

Ethnicity: An Important Consideration In Indonesian Agriculture¹

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Carol J. Pierce Colfer, Barbara J. Newton, Herman

Carol J. Pierce Colfer is currently Associate Professor at Sultan Qaboos University in the Sultanate of Oman. She is an anthropologist who served first as the farming systems researcher, and later as Team Leader of the Tropsoils-Indonesia project in Sitiung, with the University of Hawaii.

Barbara Newton is Professor of Psychology at the University of Hawaii, West Oahu. She has had extensive experience with Galileo research and analysis.

Herman is a recent graduate of Andalas University in Padang, West Sumatra, who worked on the Tropsoils Project in 1984 and 1985.

ABSTRACT This paper has two purposes: To report the findings of a study of ethnic differences in cognition in a rural West Sumatran area; and to demonstrate the importance of ethnicity—in at least some contexts—for tailoring agricultural research to farmers' needs. A cognitive mapping technique, called a Galileo, was used to measure people's views of soil and its relation to people among three Indonesian ethnic groups living in the same area. Findings from participant observation and from collaborative agricultural fieldwork with farmers of all three ethnic groups are used to evaluate and interpret the Galileo results.

Introduction

In a complex, multi-ethnic country like Indonesia, are there significant inter-ethnic differences in farming systems in the same area? Does ethnicity really make a difference in the development and extension of agricultural technology? These were the questions that prompted the research reported here. These questions emerged as important as we tried to implement a farming systems approach on a soil management project (Tropsoils) in Indonesia.

The identification of "recommendation domains" is an early step in many farming systems projects. While recognizing the importance of matching a relevant population or environment to an agricultural technology, we felt some skepticism about recommendation domains. Our experience led us to anticipate significant inter-ethnic differences in people's approaches to farming (e.g., cropping preferences, sex role variation, different attitudes toward marketing of produce, different food habits, etc.), even in the same locale.

As we gained field experience, our initial concerns gained in substance. The unanimity with which ethnic differences were ignored in other farming systems projects—both in Indonesia and elsewhere—clashed ever more stridently with our experience in rural Sumatra. This article provides quantification of one aspect of ethnic differences in West Sumatra, with reference to the relevance of such differences to agricultural research. Our hope is that our findings will be sufficiently persuasive to convince agricultural scientists to attend more seriously to ethnic differences where they exist.

The Setting

Sitiung is located in the center of the island of Sumatra, on the border between West Sumatra and Jambi Provinces, a few minutes South of the Equator. Until 1976 the area was very sparsely populated by Minangkabau villages, nestled against the banks of rivers.

The Minangkabau (or, Minang), the original inhabitants, subsist by cultivating small wet rice fields (typically $< \frac{1}{4}$ ha) and larger rubber gardens (perhaps 1 ha). The rubber gardens are an intermediate phase in a long-fallow shifting cultivation system, beginning with upland rice, and culminating in forest. The Minang supplement such endeavors with fruit trees (rambutan, duku, coconut, citrus) and coffee production; chicken, goat, and water buffalo husbandry; gold panning; fishing; small scale trade; and wage labor when opportunities arise.

Beginning in 1976, the Indonesian Transmigration Program² selected the Sitiung area as a site for locating families of Javanese and Sundanese from the over-populated island of Java. By 1983 over 10,000 families had been moved to the Sitiung area (Sitiung I-VIII); and new transmigrants were still arriving in 1986.

The Javanese and Sundanese transmigrants in Sitiung are given a $\frac{1}{4}$ ha houselot by the government, usually planted to a variety of vegetables, medicinal crops, perennials, and spices. They also receive a 1 ha field, usually planted to a rice-soybean or rice-peanut rotation (or in Sitiung I, which has irrigation, to paddy rice), further from home.

Transmigrants come from a situation of extreme land scarcity and excellent soil quality on Java; and they find themselves in Sitiung where land is abundant (given their experience and their dependence on human, mainly family, labor) and of very poor quality. Geertz's (1963) classic description of agricultural differences between Java and Bali on the one hand, and the "Outer Islands" like Sumatra and Kalimantan, on the other—though controversial—is relevant for understanding the adjustments that the transmigrants must make. Davis (1974) and Fulcher (1982) provide more recent ethnographic accounts of transmigrant adaptation to "Outer Island" settings.

Sitiung's transmigrants typically supplement their harvests with small scale trading; chicken, goat, and cattle husbandry; and off-farm labor where available. The Javanese engage in supplementary home industry like making cassava chips and fermented soybean cakes; and the Sundanese make fishponds wherever water conditions permit.

Methods

Participant observation has formed a contextual backdrop for this study. Colfer lived in Piruko (the first settled transmigrant community) for three years. She worked intensively in Aur Jaya (the most recently settled community in 1983) for 6 months then, and continued less intense involvement until 1986. This work (undertaken with Mike

Wade, a soil scientist) included some of our most productive collaborative work with farmers (on-farm agricultural experimentation). Herman did 4 months of participant observation in Koto Padang, an indigenous community in 1984; and Colfer worked in another Minang community, Pulai, from November 1985 to July 1986. The findings from the Galileo method—quantifying one way in which the three ethnic groups differ importantly—are discussed and evaluated below with reference to understanding gained from participant observation.

One impetus to the decision to conduct the study reported here was the realization that qualitative explanations of inter-ethnic differences were not compelling to agricultural scientists and policymakers. Differences with important implications for farming systems in the area were observed by means of participant observation. Distrust of qualitative methods combined with official distaste for the concept of ethnicity meant that our findings met with skepticism, sometimes disbelief.

The Galileo, a multidimensional scaling technique (Woelfel and Fink, 1981), was selected as a way to demonstrate our qualitative understanding in a quantitative manner. The most important advantage of this method over many quantitative social science methods—particularly relating to conceptual or cognitive matters—is its firm grounding in indigenously defined concepts. Colfer has found the method to be reasonably consistent with her qualitative understanding deriving from participant observation (see Colfer 1982, for an example from East Kalimantan).

The data were collected in the following way: Ten farmers from each ethnic group were selected (equally divided by sex, and including a range of wealth, education and age) for tape recorded interviews. The farmers were asked in their own language "What is the relationship between soil and people?" From then on, the interviewer was trained to speak as little as possible, so that the farmer's own concept would emerge in their monologue. These minimally directed, taped interviews, ranging from about ten to forty-five minutes, were then content analyzed.

Content analysis involved the counting of each concept mentioned by the farmers.³ A survey instrument was then created for each language, compiling 21 major concepts mentioned by the 30 farmers originally interviewed (Attachment A, for glosses/translation of concepts in five languages).

Javanese, Sundanese, and, to a lesser degree, Minang are languages that include levels of speech with quite different vocabularies. In most cases we were able to use the form encountered most frequently in the taped interviews of farmers' own

English	Indonesian	Minang	Javanese	Sundanese
Soil	Tanah	Tanah	Siti	Taneuh
Garden	Kebun	Kabun	Kebun	Kebon
Unirrig Field	Ladang	Ladang	Ladang	Ladang
Wet Rice Field	Sawah	Sawah	Sawah	Sawah
Home Garden	Pekarangan	Pakarangan	Pekarangan	Pakarangan
Rubber	Karet	Karet	Karet	Karet
Fruits	Buah Buah	Buah Buah	Wohwohan	Buah Buah
Rice	Padi	Padi	Pantun	Pare
Other Fld Crp	Palawija	Palawija	Polowijo	Palawija
Vegetables	Sayur Sayuran	Sayur Sayuran	Sayur Sayuran	Sayur Sayuran
Water	Air	Aia	Toyo	Cai
Fertilizer	Pupuk	Pupuak	Pupuk	Pupuk
Pests	Hama	Musuah	Omo	Hama
Yield	Hasil	Hasil	Kasil	Hasil
Cultivation	Pengolahan	Pangolahan	Penggarapan	Garapan
Good	Baik	Elok	Sae	Sae
Enough	Cukup	Cukuik	Cekap	Cekap
I/Me	Saya	Awak	Kulo	Abdi
Male	Laki Laki	Laki Laki	Jaler	Pameget
Female	Perempuan	Padusi	Setri	Istri
Government	Pemerintah	Pamarentah	Pemerintah	Pamarentah

speech; in the few questionable cases we sought the advice of our interviewers (all native speakers). Most interviews were conducted by high school graduates in their early twenties. Our bias was to be more, rather than less, respectful of the farmers.

A certain amount of judgment was required in the selection of these concepts. Although all the concepts selected for the survey instrument were encountered at least a few times from each ethnic group, there was a marked difference between ethnic groups in the frequency with which a particular concept was mentioned.

Among the Minang, for instance, rubber and other tree crops came up consistently in their discussions of soil - people interactions; yet the content analyses of transmigrants' interviews would not have justified including tree crops in the instrument. Similarly "other field crops" (palawija), though common among transmigrants, were hardly discussed by the Minang.

We also added the concepts "male" and "female" because of our ongoing interest in understanding farmers' views of the division of agricultural labor by sex. This did not seem inappropriate, since the farmers spoke of "people" in their open-ended interviews.

Samples of 100 farmers from each ethnic group, evenly divided by sex, were then selected. Although the selection process was not truly random, an attempt was made to get broad representation (by education, income, and age). Interviews were conducted in the three languages (Minangkabau, Javanese, and Sundanese) between May and October, 1985. Minang farmers were interviewed in

Koto Padang. All the Sundanese farmers in Aur Jaya were interviewed, supplemented by a few from Sitiung IV, Block B.

The Javanese respondents were divided evenly between residents of Aur Jaya and Piruko. The data were coded and entered in Sitiung, and computer analyzed in Honolulu, by Newton.

The questionnaire is composed simply of a pairing of each concept with every other concept. The respondent is then asked to estimate the distance between these concepts, using a cognitive "measuring stick" provided by the researcher. In this case we used the cognitive distance between black and white as the measuring stick, and arbitrarily set these two concepts at 100 units apart. The exact meaning of terms is not defined or clarified by interviewers. Respondents are to make their estimates of distance based on their own internal meaning of the terms.

The goal or product is a "map" of the world view people have of a given topic (here, soil as it relates to people). The technique is called "multidimensional" because a space, rather than a plane, is being mapped.

The most fundamental output from this technique is a "means matrix". It is simply the mean distance estimated by respondents between each concept and every other one. Although each individual response is not reliable (in that people filling out the instrument a second time will undoubtedly change their responses), the averaged responses should provide a reasonable and quantified portrayal of the general view.

In the following discussion of results, congru-

ence (and lack thereof) with our qualitative understanding will be identified and discussed. Concepts in bold face refer to the Galileo instrument; the same concepts in normal type refer to our qualitative observations and interpretations.

Results

A Means Matrix, though complete, is tedious to read. It is derived by averaging the distances between each pair of concepts from all respondents (in this case, of a given ethnic group). It is read like a matrix showing distances between cities. If a number is small, it means most people felt the two concepts (like two cities) were closely related. If the number is large, people, on average, felt the concepts were more distantly related.

The means matrices (Colfer & Newton, 1988) show that the Minang tend to have far greater distances between agricultural concepts than do the transmigrants. The overall average of all distances on the means matrices are: Minang - 44; Javanese - 30; and Sundanese - 22). Some have argued for artificially reducing this difference, by some kind of overall averaging, but we have resisted. Our reasons are that the larger numbers used by the Minang appear to correspond to important aspects of their lives—one physical and one more conceptually substantive—that differentiate them from their neighbors.

The first is the relative size of their landholdings. The Sitiung area is very sparsely populated. Scholz (1983:206) reports an average of 25 people/km² in the Sumatran penneplain (where Sitiung is located). The feeling that land is abundant remains with the Minang farmers. Fields and agricultural endeavors tend to be dispersed geographically, so it is not surprising that this would be reflected in their cognitive maps.

Population densities on Java are legendary, of course. Aur Jaya's Sundanese inhabitants come from the Garut Regency. Population densities vary, since transmigrants come from different villages. Sinaga *et al.* (1977) reported a crude population density of 1,695/km² for the village of Sukagalih, in Garut. Soentoro *et al.* (1980:4) reported a 1977 population density for Gemarang village in Ngawi Province to be 604/km². The inhabitants of Piruko come from Wonogiri; and Aur Jaya's Javanese come from Ngawi and Madiun. For people who measure landholdings in are (10 m²) landholdings are unlikely to be widely dispersed geographically.

Proportions landless, perhaps a crude predictor of a constricted view of land availability, vary between the Javanese and Sundanese, consistent with the Galileo results. In an Aur Jaya survey (in 1983),⁴ Colfer found 69% of the Sundanese to have been

landless, contrasted to only 31% of the Javanese. Sinaga *et al.* reported 29% landless in Sukagalih, West Java (1977:4); and KEPAS found no landless in Sumberagung, East Java (1985:59). Collier (1980:37) reported a number of studies, showing landless rates in West Java (ranging between 10 and 67%); in Central Java (11 to 89%); and in East Java (45 to 82%).

The second matter relates to the integration of the respective farming systems. Geertz's book, *Agricultural Involvement* (1963), has generated heated debate (e.g., Collier, 1980; Muiizenberg, 1975; Lyons, 1970). Yet his descriptions of the inward turning nature, the interconnections and integratedness of the Javanese approach to agriculture strike a responsive chord—particularly in contrast to Outer Island approaches.

The farming system of Sitiung's transmigrants is indeed integrated: The houselot, for instance, may have a plot of grass growing on it, on which cows and goats feed. The animals live in a stable nearby, and their dung is used for manure on a food crop which is grown for home consumption. Each component feeds into another.

Minang agriculture, on the other hand, is scattered, with a water buffalo feeding on a communal plot a couple of km. from the village. A wet rice field is 5 km. away. The village moved a few years back, so what used to be the houselot, with its tree crops, is ¼ of a km. from home; and the new houselot may be used principally for crop drying until the new tree crops bear. Because of such considerations, we have not altered the original data.

The Galileo provides information on the values and probable behavior of the different ethnic groups; and these will be discussed first, below. Soil, fertilizer, and cultivation were selected as particularly interesting concepts to examine, by ethnic group, given our interest in soil management. The last data we examine pertain to perceptions of sex roles as they vary by ethnic group.

Statistical tests of significance have been done on inter-ethnic differences.⁵ However, one of the difficulties of the Galileo is that the more the data are perused, the more statistical tests one wants to do. At some point, results must be presented. In many of the following cases, it is illuminating to note the intra-ethnic pattern, to better evaluate a given distance. The distance between two concepts may be insignificant *between* ethnic groups (e.g. Table III, soil-rice), but remain of interest because of the intra-ethnic pattern.

In this Minang example, rice is the closest concept to soil, and 18 units away from soil's most distant crop, fruits. For the Sundanese, soil is probably the same distance from rice as from three or

four other crops (definitely including **fruit**), statistically speaking. Such information is important in decisionmaking for agricultural experimentation, and useful hints can be gleaned by maintaining this dual comparison: inter-ethnic and intra-ethnic patterning.

In some cases, our qualitative understanding does not coincide with the Galileo results. In such cases, we try to alert the reader to the discrepancy. In other cases we undertook this investigation specifically to increase our deficient knowledge of a sphere; we try to indicate when our commentary is largely conjecture.

Six tables have been developed, by extracting concept pairs of particular interest from the means matrices. Table I deals with values. Saying something is "good" is simply an adjectival way of saying that we value it. A quick idea of the values Sitiung's inhabitants express related to agriculture can be gained by looking at Table 1, where the distance between good and selected concepts (kinds of fields, crops, and management issues) is displayed. In general, the smaller the number (or cognitive distance) in this table, the more farmers value a given concept.

Values

Transmigrants express far greater interest in agriculture than do Minang, and this is readily apparent, from the respective Galileo distances. Transmigrants enjoy their access to land in Sitiung relative to Java. In a study of aspirations of Minang students in Koto Padang, on the other hand, not

Table 1. A Measure of Values, Relating to Selected Soil Management Concepts Sitiung, West Sumatera 1985

NOTE: The smaller the number, the more highly valued the concept.

If there is a letter before the number, there is a significant difference between ethnic groups. In the Minang column, the distance between "good" and "soil" (60) is significantly greater than that perceived by Javanese (j) and by Sundanese (s).

Good and	Minang(m)	Javanese(j)	Sundanese(s)
Soil	js 60	m 31	m 23
Garden	js 60	m 27	m 19
Unirrigated Field	js 59	m 27	m 25
Wet Rice Field	js 58	m 30	m 23
Home Garden	js 56	m 28	m 20
Rubber	js 64	ms 41	mj 26
Fruits	js 56	m 29	m 20
Rice	js 55	m 25	m 24
Other Field Crop	js 62	ms 30	mj 19
Vegetables	js 62	m 24	m 23
Water	js 46	m 25	m 24
Fertilizer	s 34	s 28	mj 16
Pests	js 68	ms 52	mj 26
Yield	js 61	m 26	m 27
Cultivation	js 66	m 23	m 24

one respondent wanted to be a farmer (Elfina, 1985). The Minang express a preference for commerce, and profess to be "lazy farmers."

Our sense that the transmigrants are more similar to each other than to the Minang is also borne out by these data. Whereas all the concepts showed statistically significant differences between the Minang and the transmigrants, only four (**rubber, other (non-rice) field crop, fertilizer and pests**) of these 15 concepts showed statistically significant differences between the Javanese and Sundanese.

The Minang's low valuation of **rubber** is consistent with their overall low valuation of all things agricultural. However, the apparent dislike of the Javanese for **rubber**, vis-a-vis other crops, is more noteworthy. **Rubber** has taken on local cultural meaning as an ethnic symbol of the Minangkabau (much as cassava is a symbol of poverty for many Indonesians). This may adversely affect the crop's popularity among the Javanese, but one wonders why there isn't similar antipathy from the Sundanese. Whatever the causes, the introduction of **rubber**—a most suitable crop in the Sitiung area—among these Javanese would appear to require some extra effort.⁶

Transmigrants seem to view all five categories of crops in a fairly neutral and minimally differentiated manner (with the exception of Javanese views on **rubber**), in contrast to the Minang who view them all quite negatively.

Other field crops (palawija) are being encouraged by the Indonesian government, with considerable success among Sitiung's transmigrants. Although both Javanese and Sundanese plant such crops (e.g., cassava, soybeans, peanuts) fairly regularly, the Sundanese appear to value such crops significantly more than the other two ethnic groups.

It is noteworthy that for the soil management concepts, **cultivation** shows the greatest variation between transmigrants and indigenous people. This is consistent with observations in the field. Transmigrants see hoeing all major crops as a critical element in being a good farmer, even a good person (since an avid hoer is automatically a hard worker—also valued). The Minang only hoe paddy rice normally, substituting a herd of stomping water buffalo even for that land preparation whenever possible. A dibble stick is always used for upland rice (Colfer *et al.*, 1988).

Behavior

Table II presents similar data on the distances between me (i.e., the respondent farmer) and selected other concepts. Previous research using this method has shown that such distances tend to be highly correlated with behavior (Jones & Young,

1972; Steffle, 1972; Woelfel and Fink, 1981). For example, Green and Carmone (1972) found that products closest to the self show higher sales figures, and much of current commercial market research is based on this assumption.

Looking at the Minang responses, the large distances between **good** and the agricultural concepts in Table I have been replaced in Table II (**me** and agricultural concepts) by distances in the same range as the transmigrants' responses, reflecting their shared status as farmers.

That **rubber** is close to the Minang **me** is not surprising, given their economic reliance on the crop. Although the Sundanese **me-rubber** distance is not significantly different from the Minang distance, it is worth noting that **rubber** is the most distant from Sundanese **me** (though probably not significantly so) of all the crops. The Javanese distance between **me** and **rubber** is significantly greater than the other groups'—reinforcing our previous conclusion that rubber might not be the crop for the Javanese.

It might be worth pointing out here, though, that Javanese attitudes toward authority make many unlikely changes possible if the proper channels can be activated. Indeed, in many areas—including a neighboring Transmigration project in Jambi, Rimbo Bujang—the government has established Nucleus Estates (NES) based on rubber, for Javanese transmigrants, with some success.

One other possible interpretation should be offered. **Rubber** was not a concept that occurred very frequently in the Javanese open-ended interviews. It was used in the instrument because of its important role in Minang interviews. It is possible that

the Javanese interpreted the term to refer to the product of rubber trees; Rubber bands, gaskets, even bubble gum, as well as rubber and rubber trees, are referred to as **karet** in these Indonesian languages. That **rubber** occurred in the interview schedule, next to four other clearly identifiable crops makes this unlikely to have been a widespread interpretation, however.

The closeness of **rice** and **rubber** to Minang **me** suggest that a receptive audience might exist should experimentation focus on such crops. The widespread cultivation of rice and rubber among the Minang at this time reinforces this conclusion. **Rice** is also perceived as quite close to the Sundanese **me**, a finding supported by more qualitative findings. When Sundanese transmigrants feared they could not grow sufficient rice for daily use (and might have to eat cassava), they began returning to Java.

The Javanese, on the other hand, accepted this possibility with comparative equanimity. Javanese willingness to plant soybeans (and other field crops) in 1985 during the usual rice-growing season was a surprise to us, but that behavioral pattern is consistent with the cognitive distances reflected in Table II.

Looking at the soil management concepts, only **yield** and **pests** show significant differences by ethnicity. The Minang consider **yield** to be significantly further from **me** than do the transmigrants. Agricultural yields may be differentially evaluated by transmigrants vis-a-vis Minang because of their life experiences. The Minang may be comparing their agricultural yield (similar, in actuality, to transmigrant yields for crops they all cultivate) to their other sources of income; whereas the transmigrants may well be comparing their yields in Sitiung to their means of livelihood in Java. The different interpretation of similar yields could reflect the comparative importance of agricultural yields to a transmigrant vis-a-vis a Minang (Fahmuddin Agus, pers. comm. 1986).

Another interpretation is that Minang **yields** are far from **me** because of a perceived lack of personal control over the outcome of agricultural endeavour. The Minang strategy is low input agriculture in what is a quite high risk environment for annual food crops (unpredictable onset of rains, insects, viruses, pigs and rats, floods and short-term "droughts", high aluminum toxicity, low soil fertility, etc.). The more exclusive involvement in agriculture and the higher family labor input of the transmigrants (per ha) may give them a (perhaps false) sense of control.

Pests, reasonably enough, is the most distant soil management concepts from **me** in all the ethnic

Table 2. A Measure of Behaviour, Relating to Selected Soil Management Concepts, Sitiung, West Sumatra 1985

NOTE: The smaller the number, the closer the concepts. If there is a letter before the number, there is a significant difference between ethnic groups. In the Javanese column, the distance between "me" and "rubber" (53) is significantly greater than that perceived by the Minang (m) and the Sundanese (s).

Me and	Minang(m)	Javanese(j)	Sundanese(s)
Soil	16	24	14
Garden	27	23	19
Unirrigated Field	20	24	23
Wet Rice Field	16	24	25
Home Garden	20	19	20
Rubber	j 26	ms 53	j 30
Fruits	32	21	21
Rice	11	22	15
Other Field Crop	31	23	21
Vegetables	29	18	24
Water	29	22	17
Fertilizer	29	30	22
Pests	s 54	s 54	mj 29
Yield	js 53	m 24	m 23
Cultivation	28	21	24

groups. The closeness of **peste** to the Sundanese **me**, significantly different from the other two ethnic groups, remains a puzzle. The relationship between **peste** and the Sundanese farming system may well be worth investigating further. Certainly the Sundanese were more involved in experimenting with high-risk, high profit crops like chilies (subject to bacterial wilt, as well as fertility-related problems) in anticipation of greater cash income. Their market orientation including some high risk food crops may have required their dealing with pests more than the other ethnic groups (the Javanese express more of a low risk, subsistence orientation; and the Minang use tree crops—less affected by pests locally—for cash income).

Soil Management Concepts

Good and **me** are key concepts in most Galileo's, given their relationship to values and behavior. But there is a wealth of additional information available in the means matrices about people's views of relationships between other concepts. We have selected three topics of direct relevance in soil management to examine in detail, by means of example.

Soil

Soil and its distance from kinds of fields, crops, and related management practices, is presented in Table III. The word translated as "soil" (**tanah**), in all three languages used, also means land. All three ethnic groups report distances between **soil** and various kinds of fields as low, given their respective overall average distances.

The small distance estimates of the Minang between **soil** and various kinds of fields are interesting

Table 3. A Measure of Soil's Relationship to Field Types, Crops and Soil Management Concepts. Sitiung, West Sumatra 1985

NOTE: The smaller the number, the closer the concepts. If there is a letter before the number, there is a significant difference between ethnic groups. In the Javanese column, the distance between "soil" and "rubber" (58) is significantly greater than that perceived by the Minang (m) and the Sundanese (s).

Soil and	Minang(m)	Javanese(j)	Sundanese(s)
Garden	11	22	9
Unirrigated Field	j 8	ms 22	j 12
Wet Rice Field	j 7	ms 29	j 13
Home Garden	13	24	14
Rubber	j 17	ms 58	j 23
Fruits	28	28	20
Rice	10	19	18
Other Field Crop	19	18	22
Vegetables	19	23	12
Water	js 26	m 20	m 12
Fertilizer	js 38	m 24	m 16
Pests	s 72	s 69	mj 24
Yield	js 49	m 26	m 22
Cultivation	34	23	21

in themselves, given their typically greater distances. Although the soil - kind of field distances are not significantly smaller for the Minang than for the Sundanese, a comparison with other Minang distances is striking. This may derive from the greater extent and variety of Minang landholdings, each requiring different management strategies and characterized by different soil qualities—thus linking soil quality closely with kind of field. The complex indigenous knowledge system of the Minang related to soil is described in Colfer *et al.* (1988) and Colfer and Gill (1989).

Having habitually lived in a situation of low population densities, the Minang have not had to deal with significant land scarcity. Their land use strategy has thus been to select, comparatively freely, plots of land with characteristics that fit with the particular crop they would like to plant. Such factors as topography, stage of forest regrowth, and water availability, enter into land use decisions, as much as questions of land ownership and use rights. The soil parameters recognized by the Minang tend to be linked with kinds of fields; and this is reflected in the unusually close distances they report between **soil** and different kinds of fields.

The greater range of distances that the Minang express for **soil** and the various crops reflects their views of the appropriateness of different soils to different plants. Good soil seems to be reserved, by and large, for rice, among the Minang; whereas no significant amounts of vegetables or other field crops are grown.

The comparative closeness of **rubber** vis-a-vis **fruits** (which we would have predicted to be of comparable distance) may be related to the greater role of rubber as a traditional land ownership/use marker. Minang land ownership and use are extremely complex and flexible. Almost no one owns certificates of land ownership recognized by the Government.

There is a significant difference between the distances perceived by Javanese, on the one hand, and Minang and Sundanese on the other, between **soil** and both **unirrigated fields** and **wet rice fields**. This may be related to the greater importance (compared to the Javanese) of rice in both the Minang and Sundanese systems. Both unirrigated fields and wet rice fields are the main potential sources of rice for all three ethnic groups. But the greater commitment to rice as the subsistence base (qualitatively determined) among the Minang and Sundanese (see Table II, **me - rice**, though statistically not significant) suggest that soil quality in these two kinds of fields may be more carefully monitored than among the Javanese for whom cassava (grown anywhere) provides an acceptable—if undesira-

ble—alternative. This interpretation is supported in the Galileo data by the soil - rice distance reported by the Minang; but not for the Sundanese, for whom **vegetables** are closest to **soil**.

The strategy for ensuring (comparatively) good soil in rice fields differs by ethnic group. The Minang peruse their environment and select land/soil they consider suitable; the Sundanese, constrained to their 1-¼ ha, rely on soil management (in the soil science tradition of manipulating water, fertilizer, cultivation, spacing, etc.) to make the crop-soil mesh.

Among crops, soil and **rubber** is the only concept pair showing a significant inter-ethnic difference, with the Javanese perceiving **rubber** to be quite distant from **soil**, relative to the Minang and Sundanese. This reinforces earlier evidence that using rubber in a soil management experiment with the Javanese might not be the best choice; but that it might be very appropriate among the Minang. Although the Sundanese would be more responsive than the Javanese, the close relationship the Sundanese report between **soil** and **vegetables** might make that a better bet.

This Galileo distance is consistent with a general interest in vegetables among Sundanese. Experience with cooperator farmers in Aur Jaya gives substance to this view. In our collaborative experiments of 1983-84 (see Colfer *et al.*, 1984), there was a difference of opinion among cooperator farmers about which crop should be planted after rice. The Javanese uniformly wanted to plant peanuts or soybeans; the Sundanese expressed a preference of chilies (used in a manner comparable to vegetables in much of Indonesia, as well as offering a possibility of high profits).

The soil management concepts vary more significantly among the ethnic groups, and reflect the differentiation discussed earlier between the Minang strategy and that of the transmigrants. Where the Minang, with a comparatively large land base, look for land suitable to the crop they'd like to plant, the transmigrants attempt to alter their limited land base to guarantee subsistence and produce cash income. The Sundanese and Javanese perceive a significantly closer relationship between **soil** and **water** than do the Minang. Similarly, fertilizer and yields are seen as more closely connected to **soil** among the transmigrants than among the Minang. **Soil** and **pests** are seen as close by the Sundanese, providing another of the few cases where the Minang and Javanese concur in a significant difference from the Sundanese.

This suggests that collaborative experiments on soil-water, soil-fertilizer, and soil-yields relationships, might best be undertaken with the

transmigrants rather than with the Minang. A study of soil and pests might be best done with the Sundanese, since the concepts are already perceived as comparatively close.

Indeed, virtually all of Tropsoils' collaborative experimental work with farmers to date has been with transmigrants.⁷ However, the congruence of transmigrant strategies with the usual approach of soil scientists is another important factor in this choice. World population increases provide continual pressure toward the intensive management solution, and we were responsive to this pressure.

However, the ecological advantages of tying cropping patterns to land suitability, by integrating tree crops with a marketable product into combined subsistence-cash farming systems (not to mention the risk-reducing, labor-reducing, and income-producing advantages of tree crops), strikes us as a currently neglected, high potential opportunity—and one that should benefit the indigenous farmers, the transmigrants, and the environment. Sustainability, as well as productivity, remains an important concern for agricultural development.

Fertilizer

Fertilizer is one of the easiest soil management practices to modify, and one that is consistently a part of soils research. The following discussion refers to Table IV, in which distances between fertilizer and various agricultural concepts have been extracted. The Minang make much clearer differentiations between fertilizer and the different kinds of fields, and the different crops than do the transmigrants. In the four kinds of fields, there is a 40 unit spread in perceived distance from fertilizer for the Minang, in contrast to a maximum spread of 6 for the Javanese and 13 for the Sundanese. This would seem to reflect the greater variation in the soil/land the Minang cultivate (and correspondingly different fertilizer needs), perhaps partly due to simple physical dispersion of Minang holdings, relative to any individual transmigrant.

Fertilizer is viewed as significantly closer to **garden**⁸ and **home garden** by the transmigrants, vis-a-vis the Minang. **Garden**, or **kebun**, is, in local parlance, an unirrigated field of tree crops; **home garden** (**pekarangan**) is the houselot. Minang, to our knowledge, *never* use fertilizer on either of these two kinds of fields, restricting it, if used at all, to wet rice fields. Transmigrants, on the other hand, typically used disproportionate amounts of their government fertilizer allotment on their home gardens (in Aur Jaya, because their other field was not ready for agricultural use when they arrived).

Gaining a livelihood from extremely small land-holdings, dictated by the transmigrants' earlier re-

Table 4. A Measure of Perceptions of Fertilizer as Related to Field Types, Crops and Soil Management Concepts Sitiung, West Sumatra 1985

NOTE: The smaller the number, the closer the concept. If there is a letter before the number, there is a significant difference between ethnic groups. In the Javanese column, the distance between "fertilizer" and "garden" (16) is significantly smaller than that perceived by Minang (m).

Fertilizer and	Minang(m)	Javanese(j)	Sundanese(s)
Garden	js 43	m 16	m 21
Unirrigated Field	35	19	29
Wet Rice Field	28	21	16
Home Garden	js 68	m 29	16
Rubber	35	46	28
Fruits	js 42	m 23	m 24
Rice	24	19	m 16
Other Field Crop	36	22	22
Vegetables	29	22	17
Water	js 47	m 27	m 25
Pests	js 62	m 24	m 24
Yield	js 63	m 28	m 22
Cultivation	29	18	24

sidence on overcrowded Java, makes the importance of fertilizer in their views of agriculture reasonable. Though access to fertilizers is difficult for them, transmigrants value it highly, buying it if they can using manure if they have animals, even borrowing money for it (Fahmuddin *et al.* 1987).

Minang recognize that it increases yields, but rarely buy it and never use manure. Cattle-owning Javanese, with their ready source of cattle manure, regularly use manure. Transmigrants have also been more routinely exposed to agricultural extension efforts aimed at increasing fertilizer use than have farmers on the Outer Islands in remote areas like Sitiung.

Rubber is the crop perceived as most distant from fertilizer by the transmigrants, and virtually tied for most distant by the Minang. The only significant interethnic difference in views of fertilizer - crop distances is the fertilizer - fruit connection. Transmigrants, who view fruit as closer to fertilizer, grow their fruit trees on their home gardens (partially because of a Transmigration Program directive, abandoned in 1985—prohibiting tree crops except in the home gardens) which, again, provide a regular source of animal manure. Extension efforts for transmigrants have also included both information and inorganic fertilizers for fruit trees.

The Minang, on the other hand, neither use animal manure nor have ready access to it for their home gardens, because they keep most of their water buffalo in a communal grazing area a kilometer or so from the village. The dung is burned nightly in the pens as an anti-mosquito measure. Minang have separate fruit gardens, devoted specifically to rambutan, duku, or citrus, though they usually

have a few coconut and rambutan trees in their home gardens. Bought fertilizer is very unlikely to be used for fruit trees (see fertilizer - fruit distance compared to other crops in Minang column; also Naim and Herman, 1985).

Turning to fertilizer's relationship to other soil management concepts, fertilizer's relationship to water, pests, and yield is significantly closer for the transmigrants than for the Minang. We have observed what appears to be a greater congruity between transmigrants' views of agriculture and soil scientists', in that both lean toward more intensive soil management than do the Minang. High labor inputs are expected by the transmigrants and other kinds of inputs like fertilizer and pesticides are highly valued by them, in exchange for higher yields on small plots of land.

The Minang depend less on high, per ha yields, focusing more on low labor input crops and management strategies, with the expectation that they will subsist on their agricultural endeavors (only selling rice in situations of extreme duress) and supplement their income by non-agricultural means. As noted earlier, they, in effect, suffer from no land shortage.

This distance reported by the Minang between fertilizer and yield may be distressing to agricultural scientists, as an indication of a major need for reeducation. However, after three years' research in the Sitiung area, it became clear that the relationship between fertilizer use and increased yields is not always direct and clear. We have experimental results showing green manure to be as, or more, effective than inorganic fertilizer in some cases (Gill *et al.*, 1986; Heryadi and Wade, 1985; Makarim and Cassell, 1985), and weather, pests, and marketing problems can nullify the added value from fertilizer. Perhaps the Minang view is based on experience rather than misperception.

Lack of funds among all ethnic groups to buy agricultural inputs has led us to examine the Minang strategy for possible hints in improving usable agricultural technologies for environments like Sitiung. Certainly the Minang emphasis on tree crops is consistent with scientific consensus about appropriate crops for rolling lands like Sitiung.

Investigation of the Minang system, being so different in its strategy from conventional (soil) scientific approaches, can provide an exciting stimulus for new research that is more appropriate for Outer Island conditions. Tree-food crop intercropping, use of tree crops for erosion control, use of organic matter as a soil amendment, and orchards in the forest (e.g., shade-requiring coffee or mature rubber) are all possibilities that appear to "fit" with local conditions.

Cultivation

We were particularly interested in the perceived relationship of **cultivation** to other agricultural concepts (Table V), because, in our collaborative work with farmers in Aur Jaya (1/5, or 5, of whom were resettled Minang—see note 7) we observed strong Minang reticence to cultivate upland fields with a hoe (in contrast to transmigrants).

Although our interest in this term derived from the above observation, unfortunately the term for cultivation (**pengolahan**) is a general term that includes other forms of land preparation, as well. So these data provide only a rough measure of notions about hoeing *per se*. Minang consider **cultivation** (in the sense of land preparation) to be significantly farther from **garden** (the tree crop fields) than do the transmigrants. It is reasonable that the Minang would consider their gardens to require little cultivation, since land preparation (the digging of holes for seedlings) occurs when the field is freshly cleared of forest and dibble-planted to rice (and, importantly, when the field is still considered an unirrigated field, or **ladang**, by the Minang). Once the rice is harvested, very little care of any kind is provided until the trees begin to bear.

Transmigrants, on the other hand, own already cleared fields of one ha, part of which they can now—after removal in 1985 of the government prohibition—use for such gardens. Transmigrants normally prepare their land for planting by hoeing it (those who have the resources plow). They also normally plant annual food crops on most of their land. The transmigrant differentiation between **gardens** and **unirrigated fields** then is less distinct than for the Minang who differentiate fields both

temporally (in the sense of stage of the swidden system) and geographically. The lack of significant differentiation between **cultivation** and the annual crops, **other field crop** and **vegetables**, is not surprising, since the difference between the groups is in likelihood of planting, not in cultivation once the decision to plant has been made. **Rice** is a mixed bag, since the Minang always hoe wet rice and never hoe unirrigated rice. None of these crops showed any significant distance differences from **cultivation** between the groups.

The significantly closer relationship between **cultivation/land preparation** and **rubber** is another of the few cases where the Sundanese and Minang show significantly different views from the Javanese (who see almost everything as distant from rubber). The Javanese perception that **rubber** gardens involve no land preparation is consistent with a view of land preparation as principally involving hoeing. It is also consistent with Javanese views of the Minang (and indeed, Minang self-perceptions) as "lazy farmers." Bearing rubber trees in Minang rubber gardens look utterly uncared for, since only the little cups attached to the rubber trees differentiate them from natural forest to the casual trespasser (see Barlow and Muharminto, 1982, for a fuller description of a similar system).

Yet the actual labor involved in preparing holes for the 100-400 rubber seedlings typically planted on a field is considerable. Naim and Herman (1985) estimate 4-6 months including land clearing (which serves a dual purpose since rice is planted first) and digging of holes. Why the Sundanese, and not the Javanese, should recognize the land preparation required for rubber is unclear to us. It is possible that, in the Sundanese interest in experimenting with cash crops, they have investigated this crop in greater detail than have the Javanese; or they may have had experience with rubber cultivation in Java.

Cultivation and **fruits** reverts to the more usual pairing, with the transmigrants seeing these as closer than the Minang. The Minang system of fruit planting in the home garden is extremely haphazard. The pit of a duku or rambutan falls to the ground and takes root. This observation is supported by Naim and Herman's (1985) data as well. Minang descriptions of their laissez-faire attitude toward fruits is consistent with the Galileo data showing considerable distance between **fruit** and **cultivation/land preparation**.

For the Sundanese and the Javanese it is unlikely that they make any significant differentiation between the **cultivation-fruit** pair and **cultivation-other crops**. The ease with which fruits are grown in the area would make them good candidates

Table 5. A Measure of Perceptions of Cultivation as Related to Field Types, Crops and Soil Management Concepts Sitiung, West Sumatra 1985

NOTE: The smaller the number, the closer the concepts. If there is a letter before the number, there is a significant difference between ethnic groups. In the Sundanese column, the distance between "cultivation" and "garden" (13) is significantly smaller than that perceived by the Minang (m).

Cultivation and	Minang(m)	Javanese(j)	Sundanese(s)
Garden	js 34	m 21	m 13
Unirrigated Field	24	20	22
Wet Rice Field	26	22	18
Home Garden	32	21	19
Rubber	j 26	ms 44	j 24
Fruits	js 49	m 27	m 18
Rice	24	22	22
Other Field Crop	27	21	16
Vegetables	27	20	19
Water	js 52	m 23	m 25
Pests	js 46	m 25	m 24
Yield	js 59	m 28	m 26

for agricultural promotion if marketing problems could be solved. All ethnic groups grow some fruit trees on their home gardens; a minority of Minang have additional gardens of fruit trees.

Some of the most interesting crop trees are the stinkbean and the jackfruit. Both grow easily and form significant parts of the "vegetable" diets of all ethnic groups. Coffee is also quite popular among all ethnic groups (Evensen, 1986; Colfer *et al.*, 1988).

Cultivation, like fertilizer, is viewed by transmigrants as significantly closer to water, pests, and yields, than among the Minang. Again the intensive strategy of the transmigrants contrasts with the extensive, low management techniques of the Minang.

Women, Men and Agriculture

Most striking about Tables VI and VII is the similarity between the sexes perceived by respondents, as regards agricultural matters. There is a sexual division of labor by task, by crop, and by field, varying to some extent by ethnic group (Martha, 1985, 1986). Yet the observed involvement of both sexes in agriculture is confirmed by the Galileo results.

The differences between the sexes will be highlighted in the following discussion to provide hints on how to enhance collaboration with farmers of both sexes. The Indonesian government has identified greater equity between the sexes as a national priority (see e.g., Sjahrir, 1985:16-17); and the participation (labor and decisionmaking) of both sexes in agriculture has been shown in numerous studies (e.g., in English, Collier, 1980; Hardjono, 1985;

Table 6. A Measure of Perceptions of Women and Soil Management Concepts, Sitiung, West Sumatra 1985

NOTE: The smaller the number, the closer the concepts. If there is a letter before the number, there is a significant difference between ethnic groups. In the Sundanese column, the distance between "women" and "fertilizer" (32) is significantly less than that perceived by the Javanese (j) and the Minang (m).

Women and	Minang(m)	Javanese(j)	Sundanese(s)
Garden	30	21	20
Unirrigated Field	21	24	25
Wet Rice Field	19	22	17
Home Garden	17	20	16
Rubber	38	52	34
Fruits	26	24	24
Rice	14	20	18
Other Field Crop	26	21	23
Vegetables	20	19	17
Water	js 48	m 24	m 21
Fertilizer	js 76	ms 63	mj 32
Pests	s 46	s 56	mj 30
Yield	js 46	m 26	m 24
Cultivation	30	19	20

Table 7. A Measure of Perceptions of Men and Soil Management Concepts, Sitiung, West Sumatra 1985

NOTE: The smaller the number, the closer the concepts. If there is a letter before the number, there is a significant difference between ethnic groups. In the Minang column, the distance between "men" and "rubber" (14) is significantly greater than that perceived by the Javanese (j) and the Sundanese (s).

Men and	Minang(m)	Javanese(j)	Sundanese(s)
Garden	14	22	19
Unirrigated Field	17	22	26
Wet Rice Field	13	23	26
Home Garden	26	24	22
Rubber	js 14	ms 50	mj 32
Fruits	29	24	23
Rice	j 10	m 24	16
Other Field Crop	33	24	23
Vegetables	s 34	js 28	mj 16
Water	s 52	s 56	mj 21
Fertilizer	js 47	m 27	m 25
Pests	s 50	s 55	mj 28
Yield	js 44	m 26	m 25
Cultivation	23	16	18

Hart, 1978; Oey, 1985; Stoler, 1978; White, 1976, 1984; among many others).

Types of fields

No significant difference, along ethnic lines, emerges from either sex in relation to the various kinds of fields. This lack of significance is particularly interesting, in light of the differing traditions relating to land ownership between the transmigrants and the Minang. The Minang inherit matrilineally, with matrilineal clans being corporate, landholding bodies that distribute land use rights to individual clan members/households.

In contrast, transmigrant nuclear families (both traditionally and consistent with Transmigration regulations) own their land, and children of both sexes inherit equally (ideally). These cultural ideals/patterns are not clear in the Galileo results.

The Minang closeness of all kinds of fields to both men and women—compared to their overall average distance (44)—is interesting when compared to the transmigrants' distances, which are closer to their average distances (Javanese—30 and Sundanese—22). This seems reasonable in light of their respective lengths of residence. Half of the Javanese had been in Sitiung for ten years; all the Sundanese had arrived 2-3 years previously.

The intra-ethnic difference between women and garden on the one hand, and women and home garden on the other, is likely to be significant for the Minang. Similarly the Minang men-home garden distance appears to be significantly greater than the men-garden distance. This is consistent with our expectations. Minang men are typically

the rubber-tappers, working in the rubber gardens; and Minang women get much of their personal cash income from home garden production (Colfer *et al.*, 1988).

In all ethnic groups, we predicted that women would be viewed as closer to home gardens than to other fields (see Colfer *et al.*, 1985; Colfer and Yost, 1987:160); this does not appear to be borne out for the transmigrants.

Kinds of Crops

In no case were there significant inter-ethnic differences in the distances between women and the various kinds of crops. However, in all three ethnic groups rubber represents the farthest crop from women. The Sundanese preference for vegetables again comes out, as does the Minang sense of closeness to rice.

Views of what crops "fit" with men are more diverse, perhaps reflecting Martha's (1985, 1986) findings that, compared to other agricultural decisionmaking, men were dominant in crop selection (among Javanese in Sitiung I and Minang in Koto Padang). The distance between men and rubber is significantly different for each ethnic group vis-à-vis every other (with the Minang men closest to rubber and the Javanese men furthest from it).

Minang men are seen as significantly closer to rice than are Javanese men, though neither is significantly different from the Sundanese. This is not surprising, given the close association of rice with subsistence and survival among the Minang; and the unacceptability of any substitute for rice as a staple among the Sundanese.

Sundanese men are seen as significantly closer to vegetables than are men of the other ethnic groups. This Sundanese commitment to vegetables fits with national stereotypes and expressed self-perceptions of the Sundanese. The Sundanese women-vegetable distance is almost the same as the Sundanese men-vegetable distance.

Soil Management Concepts

Ethnic difference becomes most apparent when management is seen in relation to people. In all ethnic groups, the soil management concepts appear to be more distant from people than the kinds of fields or the kinds of crops.

Given that hoeing is described in all ethnic groups as being men's work (despite the regular sight of women hoeing in the fields), we would have anticipated a more marked difference in the men-cultivation vs. women-cultivation distances.

Water and yield are marked by the most typical

difference, with the Minang women being far from these concepts, relative to the transmigrants women.

Women and fertilizer are significantly different distances for each ethnic group (with Sundanese women the closest to fertilizer and Minang women the furthest); and all three distances from fertilizer look significantly greater for women than for men. This is consistent with a generally expressed view in the area that fertilizer (like pesticides and fencing, among the Javanese) is the domain of men (Martha, 1985; 1986).

One reason for this general distancing of women from fertilizer may be that fertilizers require more money than women typically have. It may be related to the male bias evident throughout the extension service (the prime proponent of fertilizer use). Men's dominance in land preparation, and the frequent necessity of applying fertilizer at that point in the production cycle, may also be a factor.

The surprisingly close relationship between pests and agriculture that appears to exist among the Sundanese emerges again in these tables. Sundanese women and men are significantly closer to pests than are Minang or Javanese women and men.

Minang men are viewed as significantly greater distances from fertilizer and yield than are transmigrant men. All three ethnic groups view their own men and women as similar distances from yield. Transmigrant men and women are seen as about equally close to yield, and significantly different from Minang men and women as related to yield (cf. p. 77ff).

In the water-men link the Sundanese show significantly smaller distances than the Minang and Javanese. The Javanese and Sundanese place women about the same distance from water as Sundanese men (close), in sharp contrast to the Minang view of water and women. Sundanese are used to paddy rice cultivation, and widespread use of fish-ponds.

They come, in some senses, from the wettest part of the island of Java. Henderson *et al.* (1970) report slightly higher average annual rainfall in Jogjakarta (geographically part of the Central Java: 2001mm) than in Bandung, West Java (1947mm). But KEPAS concludes that ". . . eastern Java (roughly the provinces of Central and East Java plus Yogyakarta) has a much more pronounced dry season (of five to eight months) than West Java. ." (1985:16).

Transmigrants' accounts of their farming experience closely resemble the following contrasting accounts of West vs East and Central Java. Sinaga *et al.* write of Sukagalih, Garut Regency, West Java:

The predominant land-use type is *sawah* (terraced wet-paddy fields) which occupy 84% of the total village area, most of which can be double-cropped in paddy. . . . Small percentages of the remaining land are devoted to dry fields, clay-pits for brickmaking, home-gardens, and fishponds. (1977:3)

KEPAS, writing about Sumberagung, in the upland limestone areas of eastern Java, says,

Most of Sumberagung is rainfed agricultural land [ca 74%] . . . Rainfed *sawah* [ca 6%] is found along the rivers and is double cropped with rice or with rice followed by *palawija* (other field crops) . . . (1985:51)

Given this divergence, the greater Sundanese sense of closeness to water is not surprising.

The distance reported between Javanese men and water, particularly vis-a-vis the Javanese women-water link, is a surprise. In Sitiung, the irrigation water that is supplied to perhaps ¼ of our Javanese sample for rice cultivation, is controlled by the government. Since the Javanese transmigrants were landless or very small landholders in Java, it is improbable that many were involved in the indigenous, locally (and male) managed irrigation works that exist in Java.

The only reasonable interpretation that presents itself is that water, at least in connection with women, was interpreted by the Javanese to include household water, which is usually more a women's responsibility. Even irrigation of the houselot by hand is extremely rare in Sitiung, despite regular water stress in plants.

The similarities in the male-female relationships to agriculture suggest that collaborative research and extension should be about equally addressed to both. The Tropsoils project has documented women's involvement in agriculture in a variety of ways (by 3 time allocation studies, 3 studies of family decisionmaking, and by observation). We worked to involve women in three collaborative projects, one of which was conducted on the home gardens, on the theory that home gardens would be more available and important to women. Yet meaningful involvement of women in field experiments continued to elude us. The Galileo results again reinforce the importance of a more equitable balance in the distribution of agricultural knowledge and in gaining access to female farmers' views.

Discussion

The results of the Galileo study generally confirm our other findings on the importance of ethnic

difference in agriculture. The similarity of the Javanese and Sundanese views, in relation to the Minang, reinforces the common differentiation between Java-Bali and the Outer Islands.

The most general difference that this study has highlighted relates to the strategy or approach of the indigenous population as compared to the transmigrants'. The comparative abundance of land has allowed the local Minang (like other Outer Islanders) to develop an agricultural system that matches crop requirements to land and soil characteristics (albeit imperfectly). The infertile and rolling uplands are used for only one or two years for food crops. When rice is planted, or shortly thereafter, the field is also planted to a tree crop, usually rubber. Very quickly scrub brush develops, and gradually the land returns to forest. This preserves the thin topsoil and renews organic matter in the soil, at the same time as the tree crop provides income to the people. The advantages of a long fallow are maintained as well as a source of income over the years.

Low swampy areas are sought out for paddy rice. Areas near streams are gradually modified so water can be controlled in and out of the fields.

The comparatively fertile, low areas along the Batang Hari (a large river, running the length of the Sitiung area) are available for demanding crops (like chilies). On higher ground, homes and houselots border the Batang Hari as well.

This Minang strategy is markedly different from both transmigrants' and from soil scientists'. For both scientists and transmigrants, land ownership is a given; people must work with the land they own. The Indonesian Government, soil scientists and transmigrants have tended to assume (for logical and benevolent reasons) that rice, soybeans, peanuts, and corn were the most appropriate crops to use in agricultural experimentation.

The land abundance that has marked the Minang system in the past is unlikely to continue. However, components of their system can be profitably incorporated into the transmigrants' emerging new farming system(s), just as aspects of the transmigrants' intensive management strategy could benefit the Minang farming system.

In the Sitiung context, Minang experience with rubber could be tapped to enhance the systems being developed by (and for) the transmigrants—or at least the Sundanese. More intensive management practices, so well known by the transmigrants, could help increase Minang rubber yields. The knowledge of Javanese transmigrants about small scale, post-harvest processing (tofu, fermented soybean cakes, cassava chips) could be of particular use to Sundanese during the transmi-

grants' first anxious years. Similarly, Sundanese knowledge of vegetable production and fish culture could enhance the nutritional status of Sitiung residents.

The Indonesian Government has been nervous about any reference to the existence of ethnic groups, because of nationalistic concerns. At one point, this was probably necessary. However, we maintain that, now, the disadvantages of continuing to ignore ethnic differences outweigh the advantages.

The differences in ethnic groups represent a huge storehouse of agricultural knowledge, based on cultural factors as well as experience with the different environments that characterize Indonesia. This knowledge and experience, if recognized as different and of value, can make a huge contribution to Indonesia's agricultural research and development efforts.

Currently, inter-ethnic interaction in transmigration areas is not renowned for its cordiality. An explicit effort to recognize and draw on the different strengths represented by ethnic difference, could be set in a conceptual framework of national unity (consistent with Indonesia's national slogan, "Unity in Diversity"). Young people are in schools together, learning that they are citizens of Indonesia at the same time that their home environment stresses their ethnic identity as Minang or Javanese or Sundanese.

Whether or not an explicit attempt is made to build on the talents and potential contribution of the different ethnic groups, recognition of their differing agricultural systems, knowledge, practices, preferences, and beliefs is critical if new agricultural technology is to be adopted by rural Indonesians (see Colfer *et al.*, 1984 for a specific example of this ethnically appropriate vs. inappropriate agricultural technology).

Ethnic differences are as real and as powerful in Indonesian farming systems as are the environmental and economic differences that have formed the basis for establishing "recommendation domains." It is our experience that agricultural research and development can proceed more smoothly (and more humanely) with increased recognition by scientists and policymakers of the importance of such differences.

Notes

1. The research reported in this paper was conducted in Sitiung, West Sumatra, under the auspices of the Tropsoils-Indonesia project, as part of the Soil Management Collaborative Research Support Program, funded by USAID. The Indonesian component of this large program is a collaborative effort between the Centre for Soil Research in Bogor, Indonesia, the University of Hawaii and North Carolina State University.

sity. Tropsoils-Indonesia began in 1982, and is still underway. Research was conducted using a farming system approach to soil management. We gratefully acknowledge the help and support of Dr. M. Sudjadi (CSR), Dr. Putu Gedjer (CSR), Dr. Goro Uehara (UH), Dr. Gordon Tsuji (UH), Dr. Charlie McCants (NCSU), and the USAID Mission in Jakarta, as well as our co-workers on the Tropsoils team and the people of Sitiung.

2. Transmigration is a program to move people from over-populated Java and Bali to the sparsely populated Outer Islands of Indonesia. It was originally conceived as an answer to over-population; but in more recent years has been justified as a means of "developing" the Outer Islands and stimulating their growth. Transmigrants are normally recruited from among the landless and very poor. In unusual cases, whole areas are moved, *en masse*, because of a government project or a natural disaster. The residents of Sitiung I and II were displaced from their land by the construction of a dam in Wonogiri, Central Java.
3. The content analyses were carried out by Veronica Kasmini (Centre for Soil Research—Javanese), Endang Hidayat (CSR—Sundanese), and Herman (Minangkabau). Time constraints precluded translation of the interviews into the other languages. The data were subsequently entered into the computer by Khairul Munir (Tropsoils) and Veronica Kasmini.
4. The survey was designed to get an initial demographic and economic profile of the village; to evaluate how representative Tropsoils' "cooperator farmers" were; and to assess attitudes toward transmigration. Respondents included 40 farmers in Aur Jaya. Twenty were "cooperator farmers" conducting collaborative agricultural trials with Tropsoils (selected by village leaders from each ethnic group, and consisting of 5 Minang, 8 East Javanese, and 6 Sundanese). The remaining 20 were selected randomly, stratified by ethnic group. Interviews were conducted by Colfer in the transmigrants' homes between November 1983 and January 1984, using Bahasa Indonesia.
5. Statistical analyses of selected concept pairs were completed by Dr. Paul R. Brandon. He first did a multivariate analysis of variance (MANOVA) looking for overall differences between the ethnic groups, with the mean differences between concept pairs as the dependent variables. He then did univariate analysis of variance (ANOVAs, significant at .0001), looking at the differences between groups on each of the dependent variables. Where the ANOVA was significant he did Scheffe's *post-hoc* test (.05), to ascertain which groups showed statistically significant differences from each other.
6. Incorporation of tree crops into transmigrant cropping systems has been the topic of considerable debate, focusing particularly on the issues of food self-sufficiency and dependence on varying world market prices. The unusually infertile soils of places like Sitiung make the production of field crops expensive; and the environment makes such production risky. Our view is that systems promoted by the Transmigration Program should include both a cash and a subsistence component. The diversity of cropping that exists in all of Sitiung's farming systems provides a buffer that should be encouraged by official policy. Meaningful incorporation of some tree crops (including cash crops like rubber) into the existing mixed economy makes sense in the Sitiung environment (see Colfer *et al.*, 1988, for a description of an indigenous mixed economy of this type).
7. This has been due, partly, to pressure from the Indonesian Government, which views the plight of transmigrants as an important national priority. See Babcock, 1983 for a brief discussion of the issue of neglect of indigenous populations; or Colchester (1986a; 1986b) for a scathing condemnation of Indonesian governmental policy with regard to indigenous "tribal" peoples. In Sitiung, by 1983, a government policy required a 10% quota of "tran lokal" (ideally, indigenous landless or poor farmers who could join the transmigrants, being provided housing, land, and the first-year subsidy of food and other necessities). Aur Jaya had 20% Minang during 1983, its first year of settlement, but only two or three Minang families remained by 1985.

8. The gloss, garden for Indonesian "kebun" is not entirely satisfactory, though it is the usual translation. "Kebun" in the Sitiung area usually refers to a field of trees (for which "orchard" would seem the best translation). However, there are also "kebun cabe", or fields of chili. We left the concept as "garden" in this paper because we did a Galileo in English, with soil scientists, which we may want to compare with these results at some point.

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