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Philippine Institute for Development Studies

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*Arlene Baulita-Inocencio and Cristina C. David*

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## COMPARATIVE AND COMPETITIVE ADVANTAGE OF PHILIPPINE RICE PRODUCTION: 1966-1990\*

Arlene Baulita-Inocencio and Cristina C. David\*\*

### Introduction

Because of the economic and political importance of rice in the Philippines, rice self-sufficiency has been a major government policy goal. Whether or not such a policy goal can be achieved without significant efficiency cost depends on the country's comparative advantage in rice production. And to what extent that comparative advantage will be realized depends on the impact of government price intervention policies on the structure of incentives.

The Philippines has been historically a net importer of rice. With the widespread adoption of modern rice technology in the late 1960's and 1970's, the country turned from being a net importer of 5 to 10% of its rice requirements to being a marginal rice exporter in the late 1970's and early 1980's. The modern rice varieties (MVs) introduced in 1966 spread rapidly, covering 60% of rice crop area by early 1970's and more than 90% in the early 1990's (Fig.1). Fertilizer use per hectare and the proportion of irrigated area also increased significantly as MVs raised the profitability of fertilizer (David 1976) and irrigation investments (Hayami, et al. 1976). Consequently, growth rate in rice production accelerated, doubling from 2.4% prior to 1965 to 4.7% between 1965 and 1980 (Table 1). The contribution of increased yields to production growth rose from 45% to 80% as growth rate in yields more than tripled from 1.1%

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prior to 1965 to 3.6% in the 1965-1980 period.

Unfortunately, that strong growth performance was not sustained in the 1980's; growth rate of production declined to 2.0% due both to a slowdown in the growth rate in yields and a virtual halt in the expansion of crop area planted to rice. As a result, the country resumed importing rice by 1982 and has done so in 5 out of 10 years since then. Evidently, the gains in comparative advantage in rice production in the 1970's (Unnevehr 1986) have been dissipated by the 1980's as population growth surpassed growth in production.

Changes in the degree of comparative advantage may be accounted for by trends in the social opportunity cost of land, labor, and foreign exchange, world price of rice and tradable inputs, and the growth in productivity due to technological change. The changing trade balance, however, may also reflect changes in government price intervention policies which by directly or indirectly affecting the structure of farmers' incentives may cause changes in the country's competitive advantage in rice production.

The first study to evaluate Philippine comparative advantage in rice by comparing the domestic resource cost of rice production to the social opportunity cost (shadow) of exchange rate indeed showed that in 1974 the country had a comparative advantage in rice production (Herdt and Lacsina 1976). Unnevehr's (1986) historical analysis of comparative advantage in rice production from 1966 to 1982 indicated that this was not initially the case prior to the 1960's before the widespread adoption of the modern rice technology. The country's comparative advantage improved between 1966 to 1974 primarily due to the higher world price of rice and depreciation of the peso. It was not until after 1974 that the impact of technological change in rice became the dominant factor accounting for the achievement of comparative advantage in rice production. There were already some indication of the erosion of these gains

after 1979, but even the later study by Rosegrant and Gonzales (1987) for 1985 reported that comparative advantage in rice production in irrigated and rainfed lowland areas continued. Because modern varieties were suited mainly to irrigated and favorable rainfed areas, this study showed that in upland areas where modern rice technologies have not been profitable, there was no comparative advantage in rice production.

This paper extends Unnevehr's earlier study up to 1990, to cover the post Green Revolution period when no major technological breakthroughs were achieved and world rice prices in real terms dropped to its lowest levels in this century. The objectives of this paper are to analyze the changes in the Philippine comparative advantage in rice production from 1966 to 1990; understand the role of productivity growth and trends in world prices and shadow prices of inputs and exchange rates in changing comparative advantage; and examine the impact of price intervention policies on the country's competitive advantage in rice production.

As in Unnevehr, this study is based on the Central Luzon Survey, a survey of a sample of irrigated and rainfed rice farms periodically conducted by the Social Science Division of the International Rice Research Institute (IRRI). This study differs from Unnevehr's in several respects. It includes the later survey for 1986 and 1990 and use slightly different estimates of the impact of price intervention policies on output and input prices. The concept of domestic resource cost (DRC) in shadow and market prices rather than social and private profitability is used to evaluate comparative and competitive advantage, respectively. And finally, the shadow rather than the official exchange rate is used as basis of comparison with the DRC in shadow prices.

## Methodology

Comparative advantage in rice production is evaluated by a measure of social profitability calculated as the ratio of domestic resource cost (DRC) of foreign exchange to the shadow exchange rate (SER). The DRC is a measure of the value of domestic resources needed to earn a unit of foreign exchange through exports or save a unit of foreign exchange through import substitution, reflecting the efficiency by which foreign exchange can be earned or saved by domestic production of say, rice. It may be considered as its "own exchange rate" or the rate at which domestic resources priced at their social opportunity cost or shadow prices can be converted into foreign exchange via production and marketing of rice. The SER, in turn, is the DRC of the marginal activity that would be chosen to balance the foreign exchange budget when all DRCs of economic activities are ranked from lowest to highest. Thus, an activity with DRC that is lower than the marginal one, or a resource cost ratio ( $DRC/SER$ ) equal to less than unity reflects comparative advantage. And a decline in the resource cost ratio indicates an increase in comparative advantage.

The DRC is calculated by the following formula:

$$DRC_j = \frac{\sum x_i p_i^d}{p_j^b - \sum f_i p_i^b}$$

The numerator denotes the cost of domestic non-tradeable factors where the  $x_i$ 's are quantities used per ton of rice produced and  $p_i^d$ 's their shadow prices. These domestic factors are primarily land and labor used directly and indirectly in the production and marketing of rice. In this study, the shadow wage is assumed to be equal to the market wage because the minimum wage law does not effectively influence the level of rural wages as employment is dominated by

small-scale farming and informal non-farm work. Because of the land reform law that prohibits land sales and share tenancy, we assume the cost of land to be the residual after deducting the cost of all other inputs from the value of output, where prices of all other inputs and output are in terms of their shadow prices. Where domestically produced inputs include some tradeable or foreign components, only the domestic components is included.

In the denominator, the cost of tradeable or foreign sourced inputs is deducted from the border price of rice estimated as the world price of 35% broken rice (FOB Bangkok) adjusted by 20% to account for insurance and freight to the Philippine border. To remove the effect of world rice price instability, a five-year average of the world price is used. The cost of tradeable inputs is calculated by multiplying their quantities,  $f_i$ , with their respective border prices  $p_i^b$  by using conversion factors based on import duties, advance sales tax, and price comparisons. Appendix Table 1 shows the allocation of inputs into tradeable and non-tradeable components including the share of cost accounted for by price and trade protection policies.

Farmers allocate resources in response to market rather than to shadow prices. The degree by which domestic production of rice can compete in the world market, therefore, depends not only on the country's comparative advantage but on the impact of government policies on output and input prices, that is, the country's competitive advantage. Whereas comparative advantage is a measure of social profitability and uses shadow prices, including the SER, competitive advantage is a measure of private profitability and uses market prices to compute for DRC and compares this with the official exchange rate to compute for the resource cost ratio. Similarly, a value less than unity indicates advantage -- in this case, competitive advantage.

## Changes in Rice Farming

Central Luzon is the largest and the most progressive rice growing region in the country, accounting for about 25% of rice production and 20% of rice crop area. This region has the most favorable natural production environment for rice growing and has been the focus of government investments in irrigation, extension of modern rice technology, market infrastructure, and other agricultural support services. It is also the region with the most successful implementation of the Land Reform Law (Otsuka 1991). Although this region does not represent the marginal, nor the average rice production environment and technology, the IRRI Central Luzon farm survey provides an excellent basis for analyzing the changes in the technology, economic conditions, and institutional structure of rice production over the past 25 years.

### Socio-economic characteristics

Table 1 shows the changes in the socio-economic characteristics of the sample farms. Note that the number of farm samples varied through the years, with the decline attributable to the retirement of some sample farms, refusal of others to be interviewed again, or their absence during the survey visits. These farmers were replaced, but it was not until 1979 that the sample was significantly increased to maintain the representativeness of the sample households.

Average farm size decreased over the whole period from more than 2 has to 1.8 has by 1990. The increasing trend in the early period may be due in part to the changing of farm samples. In the 1960's, the rice farmers were predominantly share-tenants, but because of land reform, the structure of tenancy changed dramatically. The Land Reform Law of the early 1960s which set the leasehold sharing to 75-25 in favor of the leaseholder led to the increase in the



ratio of leasehold farms from 13% to 35%. With the Land Reform Law of 1974 (PD 27) which abolished share-tenancy, former share-tenants were converted into leaseholders or holders of Certificates of Land Transfer (CLT). By 1990, only a minor proportion of rice farmers remained as share-tenants by mutual choice.

Two-thirds of the rice crop area was already irrigated by 1966. With the construction in the early 1970s of the Upper Pampanga River Irrigation System, the largest reservoir system in the country, the ratio of irrigated area rose to 80%. By providing irrigation water during the dry season, rice cropping intensity was increased from 117% to 150%. On the other hand, by raising the social profitability of irrigation investments, the introduction of modern rice varieties suited to irrigated conditions and high world rice prices induced the rapid growth of irrigation investments in the 1960's and early 1970's (Hayami et al 1976 ; Hayami and Kikuchi 1978).

During the 1980's, however, the ratio of irrigated area and cropping intensity stagnated and even declined. Because of low rice prices and rising cost of irrigation construction coupled with severe budgetary constraints and foreign debt burden, irrigation investments dropped sharply in the 1980's (David 1992). Moreover, siltation and other environmental problems in Central Luzon irrigation systems have reportedly reduced effective irrigated area (Bhuiyan; Pingali). Ironically, these have meant that the decline in average farm size due to continued land population pressure on limited land area that began after the mid 1970's could not be compensated by increases in cropping intensity, as expansion of irrigated area and thus potential for increasing cropping intensity have ceased.

### **Yield-increasing technologies**

In Table 3, the trends in adoption of yield increasing technologies and average yields among irrigated and rainfed farms are reported. The spread of modern varieties was remarkably rapid. Within 5 years after its introduction, about 70% of area were already planted to modern varieties and by the end of the 1970's, adoption was complete. The fact that adoption rate was equally rapid in the irrigated and rainfed farms suggests that rainfed areas in Central Luzon have generally favorable growing conditions so that MVs also have significant yield advantage over the traditional varieties.

Fertilizer use per hectare increased dramatically between 1966 and 1990 following the pattern of modern variety adoption. It should be noted that this increase was greater in irrigated than in rainfed farms. Adoption of MVs and irrigation expansion induced higher use of fertilizer because of the greater fertilizer response of modern compared to the traditional varieties (David 1976). In contrast to the short-statured, stiff strawed MVs, higher levels of fertilizer use cause the long and weak stemmed traditional varieties to lodge. The more adequate water supply and stable yields in irrigated areas also improve incentive to increase fertilizer use.

Adoption of modern varieties, greater fertilizer use, and improved irrigation (for irrigated farms) explain the growth in yields over time. Whereas average yields are about equal between irrigated and rainfed farms in 1966, yields rose faster in irrigated areas where MVs have a greater yield potential, widening the yield gap between the two production environments by the 1980's. Because MVs are shorter growth duration, photoperiod insensitive, and induce irrigation expansion, MV adoption also contributed to the widening gap in land productivity per hectare per year by increasing cropping intensity. The decline in yields in 1974 despite higher adoption

of MVs and fertilizer use is due to the damage of strong typhoons just before harvest.

It should be noted that yields continued to increase up to the early 1980's, despite the almost complete adoption of MVs by the mid-1970's. Continuing growth in fertilizer use is one reason, but an equally important one is the development of newer modern varieties with more desirable characteristics. Table 4 reports the adoption rates of modern varieties by specific varieties. The first MV was IR8, but this was quickly replaced by IR5 which covered 40% of rice area by 1970. In 1974, IR20 which had better grain quality than IR5 was already more popular. Although the modern varieties developed thus far (first generation MV's) are high yielding, these were highly susceptible to pests and diseases. The "second generation" modern varieties that emerged with the introduction of IR36 were resistant to a broad range of major pests and diseases and are of short growth duration (110 days). In 1979, almost half of the rice crop area was planted to IR36. A later variety, IR42, with a longer growth duration (135 days) but has more tolerance to adverse environmental conditions and has better grain quality became nearly as popular as IR36 in 1982. Resistance to major pests and diseases, better grain quality, short-growth duration, and tolerance to adverse environmental conditions also characterize subsequent modern varieties, of which IR64 approach IR36 in popularity.

It should be emphasized that growth in yields tapered off after 1982 and in fact declined. It appears that modern varieties introduced during this period did not have a higher yield potential but were merely replacing earlier MVs as their resistance to pests and diseases began to break down. There is also the possibility that degradation of land quality and irrigation systems due to soil erosion, siltation, and other environmental problems may be at least partly responsible.

### Labor-saving technologies

Adoption of labor-saving technologies, particularly of tractors and threshers, became widespread over the past two decades. It has been widely believed that adoption of modern varieties induced the widespread adoption of these labor saving technologies. But tractors and threshers were already being adopted in 1966 before the introduction of modern varieties. And direct seeding, which require much less labor than transplanting as a method of crop establishment was not adopted until the early 1970's, several years after the complete adoption of MVs. Indeed, regression analysis based on a different data set indicates that relative factor prices and lack of grazing land due to increases in cropping intensity explain the rapid spread of tractor use (David and Otsuka 1991). In addition to rising wages, the decline in cost of mechanical threshing as a consequence of technological innovations and greater capacity utilization with double cropping explain the shift to mechanical threshers. On the other hand, the introduction of low-cost herbicides raised the profitability of direct seeding over transplanting.

Despite the increase in adoption rate of tractors, labor use per hectare between 1966 and 1974 increased. This is due primarily to the impact of modern variety adoption which raised demand for labor for crop care and harvesting activities. It is also due in part to the decline in use of the large stationary threshers popular before land reform when share tenancy was widespread because it provided better control over output sharing by the landlords (Hayami and Kikuchi 1982). After 1974, labor use per hectare declined with the spread of adoption of tractors, small threshers, and direct seeding. Consequently, labor productivity also increased. And interestingly, the gap in labor productivity between irrigated and rainfed farms narrowed

by 1990, mainly because adoption of large tractors was higher in rainfed area where heavy machines can move around. In general, however, a shift in use from large to small tractors have occurred in both irrigated and rainfed areas.

### **Analysis of Comparative Advantage**

Comparative advantage may be gained as a result of growth in productivity due to technological changes, increases (decreases) in world price of rice (tradeable inputs), or depreciations in the shadow exchange rate. Conversely, rising cost of domestic factors, decreases (increases) in the world price of rice (tradeable inputs), or appreciation in the shadow exchange rate lead to declines in comparative advantage. In Table 6, the trends in the estimates of domestic resource cost based on shadow prices, shadow exchange rate, and measure of comparative advantage are reported. The decomposition of sources of change in comparative advantage is shown in Table 7.

In 1966, neither the irrigated nor the rainfed areas showed any comparative advantage in rice production as evidenced by their DRCs that are greater than the shadow exchange rate. The country gained comparative advantage between 1966 to 1982, primarily because of depreciation of the exchange rate, increases in total factor productivity due to technological changes, and increases in the world price of rice. This is despite increasing cost of land and labor and sharp increases in the prices of tradeable inputs, particularly fertilizers. The fact that the resource cost ratios for rainfed farms were quite close to and up to 1979 even lower than irrigated ratio does not mean that irrigation investment is not socially profitable for at least two reasons. The resource cost ratio of irrigated farms may be biased upwards because the contribution of irrigation on increasing cropping intensity has not been taken into account,

though the cost of irrigation was also underestimated. Moreover, the rainfed lowland farms in Central Luzon have very favorable conditions for rice growing, nearly comparable with irrigated areas during the wet season.

After 1982, the gains in comparative advantage began to be eroded. By 1990, the resource cost ratio is just about unity, up from 0.5 in 1982 and barely reaching the threshold of comparative advantage. This is mainly because of the sharp drop in the world price of rice and rapid increases in price of domestic factors in the face of stagnating, even declining yields. Evidently, the rapid depreciation of the peso could not compensate for the unfavorable world rice market environment and the lack of technological breakthrough during this period.

#### Analysis of Competitive Advantage

In general, price intervention policies have been biased against rice producers (David 1993). Although domestic rice price has been higher than what it would have been without government interventions in some periods, government protection on domestic producers of fertilizers, pesticides, tractors, and threshers has been higher and thus has meant negative effective protection on rice production (see Appendix Table 2). The most important source of price distortion that lower economic incentives for increasing rice production, however, is the overvaluation of the domestic currency due mainly to the industrial protection system and macroeconomic policies defending disequilibrium in the balance of payments which is in the order of 20 to 30%.

The impact of government policies on private profitability is reflected in the measure of competitive advantage presented in Table 8 in comparison to the measure of comparative advantage shown in the earlier table. In Table 9, the sources of the divergence between

comparative and competitive advantage are decomposed. Clearly, government policies have made rice production artificially less profitable to farmers. While the RCRs in shadow prices indicate that the country does not have comparative advantage in rice only in the early period, the RCRs in market prices show that government price intervention policies have made rice uncompetitive for both irrigated and rainfed rice farming in the 4 out of the 7 years.

Policy-induced distortions in the exchange rate overwhelmingly explains the divergence in comparative and competitive advantage. The apparently higher contribution of distortions in the output price in 1974 was simply due to government's attempt to insulate the domestic market from the very sharp increase in world prices of grains during this period. Although the price distortions on traded inputs were higher than those for rice, the contributions of rice price intervention policies to the divergence between comparative and competitive advantage was higher because the share of these traded inputs are still relatively low compared to the primary factors of production of land and labor.

### Concluding Remarks

Rice self-sufficiency is a dominant policy objective. Ironically, our analysis indicates that government policies, particularly those causing the overvaluation of the domestic currency, i.e., the industrial protection system and the macroeconomic policies to defend the disequilibrium in the balance of payments, are not neutral but have hindered the realization of the country's potential comparative advantage in rice.

Technological change -- MVs, fertilizer, irrigation -- clearly contributed significantly to the gains in comparative advantage in the 1970's. However, technological breakthroughs in varietal improvement and irrigation investment were not sustained into the 1980's. In the

meantime, the increasing scarcities of land and labor are raising the cost of producing rice domestically. Yet, the decline in government investment in agricultural research and irrigation in the 1980's was not reversed in the early 1990's despite an overall recovery of public expenditures for agriculture and natural resources (David 1992).

Our analysis suggests that if price distortions that biases incentives against rice production are removed, the country may be able to maintain rice self-sufficiency, at least in the medium term. Over the long-term, however, public investments for raising productivity are essential for maintaining the country's comparative advantage particularly for rice research and extension. Numerous studies have already shown high rates of return for rice research at international and national levels (Evenson and David, 1993).



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Table 1. Growth rates (%) of palay in the Philippines, 1955-1992.

	1955-1965	1965-1980	1980-1992
Production	2.4 (100)	4.7 (100)	2.0 (100)
Area	1.3 (54)	1.1 (24)	* (0)
Yield	1.1 (45)	3.6 (76)	2.0 (100)

Figures in parenthesis are the relative shares in the explanation of production growth.

Source of basic data: Bureau of Agricultural Statistics.

Table 2. Socio-economic characteristics of rice farms, Central Luzon, 1966-1990.

	1966	1970	1974	1979	1982	1986	1990
No. of farms	92	62	58	149	136	120	109
Farm size (ha)	2.06	2.45	2.53	1.98	1.77	1.81	1.80
Tenure (% area)							
Share-tenant	75	55	26	11	11	16	6
Leasehold	13	35	55	60	64	43	42
CLT holder	0	0	0	19	15	26	36
Owner-operator	12	10	19	10	8	11	12
Others <sup>b</sup>	0	0	0	0	2	4	4
Irrigation (% area)	66	65	53	78	67	79	73
Rice cropping intensity <sup>a</sup>	117 (128)	115 (126)	119 (179)	153 (179)	154 (179)	149 (172)	146 (167)

<sup>a</sup> Figures in parentheses refer to sample of irrigated farms only.

<sup>b</sup> Others include borrowers, porsientohan and overseers.

Source of basic data: Social Science Division, International Rice Research Institute.

Table 3. Adoption of yield increasing technologies and average yields in irrigated and rainfed rice farms, Central Luzon, wet season, 1966-1990.

	1966	1970	1974	1979	1982	1986	—1990
<b>Irrigated farms</b>							
No. of farms	55	36	31	99	91	81	64
MV adoption (% area)	0	72	84	100	100	100	98
Fertilizer use (kg NPK/ha)	21	44	65	97	89	93	114
Yield (t/ha)	2.3	2.6	2.4	4.1	4.4	3.7	3.8
<b>Rainfed farms</b>							
No. of farms	37	26	27	50	45	39	45
MV adoption (% area)	0	73	70	92	100	100	96
Fertilizer use (kg NPK/ha)	19	30	46	62	62	73	84
Yield (t/ha)	2.3	2.4	1.9	2.4	3.4	3.3	3.3

<sup>a</sup> The sum of 4 wheel and 2 wheel tractor adoption may exceed 100% due to farms which make use of both in one planting season.

Source of basic data: Social Science Division, International Rice Research Institute.

Table 4. Adoption of labor-using technologies, labor use, and labor productivity in irrigated and rainfed rice farms, Central Luzon, wet season, 1966-1991.

	1966	1970	1974	1979	1982	1986	1990
<b>Irrigated farms</b>							
Tractor use (% area) <sup>a</sup>							
4 wheel	15	44	39	22	22	2	14
2 wheel	0	3	26	63	73	78	88
Thresher use (% area)							
Large	71	64	39	19	14	0	0
Small	0	0	3	23	78	98	100
Direct seeding (% area)	0	0	0	1	20	12	31
Labor use (md/ha)	60	69	94	79	72	62	68
Labor productivity (kg/md)	38	38	26	52	61	59	55
<b>Rainfed farms</b>							
Tractor use (% area) <sup>a</sup>							
4 wheel	5	42	37	34	29	8	27
2 wheel	0	8	11	22	24	44	82
Thresher use (% area)							
Large	84	85	52	52	22	0	0
Small	0	0	7	16	69	95	100
Direct seeding (% area)	0	0	0	4	9	3	16
Labor use (md/ha)	75	63	85	69	73	62	66
Labor productivity (kg/md)	32	38	23	37	47	53	53

<sup>a</sup> The sum of 4 wheel and 2 wheel tractor adoption may exceed 100% due to farms which make use of both in one planting season.

Source of basic data: Social Science Division, International Rice Research Institute.

Table 5. Distribution of rice area planted by variety, Central Luzon, 1966-1990, wet season (% of area).

	1966	1970	1974	1979	1982	1986	1990
Traditional varieties <sup>a</sup>	100	29	33	3	2	5	3
Modern varieties							
IR5	-	41	*	-	-	-	-
IR20	-	14	35	-	*	-	-
IR29	-	-	8	5	*	-	-
C-series	-	*	6	*	*	*	-
Other MV1 <sup>b</sup>	-	16	16	18	8	7	3
IR36	-	-	-	47	31	7	6
IR42	-	-	-	16	27	11	*
IR44	-	-	-	6	*	-	-
IR50	-	-	-	*	12	*	-
IR64	-	-	-	-	-	43	17
IR66	-	-	-	-	-	*	13
IR70	-	-	-	-	-	-	11
IR72	-	-	-	-	-	*	14
IR74	-	-	-	-	-	-	11
Other MV2 <sup>c</sup>	-	-	-	5	18	23	19

(\*) Less than 5%.

(-) Zero.

<sup>a</sup> Includes AR, Aroma, Aurora, Benser, Binato, Binondoc, Binonton, BE-3, BM36, BPI-series, Enisco, Inano, Intan, Kumpol Sta. Rosa, Lamyo, Macamputi, Macan, Macapagal, Malagkit, Maligaya, Malinis, Milagrosa, Peta, Ramadia, Raminad, Ramitan, Serup Ketchel, Sinebio, Surigao, Tejaha, Tjeremas, unclassified local variety and Wagwag Aga.

<sup>b</sup> Includes FK (Kennedy), IR2, IR4, IR7, IR8, IR10, IR12, IR22, IR24, IR247, IR26, IR28, IR30, IR32 and IR34.

<sup>c</sup> Includes IR38, IR46, IR48, IR52, IR54, IR56, IR58, IR60, IR61, IR62, IR70, IR72, IR74, IR76, IR98, R10, R12, R22 and 7 Tonner.

Source of basic data: Social Science Division, International Rice Research Institute.

Table 6. Trends in domestic resource cost (shadow prices), shadow exchange rate and measure of comparative advantage (RCR) in irrigated and rainfed farms, Central Luzon, wet season, 1966-1990.

	1966	1970	1974	1979	1982	1986	1990
<b>Irrigated farms</b>							
DRC	5.23	6.48	6.17	4.78	7.22	18.58	29.91
Shadow exchange rate	4.70	6.23	8.10	9.24	12.94	23.37	30.02
Comparative advantage	1.11	1.04	0.76	0.52	0.56	0.80	1.00
<b>Rainfed farms</b>							
DRC	5.40	6.74	6.22	5.60	6.99	18.41	28.53
Shadow exchange rate	4.70	6.23	8.10	9.24	12.94	23.37	30.02
Comparative advantage	1.15	1.08	0.77	0.61	0.54	0.79	0.95



Table 7. Decomposition of sources of change in degree of comparative advantage in rice production irrigated and rainfed farms, Central Luzon, 1966-1990.

	1966- 1970	1970- 1974	1974- 1979	1979- 1982	1982- 1986	1986- 1990	1966- 1990
<b>Irrigated</b>							
Change in RCR	-0.07	-0.31	-0.16	-0.07	0.25	0.16	-0.20
Due to changes in:							
World rice price	0.10	-0.69	-0.05	0.05	0.11	-0.16	-0.64
Exchange rates	-0.31	0.20	-0.08	-0.19	-0.78	-0.77	-2.33
World input prices	0.04	0.11	-0.02	0.01	0.04	0.05	0.23
Domestic factor prices	0.05	0.33	0.19	0.18	0.30	0.28	1.33
Factor productivity	0.02	0.14	-0.10	-0.06	-0.06	0.10	0.04
Residual	0.02	-0.01	-0.10	-0.05	0.64	0.67	1.17
<b>Rainfed</b>							
Change in RCR	-0.08	-0.28	-0.25	0.04	0.24	0.20	-0.12
Due to changes in:							
World rice price	0.10	-0.66	-0.05	0.05	0.11	-0.16	-0.62
Exchange rates	-0.31	-0.22	-0.09	-0.20	-0.44	-0.24	-1.51
World input prices	0.03	0.08	0.04	-0.02	0.03	0.05	0.20
Domestic factor prices	0.09	0.26	0.16	0.16	0.31	0.23	1.21
Factor productivity	-0.05	0.13	0.07	-0.14	-0.07	-0.04	-0.03
Residual	0.08	0.15	-0.38	0.20	0.30	0.29	0.64

Table 8. Trends in domestic resource cost (market prices), official exchange rate, and measure of competitive advantage (RCR) in irrigated and rainfed farms, Central Luzon, wet season, 1966-1990.

	1966	1970	1974	1979	1982	1986	1990
<b>Irrigated farms</b>							
DRC	5.01	6.20	9.28	7.10	7.95	17.98	28.40
Official exchange rate	3.92	5.37	6.98	7.51	10.35	14.47	24.01
Comparative advantage	1.28	1.15	1.33	0.95	0.77	0.92	1.18
<b>Rainfed farms</b>							
DRC	4.84	5.94	8.97	6.67	8.08	17.82	29.50
Official exchnage rate	3.92	5.37	6.98	7.51	10.35	19.47	24.01
Comaprative advantage	1.24	1.11	1.28	0.89	0.78	0.92	1.23

Table 9. Sources of divergence in comparative and competitive advantage in rice production, irrigated and rainfed farms, Central Luzon, 1966-1990.

	1966	1970	1974	1979	1982	1986	1990
<b>Irrigated farms</b>							
Comparative less competitive advantage (actual RCR)	-0.13	-0.07	-0.56	-0.34	-0.23	-0.14	-0.23
Difference (%) due to distortions in							
Exchange rate	183	255	25	44	64	130	117
Output price	-79	-154	57	34	13	-48	-26
Tradeable input prices	12	25	4	9	14	27	15
Residual	-16	-27	15	13	9	-9	-5
<b>Rainfed farms</b>							
Comparative less competitive advantage (actual RCR)	-0.12	-0.07	-0.52	-0.37	-0.22	-0.12	-0.23
Difference (%) due to distortions is							
Exchange rate	187	264	25	37	67	144	120
Output price	-81	-159	59	28	14	-54	-27
Tradeable input prices	10	22	3	17	11	20	13
Residual	-16	-27	13	18	8	-10	-6

Appendix Table 1. Allocation of input cost to foreign, domestic, and in rice production, Philippines, 1990.

	Foreign cost	Domestic cost	Taxes/ tariff
Fertilizer	72	18	10
Pesticides	41.5	41.5	17
Tractors			
2 wheel	41.5	41.5	17
4 wheel	45.5	45.5	9
Threshers	38.5	38.5	23
Fuel	27	27	46
Oil	40	40	20
Irrigation	0	100	0
Labor	0	100	0
Land	0	100	0
Marketing cost	1	99	0

Appendix Table 2. Nominal protection rate of rice and tradeable inputs in rice production.

	-1966-	1970	1974	1979	1982	1986	1990
Rice	14	18	-14	-15	3	2	12
Fertilizer <sup>b</sup>	53	19	6	20	21	12	11
Pesticides	24	29	29	35	35	20	20
Tractors							
2 wheel	20	21	21	46	46	30	30
4 wheel	20	21	21	24	24	10	10
Threshers	24	24	24	24	24	30	30

<sup>a</sup> In the DRC calculations, CIF price was used during importing years and FOB for exporting years, i.e., 1979, 1982.

<sup>b</sup> Refers to nominal protection rate urea only.

Source: Adopted from C. C. David, (1993).

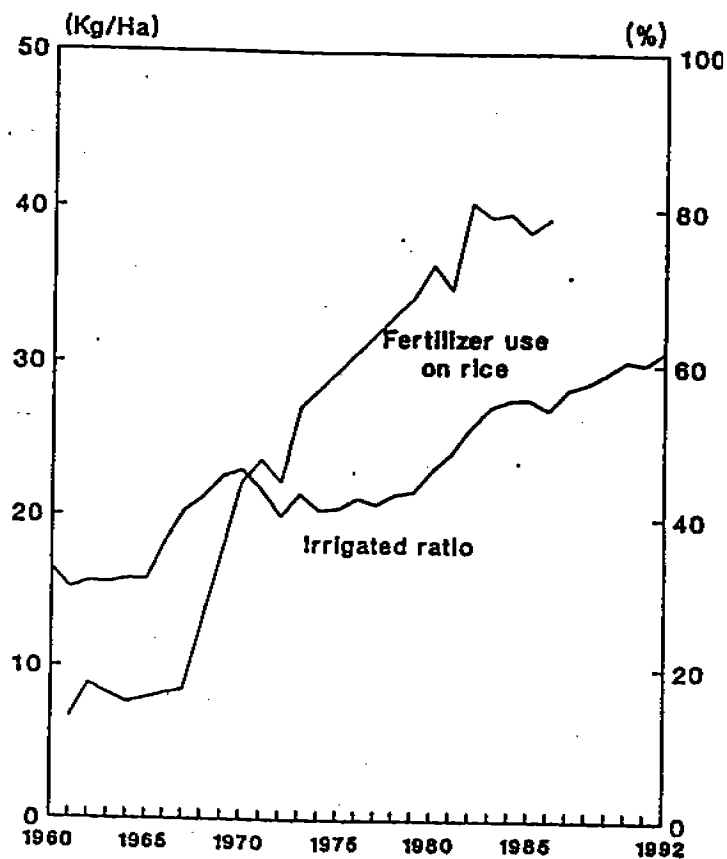
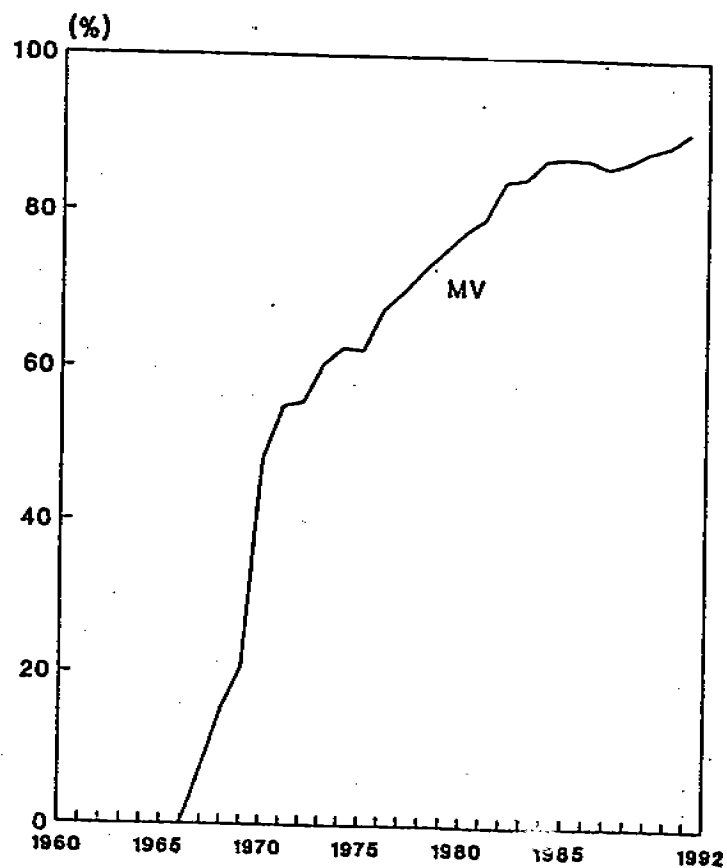


Fig 1. Trends in adoption rate of modern varieties (%), fertilizer use on rice (kg/ha), and ratio of rice crop area irrigated, Philippines, 1960-1992.