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GREEN REVOLUTION TECHNOLOGY AND COMMUNITY DEVELOPMENT

THE LIMITS OF ACTION PROGRAMS*

by

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Development, as the term will be used in this article, involves three interrelated societal activities: (1) the establishment of increased wealth and income as a perceived, attainable goal for the broad masses of the society; (2) the creation and/or selection of adequate means to attain this goal; and (3) the restructuring of society so that there is persistent economic growth.

Societies have frequently selected programs of community development (or community action) as a means to increase levels that affect income on a broad range. This is because the community is viewed as a "service center" where the major economic institutions of society have agencies. Those who hold to this view frequently assume that all members of a community have relatively equal access to and influence over these institutions. 1/

In fact, a major feature of many economic systems is the concentration of control of the major economic institutions -- and the consequent differential access to these institutions -- depending on one's relationship to those who control these agencies. If the dominant class is small and powerful, it is likely to have great control over the major economic institutions. If control is concentrated it is likely that this elite will have little concern for public welfare issues. Community development programs operating in this milieu will probably be unable

to increase the levels of income for the broad masses. 2/

The major purpose of the present study is to demonstrate empirically that when community action fails to take extant institutional arrangements into account, who has the will and the ability to introduce new techniques determines who will increase his income. Who has access to these institutions may result in a further concentration of control over productive resources.

THE SITUATION STUDIED

The community to be analyzed here is located in the coffee producing region of Colombia in Antioquia. This state (department) regularly produces about 20 percent of Colombia's coffee each year. In 1963, there were 1,575 rural families in the area studied of which 1,008 lived in the coffee producing area. The remaining families resided in altitudes either too high or low for coffee. Of these 1,008 families, 100 were interviewed in 1963. A complete description of the area is presented in Havens. 3/ All indications are that the area is typical of coffee producing areas in Antioquia. 4/

In 1963, a random sample of rural families was selected by first dividing the community into twenty areas and selecting 10 areas randomly. Next, ten family units within each area were picked, thus yielding an N of 100. Such a procedure was necessary because a sampling frame of all rural families was not available. In 1970, these families were located and reinterviewed. Not all 100 families were farm owners or renters; some were day laborers or sharecroppers. Others did not produce coffee.

Only those who were owners or renters of farms producing coffee during the 8-year period are included in this analysis.

In 1963, 64 families had control over land, either as renters and/or owners. During the study period, 4 day laborers in our sample became owners either through inheritance or purchase of small plots. In 1971, 56 of these 68 were either owners or tenants. We omitted from our analysis three who owned over 200 acres of coffee land because we were mainly interested in the small farm coffee producers. Thus, our 1971 analysis will concern 65 families. Of these 65 families, 53 still had control over land in 1971 and the three day laborers who lost land but remained in the community. Of the 9 who were no longer owners or renters in the community, eight migrated from the community and one died. Thus, the major part of the analysis to follow will deal with 56 families who were in the 1963 sample and remained in the community and were interviewed in 1971.

The major technological changes during the past seven years were that two new coffee varieties (Caturra and Borbon) and large applications of fertilizers and weed killers had become available. Public investments during the seven-year period remained relatively constant in the real terms. 5/

Of the 56 coffee producers used in the analysis, 17 had adopted the new coffee varities (they had planted the new strains and these varieties are now in production) and used commercial fertilizer and weed killer. The remaining 39 had not adopted Caturra and Borbon.

It was 1965 when the National Federation of Coffee Growers introduced the new, high-yielding coffee varieties in the community. The

Federation is an action agency within the community which provides technical assistance, credit and marketing facilities. It also regulates the internal price of coffee which is largely dependent on international coffee agreements. Its avowed prupose is to increase the levels of living of small coffee producers.

Consequences of Green Revolution Technology

"Green Revolution technology" refers to new seed and fertilizer inputs that are highly divisible and, thus, available to the small farmer. Major emphasis on Green Revolution inputs developed in the late 1960's. It wasn't until the "First Decade of Development" ended that analysis indicated that the Green Revolution may actually have a counterproductive aspect. 6/

Some analysts feel that the positive contributions of the Green Revolution were diminished because of accompanying problems of: 1) erosion; 2) the costs of the adoption package (improved seed varieties often demand irrigation and intensive application of fertilizers and pesticides); 3) storage, distribution, and marketing costs were increased, and 4) the lack of awareness of their existence by lower-income farmers. In a phrase, the Green Revolution technology was often available only to the large land owner -- the man of means -- and this could lead to further concentration of agricultural incomes. 7/ This says nothing about its possible adverse effects on employment. 8/ For a detailed analysis of these problems see Shulka 9/ and Schulter. 10/ In our opinion these studies clearly demonstrate the tendency for Green Revolution inputs to concentrate resources. Others also have argued that

not only might the Green Revolution have these effects, it also resulted in expulsion of some microplot owners from their land. 11/ Indeed, a structural change in agriculture which doesn't permit sufficient employment and hastens farm-to-city migration is an important cause of the urban problem. 12/

Those who may not benefit fully from the fruits of the Green Revolution may be small farms, sharecroppers, renters, shop keepers, artisans, agricultural laborers and industrial workers. 13/ As one example, Lele and Mellor note, "As compared to the smaller cultivators, the larger farmers can better afford the risks of innovation and they wield more political power over the developmental agencies which provide access to credit and crucial supplies such as fertilizers, seed and pesticides." 14/

In other words, the introduction of new technology, seems generally to fall under the predominant control of those who own most of the land and capital. Consequently, while new technology may increase production, and thus, incomes, these benefits may not automatically trickle down to the majority of those employed in agriculture. 15/

How did the program to introduce Green Revolution inputs into the community of Tamesis, Antioquia, work out in fact when the distribution of income and land are considered? To what extent were institutional arrangements affected by the program and limited non-adopter access to credit necessary for changing over to the new varieties?

The Possibilities

The National Federation of Coffee Growers made available new coffee

varieties and fertilizers but credit to enable the small producer to stand the cost of changing to the new varieties was not provided. Unlike improved corn or rice which are frequently presented as the exemplars of the Green Revolution, when coffee trees are planted land to grow them must be taken out of production for three years while the trees come into production.

Institutional arrangements usually provide that credit is not provided if the loan exceeds the mortgage value of property owned. Because the small producer must take so much land out of production that would ordinarily support subsistance crops, he does not receive enough credit to sustain him for the length of the change-over period. Moreover, the new varieties don't produce well until relatively large amounts of fertilizer are applied. Small producers cannot initially afford this cost either. If the producers who want to plant new varieties could be provided with support during the changeover period, regardless of size, all landowners could benefit from new varieties.

Unfortunately this is not the case, the owners of smaller plots are restricted in their ability to adopt. Farmers with larger acreages are regarded as good credit risks and prime candidates for loans. Thiesenhusen suggest other reasons for this bias in that...

> the cost of servicing a loan to a small farmer may be as great as that to a large one. The red tape and delay may also deter the small farmer from borrowing. Even assuming zero credit availability to everyone, large-scale farmers would be able to finance a certain level of inputs from their own savings

while small holders usually find this impossible. And even if small farmers who are prevented from receiving public credit are able to borrow from private credit market, they will probably have to pay usurious rates which may well cancel out profit. Worse yet, the peasant may be so encumbered with past due accounts that he is not able to avail himself of any credit -- private or public. 16/

Griffin 17/ suggests that green revolution technology is biased against the small producer unless landownership is equally distributed in small parcels and that all peasants have approximately equal access to fertilizer, water, technical knowledge, and credit.

This certainly is not the case in Tamesis. In 1963, sixty percent of the producers owned less than five acres of land. Thus it would seem reasonable to hypothesize that these producers would be at least partially blocked from adopting unless institutional arrangements affecting credit availability were changed. The case was that those who began with higher incomes and owned more land could better withstand short-run loss of production during change-over and were eligible for higher credit levels. With this situation, the consequences of introducing new techniques without changing institutional arrangements is to further concentrate control over income and land, we predict.

The Findings

Of the 65 families who were in the 1963 sample, 17 adopted and 48 did not. Of the 48, thirty-six still were farm operators, eight migrated to other areas, three became day laborers and one died. Twenty three

percent of the non-adopters (11 out of 48) who were either owners or renters in 1963 had become rural or urban day laborers by 1971. Of the eight migrants more than half of the families migrated to Medellín or Bogotá. All 17 of those who adopted the new technology during the study period kept control of their land (see Table 1).

All subsequent analysis will only treat the 56 families who remained in the community in 1971 (53 as owners and/or renters and 3 as day laborers). Table 2 presents data on annual net income per family unit in 1963 and 1970 for adopters and non-adopters for the 56 families. Looking at the total number of families and the distribution of income in 1963 and 1970, we find that the Gini Coefficient for concentration in 1963 was .275 and in 1970 was .443 showing that income distribution has become more concentrated during the eight year period. We can infer from Table 2 that a relatively small group increased their control over the income in the community from 1963 to 1971. The adopters' income increased from an average of 6,731 pesos per year to 21,443 while the non-adopters increased from 4,509 pesos to 12,063 pesos. The increase in income for both adopters and non-adopters was statistically significant, but the difference in the amount of increase between adopters and non-adopters 18/ was also significantly different. In other words, more of the increase in income flowed to the adopters than to the non-adopters. It is also worth underlining the fact that adopters started at a higher income level in 1963 than did non-adopters.

Table 3 presents the same data but 1971 currency is converted to 1963 pesos. The same differences are observed for adopters but the

increase for non-adopters rose from 4,509 to 6,274 which is not statistically significant. When income is converted to real terms, therefore, adopters have increased their income significantly but non-adopters have not. Subsequent calculations are all expressed in real terms.

What is the source of this new income? Perhaps it is accounted for by more family members coming of working age and contributing to total family income. The average number of family members that were employed by families adopting the new inputs was 2.1 in 1963 and 2.9 in 1971; for non-adopters the average was 2.2 and 3.1 in 1971. These averages are not statistically different so we can reject the notion that more total family members working accounted for the increase in income.

Perhaps the best explanation for the increase in income is in successful adaptation of new varieties of coffee. It was thought that monetary return for each acre of coffee in production would give a good measure of "successful adoption." Table 4 presents these findings. Adopters and non-adopters both began at about the same level of net income per acre in 1963 (290 pesos for adopters versus 222 for non-adopters). But by 1971 the adopters increased net income per acre to 1,642 pesos. Net return per acre for non-adopters increased to only 632 pesos 19/ and the difference in the amount of increase between adopters and non-adopters was highly statistically significant. Thus, there appears to be very little doubt that the change in income levels is largely accounted for by the adoption of the new inputs.

If adopters have increased their income levels, how have they invested their greater surplus? Clearly, part of it has been invested in

the change-over to new varieties. But Table 5 leads us to believe that some new land was bought by adopters as well; land has become concentrated in fewer hands. The Gini Coefficient of concentration was .706 for 1963 and .859 for 1971. It is also clear that it is the adopters and not the non-adopters who acquire land. The adopters increased their farm size from an average of 18.86 to 33.13 acres while the holdings of the non-adopters decreased from an average of 7.97 to 6.42 acres. It is worth underlining that even in 1963 those who subsequently adopted the technology controlled more acreage. The average farm size was 18.86 acres for adopters and 7.97 acres for non-adopters.

Institutional Arrangements as Limiting Factors

It has been demonstrated that the distribution of income and land has become more concentrated in the community under study and that the adopters of the new coffee varieties began with the more resources and have enjoyed the bulk of these gains in income and land from 1963 to 1971. Because they have more land to use as collateral, it is quite probable that adopters have had greater access to credit than non-adopters on the average.

During this ten-year period adopters received an average of 1,040 pesos of credit per acre each year while non-adopters received an average of 436 pesos per acre annually. Moreover, a significantly greater number of adopters than non-adopters used credit (79 percent of the adopters and 47 percent of the non-adopters).

Based on this preliminary evidence, we constructed three measures of institutional constraints that may be blocking receipt of the new technology to non-adopters. There is little doubt that adopters achieve the goals of the action programs, they significantly increased their income levels. The problem is with the 70% of the sample farms that did not adopt the new varieties. It is our contention that this lack of adoption is partially due to perceived or real institutional blocks to credit availability.

Three measures were constructed to reflect the real or perceived blocks to credit: 1) total credit received from 1962 to 1971 for the total sample; 2) the percent of credit asked for and received during the same time period; and 3) the respondents perception of credit availability from the institutionalized credit sources. 20/ Table 6 presents the intercorrelation metrix between these variables and the adoption of Caturra. As can be seen, the total amount of credit used per acre is related significantly to the adoption of Caturra as is the percent of credit asked for and received. Respondents' perception of the ease of receiving credit is highly related to adoption and to the percent of credit asked for and received.

It seems that small scale farmers have "learned" over a long period of time that credit can only be used for those with greater levels of income and larger acreages. Indeed, the small acreage farmers may not even ask for credit. As one small farm owner (4 acres) said, "I don't have any land or money resources. If I did, I would use Caturra but it is only for those who have lots of land." Another (.4 acreas) said, "I would

like to use Caturra but up to now I have not been able to find the means to do so." A non-adopter with 1.5 acres explained the situation thus, "I haven't cultivated it because it is very costly due to the requirement of chemical fertilizers, insecticides, and fungicides. How can a poor person afford that when he can't get credit"? Another coffee producer also indicated they didn't adopt it due to lack of money and credit. Thus, there appears to be a definite structural limiting factor affecting the action program. Lack of credit seems to block more than half of the farm owners from participation in the program.

Implications

Rural communities in developing countries are not autonomous units. Economic institutions are largely controlled directly or influenced by decisions taken in the major economic centers of the country where there may be little knowledge of or concern for the needs of local people. In this study, the major sources of public credit in the community were banks which have their main office in the capital city. Whether or not there is a conscious effort of the city policy-maker to withhold resources from small farmers is not at issue here. The fact is that credit was not included as part of the green revolution package to many small farmers.

An argument can be made that these farms are too small to operate efficiently and that their loss may be a better allocation of resources. Six of the eight migrants, however, became part of the migration streams to large cities, such as Bogotá and Medellín. 21/ The question is whether the migrants are economically more productive to the Colombian economy in

the urban sector than they were in the agricultrual sector. Preliminary analysis of the migrant data indicate that this may not be the situation. All six rural-to-urban migrant household heads moved to Medellín and Bogotá which had an unemployment rate of approximately 15 and 13 percent respectively in 1967. 22/ Upon arrival in the city, over one-half of the migrants were unemployed for a period of one month or longer. Thus, many may be trading under employment in the agricultural sector for unemployment in the urban sector. These "forced" migrants (non-adopters who could not compete with the adopters) seem to be less prepared for urban life than those "pulled" by the city. 23/ For example, they possess lower levels of education and skills.

The creation of jobs for this group is the most costly and difficult. For example, James 24/ indicates that it cost $10,000 of new capital to provide one urban job in Mexico in the 1960's. To construct a manufacturing plant which can compete on the international market, however, requires a capital outlay of approximately $40,000 per job. Thus, policy determination is not an easy task. The answer lies somewhere between "keeping them down on the farm" --status quo-- and induced migration -- chaotic change.

If community action program, which introduces green revolution technology, is to raise the socioeconomic levels of the majority of the people, it must provide for more equal access and control of institutional resources. In Colombia, several action programs are currently directing energies to this issue. The problem is that the number of small farmers is large and the available resources may not be sufficient for the task.

If broad access to productive resources is not feasible, planners must be cognizant that induced changes may have negative consequences for certain segments of the population who are structurally blocked from institutional resources. Thus green revolution technology may be exacerbating what is already a bad situation-- increase rural-to-urban migration, increase income gap between the rich and poor, and trade under-employment for unemployment.

Summary

For the seventeen adopters of the new coffee variety, the new technology greatly increased income per acre. On the other hand, fourteen of the 48 non-adopters lost control of their land and are employed as wage laborers (see Table 1). Sixty percent of these migrated to urban centers of more than 10,000 inhabitants.

Focusing on the small farmer who remained behind, there seems to be a clear tendency for land and capital resources to become more concentrated in few hands. Most of this concentration occurred among those who were able to make use of an adequate package of new varieties and a heavier rate of fertilization. Those who used the new inputs had greater access to institutionalized credit resources. Similar tendencies have been noted in other regions of Colombia, 25/ so, the present study appears to be part of a general pattern in the coffee growing area of Colombia and not an exception. Thus, the type of land tenure system and the delivery of credit--social structural variables-- seem to be crucial

determining how technology is shared and, hence, how and to whom
reams are directed. Given a more egalitarian arrangement, however,
ie results might be quite different. 26/

FOOTNOTES

* This study was supported by grants to the University of Wisconsin from the Ford Foundation, Rural Modernization in Latin America Contract and U.S. AID Grant cds. 2823.

1/ Todd Gitlin, "Local Pluralism as Theory and Ideology," in Recent Sociology, ed. Hans Peter Dreitzel (London: MacMillan Company, 1969), pp. 62-87.

2/ Manning Nash, "Some Social and Cultural Aspects of Economic Development," Economic Development and Cultural Change 7 (October 1961): 137-150.

3/ A. Eugene Havens, Támesis: Estructura y Cambio (Bogotá: Tercer Mundo, 1966).

4/ Hernando Ochoa, Cooperativismo y Cambio Estructural en Támesis (Geneva: United Nations Research Institute for Social Development, 1968).

5/ A. Eugene Havens, Income, Employment and Occupational Structure in Small Farm Sector of Colombia (Bogotá: Universidad de Wisconsin Serie Investigativa, 1971).

6/ Clifford R. Wharton, Jr., "The Green Revolution: Cornucopia or Pandora's Box?" Foreign Affairs 47 (April 1969): 464-476; Samir Amin, "Los Límites de la Revolución Verde," Ceres 3 (January 1970): 49-52; Lester R. Brown, Seeds of Change: The Green Revolution in the 1970s (New York: Praeger, 1970); S.L. Parmor, "What Good is Economic Betterment?" Ceres 3 (January 1970): 21-25; Leslie Nulty, The Green Revolution in West Pakistan (New York: Praeger, 1972); and James M. Blume, War on Hunger 7 (April 1973): 22.

7/ Luis Ramior Beltrán, La Revolución Verde y el Desarrollo Latinoamericano (Bogotá: Centro Interamericano de Desarrollo Rural y Reforma Agraria, 1971).

8/ The adoption of green revolution technology is often accompanied by the importation of labor-saving machinery which often means fewer jobs. Some types of green revolution technology may have the same total demand for labor but change the structure of employment. See Randolph Barker, William H. Meyers, Cristina Crisostomo, and Bart Duff, International Labour Review 106, nos. 2-3 (August - September 1972): 111-139. Other green revolution inputs may increase the demand for labor. See Refugio Rochin, "Dwarf Wheat Adoption by Barani Smallholders of Hazara District: Techonological Change in Action." Mimeo (Islamabad: Ford Foundation, May 1971)

9/ V. P. Shukla, An Economic Analysis of Resource Use in Farming, Jabulpur District, Madhya Pradesh, India (Ithaca: Cornell University Occasional Paper 26, 1969).

10/ Michael Schluter, Differential Rates of Adoption of New Seed Varieties in India (Ithaca: Cornell University Occasional Paper 47, 1971).

11/ Rodolofo Stavenhagen, "Seven Fallacies about Latin America" in Latin America: Reform or Revolution, eds. James Petras and Maurice Zeitlin (Greenwich: Fawcett Press, 1968).

12/ William C. Thiesenhusen, "Latin America's Employment Problem," Science 171 (March 5, 1971): 868-874.

13/ Das indicates that assisting the neglected group resulting from green revolution is not an easy task and indeed varies from situation to situation. See Amritananda Das, "Understanding the Green Revolution," Economic and Political Weekly (November 18, 1972): 2266-2267.

14/ Uma J. Lele and John W. Mellow, "Jobs, Poverty and the 'Green Revolution'," International Affairs 48 (January 1972): 20-32.

15/ Kleth Griffin, "The Green Revolution: An Economic Analysis," Report No. 72-76 (United Nations Research Institute for Social Development, 1972): 48.

16/ William C. Thiesenhusen, "What Changing Technology Implies for Agrarian Reform," Mimeo. Paper prepared for the International Bank for Reconstruction and Development (Land Tenure Center, University of Wisconsin, Madison, April 20, 1973): 24.

17/ Griffin, "The Green Revolution: An Economic Analysis": 47.

18/ For the test of difference between means for dependent samples over time see Wilfred Dixon and Frank Massey, Introduction to Statistica Analysis (New York: McGraw-Hill, 1969).

19/ These averages are very close to national statistics. In 1963, the average return per acre was 263 pesos while in 1971 the return for non-improved varieties was about 650 pesos and for improved varieties about 1,600 pesos. See Aristóbulo Hozman Cruz, "EL Crédito Agrícola y la Asistencia Técnica como Factores de Producción," Revista Cafetera de Colombia 20 (January 1971): 18-23; and Fedecafe "Los Ingresos de los Cafeteros," Economía Cafetera 2 (March 1972):

20/ Perception of credit availability is a critical aspect of the present analysis. If an individual has experienced a history of rejection of his request for credit, he rather quickly defines the situation so as to preclude future credit seeking from institutionalized sources. Such a perception may be categorized by others as "objectively wrong" but the behavior of the individual will remain the same.

21/ The six migrants referred to are household heads. The total number of family members affected by migration was 52 people or 7.8 per cent of the 1963 sample.

22/ International Labour Office, Towards Full Employment (Geneva: International Labour Office, 1970): 360

23/ The migrants did not sell out to take advantage of higher land prices, but to pay off debts.

24/ Preston E. James, "Uneven Patterns of Change in Latin America." Paper presented at the Conference of Latin Americanist Geographers, University of Calgary, Calgary, Cauada, June 28-30, 1973: 5.

25/ A. Eugene Havens, Income, Employment and Occupational Structure in the Small Farm Sector of Colombia; and Orlando Fals Borda, Hombre y Tierra en Boyaca (Bogota: Punta de Lanza, 1973).

26/ For a thorough discussion, see William C. Thiesenhusen, "What Changing Technology Implies for Agrarian Reform": 11-27.

TABLE 1. Change in Land Tenure Patterns of Adopters and Non-Adopters of New Coffee Varieties, Támesis, Colombia, 1963-1971

Status in 1963	STATUS IN 1971					
	Owner or owner/renter	Renters Only	Day Laborers	Sold Property and migrated	Household Head Died	Total
1. Adopters owner or owner/renters	14	0	0			14
Renters only	2[a]	1	0			3
Day laborer only	0	0	0			0
Sub-Total	16	1	0			17
2. Non-adopters owner or owner/renter	28	3	3	8[b]	1	43
Renters only	1	0	0			1
Day laborer	3[c]	1	0	—	—	4
Sub-Total	32	4	3	8	1	48
GRAND TOTAL	48	5	3	8	1	65

(a) In 1971 one individual secured property through inheritance, one purchased land and one still rents land.

(b) The average amount of land in coffee for migrants in 1963 was 4.29 acres. The range was 1.58 to 7.90 acres.

(c) The average amount of coffee land bought or inherited by these individuals in 1971 was .93 acres. The range was .39 to 1.58 acres.

TABLE 2. Changes in Actual Net Family Income for Adopters and Non-Adopters of New Coffee Varieties, Támesis, Colombia, 1963-1970

Income in Pesos	Adopters		Non-Adopters		Total	
	1963 (N=17)	1970 (N=39)	1963 (N=17)	1970 (N=39)	1963 (N=17)	1970 (N=39)
0 to 2,500	5.9	0.0	23.1	5.1	17.9	3.6
2,501 to 5,000	23.5	0.0	41.0	12.8	35.6	8.9
5,001 to 7,500	41.2	11.8	25.6	20.5	30.4	17.8
7,501 to 10,000	17.6	5.9	10.3	17.9	12.5	14.3
10,001 to 12,500	5.9	11.8	0.0	12.8	1.8	12.5
12,501 to 15,000	0.0	17.6	0.0	5.1	0.0	8.9
15,501 to 17,500	5.0	0.0	0.0	5.1	1.8	3.6
17,501 to 20,000	0.0	23.5	0.0	2.7	0.0	8.9
20,001 to 22,500	0.0	0.0	0.0	2.7	0.0	1.8
22,501 to 25,000	0.0	5.9	0.0	5.1	0.0	5.4
25,501 to 27,500	0.0	0.0	0.0	5.1	0.0	3.6
27,501 to 30,000	0.0	0.0	0.0	0.0	0.0	0.0
30,001 plus	0.0	23.5	0.0	5.1	0.0	10.7
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average Income	$6,731	$21,443	$4,509	$12,063	$5,183	$14,910

Difference in total family income between adopters and non-adopters in 1963.

$t = 2,336$, D.F. $54 > .01$

Difference in actual total family income between adopters and non-adopters in 1971.

$t = 2.336$, d.f. $54, > .01$

Changes in actual family income between 1963-1970 for non-adopters.

$t = 3.607$, d.f. $39, > .01$

Changes in actual total family income between 1963-1970 for adopters.

$t = 3.893$, d.f. $17, > .01$

Changes in the amount of increase or decrease in actual total family income between adopters and non-adopters during period 1963-1970.

$t = 4.278$, d.f. $54, > .01$

The Gini Coefficient for income concentration in 1963 is: .275
The Gini Coefficient for income concentration in 1970 is: .443

TABLE 3. Changes in Real Total Family Income for Adopters and Non-adopters in New Coffee Varieties, Támesis, Colombia, 1963-1970

	Adopters		Non-Adopters		Total	
	1963 (N=17)	1970 (N=39)	1963 (N=17)	1970 (N=39)	1963 (N=17)	1970 (N=39)
0 to 2,500	5.9	0.0	23.1	20.5	17.9	14.3
2,501 to 5,000	23.5	17.6	41.0	33.3	35.6	28.5
5,001 to 7,500	41.2	23.5	25.6	15.4	30.4	17.9
7,501 to 10,000	17.6	23.6	10.3	10.2	12.5	14.3
10,001 to 12,500	5.9	11.8	0.0	7.6	1.8	8.9
12,501 to 15,000	0.0	0.0	0.0	7.6	0.0	5.4
15,001 to 17,500	5.9	0.0	0.0	2.7	1.8	1.8
17,501 to 20,000	0.0	5.9	0.0	0.0	5.9	1.8
20,001 to 22,500	0.0	0.0	0.0	0.0	0.0	0.0
22,501 to 25,000	0.0	17.6	0.0	2.7	0.0	7.1
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average Income	$6,731	$11,620	$4,509	$6,274	$5,183	$7,897

Difference in real family income between adopters and non-adopters in 1963.

$t = 2.335$, d.f. 54, $> .01$

Difference in real family income between adopters and non-adopters in 1971.

$t = 2.479$, d.f. 54, $> .01$

Changes in real family income between 1963-1970 for non-adopters.

$t = 1.996$, d.f. 39 n.s.

Changes in real family income between 1963-1970 for adopters.

$t = 2.284$, d.f. 17, $> .01$

Changes in the amount of increase or decrease in real family income between adopters and non-adopters during 1963-1970.

$t = 3.884$, d.f. 54, $> .01$

TABLE 4. Changes in Actual Net Income for Coffee per Acre of Coffee Production for Adopters and Non-Adopters of New Coffee Varieties, Támesis, Colombia, 1963-1971

Income per Acre from Coffee Production	1963			1971		
	Adopters (N=17)	Non-Adopters (N=39)	Total (N=56)	Adopters (N=17)	Non-Adopters (N=39)	Total (N=56)
0 to 250	35.3%	41.0%	39.3%	0.0%	15.4%	10.7%
251 to 500	52.9	53.9	53.6	5.9	15.4	12.5
501 to 1,000	11.8	5.1	7.1	17.6	53.9	42.8
1,001 to 1,500	0.0	0.0	0.0	23.5	12.8	16.1
1,501 to 2,000	0.0	0.0	0.0	5.9	2.5	3.6
2,001 to 2,500	0.0	0.0	0.0	35.3	0.0	10.7
2,501 plus	0.0	0.0	0.0	11.8	0.0	3.6
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average Income per Acre of Coffee Production	$290	$222	$242	$1,642	$632	$938

Difference in net income per acre between adopters and non-adopters in 1963.

$t = 1.421$, d.f. 54 n.s.

Difference in net income per acre between adopters and non-adopters in 1971.

$t = 7.777$, d.f. 54, $> .001$

Changes in net income per acre between 1963-1970 for non-adopters.

$t = 4.709$, d.f. 39, $> .01$

Changes in net income per acre between 1963-1970 for adopters.

$t = 6.437$, d.f. 17, $> .001$

Changes in the amount of increase or decrease in net income per acre between adopters and non-adopters during 1963-1970.

$t = 9.185$, d.f. 54, $> .001$

TABLE 5. Changes in Farm Acreage for Adopters and Non-Adopters of New Coffee Varieties, Tamesis, Colombia, 1963-1970

Acres in Farm	Adopters		Non-Adopters		Total	
	1963 (N=17)	1970 (N=39)	1963 (N=17)	1970 (N=39)	1963 (N=17)	1970 (N=39)
0 to 5	17.6%	17.6%	64.2%	64.2%	50.0%	50.0%
5.1 to 10	11.8	17.6	12.8	17.8	12.5	17.8
10.1 to 15	11.8	17.6	10.2	2.6	10.7	7.1
15.1 to 20	17.6	0.0	2.6	2.6	7.1	1.8
20.1 to 25	17.6	16.6	0.0	0.0	5.4	5.5
25 plus	23.6	29.6	10.2	12.8	14.3	17.8
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average number of Acres	18.86	33.13[a]	7.97	6.42[b]	11.28	14.42

[a] Three farmers accounted for most of this increase. On the other hand five farmers who owned and rented land stopped renting and more intensively farm their own land.

[b] This mean is computed on the basis of 38 farmers. One landless farmer inherited 79 acres and was dropped from the analysis. With this individual included the average farm size for non-adopters in 1971 was 8.28 acres.

Difference in amount of land between adopters and non-adopters in 1963.

$t = 3.503$, d.f. 54, $> .001$

Difference in amount of land between adopters and non-adopters in 1971.

$t = 4.021$, d.f. 54, $> .001$

Changes in amount of land between 1963-1970 for non-adopters.

$t = .601$, d.f. 32, n.s.

Changes in amount of land between 1963-1970 for adopters.

$t = 1.969$, d.f. 17, $> .05$

Changes in the amount of increase or decrease in land between adopters and non-adopters during the period 1963-1970.

$t = 2.019$, d.f. 54, $> .05$

The Gini Coefficient for land concentration in 1963 is .706.

The Gini Coefficient for land concentration in 1970 is .859.

TABLE 6. Interrelationship of Total Credit Used of Credit Asked for and Received, Perception of Credit Availability and Adoption of New Coffee Varieties.

Variables	Variables			
	1	2	3	4
1. Total Credit Used	1.000	.459**	.333**	.413**
2. Percent of Credit Asked for and Received		1.000	.437**	.339**
3. Perception of Credit Availability			1.000	.607**
4. Adoption				1.000

** Significant at .05 percent level.