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Conditions for agricultural development in Central Kalimantan, Indonesia

Leif Petersen

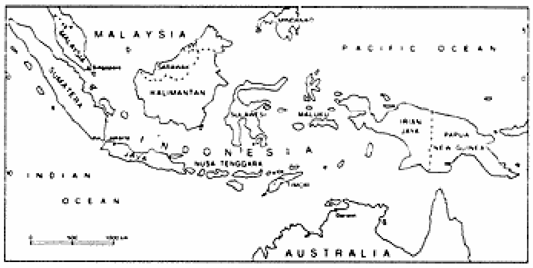

Fig. 1. Map of Indonesia. *Fig. 1. Kort over Indonesien.*

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The Indonesian province of Central Kalimantan is planned to receive a substantial number of settlers from Java. The settlers will be occupied in agriculture. In some areas the suitability of the land for agriculture is limited due to steep slopes, shallow soils, sandy soil texture or poor soil drainage. In the central parts of the province these limitations are less serious, but the soils are acid and low in most plant nutrients.

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Keywords: *Indonesia, Kalimantan, Transmigration, Ultisols, Soil Fertility.*

The population of Indonesia is extremely unevenly distributed among different regions (Table 1). In the heavily populated regions, i.e. Java and the islands nearby, there is a serious overpopulation. This leads to a number of problems such a high rate of unemployment and pressure on agricultural land. The high demand for agricultural land has forced people to cultivate land which is marginally suitable for agriculture, e.g. steep upland areas. Cultivation of such areas usually results in poor yields and often causes severe soil erosion. This is described f.ex. by Repetto (1986) for regions in West Java.

On the other hand, the thinly populated regions, in particular Irian Jaya (the Western part of New Guinea) and Kalimantan (Borneo), are characterized by a low stage of development with a weak infrastructure and few service facilities.

In ordrer to relieve the problems due to population pressure in the central region around Java and to promote development in the thinly populated islands and provinces, the Indonesian Government encourages and sponsors the moving of people from densely to thinly populated regions through the so-called transmigration program. From 1969 through 1983 a total of about 2.3 million people have moved from Java and nearby islands to Su-

	Area (1000 km²)	Population 1984 mio.	Density persons per km²	Growth (% per year)
Java	132	99	748	1.9
Sumatera	474	32	67	3.2
Kalimantan	549	7.6	14	2.9
Sulawesi	189	11	60	2.1
Irian Jaya	422	1.3	3	2.5
Indonesia	2027	162	80	2.2

Table 1. Indonesia. Area and population. (Source: Statistik Indonesia 1984.)

	(1000 persons) 1969-83	1983	1969-83 (%)
Sumatera	1357	316	58
Kalimantan	482	150	21
Sulawesi	343	76	15
Maluku	44	12	2
Irian Jaya	88	33	4
Total	2314	587	100

Table 2. Transmigration from Java and islands nearby to other regions in Indonesia. (Sources: Arndt 1983 and Statistik Indonesia 1984.)

matera, Kalimantan, Sulawesi, Irian Jaya and some smaller islands (Table 2). To the figures in Table 2 a total of about 400,000 people, moved from 1950 to 1969, should be added. Hence the total number of transmigrants until the end of 1983 is about 2.7 million. The number of transmigrants is increasing rapidly, in 1983 it was almost 0.6 million, i.e. more than 20% of the total number of transmigrants in the period 1950-1983.

In the settlement areas the transmigrants are usually occupied in agriculture. However, various development models are used. Some transmigration settlements are established in connection with an existing or newly established production unit, e.g. a rubber factory. In these settlements the transmigrants earn their living mainly from production of the commodity processed by the factory. In areas where suitable production or marketing facilities are not available the transmigration settlements are based primarily on food crop production. The main objective of these settlements is to enable the transmigrants to achieve self sufficiency in food production and to obtain a sufficient cash income by producing and marketing a surplus of food or other crop products, often from tree crops. Typically the settlements consist of villages with about 500 families. The villages are normally developed in recently cleared forest areas. Prior to the arrival of the transmigrants, houses and service facilities such as schools, medical centers etc. are established. Each transmigrant family is allocated an area for arable agriculture. In addition an uncleared area intended for future development, usually with tree crops, is allocated to each family.

The selection of the areas to be used for transmigration is based on the availability and suitability of land. Available land is that which is not required by the indigeneous population or reserved for other purposes such as forestry. Suitability is determined by natural factors such as climate, slope and soil properties. The suitability of the land in combination with the agricultural techniques adopted must facilitate a sufficiently large and stable production in a system of permanent agriculture.

One of the main obstacles to agricultural production in many transmigration areas is low soil fertility. In fact, the main reason for the huge difference in population density between Java and the nearby islands on the one hand, and the other islands (the so-called outer islands) on the other hand, is a higher soil fertility in the Java region. The soils in Java are mainly developed on young volcanic rocks with a high content of easily weatherable minerals, which will provide a constant supply of plant nutrients. In the outer islands most soils are developed on older rocks which at present are highly weathered. Hence, the supply of plant nutrients will be low in these soils.

In the following these and other constraints to permanent agriculture in the province of Central Kalimantan will be discussed. This province has up to 1983 received some 100,000 transmigrants and it is also planned to receive a substantial number of future transmigrants.

Fig. 2. Map of Kalimantan. *Fig. 2. Kort over Kalimantan.*

Area	153,800 km^2
Population	1,088,000
Population density	7 persons per km^2

Table 3. Central Kalimantan. Area and population. (Source: Statistik Indonesia 1984.)

Yearly mean temperature	25-26 ^{0}C
Monthly variation	1-2 ^{0}C
Diurnal variation	10-15 ^{0}C
Mean precipitation	2600 mm/year
Potential evapo-transpiration	1350 mm/year

Table 4. Temperature, precipitation, and potential evapotranspiration at Pangkalanbun, Central Kalimantan.

CENTRAL KALIMANTAN

Geographical Situation and Population

The location of Central Kalimantan is shown on the map in Fig. 2. Its area and population are shown i Table 3. The province covers about 28% of the land area of Kalimantan. Its population density is almost similar to that of East Kalimantan while South and West Kalimantan have densities of 60 and 18 inhabitants per km² respectively. In Indonesia only Irian Jaya has a population density lower than those of East and Central Kalimantan. It is probably justified to characterize the province as being among the least developed areas in Indonesia. The infrastructure is very weak. The total length of public roads is about 4000 km, only 10% of which are hard surface roads. The road system is interconnected only to a small extent, and the main means of communication and transportation are the rivers.

The majority of the population lives in remote villages, usually situated along the rivers. The main occupation is agriculture based on shifting cultivation. The crops grown are rice, cassava, vegetables, various fruits etc., which are to a large extent consumed by the people themselves. Small amounts of food products as well as various forest products are marketed and provide for a modest cash income.

Climate

The province extends from slightly North of Equator to about 3° 30' South. Climatic data for Pangkalanbun which is situated in the Soutwestern part of the province are given in Table 4. The temperature fluctuations over the year are small, the difference between the means of the hottest and coldest months being less than 2 °C. The diurnal variation is 10-15 °C.

Fig. 3. shows average, maximum and minimum precipitation as well as potential evapotranspiration for each month. These values are, of course, not representative for the entire province. With increasing distance from the coast there is some increase in the precipitation.

It is evident from Fig. 3. that the precipitation is subject to considerable fluctuations. For all months the differences between the highest and the lowest precipitation ever recorded are very large. This unreliability of the precipitation is very important when considering rainfed agriculture. Although the mean precipitation in all months is higher than the potential evapotranspiration there is a serious risk of drought, particularly from July through October. The precipitation mostly occurs with a high intensity, usually during thunder storms. The high precipitation intensity causes a great risk of erosion on bare, sloping land.

Geology and Geomorphology

A geological sketch map is shown in Fig. 4. The Northern part of the province consists to a large extent of hills and mountains. The dominating rocks are pretertiary igneous, metamorphic and sedimentary rocks. Towards South the land changes into a rolling to undulating plain consisting mainly of tertiary sand- and siltstone. In some areas volcanic rocks, also of tertiary age, occur.

The Southern part of the province is a level plain at a low altitude consisting of alluvial deposits of late tertiary and quaternary age. Along the coast the plain is mainly a peat swamp. The eastern part of the province has been subject to a considerable subsidence and have thick tertiary and quaternary sediments. In this area the peat swamp extends several hundred km inland. North and West of the swamp the plain consists of rather coarse sandy terrace deposits of late tertiary and quaternary age.

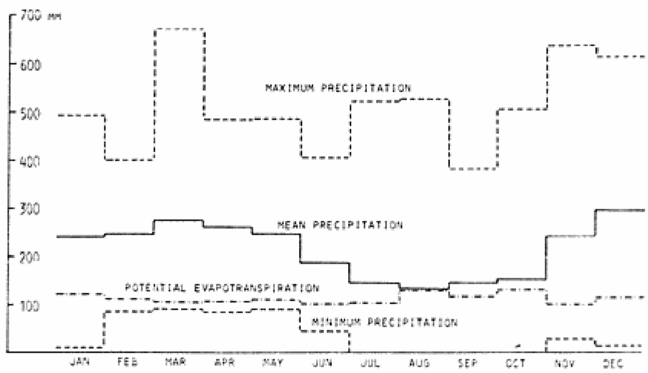

Fig. 3. Monthly precipitation and potential evapotranspiration at Pangkalanbun, Central Kalimantan. 1917-1980.

Fig. 3. Månedlig nedbør og potential evapotranspiration ved Pangkalanbun, Centralkalimantan.

Vegetation

The mountains and the hilly, rolling and undulating areas in the Northern and central parts of the province are covered with tropical rain forest. The vegetation in the Southern peat areas is swamp forest. On some of the coarse sandy terrace deposits a poor forest known locally as keranggas is found. This forest is characterized by a rather open stand of small trees and a fairly high frequency of conifers.

Soils

The swamp areas in the Southern and Southeastern parts of the province are dominated by poorly drained peat soils and slightly developed mineral soils. According to Soil Taxonomy (SMSS, 1985) the peat soils are classified as Histosols and most of the mineral soils will be Entisols (Fluvents). In coastal areas the peat and mineral materials are to a large extent deposited in brackish water and contain pyrites. If these soils are drained, the pyrites will oxidize to sulfuric acid and cause the soils to become strongly acid.

North and West of the swamp areas highly weathered and strongly leached soils dominate. The high degree of weathering and leaching is due to the fact that the soils have been exposed to a hot, humic climate during an extensive period of time. The soils are low in weatherable minerals and they have a low content of most plant nutrients. Furthermore, they are rather acid. The surface layers of these soils usually have a lower clay content than the subsurface layers. This is due to the fact, that clay has been leached from the top layers to the subsoil.

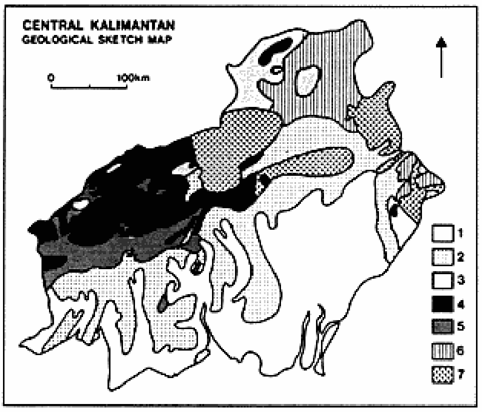

Fig. 4. Central Kalimantan. Geological sketch map.

Fig. 4. Centralkalimantan. Geologisk oversigtkort.

1. Alluvial deposits, quaternary. *1. Alluviale aflejringer, kvartære.* 2. Sedimentary rocks, tertiary. *2. Sedimentære bjergarter, tertiære.* 3. Sedimentary rocks, pretertiary. *3. Sedimentære bjergarter, prætertiære.* 4. Igneous rocks. *4. Dybbjergarter.* 5. Volcanic rocks, tertiary. *5. Vulkanske bjergarter, tertiære.* 6. Phyllitic metamorphic rocks. *6. Phyllitiske metamorphe bjergarter.* 7. Metamorphic rocks, undifferentiated. *7. Metamorphe bjergarter, udifferentierede.*

Land form:	Undulating plain.	Slope:	5 %.
Elevation:	38 m a.s.l.	Parent material:	Sandstone.
Vegetation:	Mixed dipterocarp forest.	Drainage:	Well drained.

Classification: Soil Taxonomy, Typic Paleudult (SMSS, 1985). FAO-Unesco, Orthic Acrisol (FAO-Unesco, 1974).

Horizon	Depth cm	Description
O	-2-0	Forest litter; abrupt smooth boundary.
A	0- 6	Brown to dark brown (10YR4/3); silty clay loam; moderate fine to medium granular structure; moist, friable; abrupt smooth boundary.
E	6- 25	Brownish yellow (10YR6/6); silty clay loam; moderate fine to coarse subangular blocky structure; moist, friable to firm; gradual smooth boundary.
BtE	25- 53	Yellowish brown (10YR5/8); silty clay; moderate medium to coarse subangular blocky structure; moist, firm; gradual smooth boundary.
Bt1	53-100	Strong brown (7.5YR5/6) with brownish yellow (10YR6/6) mottles; clay; moderate medium to coarse subangular blocky structure; moist, firm; thin cutans; clear wavy boundary.
Bt2	100-	Reddish yellow (7.5YR6/6) with very pale brown (10YR7/3) mottles; silty clay; moderate coarse subangular blocky structure; moist, very firm; thin cutans.

Table 5. Description of soil profile from Central Kalimantan.

The properties of the soils vary according to geology and topography. Shallow soils are found on steep slopes in the Northern mountain and hilly areas. The soils are shallow because soil material is being continuously eroded. On level and undulating plains the soils are usually deep.

Coarse textured soils are found on the sandy terrace deposits and to some extent in areas where the parent material is sandstone. On the coarsest materials the dominant soils are Spodosols according to the Soil Taxonomy classification (SMSS, 1985). In some soils the spodic horizon is found below a depth of 2 m and such soils are formally classified as Entisols.

The dominant soils of the undulating and rolling plains are deep clayey soils. Since they have been subject to clay translocation as mentioned above, they are classified as Ultisols according to Soil Taxonomy (SMSS, 1985).

A specimen Ultisol profile is described in Table 5 and analytical data are presented in Table 6. The soil has rather high contents of silt and clay, and the clay content increases with depth. The contents of organic carbon and nitrogen in the surface horizons are fairly high. From the profile description it appears that the surface horizons are friable and have granular to subangular blocky structure indicating fairly good physical properties.

The chemical properties are not very satisfactory, however. The low pH values, the low base saturation percentage and the high content of exchangeable aluminium all shows that the soil is strongly acid.

The surface horizon has a reasonably high content of some plant nutrients such as potassium and phosphorus. However, since this horizon is very thin, and since the deeper horizons have only low contents of these elements, the total amounts in the soil profile are low. The amounts of exchangeable calcium and magnesium are also substantially higher in the surface horizon than in the underlying horizons. However, even the contents found in the surface horizons must be considered to be very low.

Despite the low content of plant nutrients in the soil it supports a vigorous growth of tropical rainforest. This is possible because considerable amounts of plant nutrients are present in the vegetation. These nutrients are recycled at a high rate. Plant residues falling on the soil surface are rapidly decomposed in the hot humid environment, and the nutrients liberated by the decomposition are rapidly absorbed by plant roots. This implies that the majority of the plant nutrients are taken up from a shallow soil layer near the soil surface. This is in accordance with the higher contents of plant nutrients in this layer (Table 6) and with the fact that the root density is very high in the surface layer.

A consequence of the rapid recycling of plant nutrients is that a large fraction of the total pool of plant nutrients

Depth cm	Texture, %			pH		C	N	C/N	Total K
	Sand	Silt	Clay	H_2O	KCl	%	%		(me/100 g)
0- 6	15	55	30	3.8	3.1	9.0	0.58	16	0.4
6- 25	16	45	39	4.5	3.5	1.3	0.12	11	0.2
25- 53	19	40	41	4.6	3.6	0.7	0.07	9	0.2
53-100	19	38	43	5.0	3.8	0.3	0.04	9	0.2
100-125	9	47	44	4.9	3.7	0.2	0.04	6	0.2

Depth cm	Exchangeable cations (me/100g)					CEC (me/100g)		Base sat.	P (ppm)	
	Ca	Mg	K	Na	Al	pH7	Soil pH	%	Total	Avail.
0- 6	1.1	<0.1	0.3	0.1	6.6	23.7	8.1	7	140	36
6- 25	0.1	0.2	0.1	<0.1	4.3	7.8	4.8	6	59	4
25- 53	0.1*		<0.1	<0.1	3.6	5.4	3.9	6	43	2
53-100	0.1*		<0.1	<0.1	2.9	4.1	3.3	7	38	2
100-125	0.1*		<0.1	<0.1	2.9	4.6	3.3	7	25	

*) Ca + Mg

Table 6. Soil profile from Central Kalimantan. Analytical data.

in the ecosystem is present in the vegetation, and only a small fraction is found in the soil. The rapid uptake of plant nutrients from the soil counteracts losses of plant nutrients by leaching. Hence, the nutrient cycle in the rainforest ecosystem is an almost closed cycle with minimum losses.

Potential for Agricultural Development

The physical environment described in the preceding sections imposes a number of constraints as to agricultural use of the land. In the Northern part of the province steep slopes and shallow soils make the majority of the land unsuited for arable agriculture without expensive soil conservation measures. Some areas could be used for cultivation of tree crops. However, this requires factories for treatment of the products and marketing facilities. At present neither are available, and an almost complete lack of roads and other means of communication makes transport of large amounts of commodities virtually impossible.

In the Southern part of the province the soils are poorly drained and will require expensive artificial drainage systems if they are to be used for dryland agriculture. Certain crops such as lowland rice may be grown on poorly drained soils. Peat soils are, however, poorly suited for cultivation of rice, partly because they become very soft when flooded. Since peat soils cover large areas in the Southern and Southeastern parts of the province, the potential for rice production is limited. It is further reduced by a low soil fertility and by the presence of pyrites in some soils.

The level plains on the terraces North of the swamp areas have coarse textured soils with a low water holding capacity. These soils are not well suited for rainfed agriculture due to a high risk of crop failure during dry spells. Due to the rainfall being being rather unreliable, several consecutive days may be without rain, even in the wet season. Since the evapotranspiration is high because of a high temperature, the soil must contain a rather high amount of plant available water to avoid water stress to the crops.

The undulating to rolling plains, located between the hilly land in the North and the swamps and sandy terraces in the South and Southeast, definitely offer the highest potential for dryland rainfed agriculture. Some areas, admittedly, have slopes so steep that risk of erosion makes the land unsuitable for arable agriculture. However, considerable areas with sufficiently low slopes do occur. In these areas the dominant soils are the deep clayey Ultisols discussed above. These soils are considered to have a water holding capacity which is high enough to reduce the drought risk to an acceptable level.

However, the acidity and the low level of available plant nutrients precludes permanent cultivation without suitable appliciations of lime and fertilizers. At present, the soils are used by the local population for shifting cultivation. In this system the nutrients present in the vegetation are made available by burning the vegetation after clearing the land. The ashes produced by the burning is alkaline and reduces the soil acidity. However, the amounts of plant nutrients and alkalinity produced are sufficient for production of only 1-2 arable crops. In order to accumulate plant nutrients for another 1 or 2 crops, the land must be left for 15-20 years.

The amounts of lime and fertilizers required to keep the acidity sufficiently low and the nutrient status sufficiently high to facilitate permanent cultivation of arable crops depend on soil properties and on the plant species and cultivars to be grown.

Plants seem to be little affected directly by soil acidity, but rather by a number of factors which depend on the acidity. At high levels of acidity some plant nutrients are present in the soil in too low amounts, e.g. calcium and magnesium, while others may become fixed in forms unavailable to plants, e.g. phosphorus. On the other hand, certain elements may be present in excessesive amounts which are toxic to plants, e.g. aluminium and manganese. Aluminium, which is a common constituent of most soil minerals, becomes soluble in acid soils and a high content of soluble and exchangeable aluminium is considered to be a principal reason for poor plant growth on acid soils. Hence, a reduction of the amount of exchangeable aluminium is considered to be the main beneficial effect of liming.

The amount of aluminium that must be removed by liming depends on the total content of exchangeable aluminium in the soil and the amount that can be tolerated by the crops to be cultivated. The tolerance towards exchangeable aluminium differs among different crops and among different varieties of the individual plant species. Tolerant varieties of some crops will grow at an aluminium saturation percentage of about 40% of the cation exchange capacity (CEC) at soil pH. Hence, the aluminium saturation percentage must at least be reduced to this level to facilitate crop production. In the soil shown in Tables 5 and 6 the weighted average content of exchangeable aluminium in the top 20 cm is 5.0 meq/100 g and the weighted average CEC at soil pH in this soil layer is 5.8 meq/1000 g. To reduce the content of exchangeable aluminium to 40% of the CEC at soil pH, about 2.7 meq/100 g aluminium must be removed. According to Sanchez (1986) 1.65 t $CaCO_3$ is required per ha for every meq/100 g aluminium that must be removed. Hence, about 4.5 t $CaCO_3$ is required pr ha to reduce the content of exchangeable aluminium to a level that can be tolerated by the least sensitive crop plants. It should be mentioned that this is a rough calculation which disregards changes in CEC which will occur following the pH increase caused by the liming. The fact that the soil in question has a considerable content of organic matter, which will increase the amount of lime required, has also been disregarded. Effects of removing the present rainforest vegetation has also been neglected.

An amount of 4.5 t $CaCO_3$ per ha is not very large compared with normal liming rates, e.g. for intensively cultivated soils in Northern Europe. The reason for the moderate lime requirement is that the clay minerals in the soil in question are mainly kaolinite and iron and aluminium oxyhydroxides which have low cation exchange capacities compared with the clay minerals which are found in soils in temperate regions.

The amount of lime calculated above is necessary in order to initiate cultivation. However, during cultivation the soils will be subject to leaching and acidification which will require liming at frequent intervals. In an experiment carried out under similar climatic conditions and on a similar, but slightly coarser textured, soil in Peru, Sanchez at al. (1982) applied 3 t $CaCO_3$ every three years.

Although these amounts are not large, again compared with common liming rates in intensive agriculture in temperate regions, it is difficult and very costly to transport them to remote areas in Central Kalimantan, due to the absence of a road system. Lime is available at some locations in Kalimantan, and it may be possible to transport the lime to some areas by river transport, but it may prove cheaper to ship the lime from other islands in Indonesia. In either case the transport will involve large costs.

In addition to lime the areas will require regular input of fertilizers. The most important ones are nitrogen and phosphorus fertilizers but in the long run a number of other elements such as potassium, magnesium (if the lime used does not contain magnesium) and some micronutrients are required. Some nitrogen liberation can be expected during the initial cultivation due to decomposition of organic matter. However, this effect will be of short duration. Cultivation of legumes may provide some nitrogen input but hardly sufficient to avoid application of nitrogen fertilizers. Phosphorus fertilizers will be required in rather large amounts, not only to satisfy the requirements of the crops but also because the soils are likely to fix phosphorus in forms which are unavailable to plants. The amounts of fertilizers required depend on the crops and cropping pattern, and on the number of crops to be cultivated per year. In the season with the lowest precipitation the risk of drought is rather high. A cropping pattern with two crops, each of about 4 months, seems to be suitable.

In the settlements established for transmigrants no livestock except poultry and other small animals is provided for. Hence, animal manure will not be available in significant amounts, and the plant nutrients must, therefor, be provided mainly from commercial fertilizers.

CONCLUSIONS

From the discussion above it may be concluded that viable settlements based on rainfed dryland agriculture may be established in those parts of Central Kalimantan, where the land is sufficiently level and the soils are deep, well drained and have a sufficiently high water holding capacity. However, due to the inherent acidity and low content of plant nutrients in all soils, large and expensive inputs of lime and fertilizers are required.

The development costs probably exceed the benefits for a rather prolonged period. However, the benefits of the land development cannot be assessed only from the amount of crops produced. Since transmigration involves establishment of service facilities, including medical facilities, a road network etc., it will have a significant impact on the entire region and its indigeneous population.

Summary

The population density of Indonesia ranges from 750 persons per km^2 in Java and nearby islands to 3 persons per km^2 in Irian Jaya. Some consequences of this are a serious overpopulation in the Java region and a low stage of development in the thinly populated regions. To relieve these problems the Indonesian Government supports moving of people from the Java region to the provinces having a low population density.

The province of Central Kalimantan, which at present has a population density of about 7 persons per km^2, is planned to receive a substantial number of settlers from Java. These settlers will be occupied in agriculture. The climate is, in most seasons, suitable for agriculture, but the suitability of the land varies. In certain parts of the province the land suitability is limited by steep slopes, shallow soils, a sandy soil texture or poor soil drainage. In some areas, mainly in the central parts of the province, such constraints are not serious. However, the soils are acid and low in most plant nutrients. In order to utilize this land for agricultural production, and hence provide a basis for settlers, application to the soil of rather large amounts of lime and fertilizer are required.

Resumé

Indonesiens befolkning er ekstremt ujævnt fordelt mellem landets forskellige regioner. På Java og nærliggende øer bor over 100 millioner mennesker, og den gennemsnitlige befolkningstæthed er 750 personer pr. km^2. I Irian Jaya (den vestlige del af New Guinea) bor kun omrking 3 personer pr. km^2 og i Kalimantan (Borneo) ca. 14. Den gennemsnitlige årlige befolkningstilvækst er over 2%, hvilket medfører, at befolkningen vokser med over 3 millioner om året, heraf omkring 2 millioner på Java og nærliggende øer. Nogle af følgerne af den skæve fordeling er alvorlige overbefolkningsproblemer i de tæt befolkede egne og en lav grad af udvikling i de tyndt befolkede områder.

For at reducere befolkningspresset på Java og især for at fremme udviklingen i de tyndt befolkede provinser har landets regering igennem en årrække støttet flytning af personer fra tæt befolkede til tyndt befolkede områder. I perioden 1950-1983 er der ialt flyttet ca. 2,7 millioner mennesker fra Java til andre øer. Af disse er de fleste blevet bosat på Sumatra. Flytningen forventes at fortsætte og stige i de kommende år.

De mennesker, som bosættes i de tyndt befolkede områder, beskæftiges næsten udelukkende ved landbrug. Bosættelse finder i almindelighed sted i områder, som på nuværende tidspunkt ikke benyttes til landbrug, og hvor den naturlige vegetation ofte er tropisk regnskov. Før bosættelsen udføres undersøgelser, som danner grundlag for valg af egnede områder, og der opføres boliger, skoler, sundhedscentre og andre faciliteter.

Om et område kan anvendes til bosættelse afhænger af, om der er jord til rådighed, og om naturforholdene er så favorable, at et landbrugssystem baseret på permanent dyrkning kan etableres.

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