Since land and human capital are the two most important resources in rural areas, it is essential to increase the amount of land and human capital owned by the poor and to increase wage rates for them by increasing labor demand, in order to reduce rural poverty. The major policy means to achieve such goals are land reform, investment in agricultural research, investment in human capital, and promotion of rural industrialization. Policies intended to reduce rural poverty, however, are often ineffective and sometimes result in adverse consequences. The major purposes of this paper are to identify major flaws of the existing policies and to derive policy implications for more effective poverty reduction, through a survey of the literature on land reform and land tenancy, agricultural research, human capital investment, and rural industrialization.

I. INTRODUCTION

Since income basically consists of the sum of returns to owned resources, including both physical and human assets, it is determined by the amount of owned resources and the rates of returns to those resources or factor scarcities reflected in factor prices. Important assets in rural areas are land and human capital. Thus, the agricultural landless laborers are generally poor because they do not own land (David and Otsuka 1994, Hayami and Otsuka 1993a). Furthermore, in general, they possess smaller amounts of human capital. Landless tenants are generally wealthier than landless laborers, because tenants tend to engage in management-intensive activities requiring human capital, such as fertilizer application and water control, whereas landless laborers tend to engage in simple tasks, such as weeding and harvesting. Farmers in low-potential or agriculturally marginal areas, which tend to be located in remote areas, are poor primarily because

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returns to land and labor tend to be low or the quality-adjusted labor and land endowments are meager. It is also important to note that the poor spend much of their income on foods. Therefore, their welfare depends critically on the availability of cheap foods.

In order to reduce rural poverty, it is essential to increase the amount of land and human capital owned by the poor, to reduce land rent if the poor are tenants, to increase wage rates for the poor by increasing labor demand, and to reduce food prices by increasing food supply. The major policy means to achieve such goals are: (i) land reform, (ii) investment in agricultural research, (iii) investment in human capital or schooling, and (iv) promotion of rural industries. Land reform is supposed to transfer land or returns to land from land-rich to land-poor households. Investment in agricultural research, coupled with investment in irrigation and drainage, increases the supply of food and, in addition, the demand for labor, if developed technology is labor-using. If research successfully develops appropriate technologies for unfavorable areas, it will contribute to increases in factor returns for the poor. Investment in human capital and rural industrialization both increase labor income of the rural poor by increasing the stock of and demand for human capital.

At the outset it must be pointed out that although not explicitly covered in this paper, there are other policy instruments that can be also used to achieve poverty reduction. Investments in road and other social infrastructures can increase access to labor markets for the poor. Provision of microenterprise credit to poor rural households that are credit-constrained may be able to increase the returns to labor held by the rural poor.

While the theoretical consideration to reduce rural poverty is simple and straightforward, actual policies intended to reduce rural poverty often result in adverse consequences. The first purpose of this paper is to review critically the impacts of existing land reform programs on the welfare of the poor with a view to suggesting the design of desirable land reform programs. The second purpose is to reconsider the role of agricultural research in poverty reduction based on the experience of the rice Green Revolution in Asia. Finally, the importance of human capital investment and the development of rural industries to reduce rural poverty will be discussed.

II. LAND REFORM

A. Common Features of Land Reform Programs

Land reform programs in Asia typically consist of tenancy reform and land redistribution programs. Tenancy reform rules out the practice of share tenancy.

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1This section draws partly on Otsuka (1993).
regulates the leasehold rent at a low level, and prohibits the eviction of tenants. The land redistribution policy sets the ceiling on the maximum land holding and transfers the ownership right of land in excess of the ceiling to the actual cultivators. In order to “protect” or preserve the status of land reform beneficiaries, transaction of tenancy rights including new leasing and subleasing is prohibited by law. Another common feature is that areas under owner cultivation are exempted from land reform, which permits large owner-cultivation with the employment of hired labor. These features of the Asian land reform programs are widely shared by land reforms laws in a number of Asian countries (Ladejinsky 1977; Herring 1983; Prosterman and Riedinger 1987; Hayami, Quisumbing, and Adriano 1990; Riedinger 1995).

Land reform programs have the twin objectives of reducing rural poverty by transferring wealth from the landed class to landless tenants, and achieving higher production efficiency by converting share tenancy to owner cultivation as well as leasehold tenancy. There are two important presumptions justifying these programs. First, the tenants belong to the poorest segment of rural society. Second, share tenancy is less efficient than leasehold tenancy and owner cultivation, even with the employment of hired labor.

In general, however, these presumptions are empirically incorrect. In what follows, the paper will examine the adverse consequences of the existing land reform programs and suggest the direction of desirable changes.

B. Effects on the Landless

First of all, it must be emphasized that the poorest of the rural poor are landless laborers (David and Otsuka 1994). Yet, the conventional land reform programs are ineffective in reducing the incidence of landlessness, which is a major source of rural poverty. Clearly, a major reform is needed in the design of land reform programs so as to provide direct benefits to the landless laborers.

Second, by suppressing the option of tenancy contracts, land reform tends to induce large owner cultivation with the employment of hired labor. In fact, it is widely reported that in areas where land reform was implemented, tenants were often evicted and converted to hired laborers. Moreover, large owner-cultivation with hired labor is inefficient (Hayami and Otsuka 1993a). The inefficiency arises because it is costly to supervise the work effort of hired labor. In fact, hired laborers have weaker incentives to work than tenants, since the former receive fixed or

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2 Landlessness pertains exclusively to landless laborers, but not to landless tenants, as tenants have access to cultivation rights on land. Also note that landless households refer to landless laborer households in subsequent discussions.

3 This type of hired labor is also called permanent labor employed for at least a season or a year, whose obligation is to perform the same type of farm tasks as tenants. Permanent labor must be distinguished from hired labor employed for specific tasks.
near-fixed wages regardless of their work effort (Otsuka, Chuma, and Hayami 1993). This inefficiency is likely to explain, at least partly, why the inverse correlation often exists between farm size and productivity, in which family-labor-dependent, efficient small farms coexist with hired-labor-dependent, inefficient large farms.

Third, land reform tends to block the agricultural ladder for landless laborers to ascend by prohibiting or suppressing tenancy transactions, thereby perpetuating rural poverty (e.g., Hayami and Otsuka 1993b). When one is young, one may begin one’s farming career as a landless laborer. As he/she accumulates farming experiences and small amounts of capital, he/she may be able to become a share tenant or even a leasehold tenant. Finally, the tenant may become an owner-cultivator after acquiring larger amount of human and financial resources. Such agricultural ladder is closed if tenancy transactions are suppressed. Thus, once the landless become landless laborers or were born as children of the landless, they have little chance to become even tenants and are forced to remain poor agricultural laborers.

C. Land Reform and Share Tenancy

Contrary to the presumption of conventional land reform programs, share tenancy is generally not significantly inefficient compared with leasehold tenancy and owner-cultivation, according to the global survey of the empirical literature by Hayami and Otsuka (1993a). Traditionally share tenancy was considered inefficient in the economic literature, in view of the fact that they receive only a portion of the output, which, like proportional income tax, will reduce work incentives (Otsuka, Chuma, and Hayami 1992). Share tenancy contracts, however, are often made among the circle of extended family members and friends, and enduring personal relationships tend to deter shirking of tenants. Furthermore, more often than not, share tenancy contracts are long-term and, hence, dishonest behaviors are penalized in the long run in terms of loss of reputation in the rural communities, termination of contracts, or even ostracism. As a result, share tenants tend to work as hard as owner cultivators and leasehold tenants.

Yet, there are two well-known studies that report the significant production inefficiency of share tenancy (Bell 1977, Shaban 1987). They found significant inefficiency by comparing yields of owner-operated and share-tenanted fields of the same operators in India. In India, however, the land redistribution program, known as the land-to-the-tiller program, was implemented to transfer land from large landlords to tenants who actually cultivate the land (Ladejinsky 1977, Herring 1983). The important assumption of this program is that there is only a single tenant on each plot of tenanted land. In many areas, however, landlords shifted tenants every year or every season to prevent them from claiming that they are actual tillers of any particular plot of land (Ladejinsky 1977, Walker and Ryan
In other words, share tenancy contracts became extremely insecure as the landlords attempted to circumvent the implementation of the land-to-the-tiller program. It is precisely under these conditions that Bell and Shaban found the significant inefficiency of share tenancy.

Under the one-period contract with no possibility of contract renewal, the penalty on a tenant’s shirking is bound to be limited because future punishment, such as termination of contract, is absent. In consequence, productivity is adversely affected. Thus, significant inefficiency of share tenancy is likely to be more of a consequence of land reform regulations than of the inherent difficulty of enforcing contractual terms under a share contract. In fact, significant inefficiency of share tenancy is not found in Southeast Asia where land reform programs have seldom been implemented except in the Philippines. In this country, significantly lower profit per hectare is found under share tenancy in Central Luzon, where land reform was vigorously implemented (Estudillo and Otsuka 1999).

D. New Designs of Land Reform Programs

The major issue of land reform in Latin America and southern Africa is to transfer land from huge mechanized, commercial estates to hired laborers, who are not experienced in farm management. Binswanger and Deininger (1993) and Deininger (1999) therefore argue that land reform is much more difficult in these regions than in Asia, because inexperienced farm-laborers must be trained; in contrast, simple transfer of land rights from large landlords to experienced tenants is sufficient in Asia.

In Asia too, however, the transfer of land to inexperienced landless laborers is becoming an important agenda of land reform, if its aim is to reduce rural poverty. De Janvry et al. (2001) strongly argue in the context of Latin America that tenancy contract must be promoted to provide opportunities to manage farms for landless workers, so as to make it possible for them to ascend the agricultural ladder in the future. When contemplating the reform of dualistic farm structures in South Africa, Binswanger and Deininger (1993) and Deininger and Binswanger (2001) also develop essentially the same argument. Considering that share tenancy provides management experience to the rural poor and that the poverty associated with growing landlessness is becoming important in Asia, it is highly advisable to activate the share tenancy transactions in Asia. Thus, the first recommendation is to remove any legal obstacles to prevent or suppress share tenancy in Asia. We expect that such policies will reduce inefficiency of production on large farms with the employment of hired labor and the inefficiency of share tenancy caused by inappropriate tenancy policies. Furthermore, such policies will contribute to the reduction of severe rural poverty associated with landlessness.

Needless to say, the promotion of tenancy contracts alone cannot solve the rural poverty and income inequality associated with unequal distribution of land.
Unfortunately there are good reasons to believe that land sales market cannot reallocate land from less efficient large farms to more efficient small farms. The conventional redistributive land reform that attempts to transfer land from landlords to tenants is often ineffective and, where effective, creates adverse consequences, such as the eviction of tenants, excessive employment of hired laborers, and the adoption of labor-saving production methods to produce labor-extensive crops. A recent and detailed review of the Philippine land reform by Riedinger (1995) amply exemplifies the difficulty of implementing land reform, even if the government has a strong will to achieve land redistribution. Thus, a large number of economists recommend market-assisted land reform, which attempts to accomplish land reallocation by “voluntary” land market transactions (Hayami, Quisumbing, and Adriano; Binswanger and Deininger 1993; Deininger 1999; Deininger and Binswanger 2001; Sadoulet, Murgai, and de Janvry 2001).

“Voluntary” land markets cannot function without deliberate policy interventions in support of purchase of land by poor households. Such intervention can be justified not only on the equity ground but also by the generalizable proposition that small farms are more efficient than large farms, unless markets are unduly distorted. Thus, it is imperative to remove all the policies that favor large farms, such as the majority of formal-sector credit programs requiring land as collateral, inappropriate tax, subsidy, and marketing policies in favor of large farms. Further, it is highly recommended to support credit programs targeted specifically at the rural poor.

In order to effect massive land transfers, policy measures directly assisting land transfers, such as subsidy for the purchase of land or imposition of progressive land tax, will be indispensable. The World Bank experimented on market-assisted land reform, which provides grant or subsidy to the poor to purchase land (Deininger 1999). Hayami, Quisumbing, and Adriano (1990) propose the progressive land tax, which intends to induce land sales by large landowners. It is beyond the scope of this article to delineate the circumstances under which one policy option performs better than the other.

III. AGRICULTURAL RESEARCH

A. Lessons from Green Revolution

Agricultural research can contribute to poverty reduction in three major ways. Since the poor people spend a considerable share of their income on foods, the first objective of agricultural research should be to contribute to an increase in supply of foods by developing yield-increasing technologies. Binswanger and Quizon (1989) demonstrate that equity-enhancing effects of the Green Revolution

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4This section draws heavily on Otsuka (2000).
technology came mainly from lowered food prices due to output expansion. There is no question that the Green Revolution contributed to the declining trend of rice and other grain prices for the last three decades (Pingali, Hossain, and Gerpacio 1998). Thus, the development of high-yielding varieties must remain a critical component of the research strategy to alleviate poverty (Barker and Herdt 1985).

Second, since the poor depend primarily on labor incomes, the research should aim to increase labor demand by developing labor-using technologies. It is widely accepted that the Green Revolution technology, represented by the development and widespread adoption of modern varieties (MVs), is labor-using and land-saving, so that the share of labor income increases relative to income accrued to land. Since the land is distributed much less equally than labor among rural households, it is expected that the Green Revolution technology would contribute to the reduction in poverty as well as equalization of income distribution (Hayami and Kikuchi 1982). It is found, however, that the effect of MV adoption on labor demand is relatively modest and that the subsequent adoption of labor-saving technologies, such as tractors, threshers, and direct seeding replacing transplanting in rice production, often offset or even more than offset the earlier gains in labor demand (Otsuka, Gascon, and Asano 1994).

Third, since the poor tend to reside in unfavorable or marginal agricultural areas, the research should aim at developing technologies suitable for such areas. It is widely argued that the Green Revolution neglected the unfavorable areas, thereby worsening the poverty in such areas by reducing market prices of grains without improving technology (Lipton and Longhurst 1989). There is, however, evidence that benefits of the Green Revolution technology in favorable areas accrue to unfavorable areas through interregional labor migration from the latter to the former areas (David and Otsuka 1994, Renkow 1993). The question remains, however, as to what types of technology are suitable for marginal areas, for which research has high expected payoffs in terms of income generation and, hence, poverty reduction in such areas.

B. Favorable vs. Unfavorable Areas

Recent data comparing yields of MVs and traditional varieties (TVs), labor use, and income across production environments are rare. We examine here the community and household data collected by the International Rice Research Institute in the late 1980s (David and Otsuka 1994). Table 1 compares the MV adoption and yields of MVs and TVs across production environments in India, Philippines, and Thailand. As would be expected, the adoption rates of MVs are higher in more favorable production environments. It is also true that MVs were

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5We have chosen only these three countries because MVs completely dominated in many survey areas so that the comparison of yields of MVs and TVs is infeasible.
widely adopted in rainfed areas. According to the resurvey of the same villages in Bangladesh and the Philippines (Hossain, Sen, and Rahman 2000; Hossain, Gascon, and Marciano 2000), as well as in Thailand (Isvilanonda, Ahmad, and Hossain 2000), the same tendencies have been confirmed in recent years.

### Table 1. Adoption and Rice Yields by Variety across Production Environments in Selected Locations of Asia, 1985-87

<table>
<thead>
<tr>
<th>Location/Environment</th>
<th>MV Adoption (%)</th>
<th>Modern Varieties</th>
<th>Traditional Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Luzon and Panay islands, Philippines, 1985</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigated</td>
<td>97</td>
<td>3.6</td>
<td>2.4&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Favorable rainfed</td>
<td>99</td>
<td>3.3</td>
<td>2.2&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Unfavorable rainfed</td>
<td>40</td>
<td>2.6</td>
<td>2.0</td>
</tr>
</tbody>
</table>

| Central Thailand, 1986 | | | |
| Irrigated | 71 | 4.4 | 1.9 |
| Rainfed | 11 | 3.3 | 2.1 |
| Deep-water | 1 | 1.8 | 1.9 |

| Tamil Nadu, India, 1987 | | | |
| Canal irrigation | 100 | 5.6 | n.a. |
| Tank irrigation | 72 | 4.3 | 2.6 |
| Rainfed | 66 | 3.9 | 2.8 |

<sup>a</sup>Based on survey of 50 villages in the Philippines, 33 villages in Thailand, and 30 villages in India.

<sup>b</sup>Yields when traditional varieties were grown in the 1970s.

Source: David and Otsuka (1994).

It is important to observe that the yields of MV are higher in more favorable areas, whereas the yields of TVs are less sensitive to differences in production environments. This observation implies that the yield gains associated with MV adoption are larger, the more favorable are the production environments. Thus, as Byerlee (1996, 701) aptly points out, based on the more comprehensive literature review, “the yield advantage of MVs is lower in marginal areas.”

Recently, however, Fan and Hazell (1999) report that based on the estimation of agricultural production function, the marginal returns to agricultural research were higher for low-potential rainfed environments than for irrigated environments in India. They use district level data, define rainfed areas as areas where less than 25 percent of the area is irrigated, and use MV adoption rate as a key explanatory variable. I would like to point out that it is possible that MVs were
adopted in the irrigated portion of “rainfed” districts. It is also surprising that MV adoption was insignificant in the estimation of production function for irrigated environments but highly significant for low-potential rainfed environments (Table 4), even though the estimated total factor productivity grew faster in the former than in the latter. Moreover, the estimated coefficient is much higher for low-potential rainfed environments. Such findings are obviously inconsistent with the general observation that at present MV adoption and crop yields are higher in irrigated areas than in rainfed areas in India (e.g., Janaiah, Bose, and Agarwal 2000). Thus, while we cannot deny the potential contribution of Fan and Hazell, their findings need to be interpreted with caution before they are supported by micro-level empirical evidence.

The use of hired labor for weeding, harvesting, and other simple tasks, is closely associated with the production environments and the rate of MV adoption. This hired-labor using effect would arise partly from the short maturity of MVs, which leads to sharp peak demands for labor, and partly from the negative income effect of MV adoption on supply of family labor of farm households (David and Otsuka 1994). The increased demand for hired labor would have expanded the employment opportunities in rice production. Since the main source of hired labor is landless laborers, there is no question that the adoption of MVs in favorable production environments does contribute to the reduction in poverty.

The greater labor demand, particularly for hired labor, from modern rice technology should increase wage rates in the favorable areas faster than in the unfavorable areas, unless interregional labor migration from unfavorable to favorable areas takes place. If a labor market adjusts through interregional permanent and seasonal migration, wages will tend to equalize across production environments. In such a case, benefits from technical change in the favorable areas will be shared with people in the unfavorable areas, particularly with landless workers, who tend to be geographically more mobile than farmers. Those who remain in unfavorable areas, as well as migrant workers, benefit from MV adoption in the favorable areas because wage rates increase in unfavorable areas as a result of out-migration.

It is clear that rice research for unfavorable areas does not have high returns. Then, what types of technologies are appropriate for such areas? Although it is difficult to provide general answers to this question, an example is provided here of appropriate technology for marginal areas, specifically agroforestry growing commercial tree crops in hilly and mountainous environments.

In marginal areas shifting cultivation is often practiced. In a recently completed comparative study of Asia and Africa by Otsuka and Place (2001), it is found that agroforestry is much more profitable and efficient than shifting cultivation growing miscellaneous food crops on sloping land. They also argue that the establishment of agroforestry on degraded land will contribute to the prevention of soil erosion and the creation of biomass. Another major finding of their study is that customary or communal land tenure institutions are largely favorable or mov-
ing in the right direction to provide proper incentives to plant and manage tree crops.

Here we briefly examine the profitability of rubber agroforestry in comparison with upland rice cultivation, which is a major alternative use of upland in Western Sumatra (Quisumbing and Otsuka 2001; Suyanto, Tomich, and Otsuka 2001). As is shown in Table 2, the average profit of upland rice production is almost zero, despite the large inputs of family labor (i.e., 173 days per hectare). Yet, upland rice fields are located in relatively flat land, which is more suitable for cultivation than rubber fields located on sloping land. A major factor affecting the low profitability of upland rice cultivation is the shortening of fallow periods because of increasing population pressure and limited access to new forest land. Currently, the average fallow period is about five years, which is insufficient for restoring soil fertility.

Table 2. Gross Revenue, Residual Profit, and Labor Use per Hectare between Upland Rice Production and Rubber Agroforestry, by Age of Trees in Sumatra, 1997a

<table>
<thead>
<tr>
<th>Age of Trees</th>
<th>Gross Revenue (‘000 Rupiah)</th>
<th>Residual Profit (‘000 Rupiah)</th>
<th>Labor Use (person-days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upland rice</td>
<td>622</td>
<td>4</td>
<td>173</td>
</tr>
<tr>
<td>Rubber</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st year</td>
<td>23</td>
<td>-339</td>
<td>59</td>
</tr>
<tr>
<td>2-3</td>
<td>0</td>
<td>-193</td>
<td>33</td>
</tr>
<tr>
<td>4-7</td>
<td>0</td>
<td>-60</td>
<td>14</td>
</tr>
<tr>
<td>8-10</td>
<td>728</td>
<td>165</td>
<td>78</td>
</tr>
<tr>
<td>11-15</td>
<td>1,007</td>
<td>217</td>
<td>101</td>
</tr>
<tr>
<td>16-20</td>
<td>1,017</td>
<td>278</td>
<td>88</td>
</tr>
<tr>
<td>21-25</td>
<td>1,166</td>
<td>328</td>
<td>110</td>
</tr>
<tr>
<td>26-30</td>
<td>1,303</td>
<td>378</td>
<td>114</td>
</tr>
<tr>
<td>30-</td>
<td>964</td>
<td>284</td>
<td>91</td>
</tr>
</tbody>
</table>


In the first year of rubber field management, some annual crops are grown, which generate some revenue, but the residual profit is negative and large due to labor costs for land preparation and tree planting. Gross revenue is zero for the next several years. Most trees, if not all, begin to produce latex in the eighth year and consequently the residual profit turns positive. The internal rate of return to investment in rubber is estimated to be 15 to 20 percent, using cross-section age-profile of profits. Thus, the rubber agroforestry system is reasonably profitable and its adoption will increase farmers’ income by increasing the efficiency of land use.
It is important to emphasize that rubber production is highly labor-intensive. Although labor use per cultivated hectare during the cropping season was higher for upland rice than for rubber, upland rice requires a fallow period. Thus, if the fallow period is considered, the average labor intensity for the land use system taken as a whole is much greater for rubber production than it is for upland rice.

Similar findings are made for cinnamon cultivation in Sumatra and cocoa agroforestry in Western Ghana (Quisumbing and Otsuka 1999). In Uganda, the adoption of cocoa agroforestry has been increasing, which suggests the greater profitability of coffee over food crops (Place and Otsuka 2001). In addition to the high profitability and labor-using nature, another advantage of agroforestry is storability of outputs, which reduces transportation costs, so that agroforestry can be developed in remote areas. It is clear that agroforestry systems growing commercial trees are appropriate for remote and hilly areas, where people are particularly poor.

C. New Designs of Agricultural Research Policy

Rice research has historically focused on favorable environments, such as irrigated environments and lowland rainfed environments free from flooding and deep water, because of high probability of scientific success. The homogeneous nature of irrigated areas also implies wide adaptability of new technologies, ensuring the large effects on rice production. Rice research, however, has been under strong pressure to shift priorities toward the unfavorable rice production environments as a way to reduce rural poverty. It is, however, scientifically much more difficult to develop new varieties for unfavorable production environments (David and Otsuka 1994). Unfavorable environments are highly heterogeneous, suffering from drought, submergence, salinity, and other problems, so that superior varieties, even if successfully developed, can be diffused only in limited areas. Moreover, the effect of new varieties tends to be marginal in marginal areas not only in rice production, as we have seen, but also in wheat and maize production (Byrlee 1996). Thus, if grain research focuses on marginal areas, it will have limited impacts not only on the supply of grains but also on the welfare of poor people in marginal areas. Indeed it is hardly believable that cereal producers in marginal areas in developing countries can compete with producers in developed countries, the majority of whom are in favorable areas, through international trades. It is also worth emphasizing that the landless are net consumers of rice and, hence, benefited from lower prices of rice.

The first conclusion therefore is that the allocation of research resources to the development of high input cereal technology for marginal agricultural areas
can be justified neither from the efficiency point of view nor from the viewpoint of poverty reduction.6

I do not argue that agricultural research should not try to develop new technologies for marginal areas. I argue that resources should be allocated to research, which generates appropriate technologies for such areas. I argue against rice and other cereal research for unfavorable areas, simply because the development and diffusion of appropriate technology can hardly be expected. I would like to suggest that the development of new technology for agroforestry growing commercial trees has high potential, as it is much more efficient than shifting cultivation. Therefore, the development and wide adoption of new and more efficient agroforestry systems will improve income of poor farmers in marginal areas by increasing the efficiency of land use. Yet, it is surprising that no serious research has been conducted on this promising technology. There might be also other crops and technologies particularly appropriate for agriculturally marginal areas.

The second conclusion is that if agricultural research ought to reduce poverty in marginal areas by developing new technologies for such areas, it must focus on the development of appropriate technologies conducive to the efficiency of resource use.

III. HUMAN CAPITAL INVESTMENT AND RURAL INDUSTRIALIZATION

A. Increasing Role of Human Capital

Household incomes in rural areas of Asia have increasingly depended on nonfarm income sources. This is the case even in the Philippines where the development of the nonfarm sector has been less spectacular than in other countries (Estudillo and Otsuka 1999). It is also widely observed that human capital, as reflected in schooling, is a major determinant of nonfarm income throughout Asia (David and Otsuka 1994). Let us examine the increasing importance of nonfarm income and human capital based on the case studies in the Philippines (Estudillo, Quisumbing, and Otsuka 2001a, b, c).

Table 3 compares the average annual income per capita between farm and landless households across the three villages in Panay Island in 1985 and 1998. Income of farm households in irrigated village is higher than in rainfed villages, and income of farm households is higher than that of landless households in the same production environment. However, income of the landless in unfavorable rainfed, i.e., rainfed village II, is significantly lower than the income of the landless in other villages. The landless in rainfed village II were significantly poorer.

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6If biotechnology is particularly useful for developing disease- and pest-resistant varieties, those varieties will be diffused primarily in favorable areas, as in the case of the Green Revolution technology.
not only because this is the least favorable village in rice production but also because this is located in the most remote area with the least access to nonfarm sectors. Therefore, there were a relatively small number of landless households in this village. Landless households are also geographically mobile and our respondents in 1985 had left the village in 1998. It is also found that there was no significant difference in agricultural wages between the three villages.

Table 3. Changes in Average Annual Per Capita Income of Farm and Landless Households in Selected Villages in the Philippines, 1985 and 1998*

<table>
<thead>
<tr>
<th>Household Characteristics</th>
<th>Irrigated Village</th>
<th>Rainfed Village I</th>
<th>Rainfed Village II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1985</strong> Farm Household</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per capita income (1,000 pesos)</td>
<td>4.5</td>
<td>3.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Proportion of rice income (%)</td>
<td>(37)</td>
<td>(45)</td>
<td>(14)</td>
</tr>
<tr>
<td>Proportion of nonfarm income (%)</td>
<td>(37)</td>
<td>(27)</td>
<td>(37)</td>
</tr>
<tr>
<td>Landless Household</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per capita income (1,000 pesos)</td>
<td>2.6</td>
<td>3.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Proportion of rice income (%)(^b)</td>
<td>(9)</td>
<td>(20)</td>
<td>(52)</td>
</tr>
<tr>
<td>Proportion of nonfarm income (%)</td>
<td>(81)</td>
<td>(73)</td>
<td>(32)</td>
</tr>
<tr>
<td><strong>1998</strong> Farm Household</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per capita income (1,000 pesos)</td>
<td>26.3</td>
<td>16.5</td>
<td>9.6</td>
</tr>
<tr>
<td>Proportion of rice income (%)</td>
<td>(30)</td>
<td>(12)</td>
<td>(22)</td>
</tr>
<tr>
<td>Proportion of nonfarm income (%)</td>
<td>(61)</td>
<td>(66)</td>
<td>(22)</td>
</tr>
<tr>
<td>Landless Household</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per capita income (1,000 pesos)</td>
<td>14.3</td>
<td>10.9</td>
<td>--(^c)</td>
</tr>
<tr>
<td>Proportion of rice income (%)(^b)</td>
<td>(8)</td>
<td>(5)</td>
<td></td>
</tr>
<tr>
<td>Proportion of nonfarm income (%)</td>
<td>(74)</td>
<td>(75)</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)Income figures are undeflated.
\(^b\)Wage income from labor employment in rice production.
\(^c\)There was only one full-time nonfarm landless household.

Sources: David and Otsuka (1994); Estudillo, Quisumbing and Otsuka (1999).

Incomes of the landless households in irrigated village and rainfed village I were comparatively high in both 1985 and 1998, because the landless actively engaged in nonfarm jobs. As a result, nonfarm income accounted for 70 to 80 percent of their incomes. In contrast, the proportion of nonfarm income among the landless was noticeably low in rainfed village II in 1985. Moreover, their income
from hired wage employment in rice production is barely sufficient for their own rice consumption. This implies that, in all likelihood, reduction in rice price will increase their welfare, even if it will reduce the demand for hired labor in rice production.

The importance of agricultural income, in general, and rice income, in particular, declined from 1985 to 1998. On the average, across three villages, rice income accounted for 40 percent and 16 percent of income of farm and landless households, respectively, in 1985. It accounted for only 21 percent and 6 percent, respectively in 1998. The dependence of the landless households on wage earnings in rice production was even lower. In terms of agricultural income or rice income, the gap between farm and landless households became smaller in 1998 than in 1985. The overall income gap between them, however, became larger, because the gap in nonfarm income became even larger. This is explained by the fact that members of farm households are more educated than those of the landless households and that education is the most important factor in wage earnings from nonfarm sectors including overseas employment.

In short, the major determinant of income gap across areas and between the farm and landless households changed from the difference in access to land to the difference in human capital. This is true not only in Panay but also in Central Luzon and Laguna (Hayami and Kikuchi 2000). It is expected that the importance of schooling will continue to increase as a determinant of income and poverty reduction, so far as the nonfarm sector continues to grow. It is also worth emphasizing that the poor landless no longer rely on labor employment in rice production to a significant extent, at least in the Philippines. This suggests that the impact of research on rice may not have major direct impacts on their livelihood.

Although how universal such changes observed in the Philippines are needs to be examined carefully, it is highly likely that the same tendency is observed. This is because the growth rate of the Philippines economy has been very slow compared with its neighboring countries. If so, investment in schooling for children of poor households will have to play a larger role in poverty reduction in the future in most Asian countries.

B. Role of Rural Industrialization

It is well known that large cities in Asia are highly congested and polluted. Thus, the conventional prescription that the economic development must entail continuous flow of migrants from poor rural areas to cities, where modern sector develops, is no longer valid. Given the congestion in cities, the prevalence of rural poverty, and increased dependence of incomes of farm population on nonfarm sources, the optimum development strategy should include the development of rural industries, which provide lucrative nonfarm employment opportunities for the rural poor.
Historically food processing and production of wood products used to be major categories of industrial sectors in rural areas. Yet, the evolution of rural industrialization involved a shift from relatively undynamic rural activities, using traditional technologies and targeted to local rural markets, to more dynamic activities geared to the demands of the urban and export markets. In fact, such new industrial sectors as garments, metal products, and machinery have become more important in rural areas of East Asia (Otsuka 1998). In this new stage of development, small-scale industries play a major role in the development of rural industries.

Not only social infrastructure but also “social capital” made significant contributions to rural industrialization in East Asia. Many rural entrepreneurs in East Asia, who are enterprise managers and local traders, were born and grew up in the locality where they operate their businesses, and they generally have work experience either in urban enterprises, with which subcontracting arrangements are often made (Otsuka 1998). They have enduring personal relations with locally recruited workers and have established a reputation as reliable partners among urban-based entrepreneurs and traders, who offer subcontracts to them. Hayami (1998) argues that the system of “relational contracting”, which denotes the long-term, continuous contract relations that are enforced and maintained by personal ties, mutual trust, and community obligations, can be a dominant production organization in rural areas. The relational contracting embraces the operation of small rural enterprises connected by web of interenterprise cooperation and coordination. Traders and trading houses also assist the operation of small-scale rural enterprises not only historically in Japan (Hayami et al. 1991) but also in contemporary Taipei, China (Levy 1991). The system of rural-based small-scale industries is viable, only if transaction costs of interenterprise cooperation are comparatively small. The East Asian model of rural industrialization attests to the importance of low cost of interenterprise transactions in stimulating the development of small-scale enterprises in rural areas.

The development of transactions between urban and rural enterprises is the key to successful rural industrialization, because of the difficulties rural enterprises would face, which include inadequate access to modern technology and product methods; lack of access to markets and market information, such as designs most demanded by markets; and lack of capital. Many authors therefore advocate the subcontracting of rural enterprises with urban enterprises and trading houses, which possess better knowledge of marketing and modern technology and have better access to financial markets (e.g., Schmitz 1982, Lanjouw and Lanjouw 1995). Furthermore, subcontracting may promote the division of labor or the specialization of production processes among enterprises so as to reduce overall production costs (Watanabe 1971, Mead 1984). The specialization makes it possible to operate small-scale factories in rural areas, which reduces the initial capital requirements and, hence, entry barriers. Moreover, if parent companies provide
materials under putting-out contracts, working capital for subcontracting enterprises can be saved. Further, materials provided by the urban principal under putting-out contract usually embody designs demanded by markets, and the contract itself assures the procurement of materials and sales of final products. Thus, subcontracting can potentially overcome constraints imposed on the development of rural industries.

The rigorous quantitative assessment of how important subcontracting is for rural industrialization and how moral hazard and adverse selection, which potentially arise under subcontracts, are overcome is an important issue for further study. It seems clear to me, however, that it is difficult to reduce rural poverty without the development of rural industries, which provide ample employment opportunities for the rural poor.

**IV. CONCLUSION**

Several policy implications can be derived from our preceding discussions for the alleviation of rural poverty. First, land reform program should encourage tenancy transactions, contrary to the existing land reform programs that discourage such transactions.

Second, in order to facilitate the transfer of land, market-assisted land reform programs must be sought. To develop effective market-assisted programs, however, further in-depth research is needed.

Third, regarding agricultural research, it is imperative to continue the development of yield-increasing grain technologies for favorable areas, while paying due attention to the development of appropriate technologies for agriculturally marginal areas. It must be clearly understood that without increasing the efficiency of resource use in marginal areas, the contribution of agricultural research to the reduction of rural poverty is necessarily limited. It must be also emphasized that a major contribution to the poverty reduction that modern scientific agricultural research can make rests on the enhancement of overall production efficiency of food production sectors, thereby increasing the food security for the poor.

Fourth, investment in schooling of the children of the rural poor will have to play increasingly a major role in the reduction of rural poverty, considering the importance of human capital in nonfarm employment and the increasing importance of nonfarm income in rural areas.

Finally, the development of rural industries should be promoted. Yet, empirical research on rural industrialization is scanty. Thus, what policies are conducive to rural industrialization need to be further examined through careful empirical studies.
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Wallingford, UK: CAB International.