Kenyah Forest Use in East Kalimantan: Responses to El Niño, Transmigration and HTI [1]

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(with the people of Long Segar)

Abstract

This paper recounts the results of a household survey done in Long Segar, East Kalimantan, in June 1997 (See Figure 1), covering the period from 1991-1997. This survey is a follow-up of a survey of land use, conducted first in 1980 (1962-1980) and again in 1991 (1981-1991). The initial purpose of the 1997 survey was to assess changes in land use since the development of industrial timber plantations near Long Segar. During the study period, there were two El Nino events.

The results show fewer significant changes from previous conditions than expected. Cutting of old growth forest for ricefields has diminished precipitously from previous levels. Old secondary forest is now the dominant forest type used for swiddens. Yields have fallen from an average of 1.2 tons/ha to one ton/ha. Individual field size has increased while household land/forest use remains almost the same. Use of low-lying areas has increased relative to previous patterns, probably a response to recent, recurrent drought conditions. Long Segar households had four consecutive years of bad yields, with drought being a major problem. This is unprecedented during the previous studies. Recourse to wage labour has increased considerably, in response to agricultural failures. Standard of living appears not to have fallen disastrously. Ownership of chainsaws and outboard motors has increased somewhat. Women's traditionally dominant role in rice production seems to be holding its own (contrary to previous predictions), with slightly more agriculturally active men per household, but a greater impact of women's input on rice production.

We conclude that the Long Segar community is coping, by creative use of opportunities when its rice crops fail. But we wonder if the dramatic reductions in natural forest cover precipitated by other parties in the area (transmigration, logging, industrial timber plantations) may be having an impact on Long Segar's micro-climate, with potentially long term and disastrous effects. This year is predicted to be the "Mother of all El Niño's".

[1] This study was undertaken as part of CIFOR's (Center for International Forestry Research) effort to monitor changes occurring in East Kalimantan, one of our focal areas.
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Introduction - History and Rationale

In trying to understand the dynamics of what has been happening in the world's tropical rain forests, it is instructive to look at how events unfold over time in one such location. The village of Long Segar (Figure 1) is an instructive example because we have the results of two land use history studies covering the period from first settlement in 1962 to 1991 (Colfer with Dudley 1993)---a period of quite dramatic changes in the landscape.[3]

We were prompted to conduct a third land use survey in June 1997. We feared significant negative impacts of the Indonesian policy to encourage industrial timber plantation (HTI) development during recent years on local people's well being. In March 1995, we visited Long Segar, arriving for a harvest festival at which there was very little rejoicing. The people complained of four straight years of drought. In none of the previous results had there been more than two drought years in succession. Meanwhile significant landscape level changes had occurred.

Repeating this survey provided an opportunity to compare land and forest use, yields, and coping strategies now with those before the introduction of HTIs in the area. We also wanted to corroborate (or refute) the notion that there were four years of drought, as a potential indicator of micro climatic change. The years, 1991-92 and 1994-95, were considered El Niño years, as well as 1997-98 (http://www.cdc.noaa.gov/ENSO/enso.different.htm).[4] We analyze the land use history data statistically and supplement these analyses with our longitudinal and ethnographic perspectives. We hope, in this way, to examine some of the connections among local people's well being, land clearing for HTIs and transmigration, and drought in the area.

To place these events in perspective, we give a short history of Long Segar, focusing on the issues most pertinent to forest and land use decisions and options. The first settlers came to Long Segar in 1962 from remote, Long Ampung (near the Malaysian border with Sarawak). They selected the area, they said, because of the abundance of old growth, pigs and ironwood (*Eusideroxylon zwageri*), the nice view from the river, and increased access to the outside world (notably markets, education, medicine, technological devices, and consumer goods).

Since that time many changes have occurred. In 1972, the people suffered a severe El Nino-related drought, followed the next year by an equally traumatic

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[3] Unless otherwise indicated, information reported from the previous studies will have been taken from this book.

[4] Brookfield *et al.* (1995) consider the whole period from 1991-95 a prolonged El Niño event. If this is indeed the case---that these years are marked by global peculiarities---our data do not substantiate our fears about the effects of *local* land clearing on East Kalimantan's micro-climates.

infestation of rats. During the same period, they were decreed a "Resettlement Village" by the Indonesian government, thus giving them access to a variety of governmental gifts (construction materials, agricultural inputs and advice, a school, a medic, some volunteers, etc.)---and government instructions (reduce land use to three ha per family; construct individual family residences rather than longhouses; plant home gardens following a standardized pattern; etc.). Meanwhile the area was declared a timber concession, managed by the American logging company, Georgia Pacific. The 1970s brought the introduction and widespread adoption of the chainsaw and the outboard motor in the community. The population had grown by 1980, to 1,000 people.

In 1983, they survived the great burn of some three million hectares in East Kalimantan (including their lands). Rice yields were slightly better in 1983 than 1972, suggesting a possibly less severe drought. Yet the impacts of fire were dramatically more significant. Brookfield *et al.* (1995) give an overview of studies showing that logged areas were more likely to burn than unlogged areas. The general reduction in forest humidity may have been an important factor. Following the 1983 fires, Long Segar experienced a human exodus, with half of the community moving away. A government plan to move 6,000 transmigrant families (with 2.25 ha each) to Muara Wahau, an area just North of Long Segar, was implemented. Some of Long Segar's inhabitants went there. Some went to Tanah Merah, a village two hours up the Mahakam River from Samarinda. Some went to a village that has become a suburb of Samarinda, Karang Mumus. Georgia Pacific abandoned its concession, and P. T. Kiani Lestari, one of Bob Hasan's companies, took over.

Meanwhile by 1990, a government plan had been hatched to send additional transmigrants to the Kiani Lestari concession to provide labour for planned industrial timber plantations (HTIs). HTI development had become a major government initiative. Four villages of 300 transmigrant families each (around 6000 people) were settled in the Kiani Lestari concession in the early 1990s. Each family was given ¼ ha for a houselot, ¼ ha for vegetable garden and rights to tap one ha of rubber (but no rights to land or trees), in recognition of their status as agricultural workers rather than independent farmers.

P. T. Kiani Hutan Lestari was granted permission to plant 53,000 ha of HTI (virtually all in logged natural forest), and had planted 23,000 ha by March 1995 (Colfer *et al.* 1997). P. T. Sumalindo planted about 300,000 ha of HTI in the early 1990s, just south of the Kiani Lestari concession.

To summarize, between 1962 and 1997 in the Long Segar area, vast areas of old growth tropical rain forest were logged, and then cleared for settlement or converted to plantations. Large numbers of transmigrants have come to the area, increasing the population dramatically. Opportunities for wage labour increased, as did ecological threats (e.g., to biodiversity, forest health, wildlife,

stream quality, soil fertility). Local people's security of access to resources and voice in forest management---two issues deemed vital for sustainability (Prabhu *et al.* 1996; 1997; Colfer *et al.* 1996a,b; 1997a,b)---decreased significantly over this period.

Methods

In the previous land use surveys in this community, all households were surveyed by Colfer and collaborator, Tamen Uyang. The June 1997 survey was conducted over a period of four days. Five Long Segar men were hired and trained as interviewers for the survey. The community was divided into five geographic areas, and the interviewers were instructed to interview every household with representatives in the community at that time (a *de facto* census). Long Segar has 215 household heads registered (though many households contain more than one official "household head"). In our 1991 survey (100%), we interviewed 98 families with ricefields. In this recent survey we interviewed 63 families with ricefields. We cannot be sure of the exact percentage of Long Segar's *de jure* households interviewed, but it was probably at least 60%. Most interviews were conducted in the Kenyah language, and the interview schedule was in Kenyah.

Results

We have divided our discussion of results, based on two kinds of analysis. The first deals with the *ricefield* as the unit of analysis, examining the forest from which ricefields are cut, the topography of the land, the size of the field, the distance from the village, and the yield per ha. The second approach takes the *household* as the unit of analysis, and looks at total land per household, number of people within the household, division of labour by gender, perceptions of sufficiency of yields, and strategies available to household members when rice crops fail. In each case, our current results are compared with the results from the previous studies, in the hope of shining some light on the changes that are underway.

Ricefields

Our analysis of the changes in Long Segar land use from a biophysical perspective has focused on type of forest from which ricefields were cut, topography, size of ricefields, distance to ricefields, and yields per ha.

Forest Type

The abundance of old growth forest in and around Long Segar was one of the factors motivating people to move there in 1962. During the first 28 years of occupancy, the people cut, on average, 73% of their ricefields from old growth forest. That percentage declined fairly steadily, over the years, with the 1990 percentage falling to 66%.

As can be seen in Table 1, the decline in this percentage has been precipitous since the 1991 survey, reaching its nadir in 1996-97 with only 3.1% of the fields cut from old growth forest (Figure 2). This is the same percentage of old growth reported to be cut for ricefields in Long Ampung (1985-1990), the homeland of Long Segar people and a long established community. This may signal the change from a "pioneer community" to a "stable community."

Interestingly, from the perspective of maintaining yields, the switch in dominance from old growth to old secondary is unlikely to adversely affect rice yields or maintenance of good forest cover. Our previous analyses showed the best rice yields in fact coming from old secondary forest (a conclusion supported by Soedjito 1985, 1990; Riswan 1982). The stated preference for old growth among Long Segar inhabitants was partially related to people's interest in establishing recognized claims to land. Their previous homeland, in the center of Borneo (Long Ampung), had very little old growth left, and also had a pattern of rainfall that made burning old growth more difficult (cf. Dove 1980) than in the Long Segar context.

Another pattern worth noting is the jump in old growth clearing during the previous El Nino years (1991-92 and 1994-95). This is probably related to the generally greater difficulty of burning old growth (because of its wetness) and consequent opportunism on the part of local people to burn it when droughts make success more likely.

Table 1. Number and Percentage of Fields by Type of Forest - Long Segar

Year	Type of Forest							
	New Fallow		Young Secondary		Old Secondary		Old Growth	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1991-92	**0**	**0.0**	**2**	**3.6**	**38**	**69.1**	**15**	**27.3**
1992-93	2	3.2	8	12.7	42	66.7	11	17.5
1993-94	1	1.5	10	15.2	48	72.7	7	10.6
1994-95	**0**	**0.0**	**9**	**13.6**	**47**	**71.2**	**10**	**15.2**
1995-96	0	0.0	7	10.1	52	75.4	10	14.5
1996-97	1	1.6	10	15.6	51	79.7	2	3.1
Overall	*4*	*1.0*	*46*	*12.0*	*278*	*72.6*	*55*	*14.4*

El Nino years are entered in bold face in all tables.

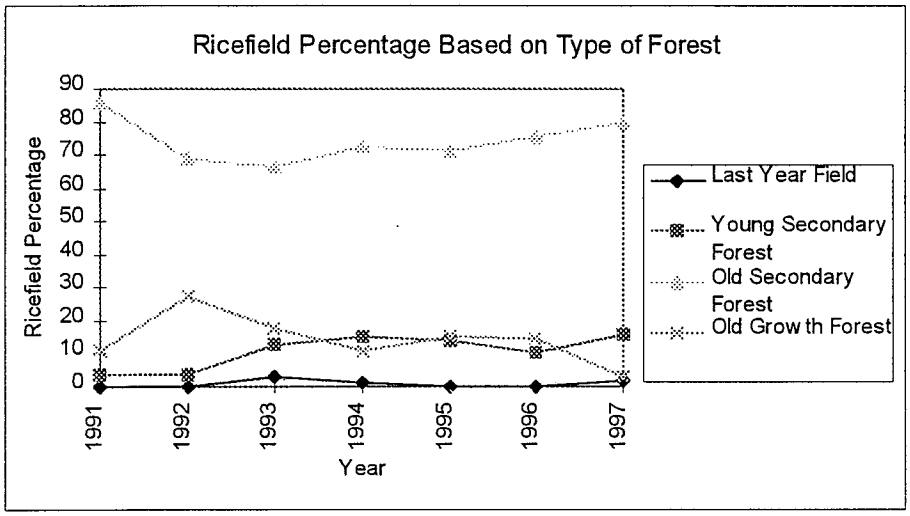

Figure 2. Ricefield Percentage Based on Type of Forest (1991 - 1997)

Yields from each forest type were compared. Oddly, the best yields (1.36 ton/ ha) occurred on the four new fallows. This sample is too small, however, to draw believable conclusions. Young secondary, again contrary to expectation, was the second best producer at 1.23 ton/ha. The old secondary gives only 1.06 ton/Ha. The worst producer, now as in the previous study, was old growth (0.96 ton/ha). None of these differences among forest types was significant (ANOVA $P>0.05$). The oddly higher average yields in young secondary forest appear to be because the fields made from other forest types were more likely to be disastrously hit by floods, drought, or pests. There were yields of 0 kg/ha in 7% of the fields cut from old secondary, 8% from old growth and 25% from new fallows). Only 2% of fields cut from young secondary forests had 0 yields. There has been a slight trend during this period for the percentage of fields cut from young secondary forest to increase, while those from old growth tended to decrease.

Conventional wisdom among the Kenyah is that use of new fallows or young secondary forest for rice fields is typically restricted to widows or other woman-headed households that do not have the manpower needed to cut larger trees. We found 25% of fields cut from new fallows and 6.5% from young secondary forests were cut by single women (households with no agriculturally active man). These are indeed higher than the percentages of fields cut by single women from older forest types: 2.5 % from old secondary and 1.8 % from old growth were cut by a single woman.

We were also interested in the significance of owning a chainsaw for the type of forest cut. There was some evidence that people with a chainsaw tended to cut more *old growth* forest (Chi Square, $P<0.005$). This is reasonable, since old growth is considerably more difficult to cut than the other forest types. In 1990,

31% of the fields were cut by people who owned a chainsaw in Long Segar. In 1997, the corresponding figure was 45.5%.

Topography

During most of Long Segar's history, hilly areas (**mudung**) have been the predominant choice for rice fields. The average percentage of fields made in lowlands (**leka'**) over the 28 years of the previous study was 18%, hilly areas 70%, and mixed topography 12%. Whereas in the 1970's and 80's the "topographical choice" shifted away from an early preference for riverbanks and flat areas because of people's experiences with flooding, this trend seems to have reversed now—probably because of the regularity of drought in the years of this study. The average percentage of fields in the low-lying areas over these 6 years has been 33.6% (see Table 2).

The previous studies showed mean rice yields from each topographical type to differ significantly. Yields were the lowest in the lowland (883 kg/ha---due to many 0 yields due to flooding), second in the hilly areas (1,000 kg/ha) and best in mixed topography (1,133 kg/ha).

In this more recent data set, mixed topography again gave the best yields per ha (1,178 Kg/ha), hilly topography the second (1,056 Kg/Ha) and flat topography the worst (988 Kg/ha)---again due to recurrent flooding. This difference is not statistically significant (ANOVA, $P > 0.05$)---probably due to the smaller number of cases.

Table 2. Number and Percentage of Fields According to Topography (1991 - 1997)

Year	Type of Topography		
	Hilly	Flat	Mixed
1991-92	**17 (30.4 %)**	**20 (35.7 %)**	**19 (33.9 %)**
1992-93	22 (33.3 %)	26 (39.4 %)	18 (27.3 %)
1993-94	20 (29.9 %)	26 (38.8 %)	21 (31.3 %)
1994-95	**22 (34.4 %)**	**19 (29.7 %)**	**23 (35.9 %)**
1995-96	21 (30.4 %)	25 (36.2 %)	23 (33.3 %)
1996-97	24 (36.9 %)	14 (21.5 %)	27 (41.5 %)
Overall	***126 (32.6 %)***	***130 (33.6 %)***	***131 (33.9 %)***

Ricefield Size

Between 1962 and 1990, the average field size in Long Segar was 2.35 ha, showing no discernible trend. During the 1991-97 period, the average size was 2.52 ha (see Table 3). Again, there was no statistically significant trend in

changes in ricefield size by year (ANOVA, P>0.05). However, this figure is close to that found in the Kenyah community at the Muara Wahau Transmigration area from 1988 - 1990, when they had abandoned their unproductive, government-allocated plots and returned to swidden cultivation: 2.62 ha.

The jump in field size, during the El Niño years (1991-92 and 1994-95) is noticeable. This is because the people monitor the weather very closely when they are preparing for a burn. If the weather is dry in August, they typically maximize the size of their fields, insofar as possible (given labour constraints and land availability in the selected area). There is a careful weighing of risk. A good burn can result in an increase in both area and field fertility, and thereby with luck, increased yield. A bad drought makes a large field attractive, as a means of increasing the likelihood of *some* return.

Table 3. Number of Ricefields and Average Ricefield Size (1991 - 1997)

Year	Number of Ricefield	Average Ricefield Size (Ha)
1991-92	**57**	**2.75**
1992-93	66	2.46
1993-94	69	2.19
1994-95	**67**	**2.64**
1995-96	71	2.58
1996-97	66	2.50
Overall	***66***	**2.52**

The are significant differences in ricefield size among forest types (ANOVA, P < 0.001). Ricefields from old growth forest are the largest and new fallows, the smallest. Probably, a significant male labour constraint accounts for this difference in field size, since cutting old growth requires the maximum amount of male labour during the clearing period. 75% of fields from new fallow and young secondary forest were cut by families with a small number of agriculturally active workers (< 3) with no, or one, agriculturally active man. On the other hand, only 54.9% of fields from old secondary and 44.5 % of fields from old growth were cut by a family satisfying that condition.

Ricefield size differs significantly among topography types as well, with fields in hilly areas tending to be smaller than the others.

Distance to Ricefield

Between 1962 and 1990, the distance to ricefields increased quite consistently every year, beginning at 0 and ending close to 7 km. The average

distance over the recent years was 3.49 km.[5] This also reflects the reduction in population during the 1980s, with abandoned land typically available for other community members to use. Land initially cleared in the 1960s would be considered ready to clear again for rice cultivation in the 1980s.

Between 1991 and 1997, there was no discernible trend in distance to fields (Table 4), reflecting the fact that Long Segar ricefields had reached the borders of the neighbouring communities or the maximum practical distance for people to travel from their community. The fact that separate Long Segar sub-communities have been established at Kilo Enam (on the Pantun River) and along the Kernyanyan River suggests that people feel they have reached a limit of practical distance from the mother-village. This interpretation is strengthened by the fact that even though the percentage of people *owning* an outboard motor has increased, the distance to ricefields remains constant. There remains a statistically significant tendency (ANOVA) for people who own outboard motors to make their fields further away (average of 7.93 km) than people who do not have outboard motors (average 5.67 km).

Table 4. Average Distance to Ricefield during 1991 - 1997 Periods

Year	Average Distance to Ricefield (Km)
1991-92	**7.97**
1992-93	6.12
1993-94	7.30
1994-95	**8.36**
1995-96	7.84
1996-97	7.17
Overall	***7.47***

Yields per Hectare

The precarious nature of rice cultivation in the Long Segar environment was abundantly clear from the previous studies. Droughts, floods, animals, insects, disease regularly adversely affect rice yields; and human factors like illness, marriage, education, wage labour, pregnancy can also result in lower yields for a family.

Most of the years covered by the 1997 study were agriculturally sub-normal, as shown in the low average yields per hectare (Table 5). 1991-92 was a dry year with 39% of the rice fields suffering from drought, 25% from floods and 23% from both (Table 6). In 1992-93 drought was less of a problem, but 42% of the

[5] These distances are only rough measures of actual distances, and represent an under-estimate. People are not used to estimating distances. We used the estimate of 15 minutes per kilometer. This works well with walked distances, less so well with distances traveled by canoe.

ricefields were damaged by flood. In 1993-94 and 1994-95, drought surfaced again, sometimes combined with flooding (although less seriously than in 1991 - 1993). The final two years, 1995-96 and 1996-97, were only slightly affected by droughts and flooding.

Table 5. Average Yield per Hectare (1991 - 1997)

Year	Average Yield (Ton/Ha)
1991-92	**0.7**
1992-93	0.7
1993-94	0.9
1994-95	**1.0**
1995-96	1.4
1996-97	1.6
Overall	***1.07***

The average number of tons of rice per ha between 1962 and 1990, was 1.2. For this more recent period, 1991 - 1997, the average yield fell to 1 ton/ha. During this time there were two El Niño events (1991-92 and 1994-95). Tables 7 and 8 report the incidence of animal pests and insect pests, as experienced by Long Segar's farmers. Data such as these do not depict the severity of each problem, but they do reflect the real risks involved in rice cultivation in tropical rain forest areas like Borneo. This year (1997-98) has been predicted to be the worst El Niño in 150 years, with predictable impacts on Long Segar's rice yields.

Tabel 6. Water-Related Problems on Rice Fields (1991 - 1997)

Year	Rice Fields Affected by Water-Related Problems			
	None	Flood	Drought	Flood & Drought
1991-92	**8 (14.0 %)**	**14 (24.6 %)**	**22 (38.6 %)**	**13 (22.8 %)**
1992-93	12 (18.2 %)	28 (42.4 %)	20 (30.3 %)	6 (9.1 %)
1993-94	13 (18.8 %)	5 (7.2 %)	29 (42.0 %)	22 (31.9 %)
1994-95	**13 (19.4 %)**	**1 (1.5 %)**	**32 (47.8 %)**	**21 (31.3 %)**
1995-96	32 (45.1 %)	2 (2.8 %)	11 (15.5 %)	26 (36.6 %)
1996-97	41 (62.1 %)	1 (1.5 %)	7 (10.6 %)	17 (25.8 %)

Tabel 7. Percentage of Rice Fields Affected by Animal Pests (1991 -1997)

Animal Pests						
	91-92	92-93	93-94	94-95	95-96	96-97
None	**35.7**	28.8	30.4	**29.9**	15.5	18.2
Rats	**19.3**	31.8	26.1	**20.9**	18.3	10.6
Pigs	**56.1**	59.1	59.4	**64.2**	77.5	69.7
Deer	**19.3**	27.3	10.1	**17.9**	19.7	16.7
Monkeys	**5.3**	13.6	7.2	**9.0**	8.5	9.1

Birds	**10.5**	13.6	15.9	**16.4**	14.1	15.2
Other	**3.5**	1.5	0.0	**0.0**	2.8	1.5

Tabel 8. Percentage of Rice Fields Affected by Insect Pests (1991 - 1997)

Animal Pests						
	91-92	92-93	93-94	94-95	95-96	96-97
None	**75.4**	68.2	71.0	**73.1**	73.2	65.2
Pau (locusts)	**17.5**	19.7	23.2	**13.4**	18.3	22.7
Ulet (grubs?)	**3.5**	6.1	5.8	**9.0**	11.3	13.6
Kamang (Stalk eyed borer)	**3.5**	4.5	4.3	**6.0**	4.2	6.1
Njau alang (rice bug)	**1.8**	3.0	4.3	**9.0**	8.5	4.5
Ngeruseng (blast?)	**5.3**	10.6	7.2	**13.4**	2.8	4.5
Kutip (black bug)	**1.8**	1.5	2.9	**9.0**	5.6	1.5
Other insects	**0.0**	0.0	0.0	**0.0**	0.0	4.5

Major Changes since Previous Study

1. There has been a shift away from old growth forest, with old secondary forest taking the dominant position as a source for rice fields. This is probably due to a reduction in the amount of old growth remaining within commuting distance, as well as Long Segar's territory reaching the boundaries of neighbouring communities. The availability of old secondary forest, owned by Long Segar inhabitants or family members, has only recently been an option, since lands cut in the 60's and 70's would only now be reaching an old secondary stage of growth.

2. There has been a shift to a more even distribution among the three types of topography. Whereas in the 1980s the people were concerned about flooding, they are now cognizant of the increased incidence of drought.

3. Field size has increased, when compared to the earlier study where people averaged 2.35 ha. The average size in the 90's has been 2.52 ha.

4. Distance to fields has remained comparatively constant during this period, despite the near-yearly increase in distance during the first 28 years of settlement of Long Segar. This suggests the approach of Long Segar territory to the boundaries of her neighbours, maximum commuting distances, and availability of nearby land abandoned by out-migrants.

5. Yield per hectare has declined from an average of 1.2 tons/ha between 1962 and 1990 (with no discernible trend) to just over 1 ton/ha since 1991---due in

part to adverse weather conditions. One might expect the increase in use of young secondary forest for ricefields to be a factor, but these data do not support this interpretation.

Families

We have also looked at these data from the perspective of families and their welfare. In the following sections we look at rice production per family, perception of sufficiency, division of labour, and options available to families with insufficient rice production. These are discussed separately below:

Rice Production per Family

In the earlier study, families tended to produce about 3.2 tons of rice per year altogether. Thirty-six percent of the families produced 1-3 tons/year and 21% produced 3-5 tons/year. Fifteen percent produced more than 5 tons and 28% less than 1 ton.

Table 9. Average Rice Production per Family during 1991 - 1997 Periods

Year	Average Rice Production per Family (Kg)
1991-92	**1843.6**
1992-93	1449.8
1993-94	2141.8
1994-95	**2628.8**
1995-96	3750.5
1996-97	4130.2
Overall	***2689.6***

As seen in Table 9, average rice production per family was noticeably (and significantly) lower in 1991-92 and 1992-93, as compared with the other years. In 1994-95, an El Niño year, rice production per family improved somewhat, suggesting that the drought may have been less severe. Indeed, the overall average production (2,690 kg) during this more recent period is considerably less than the average family's annual production between 1962 and 1990: 3.2 tons.

Note, in Table 10, the increased hectarage cleared during El Niño years. The increased hectarage, combined with a less severe drought in 1994-95, appears to have sufficed to make a reasonable living for local farmers. Average hectarage used per year per family during the previous study was 2.7 ha. The current average area cleared per family is slightly lower at 2.62 ha. Whereas

previously many families had two somewhat smaller fields, now most have only one, larger field.

Tabel 10. Households and Their Ricefields (1991 - 1997)

Year	No Households	Ave. No of Rice Fields per Household	Ave. Total Ha per Household (in rice field)
1991-92	**56**	**1.02**	**2.88**
1992-93	65	1.02	2.49
1993-94	66	1.05	2.35
1994-95	**66**	**1.02**	**2.73**
1995-96	69	1.03	2.67
1996-97	64	1.03	2.64
Overall	***64.3***	***1.03***	***2.62***

Perception of Sufficiency

People's perception that they do or do not have enough rice is another measure of human well being. A high proportion of people during the first four years of the study period did not feel that they had sufficient rice (Table 11). Our qualitative sense that the difference between "good" and "sufficient" is not very meaningful---due to people's unwillingness to boast when they do well---was borne out by statistical analysis showing the average yield per hectare for categories considered 'good' (1.47 Ton/Ha) was not significantly different from average yield per hectare from categories named 'sufficient' (1.27 Ton/Ha). Both categories are significantly different from categories viewed as 'insufficient' (0.59 Ton/Ha). Perception of sufficiency is, not surprisingly, strongly correlated with yield per hectare ($P < 0.001$, ANOVA).

Table 11. Number and Percent of Families According to Perception of Sufficiency - 1991 - 1997

Year	Perception of Sufficiency					
	Good		Sufficient		Insufficient	
	Number	Percentage	Number	Percentage	Number	Percentage
1991-92	**2**	**3.6**	**33**	**58.9**	**21**	**37.5**
1992-93	5	7.6	15	22.7	46	69.7
1993-94	2	2.9	45	65.2	22	31.9
1994-95	**6**	**9.4**	**40**	**62.5**	**18**	**28.1**
1995-96	16	22.9	44	62.9	10	14.3
1996-97	12	18.8	42	65.6	10	15.6
Overall	***43***	***11.4***	***212***	***55.9***	***124***	***32.7***

We compared the distribution of perceptions among "good," "enough", and "insufficient" during the earlier period of study (1963-1990) and the more recent period (Table 12). The percentage of rice yields perceived as "good" went down (Chi square, $P < 0.05$) from the previous level. The "sufficient" response rose, while "insufficient" remained constant.

Table 12. Comparison of Rice Sufficiency Between two Periods of Study

Periods	Rice Sufficiency Categories		
	Good	Enough	Insufficient
1963 - 1990	274 (15.9 %)	870 (50.6 %)	576 (33.5 %)
1991 - 1997	43 (11.4 %)	212 (55.9 %)	124 (32.7 %)

[In this table, unlike the next one, missing values were excluded because chi square tests cannot deal with them. The average values reported in the two tables therefore differ slightly.]

This final table shows the differences among four Uma' Jalan locations studied previously. The truly adverse conditions at the Muara Wahau transmigration location are clear. Long Ampung is the remote site where subsistence has been fairly secure. Tanah Merah is an area near the city, with better soil conditions than the other areas.

Table 13. Number and Percentage of Families at Several Locations According to Their Perceptions of Rice Sufficiency

Locations (years studied)	Rice Sufficiency Categories		
	Good	Sufficient	Insufficient
Long Ampung (85-90)	3 (2.4 %)	95 (74.8 %)	29 (22.8 %)
Long Segar[a] (62-90)	274 (15.1 %)	870 (48.1 %)	576 (31.8 %)
Long Segar (91-97)	**43 (11.4 %)**	**212 (55.9 %)**	**124 (32.7 %)**
Muara Wahau (86-90)	1 (0.9 %)	44 (39.6 %)	66 (59.5 %)
Tanah Merah[b] (83-90)	33 (17.0 %)	112 (57.7 %)	47 (24.2 %)

[a] 89 responses (4.9 % of total data from Long Segar) are missing
[b] 2 responses (1.0 % of total data from Tanah Merah) are missing

Household Size

Household size in Long Segar had decreased from 6.32 in 1980 to 5.35 in 1990. During this period birth control technology was introduced and provision of such services institutionalized within the community. According to the 1997 data (Table 14), the number of co-resident family members has risen somewhat to an average of 5.62 members, between 1991 and 1997.

Table 14. Details of Household Membership in Long Segar (1991 - 1997)

Division of Labour (averages)	91-92	92-93	93-94	94-95	95-96	96-97	Overall
No. Household Members	**5.70**	5.58	5.61	**5.66**	5.54	5.67	***5.62***
No. Agriculturally Active Men	**1.63**	1.58	1.62	**1.63**	1.65	1.55	***1.61***
No. Agriculturally Active Women	**1.42**	1.39	1.38	**1.39**	1.41	1.33	***1.39***
No. Dependents	**2.61**	2.56	2.58	**2.57**	2.49	2.67	***2.58***
No. Men with a Job	**0.26**	0.29	0.29	**0.30**	0.28	0.39	***0.30***
No. Women with a Job	**0.06**	0.06	0.06	**0.04**	0.03	0.05	***0.05***
No. People with a Job[6]	**0.32**	0.35	0.35	**0.34**	0.31	0.44	***0.35***

Division of Labour and Gender

Globally there is considerable evidence that women's involvement in productive activity is a necessary, though not sufficient, prerequisite for high female status (Sanday 1974). Borneo's Dayaks are well known for the comparatively high status of their women (e.g., Sutlive 1993), with consequent desirable effects on human well being (e.g., women's and children's health, reproductive choice, voice in community and agricultural decisionmaking). Previous analyses (Colfer 1983; 1985b; 1991; Colfer with Dudley 1993) showed a significant change in division of labour between men and women, with anticipated negative impacts on women's position and general well being within the community. In the 1980's there were several signs that women's traditionally dominant role in rice cultivation was being eroded.

One clear indicator in Long Segar was the sex ratio among agriculturally active family members, which went from 0.87 in 1980 to 1.27 in 1990. A comparable figure in the remote Kenyah community of Long Ampung over a five year period in the 1980s was 0.81. In this newer, Long Segar data set, we still found more agriculturally active men (sex ratio = 1.2) though less so than in 1990. Sex ratio within the family did not, however significantly influence average rice production for that family ($P > 0.05$).

In our effort to ascertain the potentially changing impacts of gender roles on rice production---as the economic base of the community---we found that the number of men and the number of women both significantly affected rice production (see Figure 3). The number of women, however, was somewhat more closely correlated with average rice production ($r = 0.3092$) than was the number of men ($r = 0.2190$).

With non-parametric tests, men's contribution to family rice production is significant at $P < 0.05$ and women's contribution is significant at $P < 0.001$.

[6] People with a job are often also agriculturally active members of the family, so the subsequent cells in a given column do not sum to the cell for "number of household members". In other words, for any given year, the sum of rows 2-6 does not necessarily equal row 1.

Though both men's and women's contribution are significant, we can conclude that women's contribution to average rice production per family is somewhat more significant than men's.

We were also interested to know whether the proportion of men's labour differs by forest type. We found that the proportion of men's labour within the family, in fields cut from new fallows (33.33%) differed significantly from those cut from old secondary (51.90%) and old growth forest (53.24%). These data support the local view that women are more likely to have ricefields cut from new fallows, whereas men predominate in fields cut from old secondary and old growth forest. In young secondary forest it seems that men's and women's contributions are more equal.

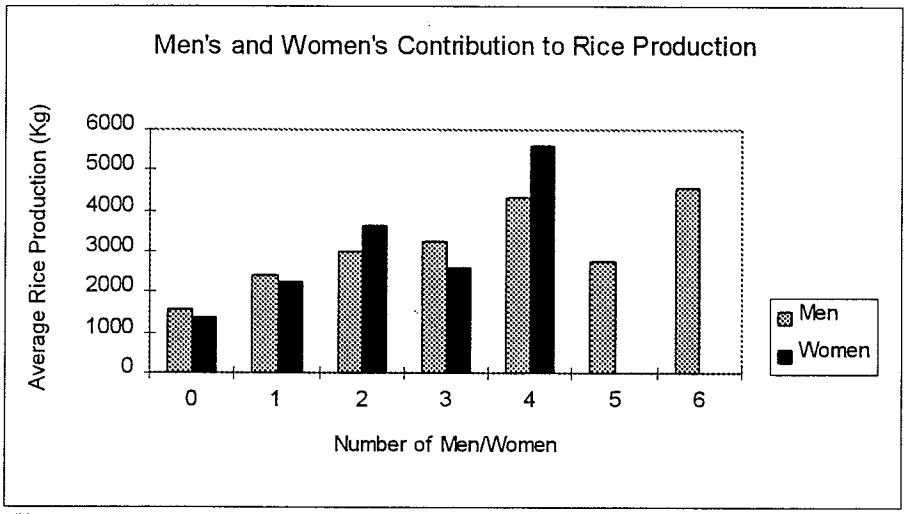

Figure 3. Men's and Women's Contribution to Rice Production

One possible explanation for the larger number of male agricultural workers than female (in contrast to Kenyah tradition) is that young women are pursuing their education in greater numbers. We do not have systematic data on this issue, but the need to leave the village to pursue one's education could account for the lower number of agriculturally active women. The explanation given to Colfer at the June 1997 junior high school graduation, for girls winning all the prizes, was that Kenyah girls consistently did better in school than the boys. The number of young Iban women (a related Dayak group) pursuing an education was higher than for men in a recent study (Colfer *et al.* n.d.). Pursuing a high school and even a college education is much more common now in Long Segar than previously (Sardjono *et al.* (1997) favorably compare Long Segar's "human resources" to those in neighbouring Kernyanyan).

Measures of Standard of Living

During the previous study, although money was used, it was not a particularly important element in daily life. Most needs were met by subsistence activities (agriculture, hunting, gathering, fishing, and home production), some were met by barter, and very few items were purchased. In a 1979-80 food recordkeeping study, for instance, only 9% of non-rice food items were bought, and all rice, which comprised about 75-90% of people's diet, was home-grown (Colfer and Soedjito 1996). In a one month study in 1991, the corresponding figure for bought food items was <5% (Colfer with Peluso and Chin 1997).

One proxy indicator of people's income is the percentage of families owning outboard motors and chainsaws. These are highly valued technological devices that "caught on like wildfire" when they were first introduced into the community in the mid 1970's. By 1980, 35% of Long Segar families owned a chainsaw and 71.6% owned an outboard motor. By 1990, ownership of both devices had gone down somewhat: Chainsaw ownership was reduced to 22.7% and outboard motor ownership, to 68.0%. (see Table 15).

Table 15. Number and Percentage of Family at Several Locations and Times Owning Outboard Motors and Chainsaws

Location (date)	Chainsaw		Outboard Motors	
	With	Without	With	Without
Long Ampung (1990)	5 (20.0 %)	20 (80.0 %)	1 (4.0 %)	24 (96.0 %)
Long Segar (1980)	**21 (35.0 %)**	**39 (65.0 %)**	**43 (71.6 %)**	**17 (28.4 %)**
Long Segar (1990)	**22 (22.7 %)**	**75 (77.3 %)**	**66 (68.0 %)**	**31 (32.0 %)**
Muara Wahau (1990)	3 (11.1 %)	24 (88.9 %)	4 (14.8 %)	23 (85.2 %)
Tanah Merah (1990)	11 (29.7 %)	26 (70.3 %)	22 (59.5 %)	15 (40.5 %)

During the period of the most recent study, on average 41% of Long Segar families had chainsaws and 80% had outboard motors, and (Table 16).

Table 16. Number and Percentage of Families Owning Chainsaws and Outboard Motors - 1991 - 1997

Year	Chainsaw		Outboard Motor (Ces)	
	with	without	with	without
1991-92	**24 (42.9 %)**	**32 (57.1 %)**	**43 (76.8 %)**	**13 (23.2 %)**
1992-93	25 (38.5 %)	40 (61.5 %)	47 (72.3 %)	18 (27.7 %)
1993-94	28 (42.4 %)	38 (57.6 %)	49 (74.2 %)	17 (25.8 %)
1994-95	**26 (39.4 %)**	**40 (60.6 %)**	**52 (78.8 %)**	**14 (21.2 %)**
1995-96	27 (39.1 %)	42 (60.9 %)	59 (85.5 %)	10 (14.5 %)
1996-97	29 (45.3 %)	35 (54.7 %)	55 (86.9 %)	9 (14.1 %)
Overall	***159(41.2 %)***	***227(58.8 %)***	***305(79.0 %)***	***81 (21.0 %)***

This can be compared to ownership of these devices reported in sample surveys in several other Kenyah communities in 1991. In remote Long Ampung (where access to fuel was extremely problematic), 20% of sample households had

chainsaws; and 4% owned an outboard motor. In Tanah Merah, a Kenyah community only two hours from Samarinda, 30% of families owned chainsaws and 60% owned outboard motors. In Muara Wahau, the transmigration location upriver from Long Segar, 11% of the families owned chainsaws and 15% owned outboard motors.

These figures show the comparatively high current ownership of these valuable technological devices relative to other communities and suggest that the community remains economically viable, despite the problems it has encountered based on adverse weather conditions and competition for land in the area.

Strategies When Rice Crops Fail

Most of the same strategies exist now as did during the earlier study, but the distribution/frequencies have changed considerably (Table 17). Before 1990, people depended on cassava as their mainstay in times of crisis, with additional supplements from the surrounding forests. In 1980 and again in 1991, people's first response, when asked what they did in case of crop failure, was a good natured "**uman ubi**" (eat cassava). Now, none responded in this way.

Although some were able to get non subsistence work prior to 1990, the numbers were small. The high percentage of households with at least one member with some "other job" (i.e., not with a company) may suggest a somewhat skewed sample. Those with "other jobs" might be more likely to be in the village when we came calling. On the other hand, the introduction of the timber company's "Village Guidance Program" (**HPH Bina Desa**) in the early 90s has meant a considerable increase in resident, salaried persons. Although salaries are always welcome, very rarely can households depend entirely on the low salaries typically available.

The new daughter community of Kilo Enam has particularly close links with the HTI and HPH Bina Desa, with whom they have been trying to fashion an alternative livelihood strategy. Kilo Enam has about 20 permanent families, all of whom work part of the time for the company as a supplement to their rice production and other agroforestry endeavours. There are also several entrepreneurial Uma' Jalan men who take on land clearing sub-contracts, and who use Long Segar as a source of such labour. Off-farm work opportunities have definitely increased during the 1990s.

Table 17 also shows people's continuing reliance on the forest as a "fall back" resource when rice fails. Hunting of pigs and fishing were important throughout the years. People's continuing willingness to request help from relatives suggests that an important part of their cultural "safety net" continues to function,

though the small number who report requesting from non-family members suggests that the wider safety net that once functioned (described by Dove 1988 for the Kantu') may be wearing thin. Note the reliance on rattan, gold, and the making of boards and beams only during the difficult years.

For the Uma' Jalan, rice cultivation has a strong symbolic value, both for women's roles and for ethnic identity. These people feel that being rice farmers is integral to their self-perception. One bit of evidence for this, when looking at their involvement in wage labour, is the relationship between the perception of inadequate rice harvests and wage labour. Taking the perception of insufficiency as the independent variable---consistent with their earlier value on rice cultivation as their mainstay---we found the Uma' Jalan to be 72 times more likely to go to work for a company if their harvest was insufficient than if their harvest was sufficient or good.

During this period, Long Segar farmers have become considerably more involved in wage labour. This prompted us to examine the possible relationships between involvement in wage labour and type of forest used for rice fields. We found that households without a wage earner were significantly more likely to cut old secondary and old growth forest than to cut new fallows and young secondary forest (Chi Square, $P < 0.001$). On the other side householders with a wage earner preferred to cut new fallows and young secondary forest. This preference seems likely to be related to an agricultural labour shortage in wage earning families. The possibility that households with a wage earning member are better educated or more intelligent could also be a factor in the unexpectedly higher yields per hectare on new fallows and young secondary forest than the others two forest types.

We also considered the possibility that having off farm jobs could have a negative impact on rice production. We found that working at a company resulted in a statistically significantly decrease in rice yields per family (t-test, $P < 0.02$). If a family sent a person to work at a company they tended to get lower rice yields (741.4 Kg) than if they did not send a person to work at a company (1160.9 Kg). It seems probable to us that we are looking at a case of spiralling causation. People get bad yields and go to work for a company as a survival strategy. Working in the company in turn may precipitate further low yields due to labour shortage. Kenyah men have traditionally gone away on temporary journeys (earlier in search of salt, more recently in search of trade goods). Local wage labour opportunities, only recently available, make use of both men and women workers.

Table 17. Coping Strategies when Rice Crops Fail (percentages)

Alternatives						
	1991-92	1992-93	1993-94	**1994-95**	1995-96	1996-97

Gather Rattan	**0.0**	6.7	9.5	**5.6**	0.0	0.0
Look for Gold	**28.6**	15.6	9.5	**16.7**	0.0	0.0
Makes Beams/Boards	**4.8**	2.2	4.8	**0.0**	0.0	0.0
Ask from People	**0.0**	0.0	0.0	**5.6**	0.0	0.0
Ask from Relatives	**19.0**	11.1	14.3	**5.6**	20.0	11.1
Work in a Company[7]	**33.3**	51.1	47.6	**16.7**	40.0	11.1
Hunt for Pigs	**19.0**	6.7	14.3	**22.2**	30.0	11.1
Hunt for Fish	**14.3**	6.7	14.3	**22.2**	20.0	11.1
Makes Shingles	**0.0**	0.0	4.8	**0.0**	10.0	0.0
Other Jobs[8]	**33.3**	33.3	33.3	**38.9**	20.0	66.7

One of the interesting features of this table, is the important role that the timber companies have played in providing alternatives when rice production fails. In 1992-93 and 1993-94, around half of the needy families sent someone to work for a company. Another interesting change pertains to the making of beams and boards. During the earlier study, this was a very common way for people to make additional money. By 1995, the practice had subsided considerably, due to the perception of stricter enforcement, including a number of tales of people who had gone to jail for illegal, or "wild" cutting ("penebangan liar").

Important Changes for Families Since Previous Study

- The average number of fields per family has fallen, but the average size per field has risen, resulting in approximately the same amount of total area cut per family.
- Rice production has fallen per family from about 3.2 ton to 2.7 tons per year, with unusual fluctuations (e.g., four consecutive years of bad yields).
- The average household size has increased slightly from 5.35 in 1990 to 5.62 in 1997.
- Men's involvement in agriculture continues, as does women's slight dominance in impacts on productivity.
- People's reliance on the forest as a supplemental subsistence resource, in cases of crop failure, remains critically important.

[7] "Companies" generally refers to timber or plantation companies. Long Segar is located in the P.T. Kiani Lestari concession, and there are subsidiaries and other timber companies all up and down the Telen River, on which they are situated. P.T. Kiani Hutan Lestari is the subsidiary that operates the local HTI.

[8] Among "other jobs" the most common include teacher, paramedic, government official, preacher/pastor and small store operator.

- There has been an important increase in off farm labour, partly as a response to bad yields, partly as a mechanism for coping with risks perceived from external, powerful claims on their land, e.g., by HTI's, transmigration, and a planned oil palm estate.
- Ownership of valued commodities like chainsaws and outboard motors has increased somewhat.
- Educational level appears to be gaining ground.

Conclusions

We had several concerns when we began this study. Our impressions, during a brief 1995 visit, suggested that Long Segar was suffering from drastically reduced rice yields. For the first time, we heard complaints (at Kilo Enam) about the invasive grass, *Imperata cylindrica*. We suspected that these problems might be due to the establishment of a large HTI (industrial timber plantation) in the area, with possible reductions in area available for rice cultivation or shortened fallows again due to reductions in land availability. We did not see any obvious improvement in standards of living or quality of life for the people in Long Segar.

Because of these impressions, we conducted the study reported here. In the interim, we learned about the two El Niño events in 1991-92 and 1994-95. These data suggest that there has indeed been some reduction in land availability---as shown by the increase in use of young secondary forest for rice fields and the shift from old growth to old secondary as the dominant forest type used for rice fields. But this change is less significant than we had feared. The reduction in rice yields appears due in large part to climatic conditions (droughts and to a lesser extent, flooding). Field sizes are larger than they were before but each household is clearing slightly less, *in toto*, than previously (most clearing one field rather than two).

The reduction in the fallow cycle has only shifted from old growth to old secondary forest (a shift that would be unlikely to precipitate a reduction in yields). Fields planted in new fallows or young secondary forest remain a small proportion of the total Long Segar fields.

The increased reliance on wage labour is undoubtedly seen as a positive trend by many; however, we remain concerned about its impacts on cultural integrity and long term well being. With rice production such an important element in people's perceptions of themselves, it is easy to imagine significant cultural discontinuities deriving from the changes underway, The people's current ability to maintain their standard of living is based on a combination of rice production

and wage labour (largely in forest clearing activities). One can envisage a scenario in which rice yields continue to decline and the people rely more and more on wage labour. Their involvement in wage labour (and consequent agricultural labour shortage) results in a reduction in size of agricultural fields which in turn reduces their only quasi-recognized security of tenure. The people, who are now independent, land owning forest farmers, could easily become a poor, rural proletariat without access to a means of production other than the sale of their own labour---such as one sees commonly in Java.

Finally, although this study cannot of course provide conclusive evidence, we are left wondering if the forest clearing activities that are so drastically altering East Kalimantan's landscape have a causal connection to the unusual weather patterns documented here. Human adaptability and creativity, both local people's and that of the various extension agents from the timber company and the transmigration program, have precluded real disaster as the people have coped with these crises. This 1997-98 "mother of all El Niño's" may be the most demanding test of their mettle yet encountered. It is possible that we are witnessing a downward spiral of productivity and ecological health which only a reduction in large scale land clearing activities can stop.

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