	Number of agricultural machines	% of the total	Number of settlers	% of the total	STATISTICS
0	0	0	19	59	Median = 0.34
1	11	73	11	35	Mode = 0.00
2	4	27	2	6	Mean = 0.47
Total	15	100	32	100	St. error = 0.11

Table 6.11 : Analysis of variance and variance ratio (F) for the "agricultural machinery" indicator .

Source of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio (F)
Between categories plots	3	1.47	0.49	$F = \frac{0.49}{0.37}$
Within categories plots	28	10.50	0.37	$F = 1.32$
Total	31	11.97	-	

Table 6.12 : Agricultural machinery statistics.

Number of equipments / Agricultural machinery	NIL		ONE	
	Number of settlers	% of the total	Number of settlers	% of the total
Tractor	32	100	-	-
Plough	25	78	7	22
Harrow	32	100	-	-
Cultivator	28	88	4	12
Sowing machine	32	100	-	-
Threshing machine	32	100	-	-
Diesel engines	31	97	1	3
Chain-saw	30	94	2	6
Spraying machine	31	97	1	3

$$p = \Sigma\, 2(\text{car} + \text{van}) + \text{refrigerator} + \text{television} + \text{radio} + \text{gas cooker} + \text{water filter} + \text{electricity} + \text{piped water}.$$

Thus, a score nine would be achieved by a settler who has either a car or van plus the other seven items of possessions listed above.

Scores in "possessions" range from 'zero' to three with an overall mean for the population of 1.6, indicating a very low general level of material possessions. The majority of settlers scored either two (53 %) or 'one' (35 %), as illustrated in Table 6.14. In relation to the four categories of plots (A, B, C, D), settlers farming plots D fared slightly better than the others.

Comparisons between the four individual means and the overall mean (1.6) show that two means are greater (D = 2.0, B = 1.8) and two means (A = 1.5, C = 1.1) are smaller than the population mean (Table 6.13). The difference between any of the four means and the population mean is small because scores are also relatively small and evenly distributed in the four categories of plots.

The F ratio calculated (Fc = 2.17) in Table 6.15 is large but it is still smaller than the F-table (2.95), with twenty-eight and three degrees of freedom, at the 5 % level of significance. Therefore, the four means (A = 2.0, B = 1.8, A = 1.5, C = 1.1) are not significantly different at the 5 % level. This means that no significant differences were recorded in the degree of success measured through "possessions" between settlers farming plots with different land assets:

A radio is the most common household possession encountered in the Project with 81 % of settlers having one. Next comes water-filter with 66 % and piped water 9 %. None of the other types of possessions considered here (cars, vans, televisions, refrigerators, etc.) were found among settlers as illustrated in Table 6.16.

In interpreting "possessions" as an indicator of success allowance has to be made for the mutual dependence of possessions and the geographical location of the Project. The implications of these two factors to the relatively low level of material possessions owned by colonists were discussed in 5.4.3.

Table 6.13 Scores for the indicator "possessions".

Category of farm plots								
	A		B		C		D	
	Colonist	Score	Colonist	Score	Colonist	Score	Colonist	Score
	1	0	2	1	2	0	1	1
	3	1	8	2	4	1	3	2
	3	2	-	-	3	2	1	3
	1	3	-	-	-	-	-	-
Total	8	-	10	-	9	-	5	-
Mean	-	1.5	-	1.8	-	1.1	-	2.0

Table 6.14 : Frequency distribution for "possessions".

Classes of possessions	Number of possessions	% of the total	Number of settlers	% of the total	STATISTICS
0	0	0	3	9	
1	10	20	10	32	Median = 1.7
2	37	68	17	53	Mode = 2.0
3	6	12	2	6	Mean = 1.6
Total	53	100	32	100	St.error = 1.3

Table 6.15 : Analysis of variance and variance ratio (Fc) for the "possessions" indicator.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio (F)
Between categories plots	3	3.39	1.13	$F=\frac{1.13}{0.52}$
Within categories plots	28	14.49	0.52	$F=2.17$
Total	31	17.88	-	

Table 6.16: Statistics relating to the indicator 'possessions'.

Possessions	NO		YES	
	Number of settlers	% of the total	Number of settlers	% of the total
Cars	32	100	-	-
Vans	32	100	-	-
Refrigerator	32	100	-	-
Television	32	100	-	-
Radio	6	19	26	81
Gas-cooker	32	100	-	-
Electricity	32	100	-	-
Piped-water	29	91	3	9
Water-filter	11	34	21	66

Despite the short-comings pointed out in the previous chapter, the "possession" factor discussed here is still useful in providing a general view of the standard of living of settlers. If it is assumed that the project is a success in economic terms (settlers' annual income) it is obvious that the economic success has not resulted in an increase in the standard of living. Furthermore, it also shows that "possessions" do not vary between settlers farming plots with different land assets.

6.4.4 "Farm buildings and the like"

The indicator of success referred to as "farm buildings" comprises buildings, sheds, outhouses and storehouses which are commonly encountered in rural areas with a permanent settlement. The answers to the questionnaire on farm buildings supplied by settlers were either 'yes' or 'no' which were coded 'one and 'zero', respectively. Scores in "farm buildings" (f.b.) for each settler were compiled through the following formula:

f.b. = Σ storehouse + maize store + grain store + corral + pig sty.

Thus, a score five would be achieved by a settler who has all buildings listed above.

Scores for "farm buildings" range from 'zero' to three with an overall mean for the population of 2.1. The majority of settlers has either three (44 %) or two buildings (31 %) as illustrated in Table 6.18. Scores for settlers farming plots A, B and C are very much the same and the means (A = 2.2, B = 2.3, C = 2.3) are slightly greater than the population mean (2.1). However, the mean (1.2) for settlers farming plots D is smaller than the population mean (2.1). The difference between D and the other three means (A,B,C) is relatively large (Table 6.17).

The F-ratio calculated (Fc = 2.12) shown in Table 6.19 is large but it is still smaller than the F-table (Ft = 2.95) with three and 28 degrees of freedome at the 5 % level of significance. Therefore, the four means (A = 2.2, B = 2.3, C = 2.3, D = 1.2) are not significantly different at the 5 % level. This indicates that there are no differences in the degree of success between settlers farming plots with different land assets measured through the indicator "farm buildings".

The majority of settlers have pig-sties (84 %) and corral (66 %). These are the most common 'buildings' on the farming plots and indicate the concentration upon livestock activities. The other 'buildings' related to storing of crop production are less common. The percentages for maize store, (paiol) store house and grain store are 47 %, 13 % and 3 % respectively (Table 6.20). Thus it appears that at farm level, there is a shortage of storing facilities which may force settlers to sell their production at harvesting time when the prices of crops are usually at their lowest.

In summary, it was not possible to find any significant correlation between the number of 'farm buildings' and the land qualities. However, the relatively high number of 'farm buildings' already encountered in the Project is an indication that a permanent agricultural settlement has been established in the area.

6.4.5 "areas farmed and farming practices"

Crop cultivation using modern farming practices was the main economic activity fostered in the Project (6.2). Thus, an assessment of crop peformance, the area farmed and farming practices, can be used as an indicator of the overall degree of success attained in the Project. "Areas farmed with crops" (a.f.) for each settler was compiled through the following formula:

a.f. = $\sum$ area in perennial crops + area in biennial crops + area in annual crops

In the 1979/1980 agricultural year settlers farmed on average 8.1 hectares. Half of the settlers farmed at least 6.6 hectares as shown by the median in Table 6.22. The cultivated area varied considerably amongst settlers, as indicated by the range (25 ha) illustrated in Table 6.22.

Settlers farming plot B cultivate the largest areas - 9.5 hectares on average. The others (A,C,D) cultivate 8.7, 7.6 and 5.7 hectares, respectively (Table 8.21). Nevertheless, the four means (9.5, 8.7, 7.6 and 5.7) are not significantly different at the 5 % level of significance as the F calculated in Table 6.23 (Fc = 0.38) is smaller than the F-table (Ft = 2.95). This indicates that settlers farming plots with different land assets are cultivating the same amount of land.

Only 'traditional crops' (rice, beans and maize) are being cultivated by settlers. Fruit crops (guava, mango, avocado, citrus and 'non-traditional'crops (cotton, groundnuts, castor oil plant) are not being cultivated, as planned in the Projeto Tecnico (INCRA, 1974). One interesting point is that the majority of settlers interviewed did not know that the establishment of 'fruit' and 'non-traditional' crops was one of INCRA's objectives. This illustrates the inadequacy of communication between the administration and the settlers.When settlers were selected they should have been made aware of what crops they were expected to grow and the preferred or potentially most appropriate areas to be farmed and the levels of productivity they were expected to achieve. It can be argued that the resistance shown by settlers to developing their plots in accordance with the administration, would not have been so great if they had known beforehand the exact nature of INCRA's objectives. Furthermore, the high turn-over of settlers (96 settlers gave up between 1974-1979) may not have occurred.

The reasons why INCRA did not develop 'fruit' and 'non-traditional crops' could not be found in written reports anywhere. However, in conversation with former INCRA officials it seems that a combination of two factors was responsible: These were:

a) that the primary targets established for rice, beans and maize for the first three years were not met and consequently fruit growing, which was a second priority, never became established. This was a result of climatic problems (particularly drought) and partly because of the failure of the administration to implement the ambitious land use plan. Consequently, the introduction of fruit and non-traditional crops from the second year onwards was postponed and was, in fact, never implemented;

b) that unlike credit for 'traditional crops' agricultural loans for 'fruit and non-traditional crops' were not readily available. Thus, colonists did not have the financial resources for planting crops other than rice, maize and beans.

Table 6.17 Scores for the "farm buildings" indicator

Category of farm plots								
	A		B		C		D	
	Colonist	Score	Colonist	Score	Colonist	Score	Colonist	Score
	2	1	1	1	2	1	2	0
	2	2	5	2	2	2	1	1
	4	3	4	3	5	3	1	2
	-	-	-	-	-	-	1	3
Total	8	-	10	-	9	-	5	-
Mean	-	2.2	-	2.3	-	2.3	-	1.2

Table 6.18: Frequency distribution for 'farm buildings'.

Classes of farm buildings	Number of farm buildings	% of the total	Number of settlers	% of the total	STATISTICS
0	0	0	2	6	Median = 2.3
1	6	9	6	19	Mode = 3.0
2	20	29	10	31	Mean = 2.1
3	42	62	14	44	St.error = 0.17
Total	68	100	32	100	

Table 6.19 : Analysis of variance and variance ratio (Fc) for the indicator "farm buildings".

Source of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio (F)
Between categories plots	3	5.10	1.70	$F = \frac{1.70}{0.80}$
Within categories plots	28	22.40	0.80	$F = 2.12$
Total	31	27.50	-	

Table 6.20 : Statistics for farm buildings.

Farm buildings	NO		YES	
	Number of settlers	% of the total	Number of settlers	% of the total
Grain-store	31	97	1	3
Store-house	28	88	4	13
Maize-store	17	53	15	47
Corral	11	34	21	66
Pig-sty	5	16	27	84

Table 6.21 Scores for the indicator "areas farmed with crops"

Category of farm plots								
A			B		C		D	
Colonist		Score	Colonist	Score	Colonist	Score	Colonist	Score
	1	2.6	1	0.0	1	2.0	2	0.0
	1	3.5	1	1.0	1	4.0	1	4.0
	1	5.3	1	1.2	1	4.5	1	4.4
	1	7.5	1	4.3	1	6.0	1	20.0
	1	8.0	1	6.6	1	7.3	-	-
	1	12.6	1	9.1	1	8.0	-	-
	1	14.0	1	11.5	1	9.6	-	-
	1	16.0	1	12.0	1	12.6	-	-
	-	-	1	24.0	1	14.0	-	-
	-	-	1	25.0	-	-	-	-
Total	8	-	10	-	9	-	5	-
Mean	-	8.7	-	9.5	-	7.6	-	5.7

Table 6.22: Frequency distribution for "areas farmed with crops".

Classes of areas farmed with crops (ha)	Areas farmed per each class	% of the total	Number of settlers	% of the total	STATISTICS
0.0	0.0	0.0	3	9.0	
0.1 - 5.9	36.8	14.0	11	35.0	Median=6.6
6.0 - 10.9	62.1	24.0	8	25.0	Mode =0.0
11.1 - 15.9	76.7	29.0	6	19.0	Mean = 8.1
16.0 - 20.9	36.0	14.0	2	6.0	St.er =1.2
⩾ 21.0	49.0	19.0	2	6.0	Range=25.0
Total	260.6	100.0	32	100.0	—

Table 6.23 : Analysis of variance and variance ratio (Fc) for the "areas farmed with crops " indicator.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	Variance ratio (F)
Between categories plots	3	53.42	17.81	$F = \frac{17.81}{46.53}$
Within categories plots	28	1302.80	46.53	$F = 0.38$
Total	31	1356.22	-	

Table 6.24: Farming practices adopted by settlers in the Sagarana Project.

Farming practices	NO		YES	
	Number of settlers	% of the total	Number of settlers	% of the total
Irrigation	32	100	-	-
Contour planting	22	69	10	31
Terracing	32	100	-	-
Fertilising	32	100	-	-
Liming	32	100	-	-
Improved seeds	7	22	25	78
Intercropping	14	44	18	56
Spraying	31	97	1	3
Ploughing	17	53	15	47
Harrowing	17	53	15	47

Productivity of traditional crops which was low before the establishment of the Project has probably not increased. Settlers continue to use an inadequate management system in which the use of modern farming practices such as liming, fertilising, spraying is not included. The majority of settlers plant improved seeds of rice or beans. Inter-cropping of maize and beans is widely used (Table 6.24).

Furthermore, crop productivity is also likely to be affected by time of planting, spacing, and weeding practices which are not properly considered by settlers. It should be pointed out, however, that local agricultural experimentation into crop management is lacking and advice in the management techniques described above is also missing. Consequently, it is impossible to quantify the effects of farming practices on crop productivity.

Nevertheless, since the soils of the Project area are relatively infertile and acid (Chap.3), a simple programme of liming and fertilisation is likely to increase crop productivity.

The data presented shows that in the Sagarana project neither the amount of cultivated land nor the type of land vary with land quality. These two factors have an important bearing upon the lack of significant differences of the indicator of success discussed previously. This will be demonstrated in the following section.

6.5 Evaluation of the performance of the Sagarana project

Even if, at the end of this section, the conclusion is reached that the Project has fallen well short of its expectations, it may still be argued that the Project had a good start. The reasons for this may be put as:

a) the selection of the Project site was based on clearly defined criteria (6.2.1);

b) the execution of a socio-economic survey of the people already living in the area (6.2.2). The recording of the socio-economic conditions of the people prior to the implementation of the Project, permits a comparison with the period or periodic intervals subsequent to the start of the Project.

c) The execution of the land capability studies (6.2.2b) which led to the determination of the size of plots in accordance with their land quality.
d) The design of the "Projeto Técnico' for the implementation of the Project, establishing targets and giving guidelines for its implementation (6.2.4).

6.5.1 Achievement of socio-economic objectives

The socio-economic and strategic objectives of the Sagarana Project were mentioned at the beginning of this chapter. These objectives can be summarised under four main headings:

1. to contribute to the effective occupation of north west Minas Gerais by firmly attaching landless people to the land;
2. to promote the rational utilisation of land resources;
3. to improve the standard of living of the landless people already living in the region and others who would move to the area, and,
4. to contribute to the regional economic growth.

In the 'Projeto Tecnico' (INCRA, 1974) these rather general objectives were translated into targets (6.2.3). The degree of fulfilment of these targets furnishes a meaningful way of assessing the levels of achievement of the Project as a whole. The degree of fulfilment of the objectives listed above will be assessed in this section.

In connection with the first objective the main targets were to settle 208 landless families,providing them with titles of landownership. At the beginning of 1980, there were 198 official settlers and 74 of them held land titles (see 6.2.4).

The accomplishment of 95 % of the target for families to be settled is satisfactory, but 36 % for the allocation of land titles is quite unsatisfactory. This is particularly important in view of the role of land titles in the acquisition of credit. A settler without land title is virtually prevented from obtaining long-term credit for investment (construction of storage houses, acquisition of agricultural machinery and livestock, etc.). Further, he cannot mortgage the plot he is occupying because he does not own it formally. With restricted access to credit and in the absence

of capital of his own, a settler cannot develop his plot to its full potential. There is also the problem of insecurity which is likely to have an adverse effect on his productivity.

In addition to the poor level of allocation of land titles the high turn-over of settlers (6.2.4) raises serious doubts about the achievement of the objective of 'firmly attaching man to the land'. One cannot be sure that the high turn-over of settlers will continue into the 80's. The author believes that it is unlikely to be as high as it was in the 70's because one of the factors which contributed to settlers giving up plots was the imposition of a new way of life which they were reluctant to accept (6.2.4). With the withdrawal of INCRA's personnel, this factor ceased to exist. On the other hand, without INCRA's direct control the least successful settlers, with little hope of developing their plots may not resist the temptation of getting some cash by selling part or even all of their plots.

It will be interesting to follow up the development of the Project now that settlers are free to make their own decisions in the selection of crops and amount of land to be farmed. There may be a case in future colonisation schemes to interfere less with what a settler should or should not do in his plot.

The second objective 'to promote the rational utilisation of land resources' implies: a) the cultivation of certain percentage of the total area, b) adoption of modern farming practices and, c) achievement of specified levels of productivity for agriculture and livestock. The main targets set out in the 'Projeto Técnico' (INCRA, 1974) for each farm unit were as follows:

1. to cultivate 14 hectares of land with 'traditional crops' (rice, maize and beans), 8 hectares with 'non-traditional crops' (cotton, groundnuts, and castor oil plant) and 8 hectares with fruit tree crops (citrus, mango, avocado and guava).
2. to adopt modern farming practices such as liming, fertilising, spraying, contour planting, planting of improved seeds and other practices recommended by research institutions.

3. to raise 40 head of cattle.

It was shown in 6.4.5 that only rice, beans and maize were being cultivated by colonists. On average 8.0 hectares of land were planted in the 1979/1980 agricultural year (Table 6.21). The farming practices employed by settlers did not include the use of liming, fertilising nor irrigation. Other modern farming practices are only adopted by a small proportion of settlers (see Table 6.24). As for livestock, on average settlers were raising 17 head of cattle (Table 6.8).

The accomplishment of 57 % for area farmed with traditional crops and zero with the other crops plus 44 % for the raising of cattle are not sufficient to argue that the objective of promoting the rational utilisation of land resources has been adequately realised. Furthermore, modern farming practices are either not used or used to a modest degree by a small proportion of settlers.

The other two objectives "improvement of the standard of living of settlers"and "contribution to the regional economic growth" are difficult to assess quantitatively. However, if one considers that settlers are now living in better houses than previously, that education facilities have been improved, medical and dental services are being provided, roads have been built, electricity supply was brought into the area, it can be concluded that the standard of living of settlers has improved. In comparison with landless people living in the surrounding areas, settlers do seem to enjoy a higher standard of living.

The contribution of the Project to the regional economic growth was not as high as it was anticipated since targets for agriculture and livestock were not realised. It also follows that the consumer-buying power of settlers is not what was predicted because income did not increase as anticipated. However, with the social infra-structure built in the area, and the increase of the population it is undeniable that the Project has made a positive impact on the regional economy.

If the performance of the Sagarana Project is solely appraised against the targets set out in the 'Projeto Técnico', the conclusion would be that the Project is a failure.

On the other hand, if the performance is assessed in the light of the conditions which prevailed during the development of the Project, the conclusion may be the opposite one. The main factors which hindered the development of the Project will be considered next.

6.5.2 Factors which limited the performance of the Project

The relatively modest success of the Project is attributed by people who have been involved with its administration to problems with weather, particularly shortage of rainfall, and to the settlers' attitudes. However, the author considers the administration of the Project at least as much responsible. Problems relating to financial assistance and technical advice provided by the management are amongst the factors which hampered the development of the Project. These factors and the settlers'contribution will be examined here.

1. *Financing and technical advice*

In the design of the Projeto Técnico various assumptions were made. Critical for the development of the Project were the assumptions that:

a) adequate financing was forthcoming;
b) settlers had or would acquire a strong profit motivation and would make productive investments, and
c) the crop yields would reach the predicted levels.

Equally important were the assumptions on availability of labour resources and labour productivity. The achievements of the objectives was dependent upon the realisation of these assumptions. It seems, however, that in the implementation of the Project some of the actions taken by the administration did not contribute to the realisation of these assumptions. It should be pointed out, on the other hand, that securing of conditions for the realisation of all assumptions were not entirely within INCRA's capabilities.

First of all the financing of the agricultural land use plan was affected by changes in government policies leading to a periodic suspension of long-term-credit. As a consequence, INCRA itself had to pay the 'Companhia Agricola de Minas Gerais (CAMIG) for conducting the 1976 site preparation (vegetation clearance and ploughing), for 62 plots. Furthermore without long-term-credit, investments in the acquisition of livestock, formation of pasture and the planting of fruit crops were virtually impossible for lack of capital. In effect, only short-term-credit for the cultivation of subsistence crops (rice, maize and beans) remained open to settlers. The seasonal credit only lasts for the period which goes from the site preparation up to 60 days after harvesting when the repayment of the loan has to be made. This coincides with the time that price of agricultural products is at its lowest.

Since credit was only available for cultivation of subsistence crops, the introduction of cash crops and the diversification of crops, which were previously objectives, became almost unattainable. Diversification was highly desirable to make better use of land and labour resources. Furthermore, in areas where rainfed agriculture is practised and crop failures occur due to drought, a diversity of crops is less likely to cause total economic disaster than monoculture or a very restricted range of subsistence crops.

Since the banks were reluctant to lend to people without land titles, INCRA did well in securing credit for the cultivation of subsistence crops. However, the way that credit was applied led to unsatisfactory results - settlers are now deeply in debt and sceptical about the value of using yield improving investments such as fertilisers, lime or pesticides.

Although INCRA did attempt to promote a rapid increase in settlers' income through cultivation of subsistence crops on a commercial scale, the scheme was hardly a success. In the first agricultural year (1975/1976) on average 5 hectares of land were planted per farm unit. Crop yields were low and only 26 % of settlers were able to repay their loan to the bank (INCRA, 1976).

Low yields were attributed to the shortage of rainfall. This could not be confirmed because there were no climatological stations in the area. Even assuming that a short drought occurred, it is not accurate to affirm that low yields were exclusively due to the inadequate rainfall because other limiting factors were not absent. Agricultural practices including times of planting, quality of seeds, density of plants, fertilising, weeding and other farming methods have also to be taken into consideration.

Settlers reported that planting was late because there were delays in site preparation and in the availability of seeds and fertilisers. The latter were applied in very acid soils (Chap. 3). It is a standard practice for cultivation of crops in acid soils to apply lime at least two months before the sowing of seeds but in the Sagarana Project lime, although recommended (Pinheiro, 1974), was not applied at all.

The basic principles of crop management were not observed partly because they were insufficiently clear to settlers and because there was insufficient financial assistance and technical advice. The poor crop performance cannot therefore be attributed solely to the weather. The fact was, that at the end of the first year 74 % of settlers were unable to repay the bank.

In the second year the area farmed doubled (10 hectares per farm unit). So did the credit obtained by INCRA on the settlers' behalf. Following a repetition of the same management practices the anticipated crop yields were not realised. The weather was once again blamed for the poor crop performance. As a consequence, at the end of the second year, settlers found themselves even more indebted and unable to repay the bank.

At this stage, the administration thought that the solution to the repayment problem was to increase the area farmed. Fifteen hectares of land were cultivated on average, in the third year. Once again,however, the anticipated crop yields did not materialise and the debts of settlers became even greater. At this point, the bank refused to lend more money to settlers in debt. In 1980, a large proportion of settlers were still repaying loans due for repayment in 1975. The serious indebtedness of settlers is another factor likely to contribute to settlers' departure from the area

in the near future. Some settlers will probably have to sell their plots to repay the bank.

A better crop performance might have been achieved if the recommendations for crop management of the organisation (JPF), which conducted the land capability studies, had been followed. They did stress that if the Project was to succeed, great care would be needed in the observation of crop management practices (liming, fertilising, selection of varieties, time of planting, etc.). In particular, they singled out the importance of liming on account of the acid soils. Ironically, within the Project boundaries there are large deposits of limestone rocks more than capable of meeting the requirements of the Project (Pinheiro, 1974).

If one considers the total investment made in the Project and the importance of liming in acid soils, the non-utilisation of the limestone deposits because of costs involved in development is difficult to understand. The administration must bear responsibility for failing to use the resources adequately as well as for not providing adequate technical advice.

2. *The Settlers*

The high turn-over of settlers cannot be attributed to failure on the part of the colonists to adapt to the environment. This is because virtually all settlers were already living in the region prior to the establishment of the Project and were familiar with the type of land and climatic limitations.

It can be argued that the high turn-over of settlers was partly due to the new way of life the administration was trying to impose on them. Settlers were not allowed to participate in decisions concerning their lives such as the amount of land to be farmed, the crops to be planted, the amount of credit to be taken up. The only thing they contributed was labour.

Since most of the factors important for the development of the Project were beyond settlers' control, they cannot be blamed for the Project falling well short of their expectations. In

fact, to attribute the modest performance of the Project to the settlers' attitudes is unfair and misleading.

It is misleading because instead of studying the Project to find out what went wrong, and to learn from past experience, the poor performance of the Project is presented as one more proof that landless people are stupid, lazy and not capable of making progress by acquiring possession of land. The progress made by settlers of the Gusmão Project does not support this view. The implications of laying the blame for the poor performance of colonisation projects upon settlers will be further examined in the final chapter.

6.6 CONCLUSIONS

The main conclusions derived from this study are:

- differences in land quality and size of plots are not causing significant differences in the success of colonists. This has been determined from the level of settlers possessions measured through the indicators "domestic animals", "agricultural machinery", "farm buildings" and "material possessions".
- The objective of contributing to the effective occupation of north west Minas Gerais has not been completely successful. This conclusion is supported by the high turn-over of settlers (± 32 %), and the poor allocation of land titles, only 74 (37 %) of the 198 colonists had already received land titles.
- The objective of promoting the rational utilisation of the land resources has not been fulfilled. This conclusion was derived from the poor accomplishment of the targets for areas farmed, crops grown, farming practices adopted, and cattle raised. Only subsistence crops are grown under a low management (liming, fertilising and irrigation are not used at all). Only 57 and 44 % of the targets for areas farmed with traditional crops, and cattle were accomplished, respectively.
- Despite the fact that the Project has fallen short of its targets it has made positive impacts on both the standard of living of settlers and the regional ecnomic growth. The positive effects derive basically from the social infra-

structure (roads, schools and medical assistance) created in the region.

- Claims that a combination of settlers' attitudes and weather were the main elements preventing the realisation of the anticipated economic progress are not justified. This is based on two facts:
  i) the inability of settlers to control important factors for the development of the Project such as finance and technical assistance; and
  ii) the inadequate crop management practices which prevailed during the implementation of the Project.

- Inadequate finance and management are the main factors which hindered the development of the Project.

CHAPTER 7

ALEXANDRE DE GUSMÃO INTEGRATED COLONISATION PROJECT

The Gusmão Project located in the cerrado of the Federal District has been running since 1962 (Figure 7.1). It comprises an area of 22,530 hectares, consisting of 480 individual plots covering 11,575 hectares (51 % of the total area) and 9,694 hectares (44 %) originally left as 'reserve' for the demarcation of additional farming plots. The remaining 1,261 hectares (5 %) comprises 966 hectares of land under water, 295 hectares of roads and irrigation channels.

In 1980 there were 480 colonists officially settled which means that all farming plots were occupied and there were no plans to settle more colonists. The areas left as 'reserves' now belong to the Federal District Authority (GDF) and are partly occupied by unauthorised settlers.

The immediate objective for setting up the Gusmão project was to control the occupation, since the Project area was being invaded by migrants. However, the objectives: to improve the standard of living of migrants, to promote the rational utilization of land resources and to contribute to the regional economic growth - were presented as justification for the investment required for the implementation of the Project.

A description of the geographical location of the Project (7.1), its establishment and development (7.2) will be considered next, as a background to the assessment of the effects of land quality upon the success of settlers (7.4) and the evaluation of the performance of the Project (7.5).

7.1 'Geographical location'.

The Gusmão Project is located in a very strategic position in relation to major consumer centres. Apart from Brasília (30 km away), the Project has boundaries with three towns; Taguatinga and Ceilandia in the south east and Brazlandia in the west (Figure 7.1). The total population of these three towns is 503,599 inhabitants (Codeplan, 1980*). The urban

* preliminary results of the census of 1980.

centres are important both as a potential market for the agricultural produce and as a source of labour.

The Project area has a good road network (Figure 7.1). Three roads run east to west. They are the Br-70, BR-41 and DF-8. The other runs north to south and is called DF-3. Two of these roads are paved. The others, although not paved, are passable in all weathers. These good roads make the import and export of agricultural produce possible throughout the year.

7.2 Establishment of the Project

7.2.1 Historic aspects of the occupation of the area.

In the eight-year period 1954-1961, the number of families settled in the Project area increased considerably. It rose from 10 in 1954 to 2400 families in 1961 (IBRA, 1966). This rapid population increase coincided with the time that Brasília was being built.

Annual figures for the increase in the number of families living in the Project area, in this period, are not available. However, IBRA argues that a small number of families settled in the area in the early days of the construction of Brasília (1956), aiming at producing agricultural products, mainly vegetables, to supply the newly-created market. With the inauguration of Brasília in 1960 and a consequent reduction in job opportunities for unskilled migrants, there was a rush to occupy the area.

Thus, against this background (in particular a large number of families illegally settled in the area), the Gusmão Project was created through the Decree No. 51517 of the 25th June 1962.

Four years elapsed between the creation of the Project and the beginning of the official allocation of plots to settlers. Since the allocation of plots was preceded by a land capability evaluation, this will be considered next.

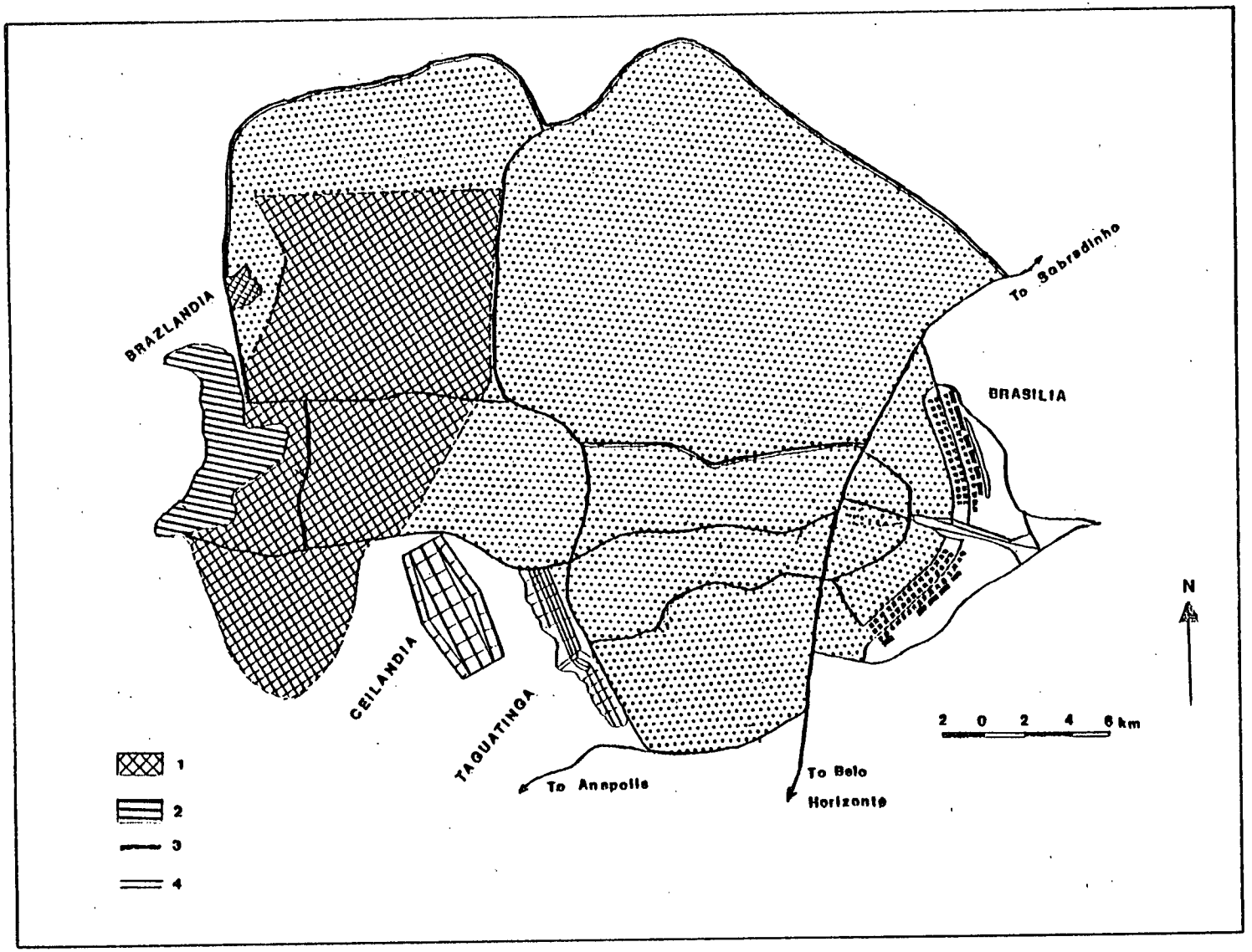


Figure 7.1 Location of the Gusmao Project. 1 = Gusmão project, 2 = lake, 3 = paved road, 4 = unpaved road.

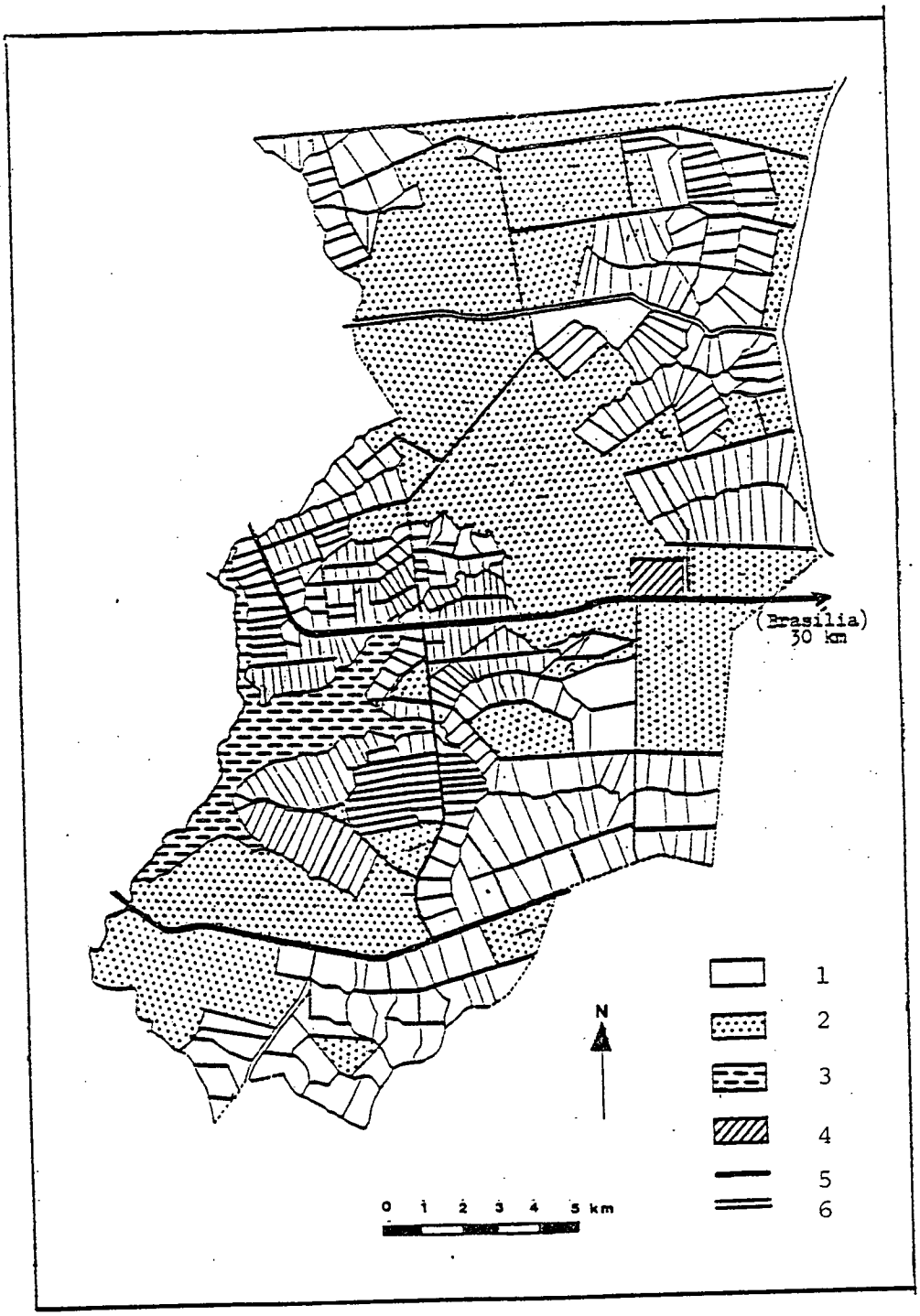


Figure 7.2 Lay-out of farming plots in the Gusmão Project.
1 = farming plot, 2 = 'reserves', 3 = lake,
4 = administration, 5 = paved road, 6 = unpaved road.

7.2.2 'Land capability studies'.

In 1966 the Brazilian Institute for Land Reform (IBRA), the Agency in charge of the Project at that time, hired the services of a private Brazilian-Argentinian firm to conduct studies in the area. Under the terms of the contract, GEO-ETAS were responsible for:

1. surveying the natural resources and assessing the agricultural potential of the area;
2. determining the number of farms and their respective sizes;
3. devising land use plans stating input requirements and management procedures, and
4. determining the basic infra-structural needs (roads, administrative buildings), services (health, education, marketing, agricultural extension, etc.), construction of dams for electricity and the domestic supply of water, irrigation and drainage works.

For this project appraisal IBRA paid 371,420 U.S.$. The results of the study were reported in two bulky volumes, totalling 800 pages excluding appended maps, tables and graphs. The total investment costs of the Gusmão project were estimated by GEO-ETAS at 6,038,425 $ U.S. The total amount was to be spent over a 7-year period distributed as follows: 57 % in the first year, 15 % in second year, 7 % in the third year, 8 % in the fourth year, 8 % in the fifth, and the remaining 5 % in the last two years (6th and 7th years). About 60 % of the total cost of the Project was to be spent on farm investment with housing and establishment of perennial crops account for half.

GEO-ETAS recommended a land use plan envisaging a multiple system of the utlization of the area by agriculture, livestock (dairy), pig farms and poultry (IBRA, 1966). Agriculture, including the growth of tree crops (fruits), grain crops (rice, maize, beans, etc.) and vegetables, was to be the main agricultural activity, contributing 75 % of the total gross

revenue. Agricultural development was to be carried out in individual plots owned and run by individual families of settlers.

The project area was to be divided into 1289 farming plots accounting for 90 % of the total area. The rest (10 %) was to be occupied by community centres, roads, water reservoirs, an agricultural experimental station and nature reserves. The demarcation of plots was to be accomplished in two phases; 893 in the first phase and 396 in the second phase (5 years later). The second phase was to be implemented based on experiences gained in the previous phase.

Settlers were expected to live on their own farms. Basic services such as agricultural extension, marketing and supply of inputs (fertilisers, lime, seeds, pesticides, etc.) were to be provided through eleven community centres. The community centres were to be localised in such a manner that settlers would not be sited more than 3 km away from the nearest community centre.

According to the GEO-ETAS proposed allotment plan, the 1289 plots were to vary in size from 6 hectares to about 50 hectares divided into seven categories. Farms type A, were to average 7.5 hectares; types B and C were to average 130 hectares; types D, E, F and G were to average 15, 18, 22 and 30 hectares, respectively. The main criteria employed in the establishment of the seven categories of farms were:

1. availability of water and the ease of utilisation for irrigation,
2. soil type, and
3. forms of agricultural activity to be practiced.

Land management plans were devised for each of the seven categories of farms. In farms type A (7.5 ha), a permanent supply of water through irrigation by gravity would be available. Growth of vegetables and fruit trees were to be the main activities, all year around. In farm types B, C and D sited either along the artificial lake or water courses, irrigation of a limited part of the farms would be feasible (0.5 - 2.0 hectares).

Growth of vegetables and fruit trees on a smaller scale than in the previous type plus rice and maize during the rainy season were the recommended forms of land use.

In the other types of farm (E, F and G), water supply through irrigation was either not possible or too costly. In these farms a combination of dairying, the raising of pigs and chicken plus rain-fed agriculture were the forms of economic activities proposed.

GEO-ETAS made intensive use of aerial photograph interpretation, field surveys and laboratory analyses of soil and water in its land resources appraisal. It is outside the scope of this thesis to go into a detailed criticism of the land capability studies such as:

a) accuracy of soil and water surveys;
b) adequacy of recommended inputs (fertiliser, lime, pesticides, etc.),
c) selection of crops and estimation of yields.

These elements are clearly influenced by the resources and knowledge available at the time of the surveys. To assess these aspects in the light of current knowledge would be unfair and unrealistic.

Nevertheless, the main conclusions they arrived at and the principles employed do merit comment. The GEO-ETAS land evaluators acknowledged two main constraints to the practice of agriculture in the area, i.e., inadequacy of water supply through rainfall and the inherent infertility of the soils. They also suggested means of overcoming these limitations through irrigation, mulching and other soil-water conservation measures, together with fertilisation, liming and the selection of varieties more adapted to local conditions (based on agricultural experimentation).

Furthermore, they also recognised that different forms of land utilisation - agriculture, livestock, forestry and even different crops - have different requirements (moisture, soil nutrients, soil depth, soil drainage conditions, etc.) and thus require distinct forms of land management.

7.2.3 Implementation of the Project

By the time the GEO-ETAS studies were completed the administration of the Project had already changed twice. In 1962 when the Project was created, the responsibility for promoting its development was assigned to the National Council of Immigration and Colonisation (INIC). In 1964, INIC ceased to exist. The responsibility for the Project was assigned to the newly-created Brazilian Institute of Land Reform (IBRA).

Before the allocation of plots which did not start until 1966, a spectacular reduction in the number of families living in the Project area had occurred. In 1965 there were 317 families settled in the area in contrast to the 2400 families registered four years earlier (IBRA, 1966). IBRA claims that the difficulties in cultivating the land caused by climatic and pedological factors were the main factors responsible for the reduction in the number of people living in the area.

However, some of the pioneer settlers interviewed reported that a large proportion of the families settled in the area were forced out. Apparently, there were serious attempts on the part of the colonisation agency to convince squatters to move out and to apply for a plot through the formal channels. The administration proposals were not accepted calmly and there were a number of violent incidents.

The author believes that the role played by the administration both directly, by forcing squatters out and indirectly, by delaying the allocation of plots contributed to the reduction in the number of families living in the area.

In 1970, IBRA and the National Institute for Agrarian Development (INDA) were abolished, and the National Institute for Colonisation and Land Reform (INCRA) replaced them. Thus, since 1970 INCRA has been in charge of the Project.

In 1972 there were 334 families of migrants officially settled; 64 of them had already received provisional land titles (INCRA, 1972b).

In 1976, INCRA withdrew most of its personnel stationed in the Project. By that time, the management of the Project had changed three times, at the Federal level, and 12 times at the project level. These frequent changes, were bound to have caused discontinuity in the policies, insecurity and uncertainty to settlers.

The proposed GEO-ETAS plan was not implemented in full. The reasons for not executing the GEO-ETAS plan were not stated. However, in conversation with people who at some stage worked for the Agency in charge of the Project, the reasons given for not carrying out the proposed plans were: a) that the plans were unrealistic in terms of infra-structure (buildings, roads, workshops, etc.) and b) that the on-farm investment was too high. The former was estimated at 40 % of the total cost of the Project, the latter was estimated at 60 %. The total cost per each family settled was 7,000 U.S.$.

The reasons put forward by the Agency's personnel need to be commented upon. I am not convinced that cost, as stressed, was the main factor which prevented the implementation of the proposed plans. Instead, I think that the high level of management required and the limitations that the Agency had in choosing suitable settlers played a more important role. Most of the prospective settlers were landless migrants who had already moved a couple of times previously.

These people were believed to present strong resistance to changes in their farming practices and in their way of life such changes were necessary in the implementation of the proposed plans if the Project was to attain its objectives. In addition there was little previous experience at the time in using the cerrado for intensive agriculture. The recommended plans requiring high inputs and advanced levels of management, were therefore not based on experimental evidence (although there were reasonable estimates). Thus the outcome of implementing such plans was rather uncertain.

A shortened version of the proposed GEO-ETAS plans was implemented. Two community centres, instead of seven, were built and 480 plots, instead of 1289, were demarcated. The

480 plots range in size from 6 hectares to 60 hectares averaging 25 ha (Figure 2.1). The farming plots were demarcated in areas where water for irrigation was easily available. Two irrigation channels were built to supply water to 142 plots. All the settlers interviewed said that they received fertiliser, lime, seeds, pesticides, and technical advice after the plots had been allocated to them.

In 1980, 458 of the 480 settlers had already received land ownership titles. The rest, although officially settled were still awaiting their titles. However, the land tenure situation in the area was not satisfactory for two main reasons:

a) a large number of squatters moved in again, settling in the area left as 'reserve'. In 1979 there were already 206 families of squatters living in the area; and
b) 84 settlers out of the 458 with land titles have been disappropriated through the Decree No. 3354 of the 12th August 1976 (Brasil, 1976).

These 84 settlers owned plots along the lake margin. They were dispossessed from their plots on the grounds that their agricultural activities were polluting the water reservoir which supplies water to neighbouring towns. However, none of the 84 settlers involved moved out of their plots. They appealed against the Decree. By 1980, the matter had not been resolved. Over the past four years the 84 settlers have had their access to official agricultural credit curtailed. Consequently, they may not be farming as much land as they would if access to credit had continued.

In 1980 an amicable solution to the case was being sought by INCRA who was acting as a mediator between settlers and the GDF. INCRA's suggestion was to disappropriate a single strip of land (50m) along the lake, and to keep it as a reserve. In addition to this provision should be made to control the use of land by settlers in another adjoining strip of land of 50 m width. The chances of GDF accepting INCRA's suggestion are good for three reasons:

a) the strong resistance put up by settlers;

b) the high sum of money involved in compensation. The compensation was underestimated in the first place, and

c) the controversial nature of the subject of pollution control and the difficulties in defining acceptable levels of pollution. In addition, it has been suggested that the other settlers in the water basin would be contributing to the pollution of the water reservoir as much as the ones settled along the lakeside. Thus, policies aimed at introducing changes in agricultural farming practices (soil management, spraying of pesticides, etc.) could prove effective in preventing the increase of pollution.

In summary, the allocation of plots to settlers was delayed for four years (it did not start until 1966). After the allocation of plots settlers were provided with technical advice and material support such as fertiliser, lime, seeds, pesticides. By 1971 the administration of the Project had changed three times at the Federal level. In 1976 most of INCRA's personnel were withdrawn. In the same year 84 settlers were dispossessed from their plots, and squatters began moving in again, in the areas supposedly left as reserve. By 1980, there were 480 families officially settled, 458 of them had land titles, and the rest had provisional documents of land ownership.

7.3 Definition of categories of farms based on land quality and sampling procedure.

The number of farming plots (468) in the allotment map (Figure 2.1) does not coincide with the number of plots (480) reported at the time, by the Director of the Department of Projects of INCRA (internal report dated 24.10.78, Ref. D.P. No. 18). The allotment map was used in the stratification of plots because it was necessary to assess land assets at the farm level.

In the stratification of farms based on land quality 360 farming plots of the 468 mapped were included. The 108 plots

excluded comprise the 86 plots whose owners were disappropriated in 1976 (Brasil, 1976) and the 22 plots whose owners had not received land ownership titles. Both groups of settlers did not have access to credit at the time of the field survey: the former (86) colonists since 1976, and the latter (22) colonists since they settled in their farming plots. Therefore, these 108 settlers had not had the same opportunities to develop their plots as the other colonists.

The stratification of farms followed the overall methodology outlined in 4.3. The most detailed land capability map available for the Gusmão area was used in categorization of farms. This was the land capability map of Embrapa (1978) published at a scale of 1:100,000.

The 360 farms included in the sample population were divided into two categories (A and B). The category A of plots included farms with their total area falling within the "Land Suitability Group 2" (suitable for cultivation of crops) of Embrapa's land evaluation methodology outlined in 3.2. The category of plots B included farms with either all or part of their total area falling within the "Land Suitability Groups 4, 5 and 6" (unsuitable for crops) (see Tables 3.3, 3.4, 3.7, 3.8).

The 205 farms in the category A, have 90 and 10 % of their land in the "suitability sub-groups" 2(b)c and 2(b)c III, respectively. The 155 farms in the category "B" have 51, 44 and 5 % of their land in the "Suitability Sub-groups" 5(n), 2(b)c and 2(b)c III, respectively, as illustrated in Table 7.1. As defined in 3.2, the symbols 2(b)c, 2(b)c III and 5(n) are interpreted as:

2(b)c: suitability "FAIR" for annual and perennial crops in the Management System C. Suitability "RESTRICTED" in the Management System B and "UNSUITABLE" for crops in the Management System A;

2(b)c III: As 2(b)c for cultivation of annual crops but "UNSUITABLE" for perennial in the three Management Systems (A,B,C);

5(n): "UNSUITABLE" for cultivation of crops, planted pasture and silviculture; suitability "RESTRICTED" for native pasture.

TABLE 7.1 Characterization of plots in categories A and B based on land quality.

Category of Plots	LAND SUITABILITY GROUP PERCENTAGE		
	2(b)c	2(b)c III	5(n)
A (205)	90	10	0
B (155)	44	5	51

After the stratification of farms into categories 18 farming plots, i.e., 9 from each category were chosen for their owners to be interviewed. The nine plots studied from category A have on average 81 and 19 % of their land belonging to the "Suitability Sub-groups" 2(b)c and 2(b)c III, respectively. The nine plots sampled from category B have, on average, 51 and 49 % of their land belonging to 2(b)c and 5(n), respectively; as illustrated below:

Sampled Plots	SUITABILITY SUB-GROUPS (%)		
	2(b)c	2(b)c III	5(n)
A(9)	81	19	-
B(9)	51	-	49

As stated in 7.2.3, the size of plots in the Gusmão Project range from 6.00 to 60.00 hectares averaging 25.0 hectares. The 18 plots studied range in size from 6.94 hectares to 50.00 hectares, averaging 22.0 hectares. The size of plots vary independently of their land qualities, as illustrated below:

PLOT A		PLOT B	
Farm Code No.	Size of Plot in hectares	Farm Code No.	Size of Plot in hectares
02	37.86	01	49.00
04	36.81	03	16.18
05	6.94	06	20.40
09	7.86	07	16.37
10	14.10	08	9.02
11	10.50	13	9.66
12	10.34	14	27.66
16	14.09	15	28.91
18	30.00	17	50.00
$\bar{X}$ = 18.72 ha		$\bar{X}$ = 25.24 ha	

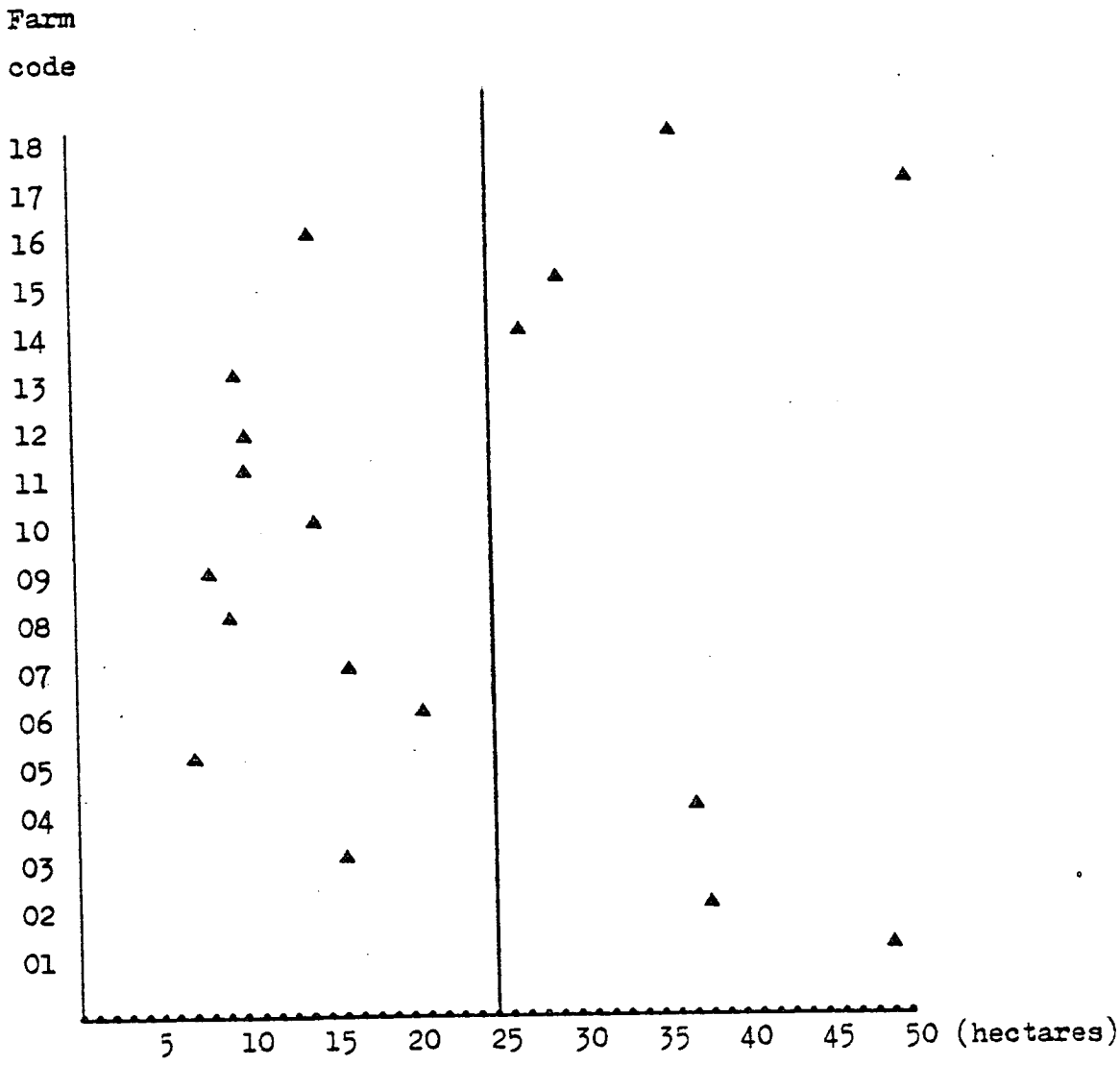
In the next section relationships between the success rate of colonists farming plots A and colonists farming plots B will be studied. Allowance will be made for the variation in the size of plots.

7.4 Relationships between land quality and settlers success

The success of colonists farming plots A and B will be assessed through the four indicators of success defined in 4.2. These are: "domestic animals" (7.4.1), "agricultural machinery" (7.4.2), "possessions" (7.4.3) and "farm buildings" (7.4.4). The relationships between land quality and areas farmed with crops and farming practices adopted by colonists will be considered in 7.4.5.

In order to assess the effects of farm size upon the success of settlers, the 18 plots studied are divided into two categories: Size 1 (S1) comprising 11 farming plots ranging in size from 7 to 20 hectares, averaging 12 hectares; and Size 2 (S2) comprising 7 plots ranging from 28 to 50 hectares, averaging 38 hectares, as illustrated in Table 7.2.

Table 7.2 Categorization of farms into two categories according to farm size.



Throughout this section the single effects of both land quality and size of plots, and also their interactive effects upon the success of colonists will be assessed through a two-day analysis of variance and F-tests. In this analysis, land quality and size of farms are the independent variables and the indicators of success form the dependent variable.

7.4.1. "Domestic animals"

The indicator of success referred to here as "domestic animals" comprises cattle, swine, horses and other animals (water buffalo and mules). It does not include birds. Scores in 'domestic animals' (d.a) for each settler were compiled through the following formula:

d.a. = Σ cattle + swine + horses + others

Scores in "domestic animals" range from zero to 32 with a large proportion of low scores and with only 11 % of scores above 5.0. Twenty-eight % scored zero and 61 % scored between one and five (Table 7.5).

The numbers of animals for settlers farming plots A and B averaged 3.0 and 6.6 respectively. In relation to farm size, the number of animals averaged 5.3 and 4.0 for settlers farming plot size 1 ($\bar{X}$ = 12.0 ha) and size 2 ($\bar{X}$ = 38.0 ha), respectively (Table 7.3).

The F value (0.94) for the investigation of the effects of land quality upon the number of domestic animals is small and not significant at the 5 % level. Thus, we cannot conclude that the number of domestic animals for settlers farming plots with different land assets is significantly different. The F value (0.20) for the investigation of the effects of farm size on the number of domestic animals is even smaller than the previous one. This indicates that the number of domestic animals owned by settlers farming different sized plots is not different at the 5 % level (Table 7.4).

The figures in Table 7.6 show that 9 0 % of the colonists interviewed owned neither cattle nor horses. However, 67 % of the colonists reared pigs.

The small percentage of settlers who own domestic animals, particularly horses and cattle, indicates that domestic animals are not widely used to pull agricultural implements. The small percentage of cattle owners also indicates that the majority of settlers have to buy milk for their family consumption.

From the small number of domestic animals we can conclude that livestock in the Gusmao project are not important as a source of income. Nevertheless pig and poultry activities (100 % of settlers have chicken), at the farm level, are important as a source of supply of animal protein for the settlers. Occasionally, settlers do sell pigs and chickens. How much of their income comes from this source could not be estimated, because all but one settler stated that the income from selling pigs and chickens was not significant.

Table 7.3 Scores for the "domestic animals" indicator categorized according to the factors'land quality' and 'farm size'.

	Land quality stratum				Farm size stratum			
	A		B		Size 1		Size 2	
	Colonist	Score	Colonist	Score	Colonist	Score	Colonist	Score
	1	0	4	0	3	0	2	0
	1	1	1	2	4	3	1	1
	1	2	1	3	3	5	2	2
	3	3	1	5	1	32	1	5
	3	5	1	18	-	-	1	18
	-	-	1	32	-	-	-	-
TOTAL	9	-	9	-	11	-	7	-
Mean	-	3.0	-	6.6	-	5.3	-	4.0

Table 7.4 Two-way analysis of variance , variance ratio (F) and significance of F for the "domestic animals" indicator.

SOURCE OF VARIATION	SUM OF OF SQUARES	DEGREES OF FREEDOM	MEAN	F	SIGNIF. OF F
MAIN EFFECTS	74.42	2	37.21	0.53	0.60
land quality	66.46	1	66.46	0.94	0.35
farm size	13.92	1	13.92	0.20	0.66
2-WAY INTERACTIONS	6.58	1	6.58	0.09	0.77
EXPLAINED	81.00	3	27.00	0.38	0.77
RESIDUAL	991.50	14	70.82		
TOTAL	1072.50	17	63.09		

Multiple R squared 0.069

Table 7.5 Frequency distribution for the 'domestic animals' indicator

Classes of domestic animals	Total no. per class	% of the total	Settlers	% of the total
0	0	0.0	5	28
1 - 5	37	43.0	11	61
≥ 6	50	57.0	2	11
Total	87	100.0	18	100

Median 3.0; mean 4.8 ; range 32.0

TABLE 7.6: Statistics for cattle, swine and horses

Classes of Animals (head)	CATTLE				SWINE				HORSES			
	Animals		Settlers		Animals		Settlers		Animals		Settlers	
	Total Number	% of the Total	Total Number	% of the Total	Total Number	% of the Total	Total Number	% of the Total	Total Number	% of the Total	Total Number	% of the Total
0	0	0.0	16	88	0	0.0	6	33	0	0.0	16	89
1 - 4	-	-	-	-	16	26.7	7	39	5	100	2	11
5 - 8	8	36.4	1	6	20	33.3	4	22	-	-	-	-
> 9	14	63.6	1	6	24	40.0	1	6	-	-	-	-
TOTAL	22	100.0	18	100	60	100.0	18	100	5	100	18	100

In summary, the number of domestic animals within the Project area is very small. The statistical analysis show that the numbers of livestock for settlers farming plots with different land assets are not significantly different. Furthermore, the number of domestic animals owned by settlers farming different sized plots is also not significantly different.

7.4.2 "Agricultural machinery".

This indicator comprises basic agricultural implements which are often found on farms where successful agriculture is being practiced. Scores in "agricultural machinery" (a.m) for each settler were compiled through the following weighted formula:

$$a.m = \Sigma\, 2(\text{tractor}) + \text{plough} + \text{harrow} + \text{cultivator} + \text{planting machines} + \text{threshing machines} + \text{spraying machines} + \text{diesel engines} + \text{chain-saw}.$$

Thus, a settler who owned one of each of the nine implements listed above would score ten. Clearly, scores greater than ten were possible because a settler would own more than one of each type of implement, such as two cultivators, three spraying machines and so on.

Scores for the indicator 'agricultural machinery' range from two to ten. However, the majority of settlers scored above six as indicated by the median (6.7) in Table 7.9.

The means 6.3 and 6.8 for settlers farming plots A and B, respectively are close (Table 7.7). These two means are not statistically significant different at the 5 % level of significance as indicated by the F value (0.70) and the significance of F (0.42) in Table 7.8. On the other hand, the mean 7.5 for farm size 1 is significantly greater than the mean 5.1 for farm size 2 ; as shown by the F-value (6.00) and the significance of F (0.03), in Table 7.8. Thus, we can conclude that settlers farming 'size 1' plots ($\bar{X}$ = 12.0 ha), have more agricultural implements than settlers farming 'size 2' plots ($\bar{X}$ = 38.0 ha). This finding will be elaborated at the end of this chapter.

The statistics in Table 7.10 show that 83 % of the settlers interviewed have at least one tractor. Ploughs and harrows are owned by 83 % of the colonists, and the most common agricultural

implement found amongst settlers is the 'spraying machine' with all settlers owning at least one. On the other hand, none of the settlers interviewed had threshing machines, chain-saws or sowing machines.

The high number of agricultural implements indicates that mechanization within the Project area is widely practised. Furthermore, it also indicates that settlers are relatively successful and are practising a market-orientated agriculture.

In summary the statistical analysis carried out here shows that there are no differences in the degree of success measured through "agricultural machinery" for settlers farming plots with different land assets. However, the number of agricultural machines for settlers farming 'size 1' plots ($\bar{X}$ = 12.0 ha) is significantly greater than for settlers farming 'size 2' plots ($\bar{X}$ = 38.0 ha).

7.4.3 "Possessions"

The indicator referred to here as "possessions", includes household possessions, cars and vans. The answers given by settlers on "possessions", except for automobiles, were either 'yes' or 'no' and the replies were coded 'one' or 'zero', respectively. For automobiles, the actual numbers of cars and vans owned by settlers were recorded.

Scores in "possessions" (p) for each settler interviewed were compiled through the following weighted formula:

$$p = \Sigma 2(\text{car} + \text{van}) + \text{refrigerator} + \text{television} + \text{radio} + \text{gas cooker} + \text{electricity} + \text{water filter} + \text{piped water}.$$

Thus, a settler who has either a car or van plus one of the other seven items of possessions would achieve a score of nine. Scores greater than nine are possible because a settler would own more than one automobile.

Scores in "possessions" range from two to 13 with an average of 7.5. However, 55 % of the settlers interviewed scored over eight; as illustrated in Table 7.13.Scores in "possessions" are evenly distributed for settlers farming plots with different

Table 7.7 Scores for the indicator "agricultural machinery" categorized according to the factors 'land quality' and 'farm size'.

Land quality stratum					Farm size stratum			
	A		B		Size 1		Size 2	
	Colonist	Score	Colonist	Score	Colonist	Score	Colonist	Score
	1	2	1	3	1	5	1	2
	1	3	1	5	2	6	2	3
	1	6	3	6	4	7	2	6
	4	7	1	8	2	9	2	8
	1	8	2	9	2	10	-	-
	1	10	1	10	-	-	-	-
Total	9	-	9	-	11	-	7	-
Meam	-	6.3	-	6.8	-	7.5	-	5.1

Table 7.8 Two-way analysis of variance, variance ratio (F) and significance of F for the "agricultural machinery" indicator.

SOURCE OF VARIATION	SUM OF OF SQUARES	DEGREES OF FREEDOM	MEAN	F	SIGNIF. OF F
MAIN EFFECTS	27.78	2	13.89	3.16	0.07
land quality	3.08	1	3.08	0.70	0.42
farm size	26.39	1	26.39	6.00	0.03
2-WAY INTERACTIONS	0.95	1	0.95	0.22	0.65
EXPLAINED	28.73	3	9.57	2.18	0.14
RESIDUAL	61.55	14	4.40		
TOTAL	90.28	17	5.31		

Multiple R squared 0.31

TABLE 7.9: Frequency distribution for the 'agricultural machinery' indicator.

Classes of Agricultural Machinery	Agricultural Machines		Settlers	
	Total Number	% of the Total	Number	% of the Total
2 - 4	8	7.0	3	17
5 - 7	57	48.0	9	50
8 - 10	54	45.0	6	33
TOTAL	119	100.0	18	100

Median = 6.7; Mean = 6.6; Range = 10.0

TABLE 7.10: Statistics relating to the indicator 'Agricultural machinery'

Agricultural Implements	NUMBERS							
	0		1		2		3	
	No. of farmers	% of the total	No. of farmers	% of the total	No. of farmers	% of the total	No. of farmers	% of the total
Tractors	3	17	13	72	2	11	0	0
Threshing Mach.	18	100	0	0	0	0	0	0
Ploughs	3	17	15	83	0	0	0	0
Harrows	3	17	15	83	0	0	0	0
Sowing Mach.	18	100	0	0	0	0	0	0
Cultivators	3	17	15	83	0	0	0	0
Spraying Mach.	0	0	7	39	7	39	4	22
Chain-saw	18	100	0	0	0	0	0	0
Diesel engines	3	17	10	56	3	17	2	11

land assets. The means for settlers farming plots in category A and B are equal (Table 7.11).

Nevertheless, the mean 9.3 for settlers farming plots averaging 12.0 hectares in size are significantly greater than the mean 4.8 for settlers farming plots averaging 38.0 hectares (Table 7.11). This is shown by the F(12.4) and the significance of F(0.003), illustrated in Table 7.12. The multiple R squared (0.47) indicate that 47 % of the variation in "possession" is explained by the factor "farm size". The rest could be due to other elements (settlers background, settlers age, size of family, settlers main economic activities, sampling error, etc.).

The statistics in Table 7.14 show that over half of the the settlers interviewed have either a car or van as a means of transport; 89 % have electrical supply and water filter in their homes. Seventy-eight per cent of settlers have television and the same proportion of settlers have radio. Seventy-two per cent have refrigerators, and 94 % have gas-cookers.

The high level of household possessions and the number of automobiles indicates that settlers are successful and are enjoying a relatively high standard of living. A general comparison between the degree of success achieved in the three case studies will be made in the last chapter.

The statistical analysis did not show significant differences in the indicator "possessions" for settlers farming plots with different land assets. It showed that the number of possessions is significantly greater for settlers farming plots averaging 12.0 ha, than for settlers farming plots averaging 38.0 hectares. The implications of these conclusions will be considered in the next section.

7.4.4. "Farm buildings"

The indicator of success referred to as "farm buildings" comprises store houses, outhouses and sheds. In the compilation of scores in "farm buildings" (f.b), the following formula was used:

Table 7.11 Scores for the indicator "possessions" categorized according to the factors 'land quality' and 'farm size'.

Land quality stratum					Farm size stratum			
A			B		Size 1		Size 2	
	Colonist	Score	Colonist	Score	Colonist	Score	Colonist	Score
	1	2	2	3	1	4	1	2
	1	4	1	4	1	7	2	3
	2	7	1	6	1	8	1	4
	1	8	2	9	3	9	1	6
	2	9	1	10	1	10	1	7
	2	11	1	11	3	11	1	9
	-	-	1	13	1	3	-	-
Total	9	-	9	-	11	-	7	-
Mean	-	7.5	-	7.5	-	9.3	-	4.8

Table 7.12 Two-way analysis of variance, variance ratio (F) and significance of F for the "possessions" indicator.

SOURCE OF VARIATION	SUM OF OF SQUARES	DEGREES OF FREEDOM	MEAN	F	SIGNIF. OF F
MAIN EFFECTS	84.50	2	42.25	6.20	0.01
land quality	1.10	1	1.10	0.16	0.69
farm size	84.50	1	84.50	12.39	0.003
2-WAY INTERACTIONS	0.49	1	0.49	0.07	0.79
EXPLAINED	84.99	3	28.33	4.16	0.03
RESIDUAL	95.45	14	6.82		
TOTAL	180.44	17	10.61		

Multiple R squared 0.47

TABLE 7.13: Frequency distribution for the indicator 'Possessions'.

Classes of possessions	Possssions		Settlers	
	Total per class	% of the total	Number	% of the total
2 - 4	16	12.0	5	28
5 - 7	20	15.0	3	17
8 - 10	54	40.0	6	33
⩾ 11	46	33.0	4	22
TOTAL	136	100.0	18	100

Median = 8.5; Mean = 7.5; Range = 13.0

TABLE 7.14: Statistics relating to the indicator 'Possessions'.

Possessions	NO		YES	
	No. of Farmers	% of Total	No. of Farmers	% of Total
Vans	11	61	7	39
Cars	9	50	7	39
Refrigerator	5	28	13	72
Gas-cooker	1	6	17	94
Television	4	22	14	78
Radio	4	22	14	78
Electricity	2	11	16	89
Piped-water	8	44	10	56
Water-filter	2	11	16	89

f.b = Σ store houses + maize stores + grain stores + corral + pig sties.

Scores for "farm buildings" range from 'zero' to 'four' with an overall mean of 1.7. Eleven per cent of settlers interviewed scored 'zero' and the majority (62 %) scored at least two (Table 7.17).

The 18 scores for "farm buildings" are evenly distributed between settlers farming plots with different land assets. The mean for settlers farming plot A is equal than the mean for settlers farming plots B (Table 7.15). In relation to the factor 'farm size', the mean (1.9) for colonists farming plots size 1 is not significantly greater than the mean (1.6) for settlers farming plots size 2, as indicated by the value of F and its significance illustrated in Table 7.16. The multiple R squared (0.03) is rather small and indicates that only 3% of the variation in "farm buildings" is accounted for by the factors 'farm size' and land quality.

The most common building amongst settlers is the 'store house' with 79 % of settlers having at least one. Next comes pig sties, with 61 % having one. Grain and maize stores are not found amongst the settlers interviewed (Table 7.19).

The low percentage of corrals amongst colonists is directly related to the small percentage of settlers raising cattle, in the same way as the large number of pig sties is related to the extensive rearing of pigs. The relatively low number of store houses is connected with the main crops farmed in the area. This will be clarified when the indicator "areas farmed with crops" has been discussed.

The statistical analysis for the indicator "farm buildings" did not detect any statistically significant differences for settlers farming plots with different land assets, nor settlers farming plots with different sizes.

Table 7.15 Scores for the indicator "farm buildings" categorized according to the factor 'land quality' and 'farm size'.

Land quality stratum					Farm size stratum			
A			B		Size 1		Size 2	
	Colonist	Score	Colonist	Score	Colonist	Score	Colonist	Score
	1	0	1	0	3	1	2	0
	3	1	2	1	6	2	2	1
	3	2	4	2	2	3	1	2
	1	3	2	3	-	-	1	3
	1	4	-	-	-	-	1	4
Total	9	-	9	-	11	-	7	-
Mean	-	1.8	-	1.8	-	1.9	-	1.6

Table 7.16 Two-way analysis of variance, variance ratio (F) and significance of F for the "farm buildings" indicator.

SOURCE OF VARIATION	SUM OF OF SQUARES	DEGREES OF FREEDOM	MEAN	F	SIGNIF. OF F
MAIN EFFECTS	0.49	2	0.25	0.19	0.83
land quality	0.00	1	0.00	0.00	1.00
farm size	0.49	1	0.49	0.37	0.55
2-WAY INTERACTIONS	0.12	1	0.12	0.09	0.77
EXPLAINED	0.61	3	0.20	0.15	0.93
RESIDUAL	18.50	14	1.32		
TOTAL	19.11	17	1.12		

Multiple R squared 0.03

TABLE 7.17: Frequency distribution for the indicator 'Farm buildings',

Classes of farm buildings	Farm buildings		Settlers	
	Total No. per class	% of the total	Number	% of the total
0	-	-	2	11
1	5	16.0	5	28
2	14	44.0	7	39
3	9	28.0	3	17
4	4	12.0	1	6
TOTAL	32	100.0	18	100

Median = 1.8; Mean = 1.8; Range = 4.0

TABLE 7.19: Statistics relating to the indicator 'Farm buildings'.

Farming Buildings	NUMBERS							
	0		1		2		3	
	No. of farmers	% of the total	No. of farmers	% of the total	No. of farmers	% of the total	No. of farmers	% of the total
Store houses	4	22	12	67	1	6	1	6
Grain stores	18	100	0	0	0	0	0	0
Maize stores	18	100	0	0	0	0	0	0
Corral	14	78	4	22	0	0	0	0
Pig-sty	7	39	11	61	0	0	0	0

7.4.5 "Areas farmed with crops and farming practices"

The effects of land quality and size of farms upon the amount of land farmed and the farming practices adopted will be considered here.

A score in "areas farmed with crops" (a.f) was compiled for each settler interviewed through the following formula:

a.f. = Σ area in perennial crops + area in biennial crops + area in annual crops + area in vegetables.

Scores for "areas farmed with crops" range from 2.0 to 25.0 hectares. On average each settler interviewed was cultivating 9.6 hectares of land in December 1979. Half of the settlers interviewed were farming more than 7.0 hectares as indicated by the median in Table 7.22.

The means in "areas farmed with crops" for plots in categories A and B are 7.9 and 11.3 hectares, respectively (Table 7.20). Although in absolute terms these two means appear different, statistically they are not significantly different mainly because of the variation which occur within each category, as illustrated in Tables 7.20 and 7.22. As for size of farms the mean 13.3 hectares for plots size 2 ($\bar{X}$ = 38.0 ha) (Table 7.20), is significantly greater than the mean 7.2 for plots size 1 ($\bar{X}$ = 12.0) at the 7 % level of significance, as illustrated in Table 7.21. The multiple R squared (0.26) indicates that only 26 % of the variation in area farmed is explained by land quality and size of farms.

Perennial crops (fruit-trees and coffee) account for 35 % of the total area farmed with crops; annual crops (rice, maize and beans) account for 38 %; green vegetables and roots account for 23 %. Biennial crops (sugar-cane, cassava) account for the remaining 4 % (Table 7.24).

Although vegetables occupy the second smallest area they are farmed throughout the year, and are the crops which contribute most to settlers' incomes. Perennial crops (orange, avocado, banana, coffee etc.) are also farmed on a commercial basis. However, rice,maize and beans are usually farmed for the settlers' own consumption.

Table 7.20 Scores for the indicator "areas farmed with crops" categorized according to the factors 'land quality' and 'farm size'.

Land quality stratum					Farm size stratum			
	A		B		Size 1		Size 2	
	Colonist	Score	Colonist	Score	Colonist	Score	Colonist	Score
	1	2.	1	3.	1	2.	1	7.
	2	4.	1	4.	1	3.	1	9.
	1	5.	1	5.	3	4.	2	10.
	2	7.	2	10.	2	5.	1	15.
	2	9.	1	15.	1	7.	1	18.
	1	25.	1	16.	1	9.	1	25.
	-	-	1	18.	1	16.	-	-
	-	-	1	20.	1	20.	-	-
Total	9	-	9	-	11	-	7	-
Mean	7.	7.9	-	11.3	-	7.2	-	13.3

Table 7.21 Two-way analysis of variance, variance ratio (F) and significance of F for the "areas farmed with crops indicator.

SOURCE OF VARIATION	SUM OF OF SQUARES	DEGREES OF FREEDOM	MEAN	F	SIGNIF. OF F
MAIN EFFECTS	193.29	2	96.65	2.59	0.11
land quality	35.54	1	35.54	0.95	0.34
farm size	139.21	1	139.21	3.73	0.07
2-WAY INTERACTIONS	24.22	1	24.22	0.65	0.43
EXPLAINED	217.51	3	72.50	1.94	1.17
RESIDUAL	522.00	14	37.29		
TOTAL	739.53	17	43.50		

Multiple R squared 0.26

TABLE 7.22: Frequency distribution for the indicator 'area farmed with crops'.

Classes of area farmed	Total area farmed	% of the total	No. of Settlers	% of the Total
2.0 - 5.9	27.0	15.6	7	39
6.0 - 9.9	32.0	18.5	4	22
10.0 - 15.9	35.0	20.2	3	17
⩾ 16.0	79.0	45.7	4	22
TOTAL	173.0	100.0	18	100

Median = 7.1; Mean = 9.6; Range = 25.0

TABLE 7.23: Farming practices adopted by settlers

Farming Practices	YES		NO	
	Number	%	Number	%
Irrigation	10	56	8	44
Contour planting	16	89	2	11
Terracing	2	11	16	89
Fertilising	17	94	1	6
Liming	18	100	0	0
Improved seeds	17	94	1	6
Intercropping	16	89	2	11
Spraying	18	100	0	0
Ploughing	17	94	1	6
Harrowing	18	100	0	0

TABLE 7.24: Areas farmed with perennial crops, annual crops and vegetables grouped into classes according to the size of the area farmed and the number of settlers who farm them.

Classes of Area farmed in hectares	Perennial crops				Annual crops				Vegetables			
	Area farmed		Settlers		Area farmed		Settlers		Area farmed		Settlers	
	Total area	% of the Total	Number	% of the Total	Total area	% of the Total	Number	% of the Total	Total	% of the Total	Number	% of the Total
0.0 - 2.0	2.0	3.0	5	28	6.0	9.0	8	45	3.0	8.0	6	33
2.1 - 4.9	26.0	43.0	10	56	25.0	38.0	7	39	36.0	92.0	12	67
⩾ 5.0	33.0	54.0	3	16	34.0	53.0	3	16	-	-	-	-
TOTAL	61.0	100.0	18	100	65.0	100.0	18	100	39.0	100.0	18	100

More important than the amount of land farmed in a single year are the farming practices adopted by settlers. The high management levels employed by the settlers interviewed can be presented as evidence that 'landless' people settled in colonisation projects can adopt advanced farming practices when certain conditions are fulfilled. These conditions will be considered in the final chapter.

The statistics in Table 7.23 show that all settlers use liming- 94 % adopt fertilization practices and plant improved seeds. Eighty-nine per cent use contour planting, and 56 % use irrigation. The high percentage of adoption of advanced farming practices is one of the positive achievements of the Gusmão Project.

The discussion on the indicator area farmed with crops and farming practices can be summarized as follows:

a) that settlers were cultivating on average 9.6 hectares of land;
b) that the differences in the amount of land cultivated by colonists farming plots with different land assets are not statistically different;
c) that the amount of land farmed by settlers farming plots 'size 2' ($\bar{X}$ = 38.0 hectares) is significantly greater than the amount of land farmed by colonists farming plots 'size 1' ($\bar{X}$ = 12.0 ha), and
d) that the majority of settlers adopt a high management level.

7.5 Evaluation of the performance of the Project

This section will be divided into two parts. In 7.5.1 the achievement of the socio-economic and political objectives will be assessed against the objectives the Project was created to fulfil. This assessment will be followed by a discussion of the main factors which have contributed to the development of the Project to date (7.5.2).

7.5.1 Achievement of the socio-economic and political objectives.

As stated, at the beginning of this chapter, the objective of controlling the occupation of the area played a major role

in the setting up of the Project. Therefore, this objective will be assessed first. This will be followed by an appraisal of the fulfilment of the other objectives, i.e., to improve the standard of living of settlers, to contribute to the regional economic growth and to promote the rational utilization of the land resources.

Objective one:

To control the occupation of the area

As noted in 7.2, the number of families living in the Project area increased dramatically in an 8-year period (1954-1961). It grew from 10 families, in 1954, to 2400 families, in 1961. This rapid increase in the population was attributed by IBRA (1966) to a reduction in the number of jobs for unskilled migrants which followed the inauguration of Brasilia.

The majority of families living in the area had settled along water courses. They had cleared between 1 to 2 hectares of land and were practising a subsistence agriculture. Incomes and standards of living of the families living in the area were very low (IBRA, 1966). Furthermore, the occupants of the area were considered "squatters". As squatters, they did not have access to credit nor technical assistance. Those circumstances were clearly not favourable for the establishment of a permanent and successful agricultural settlement in the area.

Therefore, it was imperative to control the occupation of the area for three main reasons:

a) to avoid possible conflicts over land tenure amongst settlers;
b) to avoid the fragmentation of the area into very small farming plots which would make it difficult to develop a market-orientated agriculture; and
c) to give legal access to the land to landless migrants through the issuing of land titles.

Since information on the implementation of the Project is scarce, the assessment of the achievement of this objective has to be based on the conditions existing at the time of the field survey.

Conflicts over land ownership among settlers were not reported by the colonists interviewed nor by the colonisation agency officials to whom I spoke. The indiscriminate sub-division of the land was avoided, as the colonisation agency was able to design and implement an allotment plan (Figure 7.1).

Furthermore, the issuing of 158 land titles to the 480 colonists officially settled by 1980 is quite satisfactory. However, as stated in the previous section, a large number of families have settled in the Project area as squatters. The exact number of squatters living in the area could not be ascertained. However, it should be over 200, as in the previous year (1979) 206 sites occupied by squatters were mapped in the allotment plan.

If one considers the large number of squatters living in the area, and the lack of land titles for all the official colonists, the conclusion is that the objective of controlling the occupation of the area has not been completely successful.

Objective two:

To improve the standard of living of landless migrants.

As noted previously, settlers'incomes and standards of living prior to the implementation of the Project were very low. The 1 to 2 hectares they were cultivating with subsistence crops (cassava, beans, rice, etc.) were not sufficient to allow considerable improvements in the standard of living. Housing conditions were poor (rustic earthen-floor houses, without electricity and running water), and there were no household possessions such as gascookers, refrigerators, television sets or automobiles (IBRA, 1966).

However, by the time of the field survey the majority of settlers were living in relatively good houses with electricity, and running water. Seventy-two per cent of the colonists interviewed were living in brick houses, and the remaining colonists were living in wooden houses which are of inferior condition than the brick built houses. However, 89 % of the colonists had an electrical supply in their houses (Appendix 1).

The levels of household possessions, as indicated in 7.4.3 and Appendix 1 are high. Ninety four per cent of the colonists owned gas cookers, 72 % had refrigerators, 72 % had both television and radio sets. Furthermore, 61 % of the colonists owned automobiles (Table 7.14).

The good housing conditions and the high levels of material possessions indicate that the settlers incomes have risen considerably leading to improvements in their living standards. Furthermore, settlers and their families have access to the educational and medical care facilities available in the neighbouring towns. These facilities are in general better than the ones found in the other colonisation projects located in more remote areas.

Objective three:

To contribute to the regional economic growth.

The enhancement of settlers' incomes has a positive impact upon other sectors of the regional economy. The demand for industrialized goods, and services such as transport, banking, and leisure facilities increase as income rises. This in its turn would stimulate the creation of jobs outside the agricultural sector.

As the Gusmão project is located near to major urban centres, including Brasilia, the capital of the country, it can be argued that settlers have benefited from the infra-structure of roads and social services which had to be established to support the urban centres. This is in sharp contrast with other projects, in more remote areas, where the social infra-structure of roads, schools, hospitals and other services is usually created to support the development of a project.

Nevertheless, a direct contribution of the Gusmão project to the regional economy is its participation in the supply of agricultural products to the urban population of Brasilia and the other "satellite" towns (Taguatinga, Ceilandia, Brazlandia). The area (11,575 hectares) allocated to settlers accounts for a mere 2 % of the total area (581,400 hectares) of the Federal District.

Still, it is estimated that 30 % of the green and root vegetables produced in the Federal District are grown in the Gusmão Project area.

The volume of green and root vegetables marketed at the "CEASA-BRASILIA" under the control of the Ministry of Agriculture is illustrated in Table 7.25. Nearly 100 % of the fruit and vegetable products consumed in Brasilia and surrounding towns are marketed at the "CEASA".

All settlers interviewed reported that either all their agricultural production or the major part of it is sold at the CEASA. However, some colonists sell part of their production outside the CEASA to people who come to their farming plots, or to owners of green grocery shops in the urban areas. Others sell direct to the public, on stalls at open market places in the urban centres.

The important thing is that colonists have several options to market their products. Consequently, losses of crops due to difficulties in getting access to the market should be minimal for colonists in the Gusmão Project. Furthermore, due to the proximity to the market, transportation costs are not high. The most successful settlers have their own means of transportation (61 % of the colonists interviewed). A pool system to transport products to the market was also reported by colonists.

In summary it can be concluded that the Gusmão Project has contributed to the regional economic growth in two ways:

- through the enhancement of settlers'incomes who are now buying more industrialized goods and services, and through the relatively large volume of vegetables and fruit that is being produced in the Project area.

Objective four:

To promote the rational utilization of land resources.

As already noted, the ultimate aim of this objective is to make the best sustainable use of the land resources leading to the fulfilment of the socio-economic and political objectives of colonisation projects. Implied in this objective are:

TABLE 7.25: Quantity of green and root vegetables marketed at the "Ceasa-Brasilia" and the participation in the total amount sold of vegetables grown in the Federal District and the Gusmao Project area.

Year	Vegetables	Quantity marketed at the Ceasa (ton)	Quantity produced in the Federal District	Quantity produced in the Gusmao Project
1978	Green vegetables	4975	4443	1004 (23)
	Root vegetables	22454	5386	1744 (32)
1979	Green vegetables	5042	4979	1073 (22)
	Root vegetables	31099	7045	2194 (44)
1980*	Green vegetables	2387	2069	421 (20)
	Root vegetables	12441	1835	671 (37)

* Up to June

Source: Ceasa

Bracketed numbers refer to the percentage of vegetables produced in the Federal District which were grown in the Gusmao Project.

a) the cultivation of an appropriate percentage of the total area of the Project;
b) the diversification of crops and animal production;
c) the adoption of up-to-date farming practices; and
d) the achievement of specified sustainable levels of productivity.

The degree of fulfilment of this objective will be assessed based on total area farmed, crops grown and farming systems adopted by colonists.

As land quality is closely related to the three criteria which will be used in the evaluation of the objective of promoting the rational utilization of the land resources, the main land qualities for crop growth in the Gusmão Project area discussed in Chapter 3 will be summarized here.

It was shown in the previous chapter, that 90 % of the total area of the Gusmão Project is made up of latosols (75 %) and cambisols (15 %). The low nutrient status is the major constraint these soils present to crop growth. On the other hand, physical properties of these soils such as effective depth, structure, texture, porosity and drainage conditions are, in general, favourable for tillage and suitable for the development of adequate root systems.

Therefore, the adoption of farming systems aimed at correcting the deficiencies of plant nutrients, is of utmost importance for farming the area successfully. The use of chemicals (fertilisers, limes) and the cultivation of species more adapted to the local conditions, are among the means to remedy the low nutrient status of the soils of the Gusmão Project.

In addition to the low nutrient status, inadequate soil moisture is the other major constraint to crop growth. The problems with soil moisture, as stressed in Chapter 3, are due to a combination of the low moisture holding capacity of the soils, aggravated by the distribution of rainfall (long dry season and dry spells during the rainy season). The use of irrigation, the planting of more adapted species, the practice of mulching, and

the time of sowing are among the practices which could help to overcome the moisture problems of the Gusmão area.

As illustrated in Table 7.23, liming and fertilising are adopted by 100 % and 94 % of the settlers respectively. Therefore, one of the major constraints to crop growth, i.e., the low nutrient status of the soils is being corrected by the colonists. On the other hand, irrigation to make up for the soil moisture problems, is practised by only 56 % of the settlers. The lower rate of adoption of irrigation is mainly due to the high investment costs which are needed to establish irrigation systems. Contour planting and sowing of improved seeds are also widespread practices adopted by colonists.

As for the diversification of crops over 70 species of plants are cultivated in the area, on a commercial scale. Green and root vegetables account for about 75 % of the species grown. Fifteen species of fruit trees are also cultivated on a commercial scale. Other crops grown in the area include basic food crops (mainly for the colonist's own consumption) and cash crops such as coffee.

The great diversification of crop production may be related to the ease with which agricultural products can be sold. It is also related to the widespread use of irrigation which allows the cultivation of crops throughout the year. Crop diversification offers some protection against fluctuations in price and total failures caused by pests, and diseases. Thus, the diversification of crop production is a good way for a settler to secure a consistent income, even if adverse factors (prices, pests, diseases) affect some of his crops.

Furthermore, the diversification of species and crop rotation are desirable ecologically for the control of diseases and pests. This is because a number of the disease organisms only attack specific species. The cultivation of single species for several seasons at the same site or on a monoculture basis can lead to great losses in production.

On the evidence presented, it can be concluded that the objective of diversifying crop production under adequate farming practices has been successfully achieved. The non-allocation of the areas left as 'reserves' was the correct policy at the time. This decision was taken on the grounds that those areas had lower agricultural potential due to the difficulties of obtaining water for irrigation. However, the present land tenure situation in the 'reserves' is undesirable, and could have been avoided if proper steps such as afforestation or simply policing, had been taken to secure a better utilization of the land resources of the total area of the Project.

7.5.2 Factors which affected the development of the Project.

The most important factors which have contributed either positively or negatively to the fulfilment of the objectives of the Project have already been identified in the previous sections. The three most important factors which affected the development of the Project, i.e.,

1) easy access to markets;
2) investment in improvement of land conditions, and
3) the management of the project, will be considered here.

In the final chapter, comparison of the three case studies, the relative importance of these factors to the performance of colonisation projects will be elaborated.

1) *Easy access to markets.*

This factor affected the performance of the Project in a positive way. The easy access to markets is due to the combination of the geographical location of the Project (near to major urban centres) and to the good road network (7.1).

The easy physical access to the urban centres means that colonists can sell their products when they wish to; that transportation costs are low; that colonists can obtain credit and technical assistance, and that the job of agricultural extensionists working in the field is not hindered by access.

The interacting aspects of the points listed above, in connection with the factor 'easy access to markets' contributed considerably to the relatively high performance of settlers.

2) *Investments in the improvement of land conditions.*

The large investment made with the application of fertilisers, lime and the establishment of the irrigation system aimed at remedying the deficiencies in the nutrient status of the soils and the soil moisture problems have also contributed to the development of the Project.

The use of irrigation by colonists farming smaller plots is the major factor accounting for the better performance of settlers. It was concluded (7.4) that the levels of material possessions of colonists farming plots averaging 12 hectares were significantly greater than the levels of possessions of colonists farming plots averaging 38 hectares. Eighty per cent of settlers who use irrigation are farming smaller plots (Appendix 1). The implications to agricultural planning of this finding will be considered in the final chapter.

3) *Management of the Project*

The colonisation agency deserves credit for the large investment made to improve land qualities for crop growth. On the other hand, the four-year delay in the allocation of plots to colonists, the continuing delay in the issuing of land titles, and the frequent changes in the management of the project should have affected negatively the performance of settlers and consequently the success of the Project.

As stated in 7.2.3, the management of the Project changed three times at national level, betweeen 1962 and 1970, and 12 times at the Project level, between 1966 and 1976. The frequent changes in the Project management were bound to have caused discontinuity in policies negatively affecting the development of the Project.

7.6 CONCLUSIONS

The main conclusions derived from this study are:

- Differences in land quality are not causing differences in the degree of success of colonists. These have been measured through the indicators of success named: "domestic animals", "agricultural machinery", "farm buildings" and "material possessions".

- Settlers farming smaller farms, averaging 12.0 hectares, are better off in terms of material possessions than colonists cultivating larger farms, averaging 38.0 hectares. The differences in the degree of success can be related to the access to irrigation channels enabling settlers to grow crops throughout the year.

- The objective of controlling the occupation of the area has been only partially fulfilled on the grounds that:
  a) large numbers of squatters have invaded the areas left as reserves causing an undesirable land tenure situation, and
  b) the issuing of land titles to colonists has not been completed 18 years after the creation of the Project. The positive accomplishment was that the colonisation agency designed and implemented a farm allotment plan avoiding, therefore, the fragmentation of the area into small farming plots unsuited to the practice of commercial agriculture.

- The objective of improving the standards of living of settlers has been fulfilled. This conclusion is based on the comparison of settlers' material possessions and housing conditions at the beginning of the Project (IBRA, 1966), and the present housing conditions and material position of the settlers.

- The objective of contributing to the regional economic growth has been satisfactorily fulfilled. The main contribution is in the supply of agricultural products to the urban centres of the region. It was pointed out that although the Gusmão colonists farm only two per cent of the total area of the Federal District, they produce about 30 % of the green and root vegetables grown in the Federal District. The other contribution derives from the relatively high economic success of colonists which, in turn, has led to a high demand for industrialized goods and services. This should be causing a positive impact on other sectors of the economy.

- The objective of promoting the rational utilization of land resources has not been completely fulfilled. The positive sides of the fulfilment of this objective are:
  a) the diversification of crop production (over 70 species are grown in the area commercially), and
  b) the high level of management adopted by settlers.
  The negative side relates to the fact that nearly half of the total area of the Project set aside as reserves, is neither managed nor policed. This has surely contributed to their invasion by squatters creating, therefore, an undesirable land tenure situation.

- The main factors which contributed to the relatively high performance of settlers and the Project as a whole
  a) the easy access to markets, due to the location of the Project near to major urban centres and the good road network. This facilitates marketing, keeps transportation costs low, facilitates access to credit, technical assistance and other services (health, education, etc.) and it also facilitates the work of agricultural officers working in the field.

b) The investment made in the improvement of land conditions for crop growth. Large investments were made in improving the nutrient status of soils (fertilisers and lime) and in the remedying of the inadequacy of soil moisture through the establishment of irrigation systems.

c) The management of the Project made both positive and negative contributions to the development of the Project. The positive contribution was the investment made in improving land condition. The main negative aspects were: the four-year delay in the allocation of plots to colonists and the constant changes in the management of the Project.

CHAPTER 8

COMPARATIVE DISCUSSION OF THE THREE CASE STUDIES AND SUMMARY OF MAIN CONCLUSIONS

This study examines the relationships between land quality and the success of individual settlers. Within each Project it was not possible to detect any significant differences in the degree of success brought about by differences in land quality. In interpreting this finding five points have to be considered. These are:

1. the inherent land quality from the point of view of agricultural development of the two major environments studied;
2. the variability of land quality within each category of farm;
3. capital;
4. length of time that the projects have been in operation; and
5. the farming system adopted.

The implication of the five points listed above will be assessed next (I). This will be followed by a subjective comparison of the achievements of the three Projects (II), a discussion of the main non-land factors which contributed to or hindered the development of the Projects (III), and finally, the implications of the findings of this research for future projects (IV).

(1) *The inherent land quality of the two environments*

It was shown in Chapter 3 that the Ouro Preto project (situated in evergreen forest) has the highest agricultural potential among the three case studies and that the Sagarana and Gusmao Projects in the cerrado have potentials similar to one-another. This is in itself unusual since surveys have demonstrated that less than 10 % of the soils beneath rain forest in the Amazon area have any sort of crop potential. The cerrado soils are generally considered to be more suited to agricultural development (Goodland, 1980).

The majority of the soils of the Ouro Preto project are derived from mineralogically rich basic rocks. About 75 % of the Ouro Preto soils have medium to high contents of exchangeable bases and low contents of exchangeable aluminum. These soils are classified as having the suitability category 'Good' for the cultivation of crops in the three management systems (A, B and C).

On the other hand, nearly all the Sagarana and Gusmao soils are

very acid with exchangeable aluminum toxicity and they also have low contents of echangeable bases (Ca, Mg, k, Na). These soils are considered to lie in the category 'Unsuitable' for the cultivation of crops in Management system A, a 'Restricted' suitability in Management system B and 'Fair' suitability in Management system C.

It should be kept in mind therefore, that in the chapters dealing with individual case studies, the importance of land quality to the success of settlers was studied within each environment: one environment possessed a majority of medium to high nutrient status soils (the Ouro Preto project), and the other was characterised by the low nutrient status of its soils (the Sagarana and Gusmão projects).

It should be noted however, that the categories of farms studied in each project differed from one another. The degree of the difference varied with the detail of the land capability and soil maps used in the definition of land qualities and stratification of farms (5.3, 6.3, 7.3). It may be that the differences in land quality between categories of farms within each project are not large enough to affect the success of settlers.

(2) *Variability of land quality within each category of farms and size of plots.*

Due to the variability of land quality and the size of plots it was not possible to compare the success between two groups of colonists farming plots with very distinct characteristics. These would include for example, a group of colonists farming 10 hectare plots made up of Class I land, and another group also farming 10 hectare plots comprising class III land.

As noted in the stratification of farms (5.3, 6.3, 7.3) the range of variability of land quality within each category of plots is considerable. In the Sagarana project, farms in Category A are made up of 90 % arable land (Classes II, III and IV) and 10 % of non-arable land (Classes V, VI, VII and VIII), and Category D is made up of farms averaging 23 % arable land and 77 % non-arable land. Farms in category A and D average 84 and 240 hectares, respectively. Thus, colonists farming plots A and D have on average 76 and 55 hectares of arable land respectively. This indicates that both groups of colonists have large areas suited to cultivation.

Although the categories of plots studied differ from one another in

their land assets, the effects of the differences on success of settlers will not show up if the activities of colonists have not been restricted by the availability of land.

It is unlikely that areas farmed by colonists in any one year were determined by the availability of land. This is because farm plots in the three projects are relatively large. They average 140, 100 and 25 hectares, respectively. The areas cultivated with crops in the 1979/1980 agricultural year averaged 8, 17 and 9 hectares, respectively (5.4.5, 6.4.5, 7.4.5). This indicates that only a small proportion of the total area was being cultivated. It is possible therefore due to the variability in land quality, the size of plots and the small areas farmed, that colonists have cultivated land with similar crop potential.

(3) *Capital*

At the beginning of the colonisation projects the typical colonist did not have capital of his own sufficient to farm the land allocated to him to its full potential. His access to capital was hindered by a number of factors such as (a) delays in the issuing of land titles, (b) a limited number of credit institutions, (c) the reluctance of bank managers to lend to people without land deeds, (d) biased Government policies favouring successful farmers, (e) failure of the Colonisation Agency to secure adequate financial resources to implement the schemes. Since adequate capital was denied to the colonist particularly in the Ouro Preto and Gusmão projects, most of his land remained either unused or simply underutilised (5.5.1, 6.5.1).

Therefore, with capital limiting colonists activities, the significance of having either 60 or 20 hectares of arable land on the success of colonists may have been masked by the fact that they own more land than they could farm with their own resources.

The results of the Gusmão project (7.4), showed that colonists farming smaller plots averaging 12 hectares are better off than colonists farming plots averaging 38.0 hectares. Since plots, independent of their size, are made up of land with similar inherent quality, we can conclude that larger holdings are not sufficient to guarantee better performance. The main factor associated with the different degrees of success amongst the colonists of the Gusmão project, is the use of irrigation in the cultivation crops. With irrigation, crops can be farmed throughout the year. Therefore, in the Gusmao project, intensity

of land use is more important to settlers' success than the actual size of their plots.

(4) *Length of time that the Projects have been in operation*

This is another factor which could have contributed to diminish the significance of land quality to settlers' success. The Gusmão project is the oldest. It was founded in 1962, but the allocation of plots did not start until 1966. The Sagarana project was created in 1967, but the allocation of farming plots to colonists started in 1973. The Ouro Preto project was set up in 1970, and the allocation of plots began in the same year.

The short length of time the projects have been in operation, particularly the Sagarana and Ouro Preto projects, may mean that settlers have not yet benefited from the investments made in the first few years. These include land clearing, and the planting of perennial crops. Rubber trees, for instance, take about 7 years to come into production, coffee and cocoa take about 2 to 3 years.

It is possible that in the long run, differences in land quality may begin to cause differences in the degree of a colonists' success. This will only happen if the activities of colonists begin to be determined by the availability of land, instead of the non-land factors.

(5) *Farming systems adopted by colonists*

As pointed out above, the factors associated with success for the Gusmão colonists were the farming practices and not the inherent quality. A similar relationship was found in the Ouro Preto project where settlers who are cultivating larger holdings with perennial crops were the ones more successful. As noted, the majority of the soils of the Ouro Preto project have a good suitability rating for perennial crops (3.2, 5.5).

Within each project the farming practices adopted are fairly similar, independent of the type of land a colonist is cultivating.

In the Gusmão project the farming system adopted by colonists includes practices to remedy two main constraints to crop growth. These are the low nutrient status of the soils and the problems related to soil moisture availability. These constraints are being remedied by the application of fertilisers, lime, irrigation and by crop diversification (over 70 species of plants are commercially grown in the area). It may be therefore, that the relatively high management level adopted

by the Gusmão colonists is masking the differences in land quality and consequently the effects of land assets upon the success of settlers.

The farming system adopted by the Sagarana colonists does not include practices to remedy the two main constraints on crop growth. Liming, fertilising and irrigation are not used at all (Table 8.1), and crop production is not diversified (only rice, maize and beans are commercially grown). It therefore appears that in this case the low management level adopted by the Sagarana colonists may be offsetting the effects of land quality upon the success of colonists.

In the Ouro Preto project yield improving practices are hardly adopted at all by colonists as illustrated in Table 8.1. The same reasoning applied to the Sagarana project is also valid for the Ouro Preto project.

The relative unimportance of land assets to settlers' success found in this study is, to some extent, similar to the conclusion of Young and Goldsmith (1977). These authors, studying soils with low nutrient status in Malawi, did not find any significant increase in crop yields due to differences in soil types.

TABLE 8.1: Farming practices adopted by colonists expressed in percentage.

Farming Practices	Projects		
	Gusmão (18 Colonists)	Sagarana (32 colonists)	Ouro Preto (105 colonists)
Fertilising	94	0	4
Liming	100	0	0
Spraying	100	3	19
Contour planting	89	31	22
Improved seeds	94	25	15
Irrigation	56	0	0

Comparison of the Performance of the Three Case Studies

Evaluation of the degree of achievement of the objectives of each project shows that, in general, the projects have fallen short of their expectations (5.5, 6.5, 7.5).

The objectives of creating a permanent agricultural settlement and to 'attach' man firmly to the land have to some extent been successfully

fulfilled. However, due to the short length of time that the projects have been in operation and to particular factors affecting each project, some observations about the fulfilment of these objectives are needed.

In the Ouro Preto project, the number of colonists settled (5050), the low turn-over of settlers, the non-existence of conflicts over land ownership amongst colonists and the creation of an agrarian structure based on medium size farms (100 - 200 hectares), support the conclusion that the above objectives have been fulfilled. Furthermore, the extension of the area planted to perennial crops and the infra-structure of roads, buildings are an indication that a permanent settlement has been established.

The number of colonists settled in the Ouro Preto project is in itself very impressive. However, its desirability is questionable and illustrates the inability of INCRA to control the indiscriminate appropriation of land by individuals arriving in the Ouro Preto area. The number of families which were to be accommodated in the Project has been put at 500, 1000 and 2000 families by different authorities. Even if we accept the highest figure as the correct one, the number of colonists settled in the Project has been exceeded 2.5 times.

Most of the Ouro Preto colonists were not settled by INCRA. They established themselves in the area without INCRA's authorisation and later were recognised as official settlers in accordance with the squatters rights legislation applied in the area (see page 58,). This means that the majority of colonists were not selected by INCRA. The other negative aspect of the spontaneous settlement was that the administration had to cope with large numbers of settlers with limited resources. The supply of an adequate infra-structure of feeder roads, and technical and financial assistance were severely restricted and have probable affected even the official settlers. The design and implementation of an agricultural land use plan, for example, which was one of INCRA's aims, did not occur.

The size of the Project also means that there are colonists settled 100 kilometres from any urban centre. Their access to services (technical assistance, health, dental, etc.) are restricted not only by distance from the centre of services but also by the inadequate road-network. It can be argued that colonists settled in remote areas, have smaller opportunities to develop their plots than the ones settled in more accessible areas. Although the number of settlers is usually used

to highlight the success of the Project, the low standard of living amongst settlers, and the under-utilisation of the natural resources, cannot be considered success at all.

The objective of creating an agrarian structure based on small size farms, may not last very long in the Ouro Preto project. It can be modified in two ways :

a) by the more successful settlers buying plots of the least successful colonists, and
b) by people from outside the area acquiring a number of plots thereby creating large estates which the colonisation agency aimed to avoid.

Although, amalgamation of plots is not occurring at a significant scale at present, the paving of the BR-364 road, improving the accessibility to the region, is likely to attract capital to the area, and consequently increase the process of amalgamation.

In the Sagarana project the high turn-over of settlers furnishes grounds for questioning the degree to which the objective of firmly 'attaching' the rural population to the land has been fulfilled. Between 1973 and 1980, 96 settlers gave up their plots and in 1980, 10 plots of the 208 which comprise the Project were still unoccupied. Furthermore, only 74 of the 198 settlers had received land titles.

In the Gusmão project the 480 plots which comprise the Project were occupied, and 454 of the 480 settlers had received land titles. The agrarian structure of the Gusmão project is the most stable amongst the case studies, and is unlikely to change substantially because the majority of settlers realise high incomes and enjoy relatively high standards of living, indicated by their material possessions. The continuation of the present agrarian structure, in the other projects, will depend on the ability of settlers to increase their incomes.

Despite the fact that the projects have fallen short of their expectations they still have contributed to the regional economic growth in two ways. Directly, they have increased the food supply to the region, particularly the Gusmão and Ouro Preto projects. About 30 % of the green and root vegetables produced in the Federal District are grown in the Gusmão project, which occupies only two per cent of the total area of the Federal District, (7.5, and Table 7.25). The Ouro Preto project is estimated to produce about 60 % of the rice needs of the Territory of Rondonia (Fig. 5.1).

Indirectly, the projects have stimulated the building of roads, bridges and improvements in the public services (health, education, transport). Furthermore, the enhancement of the income of landless migrants, no matter how small it has been, led to higher demands for goods and services making therefore a positive impact upon the regional economy.

A further objective in each project was the promotion of a rational utilisation of the land resources. The conclusion is that it has not been fulfilled in the Ouro Preto and Sagarana projects and only partially fulfilled in the Gusmão project.

In the Ouro Preto project, the high rate of deforestation, the wasteful process of forest clearance, the under-utilisation of the deforested area (land abandoned and understocking of pasture) and the low level of adoption of conservationist practices, were discussed earlier in concluding that the land resources are not being utilised rationally.

Over half of the total area of the Ouro Preto project has already been cleared. By legislation half of the area of each plot cannot be deforested. This regulation has been ignored by the majority of the colonists interviewed (Table 5.31). Estimates of the potentially exploitable timber volume in the Amazon area range from 60 to 120 cubic meters/ha (Pandolfo, 1978). But the effective yield per hectare is seldom more than 5 m^3, because only the most valuable species are extracted; the remaining timber is burnt (SEAC, 1980). Furthermore, the deforested area is under-utilised. Forty per cent of the total deforested area is used as pasture, grazed by 0.9 head of cattle/ha and 17 % of the cleared area is now in capoeira (Table 5.35).

On the other hand, the positive achievement of the Ouro Preto project lies on the extent of the area planted to perennial crops, covering 20 % of the deforested area (Table 3.35). Perennial crops are important for ecological, social and economic reasons. They are well suited to the environment and provide good soil protection; they are demanding in labour and provide long term employment. Furthermore, they guarantee a high income to settlers. This is indicated by the fact that perennial crop growers are better off in terms of possessions than the non-growers (5.5).

It was emphasized that despite the advantages of growing perennial crops, in the Ouro Preto project, it is not advisable to finance larger holdings than a settler can look after with his own labour. Labour in

the Territory is already scarce, and is likely to remain so. This is because the first priority of people migrating to Rondonia (the present agricultural frontier) is to acquire land and not to work as hired labour.

Furthermore, the financing of large holdings reduces the chances of a colonist to diversify crop production in his plot. Dependence for income on only one crop is dangerous. A fall in world prices or losses of harvests due to weather, pests and diseases could lead to the undesirable situation of for example, abandonment of plantations (which has already occurred in the Ouro Preto project) and even abandonment of the whole farming plot.

In the Sagarana project the targets implied in the objective of promoting the rational utilisation of the land resources have not been realised at all. INCRA goals were to foster the agricultural development of the area based on the cultivation of food, and cash crops, as well as livestock. On average, each settler was expected to grow 14 hectares of traditional food crops (rice, maize and beans) plus 16 hectares of cash crops including cotton, ground-nuts, castor oil plants and fruit trees (citrus, mango, avocado and guava), and to raise 40 head of cattle.

It may be argued that the INCRA targets were very optimistic, but the poor performance of the Project is unquestionable. Diversification of crop production has not occurred. Settlers continue to farm basically the same crops (rice, maize and beans) that they were farming before the implementation of the Project. Even these crops are cultivated on a small scale. The percentage of the total area allocated to settlers, which is actually being farmed, is very small yet farming plots average 140 hectares. In 1979/1980 agricultural year colonists planted 8 hectares of land and raised 17 head of cattle, which means that the larger part of the area is not being used.

The non- fulfilment of the Sagarana objectives are attributed to several factors, mainly the non-land ones (management, capital, technical assistance). However, the low nutrient status of the soils, and weather problems (drought in some years and excess water in others leading to flooding) also contributed to the low performance of the Project.

Ironically, the Sagarana project, in comparison to Ouro Preto project, had the best survey of its land resources before the imple-

mentation of the Project. The determination of the size of plots was based on the capability of the land, and the farming system to be adopted. However, the recommendations of the land evaluators concerning the use of irrigation, fertilisation and other practices to remedy the major constraints to crop growth were not observed. This was due mainly to inadequate finance and mis-management (6.5.2).

In the Gusmão project the objective of promoting the rational utilisation of the land resources has been partially fulfilled. Crop production is diversified (over 70 species are commercially grown) and colonists adopt a high management level including practices such as fertilising, liming and irrigation which improve land conditions for crop growth. Farming plots in the Gusmão project are very much smaller than in the other projects. They average 25 hectares. Even so, the Gusmão colonists were planting larger areas than the Sagarana settlers with plots averaging 140 hectares. In the 1979/1980 agricultural year Gusmao colonists were farming an average of 9 hectares of land per plot. The use of the land resources in the Gusmao project is more intensive than in the other two. This point, intensity of land use, will be taken up again later.

The objective of improving the standards of living of colonists has been convincingly fulfilled in the Gusmão project. In the others the standards of living remain very low. The low levels of material possessions (household goods, and agricultural implements) in the Sagarana and Ouro Preto projects, indicate that colonists in these projects are less successful than the Gusmão settlers. Scores for the indicator 'material possessions' for the Gusmão (7.4.3), Sagarana (6.4.3) and Ouro Preto (5.4.3) projects average 7.5, 1.6 and 2.0, for the 'agricultural machinery'indicator they average 6.8, 0.5 and 1.7, respectively.

The Sagarana colonists have the largest farms and possessed the smallest levels of material possessions. The levels are smaller than those registered for the rural population of the country as a whole, in the 1970 census (IBGE, 1975), despite the large Government investment made in the implementation of the Project. None of the colonists interviewed possessed gas-cookers, electricity, televisions, refrigerator or automobiles (Table 8.2). Nor did they possess tractors (Table 8.3). The levels of possessions of the Ouro Preto settlers are also small, but greater than at Sagarana.

TABLE 8.2: Material possession of the rural population of the country as a whole registered in the 1970 census, and the colonists' possessions in the three projects studied. Figures are expressed in percentage.

POSSESSION	1970* census (%)	Project		
		Gusmão (18 colonists)	Sagarana (32 colonists)	Ouro Preto (105 colonists)
Gas-cooker	5.4	94	0	0
Electricity	8.3	89	0	2
Radio	40.0	78	81	87
Television	1.5	78	0	1
Refrigerator	3.1	72	0	1
Automobiles	2.5	61	0	17

* SOURCE: IBGE (1975)

TABLE 8.3: Agricultural machinery in the three projects (percentage)

AGRICULTURAL IMPLEMENT	Project		
	Gusmão (18 colonists) %	Sagarana (32 colonists) %	Ouro Preto (105 colonists) %
Tractor	83	0	10
Ploughs and/or Harrows	83	22	9
Cultivators	83	12	7
Spraying machines	100	3	47
Chain-saw	0	6	60
Diesel-Engines	83	3	8

The Gusmão colonists are better off in terms of material possessions than the others. Ninety-four per cent of the colonists interviewed have a gas-cooker, 89 % have an electrical supply in their homes, 78 % have television and radio sets, 72 % have a refrigerator and 62 % have their own means of transportation. These levels of possessions are very much better than the ones registered in the 1970 census for the rural population of the country as a whole (Table 8.2). The better performance of the Gusmão colonists is also indicated by the levels of agricultural implements. Eighty per cent of the settlers possess tractors, ploughs, and harrows, and all of them have spraying machines (Table 8.3).

The better performance of the Gusmão colonists, farming land resources similar to the Sagarana project resources and with lower agricultural potential than the Ouro Preto colonists raises a number of issues not related to the inherent quality of the land such as accessibility (road network), credit, technical assistance, marketing and sociological aspects. During the course of the field survey recording the criteria of success, it became apparent that non-land factors were important. Since non-land factors were not the main aim of this research they were not investigated in depth. Therefore, the following interpretation of the effects of non-land factors on the performance of the Projects does not derive from a research designed specifically to investigate these factors however the results of the analyses referred to already indicate that these factors may be exerting an important influence. The importance to the performance of accessibility (road network), credit, technical assistance and marketing will therefore be discussed next.

Non-land factors

- *Accessibility (road network)*

The road network on the Gusmão project is the best amongst the projects studied. The main roads leading to Brasilia, 30 km away, are paved (Figure 7.1). Brasilia has road, rail and air links with the most developed markets farther south. The network of feeder roads is also well developed. The export of agricultural products and the import of inputs (fertilisers, lime, seeds, pesticides); access to

credit, technical assistance and public services is not hindered by the lack or inadequacy of roads.

The proximity to the urban centres, the good road network and public transport means that the time spent by the Gusmao colonists in getting to the market is not great which means that he can spend more time working in his plot, increasing therefore production and consequently increasing his income.

The road network of the Sagarana project is not as good as the Gusmão project. The trunk road which links the Project to Unaí (130 kilometres away), which is the major centre for marketing and acquisition of services, is unpaved. Unai is a small market, in 1970 it had a population of 13, 763 inhabitants (INCRA, 1973). The administration of the Project (INCRA, 1976b)reported that the major problems in marketing production of the previous years were the difficult access to the nearest market and the lack of storage facilities within the Project area. By 1980, the major constraints to marketing, reported in 1976, were still there.

The network of feeder roads in the Sagarana project is relatively well-developed. By 1978 230 kilometres of feeder-roads and 234 metres of bridges had already been built. In that year the ratio of kilometres of road to number of settlers was 230/186 = 1.23. Therefore, transportation within the Project was not a major problem.

The Ouro Preto project has by far the worst infra-structure of roads (trunk and feeder roads). Traffic in the trunk road (BR-364), linking the Project with the main markets of the centre-south (over 2000 km away), is very difficult and often comes to a halt at the peak of the rainy season.

The network of feeder roads is very inadequate. By 1978 the ratio of kilometres of road built to colonist settled was 0.23. The lay-out of farms in the Project requires about 0.40 km of road per settler. This indicates that only 58 % of the road needs of the Project had been built. The problem of feeder roads becomes even worse when one consideres that some of the roads are not passable due to lack of maintenance.

Colonists access to urban centres to market their production and to acquire services is very restricted. Post-harvest losses have been estimated at 30 %. Furthermore, Scazzocchio (1980) points that the Ouro Preto colonists have to cope with the fact that the rice they

produce is worth £1.50 at the farm gate and £5 at a distant warehouse.

The inadequate network of feeder roads, in the Ouro Preto project renders transportation costly. As a consequence, colonists returns are lowered. Under these circumstances there are few incentives to intensify production through the use of yield increasing techniques. These are problems that all colonists have faced independent of the quality of land.

The good road network of the Gusmão project favours agricultural development. On the other hand, the inadequate network of roads of the Sagarana and, notably, of the Ouro Preto project, have negatively affected agricultural development and consequently settlers' success.

- *Agricultural credit*

In the three case studies, credit to finance crop development and farm investment such as land clearing, establishment of pasture, livestock, agricultural machinery, farm buildings or fencing was to be obtained from credit institutions either directly by the colonist himself (Ouro Preto project), or indirectly by the management of the Project on his behalf (Sagarana and Gusmão projects).

In the Ouro Preto project for instance, in the 1974/1975 agricultural year, only 177 (6 %) of the 3200 colonists obtained credit to grow cocoa. Credit for establishment of coffee plantations did not start until 1976, even so, on a small scale. The fact was, that between 1974 and 1978, only 684 (14 %) of 4,750 colonists obtained credit to grow either cocoa (468), coffee (160) or rubber (56) (INCRA, 1979). Credit for other cash crops was not available. Consequently the majority of the Ouro Preto colonists had to practice a subsistence agriculture.

Over 80 % of the colonists of the Sagarana project used seasonal credit to cultivate short cycle crops (rice, beans and maize), in the three consecutive agricultural years (1975/1976/1977), as illustrated below (INCRA, 1978).

Agricultural Year	Total No. of Colonists	No. of colonists who obtained credit
1975/1976	201	165 (82)*
1976/1977	195	182 (93)
1977/1978	186	161 (87)

In addition to credit to grow short cycle crops, a small percentage of the Sagarana colonists obtained credit for investments in land clearing and fencing. However, none of the colonists obtained credit to grow cash crops (cotton, ground-nut, castol oil) or fruit trees envisaged in the Projeto Técnico (INCRA, 1974). It can be argued therefore, that the establishment of a diversified crop production in the area, which was one of INCRA's goals were severely restricted by lack of finance.

Access to credit was restricted by a number of factors mentioned earlier such as delays in the allocation of land titles, difficult physical access to urban centres (inadequate road network), and limited number of credit institutions.

As already noted, title of land ownership is a pre-requisite for colonists to obtain long-term credit for improvements of farming plots. Without land titles colonists are only eligible for seasonal credit for cultivation of short cycle crops. The repayment of seasonal loans has to be made 60 days after harvesting. This means that in order to repay the loan the colonist usually has to sell his produce when prices are at their lowest and consequently his profits are lowered.

INCRA's record on allocation of land titles has been very poor. By 1976, i.e., six years after the arrival of the first colonists in the Ouro Preto project, only 1137 (31 %) of the 3,700 official settlers had received their land titles (INCRA, 1976a). The allocation of land titles to the Sagarana colonists was just as bad. By 1978 (5 years after the allocation of plots) land titles had been issued to only 94 (58 %) of the 186 colonists (INCRA, 1978). In the Gusmão project, 10 years after its establishment, none of the colonists had received land titles (INCRA, 1972b).

The difficult physical access to urban centres, particularly in the Ouro Preto and Sagarana projects, together with the limited number

* percentage of the total number of colonists in the Project.

of credit institutions, are amongst the other factors which restricted colonists access to credit. In the Ouro Preto project for instance, at the time of the field survey, only one Bank (Bradesco) was operating at Ouro Preto Village, to serve an estimated population of 50,000 people. In the early days of the Project the situation was even worse, as the nearest Bank was in Porto Vellio, 350 Kilometres to the north.

Since the typical colonist did not have capital of his own and access to credit was restricted by the factors discussed above, we can conclude that the colonist lacked adequate financial resources to develop his plot to its full potential.

- *Technical assistance*

According to the methodology for implementation of colonisation schemes (INCRA, 1971), outlined in 5.2.3, responsibility for designing the agricultural land use plan and providing technical assistance for its implementation, lies with INCRA. To carry out those tasks INCRA proposed a ratio of one agricultural extensionist per 50 settlers.

In the Sagarana project, between 1974 and 1979, the proposed ratio was observed. In 1976 for instance, the Project was housing 201 settlers and there was one agronomist (the general manager), and six middle level agricultural extensionists giving a ratio of one agricultural extensionist per 33 settlers (INCRA, 1976b).

In the Ouro Preto project however, agricultural advice is not provided by INCRA's personnel. Since the early days of the Project, two organisations : ASTER-RO (Technical Assistance and Rural Extension Association - Rondonia) and CEPLAC (Executive Commission for Cocoa Development) have been responsible for agricultural advisory services. The latter deals only with cocoa, while the former deals with the other crops and livestock.

The assistance given by CEPLAC to cocoa growers of the Ouro Preto project is reasonably good (Mueller, 1978). On the other hand, ASTER does not have the resources to assist all settlers in the Project. In 1979, for instance, only 1,680 (33 %) of the 5,050 colonists received some sort of agricultural advice from the 15 agricultural extensionists of ASTER (ASTER, 1980).

The ratio of agricultural extensionist to settler is useful for a quantitative analysis of the resources available. However, it does

not reveal anything about the quality or efficiency of the agricultural advice. This can be better assessed by measuring increases in areas farmed, crop yields and the levels of adoption of appropriate farming practices.

As noted earlier, in the Sagarana and Ouro Preto projects the levels of adoption of yield-increasing techniques and conservationist practices are very low. In the Sagarana project, none of the 32 settlers interviewed use fertilisers, or lime, (despite the soil nutrient status) and spraying, planting of improved seeds and contour planting are practiced by 3, 25 and 31 % of the settlers respectively. In the Ouro Preto project none of the 105 colonists interviewed use lime, fertiliser, planting of improved seeds, spraying and contour planting are practiced by 4, 15, 19 and 22 % of the settlers, respectively. In the Gusmão project, liming, fertilising, spraying, contour planting, planting of improved seeds are practiced by 100, 94, 100, 100, 89 and 94 % of the settlers interviewed, respectively (Table 8.1).

The levels of adoption of advanced farming practices by the colonists of the Sagarana and Ouro Preto projects are very low as a basis for the argument that the agricultural advisory has been a successful activity in these Projects. In the Gusmão project, on the other hand, colonists are adopting a high management level. This indicates that agricultural advice has been successfully transmitted to settlers.

The low management level adopted by the Ouro Preto colonists is understandable in light of the small number of agricultural extensionists and the inadequate network of roads and other problems associated with the development which have been discussed earlier. In the Sagarana project, on the other hand, where the ratio of agricultural extensionist to settler was always observed, the low management level adopted by colonists cannot be taken as a reflection of the number of agricultural extensionists.

The low management level achieved by the Sagarana colonists cannot be solely attributed to the colonists' attitudes or educational level because the Gusmao colonists with similar back-grounds, are adopting advanced farming systems. The quality of the agricultural advice provided to colonists of the Sagarana project is therefore questionable. But, the data collected in the course of the field survey does not allow further elaboration.

The fact that only 33 % of the Ouro Preto colonists received some sort of advice from ASTER extensionists, indicates that technical assistance in the Project is inadequate. This is another non-land quality factor which has negatively affected the performance of the Project.

- *Markets and Marketing*

As noted earlier, the administration of the Sagarana project (INCRA, 1976b) pointed out that the major constraints to marketing in the Project, were the difficult access to the main urban centre (130 kilometres away) and the lack of storage facilities. These constraints also affected colonists of the Ouro Preto project, despite the fact that the Government sponsored Brazilian Storage Company (Cibrazem) has at the Ouro Preto Village, grain drying and cleaning facilities to handle 44,000 sacks (= 2,640 tonnes). However, the Cibrazem storage facilities are not used to their full capacity for two main reasons:

a) the inadequate network of roads and transport which means that colonists have their physical access to the Ouro Preto Village restricted, and
b) the bureaucratic work involved which is also time consuming.

There is no marketing board for agricultural products in the three Projects studied, except for cocoa in the Ouro Preto project, which is supported by CEPLAC. INCRA does not deal directly with marketing which is left to the responsibility of the colonists themselves. However, the Government agency CFP (Comissão de Financiamento da Produção) operates a minimum guaranteed price scheme. Before the advent of the CFP Agency, colonists were badly exploited. This is because prices were dictated by a few private intermediaries and were kept at low levels. At present, colonists are able to market their crops at better prices because the Government minimum guaranteed price has forced the intermediaries to raise their prices.

The situation of the Gusmão colonists differs from that of colonists of the other Projects because of the close physical proximity to substantial markets. There is also a good road network to the urban centres (Brasilia the main market is 30 kilometres away, and the other 'satellite' towns are even nearer to the Project) (Figure 7.1). Therefore, the opportunities for settlers in the Gusmão project to market their

produce are very much greater than those for colonists of the other Projects.

As pointed out earlier, the bulk of the production of the Gusmao settlers is marketed in Brasilia at the CEASA (Government warehouse). Part is sold directly to owners of grocery shops in neighbouring towns, in open markets, or at the farm gate. The ease with which produce can be marketed favours agricultural development and consequently settlers' success.

In comparison to the other colonists the easier access to market for colonists of the Gusmão project means lower transportation costs, better opportunities to market their products; easier access to credit and technical assistance; easier access for the agricultural extensionist working in the field; and easier access to public services (health, dental, educational, etc.).

The proximity to market increases the range of crops that can be grown economically (it has been noted that in the Gusmão project over 70 species of plants are grown). The cultivation of vegetables for instance, which is highly profitable is feasible near to markets (Gusmão region), but not so feasible in areas farther away from markets (Sagarana region) and almost certainly uneconomic in remote areas (Ouro Preto region). The cultivation of crops with high economic value near to markets (low transportation costs) leads to higher profits, increasing therefore the incentives to intensify production and to cultivate larger areas. The proximity to market, the good road network and the other related non-land factors are the major factors accounting for the better performance of the Gusmão Project.

In remote areas, on the other hand, where the road network is inadequate, transportation costly, marketing opportunities restricted, credit and technical assistance deficient and where post-harvest losses are high, agricultural development is severly affected, independent of the land qualities for crop development. Consequently the incentives to cultivate larger areas, to intensify production by adopting yield improving techniques such as fertilising, liming, irrigation, planting of improved seeds and conservationist practices, are very low indeed. Colonists of the Ouro Preto and Sagarana projects, to a lesser extent, suffered from the limitations imposed by the difficult access to markets and other related factors discussed above.

Implications of the findings of this research for future agricultural colonisation schemes.

The importance of easy access to markets for agricultural production does not need to be reiterated. The problem is that land throughout Brazil but particularly in the Centre-South with easy access to substantial markets has already been settled and the majority of such areas are privately owned. To use these areas for settlement projects would involve drastic changes in the existing land tenure leading to radical changes in the social and economic structures. There are no signs that these changes will take place in the forseeable future for two main reasons, apart from the wider political aspects. These are:

a) the uncertain economic outcome of agrarian reform, and
b) the availability of unoccupied land in the agricultural frontier.

New settlement projects are therefore likely to continue to be established in unoccupied areas such as Rondônia, far from the major urban centres, with difficult access and poor or absent infra-structure. In these areas the factors which contributed to the better performance of the Gusmão colonists will be lacking and would be the major restricting factors to the development of new colonisation schemes.

Simply allocating land to landless immigrants has not shown to be an adequate form of colonisation. Unless an adequate infra-structure of roads and services (credit, technical assistance, transport, etc.) is provided, the progress of colonists is very slow. In these conditions farm plots remain underutilised and the overall objectives of colonisation projects are not realised. The Ouro Preto and Sagarana projects are examples where the non-land factors have been the major constraints to their development.

To secure a better performance for new colonisation projects the provision of an adequate network of roads, to minimise the effects caused by the difficult accessibility, is of utmost importance. The provision of adequate credit and technical assistance, improvements in the marketing arrangements, storage facilities and price incentives are also important. This is not an easy task but can be achieved with adequate finance and efficient management if the Government is serious about the physical occupation of its more remote Territory.

The task of providing an adequate road network can be made easier by using a different lay-out of farms, less demanding in road construct-

ion. Colonists access to credit can be improved by avoiding delays in the allocation of land titles. The performance in the issuing of land titles, observed in the present projects, is quite unacceptable. In the provision of technical assistance it is important to observe an adequate ratio of agricultural extensionists to settlers. But it is more important to monitor the degree of colonsits' acceptance of new techniques and the results that the new practices are producing in terms of crop yields. The current farming system adopted by the Sagarana settlers does not reflect the fact that during the implementation of the Project, an adequate number of agricultural extensionists worked in the area.

The better performance of the Gusmão project, situated near to markets, suggests that integrated urban-rural settlement schemes could be used as basis to improve the success rate of settlement projects.

The criteria used to assess success showed that, independent of land quality, there is a group of very successful colonists and others who are much less successful. A more intensive study of these groups would be necessary to reveal the factors associated with success and failure.

This study suffered from a lack of data on the activities of colonists over a period of years. Notable deficiencies include details of the areas planted, the crop yields, the use of credit, the use of yield-improving inputs. A better monitoring of the evolution of the colonisation project would help enormously in the evaluation of the project performance. It would aid in the design of research which could be directed towards solving specific problems, instead of being of the 'fact-finding' type, as necessitated in the present research.

Finally, due to the interaction of widely differing land and non-land factors, there is no universal recipe applicable in all cases, which could be implemented to establish colonisation projects successfully. It would appear that each case needs to be assessed separately on its merits and does seem to require the detailed type of physical survey carried out in the Ouro Preto, Sagarana and Gusmão projects as well as better initial information on the social and economic aspects of the schemes. The application of the findings of this research could help in improving the performance of colonisation schemes. The inherent quality of the land is important but good quality is not

sufficient to guarantee success. However, it does appear that in the more naturally fertile areas of Rondonia (e.g. Ouro Preto) there is the chance of a viable colonisation project as opposed to the partial failure of schemes (Sidney Girao, IATA) in marginal and poor parts of Rondonia. Equally it seems that the relatively more promising soils of the cerrado (Gusmão and Sagarana) do not produce any better results than the poorer soils unless the management and other factors than land quality are sufficiently understood. The provision of an adequate road-network, credit and technical assistance, marketing facilities and other services are also important. In some cases, they are even more important, at least in a short term basis.

Summary of main conclusions.

The main conclusions derived from this study are :

- *Land quality*

In each colonisation scheme it was not possible to find a correlation betwen the relative success or failure of colonists and inherent land quality.

- *Socio-economic and ecological objectives*

The standards of living of colonists except for the Gusmão settlers, although slightly improved over their pre-colonisation levels, remain low and are indicated by poor housing and lack of material possessions.

The land resources are not rationally used. The larger part of the farming plots often remain either unused or underutilised.

The contribution to regional economic growth is to some extent achieved because of the social and physical infra-structure created in each region, and because of the increase in the supply of food crops to regional markets.

The establishment of a permanent agricultural settlement by attaching the rural population firmly to the land is frequently acheived. However, a high turn-over of settlers is recorded for the Sagarana project.

- *Non-land factors*

The comparison between the case studies suggests that the relative better performance of the Gusmão colonists is related to the location of the Project near to major markets and the good road network.

The major constraints to development of the projects studied include a number of non-land factors, particularly the inadequate provision of road-networks, credit, technical assistance, and marketing opportunities.

Claims that settlers' attitudes represent the main factor responsible for the modest performance of the case studies (Sagarana and Ouro Preto projects) are not justified. This is because the major constraints to development cannot be resolved by the settlers themselves.

Adequate evaluation of the suitability of the land resources for agricultural settlement schemes is not, in itself, sufficient to guarantee success. The Project based on the most thorough investigation of its land resources presents the poorest performance mainly due to inadequate finance and mis-management.

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APPENDIX 1

VARIABLES

01 = land assets
02 = farm size
03 = settler's province born
04 = settler's last residence before moving to the project.
05 = settler's family size
06 = number of families per farm including the settler's family

AREAS FARMED IN 1979/80 AGRICULTURAL YEAR IN HECTARES

07 = area farmed with cocoa
08 = area farmed with coffee
09 = area farmed with rubber
10 = area farmed with banana
11 = area farmed with sugar-cane
12 = area farmed with cassava
13 = area farmed with rice
14 = area farmed with maize
15 = area farmed Phaseolus beans

LAND USE IN DECEMBER 1979

16 = area farmed with perrennial crops (1)
17 = area farmed with bi-ennial crops (2)
18 = area farmed with annual crops (3)
19 = area farmed with vegetables
20 = area occupied with pasture
21 = forest cleared in 1980
22 = area occupied with 'capoeira'
23 = area occupied with buildings, roads and the like
24 = forest cleared up to December 1979
25 = forest in December 1979
26 = total area of a plot

LIVESTOCK

27 = cattle
28 = pigs
29 = horses
30 = other domestic animals excluding birds and pets

VARIABLES (Continued)

AGRICULTURAL MACHINERY

31 = Number of tractors
32 = number of threshing machines
33 = number of ploughs tractioned either by tractor or domestic animals.
34 = number of sowing machines
35 = number of cultivators
36 = number of spraying machines
37 = number of harrows tractioned by tractor or domestic animals
38 = number of chain-saws
39 = number of diesel engines

FARM BUILDINGS

40 = corral
41 = grain-store
42 = store-house
43 = pig-sty
44 = maize-store

FARMING PRACTICES: yes (Y), no (N)

45 = irrigation
46 = contour planting
47 = terracing
48 = fertilizing
49 = liming
50 = improved seeds
51 = intercropping
52 = spraying
53 = ploughing
54 = harrowing

HOUSE AND HOUSING CONDITIONS: yes (Y), no (N)

55 = brick-built house
56 = wooden-house
57 = 'tapiri'
58 = good
59 = fair
60 = bad
61 = very bad

VARIABLES (Continued)

PREVIOUS UTILISATION OF AGRICULTURAL CREDIT AND PLACE WHERE AGRICULTURAL PRODUCTS ARE SOLD

62 = agricultural credit experience
63 = marketing at the farm gate
64 = nearest urban centre
65 = co-operatives
66 = official Governments organizations

POSSESSIONS

67 = number of vans
68 = number of cars
69 = refrigerator (Y) or (N)
70 = television
71 = gas-cooker
72 = radio
73 = electricity
74 = piped water
75 = water-filter

Key for interpretation of variables 01, 02, 03, 04

VARIABLE 01 (LAND ASSETS)
Farm codes 001 to 018 (Gusmao Project)
1 = A, 2 = B, as defined in 7.3
Farm codes 019 to 123 (Ouro Preto)
6 = A, 7 = B, 8 = non-pioneer, as defined in 7.3
Farm codes 124 to 155 (Sagarana Project)
1 = A, 2 = B, 3 = C, 4 = D, as defined in 6.3.

VARIABLE 02 (farm size)
Farm codes 001 to 018
1 = $\bar{x}$ (12.0 ha), 2 = $\bar{x}$ (38.0 ha)
Farm code 019 to 123
4 = $\bar{x}$ (100 ha), 5 = $\bar{x}$ (200 ha)
Farm codes 124 to 155
7 = $\bar{x}$ (84 ha), 8 = $\bar{x}$ (115 ha), 9 = $\bar{x}$ (159 ha), 10 = $\bar{x}$ (240 ha)

VARIABLES 03 (settlers orig in) and 04 (last residence)
1 = north, 2 = northeast, 3 = south, 4 = southeast, 5 = centre-west, 6 = overseas.

Gusmão project (Farm codes 001 - 018)
Ouro Preto project (Farm codes 019 - 123)
Sagarana project (Farm codes 124 - 155)

FARM CODE	VARIABLES 01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
001	2	2	1	1	4	5	0.0	7.5	0.0	0.0	0.0	1.0	4.0	0.0	0.0
002	1	2	2	2	1	1	0.0	0.1	0.0	1.5	0.0	0.0	1.0	1.0	0.0
003	2	1	2	2	1	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
004	1	2	2	5	2	1	0.0	0.0	0.0	0.0	0.0	1.5	2.0	1.5	1.0
005	1	1	4	5	7	1	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.5	0.0
006	2	1	2	2	5	1	0.0	10.0	0.0	0.0	0.0	0.3	4.0	0.0	4.0
007	2	1	2	5	5	1	0.0	1.0	0.0	1.0	1.0	5.0	3.0	0.0	5.0
008	2	1	5	5	4	2	0.0	0.3	0.0	0.0	0.0	0.0	0.3	1.0	0.0
009	1	1	2	1	5	1	0.0	0.1	0.0	0.0	0.0	1.0	0.5	0.5	0.0
010	1	1	6	4	11	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
011	1	1	3	3	6	1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.4
012	1	1	3	3	4	1	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
013	2	1	3	3	4	1	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
014	2	2	4	4	6	1	0.0	0.0	0.0	0.0	1.0	0.0	10.0	3.0	0.0
015	2	2	4	4	2	1	0.0	3.0	0.0	0.0	0.0	0.0	3.0	1.5	0.0
016	1	1	4	5	7	1	0.0	0.0	0.0	2.5	0.0	0.0	2.0	3.0	0.0
017	2	2	2	2	2	1	0.0	1.5	0.0	0.0	0.0	2.1	2.0	0.5	0.0
018	1	2	2	2	2	1	0.0	12.0	0.0	0.0	0.0	0.0	7.5	3.0	0.0
019	6	4	2	5	8	2	0.0	0.0	0.0	0.0	0.0	2.0	5.0	2.0	2.0
020	6	4	4	4	10	3	8.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0
021	6	4	4	4	12	2	0.0	2.5	0.0	5.0	0.0	2.5	2.0	1.5	1.0
022	6	4	4	4	7	1	0.0	8.0	0.0	7.5	0.0	0.0	3.0	3.5	2.5
023	6	4	2	3	6	4	0.0	5.0	0.0	3.0	0.0	0.0	4.0	3.0	8.0
024	6	4	2	3	6	1	0.0	0.0	0.0	2.5	0.0	0.0	8.0	2.5	2.5
025	7	4	4	4	9	3	0.0	5.0	0.0	0.0	0.0	0.0	4.0	3.0	3.0
026	7	4	4	3	15	2	0.0	8.0	0.0	0.0	0.5	2.5	10.0	10.0	6.0
027	7	4	4	4	7	3	0.0	10.0	10.0	1.0	0.0	0.5	2.5	10.0	10.0
028	7	4	4	5	8	2	2.0	4.5	0.0	2.0	0.0	0.0	0.0	3.0	4.5
029	8	4	4	4	6	1	0.0	1.0	0.0	10.0	0.0	0.0	1.5	1.0	0.0
030	8	4	4	5	6	3	0.0	10.0	10.0	0.0	0.0	0.0	10.0	10.0	10.0
031	8	4	4	4	6	2	0.0	3.0	10.0	0.0	0.0	0.0	5.0	7.0	7.0

FARM CODE	VARIABLES 01	02	03	04	05	06	07
032	8	4	4	4	13	3	0.0
033	6	4	2	5	11	3	0.0
034	6	4	4	4	11	2	0.0
035	7	4	4	4	10	1	0.0
036	7	4	2	3	11	1	15.0
037	8	4	4	4	11	3	12.5
038	8	4	4	4	7	1	0.0
039	8	4	4	3	5	1	0.0
040	8	4	4	3	7	4	1.0
041	8	4	2	5	3	1	0.0
042	8	4	4	4	3	4	13.0
043	8	4	4	4	8	1	0.0
044	8	4	4	5	8	3	0.0
045	8	4	4	4	4	1	0.0
046	6	4	4	4	8	2	0.0
047	6	4	4	4	7	1	0.0
048	8	4	4	4	11	1	0.0
049	8	4	4	5	7	2	0.0
050	7	4	3	3	14	1	0.0
051	7	4	2	3	8	1	7.0
052	6	4	4	4	14	1	0.0
053	6	4	4	5	5	2	6.0
054	6	4	4	5	7	1	0.0
055	7	4	4	4	5	2	0.0
056	7	4	2	5	3	1	0.0
057	6	4	4	5	8	4	14.0
058	6	4	4	4	9	1	0.0
59	8	4	4	3	8	1	0.0
060	8	4	2	2	10	1	0.0
061	7	4	4	5	8	1	0.0
062	6	4	4	5	7	1	12.0
063	6	4	4	4	7	4	0.0
064	7	4	4	5	6	2	5.0
065	7	4	4	5	4	2	0.0

FARM CODE	VARIABLES 08	09	10	11	12	13	14	15
032	8.0	10.0	1.0	0.0	0.0	4.0	10.0	7.0
033	5.0	12.0	5.0	0.0	0.0	3.0	4.0	3.0
034	2.0	0.0	0.0	0.0	0.0	1.0	2.0	1.0
035	4.0	0.0	0.0	0.0	0.0	5.0	5.0	0.0
036	0.0	0.0	15.0	0.0	1.0	5.0	1.5	2.5
037	8.0	0.0	12.5	0.0	0.0	8.0	1.0	0.0
038	2.5	0.0	2.5	0.0	0.0	5.0	5.0	2.0
039	6.0	0.0	4.0	0.5	0.5	5.0	6.0	6.0
040	2.5	0.0	10.0	0.0	0.0	2.5	2.5	2.5
041	5.0	0.0	4.0	0.0	1.0	5.0	2.0	5.0
042	12.0	3.0	13.0	0.0	0.0	5.0	10.0	10.0
043	2.0	0.0	0.0	0.0	1.0	4.0	0.0	4.0
044	8.0	0.0	0.0	0.0	2.0	5.0	0.0	2.0
045	1.0	0.0	0.0	0.0	0.0	10.0	10.0	2.0
046	5.0	0.0	1.0	0.0	0.0	1.0	0.0	4.0
047	2.5	10.0	0.0	0.0	0.0	1.0	1.0	2.0
048	2.5	0.0	0.0	0.0	0.0	5.0	2.0	2.5
049	8.0	0.0	0.0	0.0	0.0	3.0	3.0	3.0
050	0.5	0.0	0.0	0.0	0.0	6.0	0.0	0.0
051	0.0	0.0	0.0	0.0	0.0	13.0	13.0	3.0
052	4.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
053	3.0	0.0	0.0	0.0	0.0	5.0	2.0	2.0
054	3.5	0.0	0.0	0.0	0.0	2.0	2.0	2.0
055	4.0	0.0	1.5	0.0	0.0	4.0	4.0	3.0
056	0.5	0.0	0.0	0.0	0.0	20.0	0.0	6.0
057	10.0	10.0	0.0	0.0	0.0	3.0	0.0	0.0
058	5.0	0.0	0.0	0.0	0.0	5.0	5.0	1.0
059	5.0	5.0	0.5	0.0	0.0	3.0	3.0	5.0
060	5.0	0.0	3.0	0.5	0.0	1.5	1.5	5.0
061	12.0	7.0	0.0	0.0	0.0	0.0	12.0	2.5
062	10.0	0.0	0.0	0.0	0.0	3.0	3.0	5.0
063	66.0	0.0	0.0	0.0	0.0	20.0	15.0	5.0
064	0.0	0.0	7.5	0.0	0.0	5.0	3.0	3.0
065	1.5	0.0	5.0	1.0	0.0	7.5	2.0	5.0

FARM CODE	VARIABLES 01	02	03	04	05	06	07
066	6	4	3	3	7	2	13.0
067	6	4	4	3	7	1	0.0
068	6	4	2	3	6	1	0.0
069	6	4	2	3	7	2	1.0
070	7	4	4	4	7	2	0.0
071	7	4	2	3	6	3	0.0
072	7	4	4	5	5	4	9.0
073	7	4	3	3	5	2	10.0
074	8	4	2	3	6	4	12.0
075	8	4	3	3	9	1	15.0
076	8	4	2	3	8	1	0.0
077	8	4	3	3	6	1	0.0
078	8	4	4	4	4	4	0.0
079	8	4	2	3	5	1	1.5
080	8	4	2	3	10	2	0.0
081	6	4	4	4	4	2	8.0
082	6	4	2	2	3	4	14.0
083	6	4	4	5	6	2	6.0
084	6	4	4	3	7	2	0.0
085	6	4	4	5	8	1	15.0
086	7	4	2	5	3	1	11.0
087	6	4	2	3	7	2	16.0
088	6	4	3	3	14	1	0.0
089	7	4	3	3	2	4	0.0
090	6	4	3	3	11	1	0.0
091	7	4	4	4	5	1	0.0
092	6	4	4	4	5	1	0.0
093	6	4	4	5	9	1	0.0
094	6	4	4	4	9	1	0.5
095	6	4	3	3	8	1	0.0
096	6	4	4	4	11	2	0.0
097	8	4	3	3	7	1	0.0
098	8	4	3	3	5	5	10.0
099	8	4	4	4	11	1	0.0

FARM CODE	VARIABLES 08	09	10	11	12	13	14	15
066	10.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
067	6.0	0.0	1.0	0.0	1.0	1.5	5.0	1.5
068	7.0	0.0	10.0	0.0	0.0	7.0	7.0	7.0
069	8.0	0.0	0.5	0.0	0.5	2.0	1.5	2.0
070	2.5	0.0	0.0	0.0	1.0	1.0	3.0	3.0
071	3.0	0.0	7.0	0.0	0.5	7.0	3.0	3.0
072	2.0	0.0	0.0	0.0	0.0	12.0	0.0	7.5
073	0.0	0.0	0.0	0.5	1.0	2.5	2.5	2.5
074	0.0	0.0	0.0	0.0	0.0	10.0	2.0	4.0
075	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
076	12.0	0.0	0.0	0.0	0.5	3.0	12.0	3.0
077	4.0	0.0	0.0	0.0	0.5	3.0	2.5	3.0
078	8.0	10.0	0.5	0.5	2.0	5.0	10.0	10.0
079	5.0	0.0	0.0	1.0	2.0	5.0	5.0	5.0
080	3.0	0.0	2.0	0.5	1.0	2.0	8.0	3.0
081	0.0	0.0	1.0	0.0	2.0	5.0	10.0	3.0
082	2.5	0.0	0.0	0.0	0.0	2.5	0.0	2.5
083	28.5	0.0	0.0	1.0	2.0	10.0	6.0	5.0
084	16.0	0.0	0.5	2.0	1.5	12.0	12.0	0.0
085	7.0	0.0	0.0	0.0	0.5	1.0	4.0	0.5
086	3.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0
087	0.0	13.0	0.0	2.0	0.5	4.0	4.0	0.0
088	10.0	0.0	0.0	0.0	1.0	3.0	10.0	4.0
089	0.0	0.0	0.0	0.0	1.0	20.0	0.5	20.0
090	10.0	0.0	0.0	2.0	2.0	4.0	2.5	5.0
091	0.0	0.0	1.5	0.5	0.0	2.0	1.5	3.0
092	5.0	0.0	6.0	0.0	0.0	3.0	3.0	1.5
093	7.0	0.0	6.0	0.0	0.0	4.0	5.0	4.0
094	4.0	10.0	0.0	0.0	2.0	2.5	10.0	1.0
095	5.0	0.0	0.0	0.0	0.0	3.0	2.0	3.0
096	2.5	0.0	0.0	0.0	0.5	2.0	2.5	2.5
097	2.5	0.0	0.0	0.0	0.0	3.0	6.0	2.5
098	3.0	0.0	0.0	0.0	0.0	10.0	5.0	0.0
099	6.0	6.0	0.0	0.0	2.0	6.0	6.0	4.0

FARM CODE	VARIABLES 01	02	03	04	05	06	07
100	8	4	2	3	11	1	0.0
101	6	5	3	3	4	1	0.0
102	6	4	4	4	5	1	0.0
103	6	5	4	5	9	2	0.0
104	6	4	4	5	11	4	12.0
105	7	5	4	4	9	4	16.0
106	6	5	4	5	4	1	2.0
107	6	4	3	3	5	2	11.0
108	8	4	3	3	5	1	0.0
109	8	4	5	5	7	7	0.0
110	8	4	4	4	8	1	0.0
111	8	4	4	4	2	1	0.0
112	8	4	4	4	10	2	0.0
113	8	4	4	3	5	4	1.0
114	8	4	2	5	5	3	0.0
115	8	4	4	4	9	5	0.0
116	8	4	2	2	9	1	14.5
117	8	4	4	4	8	3	15.0
118	8	4	4	3	5	2	0.0
119	8	4	3	3	5	2	14.0
120	8	4	4	5	5	1	0.0
121	8	4	4	4	7	2	0.0
122	8	4	4	3	7	4	0.0
123	8	4	4	3	4	2	0.0

FARM CODE	VARIABLES 08	09	10	11	12	13	14	15
100	5.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0
101	0.0	8.0	0.0	0.0	0.0	0.0	2.0	0.0
102	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0
103	0.0	10.0	12.0	0.0	0.0	12.0	8.0	0.0
104	2.5	0.0	0.0	0.0	0.0	0.5	2.5	0.0
105	7.0	0.0	0.0	0.0	0.0	4.0	3.0	8.0
106	7.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0
107	0.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0
108	2.0	0.0	3.0	0.0	1.0	0.0	2.0	2.0
109	10.0	10.0	0.0	0.0	0.0	2.5	10.0	10.0
110	11.0	10.0	0.5	0.0	2.0	5.0	10.0	0.0
111	0.0	0.0	0.0	0.0	0.0	2.5	5.0	0.0
112	6.0	6.0	0.0	0.0	0.0	7.0	4.0	4.0
113	2.0	0.0	0.0	0.0	0.0	5.0	5.0	5.0
114	3.0	0.0	5.0	0.0	2.0	4.0	0.5	2.0
115	20.0	0.0	0.0	0.0	3.0	2.0	2.0	4.0
116	0.0	0.0	0.0	0.0	2.0	1.0	1.0	4.0
117	5.0	0.0	1.0	0.0	3.0	1.0	1.0	0.5
118	2.5	0.0	2.0	0.0	0.0	5.0	5.0	1.0
119	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
120	5.0	0.0	2.0	0.0	0.0	14.0	5.0	3.0
121	2.5	0.0	0.0	0.0	0.0	2.0	1.0	1.0
122	12.0	10.0	0.0	0.0	0.0	3.0	7.0	4.0
123	1.0	0.0	0.0	0.0	0.0	3.0	3.0	0.0

FARM CODE	VARIABLES 01	02	03	04	05	06	07
124	1	7	4	4	12	1	0.0
125	1	7	4	4	3	5	0.0
126	1	7	4	4	7	3	0.0
127	1	7	4	4	5	1	0.0
128	1	7	4	4	6	3	0.0
129	1	7	4	4	6	1	0.0
130	1	7	4	4	1	2	0.0
131	1	7	4	4	5	2	0.0
132	2	8	4	4	6	1	0.0
133	2	8	4	4	10	2	0.0
134	2	8	4	4	4	2	0.0
135	2	8	4	4	6	2	0.0
136	2	8	4	4	7	2	0.0
137	2	8	4	4	5	2	0.0
138	2	8	4	4	7	9	0.0
139	2	8	4	4	5	3	0.0
140	2	8	4	4	7	2	0.0
141	2	8	4	4	10	2	0.0
142	3	9	4	4	10	2	0.0
143	3	9	4	4	12	2	0.0
144	3	9	4	4	6	2	0.0
145	3	9	4	4	9	2	0.0
146	3	9	4	4	7	2	0.0
147	3	9	4	4	6	2	0.0
148	3	9	4	4	8	1	0.0
149	3	9	4	4	9	2	0.0
150	3	9	4	4	7	1	0.0
151	4	10	4	4	2	2	0.0
152	4	10	4	4	4	3	0.0
153	4	10	4	4	6	1	0.0
154	4	10	4	4	6	4	0.0
155	4	10	4	4	2	1	0.0

FARM CODE	VARIABLES 08	09	10	11	12	13	14	15
124	0.0	0.0	0.0	0.0	0.0	12.0	4.0	12.0
125	0.0	0.0	0.0	0.0	0.0	6.0	2.0	7.2
126	0.0	0.0	0.0	0.0	0.0	2.0	12.0	0.0
127	0.0	0.0	0.0	0.0	0.0	1.2	2.3	0.0
128	0.0	0.0	0.0	0.0	0.0	2.6	10.0	9.6
129	0.0	0.0	0.0	0.0	0.0	0.8	1.8	0.0
130	0.0	0.0	0.0	0.0	0.0	1.3	4.0	0.0
131	0.0	0.0	0.0	0.0	0.0	4.0	3.5	0.0
132	0.0	0.0	0.0	0.0	0.0	0.8	0.0	1.2
133	0.0	0.0	0.0	0.0	0.0	4.0	8.0	8.0
134	0.0	0.0	0.0	0.0	0.0	1.2	3.8	5.4
135	0.0	0.0	0.0	0.0	0.0	2.0	7.1	3.6
136	0.0	0.0	0.0	0.0	0.0	1.5	10.0	7.2
137	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6
138	0.0	0.0	0.0	0.0	0.0	4.0	20.0	18.0
139	0.0	0.0	0.0	0.0	0.0	5.0	20.0	18.0
140	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
141	0.0	0.0	0.0	0.0	0.0	1.0	0.9	2.4
142	0.0	0.0	0.0	0.0	0.0	6.0	2.0	4.8
143	0.0	0.0	0.0	0.0	0.0	0.4	9.1	9.6
144	0.0	0.0	0.0	0.0	0.0	1.3	6.0	7.2
145	0.0	0.0	0.0	0.0	0.0	2.0	4.0	2.4
146	0.0	0.0	0.0	0.0	0.0	6.0	8.0	6.0
147	0.0	0.0	0.0	0.0	0.0	6.6	6.0	0.0
148	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.9
149	0.0	0.0	0.0	0.0	0.0	2.2	2.3	1.1
150	0.0	0.0	0.0	0.0	0.0	1.0	2.0	3.0
151	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
152	0.0	0.0	0.0	0.0	0.0	2.0	1.4	2.4
153	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0
154	0.0	0.0	0.0	0.0	0.0	0.0	20.0	12.0
155	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FARM CODE	VARIABLES 16	17	18	19	20	21	22	23
001	9.0	1.0	4.0	4.0	20.0	0.0	0.0	0.4
002	2.0	0.0	2.0	2.8	29.0	0.0	0.0	1.0
003	2.0	0.0	0.0	1.0	13.0	0.0	0.0	0.2
004	0.3	1.5	4.5	2.5	27.6	0.0	0.0	0.5
005	2.5	0.0	1.0	0.0	3.2	0.0	0.0	0.3
006	11.5	0.3	4.0	4.5	1.0	0.0	0.0	0.5
007	2.5	0.0	9.0	5.0	0.0	0.0	0.0	0.3
008	1.8	0.0	1.3	2.0	3.7	0.0	0.0	0.3
009	0.5	1.0	1.0	2.0	3.0	0.0	0.0	0.5
010	0.3	0.0	1.0	3.0	9.6	0.0	0.0	0.3
011	0.3	0.0	1.0	1.0	7.5	0.0	0.0	0.3
012	2.0	0.0	1.0	4.0	3.1	0.0	0.0	0.3
013	3.0	0.0	0.0	1.0	1.8	0.0	0.0	0.3
014	1.0	1.0	13.0	0.0	0.0	12.4	0.0	0.3
015	3.5	0.0	4.5	2.0	18.7	0.0	0.0	0.3
016	2.5	0.0	5.0	1.5	4.8	0.0	0.0	0.3
017	2.0	2.5	2.5	3.0	39.8	0.0	0.0	0.3
018	14.0	0.0	10.5	0.0	5.5	0.0	0.0	0.5
019	0.0	2.0	7.0	0.0	15.0	10.0	7.0	1.0
020	8.0	0.0	0.0	0.0	15.0	10.0	18.0	1.0
021	7.5	2.5	4.5	0.0	13.0	7.5	5.0	1.5
022	15.5	0.0	3.0	0.0	20.0	8.0	10.0	1.5
023	8.0	0.0	7.0	0.0	25.0	12.0	8.0	2.5
024	2.5	0.0	10.5	0.0	25.0	2.5	10.0	2.0
025	5.0	0.0	7.0	0.0	36.0	0.0	7.5	1.5
026	8.0	3.0	10.0	0.0	20.0	20.0	5.0	2.0
027	11.0	0.0	2.5	0.0	15.0	0.0	3.0	3.5
028	6.5	0.0	3.0	0.0	17.0	0.0	5.0	2.5
029	11.0	0.0	1.5	0.0	15.0	5.0	15.0	1.0
030	10.0	0.0	10.0	0.0	60.0	10.0	0.0	2.5
031	13.0	0.0	12.0	0.0	20.0	12.0	7.0	3.0

FARM CODE	VARIABLES 24	25	26	27	28	29	30	31
001	0.0	0.0	38.4	14	1	3	0	1
002	0.0	0.0	36.9	0	2	0	0	0
003	0.0	0.0	16.2	0	0	0	0	1
004	0.0	0.0	36.9	0	1	0	0	1
005	0.0	0.0	7.0	0	3	0	0	1
006	0.0	0.0	21.8	0	3	0	0	1
007	0.0	0.0	16.8	0	5	0	0	1
008	0.0	0.0	9.3	8	24	0	0	1
009	0.0	0.0	8.0	0	3	0	0	1
010	0.0	0.0	14.2	0	3	0	0	1
011	0.0	0.0	10.1	0	5	0	0	1
012	0.0	0.0	10.4	0	0	0	0	2
013	0.0	0.0	6.1	0	0	0	0	2
014	0.0	0.0	27.7	0	0	0	0	1
015	0.0	0.0	29.0	0	0	0	0	0
016	0.0	0.0	14.1	0	5	0	0	1
017	0.0	0.0	50.1	0	0	2	0	1
018	0.0	0.0	30.5	0	5	0	0	0
019	42.0	36.0	78.0	0	3	0	0	0
020	52.0	78.0	130.0	3	0	1	0	0
021	41.5	58.5	100.0	0	6	0	0	0
022	58.0	46.0	104.0	15	2	0	0	0
023	62.5	37.5	100.0	2	10	0	0	0
024	52.5	47.5	100.0	27	8	0	0	0
025	57.0	43.0	100.0	20	10	2	0	0
026	68.0	32.0	100.0	0	0	0	0	0
027	35.0	65.0	100.0	30	30	2	0	0
028	34.0	66.0	100.0	0	8	1	0	0
029	48.5	51.5	100.0	2	2	0	0	0
030	92.5	7.5	100.0	75	40	5	6	0
031	67.0	33.0	100.0	41	14	2	0	0

FARM CODE	VARIABLES 16	17	18	19	20	21	22	23
032	18.0	0.0	4.0	0.0	36.0	2.5	8.0	2.0
033	22.0	0.0	3.0	0.0	2.0	0.0	5.0	0.5
034	2.0	0.0	3.0	0.0	8.0	2.0	3.0	1.0
035	4.0	0.0	10.0	0.0	10.0	0.0	16.0	1.5
036	15.0	1.0	9.0	0.0	5.0	2.5	1.5	7.0
037	20.5	0.0	1.0	0.0	15.0	0.0	4.5	2.0
038	5.0	0.0	5.0	0.0	22.0	5.0	0.0	1.0
039	10.0	1.0	5.0	0.0	9.0	0.0	12.0	0.5
040	12.5	0.0	2.5	0.0	10.0	2.5	8.0	0.5
041	8.0	1.0	2.0	0.0	17.0	5.0	10.0	1.0
042	25.0	0.0	15.0	0.0	15.0	0.0	10.0	1.5
043	2.0	1.0	8.0	0.0	34.0	4.0	5.0	1.5
044	8.0	2.0	7.0	0.0	10.0	7.5	14.5	1.5
045	1.0	0.0	20.0	0.0	25.0	0.0	0.0	1.5
046	6.0	0.0	1.0	0.0	12.0	10.0	15.0	1.0
047	2.5	0.0	4.0	0.0	15.0	0.0	10.0	1.0
048	2.5	0.0	9.5	0.0	25.0	0.0	20.0	2.0
049	8.0	0.0	3.0	0.0	25.0	0.0	10.0	1.5
050	5.0	0.0	6.0	0.0	24.0	0.0	36.0	1.0
051	7.0	0.0	13.0	0.0	20.0	0.0	8.0	1.5
052	4.0	0.0	2.0	0.0	39.0	5.0	10.0	1.0
053	9.0	0.0	7.0	0.0	19.0	0.0	14.0	1.0
054	3.5	0.0	2.0	0.0	29.0	4.0	15.0	0.5
055	5.5	0.0	4.0	0.0	34.0	0.0	10.0	1.0
056	0.5	0.0	20.0	0.0	22.0	0.0	10.0	1.0
057	24.0	0.0	3.0	0.0	27.0	0.0	22.0	0.5
058	5.0	0.0	0.0	0.0	18.0	2.5	16.0	0.5
059	5.5	0.0	3.0	0.0	8.0	0.0	5.0	0.5
060	8.0	0.5	1.5	0.0	9.0	0.0	9.0	0.5
061	19.0	0.0	2.5	0.0	20.0	0.0	25.0	1.5
062	22.0	0.0	6.0	0.0	48.0	0.0	12.0	0.5
063	66.0	0.0	20.0	0.0	12.0	0.0	0.0	1.5
064	12.5	0.0	8.0	0.0	8.0	0.0	10.0	1.0

FARM CODE	VARIABLES 24	25	26	27	28	29	30	31
032	70.5	29.5	100.0	41	30	3	0	0
033	32.5	67.5	100.0	0	0	1	0	0
034	19.0	81.0	100.0	8	4	0	0	0
035	41.5	58.5	100.0	49	20	3	0	0
036	41.0	59.0	100.0	39	20	3	0	0
037	43.0	57.0	100.0	8	6	1	0	0
038	38.0	59.0	97.0	23	10	0	0	0
039	37.5	60.5	98.0	11	8	0	0	0
040	36.0	65.0	101.0	3	2	0	0	0
041	45.0	53.5	98.5	0	15	0	0	0
042	66.5	33.5	100.0	0	12	0	0	0
043	55.5	44.5	100.0	0	7	1	0	0
044	50.5	49.5	100.0	2	1	0	0	0
045	47.5	52.5	100.0	11	0	0	0	0
046	45.0	55.0	100.0	20	20	1	0	0
047	32.5	67.5	100.0	20	6	2	0	0
048	59.0	41.0	100.0	20	22	1	0	0
049	47.5	52.5	100.0	40	20	3	0	0
050	67.5	32.5	100.0	66	13	2	0	0
051	49.5	50.5	100.0	9	7	1	0	1
052	61.0	39.0	100.0	32	9	1	0	0
053	50.0	50.0	100.0	26	0	1	0	0
054	54.0	46.0	100.0	5	19	0	0	0
055	54.5	55.5	100.0	18	12	0	0	0
056	53.5	51.5	105.0	33	50	1	0	0
057	76.5	21.5	98.0	1	15	1	0	0
058	42.0	54.0	96.0	12	4	0	0	0
059	22.0	78.0	100.0	0	10	0	0	0
060	28.5	71.5	100.0	0	2	0	0	0
061	68.0	37.0	105.0	15	9	2	0	0
062	88.5	13.5	102.0	23	40	3	0	0
063	99.5	0.5	100.0	0	15	0	0	0
064	39.5	60.5	100.0	40	7	1	0	0

FARM CODE	VARIABLES 16	17	18	19	20	21	22	23
065	9.0	1.0	7.5	0.0	25.0	5.0	10.0	1.0
066	23.0	1.0	0.0	0.0	37.0	12.0	5.0	1.0
067	7.0	1.0	1.5	0.0	10.0	0.0	15.0	0.5
068	7.0	0.0	0.0	0.0	15.0	0.0	12.0	0.5
069	9.5	0.5	3.5	0.0	44.0	5.0	0.0	1.0
070	2.5	1.0	4.0	0.0	20.0	0.0	10.0	1.5
071	10.0	0.5	10.0	0.0	29.0	10.0	0.0	1.0
072	11.0	0.0	12.0	0.0	15.0	4.5	7.0	0.5
073	10.0	1.5	5.0	0.0	19.0	0.0	9.0	0.5
074	12.0	0.0	12.0	0.0	0.0	0.0	15.0	0.5
075	15.0	0.0	0.0	0.0	2.5	0.0	7.5	0.5
076	12.0	0.5	3.0	0.0	12.0	0.0	2.5	1.0
077	4.0	1.0	5.5	0.0	20.0	0.0	20.0	0.5
078	18.5	2.5	15.0	0.0	43.5	0.0	10.0	1.5
079	6.5	3.0	5.0	0.0	30.0	2.0	7.5	1.0
080	5.0	1.5	10.0	0.0	17.0	5.0	5.0	0.5
081	9.0	2.0	15.0	0.0	12.0	0.0	12.0	1.0
082	16.5	0.0	2.5	0.0	15.0	16.0	0.0	0.5
083	34.5	3.0	0.0	0.0	20.0	0.0	6.0	1.0
084	16.5	3.5	24.0	0.0	4.0	6.0	0.0	1.0
085	22.0	0.5	5.0	0.0	22.0	12.0	2.0	0.5
086	14.0	0.0	0.0	0.0	11.0	0.0	5.0	0.5
087	29.0	2.5	4.0	0.0	25.0	4.0	1.0	9.0
088	10.0	1.0	3.0	0.0	25.0	8.0	0.0	1.5
089	0.0	1.0	25.0	0.0	15.0	19.0	5.0	1.5
090	10.0	4.0	6.5	0.0	19.0	0.0	12.0	1.0
091	1.5	0.5	3.5	0.0	3.0	4.0	10.0	0.5
092	11.0	0.0	6.0	0.0	50.0	0.0	15.0	1.5
093	13.0	0.0	9.0	0.0	10.0	0.0	8.0	0.5
094	14.5	2.0	12.5	0.0	13.0	0.0	6.0	1.0
095	5.0	0.0	3.0	0.0	8.0	0.0	10.0	0.5
096	2.5	1.5	2.0	0.0	29.0	9.0	10.0	1.0
097	2.5	0.0	9.0	0.0	10.0	0.0	6.0	0.5
098	23.0	0.0	10.0	0.0	5.0	0.0	8.0	1.0

FARM CODE	VARIABLES 24	25	26	27	28	29	30	31
065	58.5	41.5	100.0	7	15	3	0	0
066	79.0	29.0	108.0	42	30	3	0	0
067	35.0	68.0	103.0	2	12	1	0	0
068	34.5	64.5	99.0	0	20	0	0	0
069	63.5	24.5	88.0	53	12	1	0	1
070	39.0	61.0	100.0	25	5	1	0	0
071	60.5	39.5	100.0	6	7	1	0	0
072	50.0	42.0	92.0	0	4	0	0	0
073	45.5	41.5	87.0	0	10	0	0	0
074	39.5	60.5	100.0	0	2	0	0	0
075	25.5	74.5	100.0	0	0	0	0	0
076	31.0	69.0	100.0	12	5	1	0	0
077	51.0	49.0	100.0	0	9	0	0	0
078	91.0	9.0	100.0	60	30	2	0	0
079	55.0	45.0	100.0	31	20	2	0	0
080	44.0	56.0	100.0	30	20	3	0	0
081	51.0	49.0	100.0	40	20	3	0	0
082	50.5	49.5	100.0	6	3	0	0	0
083	64.5	29.5	94.0	66	30	0	0	1
084	55.0	45.0	100.0	3	15	0	0	0
085	64.0	36.0	100.0	40	35	2	0	0
086	30.5	69.5	100.0	5	0	0	0	0
087	74.5	25.5	100.0	28	15	2	0	0
088	48.5	51.5	100.0	0	10	0	0	0
089	66.5	33.5	100.0	0	9	1	0	1
090	52.5	47.5	100.0	0	4	2	0	0
091	23.0	89.0	112.0	0	5	0	0	0
092	83.5	26.5	110.0	66	0	1	0	0
093	40.5	75.5	116.0	13	6	0	0	1
094	49.0	70.0	119.0	6	10	2	0	0
095	26.5	73.5	100.0	0	0	0	0	0
096	55.0	65.0	120.0	18	20	2	0	0
097	28.0	72.0	100.0	0	32	0	0	0
098	47.0	48.0	95.0	7	20	1	0	0

FARM CODE	VARIABLES 16	17	18	19	20	21	22	23
099	6.0	2.0	0.0	0.0	25.0	0.0	0.0	0.5
100	5.0	0.0	5.0	0.0	10.0	5.0	36.0	0.5
101	8.0	0.0	2.0	0.0	60.0	0.0	25.0	1.0
102	1.0	0.0	0.0	0.0	29.0	7.5	20.0	0.5
103	22.0	0.0	20.0	0.0	100.0	12.0	12.0	1.0
104	14.5	0.0	2.0	0.0	50.0	5.0	5.0	0.5
105	23.0	0.0	8.0	0.0	60.0	10.0	0.0	1.0
106	9.0	0.0	0.0	0.0	50.0	10.0	12.0	0.5
107	11.0	0.0	0.0	0.0	25.0	10.0	6.0	1.0
108	5.0	1.0	2.0	0.0	30.0	10.0	3.0	0.5
109	10.0	0.0	2.5	0.0	2.5	7.0	5.0	1.0
110	11.5	2.0	5.0	0.0	15.0	3.0	8.0	5.0
111	0.0	0.0	7.5	0.0	24.0	0.0	32.0	0.5
112	6.0	0.0	11.0	0.0	8.0	12.0	15.0	1.0
113	3.0	0.0	10.0	0.0	12.0	0.0	10.0	0.5
114	3.0	0.0	6.5	0.0	0.0	0.0	8.0	0.5
115	20.0	3.0	4.0	0.0	10.0	10.0	2.0	1.0
116	14.5	2.0	5.0	0.0	25.0	5.0	5.0	0.5
117	21.0	3.0	2.0	0.0	11.0	0.0	4.0	1.0
118	4.5	0.0	5.0	0.0	12.0	5.0	6.0	1.0
119	14.0	1.0	0.0	0.0	12.0	4.0	10.0	0.5
120	7.0	0.0	14.0	0.0	20.0	0.0	0.0	1.0
121	2.5	0.0	3.0	0.0	1.5	0.0	5.0	0.5
122	12.0	0.0	14.0	0.0	6.0	0.0	15.0	1.0
123	1.0	0.0	6.0	0.0	20.0	10.0	18.0	0.5

FARM CODE	VARIABLES 24	25	26	27	28	29	30	31
099	33.5	66.5	100.0	0	25	0	0	0
100	61.5	38.5	100.0	4	6	0	0	0
101	96.0	104.0	200.0	28	6	2	0	0
102	58.0	38.0	96.0	18	5	0	0	0
103	167.0	88.0	255.0	76	25	1	0	0
104	77.0	18.0	95.0	130	30	4	0	0
105	102.0	98.0	200.0	80	20	2	2	0
106	81.5	118.5	200.0	0	19	1	0	0
107	53.0	47.0	100.0	0	6	0	0	0
108	51.5	50.5	102.0	26	10	0	0	0
109	50.5	50.5	101.0	40	15	1	0	0
110	45.0	57.0	102.0	31	0	0	0	0
111	64.0	36.0	100.0	36	13	2	1	0
112	53.0	47.0	100.0	0	51	0	0	0
113	35.5	64.5	100.0	3	8	0	0	0
114	18.0	82.0	100.0	0	15	0	0	0
115	50.0	50.0	100.0	28	18	0	0	0
116	57.0	40.0	97.0	13	10	0	0	0
117	42.0	58.0	100.0	0	30	0	0	0
118	33.5	66.5	100.0	0	14	0	0	0
119	41.5	58.5	100.0	32	20	1	0	0
120	42.0	58.0	100.0	5	10	1	0	0
121	12.5	87.5	100.0	1	7	0	0	0
122	48.0	52.0	100.0	0	0	0	0	0
123	55.5	44.5	100.0	20	16	0	0	0

FARM CODE	VARIABLES 16	17	18	19	20	21	22	23
124	0.0	0.0	16.0	0.0	40.0	na	na	na
125	0.0	0.0	8.0	0.0	50.0	na	na	na
126	0.0	0.0	14.0	0.0	60.0	na	na	na
127	0.0	0.0	3.5	0.0	45.5	na	na	na
128	0.0	0.0	12.6	0.0	20.0	na	na	na
129	0.0	0.0	2.6	0.0	60.0	na	na	na
130	0.0	0.0	5.3	0.0	70.0	na	na	na
131	0.0	0.0	7.5	0.0	59.0	na	na	na
132	0.0	0.0	1.2	0.0	40.0	na	na	na
133	0.0	0.0	12.0	0.0	75.0	na	na	na
134	0.0	0.0	6.6	0.0	70.0	na	na	na
135	0.0	0.0	9.1	0.0	40.0	na	na	na
136	0.0	0.0	11.5	0.0	5.0	na	na	na
137	0.0	0.0	0.0	0.0	52.0	na	na	na
138	0.0	0.0	24.0	0.0	20.0	na	na	na
139	0.0	0.0	25.0	0.0	65.0	na	na	na
140	0.0	0.0	1.0	0.0	50.0	na	na	na
141	0.0	0.0	4.3	0.0	100.0	na	na	na
142	0.0	0.0	8.0	0.0	100.0	na	na	na
143	0.0	0.0	9.6	0.0	65.0	na	na	na
144	0.0	0.0	7.3	0.0	110.0	na	na	na
145	0.0	0.0	6.0	0.0	40.0	na	na	na
146	0.0	0.0	14.0	0.0	64.0	na	na	na
147	0.0	0.0	12.6	0.0	70.0	na	na	na
148	0.0	0.0	2.0	0.0	133.0	na	na	na
149	0.0	0.0	4.5	0.0	140.0	na	na	na
150	0.0	0.0	4.0	0.0	160.0	na	na	na
151	0.0	0.0	0.0	0.0	160.0	na	na	na
152	0.0	0.0	4.4	0.0	168.0	na	na	na
153	0.0	0.0	4.0	0.0	153.0	na	na	na
154	0.0	0.0	20.0	0.0	180.0	na	na	na
155	0.0	0.0	0.0	0.0	150.0	na	na	na

FARM CODE	VARIABLES 24	25	26	27	28	29	30	31
124	na	na	70.4	13	16	1	0	0
125	na	na	75.2	0	6	0	0	0
126	na	na	82.2	60	5	1	0	0
127	na	na	84.0	5	4	2	0	0
128	na	na	90.0	2	1	0	0	0
129	na	na	91.6	22	12	1	0	0
130	na	na	92.8	3	14	0	0	0
131	na	na	93.6	6	12	1	0	0
132	na	na	100.9	16	8	3	0	0
133	na	na	103.5	5	13	5	0	0
134	na	na	106.4	4	1	0	0	0
135	na	na	109.1	40	9	1	0	0
136	na	na	110.4	15	18	2	0	0
137	na	na	113.3	14	4	1	0	0
138	na	na	122.6	48	22	0	0	0
139	na	na	123.2	8	12	3	0	0
140	na	na	127.5	8	9	0	0	0
141	na	na	128.8	2	1	3	0	0
142	na	na	136.8	5	0	0	0	0
143	na	na	139.6	28	8	1	0	0
144	na	na	142.0	0	2	1	0	0
145	na	na	149.8	35	8	5	0	0
146	na	na	164.4	11	22	2	0	0
147	na	na	165.8	46	6	3	0	0
148	na	na	173.1	10	0	5	0	0
149	na	na	178.8	30	15	1	0	0
150	na	na	191.8	43	6	2	0	0
151	na	na	193.9	40	2	2	0	0
152	na	na	202.9	10	0	3	0	0
153	na	na	220.7	1	0	0	0	0
154	na	na	223.3	2	0	0	0	0
155	na	na	263.4	22	10	4	0	0

FARM CODE	VARIABLES 32	33	34	35	36	37	38	39	40	41	42
001	0	1	0	0	3	1	0	1	1	0	1
002	0	0	0	0	1	0	0	1	0	0	0
003	0	1	0	0	1	1	0	0	0	0	1
004	0	1	0	0	3	1	0	1	0	0	0
005	0	1	0	0	2	1	0	1	0	0	1
006	0	1	0	0	2	1	0	0	0	0	1
007	0	1	0	0	2	1	0	3	1	0	1
008	0	1	0	0	2	1	0	3	0	0	1
009	0	1	0	0	1	1	0	2	0	0	1
010	0	1	0	0	2	1	0	1	0	0	0
011	0	1	0	0	1	1	0	1	1	0	1
012	0	1	0	0	3	1	0	1	0	0	1
013	0	1	0	0	2	1	0	2	0	0	2
014	0	1	0	0	1	1	0	1	1	0	1
015	0	0	0	0	3	0	0	0	0	0	0
016	0	1	0	0	2	1	0	1	0	0	1
017	0	1	0	0	1	1	0	1	0	0	1
018	0	0	0	0	1	0	0	2	0	0	3
019	0	0	0	0	0	0	0	0	1	0	0
020	0	0	0	0	0	0	0	0	0	0	0
021	0	0	0	0	0	0	0	0	0	0	0
022	0	0	0	0	0	0	0	0	1	0	0
023	0	0	0	0	1	0	0	0	1	0	1
024	0	0	0	0	0	0	0	0	1	0	0
025	0	0	0	0	0	0	0	0	1	0	1
026	1	0	0	0	0	0	0	0	0	0	1
027	0	0	0	0	1	0	1	1	1	1	1
028	0	0	0	0	1	0	0	0	0	0	1
029	0	0	0	0	0	0	0	0	0	0	0
030	0	0	0	0	1	0	1	0	1	1	1
031	0	0	0	0	0	0	1	0	1	1	1

FARM CODE	VARIABLES 43	44	45	46	47	48	49	50	51	52	53	54
001	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
002	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y
003	N	N	N	Y	N	Y	Y	Y	Y	Y	N	Y
004	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
005	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
006	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y
007	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
008	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y
009	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y
010	N	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y
011	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y
012	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
013	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
014	N	N	N	Y	N	Y	Y	Y	N	Y	Y	Y
015	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
016	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
017	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
018	N	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y
019	N	N	N	N	N	N	N	N	N	N	N	N
020	N	N	N	N	N	N	N	N	Y	N	N	N
021	N	Y	N	N	N	N	N	N	Y	N	N	N
022	N	Y	N	N	N	N	N	Y	Y	N	N	N
023	Y	Y	N	N	N	N	N	N	N	N	N	N
024	Y	N	N	Y	N	N	N	N	N	N	N	N
025	N	Y	N	N	N	N	N	N	Y	N	N	N
026	Y	Y	N	Y	N	N	N	N	Y	N	N	N
027	Y	Y	N	Y	N	N	N	N	Y	N	N	N
028	N	Y	N	N	N	N	N	N	Y	N	N	N
029	N	N	N	N	N	N	N	N	Y	N	N	N
030	N	Y	N	N	N	Y	N	N	Y	N	N	N
031	Y	Y	N	N	N	N	N	N	Y	N	N	N

FARM CODE	VARIABLES 32	33	34	35	36	37	38	39	40	41	42
032	0	0	0	0	0	0	1	0	1	0	1
033	0	0	0	0	1	0	1	0	0	0	0
034	0	0	0	0	0	0	0	0	1	0	0
035	0	0	0	0	0	0	1	0	1	0	0
036	0	0	0	0	2	0	1	0	1	0	0
037	0	0	0	0	2	0	1	0	1	0	1
038	0	0	0	0	0	0	0	0	1	0	1
039	0	0	0	0	0	0	0	0	0	0	0
040	0	0	0	0	0	0	0	0	0	0	1
041	0	0	0	0	0	0	0	0	0	0	0
042	0	0	0	0	2	0	1	0	0	0	1
043	0	0	0	0	0	0	0	0	0	1	0
044	0	0	0	0	0	0	0	0	0	0	1
045	0	0	0	0	1	0	0	0	1	0	0
046	0	0	0	0	0	0	1	0	1	1	0
047	0	0	0	0	0	0	1	0	1	1	0
048	0	0	0	0	0	0	0	0	1	0	1
049	0	0	0	0	2	0	1	0	1	0	1
050	0	0	0	0	0	0	1	0	1	0	0
051	1	0	0	0	0	0	0	0	0	0	0
052	0	0	0	0	0	0	1	0	1	0	1
053	0	0	0	0	2	0	1	0	1	1	0
054	0	0	0	0	0	0	0	0	0	0	0
055	0	0	0	0	0	0	0	0	1	1	0
056	0	0	0	0	0	0	1	0	1	0	1
057	0	0	0	1	3	0	2	0	1	0	1
058	0	0	0	0	0	0	1	1	1	0	0
059	0	0	0	0	0	0	0	0	0	0	1
060	0	0	0	0	0	0	0	0	0	0	0
061	0	0	0	0	1	0	1	0	1	1	1
062	0	0	0	0	3	0	0	0	1	0	1
063	0	0	0	0	1	0	1	0	0	1	0
064	0	0	0	0	0	0	1	0	1	0	1

FARM CODE	VARIABLES 43	44	45	46	47	48	49	50	51	52	53	54
032	Y	Y	N	N	N	N	N	N	Y	N	N	N
033	N	N	N	Y	N	Y	N	Y	Y	N	N	N
034	N	N	N	N	N	N	N	N	N	N	N	N
035	N	N	N	N	N	N	N	N	N	N	N	N
036	Y	N	N	Y	N	N	N	N	Y	Y	N	N
037	Y	Y	N	N	N	N	N	N	Y	Y	N	N
038	Y	Y	N	N	N	N	N	N	Y	N	N	N
039	Y	Y	N	N	N	N	N	N	Y	N	N	N
040	Y	N	N	N	N	N	N	N	Y	N	N	N
041	Y	Y	N	N	N	N	N	N	Y	N	N	N
042	Y	Y	N	N	N	N	N	Y	Y	N	N	N
043	N	Y	N	N	N	N	N	N	N	N	N	N
044	Y	N	N	N	N	N	N	Y	N	N	N	N
045	Y	N	N	N	N	N	N	N	N	N	N	N
046	Y	Y	N	N	N	N	N	N	Y	N	N	N
047	Y	Y	N	N	N	N	N	N	N	N	N	N
048	N	Y	N	N	N	N	N	N	N	N	N	N
049	N	Y	N	N	N	N	N	N	Y	N	N	N
050	Y	Y	N	N	N	N	N	N	N	N	N	N
051	Y	Y	N	N	N	N	N	N	Y	N	N	N
052	N	Y	N	N	N	N	N	N	N	N	N	N
053	N	Y	N	N	N	N	N	N	N	N	N	N
054	Y	Y	N	N	N	N	N	N	N	N	N	N
055	N	Y	N	N	N	N	N	N	Y	N	N	N
056	Y	Y	N	N	N	N	N	Y	N	N	N	N
057	N	Y	N	Y	N	N	N	N	Y	Y	N	N
058	N	Y	N	N	N	N	N	N	Y	N	N	N
059	N	Y	N	N	N	N	N	N	Y	N	N	N
060	N	N	N	N	N	N	N	N	Y	N	N	N
061	N	Y	N	Y	N	N	N	N	Y	N	N	N
062	N	Y	N	N	N	N	N	Y	Y	Y	N	N
063	Y	Y	N	N	N	N	N	Y	Y	Y	N	N
064	N	Y	N	N	N	N	N	N	N	N	N	N

FARM CODE	VARIABLES 32	33	34	35	36	37	38	39	40	41	42
065	0	0	0	0	0	0	0	0	1	0	0
066	1	0	0	0	5	0	2	0	1	1	1
067	0	1	0	0	1	0	0	0	1	0	0
068	0	0	0	0	1	0	1	0	0	0	0
069	0	0	0	1	1	0	1	0	1	1	0
070	0	0	0	0	0	0	1	0	1	1	0
071	0	1	0	0	0	0	1	0	1	0	0
072	0	0	0	0	1	0	1	0	0	3	0
073	0	0	0	0	1	0	0	0	0	0	0
074	0	0	0	0	2	0	0	0	0	1	0
075	0	0	0	0	1	0	0	0	0	1	0
076	0	1	0	1	1	0	1	0	1	1	0
077	0	0	0	0	0	0	1	0	0	0	0
078	0	1	0	1	1	0	1	0	1	2	1
079	1	2	0	1	1	0	1	0	1	1	0
080	0	1	0	1	1	0	1	0	1	1	0
081	0	1	0	0	0	0	1	1	1	0	0
082	0	0	0	0	1	0	1	0	1	0	1
083	0	0	0	0	0	0	0	0	1	0	1
084	1	0	0	0	0	0	2	0	1	0	0
085	0	0	0	0	5	0	1	1	1	1	1
086	0	0	0	0	2	0	0	0	1	0	1
087	0	0	0	0	2	0	1	0	1	0	1
088	0	0	0	0	1	0	1	0	0	0	1
089	0	0	0	0	2	0	1	0	1	1	1
090	0	2	0	0	1	0	1	0	1	0	1
091	0	0	0	0	0	0	1	0	0	0	0
092	0	0	0	0	1	0	1	1	1	0	1
093	0	0	0	1	1	0	1	0	1	1	1
094	0	0	0	0	1	0	1	0	0	0	1
095	0	0	0	0	0	0	0	0	0	0	0
096	0	0	0	0	0	0	1	0	0	0	1
097	0	0	0	0	0	0	1	0	0	0	0
098	0	0	0	0	1	0	1	0	1	0	1

FARM CODE	VARIABLES 43	44	45	46	47	48	49	50	51	52	53	54
065	N	Y	N	N	N	N	N	N	N	N	N	N
066	Y	Y	N	N	N	N	N	N	N	Y	N	N
067	Y	Y	N	N	N	N	N	N	Y	N	N	N
068	N	Y	N	N	N	N	N	N	Y	N	N	N
069	N	Y	N	N	N	N	N	N	N	N	N	N
070	Y	Y	N	N	N	N	N	N	N	N	N	N
071	Y	Y	N	Y	N	N	N	N	N	N	N	N
072	Y	Y	N	Y	N	N	N	N	Y	Y	N	N
073	Y	N	N	Y	N	N	N	N	Y	Y	N	N
074	Y	N	N	N	N	N	N	N	N	Y	N	N
075	N	N	N	N	N	N	N	N	N	Y	N	N
076	Y	Y	N	N	N	N	N	N	Y	Y	N	N
077	Y	Y	N	N	N	N	N	N	N	N	N	N
078	Y	Y	N	Y	N	Y	N	N	Y	Y	N	N
079	Y	Y	N	N	N	N	N	N	Y	N	N	N
080	Y	Y	N	Y	N	N	N	N	Y	Y	N	N
081	Y	Y	N	N	N	N	N	Y	N	N	N	N
082	N	N	N	Y	N	N	N	Y	N	Y	N	N
083	N	Y	N	N	N	N	N	Y	Y	N	N	N
084	Y	Y	N	Y	N	N	N	N	N	N	N	N
085	Y	Y	N	N	N	N	N	N	N	Y	N	N
086	Y	Y	N	Y	N	N	N	Y	Y	Y	N	N
087	Y	Y	N	N	N	N	N	Y	Y	Y	N	N
088	N	Y	N	Y	N	N	N	N	Y	Y	N	N
089	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
090	Y	N	N	N	N	N	N	N	Y	N	Y	Y
091	Y	N	N	N	N	N	N	N	N	N	N	N
092	Y	N	N	N	N	N	N	N	N	N	N	N
093	Y	Y	N	N	N	N	N	N	Y	N	N	N
094	Y	N	N	N	N	N	N	N	N	N	N	N
095	N	N	N	Y	N	N	N	N	Y	N	N	N
096	Y	N	N	N	N	N	N	N	Y	N	N	N
097	N	Y	N	N	N	N	N	N	N	N	N	N
098	N	Y	N	N	N	N	N	N	Y	N	N	N

FARM CODE	VARIABLES 32	33	34	35	36	37	38	39	40	41	42
099	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	1	0	0	1	0
101	0	0	0	0	0	0	1	0	1	0	1
102	0	0	0	0	0	0	0	0	1	0	1
103	0	0	0	0	0	0	1	0	1	1	1
104	1	0	0	0	1	0	0	0	1	1	1
105	0	0	0	0	1	0	1	1	1	1	1
106	0	0	0	0	0	0	0	1	1	0	0
107	0	0	0	0	0	0	0	0	1	0	1
108	0	0	0	0	0	0	1	0	1	0	0
109	0	0	0	0	1	0	0	0	1	0	1
110	0	0	0	0	1	0	0	0	1	0	0
111	0	0	0	0	1	0	1	0	1	0	1
112	0	0	0	0	0	0	1	0	0	0	0
113	0	0	0	0	0	0	1	0	1	0	1
114	0	0	0	0	1	0	1	0	0	0	1
115	0	0	0	0	1	0	2	1	1	1	1
116	0	0	0	0	2	0	1	0	1	0	0
117	0	0	0	0	2	0	1	0	0	0	0
118	0	0	0	0	0	0	1	0	0	0	0
119	0	0	0	0	3	0	1	0	0	1	0
120	0	1	0	0	0	0	1	0	1	0	0
121	0	0	0	0	0	0	0	0	0	0	0
122	0	0	0	0	0	0	1	0	0	0	0
123	0	0	0	0	0	0	0	0	1	0	0

FARM CODE	VARIABLES 43	44	45	46	47	48	49	50	51	52	53	54
099	N	Y	N	N	N	N	N	Y	Y	N	N	N
100	Y	Y	N	N	N	N	N	N	Y	N	N	N
101	Y	Y	N	Y	N	N	N	N	N	N	N	N
102	Y	Y	N	N	N	N	N	N	N	N	N	N
103	Y	Y	N	N	N	N	N	N	N	N	N	N
104	Y	Y	N	Y	N	N	N	N	N	N	N	N
105	Y	Y	N	N	N	N	N	N	Y	N	N	N
106	Y	Y	N	N	N	N	N	N	Y	N	N	N
107	N	Y	N	Y	N	N	N	Y	Y	N	N	N
108	Y	Y	N	N	N	N	N	N	Y	N	N	N
109	Y	Y	N	Y	N	Y	N	N	Y	N	N	N
110	Y	N	N	Y	N	N	N	N	Y	Y	N	N
111	Y	N	N	N	N	N	N	N	N	N	N	N
112	Y	Y	N	N	N	N	N	N	Y	N	N	N
113	Y	N	N	N	N	N	N	N	N	N	N	N
114	Y	N	N	N	N	N	N	N	N	N	N	N
115	N	Y	N	N	N	N	N	N	Y	N	N	N
116	N	N	N	N	N	N	N	Y	Y	N	N	N
117	N	Y	N	N	N	N	N	N	N	N	N	N
118	N	Y	N	N	N	N	N	N	Y	N	N	N
119	N	Y	N	N	N	N	N	N	N	N	N	N
120	Y	N	N	N	N	N	N	N	Y	N	N	N
121	N	N	N	N	N	N	N	N	N	N	N	N
122	N	Y	N	N	N	N	N	N	Y	N	N	N
123	Y	Y	N	N	N	N	N	N	N	N	N	N

FARM CODE	VARIABLES										
	32	33	34	35	36	37	38	39	40	41	42
124	0	0	0	0	0	0	0	0	1	0	0
125	0	0	0	0	0	0	0	0	0	0	0
126	0	1	0	0	0	0	1	0	1	0	0
127	0	1	0	0	0	0	0	0	1	0	0
128	0	0	0	0	0	0	0	0	0	0	0
129	0	1	0	0	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	1	0	0
131	0	1	0	0	0	0	0	0	1	0	0
132	0	0	0	0	0	0	0	0	1	1	0
133	0	0	0	1	0	0	0	1	1	0	0
134	0	0	0	1	0	0	0	0	0	0	1
135	0	1	0	0	0	0	0	0	1	0	0
136	0	0	0	1	0	0	0	0	1	0	0
137	0	0	0	0	0	0	0	0	1	0	0
138	0	0	0	0	0	0	0	0	1	0	0
139	0	0	0	0	0	0	0	0	1	0	0
140	0	0	0	0	0	0	1	0	0	0	0
141	0	0	0	0	0	0	0	0	0	0	0
142	0	1	0	0	0	0	0	0	1	0	1
143	0	1	0	0	0	0	0	0	1	0	0
144	0	0	0	0	0	0	0	0	0	0	1
145	0	0	0	0	0	0	0	0	1	0	0
146	0	0	0	1	0	0	0	0	1	0	0
147	0	0	0	0	0	0	0	0	1	0	0
148	0	0	0	0	0	0	0	0	1	0	0
149	0	0	0	0	1	0	0	0	1	0	0
150	0	0	0	0	0	0	0	0	0	0	0
151	0	0	0	0	0	0	0	0	0	0	0
152	0	0	0	0	0	0	0	0	0	0	0
153	0	0	0	0	0	0	0	0	1	0	0
154	0	0	0	0	0	0	0	0	0	0	0
155	0	0	0	0	0	0	0	0	1	0	1

FARM CODE	VARIABLES											
	43	44	45	46	47	48	49	50	51	52	53	54
124	Y	Y	N	N	N	N	N	Y	N	N	Y	Y
125	N	Y	N	N	N	N	N	Y	Y	N	N	N
126	Y	Y	N	N	N	N	N	Y	N	N	N	Y
127	Y	Y	N	N	N	N	N	Y	N	N	N	Y
128	N	Y	N	Y	N	N	N	Y	N	N	N	N
129	Y	Y	N	N	N	N	N	N	N	N	N	N
130	Y	Y	N	N	N	N	N	Y	Y	N	Y	Y
131	N	Y	N	N	N	N	N	Y	Y	N	Y	Y
132	N	Y	N	N	N	N	N	Y	Y	N	N	N
133	N	Y	N	N	N	N	N	Y	N	N	Y	Y
134	N	Y	N	Y	N	N	N	Y	N	N	Y	Y
135	N	Y	N	Y	N	N	N	Y	N	N	N	N
136	N	Y	N	Y	N	N	N	Y	Y	N	Y	Y
137	Y	Y	N	Y	N	N	N	Y	Y	N	N	Y
138	Y	Y	N	Y	N	N	N	Y	Y	N	N	N
139	Y	Y	N	Y	N	N	N	Y	Y	N	Y	Y
140	Y	Y	N	N	N	N	N	N	Y	N	N	N
141	N	Y	N	N	N	N	N	N	Y	N	Y	N
142	Y	N	N	N	N	N	N	N	Y	N	N	N
143	Y	Y	N	Y	N	N	N	Y	N	N	N	N
144	N	Y	N	N	N	N	N	N	Y	N	Y	Y
145	Y	Y	N	N	N	N	N	N	Y	N	Y	Y
146	N	Y	N	Y	N	N	N	Y	Y	N	N	N
147	Y	Y	N	N	N	N	N	Y	N	N	N	Y
148	N	N	N	N	N	N	N	Y	N	N	Y	N
149	Y	Y	N	N	N	N	N	Y	Y	Y	Y	N
150	N	Y	N	N	N	N	N	N	N	N	N	Y
151	N	Y	N	N	N	N	N	Y	N	N	Y	Y
152	N	N	N	N	N	N	N	Y	N	N	N	N
153	Y	N	N	N	N	N	N	Y	Y	N	Y	N
154	N	N	N	Y	N	N	N	Y	N	N	Y	N
155	N	Y	N	N	N	N	N	N	N	N	N	N

FARM CODE	VARIABLES 55	56	57	58	59	60	61	62	63	64	65	66
001	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
002	Y	N	N	N	Y	N	N	Y	N	Y	N	Y
003	N	Y	N	N	Y	N	N	Y	N	Y	N	Y
004	N	Y	N	N	N	N	Y	Y	N	Y	N	Y
005	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
006	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
007	Y	N	N	Y	N	N	N	Y	Y	Y	N	Y
008	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
009	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
010	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
011	Y	N	N	Y	N	N	N	Y	Y	Y	N	Y
012	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
013	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
014	Y	N	N	N	Y	N	N	Y	N	Y	N	Y
015	Y	N	N	N	Y	N	N	Y	N	Y	N	Y
016	N	Y	N	N	Y	N	N	Y	Y	Y	N	Y
017	N	Y	N	N	N	Y	N	N	N	Y	N	Y
018	N	Y	N	N	Y	N	N	N	N	Y	N	Y
019	N	N	Y	N	N	N	Y	N	Y	N	Y	Y
020	N	Y	N	N	Y	N	N	N	Y	N	N	N
021	N	N	Y	N	N	Y	N	N	Y	N	N	N
022	N	Y	N	N	Y	N	N	Y	Y	N	Y	N
023	Y	N	N	N	Y	N	N	Y	Y	Y	N	N
024	N	Y	N	Y	N	N	N	Y	N	Y	N	N
025	Y	N	N	N	Y	N	N	Y	N	Y	N	N
026	Y	N	N	Y	N	N	N	Y	N	Y	N	N
027	Y	N	N	N	Y	N	N	Y	N	Y	N	N
028	N	N	Y	N	N	Y	N	N	N	N	N	N
029	Y	N	N	Y	N	N	N	N	Y	N	N	N
030	Y	N	N	Y	N	N	N	Y	N	Y	N	N
031	Y	N	N	Y	N	N	N	Y	N	Y	N	N

FARM CODE	VARIABLES 67	68	69	70	71	72	73	74	75
001	1	0	Y	Y	Y	Y	Y	Y	Y
002	0	0	N	Y	Y	Y	Y	N	N
003	0	0	Y	Y	N	N	Y	N	Y
004	0	0	N	N	Y	N	N	N	Y
005	1	1	Y	Y	Y	Y	Y	Y	Y
006	0	2	Y	Y	Y	Y	Y	Y	Y
007	1	1	Y	Y	Y	Y	Y	N	Y
008	0	1	Y	Y	Y	Y	Y	Y	Y
009	0	0	Y	Y	Y	Y	Y	Y	Y
010	1	1	Y	Y	Y	Y	Y	Y	Y
011	0	1	Y	Y	Y	Y	Y	Y	N
012	0	1	Y	Y	Y	Y	Y	Y	Y
013	1	2	Y	Y	Y	Y	Y	Y	Y
014	1	0	N	N	Y	Y	Y	N	Y
015	0	0	N	N	Y	N	Y	N	Y
016	1	0	Y	Y	Y	Y	Y	Y	Y
017	0	0	N	N	Y	Y	N	N	Y
018	0	1	Y	Y	Y	N	Y	N	Y
019	0	0	N	N	N	N	Y	N	N
020	0	0	N	N	N	Y	N	N	N
021	0	0	N	N	N	Y	N	N	N
022	0	0	N	N	N	Y	N	N	Y
023	0	0	N	N	N	Y	N	N	Y
024	0	0	N	N	N	Y	N	N	Y
025	0	0	N	N	N	Y	N	N	N
026	1	0	N	N	N	Y	N	N	Y
027	0	0	N	N	N	Y	N	N	Y
028	0	0	N	N	N	Y	N	N	Y
029	1	0	N	N	N	Y	N	N	Y
030	0	0	N	N	N	Y	N	N	Y
031	0	0	N	N	N	Y	N	N	Y

FARM CODE	VARIABLES											
	55	56	57	58	59	60	61	62	63	64	65	66
032	Y	N	N	N	Y	N	N	Y	N	Y	N	N
033	N	Y	N	N	N	Y	N	Y	N	Y	N	N
034	N	N	Y	N	N	Y	N	N	Y	N	N	N
035	N	Y	N	Y	N	N	N	N	N	Y	N	N
036	N	N	Y	N	N	Y	N	Y	Y	N	Y	N
037	N	Y	N	N	N	Y	N	Y	Y	N	N	N
038	N	Y	N	Y	N	N	N	Y	N	Y	N	N
039	N	Y	N	N	Y	N	N	Y	Y	N	N	N
040	N	Y	N	N	N	Y	N	Y	Y	N	N	N
041	Y	N	N	N	Y	N	N	N	Y	N	N	N
042	N	N	Y	N	N	Y	N	Y	Y	N	N	N
043	N	N	Y	N	N	Y	N	N	Y	N	N	N
044	N	N	Y	N	N	Y	N	Y	N	Y	N	N
045	N	Y	N	N	Y	N	N	Y	N	N	N	Y
046	Y	N	N	Y	N	N	N	Y	Y	N	N	N
047	N	Y	N	N	Y	N	N	N	N	N	Y	N
048	N	Y	N	N	Y	N	N	Y	N	N	Y	N
049	N	Y	N	N	Y	N	N	N	N	Y	N	Y
050	N	N	Y	N	N	Y	N	Y	Y	N	N	N
051	N	Y	N	N	Y	N	N	Y	N	Y	N	N
052	N	Y	N	N	Y	N	N	Y	Y	N	N	N
053	N	Y	N	N	Y	N	N	Y	N	Y	N	N
054	N	Y	N	N	Y	N	N	N	Y	N	N	N
055	N	Y	N	N	Y	N	N	N	Y	N	N	N
056	Y	N	N	Y	N	N	N	Y	N	N	N	N
057	N	Y	N	N	N	Y	N	Y	Y	N	Y	N
058	N	Y	N	N	Y	N	N	Y	Y	N	Y	N
059	N	Y	N	N	Y	N	N	N	Y	Y	N	N
060	N	N	Y	N	N	Y	N	N	Y	N	N	N
061	N	Y	N	Y	N	N	N	Y	Y	N	Y	N
062	N	Y	N	Y	N	N	N	Y	Y	N	Y	N
063	Y	N	N	Y	N	N	N	Y	N	Y	N	N
064	N	N	Y	N	N	N	Y	Y	N	Y	N	N

FARM CODE	VARIABLES									
	67	68	69	70	71	72	73	74	75	
032	0	0	N	N	N	Y	N	N	Y	
033	0	0	N	N	N	Y	N	N	N	
034	0	0	N	N	N	N	N	N	N	
035	0	0	N	N	N	Y	N	N	Y	
036	0	0	N	N	N	Y	N	Y	Y	
037	0	0	N	N	N	Y	N	N	Y	
038	0	0	N	N	N	Y	N	N	N	
039	0	0	N	N	N	Y	N	Y	N	
040	0	0	N	N	N	N	N	N	Y	
041	0	0	N	N	N	N	N	N	N	
042	1	0	N	N	N	Y	N	N	N	
043	0	0	N	N	N	N	N	N	N	
044	0	0	N	N	N	N	N	N	N	
045	0	0	N	N	N	N	N	N	N	
046	0	1	N	N	N	Y	N	N	Y	
047	0	0	N	N	N	Y	N	N	Y	
048	0	0	N	N	N	Y	N	N	Y	
049	0	0	N	N	N	N	N	N	Y	
050	0	0	N	N	N	Y	N	N	Y	
051	0	0	N	N	N	Y	N	N	Y	
052	0	0	N	N	N	Y	N	N	Y	
053	0	0	N	N	N	Y	N	N	Y	
054	0	0	N	N	N	Y	N	N	N	
055	0	0	N	N	N	Y	N	N	Y	
056	0	0	N	N	N	Y	N	N	Y	
057	1	0	N	N	N	N	N	N	N	
058	0	0	N	N	N	Y	N	N	Y	
059	0	0	N	N	N	Y	N	N	N	
060	0	0	N	N	N	Y	N	N	N	
061	0	0	N	N	N	Y	N	Y	Y	
062	1	0	N	N	N	Y	N	N	Y	
063	0	0	Y	N	N	Y	N	N	Y	
064	0	0	N	N	N	Y	N	N	Y	

FARM CODE	VARIABLES 55	56	57	58	59	60	61	62	63	64	65	66
065	N	Y	N	N	Y	N	N	N	Y	N	N	N
066	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
067	N	Y	N	N	Y	N	N	Y	N	N	N	N
068	N	Y	N	N	Y	N	N	Y	Y	N	N	N
069	N	N	Y	N	N	Y	N	Y	N	Y	N	N
070	N	Y	N	N	N	Y	N	Y	N	N	N	N
071	N	Y	N	N	N	Y	N	Y	N	N	N	N
072	N	Y	N	N	N	Y	N	Y	N	Y	N	N
073	N	Y	N	Y	N	N	N	Y	N	N	N	N
074	N	Y	N	Y	N	N	N	Y	N	N	Y	N
075	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
076	N	Y	N	N	Y	N	N	N	N	Y	N	N
077	N	Y	N	Y	N	N	N	Y	N	N	N	Y
078	N	Y	N	N	Y	N	N	Y	N	Y	N	N
079	Y	N	N	N	Y	N	N	N	N	Y	N	N
080	N	Y	N	N	Y	N	N	Y	Y	N	N	N
081	N	Y	N	N	Y	N	N	N	N	Y	N	N
082	N	Y	N	N	Y	N	N	N	N	Y	Y	N
083	N	Y	N	N	Y	N	N	Y	N	Y	Y	Y
084	N	Y	N	N	Y	N	N	Y	N	Y	N	N
085	N	Y	N	Y	N	N	N	Y	Y	Y	Y	N
086	N	Y	N	Y	N	N	N	Y	N	Y	N	N
087	N	Y	N	N	Y	N	N	Y	N	Y	N	N
088	N	N	Y	N	N	Y	N	N	N	N	N	N
089	N	Y	N	Y	N	N	N	Y	N	Y	N	N
090	N	Y	N	N	Y	N	N	Y	N	Y	N	N
091	N	Y	N	N	N	Y	N	N	Y	N	N	N
092	Y	N	N	N	N	N	N	Y	Y	N	N	N
093	N	Y	N	N	Y	N	N	Y	Y	Y	N	N
094	N	N	N	N	N	N	Y	Y	N	N	N	Y
095	N	Y	N	N	Y	N	N	N	N	N	N	N
096	Y	N	N	N	Y	N	N	Y	Y	N	N	N
097	N	N	Y	N	N	Y	N	Y	Y	N	N	N
098	N	N	Y	N	N	Y	N	Y	Y	N	Y	N

FARM CODE	VARIABLES 67	68	69	70	71	72	73	74	75
065	0	0	N	N	N	Y	N	N	Y
066	0	0	N	N	N	Y	N	N	Y
067	0	0	N	N	N	Y	N	N	Y
068	0	0	N	N	N	Y	N	N	Y
069	0	0	N	Y	N	Y	Y	Y	N
070	0	0	N	N	N	Y	N	N	Y
071	1	0	N	N	N	Y	N	N	N
072	1	0	N	N	N	Y	N	N	Y
073	0	0	N	N	N	Y	N	Y	N
074	0	0	N	N	N	Y	N	Y	N
075	0	0	N	N	N	Y	N	Y	Y
076	1	0	N	N	N	Y	Y	N	Y
077	0	0	N	N	N	Y	N	Y	Y
078	1	0	N	N	N	Y	N	N	Y
079	0	0	N	N	N	N	N	N	N
080	1	0	N	N	N	Y	N	N	N
081	1	0	N	N	N	Y	N	N	Y
082	0	0	N	N	N	Y	N	N	Y
083	1	0	N	N	N	Y	N	N	Y
084	1	1	N	N	N	Y	N	N	Y
085	1	0	N	N	N	Y	N	Y	Y
086	0	0	N	N	N	Y	N	Y	Y
087	1	0	N	N	N	Y	N	N	Y
088	0	0	N	N	N	N	N	N	N
089	0	0	N	N	N	Y	N	Y	Y
090	0	0	N	N	N	N	N	N	Y
091	0	0	N	N	N	Y	N	N	Y
092	0	0	N	N	N	Y	N	Y	Y
093	0	0	N	N	N	Y	N	N	N
094	0	0	N	N	N	N	N	N	N
095	0	0	N	N	N	N	N	N	Y
096	0	0	N	N	N	Y	N	N	N
097	0	0	N	N	N	Y	N	N	N
098	0	0	N	N	N	Y	N	N	N

FARM CODE	55	56	57	58	59	60	61	62	63	64	65	66
099	N	N	Y	N	N	Y	N	N	N	N	Y	N
100	N	Y	N	N	Y	N	N	Y	Y	N	N	N
101	N	Y	N	N	Y	N	N	Y	N	N	N	N
102	N	Y	N	N	Y	N	N	Y	N	N	N	N
103	Y	N	N	N	Y	N	N	Y	N	N	N	N
104	N	Y	N	Y	N	N	N	Y	N	N	N	N
105	N	Y	N	Y	N	N	N	Y	N	Y	N	N
106	N	Y	N	Y	N	N	N	Y	N	N	N	N
107	N	Y	N	N	Y	N	N	Y	N	Y	Y	N
108	N	Y	N	N	Y	N	N	Y	Y	N	Y	N
109	N	Y	N	N	Y	N	N	Y	Y	N	N	N
110	N	Y	N	Y	N	N	N	Y	N	Y	N	N
111	N	Y	N	Y	N	N	N	Y	N	N	N	N
112	N	Y	N	Y	N	N	N	Y	N	Y	N	N
113	N	Y	N	N	Y	N	N	Y	N	N	N	N
114	N	Y	N	N	Y	N	N	N	Y	N	N	N
115	Y	N	N	N	Y	N	N	Y	N	Y	N	N
116	N	N	Y	N	N	Y	N	Y	Y	N	N	N
117	N	Y	N	Y	N	N	N	Y	Y	Y	Y	N
118	N	N	Y	N	N	Y	N	Y	Y	N	N	N
119	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
120	N	N	Y	N	N	Y	N	Y	N	Y	Y	N
121	N	N	Y	N	N	Y	N	Y	Y	N	N	N
122	N	Y	N	N	N	Y	N	N	Y	N	N	N
123	N	Y	N	N	Y	N	N	Y	Y	N	N	N

FARM CODE	67	68	69	70	71	72	73	74	75
099	0	0	N	N	N	Y	N	N	Y
100	0	0	N	N	N	Y	N	N	Y
101	1	0	N	N	N	Y	N	Y	Y
102	0	0	N	N	N	Y	N	N	Y
103	0	0	N	N	N	Y	N	N	N
104	0	0	N	N	N	Y	N	Y	Y
105	0	0	N	N	N	Y	N	Y	Y
106	0	0	N	N	N	Y	N	N	Y
107	0	0	N	N	N	Y	N	N	Y
108	0	0	N	N	N	Y	N	N	Y
109	0	0	N	N	N	N	N	N	Y
110	0	0	N	N	N	Y	N	Y	Y
111	0	0	N	N	N	Y	N	Y	Y
112	0	0	N	N	N	Y	N	Y	Y
113	0	0	N	N	N	Y	N	N	Y
114	0	0	N	N	N	Y	N	N	Y
115	0	0	N	N	N	Y	N	N	N
116	0	0	N	N	N	Y	N	N	N
117	0	0	N	N	N	N	N	Y	Y
118	0	0	N	N	N	N	N	N	N
119	0	0	N	N	N	Y	N	N	Y
120	0	0	N	N	N	N	N	N	N
121	0	0	N	N	N	N	N	N	N
122	0	0	N	N	N	Y	N	N	N
123	0	0	N	N	N	Y	N	N	Y

FARM CODE	VARIABLES 55	56	57	58	59	60	61	62	63	64	65	66
124	Y	N	N	N	Y	N	N	Y	Y	Y	N	N
125	Y	N	N	N	N	Y	N	Y	Y	Y	N	N
126	Y	N	N	N	N	Y	N	N	Y	Y	N	N
127	Y	N	N	N	N	N	Y	N	Y	Y	N	N
128	Y	N	N	N	N	Y	N	Y	Y	Y	N	N
129	Y	N	N	N	N	N	Y	Y	Y	Y	N	N
130	Y	N	N	Y	N	N	N	N	Y	Y	N	N
131	Y	N	N	N	N	Y	N	Y	Y	Y	N	N
132	Y	N	N	N	Y	N	N	N	Y	Y	N	N
133	Y	N	N	Y	N	N	N	Y	Y	Y	N	N
134	Y	N	N	Y	N	N	N	N	Y	Y	N	N
135	Y	N	N	Y	N	N	N	N	Y	Y	N	N
136	Y	N	N	N	N	Y	N	Y	Y	Y	N	N
137	Y	N	N	N	Y	N	N	Y	Y	Y	N	N
138	Y	N	N	Y	N	N	N	Y	Y	Y	N	N
139	Y	N	N	Y	N	N	N	N	Y	Y	N	N
140	Y	N	N	N	Y	N	N	N	Y	Y	N	N
141	Y	N	N	Y	N	N	N	N	Y	Y	N	N
142	Y	N	N	N	N	N	Y	N	Y	Y	N	N
143	Y	N	N	N	N	Y	N	Y	Y	Y	N	N
144	Y	N	N	Y	N	N	N	N	Y	Y	N	N
145	Y	N	N	N	N	N	Y	N	Y	Y	N	N
146	Y	N	N	N	N	Y	N	N	Y	Y	N	N
147	Y	N	N	N	Y	N	N	N	Y	Y	N	N
148	Y	N	N	N	N	Y	N	N	Y	Y	N	N
149	Y	N	N	N	N	Y	N	N	Y	Y	N	N
150	Y	N	N	N	Y	N	N	N	Y	Y	N	N
151	Y	N	N	N	N	Y	N	Y	Y	Y	N	N
152	Y	N	N	N	N	Y	N	N	Y	Y	N	N
153	Y	N	N	N	N	Y	N	Y	Y	Y	N	N
154	Y	N	N	N	N	Y	N	Y	Y	Y	N	N
155	N	N	Y	N	N	N	Y	N	Y	Y	N	N

FARM CODE	VARIABLES 67	68	69	70	71	72	73	74	75
124	0	0	N	N	N	Y	N	N	Y
125	0	0	N	N	N	N	N	N	N
126	0	0	N	N	N	Y	N	Y	Y
127	0	0	N	N	N	Y	N	N	N
128	0	0	N	N	N	N	N	N	Y
129	0	0	N	N	N	Y	N	N	N
130	0	0	N	N	N	Y	N	N	Y
131	0	0	N	N	N	Y	N	N	Y
132	0	0	N	N	N	Y	N	N	Y
133	0	0	N	N	N	Y	N	N	Y
134	0	0	N	N	N	Y	N	N	Y
135	0	0	N	N	N	Y	N	N	N
136	0	0	N	N	N	Y	N	N	N
137	0	0	N	N	N	Y	N	N	Y
138	0	0	N	N	N	Y	N	N	Y
139	0	0	N	N	N	Y	N	N	Y
140	0	0	N	N	N	Y	N	N	Y
141	0	0	N	N	N	Y	N	N	Y
142	0	0	N	N	N	N	N	N	Y
143	0	0	N	N	N	Y	N	N	N
144	0	0	N	N	N	N	N	N	Y
145	0	0	N	N	N	Y	N	N	N
146	0	0	N	N	N	N	N	N	N
147	0	0	N	N	N	Y	N	N	Y
148	0	0	N	N	N	Y	N	N	Y
149	0	0	N	N	N	N	N	N	N
150	0	0	N	N	N	Y	N	N	Y
151	0	0	N	N	N	Y	N	N	Y
152	0	0	N	N	N	Y	N	N	N
153	0	0	N	N	N	Y	N	Y	N
154	0	0	N	N	N	Y	N	Y	Y
155	0	0	N	N	N	Y	N	N	Y

Appendix 2 Questionnaire

The questionnaire was designed to provide data on the indicators of success outlined in the methodology (chapter 4) and general information necessary to obtain an understanding of the project as a whole. Briefly the main points in the questionnaire (p. 259 - 266) are:

A - Identification

A.1 - The settler (name, origin, migration, previous occupation, year of arrival at the Project, reasons for becoming settler).

A.2 - The farm (location, farm number, farm size, acquisition of the farm (S)selected by INCRA, (M) 'marcação' or invasion, (C) bought from pioneer settler).

B - Labour force (family labour force: no. of childreen , age and sex of childreen, relatives)

C - Ecological indicators

C.1 - Crops planted in the agricultural years (1978/1979/1980) and yields

C.2 - Crops which will be planted in the 1980/1981 agricultural year.

C.3 - Crops planted in previous years and their performance (C.4 & C.5).

C.6 - Land use in December 1979

C.7 - Erosion, weeds, pests and diseases

D - Economic indicators

D.1 - Domestic animals

D.2 - Agricultural machinery

D.3 - Farm buildings

E - Social indicators

E.1 - Housing (brick built, wooden built or 'tapiri' houses, size and general condition)

E.2 - Share-croppers houses (as E.1)

E.3 - Household goods and material possessions

F - Farming systems

F.1 - Farming practices adopted

F.2 - Methods of land preparation

F.3 - Use of inputs (fertilisers, lime, pesticides)

G & H Technical assistance and agricultural credit received.

I - Marketing .

In addition to the points listed above settlers were encouraged to talk about their material position before becoming settlers . The information provided by them was subjectively used to assess settlers' progress.

Data on crop yields and use of inputs (fertilisers,lime, pesticides) was not presented in the text for two main reasons:(i) low reliability as settlers do not keep systematic records and (ii) because the data was not readily comparable. Yields are known to vary with time of planting, density of plants, weeding, quality of seeds planted and other farming practices.

Settlers were asked what income they had realised in the previous 12 months but they often did not know . The author did not attempt to estimate income because of the many assumptions it involves and the lack of data to do so. It is very difficult to cost food consumed by family, exchange of goods without payment, 'odd job services' etc. In other words settlers can exist and even flourish (up to a point) without even appearing to have an 'income'.

Appendix 2 Questionnaire

"PROJETO:

ESTRATO Nº: QUEST.Nº:

A. IDENTIFICAÇÃO

A.1. PARCELEIRO

- NOME:.....
- NATURALIDADE:.....
- PROCEDÊNCIA:.....
- OCUPAÇÃO ANTERIOR:.....
- ANO DE CHEGADA AO DISTRITO FEDERAL:.....
- MOTIVOS DA VINDA PARA O DISTRITO FEDERAL:.....

.....

.....

A.2. LOTE

- SETOR:.....
- QUADRA (GLEBA):.....
- LOTE Nº:.....
- AQUISIÇÃO (S, M, C) ANO:.....
- SUPERFÍCIE:.....

B. FORÇA DE TRABALHO FAMILIAR/Nº FAMILIAR

FILHOS	NÚMERO	IDADE
.HOMENS	.....	.....
.MULHERES	.....	.....

PARENTES	NÚMERO	IDADE
.....	.....	.....
.....	.....	.....
.....	.....	.....

ASSALARIADOS PERMANENTES (AP), MEEIROS (M) / Nº

.HOMENS:.....

.MULHERES:.....

C. INDICADORES ECOLÓGICOS

1) CULTURAS CULTIVADAS NOS DOIS ÚLTIMOS ANOS AGRÍCOLAS

CULTURAS	ÁREA CULTIVADE E SISTEMA DE CULTIVO (C) (S)		PRODUÇÃO		SEMENTE	
	78/79	79/80	78/79	79/80	78/79	79/80
1.1. TRADICIONAIS						
.Arroz						
.Feijão						
.Milho						
1.2. "CASH CROPS"						
.Soja						
.Trigo						
.Café						
.Algodão						
.....						
1.3. ENERGÉTICAS						
.Cana-de-açúcar						
.Mandioca						
.Sorgo. granífero						
1.4. OLERÍCOLAS						
.Batata inglesa						
.Tomate						
.....						
.....						
.....						
.....						
.....						
.....						
TOTAL						

2) CULTURAS QUE SERÃO CULTIVADAS EM 80/81

2.1. TRADICIONAIS — ÁREA — C ou S

Arroz

Feijão

Milho

2.2. CHSH CROPS

1) .....

2) .....

3) .....

2.3. ENERGÉTICAS

1) .....

2) .....

2.4. OLERÍCOLAS

1) .....

2) .....

3) .....

4) .....

5) .....

6) .....

3. OUTRAS CULTURAS JÁ CULTIVADAS NO LOTE

. ANUAIS

1) .....

2) .....

3) .....

. PERMANENTES

1) .....

2) .....

3) .....

4. CULTURAS QUE APRESENTARAM BOA PERFORMANCE

1) .....

2) .....

3) .....

OBSERVAÇÕES

1) .....

2) .....

3) .....

5. CULTURAS QUE FRACASSARAM

1) .....

OBSERVAÇÕES

1) .....

2) .....

6. USO DA TERRA EM DEZEMBRO/79

	ÁREA	IDADE
6.1. CULTURAS PERMANENTES		
.Café		
.Citrus		
.Outras fruteiras		
6.2. CULTURAS TEMPORÁRIAS	ÁREA	
.Tradicionais		
.Cash crops		
.Energéticas		
.Olerícolas		
6.3. REFLORESTAMENTO		
6.4. PASTAGEM ARTIFICIAL		
6.5. PASTAGEM NATURAL		
6.6. MATA, CAPOEIRAS E RESTINGAS		
6.7. ÁREA CONSTRUIDA		
6.8.		
TOTAL		

7. EROSÃO

.Tipos

.Intensidade

.Sinais

8. ERVAS DANINHAS

.Tipos

.Grau de infestação

C. INDICADORES ECONÔMICOS

1. ANIMAIS DOMÉSTICOS

	MACHOS	FÊMEAS
1.1. BOVINOS		
0-1 ano		
1-2,5 anos		
> 2,5 anos		

Prod. de leite atual (litros/dia) =
max. anual (litros/dia) =
mín. anual (litros/dia) =

1.2. SUÍNOS
.Nº de matrizes =
.Nº de varões adultos =
.Leitões desmamados =
.Leitões amamentado =
."porcos na ceva" ==

1.3. AVES no total
Corte Poedeiras

1.4. OUTRAS Equinos Muares
Asininos Caprinos
Ovinos

2, IMPLEMENTOS AGRÍCOLAS

2.1. AUTO-MOTRIZES OBSERVAÇÕES
.Trator de pneu
.Colheitadeira
.Motores estacionários
.Pulverizadores
.Moto-serras

2.2. TRAÇÃO MECÂNICA
.Arado
.Grade
.Plantadeira
.Carpideira
.....
.....

2.3. TRAÇÃO ANIMAL
.Arado
.Grade
.Plantadeira
.Carpideira

3. CONSTRUÇÕES
.Curral Barração
.Armazens Paiol
.Polcigas Represas
....

D. INDICADORES SOCIAIS

1. HABITAÇÃO/SEDE

.Paredes — nº de quartos =
.Piso — nº de cômodos =
.Cobertura
.Forro

2. AGREGADOS (Nº)

.Tipo de construção
.Conservação .....
.....

3. CONFORTO/HIGIENE

.Filtro — inst.sanitária interna
.Eletricidade — rádio
.Fogão a gás — geladeira
.TV — Telefone
.Veículo utilitário — Veículo de passeio
Tipo
Ano
Conservação
Impressões gerais

E. NÍVEL TÉCNICO DA EXPLORAÇÃO

1. PREPARO DO SOLO

.Queima anual
.Aração
.gradagem

2. PRÁTICAS CONSERVACIONISTAS

.Plantio em nível
.Plantio em faixas
.Terraceamento
.Cordões de retenção (barreira viva)
.Rotação de culturas
.Plantio consorciado

3. INSUMOS

3.1. FERTILIZANTES	CULTURAS	QUANTIDADE	Recom.Técnica
a) Minerais			
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

	CULTURAS	QUANTIDADE	Recom.Técnica
b) Orgânicos			
.....	.....	.....	.....
.....	.....	.....	.....

3.2. CORRETIVOS

CULTURAS	QUANTIDADE	RECOM. TÉCNICA
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

F. ASSISTÊNCIA TÉCNICA

Orgãos	Frequência	Quantidade
1)	.....	.....
2)	.....	.....
3)	.....	.....

G. EXPERIÊNCIA COM FINANCIAMENTO

.Trabalhou com financiamento em 79/80

Agentes financiadores	Tipo de financiamento
1)	.....
2)	.....
3)	.....

OBSERVAÇÕES: (o que acha do crédito rural?)

H. COMERCIALIZAÇÃO:

1. Comercialização na propriedade

Produtos	Pub. geral	Interm.	Atacad.	Coop.
1)	.....	.....	.....	.....
2)	.....	.....	.....	.....
3)	.....	.....	.....	.....
4)	.....	.....	.....	.....

2. Comercialização pela família produtora

Produtos	Feiras livres	Mercado	Banca no CEASA
1).....	.....	.....	.....
2).....	.....	.....	.....
3).....	.....	.....	.....
4).....	.....	.....	.....

3. No centro consumidor

Produtos	Atacadistas	Intermediários	Cooperativas
1)	.....	.....	.....
2)	.....	.....	.....
3)	.....	.....	.....
4)	.....	.....	.....

4. Órgãos do Governo

Produtos	CFP
.....	
.....	
.....	
.....	

/jtmj.