Technological Change and Agricultural Household Income Distribution: Evidence from Hybrid Rice Innovation in China

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Abstract

This paper applies a simple two-household-two-product general equilibrium model to analyze the impact of new rice technology on household income and uses agricultural household survey data from China to test the implications of this model. The theoretical model and the empirical results show that, when a new rice technology becomes available, the agricultural households with comparative advantages in adopting this new technology will adopt it and reallocate resources to increase rice production and reduce the production of other goods. Meanwhile, the non-adopting households will do just the opposite. As a consequence of the adjustment in production mixes in the adopting and non-adopting households, the income from rice becomes increasingly concentrated in the adopting households and income from non-rice becomes increasingly concentrated in the non-adopting households. Therefore, if only one source of income is examined, the introduction of new rice technology increases the inequality of income distribution in rural areas. However, due to the offsetting effect in the adjustments, if the total household income is examined, the distributional inequality is mitigated. The policy implications of the findings are also discussed.

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I. Introduction

The introduction of new rice technology since the 1960s, often referred to as the "Green Revolution," has enabled the densely populated Asian countries to meet the food demand arising from both rapid population growth and increase in per capita income. Whereas the impact of modern rice technology on productivity is unequivocal, much debate continues to surround the question of its equity implications. On the one hand, some authors argue that the income benefits from modern rice technology have been unequally distributed, favoring large over small farmers and those areas with assured irrigation over those without it, or they argue that the technology is scale neutral and that effects on distributional equity are dependent on the access farmers have to the necessary inputs, including credit (Rao 1976, Grabowwski 1979, Griffin 1974, Pears 1980, Lipton and Longhoust 1989). On the other hand, some authors argue that, although small farmers and tenants may initially lag behind large farmers in the adoption process, with experience they soon catch up and ultimately the adoption process becomes invariant regarding the size of the farm or the tenurial status of the farmer, and these authors argue that the poor may be benefitted in the long run by reducing the prices of food grains (Mellor 1978, Hayami and Herdt 1977, Ruttan 1978).

Most of the empirical studies mentioned above focus solely on the impact of rice production on the distribution of income between adopter and non-adopter and between laborer and landowner. However, one of the main characteristics of an agricultural household in the developing countries is its incomplete specialization in production (Hymer and Resnick 1969). Most agricultural households obtain only part of their incomes from rice cultivation, earnings from non-rice agricultural activities and off-farm activities constitute a substantial portion of their incomes (Shand 1986, Anderson and Leiserson 1980). The purpose of this paper is to examine the impact of modern rice technology on income distribution using a multi-sector framework. It will be shown that the conclusion from a one-sector model may not be valid in a multi-sector setting. The essence of the arguments is as follows: the introduction of modern rice technology may result in a change in a household's production mix. A household with comparative advantages in adopting modern rice technology may adopt it and reallocate resources away from non-rice production in order to increase the production of rice, whereas a household without these comparative advantages may shift its production away from rice to other goods. Therefore, the introduction of modern rice technology contributes to an increased concentration of income, viewed from a single sector, be it in rice or other goods. However, if the total household income is considered, the concentration will be reduced.

The organization of the paper is as follows: the next section presents a simple two-household-two-goods model. The impact of technological change on household income distribution is examined in a general equilibrium context, and several testable hypotheses are derived. The model is followed by a description of the data set, collected from 500 households in Hunan Province, China. The modern rice technology in the data set refers to the innovation of F_1 hybrid rice seeds. The subsequent section presents the empirical analysis. The last section summarizes the results and discusses their implications.

II. A Model of Technological Innovation and Household Income Distribution

Most analytical models involving the impact of technological change on income distribution focus on the distributional effects among producers of a given region, producers versus consumers, or landowners versus workers, or on the distributional consequences among regions (Hayami and Herdt 1977, Evenson 1978, Binswanger 1980, Quizon and Binsanger 1983). The analytical model presented in this section, however, will concentrate on the distributional impact from changes in a household's production mix. For simplicity, I will consider a simple two-household-two-goods model in a general equilibrium context.

The basic model is as follows: a household i (1 or 2) owns a vector of predetermined endowments E_i, including land, labor, human and physical capital, and so on. With this set of endowments, a household can produce two goods, non-rice (y_{i1}) and rice (y_{i2}), according to its production possibility curve.

$$y_{i1} = F_i\ (y_{i2} \mid E_i) \tag{1}$$

The input requirements for these two goods are assumed to be different. For example, rice is more land-intensive than non-rice, whereas non-rice is more labor-intensive than rice. Because the endowment structure is different between these two households, the comparative advantages in producing these two goods are different. For the purpose of exposition, household 1 is assumed to have comparative advantages in rice production and household 2 in non-rice production, as shown in figure 1.

To set forth the argument in the clearest way, I will assume that no factor market exists but that the product markets are perfect. Therefore, all exchanges between these two households are made through the product markets. Without loss of generality, the price of non-rice is assumed to be unity, and the price of rice is p. The total income for household *i* is

$$I_i = y_{i1} + p\, y_{i2}. \tag{2}$$

Household *i* is assumed to derive utility u_i from consumption of non-rice (x_{i1}) and rice (x_{i2}) with the budget constraint

$$x_{i1} + x_{i2} = I_i = y_{i1} + p\, y_{i2}. \tag{3}$$

Expression (3) can also be expressed in a different way

$$(x_{i1} - y_{i1}) + p(x_{i2} - y_{i2}) = 0. \tag{3'}$$

Let us call the difference between household *i*'s desired consumption x_{ij} and its production, y_{ij}, its excess demand for the *j*th good. If this is positive, the difference measures household *i*'s market demand for the *j*th good; if it is negative, it measures household *i*'s market supply. From the budget equation (3'), the value of a household's market demands must equal the value of its market supplies.

Each household chooses a production mix and consumption mix to maximize its own utility according to its preferences, endowments, production technology, and the prices it faces. From the Walras's law, a market equilibrium p^* exists to clear the rice market, and at the same time the non-rice market is cleared.

The equilibrium is depicted in figure 1. At the equilibrium market price, p^*, household 1's production mix is (y_{11}, y_{12}) and household 1 is a net demander for non-rice and a net supplier of rice in the markets. Household 2's production mix is (y_{21}, y_{22}) and its market demand and supply are just the opposite to household 1. For simplicity, x_{ij}s are not indicated in the figure.

Suppose now that, a new rice technology becomes available. Like most new technologies, it has a higher yield than the original technology but is risky and requires certain costs to learn. The new technology is assumed to favor household 1 because of that household's endowment structure. As a result, household 1 adopts the new technology and expands its production possibility curve, as shown by the dotted curve, whereas household 2 does not adopt this new technology. The impact of this technological change on the income and welfare of these two households can be depicted diagrammatically.

First, at the original equilibrium price p^*, the total demand for both goods will be the same as usual, but the supply of rice from household 1 increases. The new equilibrium market price $p^{*\prime}$, which clears both markets, shall be lower than p^*. How much the equilibrium price of rice falls depends on both households' marginal propensities to consume rice and non-rice. Under the new equilibrium price $p^{*\prime}$, the production mix for household 1 is (y'_{11}, y'_{12}) and for household 2 is (y'_{21}, y'_{22}).

Compared with the original production mixes, we can conclude that, for household 2, $y'_{21} > y_{21}$ and $y'_{22} < y_{22}$ and that, for household 1, definitely $y'_{12} > y_{12}$ but y'_{11} can be greater than, less than, or equal to y_{11}. However, if the fall in equilibrium p is moderate, it is likely that $y'_{11} < y_{11}$. Therefore, if only the rice income is considered, the technological innovation contributes to the increasing concentration of income in the adopting household, as claimed by many previous studies. But the non-rice income is likely to concentrate increasingly in the non-adopting household as a result of adjustments in the production mixes by both households. Due to the offsetting effects of these adjustments, the claim--based solely on the distribution of rice income--that the new rice technology contributes to distributional inequality in the rural areas is overexaggerated. It is likely that the new technology's impact on the relative income positions of these two households is negligible, even though the new rice technology is adopted by only one household. How much the distributional equity between the adopting and non-adopting households is affected is an empirical issue.

Two testable hypotheses related to the distribution of household income are in order:

Hypothesis 1: When a new rice technology becomes available, the agricultural households with comparative advantages in adopting this new technology will adopt it, and reallocate resources away from non-rice production to rice production. On the contrary, the non-adopting households will shift their production away from rice to non-rice production.

Hypothesis 2: Due to the opposing directions of adjustment in the production mixes of the adopting and non-adopting households, the income from rice becomes increasingly concentrated in the adopting households and the income from non-rice becomes increasingly concentrated in the non-adopting households. Therefore, the individual components of household income have a significantly larger distributional inequality than the total household income.

III. Data

I will use agricultural household survey data from China to test the above hypotheses. Modern rice technology in this study refers to the hybrid rice seeds. Despite many problems inherited in China's socialist economy, rice research and breeding in China have been very successful. In 1964, China began a full-scale distribution of the fertilizer-responsive, lodging-resistant semi-dwarf rice varieties with high-yield potential, two years before the International Rice Research Institute introduced them. By the end of the 1970s, the semi-dwarf varieties were planted to more than 80 percent of rice acreage in China. The full-scale dissemination of F_1 hybrid rice seeds in 1976 marked the beginning of a new stage of rice breeding and extension in China. So far, China is the only country in the world in which hybrid rice seeds are used in commercial production. In 1987, about 34 percent of the rice acreage in China was planted with F_1 hybrid rice.[1] Under the same input application levels, F_1 hybrids are found to have about 20 percent yield advantage over the conventional semi-dwarf varieties. (Lin 1991 c, He et al., 1984 and 1987)

The data that will be used to test the above hypotheses come from a cross-sectional survey of 500 households in five counties of Hunan province conducted by the author during December 1988 and January 1989.[2] Hunan province is located on the middle reaches of the Yangtze River in South China. It has a semi-tropical climate. The province is divided juridically into 105 counties in three types of geographic setting-- lake-plain, hill, and mountain. Among the five counties in the data set, two are selected from the lake-plain region, two from the hill region, and one from the mountain region. These five counties were selected from the provincial sample of 34 counties surveyed annually by the State Household Investigation Team. Samples of 100 households, selected randomly, from each of these five counties, were included in the data set. The main characteristics of the sample households are reported in table

[1]For a detailed discussion of the invention, extension, and adoption of F_1 hybrid rice technology, see Lin (1991 a and b).

[2]See Lin (1991 a) for a more detailed description of the data set.

1. Of the total 500 households, 495 devoted part of their land to rice. Detailed information on the number of households adopting and not adopting hybrid seeds in each of the five counties in 1988 is reported in the last two rows of table 1.

Table 2 reports the average annual income per household in these five counties. Agricultural income in the table includes revenues from rice, cashcrop, forestry, household sideline production, animal husbandry, and off-farm agricultural employment.[3] Non-farm income includes wages from non-farm employment, revenues from household non-farm business, and transfers. In the calculation of revenues, costs for material inputs and payments to hired services are deducted from the gross revenues; however, the costs for the family labor, capital service, and land rent are not deducted. From the table we find that rice is undoubtedly the most important source of income in the sample households.[4] However, on average, about one-half to two-thirds of the household income is from non-rice activities.

This data set represents an unusual opportunity to test the implications of the above model. This is not only because households in the samples derive their income from rice and from several other sources but also because exchanges in land and labor markets were inhibited in rural China. Before the reforms in the 1980s, such exchanges were outlawed for ideological reasons.

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[3]The price that is used to calculate the revenue of rice is the average price received by the agricultural households. It is a weighted average of the state quota price and the above quota price. In 1988, the average price was .611 yuan/kg.

[4]County 5 has the highest adoption rate of hybrid rice as shown in table 1. However, the contribution of rice income to total household income is smallest because the mountain climate dictates that the county can grow only one season of rice annually, whereas the other four counties grow two seasons of rice annually.

There has been a relaxation in land- and labor-market regulations. However, exchanges in land and labor markets are still very limited (Lin 1989). As shown in table 2, on average, a household obtains less than one percent of its income from off-farm agricultural employment. The income from land rent is even more negligible. Therefore, the impact of hybrid rice technology on the distributional equity of household income can function only through the mechanism discussed in the previous section. This data set, however, also has a limitation: a household's adjustment in its production mix in response to the change in technology may take several years. The data has one year's observation only. Therefore, we are unable to trace the dynamic path of the adjustment. Although the hybrid rice technology has been available in the study area for more than a decade and thus the adjustment may have approached the new equilibrium point, caution needs to be exercised in drawing conclusions on the basis of only one year's observation.

IV. Empirical Analysis

To examine hypotheses 1, we need to investigate how the hybrid rice technology affects various sources of income across adopting and non-adopting households. To examine the second hypothesis, we need to compare some measure of the distribution equity of rice income with that of non-rice income, as well as with that of total household income. For the purpose of the present study, the total household income will be subdivided into three components: rice income, non-rice agricultural income, and non-farm income, as shown in table 2.

Hypothesis 1

From the model in Section II, we see that a household's production of rice and non-rice is a function of the household's predetermined endowments.

Therefore, a household's income from each source is also a function of the household's predetermined endowments. To examine the effect of hybrid rice technology on household income, we need to include a dummy in the income determination function indicating whether a household is an adopter of hybrid rice seeds. Aside from a household's predetermined endowments and the adoption dummy, in a cross-sectional data set a household's income may also depend on some region-specific variables that are not observable to an econometrician. Therefore, four county dummies will be included in the income determination functions to capture the region-specific effects. The resulting equations for the determination of a household's rice income, non-rice agricultural income, non-farm income, and total income can be expressed in a similar form as that which follows:

$$\begin{aligned} \text{Ln Income} = {} & a_0 + a_1 C_1 + \ldots + a_4\, C_4 + a_5\, \text{LnLand} + a_6\, \text{LnLabor} + \\ & a_7\, \text{Capital} + a_8\, \text{Female Dummy} + a_9\, \text{Age} + \\ & a_{10}\, \text{Schooling} + a_{11}\, \text{Adoption Dummy} + \underline{u}, \end{aligned} \tag{4}$$

where a_js are the coefficients to be estimated; a_0 is an intercept term; C_1 to C_4 are county dummies; regressors 5 to 7 are a household's production endowments, including the size of landholding, the size of the labor force, and the value of farm capital stock; regressors 8 to 10 represent a household head's personal characteristics, including the dummy for gender, age, and years of schooling of the household head; regressor 11 is a dummy variable indicating whether a household adopted hybrid rice; and the last term, $\underline{u}$, is a residual. Both dependent and independent variables in the equation, expect for the dummy variables, are in logarithm form.

If the adoption of hybrid rice is exogenous, OLS is the appropriate method for fitting the regression functions. However, as argued in the theoretical model, the decision of whether to adopt hybrid rice is endogenous. In a separate study, it is found that the adoption decision is positively and significantly affected by a farm's land size, a household head's schooling, and a household's obligation of selling a certain quota of rice to the government at a state-determined price (Lin 1991 a). To obtain consistent estimates of the parameters, first we need to obtain predicted values of hybrid rice adoption based on the adoption function estimated by probit procedures, and then we need to use the predicted value as an instrument variable to estimate the parameters of the income determination functions. The results of fitting the income determination functions by this two-stage procedure are reported in table 3. The following major conclusions can be drawn from the regression results.

Comparing the income of adopting households with the income of non-adopting households and holding other factors constant, we find that the adoption of hybrid rice technology has a positive and significant effect on a household's income from rice production; however, it also has significantly negative effects on incomes from non-rice agricultural production and non-farm activities. These results are consistent with the prediction of hypothesis 1 which states that the households with comparative advantages in adopting the new rice technology adopt the technology and shift their production away from non-rice to rice, whereas the non-adopting households do the opposite. Furthermore, the estimate of the hybrid rice dummy and its related t-statistics in the last column of table 3 also shows that, as a result of these two offsetting impacts on rice income and non-rice income, the introduction of hybrid rice technology does not result in a significant difference in the total household income of the adopting households and the non-adopting households. Therefore, from the viewpoint of total household income, the introduction of hybrid rice technology does not contribute to any deterioration in distributional equity in the study areas.

It is interesting to note that a similar adjustment process in the production mix in response to a household's endowment structure can also be observed from the regression estimations. From column 1, we found that the size of a household's landholding is the most important factor determining a household's income from rice. The estimated coefficient of landholding indicates that a 10-percent difference in the size of landholding results in a 6 percent difference in a household's income from rice. However, the size of a household's landholding has a significantly negative effect on its non-farm income. The opposite signs suggest that households with small landholding shift their labor and other resources from land-intensive rice cultivation to less land-intensive, non-farm activities. As a result, the coefficient of landholding drops from .60 in the rice income determination equation to .37 in the total household income equation, while the coefficient of labor force increases from .23 to .38 in the same equations.[5]

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[5]The signs and coefficients of other explanatory variables in table 3 also provide interesting information about the determination of household income. Capital contributes positively and significantly to total household income; the impact is derived from the positive effect on non-rice agricultural income and non-farm income. The effect of capital stock on rice income is insignificant. The female dummy has a positive and significant impact on the total household income. The main reason for this positive impact is because a female household head obtains significantly more remittance--a component of non-farm income--than a male household head. On average, a female household head receives 838.67 yuan annually, compared with 255.73 yuan for a male household head. The age of a household head--a proxy for farming experience--does not have a significant effect on household income. However, it contributes positively to non-farm income. As in the case of the female dummy, the remittance is positively correlated with the age of the household head. The education of a household head is a significant variable in the

Hypothesis 2

Hypothesis 2 suggests that the introduction of new rice technology results in opposing directions of adjustment in the production mixes of adopting and non-adopting households; consequently, the distributional inequality of individual income components will be larger than the total household income. To examine this hypothesis, a measure of distributional inequality is required. The most commonly used measure is the Gini coefficient. Table 4 reports the Gini coefficient of total household income and its decomposition into coefficients of rice, non-rice agricultural, and non-farm incomes. The decomposition follows the procedure proposed by Fei, Ranis, and Kuo (1978).

Table 4 shows that the Gini coefficients of total household income in these five counties range from .21 to .25. The Gini coefficient of total household income is substantially lower than the Gini coefficients of rice income, non-rice agricultural income, and non-farm income in each of the five counties, except for the Gini coefficient of rice income in County 2. The same observation holds when the data of these five counties are pooled together. This evidence is consistent with the implications of hypothesis 2 and further confirms the existence of adjustments in the production mix in response to a household's comparative advantages in production arising from technological adoption and/or the endowment structure.

V. Concluding Remarks

A simple two-household-two-product general equilibrium model is developed

determination of total household income. Its positive impact mainly derives from the positive effect on non-farm income. The effect of education on non-rice agricultural income and rice income is insignificant. This evidence suggests that farmers with higher education have better job mobility. Education enables them to utilise the opportunities arising from non-farm sectors.

in this paper to analyze the impact on distributional equity of a new rice technology, which favors one household. The implications of the model were tested with data collected from a sample of 500 households from five counties in Hunan province, China. The empirical results are consistent with the implications of the theoretical model: when a new rice technology becomes available, the agricultural households with comparative advantages in adopting this new technology will adopt it and reallocate resources away from non-rice production in order to increase the production of rice. Meanwhile, the non-adopting households do just the opposite. As a consequence of the adjustments in the production mixes of adopting and non-adopting households the income from rice becomes increasingly concentrated in the adopting households, whereas the income from non-rice becomes increasingly concentrated in the non-adopting household. Therefore, if only one source of income is examined, the introduction of new rice technology seems to increase the distributional inequality. However, due to the offsetting effect of production-mix adjustments, if the total household income is examined, the distributional inequality is mitigated.

The findings in the paper have several implications for the design of rural development policies. The often-cited claim that the Green Revolution contributes to the inequality of income distribution in rural areas because it favors the well-off groups of farmers is tenuous. Even the poorest section of the rural population obtains a substantial portion of its income from non-rice and non-farm activities. The poor will also be benefitted by the new rice-technology as long as it is possible for them to adjust their production mixes so as to increase specialization on goods or activities over which they have comparative advantages. Therefore, the proposal for increasing research on rice technology directly targeting unfavorable environments or underprivileged groups may be unfounded.[6] A more efficient policy may be to improve education, transportation, and the infrastructure in rural areas so as to facilitate the expansion of product markets and to offer opportunities for the poor to increase the production of non-rice crops or engage in non-farm activities.

[6]The social optimal requires that the following factors be taken into consideration in the allocation of resources among breeding programs: a) the costs and time span of the breeding program and its likelihood of successfully finding a new variety, b) the yield potential of the new variety and the area size in which the new variety is applicable, and c) the distributional impact of the new variety. According to the present study, less weight should be given to the third consideration than previous studies, for example Rao (1976), suggested.

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Table 1: Characteristics of Sample Farm Households

	Hill		Lake-plain		Mountain
	County 1 (N=100)	County 2 (N=100)	County 3 (N=100)	County 4 (N=100)	County 5 (N=100)
Mean household size (person)	4.28 (.92)	4.26 (1.41)	4.59 (1.20)	4.60 (1.22)	4.20 (1.21)
Mean labor force (person)	3.11 (1.08)	3.32 (1.28)	3.40 (1.21)	3.61 (1.30)	3.26 (1.23)
Mean farm size (ha)	.33 (.15)	.31 (.11)	.54 (.20)	.56 (.20)	.40 (.17)
% of paddy land	79.3	83.4	72.8	73.0	78.1
Hybrid Rice					
Adopter	78	67	64	93	99
Non-adopter	22	33	36	7	1

Note: Figures in the parentheses are standard errors.

Table 2: Average Annual Farm Household Income by Source

	Hill		Lake-plain		Mountain
	County 1	County 2	County 3	County 4	County 5
Total household income	**3584.08** (1486.55)	**3333.77** (1461.70)	**3063.91** (1140.94)	**3660.50** (1465.64)	**2543.32** (1170.39)
Agricultural income:					
Rice income	**1186.61** (491.50)	**1484.88** (615.66)	**1547.08** (1003.38)	**1943.46** (891.61)	**826.28** (515.94)
Non-rice agri. income:	**1045.50** (617.15)	**864.49** (462.83)	**934.24** (484.78)	**974.75** (508.40)	**1073.99** (744.80)
Cashcrop	271.87 (195.92)	191.16 (168.82)	565.35 (311.32)	503.96 (295.46)	435.85 (341.64)
Forestry	34.10 (55.93)	49.46 (113.50)	0	0	180.31 (218.31)
Husbandry + sidelines	735.90 (543.06)	608.37 (394.28)	345.82 (364.88)	470.79 (365.83)	447.68 (564.42)
Off-farm agr. employ.	3.62 (15.86)	15.50 (86.41)	23.07 (111.36)	0	10.15 (32.64)
Non-farm income:	**1351.98** (1267.65)	**984.40** (1202.96)	**582.59** (596.28)	**742.28** (1063.55)	**643.05** (764.07)
Non-farm employment	153.88 (420.12)	94.23 (401.30)	63.82 (272.28)	72.73 (279.10)	89.55 (362.98)
Non-farm business	792.23 (834.56)	520.97 (698.53)	284.92 (353.13)	365.51 (594.56)	482.86 (633.57)
Transfer	405.87 (711.52)	369.20 (789.01)	233.85 (429.92)	304.04 (561.57)	70.64 (269.36)

Note: Figures in the parentheses are standard errors.

Table 3: Instrumental Variable Estimates of the Impact of Hybrid Rice Adoption on Income Determination

	Rice Income (Ln)	Non-Rice Agri. Income (Ln)	Non-Farm Income (Ln)	Total Household Income (Ln)
Constant	4.05	5.01	4.73	6.00
	(7.37)***	(8.02)***	(3.20)***	(18.92)***
C1	.39	-.24	-1.10	-.08
	(4.41)***	(2.39)**	(4.65)***	(1.63)*
C2	-.04	-.41	-1.10	-.32
	(.43)	(3.52)***	(4.01)***	(5.37)***
C3	-.06	-.15	-.63	-.19
	(.62)	(1.35)	(2.48)**	(3.44)***
C4	-.86	.09	-.65	-.44
	(8.43)***	(.74)	(2.38)**	(7.47)***
Ln Landholding	.60	.38	-.38	.37
	(7.41)***	(4.11)***	(1.75)*	(7.88)***
Ln Labor Force	.23	.23	.95	.38
	(2.62)***	(2.33)**	(4.07)***	(7.54)***
Ln Capital Stock	-.002	.05	.10	.03
	(.07)	(1.98)*	(1.73)*	(2.41)**
Female dummy	-.11	.03	.77	.27
	(.74)	(.19)	(1.98)*	(3.25)**
Ln Age	-.14	.04	.65	-.02
	(1.12)	(.31)	(1.96)*	(.34)
Ln Schooling Year	-.06	.07	.56	.10
	(.90)	(.98)	(3.39)***	(2.91)**
Hybrid Rice Adoption Dummy	1.32	-.58	-1.83	.04
	(4.70)***	(1.81)*	(2.42)**	(.27)

Note: Figures in the parentheses are absolute values of t-statistics. *,**, and *** indicate that the estimates are significantly different from zero at the .1, .01, and .001 levels of confidence.

Table 4: Gini Coefficients of the total Household Income and of the Income Components

	Component Gini (1)	Income Share (2)	Rank Correlation (3)	Gini Decomposition (4)= (1)x(2)x(3)
County 1:				
Rice income	.226	.331	.620	.046
Non-rice agri. income	.317	.292	.509	.047
Non-farm income	.456	.377	.721	.124
Total income	-	1.00	-	.217
County 2:				
Rice income	.232	.445	.679	.070
Non-rice agri. income	.299	.260	.455	.035
Non-farm income	.558	.295	.772	.128
Total income	-	1.000	-	.234
County 3:				
Rice income	.367	.505	.755	.140
Non-rice agri. income	.283	.305	.335	.029
Non-farm income	.516	.190	.419	.040
Total income	-	1.000	-	.209
County 4:				
Rice income	.246	.531	.736	.096
Non-rice agri. income	.275	.267	.512	.038
Non-farm income	.570	.202	.617	.071
Total income	-	1.000	-	.205
County 5:				
Rice income	.335	.325	.653	.071
Non-rice agri. income	.326	.421	.609	.083
Non-farm income	.574	.253	.688	.100
Total income	-	1.000	-	.254
Aggregate:				
Rice income	.322	.432	.687	.096
Non-rice agri. income	.304	.302	.455	.042

Non-farm income	.552	.266	.656	.096
Total income	-	1.000	-	.234

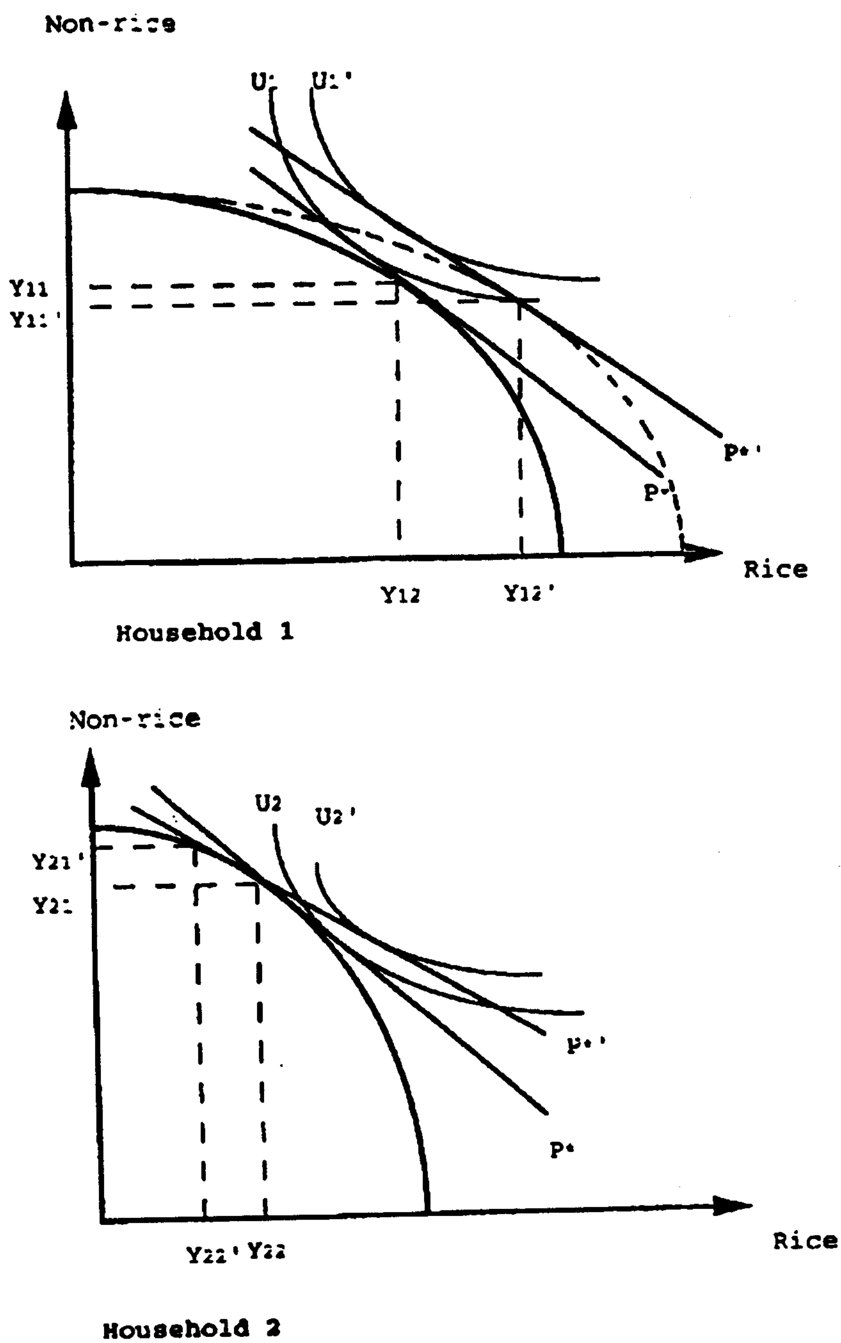

Figure 1: The Impact of Technological Change on Production-Mixes