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Irrigated Agriculture Sector Review

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₱ 1	-	100 Centavos (ctvs.)

PREFACE

Irrigated agriculture in the Philippines was last reviewed by the Bank in the context of the 1987 Agricultural Sector Review. This report updates and in some respects revises the conclusions of that earlier study, with a special focus on the demand and supply of rice and other basic grains. In particular, it is less optimistic that rice self-sufficiency can be sustained through increases in rice yields or high return irrigation projects, and suggests that substantial imports will be required.

The report touches upon a wide range of food policy and irrigation issues and explores how these are related to help establish future priorities for meeting rice requirements in a balanced manner. It reviews other food sectors (wheat, corn, livestock etc.,) to the extent that they impact on prospects for rice, but is not intended as a comprehensive review of all food production and policy. Nor does the report provide a detailed review of agricultural supporting services (research, extension, credit etc.) since its primary objective in relation to irrigation is to evaluate the justification for future investment in the light of institutional support for improving irrigation performance. A large body of work has been undertaken on these and related issues by a variety of national and international agencies including UPLB, NIA, DA, IRRI, IFPRI, and the ADB. An attempt has been made to reflect the detailed analyses undertaken by these other agencies in the report.

The report is organized into two parts. The <u>first part</u> (Chapters 2 and 3) reviews prospects for rice demand and supply within the context of the foodgrains sector, assessing trade and pricing policies in terms of their impact on the rice balance. The <u>second part</u> (Chapters 4 and 5) focuses more directly on the irrigation sector itself, reviewing priorities for investment and proposing approaches to improved irrigation performance, institutional support and inter-agency coordination. Chapter 6 draws together the conclusions of the earlier chapters. Annexes describe the physical setting (Annex 1); evaluate technical constraints on paddy yields (Annex 2); present an econometric model of the demand system together with preliminary estimates of supply response (Annex 3); review issues in the irrigation sector (Annex 4); and suggest mechanisms for improving inter-agency coordination and institutional support for irrigated agriculture (Annex 5).

The report was prepared by a mission comprising D.J.W. Berkoff, Y.K. Choi and D.O. Mitchell (Bank Staff) and M. Barber (Consultant) that visited the Philippines in July 1990. A second mission comprising D.J.W. Berkoff, D.O. Mitchell and M. Ingco (Bank Staff) took place in February 1991. Annexes or working papers were prepared by M. Adriano, D. Taylor and A. Sanchez (Consultants). The mission is grateful for the assistance and suggestions it received from NIA, DA, NEDA and other agencies in the Philippines. A workshop was held in Manila in February 1991, hosted by NIA, at which the mission's preliminary conclusions were extensively discussed and during which it received important guidance. The mission is grateful to NIA for organizing this workshop and for the support it provided at all times. The final draft report was discussed with government in January 1992.

ABBREVIATIONS AND ACRONYMS

ACPC	-	Agricultural Credit Policy Council
ADCC	-	Agricultural Development Coordinating Committee
ADB	-	Asian Development Bank
AMRIIS	-	Angat-Maasim River Integrated Irrigation System
AMSL	-	Above Mean Sea Level
ATI	-	Agricultural Training Institute
BAR	-	Bureau of Agricultural research
BAS	-	Bureau of Agricultural Statistics
BCM	-	Billion Cubic Meters
BPI	-	Bureau of Plant Industry
BPW	-	Bureau of Public Works
BSWM	-	Bureau of Soils and Water Management
CAR	-	Cordillera Autonomous Region
CALF	-	Comprehensive Agricultural Loan Fund
CARP	-	Comprehensive Agricultural Reform Program
CBP	-	Central Bank of the Philippines
CDA	-	Cooperative Development Authority
CHO	-	Constant Head Orifice
CIDP	-	Communal Irrigation development Project
CIS	-	Communal Irrigation Scheme(s)
CRC	-	Center for Research and Development
DA	-	Department of Agriculture
DAR	-	Departmen of Agrarian reform
DNER	-	Department of Natural Resources
DPWH	-	Department of Public Works and Highways
DS	-	Dry Season
EO	-	Executive Order
ERR	-	Economic Rate of Return
ESCAP	-	Economic and Social Commission for Asia and the Pacific
FAO	-	Food and Agricultural Organization
FPA	-	Fertilizer and Pesticide Authority
FSDC	-	Farm Services Development Corporation
GSA	-	Gross Service Area
HRS	-	Hydraulic Research Station
HYV	-	High Yielding Variety
IA(s)	-	Irrigation Association(s)
IBRD	-	International Bank for Reconstruction and Development
IADP	-	Integrated Agriculture Development Project
IASR	-	Irrigated Agriculture Sector Review
ICID	-	International Commission on Irrigation and Drainage
IDD	-	Institutional Development Department
IDO	-	Institutional Development Office
IER	-	Impact Evaluation Report
IIMI	-	International Irrigation Management Institute
IOSP	-	Irrigation Operation Support Project
IRRI	-	International rice research Institute
ISF	-	Irrigation Service Fee
ISIP	-	Irrigation Services Improvement Plan
LBP	-	Land Bank of the Philippines

JICA	-	Japan International Cooperation Agency
LDC	-	Local Development Councils
LWUA	-	Local Water Utilities Administration
MARIIS	-	Magat River Integrated Irrigation System
MCM	-	Million Cubic Meters
MOA	-	Memorandum of Agreement
MTPDP	-	Medium-Term Philippine Development Plan
NAFC	-	National Agricultural and Fishery Council
NAPHIRE	-	National Post Harvest Institute for Research and Extension
NCCD	-	National Committee on Crop Diversification
NEDA	-	National Economic Development Administration
NFA	-	National Food Authority
NGO	-	Non-Governmental Organization
NIA	-	National Irrigation Administration
NIS	-	National Irrigation Scheme(s)
NISIP	-	Naational Irrigation Systmes Improvement Project
NPC	-	National Power Corporation
NWRB(C)	-	National Water Resources Board (Council)
OECF	-	Organization for Economic cooperation and Finance
OED	-	Operations Evaluation Department
O&M	-	Operations and Maintenance
PAFC	-	Provincilal Agriculture and Fishery Council
PAGASA	-	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAR	-	Philippine Area of Responsibility (for Typhoons)
PBME	-	Project Benefit and Monitoring and Evaluation
PCARRD	-	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PCR	-	Project Completion Report
PD	-	Presidential Decree
PHILRICE	-	Philippines Rice Research Institute
PIO	-	Provincial Irrigation Office
PIP	-	Provincial Irrigation Profile
PIS(s)	-	Pump Irrigation Scheme(s)
PARC	-	Presidential Agricultural Reform Council
POM	-	Plan of Operations and Maintenance
PPAR	-	Project Performance Audit Report
RA	-	Republic Act
RB	-	Rural Bank
RDA	-	Regional development Assembly
RDC	-	Regional development Council
RIO	-	Regional Irrigation Office
SEC	-	Security and Exchange Commission
SFR	-	Small Farm Reservoirs
SMD	-	Systems management Department
SWIM	-	Small Water Impounding Management (project)
TV	-	Traditional Variety
UPRIIS	-	Upper Pampanga River Integrated Irrigation System
USAID	-	United States Agency for International development
UNDP	-	United Nations Development Program
WHO	-	World Meteorological Office
WS	-	Wet Season

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IRRIGATED AGRICULTURE SECTOR REVIEW

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IRRIGATED AGRICULTURE SECTOR REVIEW

EXECUTIVE SUMMARY

The Role of Irrigation in Meeting Rice Requirements

i. The Philippine government attaches great importance to the issue of food security, and several studies have assigned the dominant motive for irrigation investment to rice self-sufficiency. Thus, emerging rice imports in the early 1960s contributed to the decision to establish the National Irrigation Administration (NIA), and heralded rapid expansion in the irrigated area. This expansion coincided with the "Green Revolution". Average yields rose from 1.25 t/ha in 1965 to 2.64 t/ha in 1985, and paddy output more than doubled to 9.5 M t. Despite rapid population growth, the Philippines emerged as a marginal exporter in 1977-83, helping to sustain agriculture's contribution to GDP and creating optimism for the future. Anticipating continued rice surpluses and growing budgetary constraints, the World Bank in 1982 advocated a shift from new investment to rehabilitation and communal irrigation. With self-sufficiency apparently achieved, pressures to invest in new irrigation eased.

ii. Unfortunately, reduced investment coincided with the maturing of the Green Revolution. By 1985, 87% of the paddy area (94% of the irrigated area) was planted to HYVs, one of the highest adoption rates in Asia. Average yields have since levelled off and IRRI studies suggest that in some environments yield potential may be declining. Thus, though there was a record harvest in 1990/91, yields on average are rising at no more than 1% per annum compared to 3-4% in the 1970s. With rapid population growth, imports have once again become necessary, reaching 0.62 M t (10% of consumption) in 1990. As in the past, imports have led to renewed pressure for irrigation, with Congress passing legislation that requires exploitation of the remaining irrigation potential within ten years. NIA's 1990 Corporate Plan proposes an ambitious investment program, foreseeing rapid growth in irrigated area and rice self-sufficiency by the turn of the century.

iii. How far is a major increase in irrigation investment justified? The answer requires consideration of a number of inter-related issues including prospects for demand and supply of rice and substitute foods; the role of trade and price policies in modifying these prospects; and the relative economic justification for irrigation investment.

The Prospects for Rice Deficits

iv. The report concludes that the Philippines will remain a significant rice importer during the 1990s. Projections of supply and demand, assuming constant prices and modest irrigation expansion, suggest that rice imports will be some 0.75-1.25 M t (perhaps 10-15% of demand) in the year 2000.

v. With respect to demand, the population growth rate will be the dominant factor. Though rice is expected to remain a "normal" good through the 1990s, if per capita income grows at 2-4%, the income elasticity of demand is projected to decline from 0.25 in 1987-90 to almost zero by the year 2000.

For population growth rates of between 2.2-2.5%, demand should rise from 6.0 M t to 7.5-8.0 M t over the period. Longer term prospects are more uncertain, but stabilization and then declines in per capita consumption of rice have occurred in other Asian countries (e.g. Malaysia and Thailand). Provided its economic problems can be resolved, comparable trends may be expected in the Philippines.

vi. With respect to supply, there has been no sustained increase in the area harvested to paddy since the 1960s, and none is foreseen during the 1990s. Irrigation intensifies cropping and some additional land could be brought under cultivation, but these gains will be offset by loss of paddyland to settlement and other factors. The major "swing" area is some 0.4-0.5 M ha in upland areas that shifts between rice and corn in response to price. This was predominantly under corn in the late 1980s, with upland rice occupying little more than 0.1 M ha. It is possible that this will return to paddy. The assumption that harvested area will remain constant at about 3.3 M ha is thus an over-simplification but is unlikely to be seriously misleading.

vii. Paddy yields in the Philippines are low relative to some neighboring countries, suggesting potential for further growth. However, IRRI evidence shows that the better Philippine farmers achieve yields as high as those on research stations and, moreover, that yield potential in some circumstances may be declining. Physical constraints accounting for lower average yields in the Philippines include seasonal factors (e.g., low solar radiation); water supply (e.g., reliance on run-of-the-river irrigation); deterioration in the paddy environment (e.g., due to intensive cultivation); and high incidence of tropical cyclones and other hazards. No doubt farmer skills, irrigation management, and agricultural support services could all improve, and measures to strengthen agricultural research, extension and marketing facilities should all be given high priority. However, the impact on average yields is likely to be modest as compared to the late 1960s/1970s when all farmers could readily increase yields through initial adoption of HYV technologies. Real fertilizer prices declined markedly and fertilizer supply doubled during the late 1980s without a major impact on yields and there is little evidence that -- relative to their potential -- Philippine farmers are performing noticeably worse than farmers elsewhere. In the medium-term some upward trend in yields can no doubt be expected and for the baseline projections this is taken to be 1% per annum, comparable to that achieved during the 1980s. Allowing for some conversion of rainfed land to irrigation, but no increase in harvested area, domestic supply would reach 6.5-7.0 M t by 2000. For the longer-term, adoption of hybrid rice technologies and other technical advances can be envisaged although their impact is unlikely to be significant until the next century.

Trade Policies to Moderate the Rice Deficit

viii. Assessing the prospects for rice requires consideration of the general policy context for the grains sector, in view of substitution effects and marketing and trading interactions. The wheat trade was among the first to be liberalized in the mid-1980s. The initial impact was discouraging as NFA gave way to a cartel that kept domestic prices well above world levels. But other investors intervened and the market is increasingly competitive -- imports have risen rapidly, prices have declined and monopoly rents have been largely eliminated. In contrast, rice imports remain an effective National Food Authority (NFA) monopoly. Real domestic prices have fallen by about 50% since 1975 broadly in line with world trends, with modest implicit protection in deficit years and modest taxation in surplus years. Corn is imported by both

NFA and the private sector. However, quantitative restrictions maintain domestic marketing prices well above border prices to compensate for high domestic costs and support the farmgate price. High feed prices adversely affect the livestock industry which also faces uncertainty in feed availability and serious domestic trading and transport deficiencies.

ix. There are therefore significant differences in the trading regimes of the three major grains. Based on end-1990 exchange rates, the report concludes that 1990 wheat prices were largely set in relation to world prices subject to tariffs and duties (about 20%); rice prices were broadly at import equivalent prices; and Manila corn prices were more than 40% above world levels. There are strong arguments on grounds of economic efficiency for aligning domestic prices with those on the international market. If tariffs are to be levied, then these should in principle be equalized among the major grains. Based on a full systems model of demand and preliminary estimates of supply response, the report therefore evaluates the impact on the rice balance of two scenarios: (i) adjusting prices to border equivalent levels (abolishing all import duties and quantitative restrictions), and (ii) imposing an equal 20% tariff on the major grains (abolishing all quantitative restrictions). It concludes that aligning domestic prices with international prices (Scenario 1) could reduce the rice deficit in 2000 by some 0.35 M t, primarily due to substitution of wheat demand for rice. A uniform 20% tariff (Scenario 2) would have a similar impact on rice demand and could induce additional supply of perhaps 0.25 M t. Neither scenario would mitigate an overall grain deficit in international trade. Thus, while modifying the trading regimes as specified has the potential for moderating the rice deficit, the analysis does not fundamentally alter the conclusion that the Philippines will remain a deficit producer in the 1990s.

x. Abolition of quantitative restrictions on wheat promoted competition, and encouraged investment in marketing and processing. Reform in corn and rice can be expected to have similar effects. However, these are staple crops produced locally so that liberalization must be introduced carefully. For corn in particular, protection offsets high domestic distribution costs and a sharp reduction in prices without corresponding improvements in marketing could have an adverse impact on production and farmer incomes. Two issues need to be considered if, despite the economic costs involved, protective measures are to be adopted: the advantages of tariffs relative to quantitative controls, and an appropriate response to world price volatility. An approach which deals with both issues is a reference price/variable tariff system, with the tariff adjusted automatically to reflect the difference between a world reference price and a target domestic price. In the case of corn, the tariff rates should be lowered over time to reflect progress in reducing internal trading cost and transport constraints. In the case of rice, the aim could be to equalize tariff rates to ensure efficient competition between the main grains while insulating domestic prices from world price fluctuations. Liberalization of corn is a priority in view of the potential impact on the livestock industry which has considerable expansion potential if only feed costs can be reduced.

Domestic Interventions to Increase Market Efficiency

xi. NFA intervenes in the domestic market to balance the interests of producers and consumers. However, procurement is inadequate to support farmgate prices except at a few favored locations; and release prices are well below market levels with the result that NFA incurs losses on its domestic operations. Moreover, a low release price puts pressure on commercial margins, disrupts normal market operations and creates rent-seeking opportunities. This discourages investment in milling, storage and transport, contributing to trading inefficiencies and high post harvest losses. NFA aims to provide poorer consumers with subsidized grain while at the same time sustaining prices to the producer. But combining subsidy functions and price stabilization results in neither objective being efficiently achieved.

xii. Detailed review of the domestic trading regime is beyond the scope of this report. Nevertheless, in principle, the aim should be to promote a competitive private sector with primary responsibility for balancing the market. As a minimum, and perhaps as an interim measure, the margin between the support and release prices could be substantially increased to accommodate seasonal price movements and realistic trader costs and margins. Under such a scenario, NFA would aim to manage a transparent buffer stock with the pre-announced release price enforced by disposal of stocks and imports, and procurement supporting the producer price to the extent that NFA resources allowed. NFA's financial position would be greatly improved by such reforms. However, price stabilization could remain a relatively costly activity. In the longer-term, trade liberalization and improvements in the efficiency of the domestic trading environment could together be sufficient to moderate price fluctuations, in particular under a reference price/variable tariff regime. If so, NFA's price stabilization activities might be gradually reduced, with the public sector's role largely limited to supporting a competitive private sector through infrastructural investments and an appropriate policy environment.

xiii. Irrespective of NFA's price stabilization role, <u>subsidy</u> programs -- if any -- should <u>prima facie</u> be targeted at those segments of the population which need to be protected rather than, as at present, being available to all through NFA outlets. Such subsidy programs should be financed and accounted for separately from NFA's other operations so that the costs are readily identifiable.

<u>Irrigation Development Priorities</u>

xiv. The Philippines has abundant water resources, although river flows are often seasonal and highly variable. Readily irrigable land is estimated at 4.3 M ha (gross) of which about 50% was irrigated in 1990. Some 150 national systems operated by NIA cover a net service area of 0.6 M ha, with about 30% in three large reservoir-backed systems, 65% in run-of-the-river schemes averaging 2,500 ha (ranging from a few hundred ha to 17,000 ha), and 5% served by pumps. More than 6,000 communal systems (CIS) serve a combined area of about 0.70 M ha. They range greatly in size but average about 115 ha. Data on private irrigation are scanty. About 0.1 M ha of publicly-assisted river lift and groundwater irrigation were developed in the 1960s/70s but most of these facilities are now inoperable. In contrast, private shallow groundwater development has expanded rapidly, although its current extent is uncertain.

xv. Agricultural performance in national systems has often fallen short of expectations, with service areas, irrigation intensities and incremental yields frequently below initial expectations. It is often argued that therefore schemes are operating well below their potential, a view used to justify some rehabilitation and modernization programs. However, water use efficiency is an ambiguous concept in run-of-the-river irrigation. For much of the time, water is in surplus while at times of scarcity farmers and managers are acutely conscious of shortages and little water is wasted. Even in storage-backed schemes, the only true efficiency criterion is whether there have been unnecessary releases, since in composite systems there are invariably large unregulated flows that cannot be saved. No doubt system designs could be simplified, O&M improved and the farmer participation strengthened. Maintenance allocations have been far from adequate, with siltation a particular problem. However, the report suggests that disappointing results have been due more to unrealistic expectations than to poor performance as such. Incremental paddy yields have failed to match projections, and the evidence suggests that irrigation schemes tend to stabilize at levels which reflect an inherent balance of prevailing physical and social conditions. If so, substantial improvements in agricultural performance are often an unrealistic objective of further investment.

xvi. Communal irrigation has also sometimes fallen short of expectations, with costs exceeding appraisal estimates and over-estimation of water and land resources. Conditions, however, vary and many schemes have proven economically attractive. Small water impounding (SWIM) projects are often high cost and, though they may have benefits besides irrigation, they have yet to prove a clearly viable form of development. Performance of public sector pump and tubewell programs have also been generally discouraging. In a few cases they have been successfully transferred to farmer associations which have operated them profitably for high-return, diversified crops. More often, they have operated at low levels of efficiency or have become completely inoperable. In contrast, private groundwater development has proven an attractive investment, particularly for intensive, high-return crops. Where aquifer conditions are favorable, investment can be expected to respond to market conditions, although such investment is rarely likely to be justified for paddy cultivation alone.

xvii. These mixed results suggest caution. Although NIA's stated objectives emphasize completion of on-going projects, rehabilitation and improved O&M procedures, and small projects over large projects, in practice large multi-purpose projects account for almost 45% of the total cost of the investment program proposed in the 1990 Corporate Plan, with national run-of-the-river systems accounting for a further 22%. In financial terms, therefore, large projects dominate proposed public investments. As a whole, the program is ambitious, envisaging a 36% increase in the service area (0.53 M ha) by the end of the century. Implementation and financial constraints will in practice limit what is possible and NIA has initiated a full review of the program. In carrying out this exercise, the report recommends that a number of considerations be borne in mind: (i) large multi-purpose projects are likely to prove justified only if the costs of headworks and other joint facilities can be attributed primarily to purposes such as electric generation; (ii) new run-of-the-river national projects will continue to be important but many are high cost with a limited dry season water supply and/or difficult physical conditions; (iii) communal irrigation remains a relatively high priority, subject to rigorous application of agreed selection criteria to ensure that high cost and economically low return projects are avoided; (iv) river lift and tubewell facilities have not proved viable in the public sector and should be predicated on communal or private ownership; and (v) SWIMs should remain essentially a pilot program until their justification can be confirmed.

xviii. Irrespective of these priorities, implementation and financial constraints will limit development and several major projects have already encountered delays. A review of NIA's proposed 1990-2000 program suggests that multi-purpose projects might account for perhaps 50,000-60,000 ha; run-of-the-river NIS projects for about 80,000-100,000 ha; and communal irrigation for the balance of 120,000-140,000 ha. Other programs would be expected to contribute relatively minor amounts. Subject to the economic viability of individual projects, a reasonable objective might thus be a net increase in the service area of, perhaps, 25,000 ha per, year or 275,000 ha over the period 1990-2000. Actual new service area would need to be somewhat greater to offset loss of irrigated land to settlement and other factors. Furthermore, these targets make no specific allowance for the expansion of private groundwater irrigation which could be substantial. The latter is, however, unlikely to have a major impact on the prospects for rice output, being primarily a response to diversified marketing opportunities, which in turn will be strongly correlated with general economic performance.

Improving Irrigation Performance

xix. Besides new investment, rehabilitation and O&M programs have strong *a priori* justification. The question is what kind of rehabilitation and what O&M can be sustained. A systematic diagnosis of scheme-level problems together with farmers and agricultural agencies might ensure that physical improvements contribute directly to a workable irrigation service. An 'Irrigation Service Improvement Plan' is therefore recommended to clarify the irrigation service for any particular scheme, schedule investment works and O&M allocations in support of the service, and develop O&M plans to guide project staff. Several improvements may have general application. *First*, tradeoffs between capital and recurrent expenditures can be considered in resolving siltation, erosion and related problems -- even if solutions are relatively costly, they may be justified to avoid the continuing aggravation of regular maintenance. *Second*, a more realistic approach to water control is often desirable with design solutions simplified -- these have the potential for improving efficiency and can be readily adapted to diversified cropping if required. *Third*, there is often potential for improving operational practice, for instance to minimize silt inflows, optimize reservoir operating rules, utilize rainfall and return flows, and systematize rotational distribution and/or staggered transplanting. *Fourth*, building on NIA's highly successful farmer participation programs, O&M procedures need to be strengthened and systematized in ways that build on the role of irrigation associations (IAs) and inter-agency coordination in planning and management. While it may be unrealistic to expect substantial improvements in irrigation performance (para. xv), cost-effective O&M programs and rehabilitation can still have important benefits.

Institutional Support for Irrigated Agriculture

xx. The National Water Resources Council (NWRC) and the 1976 Water Code provide the framework for the rational appropriation, control and conservation of water. These could be further supported by the preparation of the proposed National Water Resources Master Plan to update and supplement existing basin framework plans. Conflicts between water users have arisen with respect to reservoir operations and at times of low flow, and clarification of the role of local government bodies in resolving such conflicts will increasingly be needed. Institutions for rivercourse management should be developed to involve local government bodies, improve coordination with other agencies and strengthen accountability and public participation.

xxi. NIA was created in 1964 as an independent and financially autonomous agency. Important powers were, however, retained by Government -- fee setting, personnel management, investment policy, etc. -- so that NIA has been unable to generate the internal resources to fund investment or provide adequate support for O&M. Even so, its corporate structure has stood the test of time and given it a flexibility and purpose often lacking in public infrastructure departments elsewhere in Asia. This is illustrated by its response to the phasing out of operating subsidies in the early 1980s, which has included devolution of responsibilities to farmers and staff incentives. In general, it has had more success in containing costs than in generating revenues, and revenue from Irrigation Service Fees (ISF) -- NIA's main source of income -- has stagnated in real terms. Since 1975, ISF rates have been expressed in terms of paddy and farmers can pay in cash or kind. This provides a measure of indexation against inflation, but real rice prices have declined and the basic rate remains unchanged. Moreover, payments in kind are costly to collect, store, and sell, being worth only an estimated 50% of the cash equivalent. Unless empirical evidence clearly shows that collection performance more than compensates for these drawbacks, consideration should be given to phasing out payment in kind, although not necessarily payment denominated in kind. Serious consideration should also be given to increasing the basic ISF rate which, as stated above, has remained constant since 1975 despite a large erosion in its real value.

xxii. Declining paddy prices, stagnating yields and decreasing farm size help explain relatively poor ISF recovery performance and reluctance to raise ISF rates. Although higher paddy prices and an improved irrigation service could strengthen collections, of much greater long-term importance is NIA's strategy of devolving O&M responsibilities to farmers through contractual arrangements and full turn-over of O&M to irrigation associations (IAs). From its earliest days NIA has promoted IA formation. For communal irrigation, it pioneered the participatory approach, employing irrigation community organizers as catalytic agents and evolving systematic and formalized implementation procedures. In national systems, IA formation is being greatly accelerated and strengthened under the Bank-supported Irrigation Operations Support Project (IOSP). This will reduce O&M costs and should have a favorable impact on system performance and ISF collections. However, these developments will take time and, in the absence of an increase in the basic ISF rate, NIA may find it increasingly difficult to cover its operating costs while funding O&M at levels needed to sustain performance. Additional commitments should therefore be reviewed with care so as not to over-stress NIA's financial position.

Rationalizing Inter-Agency Coordination

xxiii. Numerous agencies support irrigated agriculture and mechanisms have evolved for inter-agency cooperation and coordination. They include local government agencies (e.g. the regional and provincial development councils), line agency arrangements (e.g. the agricultural and fishery councils) and scheme-level activities (e.g. coordinating councils for MARIIS and UPRIIS). Even so, problems in coordination remain both at the planning stage and in relation to seasonal operating decisions and practices. Modifications must be consistent with the proposed local Government Code and recognize the role of local government in water resource and irrigation management. Solutions should also ensure full participation of water users in the decision-making process; account for the hydrological determinants of river basin and scheme boundaries; and facilitate the scheduling of public and private inputs and services to complement improvements in the irrigation service.

xxiv. As an initial step, it is recommended that the Agricultural and Fishery Councils be consolidated with existing sectoral sub-committees to serve as functional adjuncts to the regional and provincial councils. The consolidated committees would be responsible for sponsoring coherent and consistent rural development, and coordinating the provision of inputs and services in support of irrigated agriculture. Consideration should also be given to how scheme-specific and rivercourse management can be best institutionalized. Solutions will depend on local circumstances, notably how great pressures are on the resource and the relative importance of irrigated agriculture. One option would be for the Agricultural Committee of the Development Council to review scheme-specific measures within the framework of its other responsibilities. In other cases, such as large schemes like UPRIIS, a committee for that specific scheme or group of schemes is justified. Increasingly, however, as non-agricultural uses grow and competing pressures on scarce water resources emerge, it will become important to develop mechanisms for managing inter-sectoral allocations and resolving conflicts on a rivercourse basis. Provincial water resource committees would then be required, with appropriate mechanisms developed at a regional level for rivers that traverse more than one province.

The Balance of Future Strategies

xxv. The report evaluates irrigated agriculture within the framework of the Government's food security objectives. It concludes that the potential for enhanced paddy yields and improved irrigation performance are less than is commonly supposed. Consequently, economic returns from irrigation projects are unlikely to improve over the sometimes discouraging results of the past. Indeed as less favorable sites are exploited, economic returns from some new projects may decline. Moreover, even if the investment program proposed in NIA's 1990 Corporate Plan could be implemented, which is doubtful, this in itself would be insufficient to ensure rice self-sufficiency.

xxvi. Given this outlook, the report investigates other possible strategies for achieving the government's food security objectives. In particular, it evaluates the potential role of trade and pricing policies. It shows that elimination of protection, while improving the rice balance, generally worsens the overall trade balance in grains, in both physical and value terms, since reduced wheat and corn prices induce increased consumption and hence imports. This is true also for equalization of protection at a 20% level, though increased meat -- and hence feed corn -- consumption is then the sole cause. Thus, while national economic welfare would gain from the gradual elimination of quantitative and other forms of protection on corn and wheat, this would be at the expense of increased total grain imports due primarily to higher feed corn imports in support of increased meat consumption. Irrespective of these trade policy alternatives, the Philippines would remain a significant rice importer through the 1990s. Since wheat, and probably corn, will also be imported, the Philippines will be dependent on world markets for meeting a part of its basic food requirements.

xxvii. Rice self-sufficiency has been a long standing GOP objective and the outlook for continuing imports is a matter for concern. Nevertheless, the report argues that it will be in the Philippines economic interest to focus attention on sectors with significant potential for productive growth (for instance -- in the agricultural sector -- corn and livestock) rather than allocating scarce investment resources to achieving rice self-sufficiency at all costs. Irrigation projects need to be evaluated on a project-by-project basis, adopting realistic assumptions and clear economic criteria rather than being driven primarily by the objective of rice self-sufficiency. Import dependence carries risks which are sometimes used to justify self-sufficiency objectives. However, World Bank projections suggest that, if anything, international rice prices will decline into the next century and that therefore the efficiency cost of low return investments could be high.

xxviii. Irrespective of the level of irrigation investment, or the degree of trade protection, the report concludes that there are opportunities for strengthening irrigation performance and increasing efficiency in complementary supporting services. The specifics of many of these programs lie outside the focus of this report but their impact on the overall grain balance, though difficult to assess, could be significant. High priority needs to be given to necessary detailed studies, in particular with respect to agricultural research and extension programs and to reforms in transport, marketing and distribution which have the potential for increasing efficiency and reducing real costs to the grains trade. Though the scope for increases in paddy productivity in the medium term may be less than often supposed, the potential in corn could be substantial and would be strongly promoted by strengthened agricultural support services and a more efficient domestic trading regime.

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IRRIGATED AGRICULTURE SECTOR REVIEW

1. INTRODUCTION

General

1.1 The Philippines, with some 7,100 islands and islets, is the largest archipelago in the world with an aggregate land area of about 300,000 km^2. Luzon and Mindanao account for about two thirds of the total and the Visayas for most of the balance. Population in 1989 was estimated at 60.1 M of which 40% was urban, compared with 42.8 M and 20% urban in 1975. Some 7.8 M (or 13% of the total) live in Metro Manila. If the present growth rate (2.2% p.a.) is maintained, population would double in a generation. Rapid population growth is generally acknowledged as a major force in the degradation of the Philippine forest, marine and agricultural environment as well as in the deterioration of living conditions for the urban poor.

1.2 From 1961 to 1982, the economy performed reasonably well if judged in terms of overall growth. Real GDP increased at about 5.4% p.a. and per capita incomes rose by about 70%. During the 1980s, however, the Philippines suffered a major economic reverse. In 1983, growth virtually ceased and GDP fell in both 1984 and 1985. Moreover it became clear that the pattern of development followed in earlier years had resulted in an economy with a distorted incentive structure, an inefficient pattern of investment, and dependance on foreign resources. Since 1983, and in particular since the change of Government in 1986, policy reforms have moderated some of the major distortions and reduced the fundamental imbalances in the financial accounts. Growth was restored in 1986-87, and in 1988-89 GDP rebounded at about 6% per annum. In 1990-91, however, the economy once again slowed and growth during 1990 is estimated at only about 3.5%. More disturbingly, serious imbalances have re-emerged in the fiscal and current account deficits.

1.3 Despite recovery from the crisis of the mid-1980s, and the reforms introduced, the Philippines economy has thus still to attain a sustainable growth path. A Bank economic report (World Bank, 1990) therefore advocated further macroeconomic and structural adjustment efforts. Since this report was finalized, there has been an additional depreciation of the peso; significant domestic resource mobilization efforts; a positive outcome to the February Aid Group meeting; and in April 1990 an IMF agreement. However, exogenous shocks continue to afflict the economy (e.g. the aftermath of the Gulf war and the Pinatubo volcanic eruption) and recently there has been renewed deterioration in the macroeconomic balances. Moreover, despite the reform efforts to date, the conclusion that the Philippines has yet to achieve levels of efficiency that would make it vigorously competitive in the world economy still stands. To achieve this, there is a need to broaden the scope and deepen the intensity of the structural reform efforts.

1.4 In addition to these macroeconomic issues, the Philippines faces a poverty problem that is in many respects more serious than that of its neighbors. More than 30 million people (50% of the population) live in poverty in the sense of having an income that does not satisfy basic needs (defined as an income of P5,010 in urban and P3,760 in rural areas). Issues include maldistribution of assets (notably land), rapid growth in the labor force, and high levels of underemployment. Sustained growth would help alleviate such problems, with the type of growth and quality of economic management also important. A recent Bank report on poverty (World Bank, 1988) concluded that in addition to reforms in public expenditures and tax policies, positive steps to address poverty should include further land reform and rural development efforts, family planning measures, productivity improvements, and strengthened programs in education, health and nutrition.

The Agricultural Sector

1.5 Agriculture's contribution to past economic development has been surprisingly strong (World Bank, 1987). It would be expected in years of rapid growth that there would be structural change away from agriculture towards other sectors of the economy. However, between 1970-1980 this pattern occurred to only a modest degree with agriculture (excluding forestry) achieving annual growth rates of more than 5%. During the mid-1980s, agriculture was the only sector to retain some momentum and, though there was a drought-induced setback in 1987, the sector again grew strongly in 1988-89 at about 4% p.a. Along with the rest of the economy, growth slowed in 1990 when the agricultural growth rate is estimated to have been 2.5%. Table 1.1 shows the shares of the major subsectors and commodities in agricultural gross value added (GVA) in the period 1970-89. Agricultural growth slowed during the 1980s compared to the 1970s but its share of total GVA was largely sustained. Within agriculture, the contribution of crops also remained stable. If bananas -- which performed erratically -- are excluded, the share of crops remained somewhat above 50%, with declines in sugar offset by increases in 'other crops'. The shares of paddy, corn and coconuts all remained fairly constant although there was some decline in that of paddy during the 1970s. Livestock and fisheries have also remained relatively stable. In contrast, there has been a sharp increase in the contribution of poultry and a sharp decline in that of forestry.

Table 1.1: CHANGING STRUCTURE OF AGRICULTURAL GROWTH, 1970-89

	GVA at 1972 Prices: B Pesos			% of Agricultural GVA		
	1970	1980	1989 1/	1970	1980	1989 1/
Paddy	2.8	4.1	5.0	18.9	17.3	17.2
Corn	0.9	1.4	2.0	6.1	5.9	6.9
Coconuts	0.8	1.3	1.6	5.3	5.5	5.5
Sugar	1.0	1.3	0.9	6.6	5.5	3.1
Bananas	0.3	2.4	0.9	1.7	10.1	3.1
Other crops	2.2	4.7	6.7	14.5	19.8	23.1
Total Crops	7.9	15.2	17.0	53.1	64.1	58.6
Livestock	1.8	1.9	2.9	11.8	8.0	10.0
Poultry	0.6	1.6	3.4	4.1	6.8	11.7
Fishery	2.6	3.9	5.1	17.5	16.5	17.6
Forestry	2.0	1.1	0.6	13.4	4.6	2.1
Agriculture GVA	14.8	23.7	29.0	100.0	100.0	100.0
Total GVA	51.0	83.6	106.8	(29.0) 2/	(28.3) 2/	(27.1) 2/

1/ Preliminary. 2/ Agricultural GVA as % of total GVA.
Source: Government of the Philippines, National Accounts.

1.6 This impressive performance has occurred despite policies in the past that have discriminated against agriculture. Chief amongst these were an over-valued exchange rate that taxed tradeable goods relative to non-tradeables, reduced producer incomes and constrained consumer price increases. In industry this was offset by high levels of nominal protection while in agriculture, exports in particular (coconut products, sugar) were subject to a range of trading restrictions. There is evidence that the reform program was also initially biased against agriculture (Clarete, 1990). However, depreciation of the peso and trade reform on a broader front have substantially moderated this bias and the extent to which it remains is debatable Moreover, discrimination in grains has always been less clear cut than in agriculture as a whole. For rice, subsidies on irrigation and credit and modest protection in deficit years at least in part offset exchange rate effects, while for corn there has been considerable protection in particular since the mid-1980s. Corn, and by extension livestock, have also been subject to severe domestic trading constraints. In many ways, therefore, they have been treated comparably to industry, with protection provided to a relatively high-cost subsector that is simultaneously subject to a range of Government controls and interventions.

Irrigated Agriculture

1.7 Irrigated agriculture in the Philippines is largely synonymous with rice and expansion in the irrigated area has contributed importantly to rice production. Irrigation has a long history as witnessed by the Banawe terraces of Northern Luzon, and the Zinjara cooperative and friarlands schemes of the Spanish era (Annex 4). Large-scale public development began early in this century, and was followed by programs supporting communal schemes. With the creation of the National Irrigation Administration (NIA) in 1964, the sector entered a period of major expansion. This is indicated by Table 1.2. The official estimates substantially understate the 1964 area, in particular under communals. Even so, the service area has increased rapidly to a current total of about 1.5 M ha, with national systems operated by NIA, communal schemes operated by farmers and private pump schemes all sharing in this growth.

Table 1.2: EXPANSION IN THE IRRIGATED AREA, 1964-90

Year	Service Area ('000 ha)				Growth of Total
	National Systems1/	Communal Systems	Private Pumps2/	Total	(1964 Base Year)
1964 3/	217.5	272.0	51.5	541.0	100
1970	395.9 4/	na	na	na	na
1975	396.3	470.0	119.0	985.3	182
1980	472.2	580.0	152.1	1,204.1	223
1985	568.2	665.1	152.1	1,385.4	256
1990	621.0	714.8	152.1	1,487.9	275

1/ Estimates are revised periodically to reflect land lost to settlement.
2/ Apparent stagnation of pump areas is clearly suspect (see Annex 4).
3/ The 1964 estimate is significantly understated (see Annex 4).
4/ Based on a design area which overstates the actual service area.
Source: National Irrigation Adminstration.

1.8 Impetus to this expansion was given in the early 1970s by the Bank-supported Upper Pampanga project, the first major multipurpose project. This was followed by the Magat project and by many other Bank and ADB-supported programs which have extended major irrigation to most regions of the country. Public support for communal irrigation also continued, with the Bank-supported Communal Irrigation Development Project (CIDP 1) dating from 1982. During the 1980s, allocations were reduced as a result of the financial crisis and emphasis shifted to rehabilitation and consolidation of previous programs. Nonetheless, there was continued growth in the irrigated area as projects were completed and renewed rice imports have created interest in further expansion.

1.9 Expansion of the irrigated area coincided with the introduction of the new high yielding rice varieties (HYVs), reinforcing the latter's impact given that the HYVs require irrigation to achieve their full potential. With the closing of the land frontier, the harvested area has remained relatively constant so that the HYV technologies and conversion of rainfed paddyland to irrigation together largely explain the increase in paddy output from 4.0 M tons in 1965 to 9.5 M tons in 1989. About 70% of the total now comes from irrigated land and irrigated yields average some 50-60% more than those obtained under rainfed conditions (Table 1.3). Towards the end of the 1970s, rising output led to rice self-sufficiency. However, in the 1980s average yields leveled off. Renewed imports were required in 1984-85 and again in 1988-90, and although production rebounded in 1990 record imports were necessary to satisfy demand.

Table 1.3: PADDY PRODUCTION, AREA HARVESTED AND YIELDS, 1965-90

	Irrigated			Rainfed			Total		
Year	Prod. ('000t)	Area ('000ha)	Yield (t/ha)	Prod. ('000t)	Area ('000ha)	Yield (t/ha)	Prod. ('000t)	Area ('000ha)	Yield (t/ha)
1965	1,578	958	1.65	2,415	2,241	1.08	3,992	3,200	1.25
1970	2,761	1,346	2.05	2,473	1,768	1.40	5,234	3,113	1.68
1975	3,034	1,412	2.15	2,626	2,127	1.23	5,660	3,539	1.60
1980	4,507	1,609	2.80	3,190	1,862	1.69	7,647	3,471	2.16
1985	5,821	1,838	3.17	2,985	1,469	2.03	8,806	3,307	2.64
1990p	6,615	2,010	3.29	2,714	1,308	2.07	9,319	3,319	2.81

Sources: 1980-90: Bureau of Agricultural Statistics (BAS).
1965-75: BAS, quoted in H.E.Bouis "Prospects for Rice Supply/Demand Balances in Asia", IFPRI, 1989.

GOP's Agricultural Objectives

1.10 GOP's objectives for the agricultural sector are stated in the Agricultural Development Plan (DA, 1990) as follows: (i) to increase the productivity and real incomes of small farming and fishing families, especially in upland, coastal and other poverty-stricken areas; (ii) to help ensure the productivity of the agricultural resource base over the longer term; (iii) to attain self-sufficiency in rice and corn for food security; and (iv) to help attain a favorable balance of trade for the country.

1.11 Irrigated agriculture will play an important role in meeting each of these objectives. Expansion of the irrigated area provides an important mechanism to increase the productivity and incomes of some of the poorest Filipinos. If managed well, irrigation helps stabilize land use and productivity in the long term. More directly, expansion of irrigation contributes to rice output, and thus to meeting objectives of rice self-sufficiency and reduced food imports. The importance of irrigated agriculture is thus self-evident. However, the objective of rice self-sufficiency may conflict with efficiency objectives and irrigated agriculture's contribution needs evaluation in relation to other means of attaining the same goals. Under conditions of resource scarcity, investments in irrigation compete with those in other sectors while rice self-sufficiency -- the objective most closely related to irrigation -- can be achieved at varying levels of per capita consumption. Demand management, irrigation investment and support programs for irrigated agriculture can thus play varying roles in achieving GOP's food security and other objectives.

The Irrigated Agriculture Sector Review

1.12 Irrigated agriculture was last reviewed by the Bank in the context of the 1987 Agricultural Sector Review (World Bank, 1987). The Irrigated Agriculture Sector Review (IASR) updates and in some respects revises the conclusions of the earlier study. It is set within the framework of the Government's general objectives for the agricultural sector but with its main focus on those relating to food policy and rice production. Without prejudice to their importance, other objectives, for instance those relating to regional development and poverty alleviation, are only treated incidentally.

1.13 The report falls into two parts. The first part (Chapters 2 and 3) reviews prospects for rice demand and supply within the context of prospects for foodgrains as a whole. Chapter 2 assesses the basic determinants of demand and supply, evaluating prospects in the absence of significant changes in trade and pricing policy. Chapter 3 reviews past policies and evaluates how modifications could contribute to a more efficient production and trading environment Implications for rice demand and supply are evaluated in the light of food security issues. The second part (Chapters 4 and 5) focuses more directly on irrigation. Chapter 4 evaluates past irrigation performance, develops approaches to future improvements, and suggests priorities for irrigation investment. Chapter 5 discusses the institutional support for irrigated agriculture, including the role of farmer organizations, and recommends how irrigation management could be strengthened by decentralization and improved inter-agency cooperation. A short concluding chapter (Chapter 6) seeks to present the different components in an integrated strategy.

1.14 The report touches upon a wide range of food policy and irrigation issues and explores how these are related as a basis for helping establish future priorities for meeting rice requirements in a balanced manner. It reviews other food sectors (wheat, corn, livestock) to the extent that they impact on prospects for rice but is not intended as a comprehensive review of food production and policy, and the conclusions reached must be viewed in this light. Nor does the report provide a detailed review of agricultural supporting services (research, extension, credit etc.) since its primary objective in relation to irrigation is to evaluate the justification for future investment in the light of institutional support for improving irrigation performance.

1.15 Extensive work has been undertaken on these and other food policy and irrigation issues by a variety of national and international agencies (e.g UPLB, NIA, DA, IRRI, IFPRI, and the ADB). A major concern in carrying out the study has been to ensure that the detailed analysis undertaken by these other agencies is fully taken into account.

2. DETERMINANTS OF DEMAND AND SUPPLY

A. Issues in Demand

Consumption Trends

2.1 Food consumption patterns in the Philippines are fairly typical of a country at its stage of development (Table 2.1). Cereals account for the majority of calorific intake with smaller contributions from animal products and other commodities. The diversity of the diet has been increasing and consumption as a whole has grown significantly faster than population. Rice and corn are the dominant locally-produced grains, with about an equal area devoted to each. Higher paddy yields and use of corn for feed means however that per capita rice consumption is three times that of other grains combined.

Table 2.1: PER CAPITA CONSUMPTION OF SELECTED FOOD ITEMS, 1965-90

	1965-67	1968-72	1963-76	1977-79	1980-83	1984-86	1987-90
	(kg/head)						
Rice	80.8	72.1	79.8	84.9	90.5	94.1	94.4
Corn	20.4	21.4	23.8	22.4	19.7	17.8	16.7
Wheat	10.8	12.2	10.5	11.1	12.2	11.4	14.5
Meat	16.5	16.8	16.7	15.1	17.6	15.3	18.4
Fish	19.2	26.6	31.6	29.3	30.6	30.1	28.6
Fruits & Veg.	40.9	41.4	46.1	61.8	75.2	66.4	70.1

1/ Corn consumption in 1965-79 has been adjusted to be consistent with later estimates and to correct for a recognized data discrepancy (Annex 3).
Source: Annex 3.

2.2 Rice is the principal staple. It is notable, however, that corn and wheat have long been more important than in many neighboring countries. This reflects: (i) the limited area suitable for paddy in the Visayas and Mindanao where corn (consumed as corn grits) is the staple for perhaps 20% of the country's population, and (ii) cultural factors which favor consumption of wheat products in the urban diet (e.g. pan de sal, a traditional bread, and -- more recently -- the growth in consumption of fast foods and noodles). Not surprisingly for an island country, fish is the principal source of animal protein. However, after rising rapidly in the 1960s, per capita consumption of fish has stabilized reflecting limits on the marine resource only partly offset by growth in aquaculture. Pork and poultry are the dominant meat products, and their consumption has risen steadily if somewhat slowly. A wide range of other products (dairy products, eggs, roots & tubers, fruits & vegetables, pulses etc.) add variety to the diet. Per capita consumption of dairy products, eggs, and fruits & vegetables has risen with income while that of some other commodities (e.g. roots & tubers) has declined. The contribution of these commodities to nutritional status remains modest.

Price and Income Effects

2.3 The Demand Model. Annex 3 presents a systems model for food demand in the Philippines. The model specifies a demand system for all expenditures (non-food items treated as a single group) using 1961-90 time series data.

Urbanization, habit formation and subsistence effects on consumption are tested. Inconsistencies, notably with respect to corn consumption in earlier years, required some adjustments to the data set which may affect the results. Subject to this qualification, the results provide a complete and internally consistent set of income, own-price and cross-price elasticities of demand for each year of the period under study.[1] Table 2.2 summarizes estimates for the most recent period and Table 2.3 shows how income elasticity estimates have changed over time.

Table 2.2. PRICE 1/ AND INCOME ELASTICITIES OF MAJOR FOOD ITEMS, 1987-90

Year	Price Elasticity with Respect to the Price of: Rice	Corn	Wheat	Meat	Fish	Fruit & Vegetables	Income Elasticity
Rice	-0.148	0.003	0.100	0.087	0.036	-0.409	0.245
Corn	0.692	-0.271	0.146	0.099	0.652	-0.208	-0.557
Wheat	0.665	0.005	-0.701	-0.308	0.720	-0.192	0.855
Meat	0.381	0.003	-0.219	-0.740	0.343	-0.035	1.490
Fish	0.086	0.009	0.291	0.192	-0.361	0.509	0.641
Fruit & Veg.	-0.510	-0.001	0.033	0.002	0.228	-0.415	0.459

1/ Marshallian own and cross-price elasticities. See Annex 3.
Source: Annex 3.

Table 2.3. INCOME ELASTICITIES OF MAJOR FOOD ITEMS, 1965-1990.

Year	Rice	Corn	Wheat	Meat	Fish	Fruits & Vegetables
1965-67	0.483	0.178	0.846	1.445	0.420	-0.019
1968-72	0.362	0.176	0.867	1.466	0.601	0.093
1973-76	0.440	-0.338	0.867	1.431	0.687	0.234
1977-79	0.230	-0.037	0.845	1.550	0.643	0.385
1980-83	0.140	-0.372	0.833	1.526	0.663	0.482
1984-86	0.294	-0.273	0.841	1.586	0.652	0.419
1987-90	0.245	-0.557	0.856	1.490	0.641	0.459

Source: Annex 3.

2.4 Income Effects. The results show that income elasticity of demand for rice remains positive although declining over time. These estimates are somewhat higher than in two other studies which also used a systems approach but these were based on cross sectional data (Bouis, 1989. Bouis, 1991) or

1 The Almost Ideal Demand System (AIDS) specification is adopted which includes rice, wheat, corn, meat, fish, fruit & vegetables, and non-food commodities. The effect of urbanization is tested by including the percentage of the population in urban cities. The effects of changes in semi-subsistence farming on corn production is proxied by the proportion of corn-consumers in the population. As indicated, data limitations affect the reliability of the results but these would be encountered in any approach and it is generally accepted that the AIDS specification is the most satisfactory for food policy analyses. For a full description of the model see Annex 3.

assumed separability in the demand for cereal and other expenditure categories and so did not fully capture inter-sectoral linkages (Huang, 1990). The shifts between successive periods, for instance between 1980-83 and 1984-86, may appear surprisingly large and could be over-stated. However, the direction of change is intuitively consistent with trends in per capita incomes, decreasing at times of economic growth and increasing at times of recession (notably the mid-1980s). Income trends have been notoriously unsettled in the Philippines and this may be reflected in the results. If so, consumer behavior relating to staple foods is more variable than typically suggested by cross sectional analyses or assessments in countries with a steadier growth path.[1,2]

2.5 The conclusion that rice remains a normal good contrasts with recent studies that conclude for some other Asian countries that it is now an inferior good (Ingco, 1990; Ito, 1989). In Thailand, for instance, per capita consumption has fallen steadily at a time of rapid income growth (from 240 kg in 1969 to only 154 kg in 1988) and income elasticity has been strongly negative for many years. Whether this will occur in the Philippines is an important question. Assuming per capita incomes rise, projections using the model suggest that rice will become an inferior good early in the next century and that total demand will continue to rise rapidly during the 1990s fueled more by population growth than by the low and declining income elasticity. In contrast to rice, Table 2.3 suggests that corn for direct consumption has been an inferior good since the early 1970s. The income elasticity of demand for wheat, meat, fish and fruits and vegetables are all strongly positive, as would be expected. The low elasticity for fruit & vegetables in earlier years is anomalous and may reflect changes in the mix of this group of commodities.

2.6 These results do not distinguish between urban/rural populations, nor between different income levels. Bouis (1991) provides this detail based on a different model formulation and 1987 cross section data. Table 2.4 summarizes his results for rice and corn. They are broadly consistent with the IASR estimates although they suggest a lower average elasticity of demand for rice. Combined with the trends indicated in Table 2.2, this may imply that rice will become an inferior good even earlier than suggested above.

Table 2.4: ALTERNATIVE INCOME ELASTICITY ESTIMATES, 1987

Income Quartile	Rice		Corn	
	Urban	Rural	Urban	Rural
Bottom Quartile	0.05	0.27	-0.27	-0.64
Second Quartile	0.10	0.11	-0.42	-0.27
Third Quartile	-0.01	0.09	-0.26	-0.39
Top Quartile	-0.09	0.03	-0.60	-0.32

Source: Bouis (1991)

2.7 Price Effects. With respect to price elasticities, the results are intuitively convincing. The own price elasticities of demand for the two

[1] The widely-held perception that consumer behavior is relatively stable, not just in the Philippines, should perhaps be critically re-evaluated.

[2] Demand analysis using panel data (time series of cross-section data) would provide better indication of change in consumption over time.

staple grains are low; those for the relative luxuries wheat and meat are relatively high; and those for fish and fruits & vegetables fall in between. The negative cross-elasticity between fruits & vegetables and commodities other than fish are less convincing although vegetables may be eaten as an alternative to fish with the main staple. As would be expected, the cross elasticities between the different grains are all positive to varying degrees suggesting that consumers see them as substitutes. However, the cross price elasticities of corn and wheat with respect to rice are significantly higher than the reverse, reflecting the dominance of rice in the average diet.

B. Issues in Supply

Paddy

2.8 Areas. The paddy harvested area has remained much the same since the early 1960s (Table 1.3 and Figure 1.1). Lowlands suited to paddy have by now largely been developed, except to an extent in Mindanao, and in many regions are shrinking due to urbanization and infrastructural development (Annex 4). Loss of cultivable land has been offset by increasing intensity due to irrigation (the share of the dry season crop in total harvested area rose from 31% in 1970 to 40% in 1988) and there have been shifts in the area under upland paddy in response to relative returns from corn and other competing crops. However, the swing area amounts to no more than 15% of the area under paddy and, though shifts in upland paddy have a disproportionate effect on average yields and imports, their production impact is small. For the future, total harvested area seems if anything likely to decline due to loss of cultivable land and, perhaps, programs to diversify dry season irrigated cropping. Any increase in production will therefore have to come from yields.

2.9 Yields. Yields in the Philippines are low relative to those in some neighboring countries and this is often taken to indicate that there is substantial remaining potential for growth. However, the Philippines has if anything improved its performance relative to the rest of Asia[1] and, according to IRRI data, HYV adoption rates at 87% are the second highest in Asia after Sri Lanka. No doubt fertilizer use could be increased but response to lower real prices following deregulation in the mid-1980s was disappointing (see para. 3.19), and Annex 2 argues that there are physical constraints which will limit yields. Similar constraints of course affect other countries and a cross-country comparison would be required to evaluate their relative importance (a study that is beyond the scope of this report). Nevertheless, taken together, a variety of factors suggest that -- relative to potential -- Filipino farmers are on average performing no worse than farmers elsewhere and, if so, the potential for further increases in yields may be less than is commonly supposed. Chief among these factors are the following:

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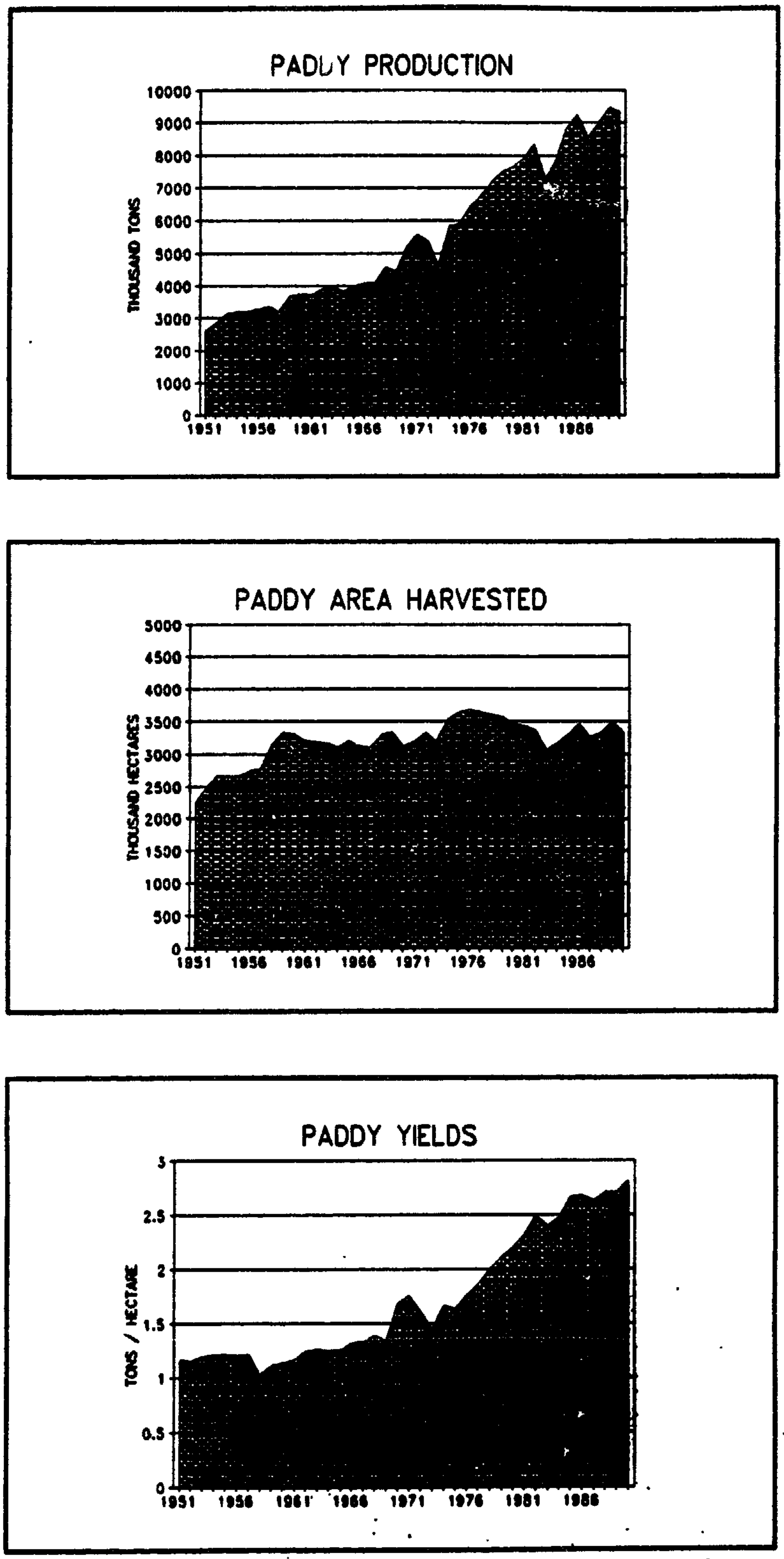
1 During the 1950s it had the lowest average yield among the ten major countries mentioned in Annex 2. By the 1980s it was in seventh position. Moreover, excluding China and Korea which have very different conditions, Indonesia is the only major country with which the Philippines compares noticeably poorly. And it is arguable that climatic, soil and water conditions are all relatively favorable on Java. Excluding Java and Bali, performance in Indonesia is no better than in the Philippines despite fertilizer subsidies that have been much more substantial and widespread.

Figure 2.1: PADDY PRODUCTION, HARVESTED AREA AND YIELDS, 1951-89



Source: Bureau of Agricultural Statistics

(a) Seasonal Factors. Nitrogen response experiments suggest potential IR20 irrigated yields in Central Luzon of about 5.0 t/ha in the wet season and 6.5-7.0 t/ha in the dry season (Herdt & Wickham, 1975). A more detailed monthly planting experiment gave an IR8 yield of more than 9.0 t/ha in May but only 5.0 t/ha in other months (De Datta and Malabuyoc, 1976). These results are consistent with the pattern of solar radiation reaching the land surface. Solar radiation peaks in April at levels that can support high yields but for most of the year is barely adequate[1]. In particular, the main harvest coincides with low incoming solar radiation to the stratosphere and cloud cover that can exceed 7.0 oktas (seven-eighths of the sky). Indeed, average annual cloudiness countrywide is as high as 6.0 oktas which puts an upper limit on yields, one that may be significantly lower than for countries that enjoy long days and clearer skies before the harvest.

(b) The Water Regime. Almost 60% of the harvested area is now irrigated, generating about 70% of output. However, some 50% of the irrigated area is in communal schemes often located in small catchments with uncertain water supplies (communal yields are typically 30-40% below those on national schemes). Indeed, few national schemes have a fully secure supply and periods of stress are common in schemes not backed by storage. An IRRI study (De Datta and Malabuyoc op cit) established that yield loss due to moisture stress averaged 4% in the wet season and 17% in the dry season (less at the head, more at the tail). At times of stress, farmers make full use of the water available and there is a prima facie case that returns to scarce water are high even if yields suffer. Conversely, when water is abundant there is little need to forgo the advantages of over-watering: low irrigation efficiencies may therefore be more apparent than real (Annex 4).

(c) The Paddy Environment. Continuous intensive paddy cultivation can result in deterioration of the immediate paddy environment. Countries suited to year-round paddy cultivation, such as the Philippines, are particularly vulnerable. An IRRI study (Pingali et al, 1989) argues that 'good' farmers (defined as those with yields in the top third of all farmers) are if anything now out-yielding experiment stations but that potential yields both on farmer fields and experiment stations have tended to decline over the last 5-10 years. Some confirmation is provided by analyses of NIA yield data for national systems (Pingali and Moya, 1990; Annex 4, Attachment 5). The hypothesis is that micro-nutrient deficiencies, the breakdown in soil structure, the build-up in pests and other factors are reducing yield potential.

(d) Climatic Uncertainty. The Philippines has the highest incidence of tropical cyclones in the world. Between 1948 and 1982, the annual

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1 One estimate suggests that cumulative solar radiation needs to be at least 14,000 calories per sq.cm. during the 30 days prior to harvest if peak yields are to be achieved (Tricket et al, 1957). This compares with 6,000 to 10,000 calories per sq.km. typical in major rice growing areas in the Philippines for the period October to December (see Annex 2). Another estimate suggests that sunshine during the two months before harvest should total more than 400 hours (Frere, 1986) compared to only 275-300 hours in major areas of the Philippines.

average was 20 with spatial incidence varying from 5 events every 2 years in Northern Luzon to one event every 12 years over most of Mindanao (Annex 1). As well as storm damage, which often coincides with crop maturity, there are periodic droughts and other natural calamities. BAS estimates indicate that an average of 14% of the harvested area was affected between 1972 and 1989 resulting in a production loss of 7%. Risk avoidance by farmers in areas susceptible to flooding and variable river discharge further constrains yields.

2.10 Irrespective of whether these factors are more limiting than in other countries, the underlying rate of increase is yields is likely to be much less rapid than during the green revolution period. Yields have increased mainly due to changes in the proportions of different technologies (HYV/traditional, irrigated/rainfed, wet season/dry season, national/communal etc.) rather than to increases within any particular set of conditions. If this pattern continues, future rates of yield increase will depend largely on the speed with which new technologies can be introduced. Since HYVs are now almost universal, this will depend on the rate at which rainfed land can be converted to irrigation, a process that is inherently much slower than the introduction of a profitable new variety. Only if this pattern changes, and yields within each individual set of conditions rises rapidly, can the rates of increase during the 1970s be approached. And in the case of the most promising set of conditions -- irrigated HYV yields -- there is no indication that this is occurring, indeed yields under these conditions may even have declined (para. 2.9c). It has been suggested that this has been in part due to adverse weather conditions and that once these return to normal yields will rebound. This may be partly true but is not entirely convincing. Table 2.5 compares rates of increase in irrigated yields between succeeding peak years when weather conditions were presumably favorable. The limited average increases between 1985 and 1990 (wet season) and between 1986 and 1989 (dry season) are particularly notable, in particular given that there was little change in the real rice price over this period but fertilizer use increased sharply and there was still some residual spread of the HYVs.

Table 2.5: IRRIGATED PADDY YIELDS: PEAK YEARS, WET AND DRY SEASONS

	Irrigated Yields: t/ha		% Change per Year over Previous Year		Urea Use Year Total
	Wet Season	Dry Season	Wet Season	Dry Season	(M t)
1966	1.88	1.66	na	na	na
1970	2.11	1.97	2.9	4.3	0.12
1982	3.05	3.09	3.2	4.0	0.34
1985	3.14	3.24 1/	1.0	1.2 2/	0.30
1990p	3.36	3.23 1/	1.2	... 2/	0.62

1/ 1986 and 1989. 2/ 1982-86 and 1986-89.
Source: Bureau of Agricultural Statistics, Fertilizer & Pesticide Authority

2.11 IRRI does not anticipate major increases in yield potential with the present generation of HYVs although pest resistance, drought tolerance and other desirable characteristics should be improved. However, IRRI is hopeful that new hybrid rice technologies may become available within the next five years or so and that a whole new generation of rice varieties that out-yield existing varieties significantly could affect the outlook early in the next century.[1] Increases during the 1990s will therefore primarily depend on exploiting the remaining potential of the existing varieties and, perhaps, the impact of hybrid rice towards the end of the decade. Any projections of technological advance are problematic but on balance it seems unlikely that the underlying growth in yields will significantly exceed those indicated for the 1980s in Table 2.5.

2.12 Supply Response to Price. Table 2.6 summarizes estimates of supply elasticities with respect to the price of rice. Given that different functional forms and time periods were used, these estimates are not directly comparable. They are briefly reviewed in Annex 3 and provide some basis for evaluating supply behavior to price changes.

Table 2.6: ELASTICITIES OF SUPPLY FOR RICE: VARIOUS ESTIMATES

		Rice Supply Elasticity with Respect to:		
		Period	Rice Price	Fert. Price
Quizon (1981)	Philippines	1948-74	0.10	-0.01
Kalirajan & Flinn (1983)	Laguna	1978	0.95	-0.16
Evenson (1985)	Philippines	1948-74	1.25	-0.49
Bantilan (1989)	Laguna	1970-84	0.33	-0.07
	Central Luzon	1966-84	0.95	-0.26
Intal & Power (1990)1/				
Short run	Philippines	1957-83	0.17	na
Long Run	Philippines	1957-83	0.30	na
IASR (1991)2/	Luzon	1970-90	0.30	-0.16
	Visayas	1970-90	0.24	-0.03
	Mindanao	1970-90	0.18	-0.01
	Weighted Average3/	1970-90	0.25	-0.09

1/ Area harvested basis. 2/ Preliminary. 3/ Weighted by production in 1989.
Sources: As Specified

2.13 The wide range of values indicates that the estimates are sensitive to the time period used and the regional coverage. Also, analyses based on micro-level data (Kalirajan & Flinn, 1983; Bantilan, 1989) suggest relatively large supply responses, whereas aggregated data (Quizon, 1981; Intal & Power; IASR, 1991) show relatively low responses with Evenson (1985) an obvious exception. The preliminary IASR results are somewhat lower than most of the other studies. One reason may well be the time period used since the earlier studies were dominated by the period of rapid spread of the green revolution.

1 The new varieties would have characteristics analogous to those of corn and sorghum: fewer tiller all of which would be productive (4-5 rather than 20-25 of which 15-16 are productive in the current HYVs); larger ppanicles (250 grains per panicle rather than 100-120); sturdy stems with many vascular bundles; dark green, erect and thick leaves; a vigorous root system; and only 90 cm tall compared to 130 cm for existing varieties. IRRI expect such an ideotype to have a harvest index (grain to total plant weight) of 0.6 compared to 0.45-0.5 for the current HYVs and perhaps 0.3-0.4 for TVs (Khush, 1991).

This may have caused some difficulty in separating the different effects of price and rapid technological growth. In contrast the IASR estimates include the recent period of the maturing of the green revolution.[1] If this is in fact the reason, it suggests that the elasticity of supply has declined over time and that the future level may be even lower than suggested in Annex 3 Clearly, more analysis is required to clarify these issues.

2.14 The analysis described in Annex 3 indicates a price elasticity of supply of about 0.25 which suggests that the decline in the real price of rice during the 1980s had a relatively modest impact on total production. If 1980 real prices had been maintained, output in 1990 might possibly have been some 3-5% or 0.25-0.45 M t higher. To account for the likely decline in its future value, an estimate of 0.2 is used below. It must be recognized, however, that this is a very uncertain estimate and that it provides only an indicative picture of future prospects. Annex 3 also suggests a low supply response to the price of fertilizer. This is consistent with estimates made by Rosegrant et al (1987) who concluded that a 50% reduction in the fertilizer price would result in a production increase of no more than about 5%. This is confirmed by experience in the late 1980s when fertilizer prices declined markedly in real terms without a significant impact on output.

2.15 Preliminary estimates have also been made of the rice supply response to the price of corn, the major alternative crop to rice in upland areas. The weighted average for the Philippines was tentatively estimated at -0.14 (Annex 3) which appears high, given that the own price response is assessed at only 0.25 and that substitutability on lowland areas (the large majority of the paddy area) is very limited. Intal and Power (1990) suggest cross price elasticities of only -0.02 in the short-run and -0.04 in the long run. However, these estimates may be too low given that price largely determines the use of the 'swing' upland area which is in the order of 0.4-0.5 ha (para. 2.6). As a working hypothesis, an estimate of -0.05 to -0.075 appears reasonable although this clearly needs to be confirmed. The likely impact on the future supply-demand balance is unlikely to be significant.

Corn and Livestock

2.16 Corn. Corn output has grown rapidly since the 1950s and growth rates remain above 4% p.a. (Table 2.7 and Figure 2.2). In contrast to rice, the increase has been due to both area and yield. However, area will inevitably expand more slowly since many upland rice areas (in the Cagayan Valley, central Mindanao) and some sugar areas have already come under corn while conversion of perennials such as coconuts is unlikely. There remains potential for forest encroachment but this will be into increasingly marginal and less productive land with lower yields and adverse environmental impacts.

2.17 Three corn technologies predominate: traditional open pollinated (OP) white corn, improved OP white and yellow corn, and hybrid yellow corn. White corn is grown for both food and feed. Yields have risen slowly with the spread of improved OP varieties. These can out-yield traditional varieties by up to

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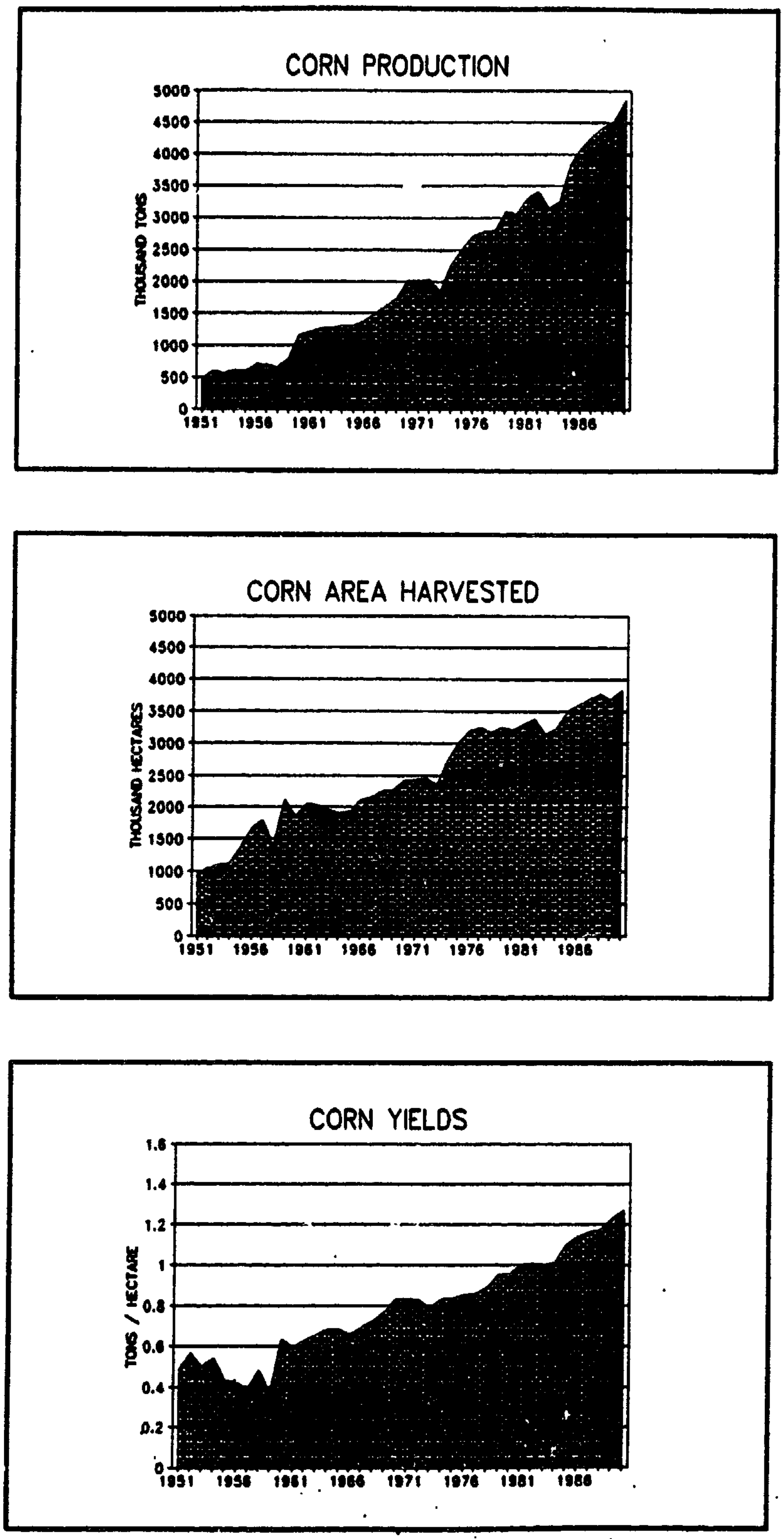
[1] The IASR estimates assume a dual approach to production analysis with aggregate quantities of outputs and inputs taken as the decision variables. The effects of technology (HYV adoption rates and irrigation) are also considered. For a description of the model, see Annex 3.

Figure 2.2: CORN PRODUCTION, HARVESTED AREA AND YIELDS, 1951-89



Source: Bureau of Agricultural Statistics

Table 2.7: CORN HARVESTED AREA, YIELD AND PRODUCTION: 1974/75-1988/89

	Harvested Area ('000 ha)		Yields (t/ha)		Production ('000 t)		
	White	Yellow	White	Yellow	White	Yellow	Total
1974/75	2,729	281	0.82	0.94	2,249	265	2,514
1979/80	2,761	440	0.98	0.92	2,717	406	3,123
1984/85	2,630	684	0.95	1.39	2,486	953	3,439
1988/89	2,755	1,009	1.06	1.60	2,911	1,610	4,522
1990	2,738	1,081	1.08	1.75	2,965	1,888	4,853

Source: Bureau of Agricultural Statistics

30% even without changes in cultural practices. However, traditional varieties still predominate and yields average only 1.0 to 1.1 t/ha. White corn accounts for 65% of the harvested area although its share has declined sharply. Output increases have come largely from yellow corn grown for feed. Its area more than doubled in the 1980s and yields rose rapidly with the spread of hybrid technologies which now account for 25-30% of the harvested. area.[1] Hybrid yields are estimated to average 3.0-3.5 t/ha. In contrast, OP yellow varieties are no higher than those of improved OP white varieties.

2.18 Experimental station yields for all corn types are consistently much higher than yields achieved by farmers. This is because few farmers apply fertilizer (20% according to one estimate) and cultural practices are often primitive. However, rainfall in Mindanao is well distributed so that two rainfed crops are often possible and there is no fundamental reason why yields should not continue to rise rapidly. Corn farmers are in some ways at a stage comparable to rice farmers in the 1960s/70s when the HYVs were first introduced. However, corn farmers face greater risks since own consumption is less and marketing difficulties are typically more severe. Not only is the infrastructure serving corn growing areas relatively undeveloped, but they are distant from Manila. If the hybrid technologies are to be exploited, marketing and related constraints will clearly need to be alleviated.

2.19 Livestock. Cattle and buffaloes are traditional work animals whose numbers have been declining. They are generally raised on pastures and crop residues with limited supplementary feed. The main meat animals are hogs and poultry whose numbers have risen substantially over the past 20 years or so, in particular those of poultry. Meat pr duction has also risen rapidly and there has been a marked increase i ductivity per animal. Commercial operations account for about 15% of hogs produced and 25% of poultry (mainly chickens) but for 20% and 50% respectively of meat production. Smallholders are widely distributed but most commercial operations are located close to Manila (hog farms are also found in Mindanao). Although smallholder productivity is much lower than on commercial farms, smallholders utilize locally available feeds (including rice husks and bran) and are less susceptible to market risks. Commercial operations on the other hand are highly dependant on purchased feeds and have been adversely affected by the constraints on feed corn referred to above. The industry's relatively slow

[1] Data on hybrid areas come from PCARRD and may not be strictly comparable with BAS data which distinguish only between white and yellow corn.

development and its failure to imitate neighboring countries (e.g. Taiwan, Thailand) in developing exports is in large measure attributable to high cost and uncertain feed availability.

2.20 No supply response estimates have been made for corn in the context of the present study. Intal and Power (1990) undertook such an analysis and concluded that the supply elasticity was very comparable to that for rice (0.17 in the short run and 0.34 in the long run).

2.21 The Feed Industry. Corn, soymeal and wheat pollards are the main inputs for the commercial feed industry which is concentrated in regions close to Manila. Corn and soymeal together account for 50-80% of all feed ingredients (IFPRI, 1991) with corn alone responsible for 40-50%. No separate estimates are available for wheat pollards but these must be of increasing significance. Indeed, with prices of wheat low relative to those of corn, it is possible that some wheat is imported for feed. Whereas corn comes largely from local sources, soymeal is largely imported. Despite the rapid increase in corn production, and in the import of soymeal and wheat, official statistics on mixed feed output (IFPRI, 1991) show little increase over the last 15 years. However, these undoubtedly understate the actual position, in particular due to under-reporting of mixed feeds produced by integrated livestock operations which compound their own feed. It is probably safe to assume that the rate of growth in mixed feed production is at least as high as the rate of growth in hogs and poultry, and probably significantly higher due to the increasing share of the commercial sector.

Other Food Crops

2.22 Many other food crops are cultivated under both irrigated and rainfed conditions. Low input root, vegetable and other crops are widely grown for own consumption with subsistence patches found throughout the agricultural areas. Intensive cultivation of high value vegetable and other crops is market driven. Areas are small and variable and farmer risks greater than for staple food or export crops. Farmers either have the financial resources to take such risks or they are closely tied into marketing arrangements which give them security. In either case, they are normally located close to major markets or in areas adapted to particular crops (e.g. temperate vegetables at high elevations) with a secure water supply from a well or perennial stream. Efforts to diversify cropping in major irrigation systems have been generally unsuccessful except where marketing and physical conditions are particularly favorable. Financial returns to scarce dry season water are often greater from diversified crops than from paddy so that pilot diversification programs are well justified. However, farmers in national schemes find it difficult to compete with established commercial operations. Where wells are installed for conjunctive use they can compete on an equal basis but diversification is likely to be slow and irrigated cropping will remain dominated by paddy.

C. Prospects for the Rice Balance

Past Trends

2.23 Table 2.8 presents data on consumption and trade for the main food and feed grains for the period 1978-90 (detailed data on supply and utilization of each commodity are given in the attachment tables). The table illustrates the trends discussed above. Rice remains the dominant staple with consumption rising steadily. Exports took place in 1977-83 but slower rates of growth in production during the 1980s have led to renewed imports which peaked at 10% of consumption in 1984 and again in 1990. Corn consumption has remained fairly steady, declining in per capita terms, while wheat flour consumption has risen particularly rapidly since the mid-1980s. Demand for feed corn has also risen rapidly together with imports of soymeal and use of wheat pollards.

Table 2.8: CONSUMPTION AND TRADE: FOOD AND FEED GRAINS, 1978-90

	Consumption: Food			Consumption: Feed			Net Imports (- Exports)			
	Rice	Corn	Wheat[1]	Corn	Soya[2]	Wheat[3]	Rice	Corn	Wheat[4]	Soya[2]
	('000 t)									
1978	3,811	1,005	501	1,848	124	169	-48	105	675	116
1979	4,007	1,006	533	1,994	123	176	-165	35	704	114
1980	4,453	1,005	582	2,118	237	197	-263	250	786	227
1981	4,593	989	593	2,313	247	199	-95	253	796	244
1982	4,810	994	687	2,485	399	231	-1	341	924	374
1983	4,639	952	592	2,436	297	199	-40	528	797	275
1984	5,164	950	567	2,393	377	192	187	182	766	375
1985	5,153	1,000	510	2,631	245	166	538	281	663	226
1986	5,224	968	790	3,036	368	240	2	...	1,044	364
1987	5,393	1,018	535	3,039	406	168	-111	56	985	401
1988	5,559	1,027	804	3,067	526	269	181	25	1,200	513
1989	5,865	1,052	963	3,478	512	328	204	176	1,310	500
1990p	5,968	848	1,087	3,559	na	335	622	348	1,340	na

1/ Wheat flour. 2/ Soymeal. 3/ Wheat pollards assumed to be 25% of imports.
4/ Wheat grain. Imports of wheat flour were negligible until 1986 but have been in the order of 50,000-60,000 t/year since then.
Sources: Bureau of Agricultural Statistics and National Statistics Office.

Demand Prospects

2.24 Food consumption patterns have been projected using the systems model described in Annex 3 and discussed above. Table 2.9 summarizes the results for the main grains to the year 2000 assuming that population grows at 2.2%p.a., per capita incomes rise at between 2% and 4% p.a., and retail prices remain at 1990 levels in real terms. The model allows for changing income elasticities over time in response to income changes (Annex 3). However, this is of less significance than population growth which is the main driving factor behind demand. Assuming 4% income growth, and 2.2% population growth, total rice demand would rise by 30% or 1.74 M t by the year 2000. At the slower rate of growth in incomes 2% p.a., rice demand and per capita consumption would be 0.17 Mt and one kg/head lower by 2000 respectively. A faster rate of population growth, say 2.5% p.a., results in an increase in total consumption of 0.25 Mt to 0.33 Mt. On all scenarios, rice roughly retains its share in total grain consumption.

Table 2.9: PROJECTED (FOOD) CONSUMPTION: RICE, CORN, WHEAT FLOUR, 1995-2000

	Population	Total Consumption: ('000t)			Consumption: kg/head		
	(M)	Rice	Corn	Wheat	Rice	Corn	Wheat
		Population Growth 2.2% p.a.					
4% Income Growth							
1990	60.81	5,968	1,046[1/]	1,087	98.13	17.20	17.88
1995	67.68	6,799	1,023	1,394	100.73	15.12	20.59
2000	75.32	7,711	949	1,799	102.36	12.60	23.89
2% Income Growth							
1990	60.81	5,968	1,046[1/]	1,087	98.13	17.20	17.88
1995	67.68	6,717	1,097	1,298	100.47	16.20	19.18
2000	75.32	7,537	1,144	1,610	101.15	15.10	20.93
		Population Growth 2.5% p.a.					
4% Income Growth							
1990	60.81	5,968	1,046[1/]	1,087	98.13	17.20	17.88
1995	68.80	6,930	1,040	1,417	100.73	15.12	20.59
2000	77.84	7,968	981	1,860	102.36	12.60	23.89
2% Income Growth							
1990	60.81	5,968	1,046[1/]	1,087	98.13	17.20	17.88
1995	68.80	6,912	1,115	1,320	100.47	16.20	19.18
2000	77.84	7,874	1,175	1,929	101.15	15.10	20.93

1/ Adjusted - see Annex 3.
Source: Annex 3.

Supply Prospects

2.25 HYV adoption rates are now among the highest in Asia (94% and 88% respectively for irrigated and rainfed lowland paddy) and little further increase can be expected. Considerable potential remains for conversion of rainfed land to irrigation (see Chapter 4) but new irrigation development is costly and protracted. Even if investment increases greatly, the rate of increase in average yields would fail to reach the levels achieved the 1970s. Other possible sources of yield growth exist. The IRRI paper quoted above (Pingali *et al*, *op cit*) shows that, even if 'good' farmers are achieving their full potential, most farmers are falling short of what is possible. Consistent standards may help explain why other countries attain high average yields and this represents an important avenue of future growth in the Philippines. However, farmers vary greatly in their personal circumstance and skills, and constraints affecting behavior (individual, social, physical or financial) are seldom easy to resolve. Even if this proves possible, the impact on average yields is likely to be modest when compared to a period when *all* farmers could readily increase yields through the initial adoption of the HYV technologies.

2.26 During the 1980s the rate of growth in irrigated yields between peak years was at most one per cent (para. 2.6). Assuming that some decline in real prices was offset by some increase in HYV adoption rates, this may indicate the underlying rate of yield increase for the dominant HYVs. With the area under paddy unlikely to increase significantly, the main technical option lies in conversion of rainfed to irrigated paddy. NIA's targets for irrigation development assume that the service area will increase by about 50,000 ha p.a. (Chapter 4). This makes no allowance for the CARP program but is itself substantially higher than achievement in the 1980s (28,000 ha p.a.) and higher even than in the late-1970s when investment was at its peak (42,000 ha p.a.). It can therefore be taken to represent a 'high' alternative. The feasibility of achieving this target is reviewed in Chapter 4 (para. 4.52) and Annex 4 where it is concluded that a more realistic target might be 25,000 ha p.a.

Prospects for the Rice Balance

2.27 Table 2.10 provides illustrative projections of the rice demand/supply balance to 2000. The demand projections are derived from Table 2.9. The supply projections reflect the considerations discussed above and assume that yield increases at 1.0% p.a.; harvested area and irrigation intensity remain constant at 1990 levels; seed, feed & waste account for 6% of output; and the milling outturn is 65%. These projections assume that real retail and farmgate prices remain at 1990 levels and therefore represent the situation before adjustments are made in trade and pricing policies. They are reviewed further in Chapter 3, and alternative strategies for moderating the deficits projected are discussed, following a review of past price and trade policies.

Table 2.10: PROJECTIONS OF RICE SUPPLY AND DEMAND: 1995 and 2000

	Income Growth: 4% p.a.				Income Growth: 2% p.a.			
	Supply		Demand	Balance	Supply		Demand	Balance
	Paddy	Rice 1/	Rice	Rice	Paddy	Rice 1/	Rice	Rice
	('000 t)							
Population Growth 2.2% p.a.								
Service Area: Increase at 25,000 ha p.a.								
1990	9,317	5,692	5,968	-275	9,317	5,692	5,968	-275
1995	10,007	6,115	6,799	-684	10,007	6,115	6,717	-602
2000	10,744	6,565	7,711	-1,146	10,744	6,565	7,537	-972
Service Area: Increase at 50,000 ha p.a.								
1990	9,317	5,692	5,968	-275	9,317	5,692	5,968	-275
1995	10,223	6,246	6,799	-444	10,223	6,246	6,717	-471
2000	11,198	6,842	7,711	-912	11,198	6,842	7,537	-695
Population Growth 2.5% p.a.								
Service Area: Increase at 25,000 ha p.a.								
1990	9,317	5,692	5,968	-275	9,317	5,692	5,968	-275
1995	10,007	6,115	6,930	-815	10,007	6,115	6,912	-797
2000	10,744	6,565	7,968	-1,403	10,744	6,565	7,874	-1,309
Service Area: Increase at 50,000 ha p.a.								
1990	9,317	5,692	5,968	-275	9,317	5,692	5,968	-275
1995	10,223	6,246	6,930	-684	10,223	6,246	6,912	-666
2000	11,198	6,842	7,968	-1,126	11,198	6,842	7,874	-1,032

1/ Assuming a 65% milling rate and 6% of output to seed, feed and waste.
Source: Mission Estimates

3. TRADE AND PRICING POLICIES

A. The Policy Context

General

3.1 Intal and Power (1990) estimated equilibrium exchange rates for 1960-86, concluding that the market rate was over-valued by an average of 22% for the period. They argue that their estimates were conservative since they do not fully capture the restrictive trade effects of non-tariff barriers. Other estimates suggest a greater over-valuation for roughly the same period (UPLB, 1986). Since 1986, however, the market rate has come much more into line with equilibrium rates. Table 3.1 summarizes market rates, nominal effective rates (weighted to reflect trading partners and competitors) and real effective rates (nominal rates adjusted to reflect relative consumer price changes). After appreciating in real terms to 1982, the peso depreciated and is now well below the 1982 level relative to comparator countries.

Table 3.1: MARKET, NOMINAL AND REAL EFFECTIVE EXCHANGE RATES: 1980-90

	Market Rate P/US$	Market Rate	Nominal Effective	Real Effective
		(1985=100)		
1980	7.5	247.4	202.8	102.4
1981	7.9	235.3	202.0	105.7
1982	8.5	217.8	201.4	109.7
1983	10.9	170.9	160.8	92.3
1984	16.7	113.9	110.6	91.4
1985	18.6	100.0	100.0	100.0
1986	20.4	91.3	78.8	78.0
1987	20.6	90.4	71.5	71.8
1988	21.1	88.2	65.9	69.8
1989	21.7	85.6	65.8	73.8
1990	24.3	77.0	55.8	71.0
1990 Dec	28.0	66.4	48.8	62.5

Source:IMF International Financial Statistics, May 1991 and past issues.

3.2 Intal and Power calculated the rate needed to balance the current account rather than tracing relative changes between countries. Their estimates are not therefore directly comparable to those in Table 3.1. However, the extent of over-valuation has clearly declined since 1986, in particular as a result of the devaluation in 1990 and, despite renewed balance of payments pressures, is much less than suggested in the earlier studies. It is beyond the scope of this report to assess exchange rate effects although, clearly, devaluation -- if it is justified -- would improve the competitiveness of domestic rice and corn producers.

3.3 As far as the agriculture is concerned relative to other sectors, Clarete (1989) suggests that trade-weighted average tariffs for industrial goods remained above those for primary and processed agricultural goods up to 1988 both in nominal terms and if allowance is made for tariffs on intermediate goods. Moreover, though trade-weighted tariffs in all sectors were greatly reduced between 1977 and 1988, reductions in agriculture were deeper than in industry and *"the trade liberalization program has been uneven, favoring industry and penalizing agriculture"*. Similarly, Intal and Power (1990) concluded that the indirect effects of an over-valued exchange rate and relative protection of the domestic market for manufactures have had a greater impact on agriculture than direct price interventions. Since 1988, however, devaluation of the peso and trade reform on a broader front has substantially moderated the bias against agriculture Direct interventions may, therefore, now be relatively more important. The impact of such interventions in the grains subsector has been uneven as described in the following sections.

Wheat

3.4 No wheat is grown in the Philippines but wheat policies impact on rice and corn through substitution effects. Wheat imports were in the range 0.5-0.9 M tons for the period 1970-85. The underlying trend was upwards but was less pronounced than might be expected from the high income elasticity of demand. Since 1985, however, imports have more than doubled, reaching an estimated 1.4 M tons in 1990. Demand for bread and noodles in particular has risen rapidly and in 1988 they accounted for about 22% and 33% of total flour consumption respectively. In contrast, the share of pan de sal (a traditional bread) fell from 75% in 1975 to 28% in 1988. In addition to its use in food, wheat is also of significance to the feed industry since, when milled, perhaps 25% by weight is available as a valuable moderately high protein animal feed (pollards). Indeed, as relative prices of wheat and corn shift, wheat grain may be diverted to animal feed. This reportedly has happened in recent years although its extent is unknown.

3.5 These trends in wheat consumption can be attributed largely to Government interventions. Price controls on wheat and flour were first imposed in the early 1970s to protect the consumer from then high world prices. The National Grains Authority (subsequently the National Food Authority, NFA) was assigned an import monopoly, and domestic prices and margins were set by Government. However, after 1975, world prices declined (Table 3.2). By maintaining -- even increasing -- domestic prices, losses turned to profits, and by the early 1980s, these profits had become very substantial. They helped ensure that NFA imposed few direct burdens on the Government budget and greatly facilitated expansion of NFA's other activities (Saldana, 1990). Despite rising incomes and falling real prices, therefore, consumption rose relatively slowly. Milling and baking remained in the private sector but there was only limited competition since NFA allocated imports to the established millers, and bakers and other customers remained relatively small scale, conservative and tied to particular suppliers. During 1983-85, NFA even took over the sale and distribution of flour so that the millers essentially became agents for the Government. Capacity utilization rose during the period but there was little additional investment in milling and the fixed margins and other controls ensured that there was little dynamism in market behavior.

3.6 The slow growth in wheat consumption during the 1970s coincided with the green revolution and, though demand for rice grew more rapidly than it might otherwise have done, this was mainly at the expense of rice exports which were unprofitable. By 1984-85, however, substantial rice imports had re-emerged (Table 2.8). Furthermore, distortions in wheat were fairly typical of

Table 3.2: WHEAT ANNUAL AVERAGE PRICES

	International Prices			Philippines Prices		
	Wheat 1/			Wheat	Wheat Flour	
	Constant	Current		CIF: Manila	Wholesale	Prices:Phil.
	1990 Prices	US$	Peso Equiv.	Current	Current	1990 Prices
	--- (US$/t) ---		(P/t)	(P/t)	--- (P/kg) ---	
1975	308	138	1,001	1,329	2.31	18.63
1976	270	123	915	1,315	2.55	17.35
1977	191	96	710	1,029	2.54	16.18
1978	217	125	921	1,122	2.60	15.75
1979	239	156	1,151	1,341	2.93	14.95
1980	239	168	1,260	1,691	3.10	13.36
1981	215	155	1,224	1,723	3.69	13.87
1982	188	133	1,132	1,564	3.94	13.36
1983	199	137	1,493	1,561	4.11	12.03
1984	207	140	2,338	2,143	6.67	11.68
1985	189	129	2,399	2,948	7.86	11.63
1986	147	118	2,407	2,859	8.52	12.83
1987	128	112	2,307	2,742	8.82	12.17
1988	148	141	2,975	3,230	8.12	9.88
1989	170	161	3,494	4,475	8.64	9.51
1990	129	129	3,135	na	9.02	9.02

1/ US No.2 Soft Red Winter, export price Gulf.
Source: World Bank and National Statistical Office

Filipino industry and, supported by the Bank (World Bank, 1984), the wheat industry was among the first to be liberalized. The initial impact of liberalization was disappointing, even adverse, since NFA's import monopoly gave way to a cartel formed by the existing millers (Saldana, 1990). Though imports were technically free, the cartel was unwilling to buy from third parties and had little reason to compete among its constituent members. By cooperating on purchasing and hedging decisions they was able to earn monopoly profits. As a result, imports increased only modestly in 1986-87 and domestic wholesale prices rose in real terms even though they were falling on world markets (Table 3.2). Moreover, high feed corn price probably also sustained the price of pollards creating an additional source of profits for the cartel.

3.7 Initially, therefore, little appeared to change. As early as 1986, however, there were significant imports of wheat flour despite the higher duty indicting that local prices were high. More importantly, other investors were soon attracted by the cartel's high profits and plans were finalized to more than double milling capacity. Even in advance of these new mills, the market had become more competitive, partly in response to the economic recovery and the associated rapid increase in the demand for convenience foods. Despite higher import prices, the current wholesale price has remained steady since 1987 (in real terms it declined) and imports rose dramatically. Mission estimates (Table 3.3) suggest that by February 1991 excess profits had been substantially reduced -- a milling charge of US$50/t is somewhat higher than international rates but not excessive -- and as new mills come into operation the industry can be expected to become increasingly competitive.

Table 3.3: WHEAT IMPORT COSTS AND REVENUES AT MANILA: FEBRUARY 1991

	US$/t	P/t [1/]
Wheat Price: $/t FOB Portland	133.0	
Freight, Handling $ Insurance: Portland-Manila	34.0	
CIF Price	167.0	4,676
Import Duties (10% tariff, 9% import surcharge [2/])		889
Domestic Transport Costs		520
Interest (90 days at 36%)		420
Total Cost of Imports	232.3	6,505
Revenues: Flour (75% at 9.6 Pesos/kg)		7,200
Pollards (25% at 2.8 Pesos/kg)		725
Total Revenues	283.0	7,925
Importer/Miller Margin	50.7	1,420

[1/] At an exchange rate of US$1= P28. [2/] Since reduced to 5%.
Source: Mission Estimates

3.8 The first new milling facilities were scheduled to open in mid-1991 and competition can be expected to intensify. Liberalization has therefore had its predicted (if lagged) effect. Saldana (1990) argues that oligopolistic pressures will remain strong and that, once the new situation stabilizes, they will return to distort the market. However, such trading practices will become increasingly difficult as the sector expands and diversifies, and as customer service and support become a more important element in sales. Any measures necessary to preserve competitive conditions should be taken as a matter of priority. Subject to this, and to the continuation of a liberalized trading environment, there see to be few issues of consequence in the wheat subsector.

Paddy and Rice

3.9 General. Rice is both the most important agricultural crop and the main food staple. Government policy has thus sought to balance the conflicting interests of producers and consumers while pursuing the long-standing aim of rice self sufficiency. Three types of market intervention have been adopted:

(a) NFA's *de facto* import monopoly and control of exports insulates the domestic market from the world market[1]. GOP trading decisions balance supply and determine the general level of domestic prices. Differences between the release price and the costs of purchasing/holding imports are accommodated in NFA's budget. Private exports are allowed but NFA would no doubt intervene to curtail a sharp increase in retail prices.

(b) NFA's domestic operations aim to stabilize prices. Domestic procurement supports farmgate prices and moderates seasonal fluctuations and market releases stabilize consumer prices. Losses on its domestic operations are reflected in NFA's budget.

1 Private imports are allowed but subject to a prohibitive 50% tariff.

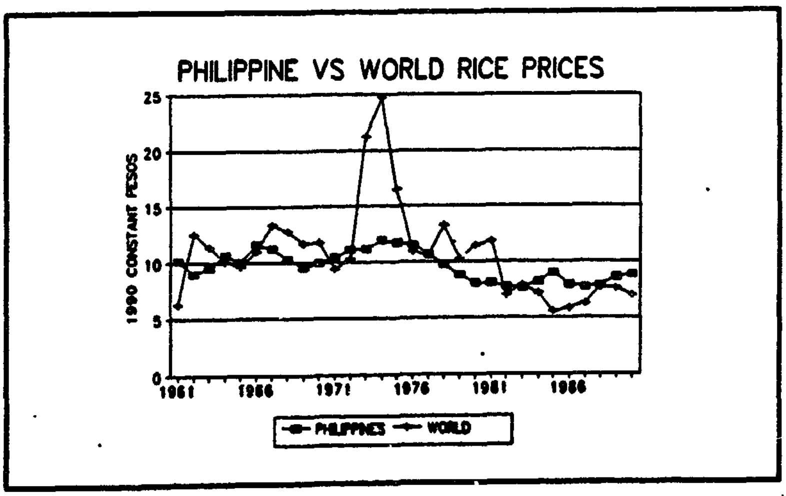
(c) Ceiling prices and anti-hoarding measures complement NFA's trading activities. NFA assists Government in regulating the industry by enforcing price controls and licensing private millers and traders.

3.10 These interventions have two distinct functions: (i) to manage prices through the combined operation of trade, buffer stock and price controls, and (ii) to allocate subsidies through NFA's operating budget. The failure to clarify these functions has adversely affected both private activity and the efficiency of subsidy programs (Abel and Binamira, 1990; AYCC, 1989).

3.11 Foreign Trade Policies. The President makes the decision to import (or export) on the recommendations of an Inter-Agency Commission. The decision is based on quarterly assessments of the grain supply-demand balance. Several months are needed to schedule imports and this bureaucratic and highly political process has sometimes led to poor timing of imports. A recent report (AYCC, 1989) estimated that up to 50% of all imports arrive too late to arrest price increases during the July-September lean season. Private traders would probably perform this function in a more timely and cost effective manner though GOP is strongly opposed to foregoing its present role (see para. 3.55).

3.12 Price controls in 1973-75 insulated domestic prices from the sharp increase in world prices (Figure 3.1, Table 3.4). Between 1975 and 1988, local prices generally followed world prices, falling by almost 50% in real terms. In surplus years (1977-83) they were generally below, and in deficit years (most years after 1984) above, world levels at the prevailing exchange rate. Rosegrant et al (1987) estimated that nominal protection rates in 1971-85 averaged -11% in surplus years and +22% in deficit years. Intal and Power (1990) similarly concluded that between 1967-86 *"there is no evidence of a persistent or strong bias in rice pricing policy in favor of either producers or consumers"*. Domestic prices have been more stable than world prices (Figure 3.1) achieving a major policy objective. Modest protection during deficit years has persisted since 1986. The margin increased in 1989-90 as renewed imports led to increases in procurement, release and ceiling prices (Table 3.5) but this was again offset by the peso devaluation in late 1990 so that in early-1991 domestic prices were about import equivalent levels (para. 3.35).

Figure 3.1: PHILIPPINE RICE PRICES COMPARED TO WORLD PRICES



Source: World Bank (Thai white milled 5% brokens, FOB Bangkok in P/kg)
BAS (Philippine Wholesale Price in P/kg)

Table 3.4: RICE PRICES: WORLD, BORDER AND WHOLESALE; 1975-90

	International Prices			Philippines Prices		
	Constant	Current		CIF:Manila[1]	Wholesale Prices:Phil.	
	1990 Prices	US$	Peso Equiv.	Current	Current	1990 Prices
	--- (US$/t) ---		(P/t)	(P/t)	--- (P/kg) ---	
1975	811	363	2.63	2.14	1.86	15.00
1976	561	255	1.90	2.08	1.99	13.54
1977	546	272	2.01	(2.07)	2.03	12.93
1978	640	368	2.71	(2.23)	2.00	12.12
1979	514	334	2.46	(2.07)	2.12	10.82
1980	609	434	3.26	(2.10)	2.30	9.91
1981	674	483	3.82	(2.49)	2.61	9.81
1982	415	293	2.49	(3.24)	2.76	9.36
1983	402	277	3.02	(2.60)	2.99	8.72
1984	374	252	3.67	3.86	4.84	8.48
1985	318	216	4.02	4.23	6.51	9.64
1986	263	210	4.28	-	5.79	8.72
1987	262	230	4.74	(4.52)	5.83	8.04
1988	319	301	6.35	6.90	6.48	7.88
1989	340	320	6.94	(3.42)	7.82	8.60
1990	287	287	6.97	na	8.81	8.81

1/ Export prices FOB are in brackets.
Source: World Bank and Bureau of Agricultural Statistics.

3.13 Domestic Policies. Three main prices are relevant to NFA's domestic operations: (i) the procurement price which also serves as the support price (in principle the minimum for private trade); (ii) the NFA selling price; and (iii) the ceiling price which sets a maximum retail price. They are set on an all-Philippines basis with no allowance for distribution costs (Table 3.5).

Table 3.5: SELECTED AVERAGE ANNUAL DOMESTIC PRICES; PADDY AND RICE[1]

	Paddy		Rice		
	Farmgate Price	NFA Support Price	NFA Sale Price[2]	Ceiling Price	Retail Price
	----------	----------	(P/kg)	----------	----------
1980	1.15	1.36	na	2.51	2.45
1981	1.30	1.51	na	2.75	2.72
1982	1.36	1.65	na	3.00	2.96
1983	1.52	1.75	na	3.23	3.19
1984	2.47	2.64	2.60	4.64	5.09
1985	3.23	3.44	3.50	6.03	7.00
1986	2.82	3.50	3.50	5.50	6.56
1987	3.07	3.25	3.50	5.50	6.61
1988	3.44	3.50	3.50	5.50	7.23
1989	4.13	3.83	7.00	5.67	8.46
1990	4.77	5.17	7.50	9.00	9.44

1/ Special variety (accounting for the majority of output).
2/ Retail price including fixed margin (0.5 P/kg in 1989).
Source: BAS and NFA.

3.14 NFA purchases a small share of production due to funding constraints and limited facilities (Table 3.6) and is thus unable to guarantee the general farmgate price. Procurement is concentrated in a few major surplus areas (the Cagayan Valley, Central Luzon, Iloilo). Price declines at harvest in these areas are moderated and NFA is assured supplies in convenient locations. The amount farmers are willing to provide depends on general price and supply conditions: in surplus years and when the procurement price is above market levels NFA's share rises, in deficit years it falls (Table 3.6). In some years, NFA has had inadequate capacity to accept all that it is offered in which case farmers may be rationed. In other years, NFA's facilities are under-utilized. Outside these favored locations, NFA's direct influence on farmgate prices is limited. Prices adjust to local supply-demand conditions and there is considerable regional, seasonal and annual variation.

Table 3.6: NFA RICE PROCUREMENT AS A PROPORTION OF TOTAL PRODUCTION

	Production	NFA Procurement	NFA Share in Total
	--------- (M t)	----------	(%)
1980	7.65	0.55	7.2
1981	7.91	0.58	7.4
1982	8.33	0.65	7.8
1983	7.29	0.53	7.3
1984	7.83	0.30	3.8
1985	8.81	0.40	4.5
1986	9.25	0.46	4.5
1987	8.54	0.57	6.7
1988	8.97	0.26	2.9
1989	9.46	0.21	2.0
1990	9.32	0.57	6.1

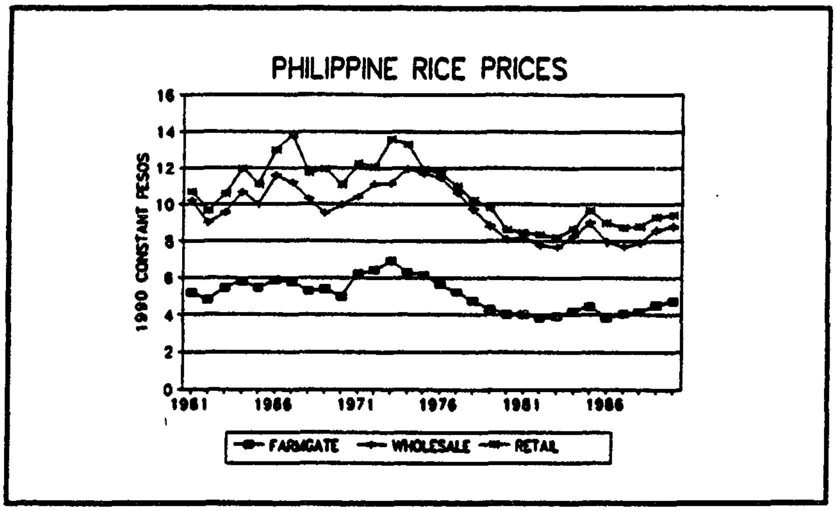
Source: National Food Authority

3.15 The ceiling price has generally been effective only in deficit years (Table 3.5). Between 1986-89, retail prices rose well above the ceiling price because it was unrealistically maintained at 5.5 P/kg. Neither NFA sales nor regulatory controls have therefore been fully effective in controlling consumer prices. This reflects the small scale of NFA's activities, import scheduling problems and deficiencies in the exercise of regulatory powers. As in the case of farmgate prices, retail prices therefore vary considerably.

3.16 A low NFA release price provides the urban poor with subsidized food. NFA sales are handled by licensed retailers in return for a standard fee of 0.5 P/kg. Diversion of NFA rice onto the free market is, however, highly profitable and occurs despite measures to minimize abuse. Moreover, NFA operates at a substantial loss. Assuming a 65% conversion rate, the 1990 procurement price was equivalent to 7.69 P/kg in terms of rice, 0.69 P/kg more than the price to the agent before allowing for NFA costs. The value of by-products is broadly equivalent to the milling charge but there remain transport, storage, administrative and other costs. Losses increase with the level of NFA's market activity. In 1987 when it procured 6.7% of the crop, total losses were P2,497 M; in 1988 when it procured 2.9% they were P 679 M. Imports can be profitable, but financial discipline is eroded since NFA cannot be self-sufficient and the Government by default must finance its operations.

3.17 The negative spread between the NFA selling and procurement prices also adversely affects the private sector, putting pressure on commercial margins which, since the early 1970s, have narrowed (Figure 3.2). Margins have also tended to stabilize which implies that normal market flexibility has been curtailed. Finally, though NFA cannot fully control the market, it comes under great pressure to intervene at a local level when prices become out of line. It thus can disrupt normal market operations, adding to the risks and costs of traders who may incur a loss when NFA sells rice unexpectedly. Recent studies (AYCC, 1989) argue that the effect has been to reduce profitability to the point where investments in milling, storage, handling and transport are discouraged, contributing to the high post-harvest losses.

Figure 3.2: FARMGATE, WHOLESALE AND RETAIL PRICES: PADDY AND RICE, 1960-89



Source: Bureau of Agricultural Statistics

3.18 Producer Incentives. Table 3.7 presents data on urea prices and their movement relative to those of paddy. Despite occasional subsidy programs, fertilizer has more often been subject to price controls, tariffs and quotas designed to protect the domestic manufacturing industry. For most of the period covered in Table 3.7, the farmer paid a price well above the world equivalent level and marketing margins were exceptionally high by Asian standards. In 1986, however, the fertilizer trade was liberalized. The Fertilizer and Pesticide Authority (FPA) relinquished its control over procurement and prices, and imports were freed subject to a 5% duty. These measures greatly stimulated competition and gross trading margins were drastically reduced, from an estimated 42% of the farmers' price in 1984 to 19% by June 1987 (Chemonics International, 1988) though remaining among the highest in Asia.

3.19 Liberalization coincided with low world urea prices and incentives for fertilizer use rose sharply. Imports of all fertilizers (including urea) rose from about 0.7 M tons in 1984-85 to 1.2 M tons in 1987-88. As discussed in Chapter 2, rice production failed to respond substantially to this increase in fertilizer use, suggesting that the marginal profitability of additional fertilizer application may be relatively low under most production conditions (para 2.10). Prices rose again in the period 1988-90 and there has been a further sharp increase in 1991. As a result, growth in fertilizer demand has moderated. Preliminary estimates suggest that 1.15 M t were imported in 1990 of which urea (used primarily in paddy) accounted for 54%.

Table 3.7: UREA PRICES: WORLD, BORDER, WHOLESALE AND FARMGATE

	World Prices		Domestic Prices			Paddy	Ratio
	1990 Prices	Current	Import	Ex-Warehouse	Retail	Farmgate	Urea/Paddy
	---- (US$/t) ----		--- (P/kg) ---		(P/kg N)	(P/kg)	(kg N/kg)
1975	444	198	2.69	1.85	4.02	0.98	4.10
1976	249	112	0.91	1.60	3.48	0.98	3.55
1977	258	127	0.96	1.51	3.28	1.00	3.28
1978	258	145	1.17	1.51	3.28	0.98	3.35
1979	268	173	1.30	1.70	3.70	1.04	3.55
1980	313	222	1.75	1.85	4.02	1.15	3.50
1981	303	216	2.17	2.16	4.70	1.30	3.61
1982	227	159	1.67	2.33	5.07	1.36	3.72
1983	199	135	1.78	2.52	5.48	1.52	3.60
1984	255	171	3.20	4.61	10.02	2.47	4.06
1985	200	136	3.10	5.50	11.96	3.23	3.70
1986	132	107	2.27	2.77	6.02	2.82	2.14
1987	132	117	2.24	2.58	5.61	3.07	1.83
1988	165	155	3.46	3.58	7.78	3.44	2.26
1989	140	132	na	na	8.20	4.15	1.98
1990p	157	157	na	na	10.30	4.87	2.11

Source: Department of Agriculture

3.20 Farmer returns have also been influenced by several important DA support programs. The Masagana-99 program was important during the 1970s in the spread of the HYV technologies even if its cost to Government was greater than planned due to poor credit recovery. More recently, rice production enhancement programs were implemented in 1988/89 and 1989/90 under which farmers received fertilizer and seed in exchange for paddy delivered to NFA. The 1990 Rice Action Plan (DA, 1990) initiated a subsidy program which provides farmers with one bag of fertilizer free for every two bought per hectare. A range of other measures are directed at providing certified seeds, reducing post-harvest losses, increasing access to credit, funding crop insurance and intensifying support for research and extension (Chapter 5). The plan also calls for the repair and construction of irrigation facilities and improved management and maintenance of existing facilities (Chapter 4).

Corn and Livestock

3.21 General. NFA intervenes in the corn market in much the same ways as in the rice market although there is at present no ceiling price and private imports are allowed under strict Government control. Imports have been severely curtailed since the mid-1980s and domestic price have been well above comparable world levels. NFA's task is even more difficult than for rice since it controls a negligible proportion of the crop; producing areas are dispersed, often inaccessible and far from the main markets; and there are major infrastructural, financial and policy constraints. NFA's activities in corn are therefore dominated by practical difficulties. Policies designed to balance the interests of corn producers and consumers may also have important and sometimes unintended implications for the livestock industry. These implications may be of greater significance than those for food since feed accounts for an increasing share of the total which may now be as high as 75%.

3.22 Foreign Trade Policies. Active Government intervention in corn also dates to the early 1970s. However, world corn prices in 1973-75 rose less than rice prices. As early as 1975, they were again below those on the domestic market where they has remained ever since (Table 3.8 and Figure 3.3). According to one report (UPLB, 1986) nominal protection rates for yellow corn averaged 17% from 1975 to 1985, increasing sharply to 47% in 1985. A similar conclusion was reached by Intal and Power (1990) who concluded that direct protection for corn averaged 42% in 1983-86. These general relationships have been maintained in 1987-90 although a good harvest depressed farmgate prices towards end-1990. World price levels have fallen by more than those for rice and it is notable that, despite the protection accorded to the corn producer, real farmgate prices declined by more than 50% over the period 1975-90.

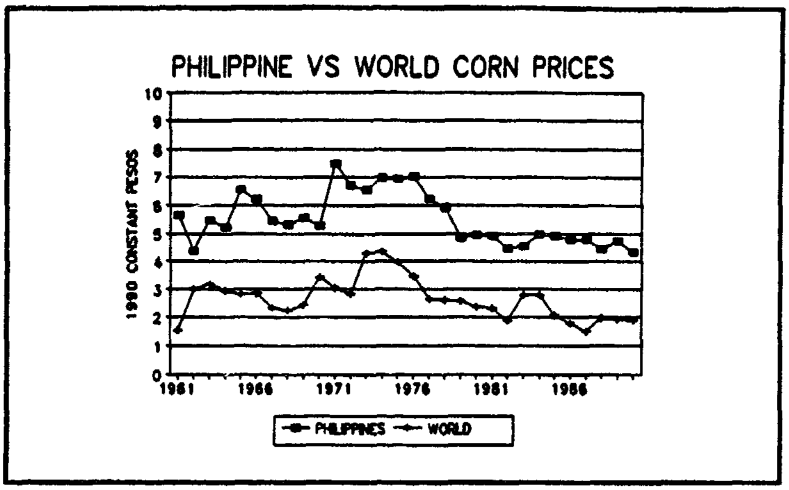
Table 3.8: YELLOW CORN PRICES: WORLD, BORDER AND WHOLESALE; 1975-90

	International Prices			Philippines Prices		
	Constant	Current		CIF: Manila	Wholesale Prices:Phil.	
	1990 Prices	US$	Peso Equiv.	Current	Current	1990 Prices
	--- (US$/t) ---		(P/t)	(P/t)	--- (P/kg) ---	
1975	268	120	0.87	1.06	1.10	8.87
1976	247	112	0.83	0.99	1.22	8.30
1977	191	95	0.70	0.92	1.19	7.58
1978	175	101	0.74	1.21	1.22	7.39
1979	178	116	0.86	1.05	1.17	5.97
1980	175	125	0.94	1.52	1.41	6.08
1981	183	131	1.03	1.78	1.59	5.98
1982	155	109	0.93	1.45	1.59	5.39
1983	197	136	1.51	1.59	1.78	5.19
1984	202	136	2.27	2.13	2.92	5.11
1985	165	112	2.08	2.06	3.57	5.29
1986	109	88	1.79	1.78	3.49	5.26
1987	87	76	1.56	2.19	3.63	5.01
1988	113	107	2.25	2.93	3.67	4.46
1989	118	112	2.44	3.36	4.33	4.76
1990	109	109	2.65	na	4.80	4.80

Source: World Bank and Bureau of Agricultural Statistics

3.23 The Philippines is a marginal importer (Table 2.9). Until recently, imports were handled by NFA which -- as in the case of wheat (para. 3.6) -- retained the margin between import and domestic prices. In 1986, imports were banned to protect the local producer. Since then relatively small imports have been allowed, initially by NFA but in 1990 predominantly by the private sector Prices have been kept above world prices by a 20% tariff (15% for ASEAN) and,more importantly, by quantitative restrictions. The profits that used to

Figure 3.3: PHILIPPINE CORN PRICES COMPARED TO WORLD PRICE



Source: World Bank - US No.2 Yellow, FOB Gulf Ports in P/kg equivalent.
BAS - Philippines wholesale price.

accrue to NFA now appear to go to those traders able to obtain import licenses (given in response to industry requests and based on NFA's assessment of market shortfalls). These profits are comparable to those earned after wheat privatization but quantitative controls preclude competitive pressures such as those that have developed in wheat (para. 3.6). The rents created accrue to a few large Manila-based millers with the influence to obtain licenses. Table 3.9 presents mission estimates of importer margins in July 1990 when significant imports were last allowed. Since the estimated CIF price Manila is well below the import cost recorded in the trade statistics (Table 3.8), the profits appear to be hidden in some way. The effects on domestic competition are discussed below and an alternative mechanism is suggested under which the rents would accrue to Government and adverse effects would be minimized.

Table 3.9: CORN IMPORT COSTS AND REVENUES AT MANILA: JULY 1990

	US$/t	P/t 1/
Corn Price: $/t FOB Bangkok	100.0	
Freight, Handling $ Insurance: Bangkok-Manila	16.5	
CIF Price	116.6	2,680
Import Duties (15% tariff)		402
Domestic Transport Costs		520
Interest (60 days at 36%)		161
Total Cost of Imports	163.6	3,763
Total Revenues (5.5 P/kg 2/)		5,500
Importer/Miller Margin	75.5	1,737

1/ At an exchange rate of US$1 = P23. 2/ Manila Wholesale Price which is well above all Philippine level in Table 3.8. Source: Mission Estimates.

3.24 Domestic Policies. Procurement and release prices are set on an all-Philippines basis which may be even less realistic than for rice (Table 3.10). Procurement is concentrated in Mindanao. Farmers sell to NFA only when the local market price falls below the procurement price which happened in 1990/91 following a bumper harvest (Table 3.11). NFA was offered far more than it could handle and, dospite a sharp increase in NFA's purchases (to 6% of production), the market price fell well below the NFA buying price. Storage problems and related difficulties are reported to have led to substantial losses. NFA sells mainly in the Visayas where the release price has generally been below prevailing retail prices. Variable production, market imperfections and uncertainties created by NFA's operations contribute to regional, seasonal and yearly price fluctuations that are if anything greater than for rice.

Table 3.10: SELECTED AVERAGE ANNUAL DOMESTIC PRICES: WHITE AND YELLOW CORN

	Shelled Corn			Corn Grits: White		
	NFA Proc. Price	Farmgate Price Yellow	Farmgate Price White	Farmgate Price	Retail Price	Ceiling Price
	(Pesos/kg)					
1980	1.15	1.16	1.05	1.34	1.84	1.75
1981	1.30	1.29	1.18	1.56	2.11	1.82
1982	1.30	1.34	1.25	1.66	2.25	2.15
1983	1.35	1.39	1.34	1.52	2.35	2.28
1984	2.00	2.36	2.34	2.66	4.05	3.55
1985	2.80	2.91	2.80	3.18	5.37	-
1986	2.90	2.70	2.54	2.88	4.88	-
1987	2.90	2.98	2.91	3.31	5.13	-
1988	2.90	2.96	2.95	3.35	5.27	-
1989	3.90	4.07	4.18	4.59	5.45	-
1990p	3.90	4.19	4.36	na	na	-

Source: Bureau of Agricultural Statistics and National Food Authority

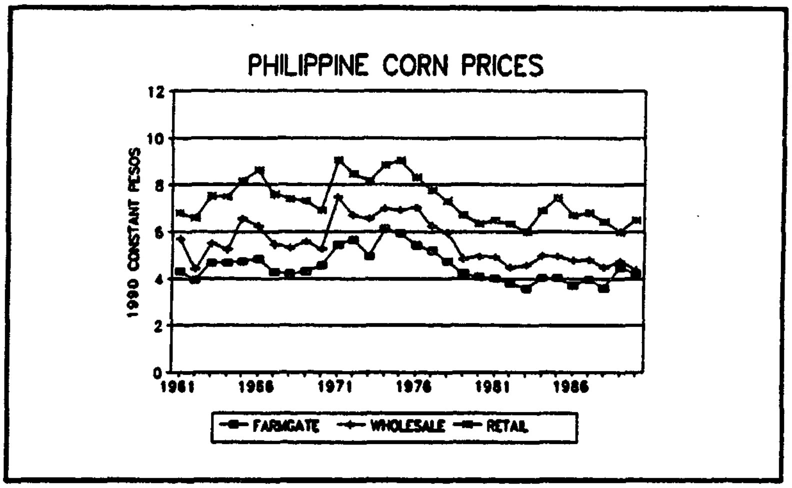
Table 3.11: NFA CORN PROCUREMENT AS A PROPORTION OF TOTAL HARVEST

	Production	NFA Procurement	NFA Share in Total
	(M t)		(%)
1980	3.05	0.01	0.4
1981	3.30	0.06	1.9
1982	3.40	0.07	2.0
1983	3.13	0.12	3.8
1984	3.25	0.02	0.5
1985	3.86	0.11	2.9
1986	4.09	0.03	0.8
1987	4.28	0.03	0.6
1988	4.43	0.12	2.8
1989	4.52	...	...
1990	5.34	0.32	6.0

Source: National Food Authority

3.25 Table 3.9 suggests that July 1990 corn prices were more than double those in Thailand. Since corn accounts for 40-60% of the material costs of feed and feed accounts for perhaps 50-70% of the costs of livestock production (lower for pork, higher for poultry), this is a substantial burden on the livestock industry, equivalent to a tax of 25-35%. Mixed feed costs are only 20-35% (IFPRI, 1991) higher than in neighboring countries suggesting that soymeal and wheat pollards are relatively less expensive. However, these only partially offset high corn prices and the domestic livestock industry is by all accounts high cost. Meat imports are discouraged by tariffs on pork (20%) and chicken (50%). In contrast to some of its neighbors, the Philippines does not export although recent analysis suggests that it has an underlying comparative advantage in both pork and poultry (Winrock International, 1991). Besides high feed prices, meat processing is adversely affected by import mechanisms that favor the larger Manila-based feedmillers and other firms are unable to guarantee supplies. Moreover, smaller operators face trading risks created by the dominant feedmillers and NFA. For instance, the former reduced purchases in 1990/91, in part in response to anti-hoarding controls. This aggravated seasonal price declines and added to trader losses. There is some indication that, as for rice (para. 3.17), margins have in any case narrowed since the early 1970s (Figure 3.4). If so, these factors could help explain the reluctance of many corn traders to invest in handling, storage and transportation facilities, aggravating shortages in post-harvest facilities and contributing to the reported large losses due to spoilage. Given all this, it is hardly surprising that a competitive livestock industry has yet to develop

<u>Figure 3.4</u>: FARMGATE, WHOLESALE AND RETAIL CORN PRICES: 1960-89



Source: Bureau of Agricultural Statistics

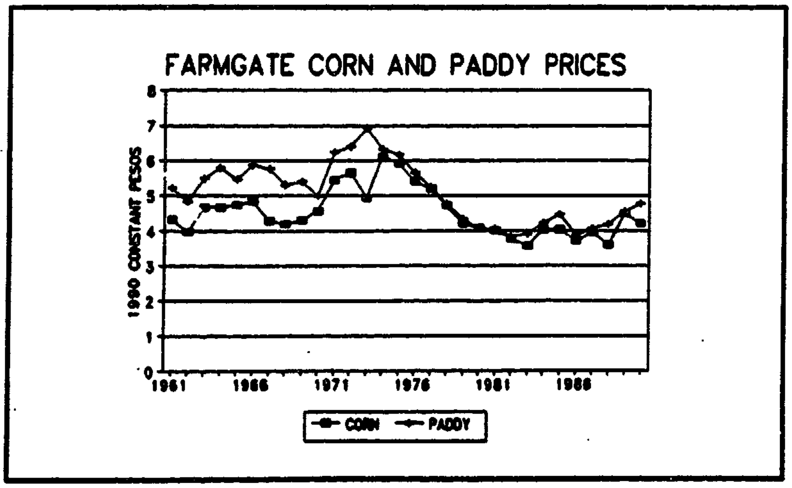
3.26 <u>Producer Incentives</u>. Import controls have favored corn over rice producers, contributing to the shift from paddy in upland areas. Figure 3.5 shows that farmgate prices for corn and paddy have been closely aligned since the early 1970s. However, relative to paddy, corn farmers are more market-orientated, unit values are lower, markets are more distant, and prices are more variable and less influenced by NFA. Deficiencies in transport and marketing are therefore of greater significance and corn tends to be a riskier venture to the farmer. As for paddy, incentives for fertilizer use improved in the mid-1980s and this has contributed to rising yields and the spread of hybrid varieties (Table 3.12). However, the new technologies have still only been adopted by relatively few farmers (para 2.11). Recent analysis suggests they are profitable provided the farmer receives the farmgate price implied by the present level of protection (IFPRI, 1991). The spread of new technologies is also influenced by DA support programs. The current 'C rn Enhancement Program' for instance aims to reduce corn production costs through subsidies in the use of hybrid seed, fertilizer and other inputs. However, production costs are unlikely to be reduced as much as DA expects although the program could play a role in accelerating their adoption.

Table 3.12: AMMONIUM SULPHATE PRICES: WORLD, BORDER, WHOLESALE AND FARMGATE

	Domestic Prices: Ammonium Sulphate			Corn	Ratio
	Import	Ex-Warehouse	Retail	Farmgate	Amsulph/Corn
	--- (P/kg) ---		(P/kg N)	(P/kg)	(kg N/kg)
1975	1.59	0.95	4.52	0.94	4.81
1976	0.50	0.92	4.38	0.94	4.66
1977	0.67	1.00	4.76	0.99	4.81
1978	0.76	1.06	5.05	0.97	5.20
1979	0.82	1.21	5.76	1.01	5.70
1980	1.03	1.34	6.38	1.13	5.65
1981	1.21	1.59	7.57	1.29	5.87
1982	0.85	1.70	8.10	1.34	6.04
1983	0.99	1.79	8.52	1.39	6.13
1984	1.80	2.45	11.67	2.36	4.94
1985	1.80	2.91	13.86	2.91	4.76
1986	1.34	1.84	8.76	2.70	3.25
1987	1.48	1.74	8.29	2.98	2.78
1988	2.08	2.28	10.86	2.96	3.67
1989	na	na	12.92	4.07	3.17
1990	na	na	16.41	4.19	3.92

Source: Department of Agriculture

Figure 3.5: FARMGATE PADDY AND CORN PRICES: 1960-89



Source: Bureau of Agricultural Statistics.

Transport and Distribution

3.27 General. Transport and distribution are significant in the delivered cost of relatively bulky and low value grains and, to a lesser extent, fertilizer. These costs include not only the direct costs of surface transport and shipping but also storage, spoilage, pilferage, interest charges, insurance payments and other costs resulting from delays and inefficiencies of the marketing system. Not only may the latter substantially exceed direct costs, they are also more variable and uncertain. In addition, the trader faces price risks arising from the activities of NFA and powerful competitors. Finally, road transport and inter-island shipping are not only constrained by poor quality infrastructure but are subject to a complex range of Government controls and regulations which further increase the real costs of transport and add to the risks of those engaged in the grain trade. Although in practice, controls are sometimes ineffective, they can act as barriers to entry into the marketing and transport sectors and add greatly to real costs. Deficiencies in transport and marketing may negate production gains, for instance arising from improved technologies or irrigation.

3.28 Transport problems are most serious in corn. Wheat is imported mainly as grain for milling in the Manila area, being consumed largely in urban areas that can be readily supplied. Paddy is typically milled close to the farm and subsequently handled, shipped and stored in the form of rice. Fully half of domestic output is consumed by farm households or in their close vicinity, and the most important surplus areas are accessible to major markets. In contrast, little corn is grown for own consumption and producing areas are dispersed and distant from markets in Manila and the Visayas. Corn is also lower value than rice so that handling and transport costs are inherently greater. Yellow corn is mainly shipped to Manila for milling and formulation into livestock feed. White corn is partly milled in the producing area but has traditionally been shipped to Cebu for milling into grits for human consumption. Both rice and corn are marketed through a multi-layered distribution system, involving local agents, intermediate barangay traders, and provincial/regional trader/millers.

3.29 Transport Costs. Handling and transport costs vary widely, depending on the state of the infrastructure, the traders involved, the supply situation and numerous other factors. Variability is a major determinant of comparative advantage among the various grain producing regions. Table 3.13 is based on a more detailed analysis contained in a transport working paper available on file. It is indicative of the costs and margins involved in rice and corn marketing to illustrate some major issues.

3.30 The table illustrates 'low' and 'high' alternatives typical of prices in 1989-90 for representative routes: (i) rice and corn from the Cagayan Valley to Manila and (ii) corn from Cagayan de Oro to Manila. Farmgate prices are set relative to the wholesale price in Manila after allowing for costs and margins. Transport, handling and milling are taken as fixed costs. Storage, waste, interest and trader margins are assumed to vary with the wholesale price. This is an over-simplification but adequate to suggest the following:

(a) Transport and handling costs are relatively higher for corn than rice but this is offset by the milling charge. Hence, the farmer's share in the final price is broadly comparable as indicated by the estimates given in Table 3.13 for the Cagayan Valley (Isabella) to Manila route.

Table 3.13: STRUCTURE OF MARKETING COSTS AND PRICES: PADDY AND CORN

	Paddy		Corn			
	Isabella-Manila		Isabella-Manila		Cag.de Oro-Manila	
	Low	High	Low	High	Low	High
	(P/kg)					
Price Structure						
Farmgate Price	4.00	5.00	3.00	4.00	2.20	3.15
Transport & Handling	0.60	0.60	0.75	0.75	1.05	1.05
Milling	0.50	0.50	-	-	-	-
Storage, Waste & Int.	0.40	0.48	0.40	0.50	0.80	0.95
Trader Margins	0.60	0.72	0.45	0.55	0.55	0.65
Wholesale Price Manila	6.10	7.30	4.60	5.80	4.60	5.80
	(%)					
% of Wholesale Price						
Farmgate Price	65	68	65	69	48	54
Transport & Handling	10	8	16	13	23	18
Milling	8	7	-	-	-	-
Storage, Waste & Int.	7	7	9	9	17	16
Trader Margins	10	10	10	9	12	11
Wholesale Price	100	100	100	100	100	100

1/ In paddy equivalent plus income from by-products
Source: Mission Estimates

(b) The farmer's share in price for corn delivered from Mindanao is lower than when delivered from the Cagayan Valley due to: (i) higher fixed costs associated with shipping and port fees, and (ii) higher variable costs related to the added time from the farm to Manila. Maintaining the domestic corn price above the world price to protect the Mindanao farmer thus provides a windfall gain to farmers closer to Manila.

(c) Even if fixed costs are higher, variable costs as defined fluctuate more between areas and seasons. The 1990 increase in freight rates was therefore generally welcomed by the grain trade since shippers are expected to give grain higher priority than in the past. Fewer delays and reduced spoilage would more than offset the higher freight charge.

(d) Trader margins are estimated at about 10-12% of the corn price. But these margins are highly variable and can be increased by collusion or undermined by erratic price movements due to NFA or import operations.

3.31 Table 3.13 implies that corn marketing costs might ultimately be reduced by up to one peso per kg (about 20% of the wholesale price). Potential reductions for rice are likely to be less although in isolated areas they could be significant. Achieving reductions in transport costs requires a wide range of infrastructural investments and policy reforms which will take time. The impact on marketing stability may be as important as on direct costs since a more competitive and stable market is as important to the farmer as price. If it is true that a 'high' Cagayan de Oro farmgate corn price is 30% above the 'low' price, it is not surprising that the farmer is reluctant to incur the risks associated with the high fixed costs of hybrid seed and fertilizer.

B. Policy Alternatives

World Price Prospects

3.32 Table 3.14 summarizes the most recent World Bank price projections for wheat, rice and corn. World prices are expected to remain in real terms at about 1990 levels, a little above in the case of wheat, about the same in the case of corn, and somewhat below in the case of rice. These projections assume there are no major changes in world trading arrangements nor in world energy prices. As with any forecasts, they are subject to considerable uncertainty with upward and downward risks.

Table 3.14: WORLD BANK PRICE PROJECTIONS: WHEAT, RICE AND CORN, 1995-2000

	Wheat1/	Rice2/	Corn3/
	---------- (US$/t at 1990 Prices) ---------		
Actuals			
1985	189	318	165
1986	147	263	109
1987	128	262	87
1988	148	319	113
1989	170	340	118
1990	129	287	110
Projections			
1995	122	257	96
2000	152	278	117
2005	125	248	105

1/ US No. 1 Soft Red Winter, export price Gulf. 2/ Thai 5% broken, FOB Bangkok. 3/ US No. 2 Yellow, FOB Gulf ports.
Source: World Bank, July 1991.

Border Equivalent Prices

3.33 Wheat. It has been suggested above (paras. 3.4-3.8) that, since trade liberalization in the mid-1980s, the wheat market has become increasingly competitive. If so, and provided competitive conditions are sustained, domestic prices will be set by international price movements subject to any tariffs or levies that are imposed. During 1990, the latter amounted to about 20% comprising a 10% duty and the temporary 9% import levy. In early 1991, the temporary levy was reduced to 5% and is scheduled to be abolished before the end of the year. Other things being equal, therefore, differentials between international and border prices will narrow further.

3.34 Rice. The spread between import equivalent and export equivalent prices is typically wide for grain crops which are low in value relative to weight. Table 3.15 indicates the order of magnitude of this spread for rice in 1990. These estimates make no allowance for the fact that the Philippines is a non-traditional exporter producing poor quality rice, and therefore may have difficulty in marketing its product abroad. The spread between import and export equivalent prices given in the table is thus probably conservative.

Table 3.15: IMPORT AND EXPORT EQUIVALENT PRICES FOR RICE, 1990

	Export Equivalent	Import Equivalent
	(US$/t)	
Export Price, 5% Broken, FOB Bangkok	287.2	287.2
Export Price, 25% Broken, FOB Bangkok	252.4	252.4
Freight & Insurance	na	16.5
CIF/FOB Price Manila	252.4 1/	268.9 1/
	(P/t)	
CIF/FOB Price Manila	6,133	6,524
Import/Export Costs	520 2/	520 2/
Interest (60 days at 36%)	314	387
Ex-Warehouse Price	5,299	7,441

1/ At an average exchange rate of US$1 = P24.3.
2/ Assumed to be comparable to the estimate for corn - see Table 2.9.
Source: Mission Estimates

3.35 Table 3.16 compares average wholesale prices (Table 3.4) with export and import equivalent prices for the period 1988-90 converted at the current exchange rate. The equivalent prices are derived as in Table 3.15, adjusting freight and insurance costs by international inflation rates and import/export costs by the wholesale price index. Also included are estimates for 1990 converted at the end-year exchange rate, together with projections at constant 1990 prices for 1995 and 2000. The use of the end-year exchange rate takes into account the devaluation during the second half of the year.

Table 3.16: IMPORT/EXPORT EQUIVALENT PRICES FOR RICE, 1988-2000

	Exchange Rate P/US$	Export Equivalent	Import Equivalent	Wholesale Philippines
		(P/kg)		
Actuals				
1988	21.1	4.96	6.58	6.48
1989	21.7	5.42	7.18	7.82
1990	24.3	5.30	7.44	8.81
At 1990 Prices 1/				
1990	28.0	6.18	8.49	8.81
1995	28.0	5.49 2/	7.71 2/	na
2000	28.0	5.98 2/	8.25 2/	na

1/ At end-1990 Exchange Rate. 2/ Based on World Bank projections.
Sources: Tables 3.1, 3.4, 3.15 and Mission Estimates.

3.36 The wholesale price averaged some 45% more than the export equivalent price during 1988-90 and was 40% higher in 1990 even based on the end-1990 exchange rate. Exports therefore would have incurred substantial financial losses. This is confirmed by an IFPRI study which, based on detailed resource cost analysis, concluded that the Philippines has no comparative advantage in rice for export (Rosegrant et al, 1987). Wholesale prices in 1988-89 were also above the import equivalent price, implying some nominal protection.

However, if 1990 prices are converted at the end year exchange rate, then the difference is only about 3-4% (Table 3.17). During 1991, world prices have risen some 10% above 1990 levels so that domestic prices probably remain broadly equivalent to international levels.

3.37 Corn. The decline in world prices since the 1970s has been greater for corn than for rice and GOP has resorted to quantitative restrictions to maintain domestic prices above international levels (para. 3.22). Table 3.17 compares estimates of import equivalent prices for yellow corn with average wholesale prices for Manila and the Philippines as a whole. The table also includes estimates for 1990 converted at the end-year exchange rate together with projections for 1995 and 2000 at constant 1990 prices.

Table 3.17: IMPORT EQUIVALENT PRICES FOR YELLOW CORN, 1988-2000

	Exchange Rate	Import Equivalent	Wholesale Prices	
			Manila 1/	Philippines
	P/US$	------------------	(P/kg)	------------------
Actuals				
1988	21.1	3.17	4.90	3.67
1989	21.7	3.40	5.10	4.33
1990	24.3	3.73	6.15	4.80
At 1990 Prices 2/				
1990	28.0	4.20	6.15	4.80
1995	28.0	3.83 3/	na	na
2000	28.0	4.46 3/	na	na

1/ Manila prices are derived from BAS. The 1990 average is somewhat higher than the July estimate used in Table 3.9. Indeed, prices fell even further towards the end of the year.
2/ At end-1990 Exchange Rate. 3/ Based on World Bank projections.
Sources: Tables 3.1, 3.8, 3.15, BAS and Mission Estimates.

3.38 The Manila wholesale price is well above the Philippines average due to high domestic distribution costs (paras. 3.27-31). The major import market is Manila where the livestock processing industry is concentrated. If imports were fully liberalized, Manila wholesale prices would tend to adjust to international equivalent levels, that is they might decline by up to 46% (Table 3.18). The extent to which prices would decline elsewhere depends on any improvements in efficiency of domestic markets following liberalization. Without such improvements, prices could be expected to adjust in proportion to fixed and variable domestic costs (Table 3.13). With some improvements in efficiency, the decline in prices elsewhere would be less.

Alternative Scenarios

3.39 There is a strong argument in economic theory for aligning domestic prices with those on the international market. This would suggest correcting for any exchange rate distortions, liberalizing foreign trade, and allowing domestic prices to be set in relation to world levels. Exchange rate adjustments in 1990 largely corrected for the previous over-valuation of the peso (para. 3.2) and, moreover, any remaining exchange rate imbalance has a comparable impact on all three main grains. The major issue is thus the different trading regimes governing wheat, rice and corn. Based on 1990 prices at end-1990 exchange rates, it has been concluded above that: (i) wheat prices were largely set in relation to world prices subject to prevailing tariffs and duties (about 20%); (ii) rice prices were broadly at import equivalent levels due to NFA operations, with the notional 50% tariff on private imports ineffective; and (iii) Manila corn prices were more than 40% above world prices as a result of quantitative restrictions rather than the prevailing 20% tariff (15% on imports from ASEAN).

3.40 The analytical framework given in Annex 3 permits some assessment of the potential impact of equalizing effective tariffs. Two scenarios are shown to indicate the effect of: (i) adjusting prices to border equivalent levels (that is abolishing all import duties and quantitative restrictions) (Scenario 1), and (ii) imposing an equal 20% tariff on the major grains (abolishing all quantitative restrictions) (Scenario 2). Scenario 1 thus assumes a 20% reduction in the wheat price, a 40% reduction in that of corn and no change in that of rice. Scenario 2 assumes a 20% increase in the rice price, a 20% decrease in that of corn, and no change in that of wheat. These scenarios are specified in terms of equalizing tariff rates. It has not been possible to undertake detailed analyses of the relationship of border prices to retail prices, in particular for wheat and livestock products. The analysis is therefore partial and the results are indicative of directions of change and orders of magnitude rather than a forecast of the impact of specific tariff rates.

3.41 Demand. The baseline projections given in Table 3.18 assume 2.2% population growth and 4% income growth (Table 2.10). They also assume a once-and-for-all price increase in 1991 (e.g. as a result of a tariff adjustment) has a relatively more pronounced impact in 1995 than in 2000.

Table 3.18: PROJECTED DEMAND: RICE, CORN, WHEAT FLOUR 1995-2000[1/]

	Population	Total Consumption: '000t			Consumption: kg/head		
		Rice	Corn [2/]	Wheat	Rice	Corn	Wheat
Baseline Projections							
1990	60.81	5,967	1,046 [3/]	1,087	98.1	17.2	17.9
1991	62.14	6,145	1,045	1,141	98.9	16.8	18.4
1995	67.68	6,799	1,023	1,394	100.5	15.1	20.6
2000	75.32	7,711	949	1,799	102.4	12.6	23.9
Scenario 1							
1990	60.81	5,967	1,046[2/]	1,087	98.1	17.2	17.9
1991	62.14	5,939	1,107	1,357	95.6	17.8	21.9
1995	67.68	6,571	1,085	1,656	97.1	16.0	24.5
2000	75.32	7,452	1,006	2,139	98.9	13.4	28.4
Scenario 2							
1990	60.81	5,967	1,046[2/]	1,087	98.1	17.2	17.9
1991	62.14	5,922	1,247	1,321	95.3	20.0	21.3
1995	67.68	6,553	1,219	1,613	96.8	18.0	23.8
2000	75.32	7,431	1,130	2,082	98.7	15.0	27.6

Scenario 1: 20% reduction in 1991 wheat price, 40% incr. in 1991 corn price.
Scenario 2: 20% increase in 1991 rice price, 20% decrease in 1991 corn price
1/ Assuming population rises at 2.2% p.a. and per capita incomes at 4% p.a.
2/ Corn for Human COnsumption 3/ Adjusted preliminary estimate (see Annex 3).
Source: Mission Estimates

3.42 Table 3.18 suggests that per capita consumption is fairly resilient in the face of the shifts in relative prices. Indirect income effects are ignored although the assumption of continued 4% average income growth ensures that all but the most disadvantaged will enjoy increased consumption levels. Indeed, average consumption rises by 6-8 kg/head, with wheat accounting for most of the increase. The disadvantaged could be supported through targeted subsidy programs (para. 3.58). No attempt has been made to disaggregate the outcome among income classes although it is recognized that this would raise important issues concerning income distribution and nutritional status.

3.43 Supply. The estimation procedures used in Annex 3 to analyze supply response reflect historical conditions. The results have been adjusted to account for possible future trends (para. 2.15). Accordingly, the supply projections are based on an own price supply elasticity of 0.20 and a cross price elasticity with respect to the price of corn of -0.075. Further work is clearly necessary to substantiate these assumptions and this should be borne in mind in interpreting the results. Table 3.19 also assumes that 50% of the increase in the Manila corn price is reflected in the farmgate price, with the balance absorbed by domestic cost savings (para. 3.38). As for the demand estimates, the assumption of a once-and-for-all tariff adjustment in 1991 has a proportionately larger impact on the results for 1995 than for 2000.

3.44 The Rice Balance. Table 3.19 presents estimates of the rice balance for the two scenarios and compares these to the baseline case.

Table 3.19: PROJECTIONS OF RICE SUPPLY AND DEMAND: 1995 and 2000

	Supply		Demand	Balance
	Paddy[1/]	Rice[2/]	Rice[3/]	Rice
	('000 t)			
Baseline Projections				
1990	9,317	5,692	5,967	-275
1995	10,007	6,115	6,799	-684
2000	10,744	6,565	7,711	-1,146
Scenario 1				
1990	9,317	5,692	5,967	-275
1995	10,158	6,206	6,571	-365
2000	10,906	6,663	7,452	-789
Scenario 2				
1990	9,317	5,692	5,967	-275
1995	10,558	6,405	6,553	-148
2000	11,335	6,877	7,431	-554

Scenario 1: 20% reduction in 1991 wheat price, 40% in 1991 corn price.
Scenario 2: 20% increase in 1991 rice price, 20% decrease in corn price
1/ Assuming the underlying growth in yields is 1% p.a.; the irrigation service area expands by 25,000 ha p.a.; the elasticity of supply with respect to the price of rice is 0.25; and the elasticity of supply with respect to corn is 0.075.
2/ Assuming 6% seed, feed and waste; and a milling rate of 65%.
3/ Assuming per capita incomes rise at 4% p.a.and population at 2.2%
Source: Mission Estimates

3.45 Subject to the qualifications discussed above, the table suggests that aligning domestic prices with international prices (Scenario 1) could reduce the rice deficit in 2000 by some 0.35 M t primarily due to substitution of wheat consumption for rice. A uniform 20% tariff (Scenario 2) would have a similar impact on demand and could induce additional supply of say 0.25 M t. Given yield constraints, the latter might come mainly from a shift to rice in upland areas (para. 2.8). The impact of these alternatives is comparable to that of changes in baseline assumptions,[1] and for both scenarios a substantial rice deficit would still be incurred in the year 2000. Thus, while equalizing tariffs at the levels specified has the potential for moderating the rice deficit, this analysis does not fundamentally alter the conclusion that the Philippines will remain a deficit rice producer through the 1990s.

3.46 Trade Prospects. Reductions in the rice deficit through tariff adjustments would be reflected in additional wheat and/or corn imports. Table 3.20 provides estimates of rice and wheat imports under the two scenarios.

Table 3.20: TENTATIVE PROJECTIONS OF TRADE IN RICE AND WHEAT: 1995 and 2000

	Import Volume		Import Value	
	Rice 1/	Wheat 2/	Rice	Wheat
	--- ('000 t) --		----- (M P) -----	
Baseline Projections				
1990	275 4/	1,489	2,335	8,173
1995	684	1,990	5,274	10,499
2000	1,146	2,464	9,455	15,252
Scenario 1.				
1990	275	1,489	2,335	8,173
1995	365	2,268	2,814	11,966
2000	789	2,930	6,509	18,137
Scenario 2.				
1990	275	1,489	2,335	8,173
1995	148	2,208	1,141	11,649
2000	554	2,859	4,571	17,497

1/ From Table 3.18. Actual imports in 1990 were 0.68 Mt. The discrepancy reflects assumptions used in the demand model (Annex 3).
2/ From Table 3.17, assuming a grain-flour ratio of 0.73.
3/ Based on import equivalent prices - Table 3.16.
4/ Based on import equivalent prices, estimated as for rice (P5.5/kg in 1995 and 6.2/kg in 2000 at 1990 constant prices).
Source: Mission Estimates.

3.47 The impact on the combined rice and wheat trade balance is positive in the case of Scenario 2 (resulting in a foreign exchange saving of P2,639 M) and neutral in the case of Scenario 1. In both cases, this is associated with

[1] For instance, if the rate of irrigation expansion doubles from 25,000 ha to 50,000 ha per year, the deficit in 2000 is reduced by about 0.25-0.30 M t; if per capita income growth is 2% p.a. rather than 4% p.a., it is reduced by 0.15-0.20 M t; and if population increases at 2.5% rather than 2.2%, then the deficit is increased by about 0.25 M t (see Tables 2.9 and 2.10).

an increase in total per capita consumption of grains (Table 3.18). Moreover, incremental wheat imports are associated with additional feed byproducts equivalent to perhaps 25% by weight.

3.48 The impact on corn imports is less straightforward. Corn consumption for food is relatively stable under all scenarios (Table 3.18), so that the impact on imports will depend almost entirely on the relationship between corn production growth and the demand for feed. Projections of meat consumption are derived using the systems model described in Annex 3 and are converted to corn equivalent assuming that three kilograms of feed are equivalent to one kilogram of meat (the average for the last 5 years was about 3.2 kg). No supply response estimates for corn have been prepared. Table 3.21 illustrates the potential impact on imports of production growth rates of 4% p.a. (somewhat below recent experience - para. 2.16) and 6% p.a.(somewhat above recent experience).

Table 3.21: NOTIONAL PROJECTIONS OF TRADE IN CORN, 1990-2000

	Corn Consumption			Import Volume Growth in Output		Import Value Growth in Output	
	Food 1/	Feed 2/	Total	4%	6%	4%	6%
	--------	('000 t)	-------	- ('000 t) -		--- (M P) ---	
Baseline Projections							
1990	1,046	3,759	4,805	...	....	...	...
1995	1,023	5,409	6,432	527	(-53)	2,018	(-156)
2000	949	7,677	8,626	1,441	(-66)	6,427	(-226)
Scenario 1							
1990	1,046	3,759	4,805	...	...	...	...
1995	1,085	6,240	7,325	1,421	841	5,442	3,221
2000	1,006	8,856	9,862	2,678	1,171	11,948	5,227
Scenario 2							
1990	1,046	3,759	4,805	...	...	...	...
1995	1,219	6,126	7,345	1,441	851	5,519	3,259
2000	1,130	8,697	9,827	2,643	1,136	11,788	5,067

1/ From Table 3.18.
2/ Assuming 3 kg of corn is equivalent to 1 kg of meat.
3/ Production growth rate based on 1990 estimate of 4.58 Mt. Actual imports in 1990 were 0.38 M t (Table 2.8). The discrepancy reflects assumptions used in the demand model (Annex 3).
4/ Based on prices derived from Table 3.17.
Source: Mission Estimates.

3.49 Table 3.21 suggests that the price changes implicit in the two scenarios would substantially increase corn imports. However, this is almost entirely due to increased meat consumption[1] as a consequence of the reduction in the price of corn under the two scenarios. Not only would this substantially improve nutritional status and contribute to growth in value-added

[1] It is assumed that meat prices would on average decrease in the ratio 0.36:1 relative to the corn price (see para. 3.25).

in the livestock industry but it would be a consequence of abolishing quantitative restrictions on corn imports irrespective of measures to be taken with respect to other grains. Futhermore, it ignores inter-actions with other feeds, changes in product mix, increased efficiency etc. Since there is considerable potential for developing alternative sources of indigenous feed, and improving the technological efficiency of feed conversion, the assumptions lying behind Table 3.21 are highly simplifying. Moreover, given the potential for yield growth and for reductions in distribution and marketing costs in corn, there is clearly considerable potential for reducing the projected corn import volumes below the notional levels indicated in the table.

Conclusions

3.50 Elimination of protection, while improving the rice balance, generally worsens the overall trade balance in grains in both physical and value terms. This is true also for equalization of protection at a 20% level though increased meat (and hence feed corn) consumption is then the sole cause. In this case, the increased demand for feed corn more than offsets decreased demand for foodgrains as a result of higher rice prices (which would otherwise tend to reduce the overall grain deficit). Thus while national welfare would gain from the gradual elimination of quantitative and other forms of protection on corn and wheat, and this would improve the rice balance -- by reduction in demand -- almost as much as a doubling of the investment program in irrigation (from 25,000 ha to 50,000 ha), this would be at the expense of increased total grain imports due primarily to higher feed corn imports in support of increased meat consumption. This conclusion has important implications for the balance between investment and trade policie (see Chapter 6 following the review of irrigation issues in Chapters 4 and 5.

C. Intervention Mechanisms

General

3.51 Public intervention in rice and corn seeks to balance consumer and producer interests while having regard to GOP's food security objectives. However, the control mechanisms adopted have led to problems and uncertainties that adversely impact on domestic production and markets. This is compounded by controls and regulations in transport and distribution. Irrespective of tariff policy, therefore, clarification of NFA's functions and reforms in transport are desirable. Four major weaknesses can be identified:

(a) Quantitative controls have created uncertainty in rice and corn supply besides providing rent-seeking opportunities in corn imports;

(b) NFA's domestic operations have been insufficient to support producer and consumer prices at announced levels while having an unpredictable impact on private markets;

(c) Low or negative margins between support and release prices have adversely affected private trade, besides undermining NFA's financial position and creating opportunities for rent-seeking behavior; and

(d) Transport policies and constraints have increased the costs and risks of internal distribution and marketing, especially in corn.

Import Controls

3.52 The private sector has responded in predictable ways to the abolition of quantitative restrictions on wheat and fertilizer imports. The result has been increased competition, reduced prices and trader margins, and investment in marketing, processing and related facilities. Reforms in corn and rice -- although more difficult -- could have similar effects. Two aspects need to be considered: first, the substitution of tariffs for quantitative controls, and second, mechanisms for responding to the volatility of world prices.

3.53 One possibility which deals with both these issues would be a reference price/variable levy system. This has been suggested in several recent reports both for rice (UPLB, 1986; World Bank, 1987) and for corn (IFPRI, 1991). Under such a scheme, quantitative restrictions on private imports and exports would be abolished. They would be replaced by a tariff that reflected the difference between an actual world reference price varying from day-to-day and a domestic target price set by Government for a longer period e.g. a season or year. This would protect the domestic producer from world prices that are below the target price, and protect consumers from domestic prices rising above world prices. If operated as a negative tariff (an export tax), it could also protect the consumer from high world prices such as those that prevailed in 1973-74. In the event that the objective is to align domestic prices with medium-term world prices, then the target price would the expected international price at which level there would be no tariff (Scenario 1). In the event that some level of protection is required, for instance if tariffs on each of the major grains was equalized at 20% (Scenario 2), then the target price would be the expected international price plus 20%.

3.54 Such a scheme could have some advantages. *"It is a measure to regulate the market by controlling the price and letting the quantity of domestic production and import adjust to this controlled price"* (IFPRI, 1991). Domestic prices would be insulated from volatile world markets while providing the level of protection desired (e.g. to moderate the rice deficit or provide time for resolving structural impediments to productivity in corn). Market conditions would determine the level and timing of imports and prices in any locality relative to the reference price. This could promote competition and efficiency, and encourage private investment. In particular, freedom to import feed corn would guarantee supplies throughout the year not only to the large Manila-based operations but also to smaller regional feedmillers and livestock producers. Irrespective of the level of protection for corn, the livestock industry would benefit from increased efficiency and security of feed supply.

3.55 A reference price/variable levy system may be contrary to commitments under GATT though abolishing quantitative restrictions in favor of a variable tariff represents a 'tariffication' of existing trade barriers and is thus a move in the right direction (IFPRI, 1991). Moreover, such a scheme might have practical implications that are difficult to anticipate. If such a system is precluded, then an alternative would be a fixed tariff set relative to the expected world market price and subject to regular review. While not fully insulating the domestic market from world price volatility, this could achieve many of the same objectives as a variable tariff. If expected world prices changed, or if domestic costs are reduced significantly, then consideration would be given to adjusting the level of the tariff.

3.56 Reform in the corn trade undoubtedly has greater urgency than in rice given linkages with livestock and the potential for productivity gains. Rice production has few inter-industry linkages and productivity is already high relative to its potential (Chapter 2). Moreover, GOP attaches greater importance to retaining control over rice than corn since rice is the staple for the majority of the population. As a matter of priority, therefore, consideration should be given to reform in corn. Detailed studies are required to determine the appropriate tariff structure (whether variable or fixed), the mechanisms for its operation and the timing of its introduction. Subject to the impact of reforms in the corn sector, consideration could be given to the introduction in due course of a similar scheme for rice.

NFA's Domestic Operations

3.57 NFA's difficulties in sustaining prices at announced levels are compounded by its dual mandate to: (i) stabilize prices to producers and consumers and (ii) make staple grain available below cost i.e. to provide food subsidies. The overlap between these two roles has meant that neither has been efficiently performed. In particular, the availability of NFA supplies to all through NFA retail outlets puts a burden on the public food distribution, weakens NFA's financial position and undermines the ability of the private market to ration supplies efficiently through price competition.

3.58 There is a prima facie case for considering NFA's two main functions separately (Abel and Binamira, 1990). The costs of NFA's price stabilization activities need to be established. Abolition of quantitative restrictions on imports and promotion of competitive market conditions could ensure that the private sector has dominant responsibility for balancing the market. How far there should be a residual role for NFA is an issue that goes beyond the scope of this report. One interim possibility would be to increase the margin between the support and the release price to accommodate realistic trader costs and normal seasonal price movements and provide the context for a competitive and efficient private sector (in practice this would involve an increase in the release price to reflect the target domestic price, para. 3.52). NFA would manage a buffer stock operation with the preannounced release price enforced by disposal of buffer stocks and imports, and procurement supporting the producer price to the extent that NFA resources allowed. NFA's financial situation would be substantially improved by such reforms. However, price stabilization could remain a relatively costly activity. In the longer-term, trade liberalization and improvements in the domestic trading environment could together be sufficient to moderate price fluctuations. If so, the public sector's role could be limited primarily to setting the appropriate level of tariffs (para. 3.40) and supporting a competitive private sector through infrastructural investments and an appropriate policy environment.

3.59 Irrespective of NFA's price stabilization role, subsidy programs -- if any -- could be targeted at those segments of the population which need to be protected against the increase in retail (release) prices rather than, as at present, being available to all through NFA outlets. If NFA is the responsible agency for such subsidy programs, they would need to be financed and accounted for separately from its other operations so that their costs are a transparent consequence of Government policy and do not distort NFA's finances. It is understood that discussions have been initiated on the potential for such a program which will need to be carefully evaluated to ensure that the real target beneficiaries can be reached.

3.60 These possible reforms essentially support the conclusions of Abel and Binamira (1990) who conclude that they would significantly improve cost-effectiveness of food policies by: *"(i) reducing the cost of supporting farm prices and subsidizing consumers, (ii) limiting Government interventions to achieving a more specific set of goals, (iii) allowing markets and the private sector to operate more freely, (iv) controlling consumer price volatility by more directly targeting the needy and allowing a larger role for price to ration supplies in the rest of the market, and (v) strengthening the role Government plays in enforcing producer price guarantees while enabling producers to benefit more from higher but tolerated market prices."* It is beyond the scope of the present study to go further into these issues although it is understood that the recommendations of earlier studies are under review and that detailed studies are anticipated to define NFA's remaining price stabilization role, identify target groups and mechanisms appropriate for delivering targeted programs and phase the introduction of such reforms.

Policies in Transport.

3.61 Numerous reports and studies (Department of Agriculture, 1989; World Bank, 1990; USAID, 1991) have advocated major policy reforms in the transport sector together with investments in barangay and provincial roads and in inter-island ports and related shipping facilities. Among reforms advocated in World Bank discussions on the transport sector are:

(a) Freer entry and exit into the road transport and inter-island industries, with abolition of territorial and numerical constraints attached to operating franchises;

(b) Revocation of Government's power to fix rates or tariffs for all freight services;

(c) Creation of a regulatory environment that is institutionalized and effective in ways that do not discriminate between different participants or types of franchise;

(d) User charges for Government facilities to be based on the direct and indirect costs of providing the service;

(e) The strengthening and streamlining of Government institutions and support services in the transport sector; and

(f) Promotion of infrastructural investments, with responsibility to be shared between the public and private sectors as appropriate.

3.62 It is beyond the scope of this report to review these reforms in any detail. If implemented, they would contribute importantly to a reduction in transport costs, in particular for corn. They would also moderate transport and marketing uncertainties. Together with other reforms, they could go a long way towards creating a competitive and efficient grains industry.

IV. IRRIGATION: PERFORMANCE AND PRIORITIES

A. Background

Water Resources

4.1 When considered in annual terms, the Philippines has abundant water. Weighted mean annual rainfall is about 2,360 mm which converts to 700 BCM per year on an area of 300,000 km^2. Annual runoff is estimated to be 479 BCM at 90% probability but its distribution is highly variable between regions and from year-to-year. Rainfall ranges from less than 1,000 mm in the extreme south to more than 4,000 mm in some eastern areas. Over most of the country it is to a greater or lesser extent seasonal. Western regions receive rain mainly with the southwest monsoon (May-September); eastern areas more with the northeast monsoon (October-January); and intermediate areas in varying combinations, some of which (e.g. central Mindanao) show little seasonal pattern. Thus, although the wet season is conventionally defined as the period of the southwest monsoon (crop harvested July-December), in many parts of the country significant rainfall also occurs at other times of the year.

4.2 The Philippines is drained by 421 rivers with catchments ranging from 40 km^2 to 25,500 km^2. Ten rivers have drainage basins exceeding 3,000 km^2, and together account for 28% of the land surface including the main alluvial plains suitable for paddy. Almost all the smaller basins have 70% or more of their land on steep slopes from which runoff is very rapid and even in the wet season dry spells are reflected in marked reductions in flow. The complexity of rainfall and runoff patterns precludes generalization. Nevertheless, flows are generally low during March-May (coinciding with the North Pacific Trade Winds), and during the rest of the year are a function of the relative importance of the southwest and northeast monsoons. A feature of the flow pattern is the great variability from year to year, with minimum flows in the range of 20-40% of mean monthly flow, and maximum flows commonly exceeding 200%. This characteristic is important to the security -- or lack of it -- of the water supply with run-of-the-river irrigation.

4.3 The main groundwater reservoirs are formed by fluvial and fluvio-volcanic deposits. Four main reservoirs underlie a combined area of about 33,500 km^2 (the Cagayan Basin 10,000 km^2, the Agno/Pampanga Basin 9,000 km^2, the Agusan Basin 8,500 km^2 and the Cotabato Basin 6,000 km^2). Although groundwater conditions are not well evaluated, it is estimated that, together with smaller areas, some 50,000 km^2 or 17% of the country is underlain by fairly abundant groundwater.

Land Resources

4.4 The primary definition of potentially irrigable land is land on a slope of less than 3%.[1] This occurs mainly in valley bottoms and on coastal plains. The break from plain to mountain is usually abrupt so that this land can be readily identified. It must be rectified to take account of physical constraints (soils, water availability, flood hazard, drainage) and land alienated to human settlement and infrastructure. The most frequently quoted

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[1] This criterion is violated by including somewhat steeper land if it is already terraced for paddy cultivation.

estimate of countrywide potential (3.126 M ha) dates to the early 1980s, being based on an analysis of topographic maps from the 1950s. Adjustments were made for some major settlements but not for water availability, nor for the costs of irrigation, drainage and flood control facilities. Furthermore, the estimate needs updating to take account of continuing land alienation. Within the context of the IASR, therefore, NIA is reassessing the irrigable land resource based on Bureau of Soils and Water Management (BSWM) estimates of present and potential rice-based land use. The methodology being followed in described in Annex 4 and Table 4.1 compares preliminary results from the reassessment with previous NIA estimates.

Table 4.1: POTENTIALLY IRRIGABLE LAND AND PROPORTION DEVELOPED UP TO 1990

Region	Previous Estimate	Prelim. Estimate of GSA		Actual as % of:1/	
		Readily Converted2/	Total3/	Readily Converted2/	Total3/
1. Ilocos	310	440	461	60	57
2. Cagayan Valley	540	783	797	50	49
3. Central Luzon	482	659	734	61	54
4. South Tagalog	264	320	502	70	44
5. Bicol	240	240	437	38	28
6. Western Visayas	197	280	471	56	33
7. Central Visayas	51	226	350	14	9
8. Eastern Visayas	84	454	663	18	12
9. Southwestern Mindanao	77	113	222	48	28
10. Northern Mindanao	230	210	291	47	34
11. Southeastern Mindanao	290	240	454	63	33
12. Southern Mindanao	362	316	372	50	37
Total	3,126	4,282	5,743	50	37

1/ Existing 'Firmed Up Area' as per cent of Net Service Area (NSA), assuming NSA is equivalent to 70% of Gross Service Area (GSA).
2/ All existing rainfed and irrigated paddy land plus land easily converted to paddy less land under sugar.
3/ All existing paddy land plus all other land that could be converted, including land under sugar, perennial crops, forests, swamps etc.
Source: NIA.

4.5 The BSWM categorizations were simplified into three groups: (i) existing paddyland plus land that could be readily converted excluding sugar land; (ii) sugar land that could be converted but is likely to remain under sugar; and (iii) land which could be converted to paddy but is now under 'difficult' land (perennials, forests and swamps). NIA's 1990 estimates of net irrigable area (firmed up area) have been provisionally taken to be 70% of present gross area. This will be adjusted once the reassessment exercise is complete.

4.6 The revised estimate of gross irrigable land is substantially higher than the previous estimate. However, the latter was commonly used as if it was a net figure and on this basis there has been little change in the apparent 50% of readily converted land that has been developed. If all the potential irrigable land is included, then only 37% of the potential has been developed. Noteworthy points include: (i) the large areas still remaining in Central Luzon and the Cagayan Valley, (ii) the low proportion developed in Bicol and the Visayas (although much of this is represented by sugar and other 'difficult' lands), and (iii) the high development of easily converted land in Mindanao (although extensive areas of 'difficult' land remain). Field checking for anomalies and to firm up the adjustment of gross to net area must await completion of the reassessment exercise.

Irrigation Development

4.7 Irrigation in the Philippines has a long history. At the end of the Spanish era, some 0.20 M ha were served by communal and private schemes. Public involvement dates to the creation of the Bureau of Public Works (BPW) in 1905. By 1930 12 national irrigation systems (NIS) had been completed serving 80,000 ha in Central Luzon and the Western Visayas. Expansion ceased in the 1930s/1940s although direct BPW support for communal irrigation dates to this period. With independence came renewed expansion, including support for communal irrigation and the first projects in Mindanao. Construction slowed towards the end of the 1950s but, when NIA was established in 1964, it was officially estimated that total service area had reached 0.54 M ha. NIA's mandate was to launch an 'irrigation age' and, since its creation, the area has expanded rapidly reaching an estimated 1.49 M ha in 1990. Growth since 1964 was summarized n Table 1.2 and Annex 4 gives further details.

4.8 National Systems. NIS are operated and maintained by NIA. Three major schemes are backed by multipurpose reservoirs (Upper Pampanga, Magat and Angat Maasim) together accounting for 15% of total service area. Classified as single schemes, they are in fact conglomerates served by multiple diversion weirs that also utilize supplies from uncontrolled rivers. Most NIS are run-of-the-river ranging in size from 100 ha to 17,500 ha, with the majority between 1,000-5,000 ha. As might be expected, intensities on run-of-the-river schemes tend to be lower than for reservoir-backed schemes although Table 4.2 may overstate this difference. Wet season and dry season cropping intensities vary with rainfall, being similar where rainfall is well distributed (Cagayan Valley, Bicol, Central and Eastern Visayas, most of Mindanao) but skewed in regions with a pronounced dry season (Ilocos, Central Luzon, Southern Tagalog, Western Visayas). Since the latter account for 55% of NIS service area, dry season intensities are on average below those in the wet season. NIS are concentrated in Luzon which accounts for 70% of total service area. Major areas are also found in Western Visayas, and Southeastern and Southern Mindanao.

Table 4.2: NATIONAL IRRIGATION SYSTEMS BY SYSTEM TYPE 1/

	No of Schemes	Service Area 1989 Total	Service Area 1989 Average	Intensity 1987-89 Wet S.	Intensity 1987-89 Dry S.
		(ha)	(ha)	(%)	(%)
Diversion Schemes	147	373,400	2,540	72	54
Reservoir Schemes	3	206,762	68,921	89	78
TOTAL	150	580,162	3,868	78	63

1/ Pump schemes included in these estimates account for 5% of the area.
Source: See Annex -.

4.9 Communal Systems. CIS are operated and maintained by farmer groups which tend to be more formally organized than in many other countries. CIS are also mainly run-of-the-river although a few are backed by tanks (Small Water

Impounding Management projects or SWIMs). They range in size from 15 ha to 4,000 ha and can thus exceed the area served by NIS. However, the large majority are well below 1,000 ha and the national average is about 115 ha. They are widely distributed throughout the country although some 46% by number are located in Ilocos (accounting for only 18% of the service area) and a further 36% elsewhere in Luzon (28% of the service area). Schemes in Mindanao tend to be larger than elsewhere and many originated under Government settlement programs. No data on cropping intensities are officially published but comparison of NIA and BAS data suggests that they are similar to those in national systems.

4.10 Private Irrigation. Data on private irrigation is scanty. Between 1964-80, the area generated under publicly-assisted river lift and groundwater projects was about 100,000 ha mainly in Central Luzon and Southern Tagalog (Table 1.2). Since then, public involvement has virtually ceased and much of the area previously developed with public assistance is now inoperable. Meanwhile, private exploitation of shallow groundwater has expanded in many favorable locations, both within and outside surface irrigation schemes, and there has been some private river lift development. Statistics are, however, unavailable and it is impossible to be sure whether the areas developed have compensated for the obsolescence of the larger publicly-developed facilities. In any event, the official statistics (Table 1.2) are inaccurate.

Irrigation Investment Trends

4.11 There have been three major periods of investment broadly coinciding with the 1920s, 1950s and 1970s (para. 4.7). Several studies have explained these trends in terms of models of government decision-making, arguing that the dominant motive has been the drive for rice self-sufficiency (Svendsen et al, 1990; Azarcon, 1990). Food shortages during the Second World War, and re-emerging imports in the early 1960s, intuitively help explain the two most recent cases. Conversely, the achievement of rice self-sufficiency in the late 1970s (Table 2.9), together with reductions in world rice prices and financial constraints, contributed importantly to a marked slow down in the 1980s.[1] Indoed, at that time, the World Bank anticipated continued rice surpluses, advocated a shift to rehabilitation, and contributed to a sharp reduction in donor support for new investment (World Bank, 1982).

4.12 The question clearly arises whether renewed imports in the late 1980s will have a similar impact on future investment. Initial indications are that this is indeed happening. Congress has adopted legislation that commits GOP to exploiting all the remaining irrigation potential within the next decade (GOP, 1990) and NIA's 1990 Corporate Plan, although less ambitious, still advocates a major increase in investment and foresees rapid growth in the irrigated area, initially largely under communal irrigation but increasingly also from national systems. The extent to which such expansion is feasible and economically justified depends on what can be expected from the irrigation sector in terms of agricultural impact (see below) and institutional performance (Chapter 5).

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[1] Due to lagged effects, investment does not necessarily coincide with area expansion. Azarcon (op cit) identified a 10-year lag for NIS but no lag for CIS helping explain continued growth in area during the 1980s (Table 4.2).

B. Performance of Irrigated Agriculture

Introduction

4.13 There has been substantial long-term growth in the irrigated area (Table 2.1), but the total paddy harvested area (rainfed and irrigated) has remained fairly constant. The spread of irrigation has therefore been largely at the expense of rainfed cropping. Average intensities have increased but the physical area under paddy has almost certainly declined due to infrastructural expansion, urbanization and related factors (as well as to shifts in the area under upland paddy, para 2.6). Moreover, there have been serious shortfalls in irrigated areas at the project level. This is illustrated in Table 4.3 which summarizes evidence for eleven World Bank and ADB-supported projects (multiple loans for the same scheme are classified as one project) which together cover no less than 60% of the total NIS service area.

Table 4.3: SERVICE AREAS: BANK AND ADB-SUPPORTED PROJECTS

	Service Area Estimates at Stages of Project				WS Area
	Appraisal	Completion	Audit	Actual:1989	1989
	(ha)				
Five IBRD Projects 1/	283,170	274,601	241,331	234,001	202,944
Four ADB Projects 2/	39,420	31,590	31,387	27,920	23,608
Sub-Total	322,590	306,191	272,718	261,921	226,552
Two IBRD Projects 3/	130,300	120,709	na	109,735	86,729
Grand Total	452,590	426,900	na	371,656	313,281
% of Appraisal Estimate	100	94	85 4/	82	69

1/ Upper Pampanga, Aurora Peneranda, Tarlac, Magat, Jalaur.
2/ Cotabato, Davao del Norte 1, Pulangui, Agusan del Sur.
3/ NISIP I and NISIP II. 4/ Excluding NISIP I and II.
Source: See Annex 4.

4.14 Service area figures are adjusted periodically and Table 4.3 is to some extent arbitrary (the difference between the PCR and PPAR totals for instance is almost entirely due to an adjustment for Magat). Nevertheless, a 20% difference in service area between actual and design has been broadly confirmed by recent NIA studies, and the fact that wet season irrigated areas are a further 15% below 'actual' service area suggests if anything that the latter may still be overstated. Similar results have been obtained for modernization projects (for instance two National Irrigation Systems Improvement Projects -- NISIP I and II -- supported by the Bank) and communal irrigation programs.[1] Not only areas but also yield estimates have fallen well short of expectations: once HYVs are adopted under irrigated conditions, yields show little further increase (see para. 2.9).

1 As a result, improved procedures for estimating service area have been included under the recently-approved second communal project (CIDP II).

4.15 With both areas and yields constrained, there must be some concern as to the economic returns to be expected not only from new projects but also from rehabilitation. The view that performance is much below potential, and can be significantly improved by appropriate interventions, has been long advocated (UPLB, 1986; David, 1989) and underlies many past, on-going and proposed projects (e.g. the Bank-supported Irrigation Operations Support Project, the ADB-supported Irrigation Systems Improvement Project, the Bank-supported Second Communal Irrigation Development Program). If this has been overstated, the justification of such projects may be less clear-cut. The following sections therefore analyze past agricultural performance in greater detail. They focus on national systems since there is less information on the performance of communal and private irrigation although these are also reviewed. Related institutional issues are considered in the next chapter.

National Irrigation Systems

4.16 NIA Performance Data. NIA is unusual among Asian irrigation agencies in collecting systematic data on performance. Despite some deficiencies, this permits a comprehensive review of all national systems. Using this data, a recent IRRI study (Masicat et al, 1990) assessed trends in agricultural performance for 92 Luzon schemes. It concluded that, although the total irrigated area has risen consistently due to new investment, performance of individual schemes has deteriorated more often over time than it has improved in terms of both irrigated area and yields. A similar study undertaken within the context of the IASR for 147 schemes in all regions (see Annex 4, Attachment 5) failed to identify the degradation trends suggested by the IRRI study but confirms a rather pessimistic picture: that paddy yields on national irrigation systems have stagnated during the 1980s, and that wet season areas have tended to decline as service area goes out of production only partly offset by modest increases in dry season performance.

4.17 Evaluation Studies. Table 4.4 summarizes evidence on physical, financial and economic performance for some audited projects. This suggests that results have been below feasibility and appraisal expectations.

Table 4.4: PERFORMANCE INDICATORS: SELECTED BANK AND ADB-SUPPORTED PROJECTS

	% Time Overrun	% Cost Overrun	ERR % SAR	ERR % PPAR	ERR % IES
IBRD Projects					
1. Upper Pampanga	43	105	13.0	14.0	8.9
2. Aurora Peneranda	88	44	17.0	8.6	2.6
2. Tarlac	69	33	15.0	13.0	n.a.
3. Magat	56 1/	-4 1/	13.0	9.5	n.a.
4. Upper Chico	90	-3	15.0	7.7	n.a.
5. Jalaur	37	-2	20.0	20.0	n.a.
ADB Projects					
1. Cotabato	15	68	14.0	n.a.	n.a.
2. Davao del Norte	30	177	17.2	18.4	n.a.
3. Pulangui	87	25	18.0	11.0	n.a.
4. Agusan del Sur	114	54	19.0	7.0	n.a.
5. Angat-Magat	45	102	24.2	16.6	n.a.
6. Laguna de Bay	63	42	14.2	2.0	n.a.

1/ Weighted average of three projects. Source: See Annex 4.

4.18 NIA data suggest that even at the PCR/PPAR stage there is a tendency to be over-optimistic. Table 4.5 compares 1989 irrigated areas with appraisal and completion/audit estimates, indicating that areas fell short of PCR/PPAR projections by 4% in the wet season and 22% in the dry. This would imply much lower returns even than indicated in the PCR/PPARs quoted in Table 4.4.

Table 4.5: IRRIGATED AREAS AT DIFFERENT STAGES OF PROJECT

	Before/Without[4/]	With:SAR	With:PCR/PPAR	Actual:1989
	(ha)			
Wet Season Area				
Five IBRD Projects[1/]	152.8	278.1	238.1	202.3
Four ADB Projects[2/]	3.4	38.0	30.4	23.5
Two IBRD Projects[3/]	225.8	401.5	355.0	289.0
Sub-Total	382.0	717.6	623.5	601.8
Dry Season Area				
Five IBRD Projects[1/]	47.7	235.0	210.8	167.9
Four ADB Projects[2/]	2.2	31.9	24.6	23.1
Two IBRD Projects[3/]	52.5	91.1	104.4	73.7
Sub-Total	102.4	358.0	339.8	264.7
Grand Total	484.4	1,075.6	963.3	866.5

1/ Upper Pampanga (including Aurora Peneranda), Tarlac, Magat, Upper Chico, Jalaur.
2/ NISIP I and NISIP II.
3/ Cotabato, Davao del Norte 1, Pulangui, Agusan del Sur.
4/ Only for the five IBRD Projects was a (small) distinction made between the 'present' and 'without' cases. The 'without' figures are given.
Source: See Annex 4.

4.19 The shortfalls in irrigated areas 'with' project are reflected in even larger shortfalls in incremental areas and hence in benefits. This is illustrated in Table 4.6. These projects were all completed by the mid-1980s and no doubt there remains some potential for further improvement in performance. However, given the general analysis quoted above (paras. 4.16), and the fact that these schemes account for no less than 60% of the total area under NISs, it seems almost certain that the 1989 levels approach their real maximum potential.

Table 4.6: IRRIGATED AREAS ACTUALS COMPARED TO APPRAISAL ESTIMATES

	IBRD Projects 1/ 5 with PPARS	IBRD Projects 2/ 2 with PCRs	ADB Projects 3/ 4 with PPARs	Weighted Average
		% of Appraisal Estimate		
Service Area	83	84	88	84
Irrigated Area				
Wet Season	73	70	62	71
Dry Season	70	81	67	70
Incremental Area				
Wet Season	40	27	58	40
Dry Season	63	55	70	62
		% of Service Area		
Cropping Intensity				
Appraisal Estimate	183	165	177	177
Actuals: 1989 2/	158	146	167	155

1/ Upper Pampanga (including Aurora Peneranda), Tarlac, Magat, Upper Chico, Jalaur.
2/ Cotabato, Davao del Norte 1, Pulangui, Agusan del Sur.
3/ NISIP I and NISIP II.
4/ Excluding NISIP I and NISIP II for which no PPAR is available.
Source: See Annex 4.

4.20 There have also been some shortfalls in incremental yields mainly due to over-pessimistic 'without' project assumptions. This was most pronounced in earlier projects since there was a general failure to anticipate the almost universal adoption of HYVs, not only under irrigated but also under rainfed conditions. For instance, the 1969 Upper Pampanga SAR anticipated rainfed and irrigated 'without' yields of 1.2 t/ha and 1.8 t/ha respectively, compared to actual national averages in 1989 of 2.0 and 3.1 t/ha. Later projects were more realistic but still assumed 'without' yields well below the revised estimates at completion and audit. In some cases, they also compensated for this with over-optimistic 'with' yields (Table 4.7) and this has been even more pronounced in more recent project documents and feasibility studies. Since incremental rather than absolute levels determine benefits, economic returns in either case were over-stated.

Table 4.7: YIELD ASSUMPTIONS: SELECTED CANK AND ADB-SUPPORTED PROJECTS

	Without R'fed WS	Without Irrig. WS/DS	With Irrig. WS/DS	Without R'fed WS	Without Irrig. WS/DS	With Irrig. WS/DS	Actual 1986 WS/DS
	(t/ha)						
Bank-Supported							
Upper Pampanga	1.2	1.8/1.8	3.8/3.8	1.9	2.6/2.9	3.8/4.2	3.0/4.2
Tarlac	1.9	2.7/2.4	4.0/4.0	?	?	4.0/4.0	3.6/3.6
Magat	1.8	2.6/2.9	4.0/4.0	2.8	3.5/3.9	4.0/4.1	4.1/4.1
Upper Chico	1.4	2.1/2.2	4.0/4.1	2.4	3.5/3.8	4.5/5.0	3.9/4.0
Jalaur	1.8	2.5/2.4	4.0/4.0	na	na	na	4.0/4.0
ADB-Supported							
Davao del N.	0.6	na	4.0/4.0	2.6	na	5.6/5.6	3.9/3.9
Pulangui	1.5	2.1/2.1	5.0/5.0	2.2	3.0/3.0	4.2/4.2	4.2/3.8
Agusan del S.	0.6	na	3.9/4.4	2.2	na	4.0/3.9	3.8/3.0

WS - West Season, DS - Dry Season
Source: See Annex 4.

4.21 Management Performance. How far is disappointing performance of major irrigation projects due to deficiencies in irrigation design, management and maintenance, and how far to unrealistic expectations? If the former, then presumably deficiencies can be rectified; if the latter, economic returns from future projects may be no better than in the past and indeed may deteriorate since costs are likely to increase as less obvious sites are exploited.

4.22 No doubt the answer lies between the two extremes. However, it seems that irrigation schemes probably perform closer to their true potential than often assumed and, if so, potential for further improvement may be limited. Evidence for this is given in Annex 4. Briefly, 'efficiency' is an ambiguous concept in run-of-the-river irrigation. For much of the time, water is in surplus and there is no reason to 'save' it. At times of scarcity, farmers and managers are acutely aware of shortages and little water is wasted. Variability in river flows (para. 4.2) means not only that there are always risks and but also that much water inherently goes to waste. The risks could perhaps be marginally reduced if rainfall and hydrological analysis were to be improved as a guide to allocation but uncertainty is inherent in the system. A detailed study of one system (HRS, 1988) concluded that: *"irrigation deliveries to principle areas of the Porac system have for the most part satisfied crop water requirements on a seasonal basis with a reasonably good level of spatial uniformity"*. Although *"most areas experienced at least two weeks in the season when supplies...were less...than requirements'*, this is almost inevitable given the great variability in flow. Not surprisingly *"tail-end areas fared worst"*, but the overall picture is one of pragmatic and fairly effective adjustment to prevailing conditions.

4.23 Even in reservoir-backed systems, the only true measure of wet season efficiency is whether unnecessary releases have been made from storage. For the Upper Pampanga system (OED, 1989) evidence suggests that low wet season efficiency is due to diversion of uncontrolled river flows rather than excessive releases. No doubt response to rainfall and river flows could be improved, and reservoir operating rules could be modified to augment carryover for dry season cropping. However, the impact is unlikely to be great. Dry season efficiency is already high (50% +) -- even too high given water shortages which lead to under-watering -- and the low crop intensity is due to basic water shortages (inadequately evaluated at appraisal) rather than to seriously deficient management.

4.24 Experience with Rehabilitation. Rehabilitation has also often proved disappointing. A study by Rosegrant (1989) provides one of the most systematic assessments of NIS rehabilitation programs. He concludes that: "*the aggregate impact of rotational irrigation and system rehabilitation on area harvested, yields, production and farm income varies widely across the systems analyzed. The benefits of both types of intervention are highly dependant on the relative water supply ... When water is abundant ... rotation or rehabilitation have a small impact on average system benefits ... benefits are also small (from systems in which severe water shortages occur) .. The highest benefits ... occur in systems that tend to suffer moderate water shortages in the dry season. Under these conditions, these interventions can significantly increase area harvested and/or yields through improved distribution of available irrigation water*". The reasons for this can be traced to the characteristics of supplementary irrigation schemes for smallholder paddy in the humid tropics, not only in the Philippines. In particular it can be traced to the interactions between design and management that typify such schemes.

4.25 Interactions between Design and Management. System design requires that flows be fully regulated by NIA staff to an outlet serving perhaps 50 ha (the standard in recent years although in practice highly variable). Planning and monitoring is on a monthly basis, with the operating plan reflecting an aggregation of demands at the outlet using accepted assumptions regarding losses, effective rainfall and crop water requirements. Transplanting is staggered by farmers below the outlet and, if necessary, at higher levels in the system. Rotation may be introduced, in particular when flows fall below specified levels, and local arrangements ensure greater or lesser equity in access to limited dry season flows. Monthly reports compare actual cropping and water use with the plan and an evaluation report summarizes seasonal achievements (areas irrigated and benefited, yields and production, irrigation service fee (ISF) collections, O&M expenditures etc.). Operating principles are therefore detailed and explicit and a basic planning and monitoring system is in place that is more open and accountable than in most other countries in the region. Pilot programs are in progress to improve and streamline this process, including the computerization of reports, records and accounts.

4.26 Despite its considerable merits, the detailed regulation and control implied by this approach are difficult to sustain in practice. Deficiencies include inoperable measuring devices; problems in maintaining discharges due to siltation and inadequate maintenance; failure by farmers to adhere to cropping schedules; lack of adequate response to fluctuating discharges and requirements; and farmer interference with gates and control structures. These factors affect production and contribute to disappointing performance. However the underlying causes are in many ways inherent in smallholder irrigation in low income tropical Asia. Supplementary irrigation under conditions of high rainfall faces sharply varying demands. For much of the time, water is abundant, careful regulation is unnecessary, and low paid staff cannot be expected to exercise troublesome detailed control. At times of stress, water has great value and headenders are unlikely to forgo advantage if a standing crop is at risk. If the physical infrastructure is damaged at times of stress (e.g. gates are removed) then it cannot function at any time. Paradoxically, therefore, damage may occur when water is short and efficiencies high (para. 4.22) but have its most serious effects when pressures ease. For instance, if a gate is removed, then the outlet will draw more than its design at all times, reducing flows to tailenders even when there is no general shortage.

4.27 Maintenance. Disappointing performance is also attributable to inadequate maintenance. Estimates made for the Bank-supported Irrigation Operations Support Project (IOSP) concluded that O&M allocations would need to more than double in real terms if performance was to be sustained (World Bank, 1987). Improved maintenance procedures are being introduced under the program (Skogerboe, 1990). Siltation is a particular problem affecting many NIS and in recent years has been aggravated by upstream development (mining, forestry, shifting cultivation etc.). However, ISF collection and related constraints will limit what NIA can afford and to the extent possible the burden on NIA needs to be reduced. One promising line of approach is to extend farmer responsibilities for O&M. Another is to investigate trade-offs between capital expenditures (e.g. in silt exclusion structures) and continuing maintenance. A third might be to simplify design so that operations are more robust in response to varying flows and conditions with the aim of reducing farmer damage and interference. Irrespective of the success or otherwise of these approaches, substantial increases in O&M allocations will inevitably be required if operating performance is to be sustained.

4.28 Conclusion. The above may help explain why NIS performance has tended to stagnate, often remaining below both what had been anticipated and what is possible. It suggests that schemes tend to stabilize at some level which reflects a balance of real factors; and that once this level has been achieved, further substantial improvements may be difficult. On the one hand, this calls for greater realism in feasibility studies and appraisal reports. On the other, a number of possible approaches to strengthening future performance have been suggested which are discussed further below (para. 4.50).

River Lift and Groundwater Irrigation

4.29 NIS Pump Schemes. A recent JICA study (JICA, 1988) evaluated six NIA-operated pump schemes and showed that they face serious technical and financial problems. Other evidence (e.g. for the Magat lift schemes) confirms the JICA conclusions with respect to most such schemes. In a few cases (e.g. in the Angat Maasim system), small lift projects have been successfully turned over to farmer management and have performed well in producing high return crops for major urban markets. Wherever financially profitable to farmers, both new cooperative projects and the transfer of existing public facilities could prove attractive. However,this form of development is unsuited to public management and there is a strong case for closing down several of the more poorly performing existing projects. Not only are returns often very low, but it has proved virtually impossible to recover O&M costs from the beneficiaries and the heavy resulting burden on NIA reduces the money available to maintain the surface systems.

4.30 Public Tubewells. A similar discouraging picture is evidenced by public tubewells whose performance has not been encouraging. Of 379 tubewells constructed since 1971, only 22 are now in operation having been successfully handed over to working farmer organizations. Of the remainder, 8 are operable; 60 would need minor works to make them operable; 243 would need major works; and 46 should be immediately abandoned. As in the case of lift schemes, much previous investment has had little return and it seems unlikely that the public sector will be in a position to operate these facilities successfully. Where farmer organizations are willing and able to take over responsibility, and have sufficient financial strength to undertake the necessary repairs, then clearly this a viable alternative. With respect to new schemes, there may be cases where further investment by farmers is justified subject to a clear financial commitment. However, smaller discharge wells and pump units serving smaller command areas, most often owned by a single farmer, are normally to be preferred wherever conditions warrant.

4.31 The Private Sector. Besides handing over public facilities to farmer organizations, the Government has supported the development of privately-owned irrigation facilities through various programs, and farmers have financed shallow wells and low lift pumps from their own resources and through the banking system. These facilities are located both within and outside national systems wherever aquifer or river conditions are suitable and markets have emerged. Many are unlicensed so that the extent of private irrigation remains unclear (NIA data quoted in Table 2.1 are misleading). The evidence available suggests that such facilities can be an attractive investment, even on occasion for paddy given the relatively high yields that are obtained. They are particularly attractive for vegetables and similar crops for which water on demand is almost an essential requirement. However, vegetable cultivation encounters marketing constraints and to some extent is limited by soil conditions even where aquifer conditions are favorable.

4.32 The potential for further private sector development is difficult to evaluate although it could be substantial since the area underlain by exploitable shallow aquifers is extensive (Annex 4). Such development could impact on the margin on rice production but only, in unusually favorable locations are farmers likely to invest solely for rice. The major significance of private groundwater development will therefore be in relation to other crops. It can be expected to respond to market demand and little public intervention will be necessary. However, research and extension could prove important, and support should clearly be provided through the agricultural banking system. There is also a need to improve licensing procedures and records.

Communal Irrigation

4.33 Agricultural Performance. Most communal schemes are based on run-of-the-river water supplies. In principle, they should be sized, in terms of both service area and canal capacity, to provide supplementary irrigation to the entire irrigable area during the wet season. In practice, however, for various reasons, as in the case of national systems, design service areas have proved over-optimistic and irrigated areas have fallen well short of expectations. During the dry season, the area irrigated is determined by water availability which varies considerably but has also often proved less than expected. NIA data indicate an annual irrigation intensity of 127% nationwide. For schemes implemented under CIDP I for which data are available, the figure is 134%. In both cases, actual intensities are probably understated since they are based on official and unrealistic estimates of service area.

4.34 Paddy yields on communal schemes have also consistently fallen below summarizes the results from two farm surveys. These estimates may reflect the stage of uptake of improved agricultural practices and individual schemes show considerable variations about the averages quoted. Nevertheless, they are very much lower than original SAR projections for CIDP I and are also below the more moderate yields projected under CIDP II (3.5 t/ha and 3.7 t/ha respectively for the wet and dry season).

Table 4.8: PADDY YIELDS; COMMUNAL SCHEMES - FARM SURVEY RESULTS

	Before Project		After Project		Ratio	
	Dry	Wet	Dry	Wet	Dry	Wet
	(t/ha)					
NIA (PBME) Study						
81 Participatory schemes	2.71	2.81	3.04	3.00	1.12	1.07
Reyes and Jopillo Study						
24 Participatory schemes	2.56	2.84	3.11	3.05	1.21	1.07
22 Non-particip. schemes	2.57	2.59	2.54	2.65	0.99	1.02
Weighted Average	2.66	2.78	2.97	2.95	1.12	1.06

Sources: NIA; Reyes and Jopillo in Korten and Sy (1989)

4.35 Economic Returns. In 1989, CRC undertook an economic evaluation of schemes completed under CIDP I (Dy, 1989). At that time, some 96 systems with declared service area totalling 18,100 ha had been completed, of which 30 were new schemes and 66 were rehabilitated schemes. For the purpose of the study, 9 new schemes and 15 rehabilitated schemes (all completed before end-1986) were selected for review, of which five have a service area less than 150 ha, six fell between 150-250 ha and four exceeded 250 ha. Capital costs of new schemes ranged from 14,490 to 42,400 P/ha (average 20,900 P/ha) at 1989 financial prices and of rehabilitated schemes from 5,580to 33,160 P/ha (average 13,260 P/ha) (Annex 4). Based on moderate expectations of irrigated area but somewhat optimistic yields, the analysis suggested an ERR for new schemes of 24.3% (import parity) and 14.3% (export parity), and for rehabilitation schemes of 25.5% and 14.1%. Individual ERRs ranged from 2.1% to 96.7% (import parity) and -5.2% to 57% (export parity) and the main causes for low rates of return included high capital cost, low utilization or a combination of the two.

4.36 Communal systems are constructed with farmer involvement and farmers contribute to capital cost and assume full O&M responsibility for completed systems (para.5.19). Agricultural impact may not always be as high as anticipated but the evidence suggests that many are both financially and economically viable. Over-assessment of the water and land resource has been a problem, and some projects have had excessively high costs. Agreements have therefore been reached under CIDP II to exclude projects which do not have a strong *prima facie* justification, and NIA has subsequently adopted these criteria nationwide.

Small Water Impounding Management Projects (SWIMs)

4.37 SWIM projects are defined as dams with heights of not more that 30 m and/or storage volumes not exceeding 50 Mm^3. Most though not all have irrigation as the primary purpose. Although several hundred possible projects have been identified, only 49 have been completed or are under construction.

The SWIM Committee established in 1979 includes representatives of relevant agencies, and DPWH, NIA and BSWM all have proposed investment programs.

4.38 Bank Experience. A component to construct 40 SWIMs was included under the Rainfed Agricultural Development (Iloilo) Project, implemented in 1980-86 by BSWM. However, after the completion of the first 16 projects, it was noted that costs substantially exceeded SAR estimates and, following a review, the component was suspended. Fifteen of the completed structures were subsequently severely damaged by typhoons and required extensive repairs. While noting the benefits derived from these projects in terms of irrigation, flood control, fish harvesting and duck production, the PCR identified a number of structural, institutional and land ownership problems, and concluded that such projects had marginal economic juctification at best.

4.39 The JICA Study. JICA undertook a review of the SWIM program as a basis for preparing a master plan (JICA, 1990). The review included post evaluation studies for eight projects. Of these, one dam was destroyed by a typhoon, one was damaged during construction, and one had its construction suspended. Two systems provide a fair irrigation service and one power facility is operating although the irrigated area failed to develop. ERRs were calculated for four projects, ranging from 3% to 14%, with capital costs from 49,000 to 89,000 P/ha (US$2,000 to 4,000). The study also highlighted weaknesses in planning, design, construction and O&M. Despite these somewhat dismal conclusions, JICA proposed a ten-year master plan to construct 230 projects (from an initial inventory of 501 projects), and optimistically anticipated a total increase in irrigated area of 28,000 ha and incremental paddy production of 200,000 t/yr.

C. Future Irrigation Investment

Introduction

4.40 Irrigation in the Philippines presents something of a paradox. On the one hand, NIA's accomplishments are impressive and the HYVs all but universal, on the other the impact of irrigation has often fallen below expectations and irrigation management faces problems that seem to defy satisfactory solution. Much of the explanation lies in unrealistic expectations and if so, it may be unreasonable to expect major increases in production from existing schemes or substantially higher returns from new projects. New investment therefore will be a relatively costly strategy -- both in absolute and economic terms given its disappointing returns -- and should be approached cautiously.

4.41 At first sight this conclusion, and the implied priorities for further development, appears consistent with NIA's stated corporate objectives. These emphasize efficient use of resources within the limits of funding through: *"completion of on-going projects, rehabilitation of existing systems, watershed management, adequate preparation of future projects, immediate turnover of completed projects to the operations sector, and balance in the number of large and small projects with priority to small projects when funds are limited"* (NIA, 1990). However, without explicitly reversing the priority given to rehabilitation, the Corporate Plan in practice gives greater emphasis to new development and foresees rapid growth in the irrigated area (Table 4.9). The severe financial constraints encountered in 1990-91 mean that the projections of the Corporate Plan have already been overtaken by events and it is understood that the plan is under review (see paras. 4.52 ff).

Table 4.9: NEW DEVELOPMENT UNDER NIA'S CORPORATE PLAN 1990-2000

Year	Annual Targets National	Annual Targets Communal	Annual Targets Total	Cumulative Total National	Cumulative Total Communal	Cumulative Total Total[1]	% of Potential[2]
	(ha)			('000 ha)			(%)
1990	16,083	19,218	35,301	621.0	714.8	1,487	50
1991	16,474	39,578	56,052	637.1	734.0	1,523	51
1992	7,616	19,964	27,580	644.7	754.0	1,551	52
1993	12,000	20,250	32,250	656.7	774.2	1,583	53
1994	20,130	21,100	41,230	676.8	795.3	1,603	53
1995	20,422	17,445	37,867	697.3	812.7	1,662	55
1996	19,165	16,250	35,415	716.5	829.0	1,698	57
1997	39,300	21,250	60,550	755.8	850.2	1,758	59
1998	50,180	24,635	74,545	805.9	874.9	1,833	61
1999	57,839	22,550	80,389	863.8	897.4	1,913	64
2000	30,000	19,750	49,750	893.8	917.2	1,963	66
Total	289,209	241,720	530,929	na	na	na	na

1/ Including 152,100 ha under private pumps (but see para. 4.10).
2/ 'Readily Converted' land with service area 70% of GSA (see para. 4.5).
Source: NIA Corporate Plan, 1990-2000.

4.42 In addition to NIA's investment program, the Corporate Plan foresees substantial new areas under the CARP program (223,806 ha by 1996, of which 80% would be in communal irrigation) although limits on CARP funding make the achievement of anything approaching these estimates very doubtful. Besides new investment, the Corporate Plan foresees major investments in rehabilitation. The targets include areas under the on-going Irrigation Operations Support Project (IOSP I) which funds relatively minor works and incremental O&M on the whole area under national schemes. Excluding this project, but including more substantial works on 60,000 ha tentatively included by NIA under second and third phases of this program (the nature of the coverage has still to be agreed with the Bank) the total area targeted for rehabilitation amounts to 772,500 ha (41% under CIS, 60% under NIS), with a further 130,000 ha tentatively targeted for CARP funding. Assuming that the latter would be spent in the communal sector, some 74% and 62% of the total area under NIS and CIS respectively would be rehabilitated during the decade.

Economic Priorities

4.43 Several reports have estimated economic returns from different types of irrigation development. Table 4.10 compares those in the Bank's 1987 agricultural sector review with those in a recent IFPRI report (Rosegrant *et al*, 1987). In both cases, they are based partly on evaluation results for past projects and partly on the simulation of future investments. Although broadly consistent with the results for completed Bank and ADB-supported projects Table 4.4) though it should be noted that these may still be over-optimistic.

Table 4.10: ESTIMATED ECONOMIC RETURNS BY SYSTEM TYPE

	Rosegrant et al	Bank 1987 Agricultural Sector Report	
	Import Subst.	Import Subst.	Export Surplus
	%		
NIS O&M Improvement	na	25-35	18-25
NIS Rehabilitation	5-9	16	13
New NIS Run-of-the-River			
Large	11	10	7
Medium	14	11	7
Small	14	17	13
New Communal	33	18-21	15-16
Reservoir	4	4	3
Pump Schemes			
Deep Tubewell	3	na	na
Shallow Tubewell	14	na	na
River Pump: Large	3	na	na
Medium	14	na	na
Small	29	na	na

Sources: Rosegrant et al (1987), IBRD (1987)

4.44 The reports are understandably cautious in drawing conclusions. The IFPRI study provides evidence that returns are highly variable and this is consistent with evidence quoted above (para. 4.17). Subject to these qualifications, there is broad agreement that new single purpose reservoir schemes generally obtain very low returns with high costs more than offsetting relatively certain production benefits; that new national run-of-the-river schemes are often marginal, although varying with local conditions; and that new communal schemes can have high returns, with low costs and short construction periods offsetting relatively low benefits per hectare. The IFPRI study confirms the returns from deep tubewells and large surface pumps (presumably in the public sector) are very low but that shallow tubewells and small river lifts (presumably in the private sector) can be very profitable. The main difference relates to rehabilitation. Estimates by the IFPRI study suggest that past returns were very low even though simulation studies suggest that in principle they could be much higher.

4.45 No attempt has been made to analyze the assumptions lying behind these estimates in detail. However, the information presented in Table 4.10 and the disappointing outcome from many past Bank and ADB-supported projects confirm that a cautious approach should be taken to new investment. That this is not always done is illustrated by Table 4.11.

Table 4.11: STUDY ASSUMPTIONS: BALOG BALOG AND PAMPANGA DELTA (IRRIGATION)

	Balog Balog		Pampanga Delta	
	Without	With	Without	With
Paddy Yields	(t/ha)			
Rainfed	1.9	-	2.5	-
Irrigated WS	2.9	5.0	3.2	5.0
Irrigated DS	3.0	5.0	3.0	5.0
Irrigated Area	(% of Service Area)			
Paddy: Rainfed	18	-	40 1/	-
Paddy: Irrigated	77	124	70 1/	183
Vegetables	-	13	15 1/	17
Other Crops	60	60	-	-
Total	155	197	125 1/	200
Annual Benefits	(% of total)			
Paddy	-	57	na	na
Vegetables	-	22	na	na
Other Crops	-	21	na	na
Costs				
M Pesos at 1990 prices	-	3,402 2/	-	1,374 2/
Average Cost: US$/ha	-	6,240 3/	-	5,200

1/ Not clear from data obtained.
2/ Irrigation costs only: derived from NIA Corporate Plan
3/ Assuming 4 ha of rehabilitation equivalent to 1 ha of new.
Sources: Nippon Koei et al:(i) Updating Report on Balog Balog Project, March 1987, (ii) Definite Plan Report (Irrigation) Pampanga Delta Project, April 1988, (iii) NIA Corporate Plan, 1990.

4.46 The table shows that feasibility studies -- the examples are for two major multi-purpose projects -- continue to adopt very optimistic scenarios in order to justify new investment. There is no evidence from past projects to suggest that 'with' project yields can reach an average of 5 t/ha; that the difference between rainfed and 'irrigated without' yields compared to 'irrigated with' yields can reach 3 t/ha and 2 t/ha respectively; that vegetable cultivation can reach anything like 13-17% of the 'with' area in large scale surface irrigation; or that non-paddy crops will provide anything approaching 40% or more of total benefits. Without these assumptions, the returns from these projects would be very low.

NIA's Investment Plan

4.47 Annex 4 reviews NIA's program as set out in the 1990 Corporate Plan by type of project and commitment status ('on-going','new' to be committed during 1990-94, and 'future' to be committed after 1994) and the program is summarized in Table 4.12.

Table 4.12: NIA'S INVESTMENT PROGRAM BY TYPE OF PROJECT: 1990-2000

	No. of Projects	Anticipated Service Area Rehab.	New	Total	Cost Total	1990-2000
		(ha)			(M P: 1990 Prices)	
On-Going: New						
Multipurpose Projects	1	11,020	28,130	39,150	3,402	3,052
NIS Run-of-the-River1/	4	8,441	39,967	48,408	2,514	16
NIS Run-of-the-River	6	20,974	84,951	105,925	5,431	1,708
NIS Rehabilitation	2	411,140	-	411,140	na	1,398
Pump	2	15,030	14,950	29,980	1,232	209
Communal	4	208,900	184,629	393,529	na	6,286
Sub-Total		675,505	352,607	1,028,132	na	12,669
New						
Multipurpose Projects	2	28,200	65,100	93,300	7,570	7,570
NIS Run-of-the-River	3	-	24,162	24,162	1,983	1,983
NIS Rehabilitation	4	259,859	300	260,159	3,402	3,402
Pump	3	17,155	26,962	34,117	na	682
Communal	2	18,415	19,557	37,972	na	1,474
SWIM Program	1	na	na	na	na	3,865
Sub-Total		323,629	125,811	449,440	na	18,976
Proposed						
Multipurpose Projects	9	91,830	127,500	219,330	26,000	18,950
NIS Run-of-the-River	14	11,830	74,509	86,339	18,915	11,278
NIS Rehabilitation	3	90,000	-	90,000	3,128	3.128
Communal	3	18,000	31,500	51,500	na	1,836
Sub-Total		211,660	233,509	445,169	na	35,192
Grand Total		1,210,794	711,947	1,922,741	na	66,837

1/ On-going projects essentially completed by 1990.
Source: See Annex 4.

4.48 Multipurpose projects account for almost 45% of the estimated cost to the year 2000. Despite priority to small projects (para. 4.39), large projects therefore in financial terms dominate the proposed program. The two projects referred to in Table 4.12 account for 44% of expenditures in 1990-94. Their justification is hard to accept and, despite costs already incurred, they should be reviewed since cancellation could release significant funds for higher priority programs. The other 'new' multipurpose project is Casecnan which involves a trans-basin diversion from the upper Cagayan to the Pampanga, firming up supplies to the Upper Pampanga system and permitting substantial new development. The project is primarily for power and is currently suspended waiting the results of power planning studies. Subject to this review, there is *prima facie* justification for the irrigation component given the sunk costs in Pantabagan dam and other facilities. Even so, costs will exceed $4,000 per ha (arbitrarily assuming that four hectares of rehabilitation is equivalent to one hectare of new development) and, while this is substantially lower than for Balog Balog, new development will need careful evaluation. Nine other multipurpose projects are tentatively scheduled for later in the decade when they will dominate the program. Given the delays that have already been incurred in the program as a whole, most of these are now unlikely to be implemented as scheduled. Moreover, they will need careful evaluation since they could be costly projects with possibly only marginal justification.

4.49 New NIS run-of-the-river projects account for 22% of allocations for 1990-2000. Costs per hectare vary very greatly - from less than $1,500 at 1990 prices (the Bank-Supported Medium Scale project) to more than $9,000 (Ilocos Norte) with an average of $2,500 for 'on-going', $3,400 for 'new' and $4,800 for 'future' projects respectively. Relative benefits also vary and costs are only indicative. Nevertheless, some of the more expensive projects have clearly fallen short of economic viability and the projected increase in average costs (based on feasibility and reconnaissance studies) is consistent with the view that construction sites are becoming more difficult. Several on-going projects are scheduled for completion in the near future and there are few new starts in the period 1990-94. Care is needed to avoid excessively costly projects, in particular on rivers with limited dry season flows, but there is still a need to initiate new work of this type.

4.50 Communal Irrigation. Communal irrigation accounts for only 14% of the expected cost during the 1990s but for as much as 33% of the new service area. This is indicative of the much lower unit costs associated with communal irrigation, offset in many cases by the lower yields and irrigation intensities. The targets projects in the Corporate Plan are ambitious and seem likely to be beyond NIA's implementation capacity and financial resources. However, communal irrigation can be a viable alternative achieving its production impact relatively quickly. Subject to rigorous application of the CIDP II criteria, therefore, it should be given relative priority.

4.51 Other Components. The other components represent a negligible share of the total with the exception of the ambitious SWIM program proposed. Information on the impact of NIA's proposed SWIM program is not at hand although the JICA master Plan proposals, including programs implemented by other agencies, anticipates a total irrigated area of 28,000 ha. As suggested above, experience with SWIM development has been discouraging and the allocations contained in the NIA plan should be carefully reassessed.

Irrigation Development Strategies

4.52 Investment Priorities. Irrigation projects vary greatly in terms of both costs and benefits. Each therefore has to be evaluated separately on its merits according to clear economic criteria and adopting assumptions that are more realistic than has sometimes been the case in the past. Viable projects undoubtedly exist and an investment program can be assembled from a flexible, careful selection of new investments and rehabilitation. With this in mind, the above discussion suggests the following broad conclusions:

(a) Large multipurpose projects are likely to prove justified only if the costs of headworks and other joint facilities can be attributed primarily to other purposes (e.g. power, water supply). If so, then relatively high irrigation development costs may well prove acceptable given the high intensities and yields to be expected;

(b) New run-of-the-river NIS projects will continue to be an important form of development but high cost locations with a limited dry season water supply and/or difficult physical conditions should be avoided Overall commitments should be clearly limited to NIA's implementation capacity, with emphasis on completion of existing projects;

(c) NIS rehabilitation programs should be carefully reviewed to ensure that they finance priority works that can be sustained once they are completed (see below);

(d) Communal irrigation should receive relatively high priority, subject to the rigorous application of the CIDP II selection criteria to ensure that high cost and economically low return projects are avoided. The scale of the program should be reviewed to accord with NIA's implementation capacity and likely financial resources;

(e) Public river lift and tubewell facilities should be privatized where feasible. If this proves impossible, then serious consideration should be given to their closure. New pump development should be predicated on communal and private ownership and management, and no new investment should be undertaken without firm IA or private sector commitment and involvement; and

(f) The SWIM program should essentially remain a pilot program designed to confirm this form of development.

4.53 The Scale of Development. Irrespective of whether these priorities are accepted, implementation and financial constraints will substantially reduce the development program below the Corporate Plan's ambitious projections (Table 4.9). Already, several major projects including Casecnan have encountered delays and the country's overall financial position will continue to restrict the funds available for investment. It is understood that NIA has recently initiated a reassessment of the program so as to reflect the impact of financial shortfalls in 1990-91. Three alternative levels of investment are being considered ranging from the "high" level implied by Republic Act 6978 (para. 4.12), through an intermediate program to a "low" program that is considered more realistic. Based on this review, a revised Corporate Plan for the period 1992-2002 will be prepared.

4.54 In anticipation of NIA's own revised estimates, a tentative review of the 1990-2000 program suggested that multi-purpose projects might account for perhaps 50,000-60,000 ha (Casecnan and, say, two other projects); run-of-the-river NIS projects for about 80,000-100,000 ha; and communal irrigation for the balance 120,000-140,000 ha. Other public programs would be expected to contribute only very minor amounts. Thus, subject to confirmation of the economic viability of individual projects, a reasonable objective might be to aim for an increase in the service area due to new investment of, perhaps, 25,000 ha per year or 275,000 ha over the period 1990-2000. Assuming this a net figure, the actual new service area would have to be somewhat greater to offset loss of irrigated land to settlement and other factors.

4.55 These targets would be broadly comparable to the achievements during the last ten years. However, several considerations need to be taken into account. First, achievements during the 1980s included substantial spillover from the previous period of rapid expansion. Financial constraints during the decade restricted new development so that it will take time to generate renewed momentum, especially in relation to national schemes. Secondly, the phasing of Casecnan is dependant on its priority for power generation and the extent of the new service area has still to be finalized. It may also be difficult to suspend the two on-going multi-purpose projects (Balog-Balog and Pampanga Delta) despite the strong prima facie case for doing so. Assuming Casecnan does go ahead sometime during the decade, there therefore may be little scope for initiating further multipurpose projects. Thirdly, given that many 'on-going' projects are approaching completion, there is considerable flexibility with respect to new NIS run-of-the-river projects. Those already identified provide a reasonable basis for choice although some are very high cost and further feasibility investigations should be given high priority. Fourthly, the communal target suggested above appears attainable. Moreover, communal investment is flexible and the program can respond to financial constraints at less economic cost than NIS programs. While some additional areas may be developed under the CARP program, it is assumed that these will in practice be limited. Fifthly, these targets assume that the SWIM program will be reduced well below that suggested in the JICA proposals. Lastly, no specific estimate is included for rehabilitation given the definitional issues discussed above. However, considerations which may help determine how far rehabilitation programs are justified are summarized below.

4.56 If achieved, these targets would increase the proportion of the total irrigation potential actually developed from about 37% in 1990 (50% of readily convertible land) to 43% (58% of readily convertible land) (Table 4.1). Considerable potential would therefore still remain in 2000 though it is debatable how much of this will prove economically justified.

4.57 These projections make no specific allowance for private investment in shallow groundwater and to this extent may understate the potential growth in the total irrigated area. However, it is considered unlikely that this will substantially contribute to the expansion of the rice area since only in favorable locations are farmers likely to invest in wells for relatively low return paddy production or incur the high recurrent costs associated with dry season rice production. The pace of private groundwater development for diversified cropping will be determined primarily by market expansion which is likely to be strongly correlated with general economic conditions. Thus, even though there may be extensive aquifers physically suited to exploitation, the extent to which they will in fact be exploited will be limited by the financial incentives facing the private investor.

D. Irrigation Rehabilitation and O&M

Introduction

4.58 Reduced O&M allocations and inadequate maintenance have contributed to system deterioration and disappointing system performance. There is thus a strong a priori argument in support of rehabilitation to appropriate standards followed by needs-based O&M allocations. The question is what kind of rehabilitation and what levels of O&M allocation. Rehabilitation can only be successful if budgetary support can be assured, either from NIA or by transferring responsibility to the farmers. Past programs have often failed to sustain performance, in part because of inadequate funding, and therefore *greater care should be exercised in the choice of systems for rehabilitation*" (Rosegrant et al, 1987). And, it could be added, in the choice of the approach to rehabilitation itself. Some basic factors that may help explain why NIS performance has stagnated are reviewed above. They suggest that rehabilitation should not simply re-establish original design standards but should consider modifications to reflect operational experience.

Rehabilitation Programs

4.59 The failure of past modernization programs to sustain improved performance is a matter of concern.[1] *"Poor performance in an existing scheme is not prima facie evidence that rehabilitation will generate significant benefits. Even if a system is badly deteriorated, rehabilitation will not be economically viable if the relative water supply is constraining... For those irrigation systems in which the relative water supply is at a level such that rehabilitation can generate significant benefits, the investment cost becomes the critical variable in determining economic viability. Many rehabilitations that have been undertaken are relatively large-scale, capital-intensive ... subject to the same types of delays and cost overruns that characterize new systems. At costs above average levels, rates of return ... decline from moderate to poor."* Clearly, procedures are needed to ensure that rehabilitation programs are responsive to the conditions prevailing in any particular scheme, including its relative water supply. Some possible approaches have emerged in the context of the Bank-supported Irrigation Operations Support Project (IOSP) and these are described below.

The Irrigation Operations Support Project (IOSP)

4.60 The IOSP was approved in 1988 as the first phase of a three stage, nine year program to: (i) strengthen the institutional capacity of NIA and water users to operate and maintain national systems; and (ii) raise performance levels of NIA systems through minor physical improvements and gradually improved O&M. It was envisaged that subsequent stages would include more substantive investments (Annex 4). Major items to date have included canal desilting, drainage re-excavation, and repairs to channel structures and service roads. The mid-term review generally confirmed the approach, emphasizing its contribution to strengthened farmer organization. However, the review advocated a more systematic diagnosis of scheme-level problems to ensure that physical improvements contribute directly to a workable irrigation service plan. It recommended that a follow-up project should focus on: (i) the turnover of sub-systems to irrigation associations (IAs) to strengthen both performance and NIA's financial status; (ii) enhanced operational skills of IAs and NIA staff; (iii) the optimization of investments in restoration and other improvements; and (iv) improved design criteria of canals and structures.

4.61 The Irrigation Service Improvement Plan (ISIP). To achieve these objectives, an ISIP would be prepared for each scheme (Meija, 1985) to clarify the irrigation service and schedule investment works and O&M allocations. It would establish: (i) the water resources available to the system; (ii) an agricultural and associated water distribution plan; (iii) the physical infrastructure required; and (iv) institutional requirements including farmer associations (IAs) and support from agricultural agencies. It would include a

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[1] Preliminary drafts of the PCRs for the Bank-supported NISIP I and NISIP II confirm that these two projects -- which covered a significant part of the total NIS area -- had very disappointing returns (see also Annex 4).

Plan of Operations and Maintenance (POM) comprising a set of documents and instructions to provide guidance at each level of the project organization. It would be prepared with the participation of the farmers, and reflect the recommendations and advice of the DA and other agencies. It would be periodically updated. A draft outline is provided in Annex 4, Attachment 4, and further guidance is given in an ICID publication (ICID, 1989).

4.62 Design Considerations. Several design improvements are likely to have general application. First, greater attention should be given to resolving siltation, erosion and related problems. Even if solutions are relatively expensive, there may still be desirable tradeoffs between capital investment and O&M expenditures so as to avoid the continuing aggravation and problems of regular maintenance. Secondly, a more realistic approach is required to water control. One coherent approach is with the "structured" approach (Shannon and Albinson, 1984) which determines at what level the irrigation agency should seek to control discharges. Above the "structured" level, all means to ensure and simplify discharge control should be explored, including automatic control devices. Below the "structured" level, distribution could be proportional and automatic without, for instance, attempting detailed flow adjustment at the turnout. Although the system's ability to meet detailed water requirements may be reduced, the best can be the enemy of the good and detailed response for paddy is seldom critical. The "structured" approach provides a logical framework for introducing both simplified operations and more resilient structures that have been recommended in a number of recent reports:" ... *it is particularly important to identify simple, sturdy, on-farm structures acceptable to the farmers which efficiently apportion water independently of upstream flow*" (ADB, 1986) It also provides for structures "*best suited to staggered and rotational rather than continuous supply*" which can improve efficiency and be readily adapted to the promotion of diversified cropping if this is required.

4.63 Operations. In addition to simplifying water distribution, there is often potential for improving operational practice, e.g. to minimize silt inflows, optimize reservoir operating rules, utilize rainfall and return flows effectively, systemize rotational distribution and/or staggered transplanting etc. An 'Operational Plan' should set out how management decisions are to be taken so as to provide the promised irrigation service (ICID, 1989). Several operational plans may be possible, in particular in reservoir-backed systems. The agricultural impact of alternative plans can often be best investigated through simulation to compute system water balances under the water supply and rainfall conditions that have historically faced the scheme.

4.64 Maintenance. Detailed surveys and training programs under IOSP I have identified requirements for "catch-up" (deferred) maintenance to restore systems to working order, and "essential structural" maintenance to provide enhanced capacity to control and monitor water flows (Skogerboe, 1990). Regular, periodic and annual maintenance inspections are in principle scheduled with IA involvement. However, maintenance procedures can be even more difficult to institutionalize than operations. Not only are procedures difficult to establish, but budgeting and related constraints lead to delays between the identification of problems in the field and implementing repairs. As in the case of the operations, the Plan of Operations and Maintenance (POM) should describe how maintenance is to be applied in the context of the particular scheme.

V. INSTITUTIONAL SUPPORT FOR IRRIGATED AGRICULTURE

A. The Irrigation Service

Water Resource Institutions

5.1 The present institutional framework for water resources development was created in the 1970s. The National Water Resources Council, now the National Water Resources Board (NWRB), was established in 1974, and the Water Code (consolidating numerous previous laws and regulations) was promulgated in 1976. Activities of the separate agencies (e.g. those dealing with irrigation, hydropower, flood control, navigation, pollution, water supply, waste disposal, watershed management and others) are coordinated by NWRB which is chaired by the Secretary (DPWH) and includes as members all relevant secretaries and agency heads. The Water Code establishes the basic principles and framework relating to appropriation, control and conservation of water resources to achieve their optimum development and rational utilization.

5.2 The twelve water resource regions reflect physical features which in practice correspond closely to the administrative regions. Between 1979-1983 basin framework plans were prepared covering essentially the whole country. All applications for new uses of surface water and groundwater are processed by NWRB's secretariat which recommends to the Board whether licenses should be granted based on water balance techniques, reference to the framework plans and other factors. In theory, all existing water uses are licensed although in practice many small users are unlicensed, and control is constrained by implementation problems as well as by deficiencies in streamflow and other data. In cooperation with other concerned agencies, NWRB has embarked on a nationwide water resources data collection program, and continues to operate and maintain a computer-based system for storage, retrieval and analysis of water data. The Government is presently reviewing a proposal, drafted with ESCAP assistance, for preparation of a National Water Resources Master Plan which would update and supplement the existing basin framework plans.

5.3 The basic arrangements therefore exist for the rational development and management of the water resource, and the major issues relate to effective implementation and control rather than to legislative, regulatory or agency authority. Conflicts over water have to date been limited although they have arisen importantly with respect to reservoir operations (notably between irrigation and the water needs of Metro Manila from the Angat Reservoir), and to quality and related issues affecting Laguna de Bay. Conflicts also arise during times of low flow, for instance between different irrigation schemes within the same basin. These can be expected to become increasingly acute as the resource is developed, and mechanisms for rivercourse management at the local level need strengthening (para.5.43). Reservoir operating plans may also need to be refined to ensure that transparent rules govern priorities between different users in particular at times of shortage.

The National Irrigation Administration (NIA)

5.4 Background. Republic Act (RA) 3601 abolished the Irrigation Division of the Bureau of Public Works and transferred its assets to the newly established National Irrigation Administration (NIA). The aim was to initiate an "Irrigation Age" implemented by an independent and financially autonomous agency. NIA was to construct national irrigation systems (NIS), recover from beneficiaries the fees necessary for "continuous operation', and reimburse the Government the costs of construction within 25 years. However, despite these provisions, NIA's field income in practice failed to cover its requirements and NIA continued to be financed essentially through the regular budget.

5.5 Presidential Decree (PD) 552 of 1974 therefore introduced changes to broaden NIA's responsibilities and institute effective self-financing. Capitalization was increased; Government equity allocations were provided for investment; and NIA was authorized to retain income from irrigation service fees (ISF) and other sources while receiving supplementary budgetary allocations as necessary. Communal irrigation systems (CIS) and drainage were also added to NIA's mandate and NIA was empowered to incur foreign debt to a limit of US$500 M for irrigation and multi-purpose water resource projects. *"The (overall) effect ....was to maintain the mandate for NIA to recover O&M and at least partial construction costs from irrigators in both national and communal systems while being relieved of the requirement to repay the government for (its) contribution to these expenditures"* (Svendsen et al, 1990). PD 1702 (1980) raised NIA's authorized capital further; made equity allocations subject to regular budgetary procedures; and authorized NIA to make a 5% overhead charge for capital projects.

5.6 The 1974 and 1980 changes recognized the difficulty of creating a fully autonomous, self-financing development agency while introducing financial incentives which *"caused it to begin to respond to the economic and financial implications of its actions"* (Svendsen et al, 1990). To this end, regular operating subsidies were ended in 1981 and NIA came under strong Treasury pressure to accept responsibility for foreign loan repayment. This has proved an unrealistic objective and in 198_ ownership of all physical assets in irrigation works was returned to DPWH. NIA is subject to Government regulation in important respects (e.g. in staffing matters, setting salaries and user fees etc.) and remains vulnerable to budgetary constraints. Nevertheless, as a semi-autonomous body under the DPWH, it has considerable operational freedom and its corporate structure has major advantages over a regular Government department in terms of the transparency of its operations and financial accountability.

5.7 Organization. NIA is governed by a Board of Directors, chaired by the Secretary (DPWH). It has four units at its Manila headquarters, each headed by an Assistant Administrator. Two are technical (Project Development & Implementation, and Systems Operation & Equipment Management which also supervises communal irrigation) and two are support (Finance & Management, and Personnel & Administrative Services). Eleven Regional Irrigation Offices (RIO) each come under a Regional Irrigation Director (RID) reporting to the Administrator. About 100 Irrigation System Offices (ISO) each under an Irrigation Superintendent (IS) are directly responsible for one or more of the 145 national systems, and 67 Provincial Irrigation Offices (PIO) each under a Provincial Irrigation Engineer (PIE) are responsible for communal irrigation. The managers of UPRIIS and MARIIS report directly to the Administrator but all other IS and PIE come under a regional office.

5.8 Staff numbers more than halved between 1977 and 1989 as construction activity declined. However, non-project staff numbers also fell as a result of major cost cutting efforts. The reductions were all the more notable since they coincided with an increase in the staff involved in institutional development. A 1989 internal review suggests that -- relative to requirements -- the central office is still over-staffed by 17%, regional offices by 5% and project offices by 109%, mainly due to the tendency of daily employees to become 'permanent'. Nevertheless, NIA's ability to adjust its staffing levels compares favorably with irrigation departments in neighboring countries, and is clearly a response to pressures associated with financial accountability. Since staffing accounts for about 75% of recurrent costs, NIA's flexibility in this matter important for its overall viability.

5.9 The Capital and O&M Budgets. Capital expenditures built up rapidly in the 1970s peaking in 1979-81. Thereafter, they declined in real terms in response to rice self sufficiency, reduced emphasis on new projects and the shift to rehabilitation and communal works. The slowdown was aggravated by the financial crisis which curtailed local funds for both investment and O&M. In 1983/84, budget allocations for O&M ceased and equity was sharply curtailed and in 1984 releases of foreign exchange accounted for no less than 84% of investment. Since local fund shortages seriously impeded implementation, NIA resorted to its corporate funds to sustain investment -- necessarily a temporary expedient. Shifts in capital financing during the 1980s illustrate the flexibility inherent in NIA's corporate structure though this is limited by the basic dependance on Government financing. World Bank and ADB loans account for the majority of the foreign financing available to NIA although OECF has in recent years also assumed importance.

5.10 Excluding incremental O&M allocations under the Bank-supported IOSP (accounted for under the capital budget) NIA has generally covered its operating costs. This achievement is unusual among countries in South and South East Asia and reflects responses to the phasing out of regular Government operating subsidies. Svendsen et al list four types of response: (i) devolution to farmers' organizations, (ii) cash incentives for commendable employee performance, (iii) revenue increases and (iv) reductions in operating expenses. The overall impact is shown in Table 5.1. In real terms NIA has succeeded in containing its operating costs. Income, however, has also declined and operating profits have been minimal. ISF income is the major source of revenue, and has generally held constant in real terms. Equipment rental and CIS amortization have risen rapidly but have been more than offset by declining interest earnings and reductions in other sources (e.g. management fees which declined as investment slowed).

Table 5.1: NIA OPERATING INCOME AND EXPENSES
(Pesos Per Ha of NIS Service Area at 1972 Prices)

	Expenses Excl. Depreciation	Income Total	Income of which: ISF
1978-80	107	153	40
1981-83	122	182	34
1984-86	83	110	37
1986-89	90	94	37

Source: See Annex 4.

5.11 Cost Recovery. Capital cost recovery is confined primarily to the communal sector. Farmers benefitting from communal projects are required to contribute 10% of construction costs in cash or kind (e.g. labor) and to repay the balance without interest over a period of 'not more than 50 years' at levels which do not exceed corresponding ISF rates on national systems. These terms represent a large real subsidy which, depending on future interest and inflation rates, may be more than 80%. Even so, collections in 1987-88 were less than 10% of obligations. Contribution to capital costs remains an important principle and collection procedures are to be strengthened under the IBRD-supported CIDP II.

5.12 Since 1975, ISF rates have been expressed in cavans of paddy, and farmers may either pay in kind or in cash at the official paddy support price. ISF rates vary depending on season and type of scheme (Table 5.2) but even for pump schemes are no more than about 5% of gross return. Paddy yields on national systems are typically perhaps 1.5 - 2.0 t/ha more than under rainfed conditions so that ISF payments account for perhaps 5-15% of incremental production and should be well within the capacity of the farmers to pay. Indeed, on equity grounds, these rates appear relatively modest.

Table 5.2: IRRIGATION SERVICE FEE RATES

	Cavans Per Ha		Pesos Per Ha: 1988		Pesos Per Ha: 1990	
	WS	DS	WS	DS	WS	DS
Diversion systems	2.0	3.0	350.0	525.0	600.0	900.0
Reservoir Systems	2.5	3.5	437.5	612.5	750.0	1050.0
Pump Systems	3.0	5.0	525.0	875.0	900.0	1500.0

Note: One cavan = 50 kg (paddy). WS - wet season, DS - dry season.
Source: NIA

5.13 Expressing the rate in cavans per ha provides a measure of indexation against inflation even though between 1975-89 the ISF rate lost about 20% of its value in real terms. Despite the indexing advantages, payment in kind is costly to NIA which must collect, store and sell paddy. Farmer deliveries are very uncertain, widely dispersed and normally of the poorest quality. If market prices are depressed, NIA may have to take delivery of significant volumes and dispose of it at a loss. If market prices are high, farmers pay cash and NIA's storage and other facilities are unused. In 1986/87 almost 50% of all ISF was collected in kind (predominantly in the main producing areas of Central Luzon and the Cagayan Valley) and losses on paddy sales amounted to as much as 6% of ISF revenues. Allowing also for overheads, the value to NIA of paddy collected in kind may be as much as 50% less than its cash equivalent. There seems to be no strong reason why delivery in kind is a necessary corollary of a rate expressed in cavans per ha. At the very least, significant penalties should be imposed on farmers who pay in kind, at least equivalent to the additional overhead costs incurred. Penalties would seem preferable to providing discounts for cash payment in view of NIA's financial position and the relatively low rates that prevail. Meanwhile, as recommended by Svendsen et al., an empirical investigation should be undertaken to establish whether or not the option of payment in kind had indeed a significant impact on collection rates.

5.14 ISF Revenues and O&M Expenditures. Excluding IOSP releases and NIA overheads, ISF collections in 1979-89 covered only about 80% of outlays.

Regional performance varied with many regions outside Luzon more than covering O&M expenditures and those in Luzon in most cases falling short. Although total ISF collections have increased, and covered a larger share of direct O&M releases in the period 1985-89 than 1979-84 (an average of 86% as against 65%), this reflected declining real O&M expenditures rather than improved collections and, in real terms, ISF income per hectare rose only marginally. The failure of ISF collection performance to improve during the 1980s is disturbing and compares unfavorably with the cost reductions achieved over the same period. Under NIA's incentive structure, a regional, provincial or NIS office is termed 'viable' when income -- largely from communal amortization payments or ISF -- exceeds direct O&M costs. Once viability is achieved all staff receive incentive payments which are significant relative to their regular salaries so that regional staff have as much to gain from improving ISF performance as from reducing costs. NIA staff have in recent years put considerable effort into ISF collection but the fall in real paddy prices, stagnation in agricultural performance on existing schemes, continued population pressure and reductions in farm size have put pressure on farm incomes and hence on farmer willingness to pay, Indeed, it could be argued that simply maintaining ISF income at past levels represents success.

5.15 Current approaches, for instance in the context of the IOSP, emphasize improved system performance together with the more active involvement of irrigation associations (IAs) in both collection and maintenance activities. Even so, collection will continue to be problematic and *"it may be that at the current standards of irrigation service to farmers and under prevailing economic conditions, payment rates have reached an equilibrium and have become relatively insensitive to"* ISF levels [Svendsen et al, 1990).

Farmer Participation

5.16 National Systems. From its earliest days NIA has encouraged formation of irrigation associations (IAs) in NIS. The UPRIIS design of the early 1970s clarified how this was to be done. An IA for each 50 ha (approx) turnout unit is in principle registered as a non-profit/non-stock entity under the Securities and Exchange Commission (SEC). This gives it the legal personality to enter into agreements with NIA and other agencies (e.g. rural banks). The IA has a formal constitution with a chairman, board of directors and officers. It is responsible for O&M below the turnout, and for coordination with NIA staff, notably the watermaster, with regard to water supplies and system maintenance. In principle, IAs can be federated along laterals and on a project-wide basis though this has occurred in only a few instances (e.g. MARIIS). In larger systems such federations participate in system-wide decision-making; in smaller systems, they could assume full responsibility. Several NIS pump schemes (e.g. within the AMRIIS service area) have been successfully transferred to farmer control and it is conceivable that all schemes up to, say, 2,000 ha or more could be privatized.

5.17 Despite this history, IA performance has been mixed and many IAs have failed to sustain an active role. Several measures have been taken (notably under the IOSP) to strengthen performance. First, Institutional Development Department (IDD) staff are now fully integrated into regional and project management. Resistance from engineering staff has been overcome and NIA is perhaps unique in having transformed its staffing patterns to reflect these new requirements. Secondly, CIS experience suggested the need for an agent to catalyze IA formation and sustain its functioning. This role in NIS is performed by a Farmer Irrigator Organizer (FIO) temporarily recruited from the local community, supervised by the watermaster, and paid a small honorarium. Such an approach is relatively cheap, avoids the need for contract staff. benefits from the FIO remaining in the village once his task is complete. Thirdly, experience suggests that O&M within the turnout area is inadequate in itself to sustain IA activities and attention has been given to widening their functions through contractual arrangements with NIA. Memorandum Circular 34 of 1985 set out a three stage approach, subsequently modified to strengthen NIA's sanctions in the event of non-compliance. For Stage 1, the IA contracts to maintain a watermaster section and to assist in operations and ISF collection - payment is at a rate below the cost of direct labor plus a small incentive for assisting in ISF collection. At Stage 2, the IA both maintains a section and collects ISF from its members based on a graduated incentive system. For Stage 3, full responsibility for up to 1,000 ha is transferred to the IA, in other words the area is converted into the equivalent of a communal system and the investment is amortized. Fourthly, a highly structured training program has been developed to support these various measures, building on previous experience in the CIS program.

5.18 The number of IAs with formal O&M contracts rose from five in 1981 to 581 at end-1989 covering almost 140,000 ha. Rapid further growth is occurring under the IOSP and it is expected that the area will more than double by end-1991. There has to date been no comprehensive evaluation of the program although Svendsen et al (1989) quote a 1988 review of four systems by Jopillo and de los Rayes which suggests that it has contributed to cost savings but has yet to be reflected in significant improvements in ISF collections or in system performance. Other studies are currently under way with the assistance of IIMI which should provide further information on the impact of the program.

5.19 Communal Systems. NIA pioneered the participatory approach to the development and rehabilitation of communal irrigation schemes employing irrigation community organizers (ICOs). Pilot projects were started in 1976 with Ford Foundation assistance and by 1980 these had extended to each of the twelve regions. Their success led to the Bank-supported CIDP I and by 1983 the approach had become standard practice for all NIA-assisted communal programs.

5.20 Communal irrigation in NIA has yet to come under a regular department and is implemented through 'projects' for locally-funded and foreign-funded programs respectively. Regional institutional staff guide provincial offices which are responsible for implementation. The ICO is fielded after preliminary investigations are complete and is usually responsible for one core project where he or she lives and one part-time project. Consideration is being given to the use of FIOs on rehabilitation schemes as an alternative to ICOs (para. 5.17). Over the past fifteen years, detailed procedures have been developed to guide staff. They are highly formalized to provide a full legal basis and increase farmer commitment and awareness. Sub-committees are set up for each major task and the aim is to involve all IA members directly in some capacity. Although the procedures appear complex, experience suggests that they are manageable and sound. The IA is fully responsible for all aspects of irrigation O&M. There is continued contact with NIA so long as the scheme is being amortized and in this context further support can be provided. Although there is little evidence that the participatory approach has had a major impact on agricultural performance (Table 4.8), it is strongly supported by farmers and has a strong prima facie justification. A principal matter for concern continues to be low rates of amortization payments for which improved procedures are being implemented under CIDP II.

5.21 Non-Irrigation Functions. While their primary focus is on irrigation O&M, several IAs have developed additional functions. As early as 1970, it had been envisaged that they would be 'pre-cooperatives' through which general farm services could be channelled and which would develop in due course into full cooperatives. NIA has recently signed a Memorandum of Understanding with the Land Bank that will enable IAs to take on credit for non-irrigation activities. Such activities potentially involve finance on a scale that greatly exceeds that of irrigation O&M and could involve NIA in activities outside its particular mandate and expertise. A study by Veneracion (1984) suggested that the impact of non-irrigation activities on IA performance was highly variable, often proving temporary and leading to 'more difficulties than benefits'. This study suggested that IAs which were able to sustain such non-irrigation activities were 'those which sought to operate these activities outside the association and through a separate entity. In effect these associations took roles as investors and organizers of new groups'.

Small Water Impounding (SWIM) Projects

5.22 The institutional arrangements for implementing SWIM projects differ in several respects from those of other irrigation projects since they have a variety of objectives and are implemented by several agencies (Annex 5). To coordinate their activities, the SWIM Committee was established in July 1979 comprising the heads of the relevant departments (DPWH, DENR, DA, and DBM). The Committee formulates operational policies; designates implementing. A working group serves as the technical and executing arm of this committee, evaluating reconnaissance surveys, feasibility studies and detailed designs, and prioritizing projects based on an initial screening by the SWIM Project Management Office (PMO). The PMO has established standards, criteria and guidelines for all technical activities relating to planning, design, construction, utilization and O&M of project facilities. It also conducts preparatory work for the selection of projects and evaluates the conditions for commencement of construction.

5.23 Five agencies are involved in the implementation of the SWIM projects; the PMO, NIA, BSWM, NEA, and FMB. NWRB and BFAR cooperate in the drafting of plans and designs and in the O & M of projects. Besides these agencies, PCARRD has recently recommended a national program on small farm reservoirs (SFR) based on indigenous technologies to harvest and store rainfall for use on individual farms. In general, SFRs are much smaller than SWIMs being about 700 - 5,000 sq. m. in area and have a maximum embankment height above ground level of about 3 meters.

B. Inputs and Support Services

The Department of Agriculture (DA)

5.24 The DA is responsible for the promotion of agricultural development through appropriate policies, public investments and support services. To accomplish its mandate, EO 116 (1987) spells out three areas relevant to irrigated agriculture: (i) the provision of integrated services to farmers/ fishermen and other food producers; (ii) the provision of mechanisms for the participation of farmers/fishermen and entrepreneurs at all levels of policy making and plan/program formulation; and (iii) coordination with other public and private agencies on matters affecting DA plans, policies and programs.

5.25 The DA's organizational structure is shown in Figure 3. Some 24,000 staff aze employed by the DA proper. Of theso, about 3,708 are stationed at the center and 20,500 are in the regional officos. Of relevance to irrigated agriculture are the offices of the Undersecretary for Policy and Planning, the Undersecretary for Operations (responsible for the principle support services both at the center and through twelve regional offices) and the Undersecretary for Attached Agencies (responsible for supervision of six councils/committee and eleven corporations/agencies). The councils include the National Agricultural and Fishery Council (NAFC) which coordinates national, regional and local agricultural activities (para. 5.__). Several changes in the structure of the DA were made in July 1990 and a more fundamental reform to streamline and rationalize the organization is currently being discussed.

Support Services

5.26 Agricultural Research. The Philippines is fortunate in being the host to IRRI whose findings are often directly applicable to local environments. IRRI has a modern center with a 252 ha irrigated farm at Los Banos and a staff of about 2,000 of whom 95 are internationally recruited. IRRI released the first semi-dwarf high yielding rice varieties in the mid-1960s and most popular varieties in the Philippines originated from IRRI's breeding program. IRRI's presence has, however, inhibited local research capability and it was not until 1986 that the Philippines Rice Research Institute (PhilRice) was established with a mandate to coordinate and unify the efforts of various agencies that have worked somewhat independently in the past. Its network comprises a central experiment station in Nueva Ecija, four branch stations, six regional research centers and eight cooperating stations. The headquarters is being expanded with a JICA grant of $15.6 million and in 1989 PhilRice had some 250 staff of whom about 60 were scientists. Other research programs are administered by the Bureau of Agricultural Research (BAR) through Regional Directors of Agriculture. Research is conducted at Regional Integrated Agricultural Research Stations (RIARS) and some experimental farms, with emphasis on adaptation and verification research, both on-station and on-farm.

5.27 Agricultural Extension. DA provides extension services to farmers through its 12 regional offices and specialized attached commodity agencies. Services are also provided by traders (particularly for agro-chemicals and fertilizers), colleges and universities, credit institutions and non-government agencies. The Department of Agrarian Reform (DAR) and the Department of Environment and Natural Resources (DENR) provide support to land reform beneficiaries and occupants of government lands respectively. In 1989, DA employed some 14,487 field extension workers comprising 1,578 Municipal Agricultural Officers (MAO) and 12,909 Agricultural Production Technicians (APT). The average number of farm families per extension worker was 242 and ranged from 138 in Central Mindanao to 407 in Central Visayas, one of the highest ratios in the world. In 1987, DA was decentralized and the APT became a generalist dealing with all concerns of the farming community. Extension expenditures have declined over the last few years from more than 1.5% of agricultural expenditures in 1985/86 to 0.8% in 1988. Operating allocations (for transport, trials, demonstrations etc.) have declined while salaries and allowances have increased. Inadequate salaries and allowances, as compared to other lower level government workers, and lack of transport, have adversely affected incentives to field staff.

5.28 The same Executive Order that decentralized the field staff also merged training and extension staff at the center into the Agricultural Training Institute (ATI) with a mandate to: (i) formulate policy guidelines on continuing education and training; (ii) establish, operationalize and manage a network of training centers; (iii) design and conduct location-specific training courses; and (iv) institutionalize workable linkages with all research and extension institutions in the country.

5.29 Input Supplies. Seeds of recently released and recommended varieties are multiplied through a national seed multiplication system. Farmers in the main rice producing areas can generally obtain certified seed from registered growers at a premium of 60% above the NFA support price. Nevertheless, only about 15% of all rice farmers use certified seed, though this is projected to increase to 30% under the Rice Production Enhancement Program. The lack of seed purity is a significant constraint on paddy yields, in part due to inadequate regulation of seed production and distribution in the absence of a suitable Seed Act. Responsibility for producing breeder seeds lies with the originating institution. Multiplication is generally by accredited private breeding entities. The Bureau of Plant Industry (BPI) is the lead agency for implementing the DA's Seed Production and Distribution Program and, under the Rice Action Program, DA has proposed a project to establish cooperative seed processing and marketing centers.

5.30 Low fertilizer application rates are also a major cause of the relatively low paddy yields. Nevertheless, fertilizer is widely available through the private sector and, following deregulation (para. 30), price differentials generally only reflect additional transport and marketing costs. A wide range of Fertilizer and Pesticide Authority (FPA)-approved pest and disease chemicals are also available throughout the country. In 1988 there were some 626 registered/licensed fertilizer and agro-chemical dealers which also had an additional 320 outlets.

5.31 Agricultural Credit. Government funds were previously available for direct lending to producers. In 1986, these were converted into a guarantee fund -- the Comprehensive Agricultural Loan Fund (CALF) -- to support loans granted to farmers by the private banking system (including rural banks). However, there is little evidence that credit availment among small farmers has improved. DA's Livelihood Enhancement and Agricultural Development (LEAD) program has also had limited effect, although the Rice Production Enhancement Program (RPEP) has proved popular as have the programs included under the Rice Action Plan. Even so, many farmers continue to use informal credit at higher interest rate, particularly for the wet season crop and several studies have concluded that farmers find informal mechanisms more readily accessible and convenient as the credit is usually provided in association with other services such as transport, drying and marketing which make the interest rate less usurious. The Land Bank has in recent years made more credit available to smallholders, but from 1991, crop production credit is to be made available only to members of registered agricultural cooperatives. However, this will include IAs under the terms of a recently-signed Memorandum of Understanding with NIA.

5.32 Crop Insurance. The Philippine Crop Insurance Corporation (PCIC) has operated since 1980. Of the 1.6 million rice farmers in the country only about 10% have annually insured their crop. Insurance cover averages about P 3,500 per ha at various premium rates depending on risk. Premium rates for rice in 1988 averaged 11% of the insured amounts, of which the farmer's share was 2%; the lending institutions' share for farmers who also borrowed 1.5%; and the balance represented a government subsidy (as share of premiums and PCIC operating expenditures). Credit institutions sometimes require farmer participation in the crop insurance scheme as a condition of lending.

5.33 Post-Harvest Services. The National Post-Harvest Institute for Research and Extension (NAPHIRE) estimates that at least 95% of total paddy dried is by solar drying. This is the cheapest method but contributes to high losses and quality deterioration due to damage by wind, rain (in particular during the wet season rice harvest) and vehicles. The national Food Authority (NFA) has acquired substantial facilities for post-harvest drying and storage operations although these are greatly under-utilized due to the authority's limited role (Chapter 3). Rice milling is almost totally in the hands of the private sector with 12,272 registered operators in 1987. Some 50-60% of paddy production is milled by small, sometimes mobile, mills, with low (50-60%) recovery rates of generally poor quality rice. Modern mills achieve recovery rates of 65-70% depending on the quality and variety of paddy. Various studies are ongoing to reduce the relatively high losses. Paddy generally moves from farmers to rice millers through assemblers/wholesalers and commission agents. A substantial portion of the harvest is custom milled on behalf of the farmer at small and mobile mills. Prices received vary considerably, depending on local supply and demand conditions and reflecting differential transport and marketing costs. NFA's activities are concentrated in the main paddy-producing areas and have been relatively ineffective in ensuring the guaranteed price to farmers in other areas. High transport and distribution costs reflect inherent features of the Philippines archipelago as well as ill-developed and uncompetitive facilities.

C. Inter-Agency Coordination

Inter-Agency Consultative Mechanisms

5.34 Annex 5 reviews the full range of inter-agency coordinating mechanisms that touch upon irrigated agriculture. The number of these mechanisms is striking and many go well beyond the purview of this report. However, four can be briefly discussed -- the Inter-Agency Water Management Crisis Committee and those evolved respectively under regional and local government, the Department of Agriculture and NIA.

5.35 Inter-Agency Water Crisis Management Committee. This Committee was established in 1987 in response to the drought with a mandate to coordinate government activities in minimizing its negative consequences. Membership is drawn from all the major agencies involved in water, and the committee is responsible for resolving conflicts in water use between competing users at times of shortage. It is thus the policy body responsible for determining how priorities in water allocation should be implemented at times of crisis, taking into account the provisions of the water code and licensing by NWRC. The Committee meets as and when required in response to the Drought Early Warning and Monitoring System of PAGASA which issues drought advisories when rainfall is significantly below normal during successive months in any region or locality. The people are informed of the consequences of any prolonged spell, including the decisions of the committee, through local government units together with press releases, radio broadcasts etc.

5.36 Regional and Local Government. Major changes were initiated under the 1987 Constitution with the objective of devolving development powers to local bodies at four levels: Barangay, Municipality, Province and Region. At each level, development councils have been reorganized and strengthened comprising elected officials, and ex-officio members drawn from line agencies and the private sector. The councils may establish sub-committees for particular sectors including agriculture. NIA participates in the development councils and their sub-committees only on an on-call/as needed basis. The councils with their secretariats formulate -- and subsequently monitor -- policies, programs and investment plans for approval by the respective elected body. These are transmitted to the next level and ultimately to NEDA to be integrated in the national multi-year and annual investment plans. Proposals are currently under discussion which would modify the Local Government Code inter alia to provide such units with direct appropriations in the national budget. If approved by Congress, this would greatly strengthen their role.

5.37 Agricultural and Fishery Councils. The National Agricultural and Fishery Council (NAFC) is an advisory body to ensure the success of the DA's programs and activities, and serve as the forum for consultation and discussions within the agricultural sector. It is replicated at the regional, provincial and municipal levels. NAFC's specific objectives are to: (i) create permanent local councils at the regional, provincial and municipal levels; (ii) design and implement a consultative mechanism between the national government and the farming and fishing communities; (iii) bring government closer to the people and establish a more productive partnership with the private sector; (iv) provide a forum where all operations and programs related to agriculture and fisheries of various agencies are coordinated; and (v) define and formulate on a continuing basis the goals and scope of the country's food and agricultural policies.

5.38 The activities of NAFC are coordinated through a range of committees: (i) the National Management Committee of top officials of line departments and other agencies (in practice this committee is inactive); (ii) a Steering Committee of chairmen of the commodity/functional committees and selected other representatives; (iii) four commodity committees (for food crops, livestock, poultry & feed, fishery & aquaculture, and industrial crops); and (iv) three functional committees (for agricultural finance, marketing and mechanization). There is thus no specific committee for irrigated agriculture. At the regional, provincial, municipal and barangay levels membership is drawn from both the private and public sectors. As in the case of the development councils, however, NIA only participates when requested. Although the NAFC is primarily an advisory body, it is also responsible for implementing the Livelihood Enhancement for Agricultural Development (LEAD) program which assists farmers in making loan applications for bank finance as well as providing some support for income-generating projects which are not yet bankable. Foreign grants are utilized and extended to farmers' organizations as start-up funds for projects with equity provided by the organization in terms of land, labor or cash. Under a Memorandum of Agreement (MOA) dated May 1989, IAs were approved for inclusion under this program although to date only very few have applied for LEAD assistance.

5.39 Scheme-Level Mechanisms. For the two largest irrigation systems (UPRIIS and MARIIS), NIA initiated scheme-level mechanisms for coordination. In MARIIS this comprises the Agricultural Development Coordinating Council (ADCC), chaired by the provincial governor of Isabella. NIA provides the secretariat and members are drawn from relevant agencies and farmers. The IAs are federated on a district and scheme-wide basis with the district chairmen members of the ADCC. The IA federation not only participates directly in scheme-level decision-making but also provides a link at each level with NIA's project management. The ADCC meets every month to coordinate the work of the various supporting agencies and, in particular, to provide a context for reviewing and approving seasonal water distribution plans and programs. An ADCC-type coordinating body was also established in the initial years at UPRIIS. However, NIA encountered problems related to convening committee meetings (with respect both to the expenditures necessary and difficulties in ensuring a quorum) and this body has evolved into a working committee of the Nueva Ecija Development Council. It is chaired by the Provincial Agricultural Officer (at times the Governor), NIA is formally represented on the committee and representatives are also drawn from the other concerned provinces.

5.40 Conclusions. Despite these various mechanisms, coordination between the various agencies in irrigated agriculture leaves something to be desired. This is particularly true at the planning stage and in relation to seasonal operational decisions and practices. Neither farmers nor agricultural support agencies are adequately involved in the planning and implementation of new irrigation projects. Similarly, though a seasonal planning and monitoring system is in place (para.4.24), agricultural agencies are not always consulted and may not schedule activities to complement and support what is proposed. For instance OED (1990) states that *"the wide distribution of support services between a large number of poorly coordinated agencies has hindered agricultural development"*. Furthermore, despite NIA's emphasis on IA development and farmer participation, only in MARIIS has a full farmer committee structure evolved at the project level. Elsewhere, the same OED report concludes that IAs have *"been used as a means of protest and pressure on the project authorities rather than as an instrument of cooperation"*. In contrast, farmers have been much more active participants in communal irrigation. They are fully involved at the planning stage and during construction for both new projects and rehabilitation.

Options for Strengthening Inter-Agency Coordination

5.41 Any modifications to existing mechanisms must respond to Government decentralization policies and to the proposed Local Government Code. This will give local government units greater autonomy and implies that mechanisms that have evolved under the auspices of central government agencies will need to respond more effectively to local government requirements. With respect of water and irrigation, a strengthened role for local government must also take into account hydrological boundaries associated with rivercourse and scheme management. This is less of a problem in the Philippines than in many other countries since both river basins and irrigation schemes tend to be small and often fall wholly within administrative boundaries (the twelve water resource regions for instance largely coincide with the administrative regions, para 5.2). However, major rivers may traverse several provinces and in a few cases irrigation schemes fall across provincial boundaries even if (as in the case of UPRIIS and MARIIS) one province is clearly predominant.

5.42 Integration of the DCs and AFCs. The responsibilities of the Agricultural and Fisheries councils (AFCs) and the Development Councils (DCs) go well beyond water and irrigation although these subjects may be reviewed among others. Working relationships between these two types of committee vary among regions, provinces and municipalities. In many cases, membership is overlapping and for instance, the chairperson of the PAFC may also head the PDC's agricultural sub-committee. In other cases, the two types of committee operate in parallel with little formal interaction. A solution in sympathy with the Government's decentralization policies would be to amalgamate the AFCs with the sectoral sub-committees of the development councils. While still receiving guidance and assistance from the DA in Manila, the sub-committees would be responsible to local government. Since the DA is not the only central ministry to have evolved a hierarchy of provincial and regional committees -- other examples include the Environment and Natural Resources Councils of the DENR and the Agrarian Reform Coordinating Committees of the DAR -- these would logically follow the same pattern and become functional sub-committees of the development councils This would not only streamline the present multitude of committees but also tend to integrate different plans and programs and coordinate inter-agency support.

5.43 A possible objection is the relatively political nature of the DCs as compared to the AFCs. The AFCs are more purely technical bodies, with fewer politicians and government officials as members and a greater preponderance of the private sector. Such an objection could be met through appropriate modifications in both membership and the rules and regulations governing their operation. Moreover, decentralization aims to increase accountability at the local level, and will inherently require that locally elected officials should play an increasing role. Representation by technical specialists and concerned private interests could no doubt balance the membership of the committees. Such an approach would facilitate integrated planning for rural development, with sectoral planning contributing in turn to the preparation of the regional and provincial development plans. The different line departments would be able to refer to such a plan in setting their individual programs, an important requirement given the proliferation of agencies working in rural areas. Preparation and implementation of such an integrated plan would itself tend to strengthen cooperation and integration between different agencies.

5.44 Management at the Rivercourse and Scheme level The DCs and their sub-committees are concerned with administrative areas and with issues which go well beyond irrigated agriculture or the development and management of a particular river basin or irrigation scheme. However, as indicated above, the coordinating mechanisms initiated by NIA for UPRIIS have evolved into a functional committee of the provincial DC, and the Governor of Isabella is chairman of the MARIIS ADCC. These schemes are of course large and of major importance to the well-being of their respective localities. Moreover, they are reservoir-backed so that discretionary management decisions of concern to farmers and local government are of more obvious significance. Nevertheless, similar if less critical issues arise in relation to smaller NIS and, increasingly, can be expected to arise in relation to allocations between users within the same river basin. In the smaller schemes, operations decided largely by NIA staff, based to a varying extent on consultation with farmers and local officials (para. 4.24). When conflicts arise in diversions along a watercourse, either due to unlicensed abstractions or to low river flows, local Government is actively involved along with the NWRC in resolving disputes and enforcing licencing provisions. The question arises whether this should be formalized following the pattern of UPRIIS and MARIIS. More specifically is the UPRIIS pattern of a separate functional committee for scheme management under the DC one that could be generalized and, if so, how would this relate to the proposed integration of the AFCs and other sectoral-based councils within the framework of the strengthened DCs? Furthermore, is this a model that could be extended in some form to river basin management?

5.45 Decentralization envisages a strengthened role for local government units which logically requires that they play an increasing role in water resource and irrigation management within their respective jurisdictions. There is a strong prima facie argument for formalizing this responsibility within the framework of a water resources sub-committee dealing with hydrologically-defined river basins, with appropriate mechanisms developed at a regional level for rivercourses that traverse more than one province. The extent to which this should in practice occur will no doubt depend on the pressures on the resources and the importance of irrigated agriculture relative to other uses. An alternative (perhaps interim) possibility would be for the DC's agricultural sub-committee to review scheme-specific proposals within the framework of its other responsibilities. This would facilitate development of a coordinated approach and assist different agencies of government and the private sector in scheduling their activities. Scheme-specific proposals would ideally be set within the context of an approved Irrigation Management Improvement Plan (para. 4.51). In other cases, as in UPRIIS, a sub-committee for one major scheme or a series of schemes could be envisaged separate from the general agricultural sub-committee. Irrespective of the particular mechanisms adopted increasingly, as other water uses grow in importance and as pressures on water emerge, it will be important to develop mechanisms for managing allocations and resolving conflicts on a rivercourse basis.

5.46 An important aspect to be considered is the appropriate role of water users. In principle, as in MARIIS, it is envisaged that an IA federation will be created in every irrigation scheme, in smaller schemes as a prelude to full transfer of management responsibility to the farmers, in larger schemes as a basis for full farmer involvement in scheme decision-making. Such federations risk becoming politicized and the pace at which they are created will depend on numerous factors, including progress in establishing effective IAs at the grass roots level. Participation of farmer representatives along with those of NIA, DA and other agencies is, however, essential in any decision-making process and is, for instance, fully provided for in the MARIIS ADCC. In the case of mechanisms for strengthening river basin management, users other than farmers and their representatives would also be consulted.

5.47 Conclusion. It is recommended that the various options be the subject of more detailed investigation. Solutions should be flexible and responsive to local conditions. Nevertheless, there are a number of general principles which would underlie any approach including the need to: (i) recognize and clarify local government responsibility for water resource development and management, (ii) ensure full participation of water users in the decision-making process, and (iii) respond to the hydrological imperatives of river basin and scheme-specific requirements.

VI. CONCLUSIONS

General

6.1 This report has evaluated irrigated agriculture within the framework of the Government's food security objectives. It has concluded that the potential in this decade for enhanced paddy yields[1] and improved irrigation performance are less than is commonly supposed. Consequently, economic returns from irrigation projects are unlikely to improve over the sometimes discouraging results of the past. Indeed as less favorable sites are exploited, economic returns from some new projects may decline. Moreover, even if the ambitious investment program set out in NIA's 1989 Corporate Plan could be implemented, this in itself would be insufficient to ensure rice self-sufficiency.

6.2 Given this outlook, the report has investigated other possible strategies for achieving the government's food security objectives. In particular, it has evaluated the potential role of trade and pricing policies. It has shown that elimination of protection would improve the rice balance but worsen the overall trade balance in grains, in both physical and value terms, since reduced wheat and corn prices induce increased consumption and hence imports. This is true also for equalization of protection at a 20% level, though increased meat (and hence feed corn) consumption is then the sole cause. Thus, while national economic welfare would gain from the gradual elimination of quantitative and other forms of protection on corn and wheat, this would be at the expense of increased total grain imports due primarily to higher feed corn imports in support of increased meat consumption. Irrespective of these trade policy alternatives, the Philippines is likely to remain a significant rice importer through the 1990s. Since wheat, and probably corn, will also be imported, the Philippines will be dependent on world markets for meeting a part of its basic food requirements.

6.3 Rice self-sufficiency has been a long standing GOP objective and the outlook for continuing imports is a matter for concern. Nevertheless, the report has argued that it will be in the Philippines economic interest to focus attention on sectors with significant potential for productive growth (for instance -- in the agricultural sector -- corn and livestock) rather than allocating scarce investment resources to achieving rice self-sufficiency at all costs. Investments in irrigation need to be evaluated on a project-by-project basis, adopting realistic assumptions and clear economic criteria rather than being driven primarily by the objective of rice self-sufficiency. Import dependence carries risks which are sometimes used to justify self-sufficiency objectives. However, World Bank projections suggest that, if anything, international rice prices will decline into the next century and that therefore the efficiency cost of low return investments could be high.

6.4 The report concludes that there are opportunities for strengthening irrigation performance and increasing efficiency in complementary supporting services, and suggests ways in which this might be achieved, e.g. with respect to irrigation operations, inter-agency coordination and support, agricultural services and marketing and distribution. The specifics of many of these programs lie outside the focus of this report but their impact on the overall

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1 In the longer-term, IRRI are optimistic that hybrid rice may become a viable proposition in the Philippines and that further technological breakthroughs are possible.

grain balance, though difficult to assess, could be significant. High priority needs to be given to necessary detailed studies, in particular with respect to strengthening agricultural research and extension programs and undertaking reforms in transport, marketing and distribution which have the potential for increasing efficiency and reducing real costs to the grains trade. Though the potential for increases in paddy productivity may be less than often supposed, the potential in corn could be substantial and would be strongly promoted by strengthened agricultural support services and a more efficient domestic trading regime.

Irrigation Investment Priorities

6.5 Preliminary results from the reassessment of irrigation potential undertaken by NIA in the context of this study suggests that the theoretical physical potential may be greater than previously thought. Moreover, there are also substantial aquifers that are suited to private development of shallow tubewells. There is therefore a substantial area that could still be developed and there is a natural tendency to assume that, since this potential exists, it should therefore be exploited. However, large-scale irrigation development has often had disappointing economic returns and for reasons presented earlier in this report, future returns are unlikely to be substantially improved. Both farmers and irrigation schemes are performing closer to their real potential than is commonly supposed and, with the maturing of the green revolution, paddy yields can be expected to rise only gradually while improved irrigation management is unlikely to have a major impact on agricultural output. With respect to groundwater development, the private sector is unlikely to make substantial investments for paddy although markets for high value diversified cropping will no doubt expand depending on general economic performance.

6.6 The report therefore recommends caution in implementing future public irrigation investments and suggests a number of considerations for NIA to keep in mind as it reassesses its investment program. These can be summarized as follows: (i) large multi-purpose projects are likely to prove justified only if the costs of headworks and other joint facilities can be attributed primarily to other purposes; (ii) new run-of-the-river national projects will continue to be important but many are high cost with a limited dry season water supply and/or difficult physical conditions; (iii) communal irrigation remains a relatively high priority, subject to rigorous application of selection criteria to ensure that high cost and economically low return projects are avoided; (iv) river lift and tubewell facilities have not proved viable in the public sector and should be predicated on communal or private ownership; and (v) SWIMs should remain essentially a pilot program until their justification can be confirmed. Irrespective of these priorities, implementation and financial constraints will constrain development and several major projects have already encountered delays. A review of NIA's program suggests that multi-purpose projects might account for perhaps 50,000-60,000 ha; run-of-the-river NIS projects for about 80,000-100,000 ha; and communal irrigation for the balance 120,000-140,000 ha. Other programs would be expected to contribute relatively minor amounts. Subject to the economic viability of individual projects, a reasonable objective might thus be a net increase in the service area of, perhaps, 25,000 ha per year or 275,000 ha over the period 1990-2000.

6.7 If achieved, these targets would increase the proportion of the total irrigation potential actually developed from about 37% in 1990 (50% of readily convertible land) to 43% (58% of readily convertible land). Considerable potential would therefore still remain in 2000 though it is debatable how much of this will prove economically justified. These projections do not make specific allowance for the expansion of private irrigation. While private groundwater development could be significant, its impact on the overall rice balance is likely to be modest.

Irrigation Performance and Institutional Support

6.8 It is unrealistic to expect substantial improvements in irrigation performance. Nevertheless, cost-effective rehabilitation, O&M programs and institutional strengthening can still have important benefits. The report has recommended a number of approaches to achieve such an objective:

(a) An 'Irrigation Service Improvement Plan' should be prepared as a basis for identifying appropriate levels of rehabilitation, modernization and O&M improvements in any particular scheme. Such a plan would seek to clarify the irrigation service to be provided, schedule investment works and O&M allocations in support of the service, and develop O&M plans to guide project staff. It would clarify design modifications that are justified, in particular to simplify operations and minimize maintenance requirements.

(b) NIA's corporate structure has stood the test of time and given it a flexibility and purpose frequently lacking in public irrigation departments elsewhere in Asia. Nevertheless, NIA's powers are limited in important respects and it has been unable to generate the internal resources to fund investment or provide adequate support for O&M. Priority must be given to rectifying this situation. Despite political resistance, consideration should be given to increasing the basic ISF rate since this has remained constant since 1975 despite a substantial erosion in its real value. In addition, depending on the outcome of a detailed empirical study, consideration should be given to phasing out payment in kind although not necessarily payment denominated in kind. NIA's strategy of devolving O&M responsibilities to farmers through contractual arrangements and full turnover has major potential for reducing O&M costs and should continue to be given high priority. This also should have a favorable impact on system performance and ISF collections. However, these measures will take time and, in the absence of an increase in the basic ISF rate, NIA may find it increasingly difficult to cover its operating costs while funding O&M at levels needed to sustain performance. Additional commitments should therefore be reviewed with care so as not to over-stress NIA's financial position.

(c) Numerous agencies support irrigated agriculture and mechanisms have evolved for cooperation and coordination. Even so, problems remain, both at the planning stage and in relation to seasonal operating decisions and practices. Modifications must be consistent with the proposed local Government Code and ensure full participation of water users in the decision-making process. As a first step, it is recommended that the Agricultural and Fishery Councils be consolidated with sub-committees of the regional and provincial councils to be responsible for sponsoring coherent and consistent rural development, and coordinating the provision of inputs and services in support of irrigated agriculture. Scheme-specific coordinating mechanisms need also to be strengthened, in particular in the larger schemes. Increasingly, as non-agricultural uses grow and competing pressures on scarce water resources emerge, it will become important to develop mechanisms for managing inter-sectoral allocations and resolving conflicts on a rivercourse basis. Provincial water resource committees would then be required, with appropriate mechanisms developed at a regional level for rivers that traverse more than one province.

Possible Trade Policy Regimes

6.9 Given these prospects for irrigation, and assuming that average yields increase annually by one per cent and the irrigation service area by 25,000 ha, the report concludes that rice imports might rise to some 0.75-1.25 M t (perhaps 10-15% of demand) by the year 2000. Besides reviewing irrigation prospects, the report has investigated how trading and pricing policies might moderate these deficits, given that there are significant differences in the trading regimes of the three major grains -- at end-1990 exchange rates, 1990 wheat prices were largely set by market forces in relation to world prices, subject to tariffs and duties (about 20%); rice prices were broadly at import equivalent prices, being essentially controlled by the scheduling of NFA imports; and Manila corn prices were more than 40% above world levels, maintained at this level through quantitative controls and, to a lesser extent, a 20% tariff (15% for ASEAN countries).

6.10 There are strong arguments on grounds of economic efficiency for liberalizing imports and aligning domestic prices with those on international markets. Abolition of quantitative restrictions on wheat in the mid-1980s promoted competition, and encouraged investment in marketing and processing. Reform in corn and rice can be expected to have similar effects. However, these are staple crops produced locally so that liberalization must be introduced carefully. For corn in particular, protection offsets high domestic distribution costs and a sharp reduction in prices without corresponding improvements in marketing could have an adverse impact on production and farmer incomes. One option would be to equalize tariffs between the three grains at levels which provided adequate protection to corn over the medium term until efficiency can be improved in the domestic production, marketing and distribution system. The report shows that a uniform 20% tariff would moderate demand for rice by the order of 0.30-0.35 M t and could induce additional supply of perhaps 0.25 M t. Thus, while unifying the trading regimes in this manner has the potential for moderating the rice deficit, the analysis does not fundamentally alter the conclusion that the Philippines will remain a deficit producer in the 1990s. Such a strategy would also lead to increase in wheat and corn imports, in particular due to increased demand for feed corn as a result of lower corn and meat prices.

6.11 Two issues need to be considered if, despite the economic costs involved, protective measures are to be adopted: the advantages of tariffs relative to quantitative controls, and an appropriate response to world price volatility. An approach which deals with both issues is a reference price/variable tariff system, with the tariff adjusted automatically to reflect the difference between a world reference price and a target domestic price. In the case of corn, the tariff rates should be lowered over time to reflect progress in reducing internal trading costs and transport constraints. In the case of rice, the aim could be to equalize tariff rates to ensure efficient competition between the main grains while insulating domestic prices from world price fluctuations. Liberalization of corn is a priority in view of the potential impact on the livestock industry which has considerable expansion potential if only feed costs can be reduced.

Domestic Interventions to Increase Market Efficiency

6.12 NFA intervenes in the domestic market to balance the interests of producers and consumers. However, procurement is inadequate to support farmgate prices except at a few favored locations; and release prices are well below private market levels so that NFA incurs losses on its domestic operations. Moreover, a low release price puts pressure on commercial margins, disrupts normal market operations and opens up rent-seeking opportunities. This discourages investment in milling, storage and transport, contributing to trading inefficiencies and high post harvest losses. A low release price aims to provide poorer consumers with subsidized grain while at the same time sustaining prices to the producer. But combining subsidy functions and price stabilization results in neither objective being efficiently achieved.

6.13 Detailed investigation of NFA's domestic operations has been beyond the scope of this study. Nevertheless, in general, the aim should be to promote a competitive private sector with primary responsibility for balancing the market. As a minimum, and perhaps as an interim measure, there is a strong prima facie case for greatly increasing the margin between the support and release prices to accommodate seasonal price movements and realistic trader costs and margins. Under such a scenario, NFA would manage a transparent buffer stock operation with the preannounced release price enforced by disposal of buffer stocks and imports, and procurement supporting the producer price to the extent that NFA resources allowed. NFA's financial position would be greatly improved by such reforms. However, price stabilization could remain a relatively costly activity. In the longer-term, trade liberalization and improvements in the efficiency of the domestic trading environment could together be sufficient to moderate price fluctuations. If so, NFA's price stabilization activities might be gradually reduced, with the public sector's role largely confined to supporting a competitive private sector through infrastructural investments and an appropriate policy environment.

6.14 Irrespective of NFA's price stabilization role, subsidy programs -- if any -- should be targeted at those segments of the population which need to be protected against the increase in retail (release) prices rather than, as at present, being available to all through NFA outlets. If NFA is the responsible agency for implementing such subsidy programs, they would need to be financed and accounted for separately from its other operations. Such subsidies should be clearly budgeted so that their costs are a transparent consequence of Government policy without distorting NFA's finances.

Concluding Remarks

6.15 It has been suggested above that national economic welfare would gain from gradual elimination of quantitative and other forms of protection on wheat and corn, and that this will improve the rice balance (by reduction of demand) almost as much as doubling of the investment program in irrigation (from 25,000 ha to 50,000 ha p.a.). Such welfare gains would, however, be at the expense of increased total grain imports (mainly feed corn in support of increased meat consumption) and, despite some reduction, the rice deficit would remain substantial. As it is imports of total grains, rather than rice alone, which are of most economic significance, it would appear to be generally more efficient to invest in the corn-producing sector (notably in agricultural research, seed production and transport and distribution) rather than in rice. While everything possible should also be done in the rice sector to increase productivity from existing areas, the prospects for productivity increases are higher in corn than in rice and growth in corn consumption is also expected to increase more rapidly than for rice.

6.16 Rice imports could in theory be moderated further through an accelerated irrigation investment program or through tariff protection. However, a larger scale of irrigation investment is likely to entail projects with low or negative returns and, in the Bank's judgment, the foreign exchange and real resource costs are not affordable in the current economic situation of the Philippines. The alternative of using protection to stimulate increased rice supply (which is unlikely to be very responsive) and decreased rice demand involves losses to consumers. Moreover, experience elsewhere suggests that agricultural protection, once imposed, is often difficult to remove and tends to worsen over time. Despite the political difficulties involved, it may thus be necessary to accept significant rice imports and efforts should go into generating the foreign exchange needed to purchase them in sectors in which the Philippines has a comparative advantage.

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Rice Supply and Utilization, Calendar Year 1961-1990
(in '000 MT, '000 Hectares, MT per hectar)

	Rice Paddy						Rice Milled						
	Supply			Use			Supply				Use		
	Harvested Area	Yield	Production	Process	Exports	Seed	Production	Beginning Stocks	Imports	Exports	Feed	Food	Process
Year	('000 ha.	(t/ha)	('000 t)				('000 t)						
1961	3,179	1.23	3,910	3,669	NA	221	2,275	NA	188	0.05	68	2,304	25
1962	3,161	1.25	3,967	3,890	NA	216	2,412	66	0	0.4	72	2,244	24
1963	3,087	1.24	3,843	3,948	NA	224	2,448	71	256	0.09	73	2,334	27
1964	3,200	1.25	3,992	3,816	NA	218	2,366	269	299	0.09	71	2,500	27
1965	3,109	1.31	4,073	3,973	NA	217	2,463	67	560	0.03	74	2,851	30
1966	3,096	1.32	4,094	4,050	NA	231	2,511	67	108	0.02	75	2,445	26
1967	3,304	1.38	4,561	4,048	1.6	233	2,510	73	290	1.00	75	2,626	28
1968	3,332	1.33	4,445	4,558	0.4	224	2,826	70	0	15.00	85	2,595	28
1969	3,196	1.71	5,464	4,637	0.3	224	2,875	103	0	1.00	86	2,677	29
1970	3,195	1.75	5,578	5,482	1.9	233	3,399	82	0	2.00	102	2,600	34
1971	3,332	1.60	5,325	5,595	0.8	224	3,469	661	370	0.00	104	2,700	38
1972	3,194	1.44	4,610	5,292	7.2	247	3,281	997	456	5.00	98	2,700	37
1973	3,528	1.66	5,841	4,906	5.2	253	3,042	896	336	3,00	91	2,783	34
1974	3,632	1.63	5,910	5,351	NA	264	3,344	466	166	0.00	100	3,109	35
1975	3,674	1.75	6,431	5,840	0.0	272	3,679	266	135	0.01	110	3,695	38
1976	3,641	1.85	6,741	6,269	NA	274	3,981	(29)	55	0.00	134	3,767	40
1977	3,602	2.00	7,199	6,977	0.2	278	4,465	94	31	14,80	134	3,766	45
1978	3,561	2.11	7,515	6,945	0.8	266	4,615	1,308	0	48.00	134	3,811	45
1979	3,637	2.15	7,836	7,419	0.9	266	4,957	1,594	0	165.00	145	4,032	48
1980	3,459	2.23	7,723	7,386	7.0	260	4,970	1,885	0	263.00	144	4,456	48
1981	3,443	2.3[illegible]	8,122	7,654	20.0	256	5,142	1,646	0	95.00	149	4,593	50
1982	3,240	2.39	7,731	8,282	0.3	251	5,417	1,611	0	0.50	162	4,810	54
1983	3,141	2.50	7,841	7,066	NA	229	4,756	1,866	0	40.00	139	4,639	46
1984	3,222	2.55	8,200	7,592	1.4	237	5,120	1,491	189	2.00	149	5,164	52
1985	3,403	2.67	9,097	8,558	NA	248	5,759	1,147	538	0.10	168	5,153	61
1986	3,403	2.63	8,958	9,027	0.0	220	6,047	1,755	2	0.00	177	5,224	59
1987	3,284	2.65	8,688	8,487	0.1	244	5,585	2,017	0	111.50	167	5,393	56
1988	3,392	2.71	9,208	9,044	0.0	254	5,867	1,575	181	0.00	177	5.559	60
1989	3,497	2.70	9,459	NA	NA	NA	6,186	1,100	220	0.00	402	5,880	NA
1990	3,318	2,81	9,319	NA	NA	NA	6,095	1,100	622	0.00	396	5,968	NA

Source: Data for 1961-77 are from FAO Production, Supply, and Utilization Databases.
Data for 1978-90 are from BAS, Statistical Handbook on Supply and Utilization Accounts of Cereals and Cereals Products and Rice and Corn Situation and Outlook, Vol. IV No. 12, January 1, 1991

Attachment 1
Table A.2

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Corn Supply and Utilization, Calendar Years 1961-90

	Supply					Use			
Year	Harvested Area	Yield	Production	Beginning Stock	Imports	Feed & Waste	Seed	Process	Food
1961	2,016	0.628	1,266	NA	0.09	NA	NA	NA	NA
1962	1,950	0.653	1,273	NA	0.01	NA	NA	NA	NA
1963	1,898	0.681	1,293	NA	0.08	NA	NA	NA	NA
1964	1,923	0.683	1,313	NA	0.06	NA	NA	NA	NA
1965	2,106	0.655	1,380	NA	2.25	NA	NA	NA	NA
1966	2,158	0.691	1,490	NA	1.05	NA	NA	NA	NA
1967	2,248	0.720	1,619	NA	48.93	NA	NA	NA	NA
1968	2,256	0.768	1,733	NA	0.08	NA	NA	NA	NA
1969	2,420	0.830	2,008	NA	25.79	NA	NA	NA	NA
1970	2,428	0.829	2,012	NA	1.01	NA	NA	NA	NA
1971	2,454	0.825	2,024	NA	54.76	NA	NA	NA	NA
1972	2,351	0.784	1,843	NA	160.46	NA	NA	NA	NA
1973	2,726	0.828	2,258	NA	80.24	NA	NA	NA	NA
1974	3,010	0.835	2,514	NA	110.10	NA	NA	NA	NA
1975	3,193	0.851	2,717	NA	121.47	NA	NA	NA	NA
1976	3,243	0.856	2,775	NA	96.40	NA	NA	NA	NA
1977	3,158	0.885	2,796	NA	148.43	NA	NA	NA	NA
1978	3,252	0.943	3,073	277	105.48	1,848	64	155	1,005
1979	3,201	0.976	3,056	384	34.77	1,994	64	153	1,006
1980	3,239	0.960	3,050	258	249.94	2,118	64	152	1,005
1981	3,361	0.979	3,296	219	253.14	2,313	66	164	989
1982	3,157	0.990	3,404	236	340.95	2,485	68	170	994
1983	3,270	1.023	3,134	264	528.44	2,436	63	156	952
1984	3,227	1.007	3,250	319	182.40	2,393	64	162	950
1985	3,511	1.100	3,863	182	281.18	2,631	70	194	1,000
1986	3,595	1.138	4,091	431	0.16	3,036	72	205	968
1987	3,683	1.162	4,278	241	55.81	3,039	74	214	1,018
1988	3,745	1.182	4,428	230	25.13	3,067	75	221	1,027
1989	3,689	1.230	4,522	293	173.00	3,438	74	227	1,111
1990	3,820	1,270	4,854	138	348.00	3,601	76	243	818

Source: Data for 1961-77 are from FAO Production, Supply, and Utilization Data bases.

Data for 1978-90 are from BAS, Statistical Handbook on Supply and Utilization Acounts of Cereals and Cereal Products and Rice and Corn Situation and Outlook, Vol. IV No. 12, January 1, 1991

Attachment 1
Table A.3

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Wheat and Wheat Flour Supply and Utilization, Calendar Years 1961-90
(in '000 MT)

	Wheat	Wheat Flour					
		Supply			Use		
Year	Imports	Production	Beginning	Imports	Feed	Process	Food
1961	248	183	NA	79	NA	1	258
1962	322	238	NA	21	NA	1	255
1963	409	303	NA	22	NA	2	320
1964	346	256	NA	54	NA	2	306
1965	434	221	NA	53	NA	1	269
1966	420	318	NA	68	NA	2	380
1967	487	368	NA	54	NA	2	415
1968	488	387	NA	92	NA	2	472
1969	553	409	NA	24	NA	2	426
1970	495	381	NA	16	NA	2	391
1971	588	465	NA	17	NA	2	474
1972	712	471	NA	36	NA	3	499
1973	504	391	NA	20	NA	2	405
1974	478	398	NA	28	NA	2	420
1975	518	391	NA	17	NA	2	402
1976	704	521	NA	13	NA	3	526
1977	651	482	NA	14	NA	2	488
1978	675	500	8	9	5	3	501
1979	705	522	4	20	5	3	533
1980	786	581	12	9	6	3	582
1981	796	589	10	13	6	3	593
1982	924	684	4	13	7	3	687
1983	797	590	6	11	6	3	592
1984	766	567	5	9	6	3	567
1985	663	490	18	27	5	3	510
1986	960	710	16	92	8	4	790
1987	672	497	22	46	5	3	535
1988	1,075	795	15	72	9	4	854
1989	1,230	NA	NA	70	NA	NA	NA
1990	1,650	NA	NA	50	NA	NA	NA

Source: Data for 1961-77 are from FAO Production, Supply, and Utilization Data bases.

Data for 1978-90 are from BAS, Statistical Handbook on Supply and Utilization Acounts of Cereals and Cereal Products.

Data for 1989 wheat imports are from USDA.

Attachment 1
Table A.4

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Philippines Total Food Consumption

Year	Cereals	Roots & Tubers	Pulses	Vegetable	Fruits	Meat & Offals	Eggs	Veg Fats & Oils	Milk	Fish
	(Thousand Tons)									
1961	3,138	1,175	37	416	750	372	73	73	98	413
1962	3,220	1,105	30	435	780	417	72	76	105	425
1963	3,399	1,197	29	420	819	431	76	78	86	485
1964	3,573	1,319	25	429	833	445	78	84	103	527
1965	3,915	1,272	25	453	848	488	82	128	102	595
1966	3,655	1,242	24	457	891	562	83	146	97	622
1967	3,995	1,134	24	464	908	575	82	142	108	671
1968	4,047	1,093	24	471	911	627	104	126	131	846
1969	4,209	1,071	23	489	957	640	129	149	141	871
1970	4,171	1,067	23	541	1,037	606	111	145	118	991
1971	4,407	731	22	536	1,046	622	123	144	112	1,062
1972	4,454	870	26	527	1,115	587	135	168	105	1,143
1973	4,481	1,075	24	562	1,083	676	148	174	96	1,244
1974	5,021	1,290	20	604	1,209	795	158	151	109	1,314
1975	5,704	1,514	28	637	1,339	667	181	120	92	1,391
1976	5,977	1,610	32	634	1,645	648	193	174	115	1,328
1977	5,858	2,213	32	684	1,833	613	274	220	128	1,378
1978	6,039	3,104	34	703	2,150	669	264	184	115	1,354
1979	6,419	2,927	34	685	2,446	800	231	172	144	1,283
1980	6,821	3,126	38	746	2,969	861	244	179	131	1,366
1981	6,973	3,057	39	750	3,006	899	241	169	112	1,505
1982	7,375	2,748	39	758	3,080	859	249	159	143	1,592
1983	6,984	1,980	41	682	3,101	908	263	207	129	1,692
1984	7,372	2,171	41	678	2,894	917	255	154	95	1,650
1985	7,723	2,321	40	667	2,913	752	226	210	116	1,611
1986	8,098	2,332	48	692	3,050	842	228	255	135	1,686
1987	7,704	2,401	46	721	3,187	913	233	206	186	1,686
1988	8,380	2,268	48	716	3,222	1,036	282	260	160	1,686

Source: FAO Food Supply and Utilization Accounts Data Base.

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Per Capita Food Consumption

Year	Cereals	Roots & Tubers	Pulses	Vege	Fruits	Meat & Offals	Eggs & Oils	Veg. Fats	Milk	Fish
	----------	----------	----------	----------	----------	(Kg/Person)	----------	----------	----------	----------
1961	110.594	41.401	1.290	14.676	26.422	13.109	2.578	3.040	3.472	14.551
1962	110.234	37.834	1.016	14.901	26.694	14.279	2.475	3.110	3.610	14.550
1963	113.528	39.970	0.955	14.017	27.361	14.404	2.539	3.191	2.876	14.192
1964	115.842	42.757	0.803	13.923	27.025	14.413	2.520	3.337	3.344	17.078
1965	123.243	40.046	0.785	14.246	26.685	15.350	2.580	4.557	3.208	18.725
1966	111.658	37.932	0.722	13.962	27.210	17.169	2.540	5.055	2.963	19.007
1967	118.524	33.642	0.725	13.766	26.933	17.043	2.444	4.818	3.215	19.890
1968	116.514	31.476	0.694	13.566	26.244	18.066	2.987	4.284	3.778	24.348
1969	117.666	29.945	0.649	13.666	26.767	17.904	3.598	4.869	3.930	24.350
1970	113.195	28.951	0.624	14.684	28.135	16.438	3.002	4.608	3.201	26.899
1971	116.272	19.278	0.586	14.129	27.588	16.407	3.236	4.498	2.957	28.008
1972	114.229	22.312	0.657	13.526	28.590	15.067	3.463	4.868	2.690	29.315
1973	111.689	26.802	0.589	14.013	26.986	16.839	3.694	4.961	2.385	31.016
1974	121.580	31.227	0.483	14.614	29.276	19.252	3.817	4.336	2.629	31.816
1975	135.581	35.995	0.668	15.148	31.826	15.862	4.313	3.469	2.184	33.068
1976	137.677	37.082	0.728	14.607	37.905	14.931	4.443	4.615	2.646	30.581
1977	131.396	49.634	0.710	15.344	41.117	13.745	6.139	5.540	2.865	30.913
1978	131.879	67.789	0.733	15.362	46.957	14.615	5.770	4.641	2.502	29.570
1979	136.468	62.857	0.715	14.558	52.007	17.003	4.902	4.360	3.063	27.274
1980	141.162	66.552	0.776	15.437	61.437	17.823	5.045	4.447	2.718	28.268
1981	140.755	61.712	0.788	15.144	60.685	18.152	4.868	4.031	2.261	30.381
1982	145.233	54.108	0.768	14.920	60.654	16.919	4.905	3.650	2.822	31.353
1983	134.152	38.041	0.796	13.102	59.566	17.439	5.043	4.565	2.480	32.495
1984	138.180	40.697	0.775	12.701	54.245	17.190	4.782	3.410	1.775	30.936
1985	141.268	42.458	0.725	12.203	53.287	13.749	4.130	4.262	2.117	29.462
1986	144.603	41.650	0.861	12.363	54.469	15.032	4.078	5.024	2.416	30.107
1987	134.317	41.864	0.796	12.568	55.559	15.919	4.062	4.103	3.249	29.393
1988	142.714	38.628	0.815	12.196	54.866	17.636	4.804	5.020	2.728	28.713

Source: FAO Food [illegible]y and Utilization Accounts Database.

ATTACHMENT 1
Table A.6

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Rice (Special Variety): Average Annual Prices
(P/Kg)

	PALAY		RICE					
'ear	Farmgate price (Market)	Support price (NFA warehouse)	Farmgate price (Market)	Support price (NFA warehouse)	Wholesale price (Market)	Retail price (Market)	Retail ceiling price	Import or price CIF (FOB)
.972	-	0.54	-	0.83	0.63	1.25	0.90	0.60
.973	0.77	0.61	1.18	0.94	0.76	1.56	1.16	1.88
.974	0.94	0.82	1.45	1.26	1.04	1.96	1.90	2.51
.975	0.98	1.00	1.51	1.54	1.08	1.94	1.90	2.14
.976	0.98	1.06	1.51	1.63	1.05	2.04	2.03	2.08
.977	1.00	1.10	1.54	1.69	1.08	2.11	2.10	(2.07)
.978	0.98	1.10	1.51	1.69	1.06	2.09	2.10	(2.23)
.979	1.04	1.25	1.60	1.92	1.10	2.29	2.36	(2.07)
.980	1.15	1.36	1.77	2.09	2.30	2.45	2.51	(2.10)
.981	1.30	1.51	2.00	2.32	2.61	2.72	2.75	(2.49)
.982	1.36	1.65	2.09	2.53	2.76	2.96	3.00	(3.24)
983	1.52	1.75	2.32	2.68	2.99	3.19	3.23	(2.60)
984	2.47	2.64	3.78	4.04	4.84	5.09	4.64	3.86
985	3.23	3.44	4.94	5.26	6.51	7.00	6.03	4.23
986	2.82	3.50	4.31	5.35	5.79	6.56	5.50	-
987	3.07	3.25	4.69	4.97	5.84	6.61	5.50	(4.52)
988	3.44	3.50	5.26	5.35	6.48	7.23	5.50	6.90
989	4.14	3.83	6.33	5.86	7.83	8.46	5.67	(3.42)

ote: The palay farmgate and NFA support price was converted into a rice equivalent price under the assumption of a 65% rice million recovery from 1972 to 1981, 65.2% in 1982, 65.4% from 1983 to present.

ources: Bureau of Agricultural Statistics and National Food Authority.

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

White Corn: Average Annual Prices
(P/Kg)

Year	Shelled Corn			White Corn Grits				
	Farm Market	Support NFA	Wholesale Phil.	Farm Market	Support NFA	Wholesale Market	Retail Market	Ceiling NFA
1972	0.46	0.40	0.54	0.56	0.46	0.72	0.92	0.83
1973	0.55	0.50	0.62	0.60	0.57	0.90	1.06	0.83
1974	0.94	0.71	0.90	1.07	0.81	1.30	1.46	1.45
1975	0.95	0.80	0.90	1.08	0.91	1.28	1.46	1.45
1976	0.97	0.90	0.98	1.09	1.02	1.39	1.53	1.60
1977	1.01	0.90	1.01	1.14	1.03	1.47	1.59	1.60
1978	0.97	0.90	1.00	1.07	1.02	1.38	1.57	1.60
1979	0.96	1.00	1.03	1.14	1.14	1.43	1.63	1.60
1980	1.05	1.15	1.18	1.34	1.31	1.65	1.84	1.75
1981	1.18	1.30	1.37	1.56	1.48	1.89	2.11	1.82
1982	1.25	1.30	1.44	1.66	1.48	2.01	2.25	2.15
1983	1.34	1.35	1.57	1.52	1.53	2.12	2.35	2.28
1984	2.34	2.00	2.64	2.66	2.66	3.78	4.05	3.55
985	2.80	2.80	3.36	3.18	3.18	5.01	5.37	*
.986	2.54	2.90	3.04	2.88	3.29	4.46	4.88	*
987	2.91	2.90	3.34	3.31	3.29	4.18	5.13	*
.988	2.95	2.90	3.40	3.35	3.29	4.78	5.27	*
989	4.04	3.90	4.18	4.59	4.43	4.91	5.45	*

* Lifted (LC #25 DTD. Oct. 10, 1989).

'ource: Bureau of Agricultural Statistics and National Food Authority.

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Yellow Corn: Average Annual Prices

Year	Farmgate Price (Market)	Support Price NFA	Wholesale Price Phil.	Wholesale Price M.M.	Import Price F.O.B.
1972	0.54	0.40	0.61	0.63	0.40
1973	0.55	0.50	0.73	0.67	0.68
1974	0.91	0.71	1.04	1.11	1.19
1975	0.94	0.80	1.10	1.18	1.06
1976	0.94	0.90	1.22	1.26	0.99
1977	0.99	0.90	1.19	1.28	0.92
1978	0.97	0.90	1.22	1.27	1.21
1979	1.01	1.00	1.17	1.31	1.05
1980	1.16	1.15	1.41	1.53	1.52
1981	1.29	1.30	1.59	1.84	1.78
1982	1.34	1.30	1.59	1.97	1.45
1983	1.39	1.35	1.78	1.96	1.59
1984	2.36	2.00	2.92	3.26	2.13
1985	2.91	2.80	3.57	3.94	2.06
1986	2.70	2.90	3.49	3.91	1.78
1987	2.98	2.90	3.63	4.40	2.19
1988	2.96	2.90	3.67	4.87	2.93
1989	4.03	3.90	4.33	5.09	3.36

Source: Bureau of Agricultural Statistics and National Food Authority.

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Fertilizer Prices: Domestic Ex-Warehouse Price and World Price, 1973-88
(P/Kg of fertilizer)

Calendar Year	UREA Domestic Ex-Warehouse price a/	UREA World price b/	AMMONIUM SULFATE Domestic Ex-Warehouse price	AMMONIUM SULFATE World price b/	MURIATE OF POTASH Domestic Ex-Warehouse price	MURIATE OF POTASH World price b/	COMPLETE Domestic Ex-Warehouse price	COMPLETE World price b/
1973	0.69	0.71	0.38	0.39	0.61	0.35	0.58	1.00
1974	1.27	1.89	0.87	1.14	0.72	0.60	1.13	1.92
1975	1.85	2.69	0.95	1.59	1.56	0.65	1.26	-
1976	1.60	0.91	0.92	0.50	1.16	0.56	1.20	-
1977	1.51	0.96	1.00	0.67	1.04	0.51	1.20	-
1978	1.51	1.17	1.06	0.76	1.04	0.52	1.20	1.26
1979	1.70	1.30	1.21	0.82	1.19	0.69	1.45	1.30
1980	1.85	1.75	1.34	1.03	1.66	1.13	1.60	1.98
1981	2.16	2.17	1.59	1.21	1.97	1.20	1.86	1.86
1982	2.33	1.67	1.70	0.85	2.04	0.99	2.17	1.53
1983	2.52	1.78	1.79	0.99	2.23	1.11	2.47	1.88
1984	4.61	3.20	2.45	1.80	3.30	1.96	4.08	3.00
1985	5.50	3.10	2.91	1.80	3.82	1.74	4.99	3.19
1986	2.77	2.27	1.84	1.34	2.68	1.78	3.84	3.47
1987	2.58	2.24	1.74	1.48	2.54	1.98	3.84	3.33
1988	3.58	3.46	2.28	2.08	2.95	2.75	4.22	4.05

a/ Computed based on the domestic ex-warehouse price for urea set by the FPA.
b/ Based on import price (CIF).

Source: Fertilizer and Pesticide Authority.

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ANNEX 1. THE PHYSICAL SETTING

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ANNEX 1. THE PHYSICAL SETTING

1. GENERAL

1. The Philippines with some 7,100 islands and islets is the largest archipelago in the world with an aggregate land area of approximately 300,000 km^2. About 90% of the area lies in the eleven largest islands of Luzon, Mindoro, Masbate, Samar, Leyte, Bohol, Cebu, Negros, Panay, Palawan and Mindanao (Map IBRD 22603). The two great islands of Luzon and Mindanao form about two thirds of the total area, while 463 small islets have an aggregate area of only 2,500 km^2 (<1% of the total country area). The island group is closely scattered within a zone bounded by latitudes 4.5^0 N to 21^0 N and longitudes 107^0 E to 127^0 E, and lies in the tropical belt to the southeast of the Asian mainland.

2. Population. In 1989, the population of the Philippines was estimated at about 60.1 M of which 40% was considered to be urban. This should be compared with an estimated population of 42.8 M in 1975 of which about 20% was regarded as urban. Some 7.8 M or about 13% of the total population presently live within the urban conurbation of Metro Manila. If the present natural growth of population of 2.4%/annum is maintained, the total population would double to about 120 M in one generation. Rapid population growth in the last four decades is generally acknowledged as a major force in the degradation of the Philippine agricultural, forest and marine resources and in the deterioration of urban living conditions, particularly in Metro Manila.

3. Administration. The country is divided into 73 provinces excluding Metro Manila. These are administrative entities with a Governor and a Provincial Assembly, which are now grouped into 12 geographical regions as listed below (Table 1) and shown by Map IBRD 22603. Within the provinces are more than 1,400 municipalities and over 30,000 barrios or villages.

2. GEOLOGY

4. The geology of the Philippines is extremely complex. The archipelago is located within a zone of very active plate tectonism and the country lies on a series of roughly north-south orientated stress lines along which numerous episodes of faulting, folding and volcanic activities have taken place. The presence of active volcanoes in the island chain and the relatively frequent occurrences of earthquakes testify to the present tectonic activity of the region. A wide range of rock types form the immediate subsurface. Among the sedimentary rock groups represented are unconsolidated alluvium of various types (often intercalated with pyroclastic volcanic deposits), various types of consolidated clastic sediments, and carbonate rocks. Volcanic rocks of both basaltic and pyroclastic types cover wide areas. Outcrops of plutonic igneous rocks and of various metamorphic rocks also occur. Alluvium or alluvium inter-bedded with pyroclastic material form the plain lands within the valleys, while hard rocks or consolidated sediments and pyroclastics form the hills. The intensive and relatively recent earth movements and major

episodes of vulcanism have produced a series of rugged mountain ranges which divide the islands into a series of relatively small watersheds. The complex geological history resulting in many rock types and the very active processes of weathering and erosion have produced a wide variety of soil types.

Table 1: Regions and Provinces of the Philippines

	LUZON	
I.	Ilocos (incl. CAR)	Abra, Benguet, Ilocos Norte, Ilocos Sur, La Union, Mountain Province, Pangasinan
II.	Cagayan Valley	Batanes, Cagayan, Ifugao, Isabela, Kalinga Apayao, Nueva Vizcaya, Quirino
III.	Central Luzon	Bataan, Bulacan, Nueva Ecija, Tarlac, Zambaales, Pampanga
IV.	Southern Tagalog	Aurora, Batangas, Cavite, Laguna, Marinduque, Mindoro Occidental, Mindoro Oriental, Rizal, Palawan, Quezon, Romblon
V.	Bicol	Albay, Camarines Norte, Camarines Sur, Catanduanes, Masbate, Sorsogon
	VISAYAS	
VI.	Western Visayas	Aklan, Antique, Capiz, Iloilo, Negros Occidental
VII.	Central Visayas	Cebu, Bohol, Negros Oriental, Siquijor
VIII.	Eastern Visayas	Northern Samar, East Samar, West Samar, Northern Leyte, Southern Leyte
	MINDANAO	
IX.	Western Mindanao	Basilan, Sulu, Tawi Tawi, Zamboanga del Norte, Zamboanga del Sur
X.	Northern Mindanao	Agusan del Norte, Agusan del Sur, Bukidnon, Misamis Occidental, Misamis Oriental, Surigao del Norte, Camiguin
XI.	Southern Mindanao	Davao del Norte, Davao del Sur, Davao Oriental, Surigao del Sur, Southern Cotabato
XII.	Central Mindanao	Lanao del Norte, Lanao del Sur, Maguidanao, Northern Cotabato, Sultan Kudarat

3. TOPOGRAPHY AND DRAINAGE (Map IBRD 22604)

5. Luzon. The island of Luzon, the largest in the Philippines, contains three major mountain ranges which occupy much of the northern part of the island. The Sierra Madre range stretches along the east coast from the extreme northeast of the island to east of Laguna de Bay as an almost unbroken series of mountains. This range abuts directly on the Pacific Ocean, leaving little plain land on the eastern part of the island. Most of northern Luzon to the west of the Sierra Madre is occupied by a massive block of mountains known as the Cordillera Central which extends from the northern coast of the island over about 270 km to join with the Sierra Madre range in the province of Nueva Vizcaya, where it is called the Carabello Mountain.

6. The Cagayan river valley lies between the Sierra Madre on the east, the Cordillera Central on the west and has the Carabello Mountain to the south. The valley measures some 200 km from north to south and is 30-80 km in width. The total area of the river basin is 15,469 km^2 and the river discharges to the sea on the northern coast of Luzon. The river has four main tributaries, the Chico, Magat, Siffu and Pinacanauan. There is a marked break in slope from the mountains on to the valley floor, which is mainly rolling land. The true flood plain is found only as a relatively narrow strip along the Cagayan river and its major tributaries, and the largest area of plain lands is found in Isabela Province in the southern part of the valley.

7. The western and northern parts of the Cordillera Central area are drained by a large number of relatively small river systems which flow independently to the South China Sea. The largest system is that of the Abra river which has a catchment area of 5,125 km^2 and drains a large part of the Ilocos Region. The plain lands on these river systems are often of relatively limited extent and mainly confined to the coastal strip.

8. The Zambales range extends along the southwest coast of the northern part of Luzon for about 200 km from the Lingayan Gulf to Manila Bay. Located to the east of the Zambales, to the south of the Cordillera Central and the Carabello Mountain, and to the west of the southern extension of the Sierra Madre, is the great plain of the Central Luzon Region, broken only by a few mostly extinct volcanoes. It forms the largest single area of plain lands in the Philippines. Measuring some 80 km by 160 km, the plain extends from the Lingayan Gulf to Manila Bay. It is crossed by a low drainage divide between the basins of the Agno and Pampanga river systems. The Agno river originates on the southern slopes of the Cordillera Central, emerges onto the plain in Pangasinan Province in Ilocos, and then turns northwest to enter the Lingayan Gulf near Lingayen City. The Agno river has four main tributaries, the O'Donnell, Bulsa, Camiling and Pila, all of which originate on the Zambales range. The total area of the basin is 7,460 km^2. Much of the plains is at low elevation and there are extensive swamps around the confluence of the Agno and O'Donnell rivers and along the coast. The Pampanga river has its source on the southern slope of the Carabello Mountain and flows southwards to debouch into Manila Bay. The major west bank tributaries are the Rio Chico and Talavera rivers. Five important east bank tributaries originate on the Sierra Madre range - the Pantabangan, Digmala, Coronel, Penaranda and Angat. The total area of the Pampanga river basin is 10,540 km^2. There are extensive swamp lands in lower lying areas where east and west tributaries join the main stream (the San Antonio and Candaba swamps respectively) and in areas adjacent to Manila Bay.

9. South-central Luzon forms part of the Southern Tagalog Region lying to the east and south of Manila. The southern part of the Sierra Madre range and its southern (isolated) extension across the Bicol Peninsula into southern Quezon Province is reduced to a series of relative low hill ranges. To the west of these ranges is a mixture of rolling lands, plains, volcanic hills and great lakes (the largest of which are Laguna de Bay and Taal Lakes). The largest drainage basin is that centered on Laguna de Bay (4,678 km^2) which spills into Manila Bay. The remainder of the area is drained by a large number of small river systems into Manila Bay to the north, the Sibuyan Sea to the southwest and the Pacific Ocean (Philippine Sea) to the east.

10. The Bicol Peninsula of Southern Luzon, which forms part of Bicol Region, has low hills on both the east and west sides which flank the Bicol Plain. Several isolated volcanoes are located within the plain. The plain is drained mainly by the Bicol river system which has a catchment area of 3,120 km^2, of which large areas are poorly drained and subject to annual flooding. The remainder of the peninsula is drained by a series of small rivers with steep upper catchments falling on to narrow and discontinuous coastal plains on the north and south sides of this part of Luzon.

11. Mindoro Island. This island forms two provinces which are included within the Southern Tagalog Region. It has a total area of about 10,000 km^2 exclusive of a number of small islets which are under its administrative units. It consists largely of mountain ranges with the highest peaks rising to in excess of 2,500 m AMSL. The plain lands are confined to a narrow and discontinuous coastal strip. The island is drained by a large number of small rivers which radiate from the mountains, flowing to the South China Sea on the west and the Sibuyan Sea on the east.

12. Palawan Island. The province of Palawan forms part of the Southern Tagalog Region and is composed of 1,780 islands and islet, the largest of which is Palawan Island. This island is 425 km long and ranges from 8 to 40 km in width. A chain of mountains runs down its entire length, most of which rise to more than 1,000 in AMSL with the highest peaks exceeding 2000 m elevations. A few pockets of level or near level land are found amid generally rolling land at the northern end of the island. There are practically no plain lands along the west coast, excepting some swamp lands around Imuran Bay in the north. Along the east coast, there are small inter-montane plains in the north, and a narrow coastal strip to the south of Puerto Princess includes near level plains intermingled with rolling terrain and coastal swamp. Most of the island is under forest. The area is drained by numerous small river systems originating in the central range of mountains which drain steep catchments to the South China Sea to the north and the Sulu Sea to the south.

13. Catanduanes Island. This island lies immediately to the east of the Bicol Peninsula and forms part of the Bicol Region. It has an area of about 1,500 km^2 and forms a province. The terrain is generally rugged with the highest peak reaching about 800 m AMSL and with some 57% of the total surface on slopes exceeding 18%. The only plain areas are found along the coast, and these are small and scattered. The island is drained radially by numerous small rivers and creeks which flow independently to the sea from generally steep catchments.

14. Masbate Island. This island also forms a province of Bicol Region, lying to the south of the Bicol Peninsula. The total area is about 4,100 km^2

excluding the small islands of Burias and Ticao which are included under the province's administration. The topography of the island ranges from undulating to mountainous. The plain lands are small and scattered along the coast. The island is divided into numerous small catchments which are mainly on steep land and drain independently to the sea.

15. Panay Island. The island has a total area of about 12,000 km^2 and comprises the provinces of Aklan, Capiz, Iloilo and Antique which form part of the Western Visayas Region. The island has a roughly triangular shape with one face to the west. There are two mountain ranges which cross the island from north to south. The western range runs the entire length of the western part of the island, completely isolating Antique Province from the three provinces to the east. The eastern range cuts across near the eastern apex of the triangle. Between the two ranges is the central plain which traverses the island from north to south and forms the rice bowl of the Visayas. The seaward sides of the eastern and western ranges fall to small and discontinuous coastal plains which have little agricultural importance.

16. Two large river systems drain large areas of the central plain. The Panay river system, with a catchment of about 2,730 km^2, drains northwards to the Visayan Sea. The basin covers virtually the entire province of Capiz and portions of Iloilo and Aklan provinces. Of the land forms of the basin, 5% are classified as delta swamp and marshes, 36% as alluvial plain, and 59% in various forms of upland terrace. About 22% of the basin area is on slopes of less than 3%. The Jalaur river basin covers about 1,450 km^2. The river system drains southwards to discharge to the Iloilo Strait to the east of Iloilo City, and almost the entire basin area lies within Iloilo Province. Most of the basin lies on rolling plain lands with 3% classified as deltaic plain and 21% as alluvial plain. About 23% of the basin area has slopes of less than 3%. Other important river systems of Panay are the Aklan system with a catchment area of about 850 km^2 which drains the northwestern part of the central plain to the Sibuyan Sea, and the Sibalom system with a catchment 564 km^2 located mainly in the western mountain range, which drains westwards into the Sulu Sea.

17. Negros Island. Negros, the fourth largest island of the Philippines with an area of about 13,330 km^2, is traversed from north to south by a range mountains which includes four volcanic peaks, one of which is still active. This topographic divide has led to the administrative division of the island into the Negros Occidental Province included under the Western Visayas Region, and the Negros Oriental Province which forms part of the Central Visayas Region. Another mountain range occupies the southwestern part of the island. The important areas of plain land are located in coastal plains along the northwestern, northern and northeastern shores of the island, and mainly within the Negros Occidental Province. Sugar plantations are located on the rolling lands adjacent to the northern plains. The Ilog river system has the largest catchment area of the Negros rivers, and drains an area of about 2,160 km^2 in the southern portion of the island to discharge into the Panay Gulf. About 56% of the basin area lies in the Occidental Province and the balance in the Oriental Province. Only about 7% of the basin area is on slopes of less than 3%, and this is all located on the narrow plain through which the river system escapes to the sea. The remaining area of Negros is divided between a large number of medium and small sized river basins with very limited areas of plain land located mainly along the coast.

18. Cebu Island. This island has a very elongated shape with a north-south dimension of about 215 km and a maximum east-west width of about 35 km, and an area of about 5,000 km^2. It forms a province of the Central Visayas Region with Negros Island lying immediately to the west, Bohol to the southeast and Leyte to the northeast. Most of the island is of mountainous and hilly terrain with peaks rising to about 1,000 m AMSL. The island has two lengthwise orientated anticlinal mountain ranges separated by a synclinal valley. The southern part of the island has a limestone topography which includes karstic features such as numerous sinkholes and caves. The hill slopes are generally steep and the plain lands are mainly limited to scattered localities along the east and west coasts. The largest area of plain lands extends for a distance of about 55 km along the coast around Cebu City, extending inland for only a few kilometers. The island is drained by a large number of small river systems which flow east and west from the central divide and discharge independently to the sea.

19. Bohol Island. The island has an area of about 4,100 km^2 and a fairly rounded shape. It forms a province of the Central Visayas Region. It has generally hilly or rolling topography. Rolling hills and broad open valleys are concentrated in the northeast and central parts, while the southern half has comparatively rough terrain. Considerable areas are formed from carbonate rocks which have highly developed karst features, including numerous swallow holes and caves. About 35% of the total area is on slopes of less than 3%. The island is drained by five medium sized river systems with an aggregate catchment area of 1,840 km^2, and numerous small rivers.

20. Leyte Island. This island has an area of about 8,000 km^2 (including Bilaran and Pana-on Islands). It contains the provinces of Northern Leyte and Southern Leyte which are included in the Eastern Visayas Region. The island is separated from Samar (the other major island of the region) by the narrow San Juanico Strait. A rugged mountain range, with peaks in the range of 700-1,100 m AMSL, runs north-south through the center of the island, but is broken by a pass in the central part which has allowed construction of an east-west highway. Along the northeast coast, facing the Juanice Strait, is a second mountain range. Between the two mountain ranges and in the northern part of the island is the plain of Leyte with an area of about 1,200 km^2. Small plains are found on the west coast to the north and south of Ormoc City. About 35% of the total land surface is on slopes of less than 3%. The island is drained by 21 small to medium sized river systems with an aggregate catchment area of 6,700 km^2 and by numerous very small rivers. The largest river basins are the Carigara-Isabel (1,379 km^2) located in the northwest, the Mayorga-Albuera (832 km^2) which drains much of the central part of the island eastwards to the Leyte Gulf, and the Ilaya-Amparo (653 km^2) which drains the southwestern part of the island south to the Mindanao Sea.

21. Samar Island. The island has a total area of about 13,400 km^2 and forms part of the Eastern Visayas Region. It comprises the provinces of Northern Samar, Western Samar and Eastern Samar. Most of the island consists of low rounded hills rising to elevations of 300-550 m AMSL. The plain lands are very limited in extent and confined to small scattered areas around the coast. Lands with slopes of less than 3% aggregate only about 7% of the total land surface. The island is drained by a large number of relatively small river systems, and 39 river systems with catchment areas in the range of 54-1,154 km^2 drain about 86% of the total surface.

22. Mindanao. This island, with a total area of about 101,700 km^2, is the second largest of the Philippines after Luzon. It comprises 22 provinces which are grouped to form the regions of Western, Northern, Southern, and Central Mindanao. The physiography of the island is best explained in its entirety.

23. The island has three long structural mountain ranges and two groups of volcanic mountains. A structural mountain range runs along the entire length of the east coast. The mountains are high in the north and south (peaks of 1,500 - >2,000 m AMSL), but are much lower in the central portion (250-450 m AMSL), and this saddle permits the passage of a road to the east coast. The range sets the provinces of Surigao del Sur and Daveo Oriental of the Southern Mindanao Region apart from the rest of the island.

24. The second structural mountain range (which also includes volcanoes of which three are active) runs north-south through the island along the western borders of Agusan del Norte and Agusan del Sur Provinces of the Northern Mindanao Region and of Davao del Norte and Davao del Sur Provinces of the Southern Mindanao Region. The range is high in the north with peaks of 2,000 - 2,500 m AMSL, but becomes lower (1,100 - 1,800 m AMSL) in the south.

25. The third structural range forms the Zamboanga Peninsula on the west coast. The mountains, with peaks of up to 900 m AMSL, occupy almost the entire peninsula and its islands extension which form the Western Mindanao Region (comprising the provinces of Zamboanga del Norte and Zamboanga del Sur on the main island and the Sulu achipelago), and Misamis Occidental Province of the Northern Mindanao Region.

26. A chain of volcanic mountains forms an arc through Lanao del Sur and Northern Cotabato Provinces of the Central Mindanao Region and western Bukidnon Province of the Northern Mindanao Region. Six peaks of this volcanic chain are still active. A second volcanic chain runs along the western borders of Southern Cotabato Province in Southern Mindanao Region and of Sultan Kudarat and Maguidanao Provinces in Central Mindanao Region.

27. Three major plains areas and a plateau region are delimited by the above described mountain ranges. Between the eastern and central structural ranges are the valleys of the Agusan river system which flows northwards to debouch into the Mindanao Sea, and the Davao plain which is drained by the Tagum - Libugano river system southwards into the Davao Gulf. The two volcanic ranges on the north and west and the central structural range delimit the broad Cotabato plain, which is drained by the Cotabato (Mindanao) river system. This system discharges into the Maro Gulf near Cotabato City.

28. The upland plateau of Lanao del Sur and Bukidnon Provinces of the Central and Northern Mindanao Regions respectively covers an area in excess of 5,000 km^2. The plateau is formed from a series of lava flow and volcanic ash. It is level to gently rolling on its top, but around the periphery is an escarpment into which erosion has carved deep canyons.

29. Plains are scattered along the long coast line of Mindanao. Along the east coast are many small isolated plains between hill lands which extend to the sea. Along the northern shore is a continuous coastal plain of varying width. Small and scattered coastal plains as well as some intermontane plain lands are present on the Zamboanga Peninsula.

4. CLIMATE

30. General Features. The climate of the Philippines is characterized by uniformity of temperature, high relative humidity, low solar radiation, diversity of rainfall and a high frequency of tropical cyclones. The principal air streams which affect the Philippines are the northeast monsoon, the southwest monsoon and the North Pacific Trade Winds. The northeast monsoon affects the area during late October to March and is most dominant during January and February. It enters the Philippines from a northeasterly direction as a tropical maritime air mass. The southwest monsoon occurs during the time of high solar altitude from May to October when the Inter-Tropical Convergence Zone (ITCZ) has moved over the area. The air mass arrives over the Philippines from the southwest, is classified as equitorial maritime, and is warm and very humid. The North Pacific Trades are generally dominant over the Philippines during April and early May. They generally arrive as a tropical maritime air mass from directions which may vary from northeast to southeast.

31. Tropical cyclones contribute largely to rainfall in the Philippines from June to December. They are usually responsible for maximal values of rainfall and winds and minimal values of barometric pressure observed in most parts of the islands. By international agreement, tropical cyclones are classified as: (i) tropical depressions with maximum wind speeds up to 63 km/hr; (ii) tropical storms with maximum wind speeds of 64-118 km/hr; and (iii) typhoons with maximum wind speeds exceeding 118 km/hr.

32. Many of the larger islands of the Philippines have high mountain ranges, most of which are orientated in a generally north-south direction across the paths of movement of the important air streams. Thus, apart from temperature effects due to elevation, the orographic effects of the mountains have important influences on regional rainfall patterns by causing increased precipitation on windward slopes and rain shadows in their lee during the two monsoon periods.

33. Temperature. The Philippines generally has high temperatures because of its generally maritime tropical setting and the warm air currents flowing over its land masses. Temperature decreases somewhat in accordance with altitude, and minor variations are caused by the rainfall distribution. The temperature range in relation to latitude or between the hottest and coldest month in any one place is extremely narrow. January mean temperature ranges from 23^{0} C in the extreme north of Luzon to 26^{0} C in southern Mindanao, while July mean temperature ranges from 27^{0} C in southern Mindanao to 29^{0} C in northern Luzon. Ranges between the mean temperatures of the coldest and hottest months are 3.8^{0} C in northern Luzon (Laoag), 2.6^{0} C in the Visayas (Cebu) and southeast Mindanao (Davao) and only 1.9^{0} C in the south of Mindanao (Jolo). Daily temperature range is also small. The absolute maximum recorded temperature was 42.2^{0} C at Tuguegaras in the Cagayan Valley in April 1912 and the absolute minimum was 3.1^{0} C in January 1903 in Baguio at an elevation of 1,482 m AMSL. The Philippines has year round temperatures suitable for crop cultivation, in particular rice at lower elevations. Table 2 gives mean monthly temperatures for selected stations.

Table 2: Mean Monthly Temperature for Selected Stations (^{0}C)

Station	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Laoag	24.4	24.8	26.3	28.0	28.9	28.2	27.7	26.9	27.3	29.4	26.5	28.4
Cabanatuan	25.8	26.3	27.6	29.1	29.5	28.5	27.9	27.4	27.6	27.6	26.9	26.2
Tuguegarao	24.4	25.3	27.4	29.3	30.4	29.3	29.2	28.9	28.5	27.4	25.9	24.7
Baler	24.4	25.7	27.0	28.1	28.3	28.3	28.1	27.9	27.1	26.1	26.1	25.1
Calapan	25.3	25.9	26.7	27.9	28.1	27.6	27.2	27.3	27.2	27.1	26.6	25.8
Legaspi	25.3	25.6	26.1	27.1	28.0	28.1	27.6	27.6	27.4	27.1	26.6	25.8
Roxas	26.4	26.5	27.3	28.6	29.0	28.5	28.2	28.1	27.8	27.8	27.7	27.7
Borongan	25.7	25.6	26.4	27.2	27.7	27.8	27.7	27.9	27.9	27.3	26.8	26.3
Zamboanga	26.6	26.5	27.2	27.5	27.6	27.2	26.9	27.0	27.0	27.0	27.1	26.9
Davao	26.4	26.5	27.2	27.9	27.8	27.3	27.0	27.1	27.2	27.4	27.3	26.9
Surigao	25.5	25.4	26.2	26.6	27.8	27.8	27.6	27.9	27.9	27.3	26.7	26.1
Cagayan del Oro	26.0	25.9	26.7	27.7	28.3	27.8	27.5	27.6	27.5	27.4	27.1	26.5

Source: R. L. Kintanar, PAGASA, 1984.

34. Relative Humidity. Mean monthly relative humidity is above 70% throughout the year in all parts of the Philippines except in the middle of the Central Luzon plain and in the northern part of Batangas Province (Southern Tagalog) where it falls to about 65% in March/April. The eastern part of Bicol, the Eastern Visayas Region and much of Southern Mindanao have mean monthly relative humidity in excess of 80% throughout the year. In accord with diurnal temperature variation, the lowest values are recorded from mid-day to early evening, except when it is raining. Generally high humidity makes drying and storage of grain crops difficult and their seeds prone to deterioration. Mean monthly relative humidities for selected stations are given in Table 3.

Table 3: Mean Monthly Relative Humidity for Selected Stations (%)

Station	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Laoag	73	72	71	71	74	81	84	85	85	78	75	73
Cabanatuan	69	68	66	64	71	80	83	86	85	81	78	74
Tuguegarao	80	76	71	69	70	75	77	79	80	82	84	84
Baler	82	82	81	81	81	81	80	81	82	82	83	82
Calapan	82	80	77	76	78	82	83	84	84	84	84	84
Legaspi	84	83	82	82	81	82	83	84	85	84	85	84
Roxas	79	78	77	75	76	79	80	80	80	80	80	80
Borongan	86	84	83	80	77	77	76	75	76	81	79	79
Zamboanga	77	75	75	76	78	80	80	80	80	80	77	79
Davao	81	80	78	78	80	82	82	81	81	81	81	81
Surigao	89	88	86	85	84	83	83	81	81	81	84	88
Cagayan del Oro	79	80	75	75	79	80	80	79	80	80	81	79

Source: R. L. Kintanar, PAGASA, 1984.

35. Solar Radiation. Incoming solar radiation to the stratosphere is highest between the spring equinox in late March and the autumn equinox in September, and lowest from October to March. However, the amount of solar

radiation reaching the land surface is influenced by the incidence of cloud cover and rainy days. Average annual cloudiness for the whole Philippines is 6.0 okta (6/8 of the sky with cloud cover). For most stations, the most cloudy months are June to December, and some have mean monthly cloud cover of 7.0 oktas or more for part of this period. However, this general pattern is not ubiquitous. Incidence of cloud cover in any month is closely related to the monthly number of rainy days. Mean monthly cloud cover and rainy days are given in Table 4. The relationships between solar radiation, sunshine duration and rainy days are illustrated by data for Quezon City in Table 5 which shows solar radiation highest during April and May.

Table 4: Mean Monthly Cloudiness (Oktas) and Mean Monthly Rainy Days for Selected Stations

Station	Item	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Laoag	C	3	3	2	2	5	7	7	7	7	5	5	4
	RD	1	1	1	1	8	15	19	21	17	7	5	2
Cabanatuan	C	4	4	4	4	5	6	7	8	7	6	5	5
	RD	2	1	2	3	11	17	20	21	21	12	9	5
Tuguegarao	C	7	5	4	4	4	6	6	7	7	6	7	7
	RD	6	4	5	5	10	13	14	15	15	14	15	11
Baler	C	7	6	6	5	6	6	7	7	7	7	7	7
	RD	15	15	16	19	19	18	18	18	18	18	18	17
Calapan	C	7	7	6	5	6	7	8	8	8	7	8	8
	RD	17	12	9	9	13	15	16	17	16	19	19	20
Legaspi	C	7	7	7	6	6	7	8	8	8	8	8	8
	RD	22	17	16	15	15	19	19	20	20	20	20	24
Roxas	C	6	6	5	4	5	7	7	7	7	7	6	6
	RD	14	10	7	5	11	17	18	18	17	18	17	17
Borongan	C	8	8	8	7	7	7	8	8	8	8	8	8
	RD	25	22	22	21	20	17	17	15	16	19	23	27
Zamboanga	C	6	6	6	6	7	7	7	8	7	7	7	7
	RD	7	6	7	8	13	15	15	15	13	15	13	10
Davao	C	7	7	7	7	7	8	8	8	7	7	7	7
	RD	13	12	11	10	17	18	16	15	15	15	14	13
Surigao	C	8	8	8	7	7	8	8	8	8	8	8	8
	RD	26	23	23	20	16	15	17	15	15	21	23	26
Cagayan del Oro	C	7	6	6	5	7	7	8	8	8	7	7	7
	RD	10	8	7	6	11	18	18	18	18	16	12	12

Note: C = Cloudiness; RD = number rainy days.
Source: R. L. Kintanar, PAGASA, 1984.

Table 5: Rainy days, Sunshine Duration and Solar Radiation - Quezon City

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainy days1/	4	2	4	4	12	19	23	24	23	17	14	9
Sunshine hours2/	6.0	7.2	7.5	8.3	7.2	5.3	4.7	4.7	4.1	5.6	5.6	5.6
Solarradiation3/	3.10	3.80	4.37	4.69	4.46	3.88	3.56	3.59	3.47	3.45	3.15	2.94

1/ average of 1961-70; 2/average h/day for 1960-71; 3/ average solar radiation in cal/cm^2/day, 1960-61
Source: Weather Bureau, Quezon City

36. Solar radiation is positively related to yield levels of grain crops. IRRI studies at Los Banos and Maligaya experimental stations have demonstrated that total solar radiation in the last 45 days before harvest is perfectly correlated to the yields of HYV rice, and similar observation have been made with regard to rice yields elsewhere in Asia.

37. Surface Winds. The prevailing wind directions at most observation stations in Philippines conform, in general, with directions of the dominant air streams during the seasons (para 30). Thus, the prevailing winds are generally from the northeast quadrant during the northeast monsoon and the southwest quadrant during the southwest monsoon. However, the winds recorded at many stations also show the superimposed effects of local topography and of diurnal periodicities on the regional wind patterns. Wind speeds are highly variable ranging from calm conditions to extremely high sustained velocities, the latter being associated to proximity to the tropical cyclones of the typhoon classification. Instantaneous wind speeds in excess of 75 m/sec (270 km/h) have been recorded in these circumstances.

38. Rainfall. Philippines is a country of high annual rainfall (Map IBRD 22605). The 1951-85 records from 60 synoptic stations show that the mean annual rainfall was recorded as less than 1,500 mm at only six stations (only one with less than 1,000 mm), 34 stations had 1,500-2,499 mm, 13 stations had 2,500 to 3,499 mm and seven stations had in excess of 3,500 mm. Any detailed isohyetal map of the Philippines shows very complicated patterns due to the marked orographic effects of the topography. Mean monthly and mean annual rainfalls are given for selected stations by Table 6. The generalized distribution of mean annual rainfall is shown in Map IBRD 22605.

Table 6: Mean Monthly and Annual Rainfall for Selected Stations, 1951-85 (mm)

Station	Month												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Laoag	5	1	2	14	123	373	407	529	371	101	18	11	1985
Cabanatuan	7	3	15	29	173	257	306	398	307	167	134	44	1840
Tuguegarao	21	16	32	47	117	160	205	237	215	253	299	101	1703
Baler	186	151	196	252	307	285	235	221	306	372	461	313	3275
Calapan	95	56	57	86	159	191	202	205	180	259	243	197	1960
Legaspi	305	201	202	178	192	232	246	278	254	328	475	520	3401
Roxas	109	53	70	54	140	259	259	237	238	333	244	188	2184
Borongan	601	419	315	270	326	223	220	216	193	297	587	691	4358
Zamboanga	45	46	42	55	95	141	141	138	144	178	114	77	1216
Davao	115	104	81	143	217	198	170	176	181	173	145	112	1823
Surigao	632	495	373	244	171	133	173	151	155	267	433	492	3819
Cagayan del Oro	105	66	50	32	108	205	220	216	213	176	129	119	1639

Source: R. L. Kintanar, PAGASA, 1984.

39. Rainfall is high on the east coasts of the major islands during November through April, while the situation is reversed in June through September. May and October being the months of transition, do not show the east-west relationships as clearly as in the other months.

40. The rainfall pattern results from the alignment of the generally north-south orientated mountain ranges on most of the islands across lines of movement of the predominating air streams in the various seasons (para 30). From late October to March, the prevailing airflow is from the northeast through the northeast monsoon and a similar direction of air flow occurs in April to early May due to incidence of the North Pacific Trade Winds. From late May to September, the southwest air stream of the southwest monsoon predominates. Since the Philippines is surrounded by broad expanses of warm ocean, whichever air stream prevails is moisture laden as it approaches the islands. However, the eastern or western mountain ranges intercept the air stream from the northeast or southeast respectively, and their orographic effects cause heavy precipitation on the windward side and deplete the moisture of the air mass which results in a rain shadow in the lee of the mountains. Thus, the western portion of Luzon and the western parts of some of the other islands have a marked dry season during November to April and a very wet season in May to October, particularly in June - September. The eastern parts of the islands do not exhibit such a marked contrast of dry and wet season. During the period of the southeast monsoon when they are on the lee side of the air stream, there is a high incidence of tropical cyclones which tend to track into the Philippines from east-southeast and deposit rain on the eastern parts. Moreover, tropical thunderstorms, resulting from local convections, are also common in the eastern parts of the islands during the southwest monsoon.

41. Given the complex physiographic features of the archipelago and the complex weather conditions that it experiences, the detailed rainfall patterns vary rapidly and widely both spatially and seasonally. Inter-seasonal and intra-seasonal rainfall variations are very wide when observed over a series of years. Extremes of monthly or shorter period rainfall events often result from the occurence of tropical cyclones which can occur in any month (though they are most common in June to December and their incidence generally decrease from north to south through the island chain - para.42).

42. The variation in rainfall patterns, and the fact that several areas (e.g. Eastern Visayas) have wet season crops when most of the Philippines is dry, disturbs the statistics on paddy production. The Bureau of Agricultural Statistics (BAS) presents its data on a fixed period definition, with the 'dry' season crop harvested in the period January-June and the 'wet' season crop harvested in the period July-December. To some extent, therefore, averages quoted for 'dry' and 'wet' seasons respectively are misleading.

43. Tropical Cyclones. The spatial and temporal incidence of tropical cyclones can be described in terms of the categories defined under para. 31 - tropical depressions, tropical storms and typhoons. Table 7 shows the monthly occurence of tropical cyclones entering or forming in the Philippines Area of Responsibility (PAR)[1] during the period 1948-82. In this period, 693 tropical cyclones crossed or formed in the PAR - an average of 19.8 per year. During June to December, the average monthly frequency of tropical cyclones is more than one event per month, and July, August and September experienced, on average, more than three cyclones each month. It should be noted that the period from January to May is not entirely free of tropical cyclones. Map

[1] PAR: The area assigned to the Philippines by the World Meteorological Organization (WMO) for issuance of tropical cyclone warnings and bulletins.

IBRD 22607 shows the geographical distribution of the incidence of tropical cyclones on the Philippines land area. The extreme north of Luzon has the highest frequency with an averag) of five events in two years. The incidence decreases southwards to about one event per year in the western islands of the Visayas, Palawan and the northern part of Mindanao. Most of Mindanao experiences an average of only one tropical cyclone event every 12 years.

Table 7: Monthly Frequecy of Tropical Cyclones in the PAR, 1948-82

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1948	1	0	0	0	1	0	3	1	3	2	6	3	20
1949	1	0	0	0	0	2	5	2	4	3	3	2	22
1950	0	0	0	0	0	2	2	1	3	2	2	1	13
1951	0	0	0	1	0	1	1	4	2	1	1	2	13
1952	0	0	0	0	0	5	2	3	4	4	4	4	26
1953	1	1	0	0	1	2	0	5	2	2	3	2	19
1954	0	0	1	0	1	0	1	6	2	3	3	1	18
1955	1	1	0	1	0	0	2	3	1	4	1	1	15
1956	0	0	1	2	0	0	4	4	5	1	5	3	25
1957	2	0	0	1	0	2	1	2	3	3	1	0	15
1958	1	0	0	0	0	1	4	2	4	2	3	0	17
1959	0	1	1	0	0	0	1	4	2	4	3	2	18
1960	1	0	0	1	1	2	2	6	1	3	0	2	19
1961	1	1	1	0	2	3	4	4	4	1	1	2	23
1962	0	1	0	0	2	0	4	6	4	1	3	0	21
1963	0	0	0	0	1	3	4	2	3	1	0	2	16
1964	0	0	0	0	2	1	9	5	5	3	3	1	30
1965	2	1	1	0	2	2	6	2	3	1	1	0	21
1966	0	0	0	1	3	1	7	1	3	2	2	2	22
1967	0	1	1	1	1	2	4	5	0	2	3	1	21
1968	0	1	0	0	0	2	2	3	3	1	3	0	15
1969	0	0	0	1	1	0	4	2	4	1	2	0	15
1970	0	1	0	0	0	3	2	4	4	4	2	1	21
1971	1	0	1	1	3	2	5	2	3	5	2	0	27
1972	2	0	0	0	0	2	4	2	4	1	1	1	17
1973	0	0	0	0	0	1	2	3	2	3	1	0	12
1974	1	0	0	0	0	3	4	4	2	5	2	2	23
1975	1	2	0	0	0	0	1	3	3	3	2	1	14
1976	1	0	0	1	1	3	3	3	4	0	2	3	22
1977	1	1	0	0	1	1	4	2	4	2	2	2	19
1978	0	1	0	1	0	3	1	7	6	1	2	1	25
1979	0	1	1	1	2	1	3	3	3	4	2	2	22
1980	0	0	1	1	3	2	4	3	2	2	3	1	23
1981	0	1	0	0	0	3	5	4	3	2	3	2	23
1982	0	0	2	0	1	0	5	4	4	3	0	2	21
Totals	18	12	11	16	28	55	115	117	109	85	77	50	693
Average	0.5	0.34	0.31	0.5	0.8	1.6	3.3	3.33	3.1	2.4	2.2	1.43	19.8
Rank	9	11	12	10	8	6	2	1	3	4	5	7	1

Source: R. L. Kintanar, PAGASA, 1984.

44. Classification of Climate Types. As rainfall is the most variable single element of climate in the Philippines, it has been used as the main criterion for classifying climate types. Several variations of classifications have been developed based on the presence or absence of a dry period and duratind time of occurrence of a dry period. A classification has also been made on the basis of ratios of dry to wet months. The basis for and the results of three generally accepted classifications (which resulted in divisions of the Philippines into four, six or seven climatic regions respectively) are compared below (Table 8). As may be expected, the maps produced by any of the classifications are but generalizations, and there are local abnormalities in any area classified.

Table 8: Various Criteria of Classification of Climatic Regions

Hainsworth and Moyer, 1945	Huke, 1972	Philippines WB 1971
A. Dry winter and spring, wet summer and fall.	A. Long dry season; 5 or 6 months with < 2.4" rainfall per month.	A. (Wet)-Rainy throughout year with at most 1-1/2 months. Q < 0.143.
B. Short dry season of 1 to 3 months.	B. Intermediate low sun dry season; 4 months with less than 2.4" of rainfall per month.	B. (Humid)-Rain well distributed with at most 3 dry Q = 0.143 or more but < 0.333.
C. No dry season pronounced winter rainfall.	C. Short low sun dry season; 1 to 3 months with less than 2.4" rainfall per month.	C. (Moist)-Rain well distributed with at most 4-1/2 dry months Q = 0.333 or more but < 0.600.
D. No dry season and no pronounced maximum rainy season.	D. Short high sun dry season; 1 to 3 months with less than 2.4" of rainfall per month.	D. (Dry)-Rain not sufficiently distributed with at most 6 dry months. Q = 0.600 or more but less than 1.00.
	E. All months with 2.4"or more rainfall; wettest low sun month with at least 3 times rainfall or dryest high sun month.	E. (Arid)-There are more dry than wet months most three 4-1/2 wet months. Q = 1.00 more but less than 1.670.
	F. All months with 2.4"or more rainfall; wettest high sun month with at least 3 times rainfall of dryest low sun month.	F. (Barren)-Deficient rainfall with less than 3 wet months. Q = 1.670 or more.
	G. All months with 2.4" or more rainfall; wettest month has less than 3 times rainfall of the dryest month.	

Note: Q = Number of dry months/Number of wet months.

45. For the purpose of this report, it is considered that the method of classification based on distribution of seasonal rainfall distribution which produces four climatic types is the most appropriate regionalization of the country. The method of classification was developed by Coronas (1920) and was applied by Hainsworth and Moyer (1945). Coronas considered a month with less than 50 mm as dry, but a month with 100 mm or more may also be classified as dry if it comes after three or more very dry months. Using the average monthly rainfall data for a set of stations, Coronas defined four types of seasonal rainfall distribution as follows:

(a) two pronounced seasons with dry seson during November-April and wet season during the rest of year;

(b) no dry season, but with pronounced maximum rainfall from November to January;

(c) seasons not pronounced, but relatively dry from November to April and wet during rest of year; and

(d) rainfall fairly evenly distributed throughout the year.

Types (a) and (b) above are, to a degree, opposites with types (c) and (d) as intermediates.

46. Kintanar (1984) updated and somewhat modified the Philippine climate classification based on Coronas using the rainfall observations from 60 primary weather stations from 1951-1980. The criteria established by Coronas for describing climate were retained except that modal values of monthly rainfall were used rather than average values. This presumably removed some of the skew introduced by some abnormally high values in the averages. The distribution of climate types produced by the Kintanar classification is shown by Map IBRD 22608, which also gives histograms of a average monthly rainfalls for a selection of typical rainfall stations.

5. SOILS

47. General Features. The relatively recent and intense tectonic earth movements and the volcanic activities which still continue have given most of the Philippines an immature topography which is being very rapidly eroded. The natural weathering process is rapid under the combination of high temperature and high and intense rainfall in conjunction with degraded cover of protective forests. The plains and the floors of valleys have deep alluvial deposits which are being continuously added to by new deposition. Being on flat or low slopes, they form almost all the irrigable land. In areas of volcanic activity, the alluvial deposits contain admixtures of pyroclastic materials. Many of the source materials weather to form clay, and thus the alluvial soils are often of fine texture. Plains soils which have been cultivated for a long time have developed plowsoles. Prolonged waterlogging in paddy soils induces reduction conditions in most of the soil profile. The soils of the hills may be residual and are usually immature. Their properties vary as widely as the parent rocks from which they are formed. Being generally on medium to steep slopes and often thin and highly drained, they offer very limited potential for irrigation, and then only with the high costs involved with terracing.

48. Productivity of the Lowland Soils. The lowland soils are basically productive, the main problems being caused by either too little or too much water. Salinity problem soils have very limited extent, except in the immediate vicinity of the coast. The need for irrigation in areas with a very distinct dry season (for example, Ilocos and Central Luzon Regions) has long been recognized. Even in other areas with more evenly distributed patterns of rainfall over the seasons, supplementary irrigation is required to sustain a paddy crop during the drier part of the year and for protection against periods of drought which can occur during the predominantly wet season. Since Independence in 1946, the Philippinnes has stepped up its efforts to bring greater areas of paddy land under irrigation. NIA estimates as of 1989 indicate that about 1.47 M ha of land had been provided with some level of irrigation[1]. Most of the irrigation is provided from surface water supplies and most of these supplies are based on run-of-the-river flows. Though such flows are generally plentiful during the wet season and then adequate to supply the associated irrigation service areas, river water supplies are much reduced during the dry season and then support lower intensities of irrigation on the service areas. The irrigation systems which will support high intensities of paddy cropping in two seasons are those surface water schemes which have reservoir storages, groundwater schemes, and some small surface water pump-lift schemes.

49. Lack of adequate drainge facilities is an important constraint to paddy production from the lowland soils under both irrigated and rainfed conditions. Though the plains and valley bottom areas are crossed by a fairly high intensity of natural drainge channels, these are often inadequate to dispose of the very large quantities of surplus precipitation falling on the lands during high intensity and prolonged rainfall events. Moreover, immense quantities of runoff from the surrounding hills debouch onto the plains as a consequence of such rainfalls. At best, the resulting high stages of the major rivers on the plains constrain the rate of runoff from the natural minor drainge network. At worst, the rivers top their banks and cause flooding which may be prolonged. The damage may be total destruction of the crop or a lowering of yield. However, farmers in areas with a high probability of crop damage in a known period due to either inadequate drainage and/or flooding from rivers, arrange their cropping patterns to avoid such periods. This occurs even within irrigation schemes since many suvch schemes, especially in Luzon, have been provided with inadezuate drainage facilities.

50. Soil Features of the Philippines by Regions. The following discussion gives summaries of the important soil types of the Philippines by administration regions, with special reference to the lowland soils which are often on slopes suitable for irrigation.

51. Ilocos: The relatively limited areas of coastal plain and valley bottom lands have alluvial soils of moderate to high fertility (excepting some areas of dune soils along the coast). Textures range from sandy loam through clay loam to clay with a corresponding reduction from good to poor internal

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1 Paddy is essentially the only irrigated crop grown in the Philippines. Only a very small proportion of sugar cane is irrigated, dry season vegetables are sometimes irrigated, but the remaining field crops are rainfed.

drainge. The rolling and hilly lands have residual soils of varying depth, texture and fertility. They have a common problem of excessive runoff and erosion. Much of the steep mountain slopes is still under forest.

52. Cagayan Valley: The important areas of lowland soils are (from north to south), the Aparri coastal plain, the Isabela plain, and the Bayombong plain of Nueva Viscaya Province. The relatively level agricultural land totals about 539,000 ha. The main soils of the Aparri plain are of silt loam, loam or sandy loam at surface but have either a clay layer or gravel layer in the subsurface which produces drainage characteristics ranging from poor to good. The Isabela plain consists of fertile clay soils with relatively flat surface and poor internal drainage on the west side. The east side has clay soils with poor internal drainage on somewhat irregular slopes. The central and southern parts of the plain have a very compact layer in the substrata which further impedes drainage. The small Bayombong plain has medium to heavy textured soils, the latter with poor drainage characteristics. The hill soils are on fragmented alluvial terraces or are residual soils developed mainly on sandstone. There are extensive areas of 'Cogon' grasslands on hill slopes from which the forest cover has been denuded, although the eastern side of the Sierra Madre range still carries extensive areas of forest.

53. Central Luzon: The plain lands of this region are the most extensive in the Philippines as a single area and total about 500,000 ha. They are developed on the river flood plains, on a series of terraces, and on natural levees along the rivers. The flood plain soils are generally heavy textured and are subject to flooding. The terrace soils have medium to light textures with fair to good drainage characteristics. The levee soils have generally coarse texture with good internal drainage. The plain includes extensive areas of swamp lands, in both the Pampanga and Agno River basins, which do not fit into the above grouping. The hill soils of the region are typical residual soils with inherited characteristics from their parent rocks, but they represent a small proportion of the agricultural land resources.

54. South Tagalog: The scattered plain lands of the part of this region which forms south-central Luzon are formed on fluvio-volcanic alluvium. They have a variety of textures with varying proportions of clay and a corresponding range of drainage characterstics from good to poor. The hill soils are mainly derived from weathered volcanics with a range of textures from sandy loam through clay loam to sticky clay. The lowland soils of Palawan Island are of limited extent along a discontinuous coastal plain or on small valley floors. They are of alluvial origin. The most wide spread soils in the lowlands are clay loams. The upland soils of Palawan are developed from igneous rocks or limestone, and most of these soils have a clayey texture. The upper mountain slopes of the island remain under forest cover.

55. Bicol: Most soils of the Bicol Peninsula are derived from volcanic rocks. The largest area of lowland soil is on the Bicol Plain and is derived from an admixture of alluvial material and volcanic ash. It generally forms a soil with a high proportion of clay (40%) but the texture grades to a fine sandy loam if the volcanic material predominates in the parent material. The plains soils of Masbate and Cantanduaanes Islands are of very limited extent. On the former island, the upland soils are derived mainly from shales and sandstones, while derivatives of shale, sandstone and igneous rocks are found on the latter.

56. Visayas Regions: The central plain is the main agricultural region of Panay Island and the largest area of lowland soils. These soils are either clay loam or clay, with a subsoil of silty clay or silt loam. The main upland soils are clay loam or clay derived from sandstone, shale and igneous rocks. On Negros Island, the main agricultural lands are concentrated on the flat and gently rolling coastal plains along the northwestern, northern and northeastern shores of the island, which have alluvial soils derived from volcanic parent rocks, and are mainly clay loam or clay. Sugar cultivation has extended onto the less stable soils of the hills where erosion is a problem.

57. Cebu Island is predominantly limestone mountains with only small areas of alluvial plain along the coast. The main alluvial soil is clay loam. The cultivated upland soils are generally clays. Bohol is an island of lowhills with scattered valley bottom areas and small coastal plains. The predominant lowland soil is clay loam. The upland soils consist of a variety of clays, clay loams and sandy loams. The main plain lands of Leyte are in the Plain of Leyte in the northeast portion and in a coastal strip along the western shore to north and south of Ormoc City. The flood plains are of alluvial sandy loam. The higher terrace alluvials have developed clay loam soils. River levees have well drained sandy soils. The rolling uplands of Leyte are widely cultivated and generally have clay soils. Samar is an island of rounded low hills with few level plains. The soils are derived from igneous or volcanic rocks in the northern part, and sandstone and shale in the central and southern parts. Drainage is not a general problem because of the topography, and the soils are not highly susceptable to erosion due to the extensive plantation cover.

58. Mindanao Regions: In the Agusan valley, the lowland soils are clay, clay loam or loam. There are swamp areas in the upper part of the valley and adjacent to the mouth of the river near Butuan Bay. The rolling and hill lands have residual soils derived from shale and sandstone which are friable and well drained. At higher elevations on the mountain ranges flanking the valley, the steep slopes retain some forest cover.

59. The Bukidnon Plateau occupies parts of Bukidnon and Lanao del Sur Provinces. All the soils of the plateau are derived from volcanic rock and lateritic soils predominate. They have excessive permeability and are highly acidic (pH 5.3). For most cropping, liming is required, but the acid tolerant pineapple is grown as a plantations crop. Below the highlands to the north are the alluvial soil areas of Misamis Oriental Province along the north coast. The area includes some coastal plain and valley bottom lands and the soils are varieties of loam and clay.

60. The Cotabato basin contains large areas of flat lowlands in the bottom lands along the main river and its major tributaries. The main lowland soils are clay loams or sandy loams. There are large areas of marsh and swamp land along the valley. The upland soils of the Cotabato basin are clays, clay loams and sandy loams. Shifting cultivation practices have ruined large areas of rolling lands and exposed them to severe erosion.

61. The Davao valley, drained by rivers flowing southwards to the Davao Gulf contains about 250,000 ha of plain lands along the river valley and along the coast. The soils are of alluvial origin and clay loams and silty clay loams predominate. The best uplands soils of the valley are lateritic clays, but the most extensive are residual clays which are thin and susceptable to erosion.

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

ANNEX 2: ISSUES IN PADDY PRODUCTIVITY

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PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

ANNEX 2: ISSUES IN PADDY PRODUCTIVITY

1. INTRODUCTION

General

1. Rice is the most important food commodity in the Philippines. Per capita consumption approached 100 kg in 1989, accounting for about 75% of grain consumption. Paddy is grown widely, accounting for perhaps 40% of the area under food crops and about 19% of the value of agricultural production. The total harvested area was 3.3 million ha in 1990, of which about 60% was grown during the wet season harvested July-December (mainly September-November) and the remainder in the dry season (harvested mainly February-April).

2. Agro-climatic conditions allow paddy cultivation in all regions, though relatively low solar radiation associated with prolonged cloud cover in most months is a factor that may limit yield potential. Rice is grown predominantly under flooded, lowland conditions with only small areas of upland cultivation. The lowland soils of the main alluvial plains and the valley bottoms are generally productive (Annex 1), the main problems being either too little or too much water. Salinity problems are largely confined to the immediate vicinity of the coast. Major growing areas located in Ilocos, Central Luzon, the Cagayan Valley, Western Visayas (the island of Panay) and Central and Southern Mindanao. Ilocos, Central Luzon and the main paddy areas in Panay are subject to a pronounced dry season [Climate Region Type (a), Annex 1 and Map IBRD 22608] and the need for irrigation has long been recognized. The Cagayan Valley and most of Mindanao have a more evenly distributed rainfall [Climate Regions (c) and (d)] but supplementary irrigation is desirable to sustain the paddy crop during drier periods which may occur even in the main rainy season. In the Eastern Visayas and East Mindanao [Climate Region (d)] the main wet season crop is harvested in the period January-June when most of the country is dry. These variations greatly complicate interpretation of the official statistics for the wet and dry season crops.

3. Paddy is cultivated under both irrigated and non-irrigated conditions[1]. The irrigation service area is about 1.5 M ha (Annex 5). Average irrigated cropping intensity based on this service area estimate is about 135%. This may, however, overstate the area that can actually receive irrigation (Annex 5) in which case irrigated intensities may be higher. About 42% of the service area comes under national irrigation systems (NIS) operated by NIA, 47% under communal irrigation systems (CIS) operated by farmers, and 11% under public and private pump systems (the latter estimate is, however, very uncertain).

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[1] Paddy land is normally classified as irrigated lowland, rainfed lowland or upland. Lowland paddy is grown under flooded conditions on leveled, bunded fields; upland paddy is always rainfed, with the fields neither leveled nor bunded. BAS statistics often combine rainfed lowland and rainfed upland under a single category.

National systems are predominantly located in the major rice growing areas and on the lowland plains. Communal irrigation is widely distributed in the hills and in the many small and scattered catchments distributed across the country's many islands.

Production Trends

4. Attachment Table 1 summarizes trends in paddy production, yields and harvested area and these trends are depicted graphically in Figure 1. The most striking feature is that harvested area nas remained remarkably constant since the late 1950s (rising somewhat in the 1970s, falling again in the 1980s) while average yields have more than doubled. As a result, production has also more than doubled, increasing from 3.7 M tons in 1960 to 9.3 M tons in 1990. Two principal factors account for the growth in yields:

a. Adoption of HYVs and Associated Input-Intensive Technologies (the green revolution). The HYV adoption level is now the highest in Asia after Sri Lanka. HYVs were first introduced in the 1960s but did not have major impact on average yields until the 1970s. They were promoted under the Masagana 99 rice production program which subsidized credit to finance seed, fertilizer and other chemicals.

b. The Development of Irrigation. The irrigated area rose rapidly during the early years of the green revolution, slowed in the 1970s and regained a relatively rapid rate during the 1980s. The expansion in the irrigated area was largely due to Government programs although private irrigation has also played a minor part (Annex 5).

5. These effects are reinforcing since the HYVs require irrigation to achieve their full production potential. However, the spread of irrigation was relatively more important in the 1960s and 1980s while the adoption of HYVs played the dominant role in the 1970s. During the 1980s yields have leveled off since irrigation has failed to expand sufficiently fast to offset the saturation of the HYV technologies (HYV adoption rates have now reached 93% on irrigated areas and 88% under rainfed conditions). A declining real farmgate price may also have been a factor which contributed to a reduction in fertilizer use in the early 1980s. The extent to which this leveling off reflects longer term trends is reviewed further below (Chapter 2).

6. Rapid growth in production during the 1970s contributed to the achievement of temporary rice self-sufficiency and exports were possible during the period 1978-83. However, the leveling off in production during the 1980s, aggravated by droughts in particular in 1983, 1987 and 1989, led to renewed imports in 1984-85 and again in 1988-90. Production appears to have rebounded in 1990 but record imports were still necessary during the year to meet demand and further imports may be necessary in the coming years (see Main Report).

Comparative Performance with other Asian Countries

7. Yield trends in the Philippines have been mirrored in neighboring countries. Attachment Table 2 presents data for selected countries and Asia as a whole (the estimates for the Philippines differ from those used elsewhere in this report). Country estimates reflect various proportions of irrigated and rainfed paddy and widely differing soil, climatic and other conditions.

The long period Japonica varieties grown in East Asia, in particular, are not comparable to the Indica varieties grown elsewhere in Asia. Comparisons are thus very suspect. This said, all the countries illustrated experienced similar trends. Limited yield growth in the 1950s was followed by rapid growth in the 1960s and 1970s and much slower growth in the 1980s. Yields stagnated in all countries in 1983-87 although some increase has occurred more recently.

8. The shared increase in productivity occurred despite major differences in absolute yields both before and after the green revolution. Some countries benefited earlier from the new technologies (Korea, Sri Lanka), some later (China, Indonesia), but all followed basically the same pattern. This is shown by Attachment Table 3 which lists countries in order of average yield for each three year period starting 1951-53. The ranking in 1984-86 was virtually the same as in 151-53. Indeed the only country to markedly improve its relative position was the Philippines. During the 1950s/1960s, it lagged but more than caught up during the 1970s. Even so, yields remain well below those in some other countries. It is thus debatable whether the Philippines has performed well because it has improved its position relative, or performed badly because it continues to have yields that are among the lowest in Asia.

Table 1: Paddy Yields in the Philippines compared to the Asian Average

	Average Yields: t/ha		Index: 1951-53 = 100	
	Asia1/	Philippines	Asia1/	Philippines
1951-53	1.73	1.18	100	100
1954-56	1.85	1.20	107	102
1957-59	1.89	1.09	109	92
1960-62	1.86	1.22	108	103
1963-65	2.06	1.27	119	108
1966-68	2.17	1.34	125	114
1969-71	2.35	1.69	136	143
1972-74	2.42	1.58	140	133
1975-77	2.55	1.87	147	158
1978-80	2.75	2.17	159	184
1981-83	3.05	2.41	176	204
1984-86	3.36	2.61	194	221
1988/89-90/91	na	2.63	na	222

1/ Including the countries of East Asia (China, Korea, Japan) where yields are much higher than in the rest of Asia (para.8).
Source: See Attachment Table 1.

Objectives of the Annex

9. A wide range of physical, biological and socio-economic constraints help explain the relatively low yields obtained in the Philippines. Physical constraints include seasonal factors, the water regime and climatic uncertainty. Biological constraints include relatively low use of fertilizer and problems related to certified seed and disease and insect control. Socio-economic constraints include declining real farmgate prices since the early 1970s contributing to relatively low incentives for fertilizer use and other inputs.

10. Despite relatively low yields, most observers conclude that the Philippines has a comparative advantage in rice production at import parity prices [see for instance Rosegrant et al (1987)]. The economic and financial issues are reviewed in the Main Report and Annex 3, and agricultural services in Annex 6. This annex assesses physical potential for further yield growth taking into account past performance, the yield potential demonstrated under research conditions, and the relatively higher yields achieved in some other Asian countries.. The discussion is largely descriptive and based on a secondary sources. The annex first reviews the underlying dynamics of past performance, taking account of recent studies by UPLB, IFPRI, IRRI and others. This is followed by an assessment of physical and biological constraints on average yields and their implications for future yield increases. The paper ends with tentative judgments concerning likely future yields under both irrigated and rainfed conditions as an input into the rice supply projections provided in the Main Report.

2. TRENDS IN PADDY PRODUCTIVITY

General

11. The green revolution and the extension of irrigation proceeded simultaneously so that trends in average yields reflect both technology and irrigation effects. This section seeks to disaggregate these as a basis for assessing future potential from each. Agro-climatic conditions vary (Annex 1), so an attempt is made to differentiate performance across the major regions in the country and since farmer performance also varies, evidence is quoted on variation in yields among farmers. The main sources for yield data are the publications of the Bureau of Agricultural Statistics (BAS). Their estimates are based on seasonal farmer interviews rather than crop cutting surveys and possibly understate actual yields. Some corroboration for this conclusion comes from NIA data (also based on farmer interviews) and from survey work carried out by IRRI and other agencies. BAS, however, provides by far the most comprehensive and consistent set and is inevitably the primary source.

Trends in Harvested Area

12. Attachment Table 4 presents data on annual areas harvested since 1966 under rainfed (including upland) and irrigated conditions. These are summarized below in Table 2. The area irrigated rose significantly during the 1960s, remained relatively constant during the 1970s and then expanded again rapidly in the 1980s. The rainfed area rose somewhat in the mid-1970 -- maintaining its share of the total -- but declined during the 1980s due mainly to conversion of lowland to irrigation and a sharp decline in the upland area due to substitution of other crops (Attachment Table 6). Irrigation is associated with increased intensities so that the dry season share increased. Since total harvested area remained constant, this implies a reduction in the physical area under paddy presumably as a result of construction of irrigation infrastructure (canals, roads etc.), loss of land to urbanization (many of the best paddy lands are in the vicinity of cities and towns) and some conversion of rainfed paddy to other crops.

Table 2: Harvested Area: Irrigated and Rainfed 1969-89

	Harvested Area:'000 ha			Irrigated as % of Total			Wet Season
	Irrigated	Rainfed	Total	WS	DS	Total	as % of Total
1966-68	1,207	1,927	3,134	34	47	39	70
1969-71	1,433	1,753	3,186	38	46	45	69
1972-74	1,356	1,909	3,265	36	53	42	67
1975-77	1,467	2,057	3,524	36	51	42	65
1978-80	1,530	1,953	3,483	39	54	44	67
1981-83	1,688	1,587	3,275	47	62	52	62
1983-86	1,824	1,488	3,312	51	62	55	60
1987-89	1,957	1,425	3,382	54	64	58	59

WS - wet season; DS - dry season.
Source: See Attachment Table 4.

13. The shares of HYVs and traditional varieties in the wet and dry seasons is given in Attachment Table 5 and under irrigated, rainfed and upland conditions in Attachment Table 6. These data are summarized in Table 3. The share of HYVs rose from 45% in 1970-73 to 87% in 1987-88. Although it was noticeably higher under irrigation in the early years, HYVs subsequently spread to rainfed areas and now account for the large majority under both all conditions. Only in upland areas do traditional varieties still predominate.

14. Trends in these relative shares have to a large extent determined average yields. In particular, the sharp reduction in the area under rainfed cultivation in the early 1980s, and some continued spread of HYVs, led to an apparent upward trend in average yields even though within each set of conditions yields had levelled off. There is no doubt potential for increased yields within each set of conditions. Nevertheless, this pattern of relatively constant yields within each technology but some increase in average yields due to the relative mix of the different technologies may well continue. It seems unlikely that there will be much further substitution of HYVs so that, apart from any increase in yields from increased fertilizer use, or from shifts in financial incentives, the only major potential for significant increase in average yields seems to lie in conversion of rainfed to irrigated paddy.

Table 3: HYVs as a Proportion of Harvested Area

	HYVs as % Harvested Area			HYVs as % of Harvested Area		
	WS	DS	Total	Irrigated	Rainfed	Upland
1970-71	41	58	45	na	na	na
1972-74	55	65	58	na	na	na
1975-77	62	71	65	82	65	na
1978-80	70	79	73	89	75	10
1981-83	81	86	83	91	80	15
1984-86	86	88	87	93	86	19
1987-88	86	88	87	94 1/	88 1/	18 1/

1/ 1987 only.
Source: See Attachment Tables 5 and 6.

Analysis of Yields

15. High Yielding Varieties (HYVs) versus Traditional Varieties (TVs). Attachment Table 8 shows that HYVs during the 1980s on average out-yielded TVs by about 60%. However, the difference appears to have declined in recent years as HYV yields leveled off while TV yields continued to increase. HYV yields in recent years have been comparable in the two seasons, but those of TVs have been higher in the dry season. This may appear intuitively surprising since TVs are predominantly grown under rainfed conditions with uncertain rainfall. which would likely more than offset the otherwise more favorable growing conditions. However, rainfed paddy harvested between January and June is grown largely in areas with no pronounced dry season so that the comparison is somewhat misleading. In Ilocos and Central Luzon, TV yields are indeed normally higher in the wet season.

Table 4: Comparison of Yields of High Yielding Varieties (HYV) and Traditional Varieties (TV)

	HYV Yields: t/ha		TV Yields: t/h		Ratio of HYV:TV Yields	
	WS	DS	WS	DS	WS	DS
1970-71	1.95	1.80	1.53	1.56	127	115
1972-74	1.72	1.76	1.23	1.35	140	130
1975-77	1.86	2.05	1.23	1.43	151	143
1978-80	2.26	2.47	1.37	1.42	165	174
1981-83	2.61	2.53	1.51	1.53	173	165
1984-86	2.73	2.75	1.61	1.86	170	162
1987-89	2.75	2.76	1.87	1.96	147	141

Source: See Attachment Table 8.

16. The relative improvement in TV yields during the 1980s reflects a sharp reduction in upland rice since yields under lowland conditions are higher. It may also reflect increased fertilizer application as farmers generally become more accustomed to fertilizer use. However, BAS data suggest that fertilizer in 1988 was applied to only 60% of the rainfed area(compared to 80% of the irrigated area, with an average application on the fertilized area of 140 kg/ha and 190 kg/ha respectively. There is therefore considerable potential for extending fertilizer use under both irrigated and rainfed conditions.

17. Irrigated versus Rainfed Yields. Attachment Table 7 compares irrigated and rainfed yields. These are summarized in Table 5 and presented graphically in Figure 2. There has been an upward trend in both irrigated and non-irrigated yields which has leveled off in recent years. The average difference between irrigated and rainfed yields has been about 60%, approximately the same as that between modern and traditional varieties. Since HYVs dominate under both irrigated and rainfed conditions, this suggests that it is the water regime that plays the principal role in determining relative yields. Whether irrigation has played the same role in determining changes in average yields over time, rather than explaining relative yields in any one year, depends of course on its share in total harvested area (see below).

Table 5: Comparison of Yields of Irrigated and Rainfed Paddy

	Irrigated: t/ha		Rainfed: t/ha		Ratio: Irrig. to Rainfed	
	WS	DS	WS	DS	WS	DS
1966-68	1.53	1.60	1.18	1.00	130	160
1969-71	1.96	1.87	1.34	1.11	146	168
1972-74	1.90	2.04	1.29	1.13	168	181
1975-77	2.10	2.45	1.35	1.27	156	193
1978-80	2.54	2.96	1.65	1.42	154	208
1981-83	2.98	2.95	1.90	1.51	157	195
1984-86	3.07	3.20	2.11	1.76	147	182
1987-89	3.11	3.20	2.11	1.76	147	182

Source: See Attachment Table 7

18. Interactions between Irrigation and HYVs/TVs. The importance of irrigation is confirmed by Attachment Table 9 and Table 6. In 1987, HYV yields were 25% higher than TV yields with irrigation, 28% higher under rainfed lowland conditions but only marginally higher under rainfed upland conditions (although the difference varied considerably from year-to-year depending on rainfall). Table 6 shows that differences between irrigated and rainfed yields were considerably greater than the difference between HYV and TV yields under the same water regime. Indeed, TV yields with irrigation (2.55 t/ha) were significantly higher than those of HYVs without irrigation (2.18 t/ha). Table 6 confirms that TV yields have risen in the longer term at almost the same rate as those of HYVs, more slowly in the 1970s and more rapidly in the 1980s, and that there has been little increase in upland yields.

Table 6: Comparison of Yields of Irrigated, Rainfed and Upland Paddy: HYVs and TVs

	Irri. Lowland		Rainfed Lowland		Rainfed Upland		Ratio:HYV to TV		
	HYV	TV	HYV	TV	HYV	TV	Irrig. Low.	R'fed Low.	R'fed Up.
	(t/ha)								
1975-77	2.36	1.73	1.57	1.28	na	na	136	123	na
1978-80	2.86	2.11	1.81	1.37	1.14	1.05	136	132	109
1981-83	2.98	2.19	1.97	1.37	1.22	0.95	136	144	128
1984-86	3.12	2.51	2.15	1.57	1.33	1.01	124	137	132
1987	3.19	2.55	2.18	1.70	1.25	1.20	125	128	104

Source: See Attachment Table 9.

19. National versus Communal Irrigation. BAS data treat irrigation as one technology. However, there are also major differences between national and communal irrigation. Attachment Table 10 provides NIA data on wet and dry season yields for 59 national irrigation systems (NIS) for which a continuous data set are available (new schemes have been excluded to avoid the effects of the build-up in yields following the first introduction of irrigation). The table shows that yields in NIS have followed the trends discussed above, in particular leveling off during the 1980s, but that they have been

significantly higher than the average for all irrigation. Table 7 compares wet and dry season yields from the 59 NIA schemes with BAS data for wet and dry season yields for all irrigated areas for the period 1966-89.

Table 7: Comparison of Yields on 59 NISs and the Average for All Irrigation

	59 NISs: t/ha		All Irrigation: t/ha		Ratio NIS:All Irrig.	
	WS	DS	WS	DS	WS	DS
1966-68	2.09	2.16	1.60	1.74	131	124
1969-71	2.51	2.55	1.87	1.95	134	131
1972-74	2.52	2.55	2.04	1.90	124	134
1975-77	2.89	2.92	2.45	2.09	118	140
1978-80	3.64	3.44	2.96	2.64	123	130
1981-83	3.85	3.85	2.95	2.98	131	129
1984-86	3.81	3.68	3.12	3.07	122	120
1987-89	na	na	3.20	3.11	na	na

Source: See Attachment Tables 8 and 10.

20. While the two sets of data may not be strictly comparable, they are sufficiently consistent to suggest that yields in national systems have been some 20-30% higher than the average for all irrigation, with both showing an increasing trend over the period. Since national systems account for almost 50% of the total, with a cropping intensity comparable to all irrigation, other forms of irrigation, predominantly communal irrigation, should have yields some 20-30% below the average. No systematic data are available for communal systems. However, the results of surveys by the Project Benefit Monitoring and Evaluation (PBME) Unit of NIA for schemes included in 1983-86 under the Bank-supported Communal Irrigation project, and those of an earlier evaluation survey for 1983-85 are summarized in Table 8.

Table 8: Paddy Yields on Communal Irrigation Schemes: Farm Survey Results

	Before Project		After Project		Ratio Before:After	
	WS	DS	WS	DS	WS	DS
	----------- (t/ha)		-----------			
PBME:						
81 Participatory Schemes	2.71	2.81	3.04	3.00	112	107
Evaluation Survey:	2.56	2.84	3.11	3.05	121	107
24 Participatory Scheme	2.57	2.59	2.54	2.65	99	102
22 Non-Particip. Scheme						

Source: See Attachment Table 11 for source of PBME data. Evaluation survey data derived from Korten and Sy (1989).

21. These data are only indicative, in particular concerning the increase 'with project' (Annex 5). There are major variations between schemes and the most successful communal systems (e.g. with a favorable water source) achieve yields as high or higher than on national systems. Nevertheless, the surveys indicate that CIS yields in the mid-1980s were perhaps 2.5 - 3.0 t/ha (10 - 20% below the irrigation average), intermediate between the NIS average (3.5 -

4.0 t/ha) and the rainfed average (1.75 - 2.25 t/ha). No doubt they are also intermediate in fertilizer use, HYV adoption rates and other characteristics.

22. From 1980-88, the NIS service area increased by about 30% and the CIS area by about 18%, helping to explain the modest increase in average irrigated yields during the first half of the decade. NIA's projections suggest a more rapid rate of increase in the total service area during the 1990s (an overall increase of 36% which is very ambitious, see Annex 5). But, if areas to be developed under the CARP program are included, the program is more evenly balanced between national and communal systems. The source of irrigated yield growth derived from changing the balance in favor of national systems may therefore no longer be available.

23. Rainfed Lowland versus Rainfed Upland Paddy. A similar conclusion relates to shifts in the relative importance of rainfed upland and rainfed lowland paddy. The reduction in the upland area during the 1980s contributed to the increase in the average for all rainfed areas (Attachment Table 6). Changes in upland area depend mainly on relative financial incentives between competing crops. The high farmgate prices for corn relative to those for paddy helped shift areas out of upland paddy in the 1980s. If this was to be reversed, farmers could shift back to upland paddy. reducing average rainfed yields but increasing paddy production

Table 9: Comparison of Rainfed Lowland and Rainfed Upland Paddy

	Harvested Area: '000 ha			Average Yield: ton/ha		
	Lowland	Upland	Total	Lowland	Upland	Total
1975-77	1,716	432	2,148	1.47	0.91	1.35
1978-80	1,613	414	2,027	1.70	1.05	1.57
1981-83	1,469	216	1,685	1.85	0.99	1.74
1984-86	1,305	160	1,465	2.07	1.01	1.95
1987	1,401	164	1,565	2.11	1.21	2.02

Source: See Attachment Table 9

24. Regional Variations. Agro-climatic conditions vary substantially within the Philippines (Annex 1) and this is reflected in regional variations in paddy yields. Attachment Tables 12 and 13 present data for 1988 on harvested area and yields by region. This is summarized in Table 10 for the three major geographical divisions (Luzon, the Visayas and Mindanao). Relative yields depend on the distribution of NIS and CIS areas and of lowland and upland rainfed cropping. Even so, yields in Mindanao -- in particular with irrigation -- are noticeably higher than in the other regions. Higher yields can be in part be attributed to a relatively favorable environment (Annex 1). Much of the remaining irrigation potential is in Mindanao and the adoption of HYVs has still to reach the levels of other regions. Therefore the role of Mindanao in raising average yields can be expected to increase.

Table 10: Comparison of Irrigated and Rainfed Paddy - Major Regions

	Irrigated	Rainfed	Total	HYV	TV	Total
	('000 ha)					
Harvested Area						
Luzon	1,241	676	1,917	1,716	200	1,917
Visayas	283	467	750	671	79	750
Mindanao	433	294	727	568	158	726
Philippines	1,956	1,437	3,393	2,955	438	3,393
Yield	(t/ha)					
Luzon	3.00	2.04	2.66	2.75	1.86	2.66
Visayas	2.89	1.75	2.23	2.34	1.35	2.23
Mindanao	3.62	2.13	3.02	3.22	2.30	3.02
Philippines	3.12	1.99	2.64	2.75	1.93	2.64

Source: See Attachments Table 12 and 13.

25. High Yielding Farmers versus Low Yielding Farmers. A recent IRRI study [Pingali et al, (1990)]provides data on the relative performances of 'good' farmers (defined as the top third of all farmers in terms of yields obtained) and 'ordinary' farmers (defined as the remaining two thirds) at two locations in Luzon. Table 11 summarizes the results. The longest series is for Laguna and suggests that 'good' farmers adopted the new technologies early. obtaining most of the yield benefits by the early 1970s, but that 'ordinary' farmers responded more slowly. Yields of 'good' farmers now approach (or even exceed) those on experimental stations (Figure 4). The weighted averages quoted in Table 11, with the exception of wet season yields in Nueva Ecija, are if anything higher than those recorded by NIA for NIS, suggesting again that BAS estimates may somewhat understate actual yields obtained.

Table 11: Trends in Paddy Yields between 'Good' and 'Ordinary' Farmers

	Yield (t/ha)			Area Planted (ha)		Weighted Mean
	'Good'	'Ordinary'	Difference	'Good'	'Ordinary'	(t/ha)
Laguna						
1966	2.92	2.33	0.59	1.92	2.52	2.59
1970	4.60	3.11	1.49	1.80	2.48	3.74
1975	4.56	3.53	1.03	1.63	2.53	3.93
1978	4.91	3.44	1.47	1.81	2.83	4.01
1981	5.59	4.27	1.32	1.80	2.54	4.82
1984	6.05	4.27	1.78	1.77	2.16	5.07
1987	5.28	3.10	2.18	1.70	2.66	3.95
Nueva Ecija: Wet Season						
1979	4.48	3.43	1.05	2.17	2.22	3.93
1985	3.82	2.36	1.46	2.20	2.21	3.09
Nueva Ecija: Dry Season						
1980	5.23	4.00	1.23	1.92	1.87	4.62
1986	4.84	3.93	0.91	2.08	1.93	4.40
1988	5.67	4.50	1.17	2.35	1.94	5.14

Source: Pingali *et al* (1990)

26. The IRRI study found that many cultural practices which are important for high yields have found little acceptance by 'ordinary' farmers. Fewer than 20% undertook line transplanting to facilitate weeding; few transplanted at the recommended 21 days or younger; and only a small proportion adopted basal and split fertilizer applications. Most 'ordinary' farmers agreed that these inputs and practices would increase yields, in particular application of fertilizer, but they were 'too expensive' and the additional production 'failed to justify their cost' (access to credit may also have played a role for smaller farmers). In other words the yields obtained are in some sense a financial optimum to the farmers given their immediate situation. The failure to maximize yields was thus not due to ignorance so much to factors that are much more difficult to resolve, including local physical conditions (distance from a water source, soils, topography etc.), differences in farmer management skills and access to credit. The IRRI study suggests similar experience in other Southeast Asian countries. It concludes that continued differences in yields between farmers, coupled with a leveling off in average yields, bode ill for further growth in production.

Contributions of Different Factors to Yield Growth

27. Bouis (1989) analyzed the factors explaining the changes in wet and dry season national aggregate yields for the period 1970-72 to 1980-82 and concluded that irrigation played only a limited role. Though the harvested area under irrigation rose by 16.5% between the two periods, the rainfed area also increased and the contribution of irrigation to the increase in average yields was thus limited. According to his analysis, shifts to modern varieties, and shifts in the fertilizer response function as a result of their adoption, in both irrigated and rainfed paddy cultivation, accounted for the largest majority (perhaps 90%) of the yield increase over the period. Increased fertilizer use within each of the four technologies considered once they had been adopted (irrigated HYV, rainfed HYV, irrigated TV, rainfed TV) accounted for no more than 10% of the yield increase. In other words, despite the smaller yield difference between HYVs and TVs under the same water regime than under different regimes, it was the rapid exploitation of this difference which largely explained the increase in yields during the 1970s.

28. Bouis also analyzed the introduction of the HYV technologies by region. He concluded that the largest shifts to HYV technologies on irrigated and rainfed land during the period under review (1970-72 to 1980-82) occurred for regions to the south and west, in particular in Mindanao. He explains this partly in terms of the better adaptability of the modern varieties to growing conditions in the south and partly to the fact that the initial benefits from the modern varieties in major growing areas in Luzon were made in the late 1960s and early 1970s. The 1970s therefore in some sense reflected the relative catching up of the southern regions of the country in obtaining the benefits of the green revolution.

29. What has been the experience during the 1980s? There has been some further growth in average yields but it is important to understand to what this is attributable. Data presented in Table 12 show that it has not been due to increasing HYV yields on irrigated areas which have remained relatively constant and are only about 20% higher than the average compared to more than 36% at the start of the decade. Relative stagnation in irrigated yields is confirmed by NIA data (Table 7).

Table 12: Average Yields compared to HYV Yields with Irrigation: 1980-87

	National Average t/ha	HYVs with Irrigation t/ha	Ratio
1980	2.16	2.93	136
1981	2.23	2.91	130
1982	2.36	3.03	133
1983	2.39	2.99	125
1984	2.50	3.04	122
1985	2.55	3.09	121
1986	2.67	3.23	121
1987	2.63	3.19	121

Source: See Attachment Table 9.

30. The increase in national average yields in the 1980s was therefore due to causes other than increases in HYV yields with irrigation. The most notable factors were the increase in the share of irrigation (in particular under NIS); the reduction in upland paddy; and continued 'catching' up in the HYV adoption rates and their spread to Mindanao. In other words, increases in the 1980s were largely due to the final stage of the green revolution. By 1987, however, HYVs accounted for 87% of all harvested area (94% of the irrigated area, 88% of the lowland rainfed area, 18% of the upland rainfed area). Some marginal further increase in HYV adoption rates is no doubt possible, but their rapid spread has inevitably come to an end. Furthermore, rainfed yields are also leveling off. If so, the main sources of growth identified by Bouis during the 1970s are no longer available. Future yield increases can therefore only come from the further development of irrigation; increased use of fertilizer and other inputs within each technology; or technological progress and the introduction of even higher yielding varieties.

31. How important will these factors be? IRRI is pessimistic that higher yielding varieties can spread in the next decade (Pingali et al, 1990) but are more optimistic for the longer term (Khush, 1991). The conclusion that further yield increases within each technology will be difficult to achieve may be over-pessimistic. Yields of both irrigated and rainfed HYVs are below their potential and further yield increases are undoubtedly possible, in particular from additional fertilizer applications. It can also be argued that weather conditions were adverse in the 1980s and there will be a return to a more rapid growth in yields once weather conditions are 'normal'. However, this argument fails to address the fact that the stagnation in yields appears to have been most pronounced for the irrigated HYV technology which a priori should have been the most resilient. Even in recent 'good' years, there is little evidence that irrigated HYV yields have increased substantially despite increased fertilizer use and more favorable real prices in recent years. Exploiting the remaining potential, however, can be expected to be more difficult than introducing the green revolution technologies in the first place. If so, extension of the irrigated area may be the most direct means by which further increases in average yields can be achieved.

3. CONSTRAINTS ON YIELD GROWTH

General

32. Prior to 1960, average paddy yield in Asia was less than 2 t/ha and there was no known higher yielding technology for the tropics. By 1975, however, following the introduction of the HYVs, average yield was 2.5 t/ha, reaching 3 t/ha in the early 1980s. In the Philippines, the average paddy yield before 1966 was only 1.3 t/ha. This increased to 2.3 t/ha in 1981 and 2.6 t/ha in 1987. However, this increase does not reflect full potential. Yields in IRRI fertilizer trials when IR8 was first introduced were as high as 10 t/ha in the dry season and 6 t/ha in the wet season. More recent varieties have improved characteristics (e.g. increased resistance to pests) but their potential appears to be lower than for IR8. Thus despite some areas and farmers obtaining much higher yields than before, substantial constraints still remain which prevent these potential gains from being universally realized. Important physical and biological constraints so far identified, studied and discussed by various workers in the Philippines are summarized below. Financial constraints are reviewed in the Main Report.

Physical Constraints and Yield Potential

33. Physical conditions set some upper limits on yields, limits which may vary substantially between countries. All Asian countries have benefited from the new technologies, but substantial differences in average yields remain (Attachment Table 2). Perhaps more striking than the absolute differences is that the relative ranking of countries has stayed remarkably constant over time despite enormous variability in political and economic development experience, including periods of major civil disruption in some countries (Attachment Table 3). Even though the Philippines has one of the highest HYV adoption rates in Asia, and has -- exceptionally -- improved its yield performance relative to most other Asian countries, yields remain relatively low. Without underestimating the role of policies and supporting services, underlying physical constraints have clearly been a major determining factor.

34. Seasonal Factors. Controlled environment and field studies at IRRI (Yoshida and Paras, 1976) suggest that variations in temperature and solar radiation during the vegetative growth stage within ranges commonly encountered do not have a significant effect on yield although they do affect dry matter production (which ranged from 256 grams per sq. cm. under 100% sunlight to 101 grams per sq. cm. under 25% sunlight). In contrast, relatively low temperatures and high solar radiation during the reproductive stage have a remarkable impact on the number of spikelets and hence on grain yield. Moreover solar radiation during the ripening stage strongly influences grain filling. Low light during the reproductive stage is irreversible and it is thought that the 45 days prior to harvest are crucial to obtaining an optimum grain yield. One estimate is that a cumulative solar radiation of 14,000 calories per sq. cm. during the 30 days prior to harvest is necessary to achieve such yields (Tricket et al, 1957). This would be equivalent to about 200 hours of bright sunshine in the latitudes of the Philippines.

35. Incoming solar radiation to the stratosphere in the latitudes of the Philippines is highest between March and September and lowest from October to

February. The solar radiation reaching the land surface is influenced by the incidence of cloud cover and rainy days. Average annual cloudiness for the whole Philippines is 6.0 okta (6/8 of the sky with cloud cover). For most stations, the most cloudy months are June to December, and some have mean monthly cloud cover of 7.0 oktas or more for part of this period (Annex 1). Incidence of cloud cover in any month is closely related to the monthly number of rainy days. The relationships between solar radiation, sunshine duration and rainy days are illustrated by data for Quezon City in Table 13 which shows solar radiation highest during March to May.

Table 13: Rainy days, Sunshine Duration and Solar Radiation - Quezon City

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainy days 1/	4	2	4	4	12	19	23	24	23	17	14	9
Sunshine hours 2/	6.0	7.2	7.5	8.3	7.2	5.3	4.7	4.7	4.1	5.6	5.6	5.6
Solar radiation 3/	310	380	437	469	446	388	356	359	347	345	315	294

1/ Average 1961-70; 2/ average h/day 1960-71; 3/ average solar radiation, cal/cm^2/day, 1960-61
Source: Weather Bureau, Quezon City

36. Figure 5 illustrates levels of monthly solar radiation for major rice-growing areas in the Philippines. At two locations (Maligaya and Los Banos), as well as in Quezon City (Table 13), solar radiation peaks in April. At all three locations, it is 400 calories per sq. cm. per day or above from March to May when the dry season crop is maturing. In contrast, it is relatively low -- 200-350 calories per sq. cm. per day -- during maturation of the main wet season crop in October to December. This is equivalent to perhaps 6,000 to 10,000 calories per sq. cm. over a 30 day period, well below the 14,000 calories per sq. cm. optimum quoted above. Even in the dry season, the optimum is achieved only for a limited period at some locations (Figure 5). Thus, not only are potential yields lower in the wet than the dry season due to lower net incoming energy during the maturing period, but for much of the rest of the year yields may be inherently lower than those potentially obtainable in countries more favorably placed with regard to sunshine.

37. This is confirmed by IRRI estimates of yield potential. Despite the high yields obtained with IR8 at Los Banos when the HYVs were first introduced, more recent nitrogen response experiments carried out with IR20 in farmers fields indicate potential yields with irrigation of only about 6.8 and 5.0 ton/ha in the dry and wet seasons respectively (Herdt and Wickham, 1975). Monthly planting experiments with IR8 (De Datta and Malabuyoc, 1976) gave a grain yield as high as 9.3 ton/ha for paddy harvested during May but only about 5.0 ton/ha when harvested in other months. The very high potential during May would is directly correlated with peak solar radiation obtained in March-May. These results confirm that potential yields with irrigation are unlikely to reach more than about 6.5 - 7.0 ton/ha in the dry season and 5.0 ton/ha in the wet season.

38. The Water Regime. About 60% of the harvested area in the Philippines is presently irrigated (Table 23). However, communal schemes account for 50% of the total and even in NIS there are periods of water shortage and some farmers are poorly located relative to the water source. An IRRI study (De

Datta and Malabuyoc, 1976) shows that yield losses, calculated on the basis of moisture stress days, at sites located in the top third of one major canal system suffered 7% loss of yield due to moisture stress during the dry season, those in the second third lost 20% of yield, and those in the last third lost 25% of yield, giving an average yield loss of about 17% due to moisture stress. If so, the potential attainable average yield in NIS during the dry season allowing for moisture stress would be about 5.6 t/ha (6.8 t/ha less 17%). During the wet season, IRRI recorded much less moisture stress, with a reduction of 4% in the top third of the canal system, 4% in the second third, and 8% in the last third, for an average reduction of about 5%. This suggests a maximum attainable wet season yield under existing conditions of 4.7 t/ha (5.0 t/ha less 5%).

39. Data for NIS (Table 7) indicate relatively little difference between actual wet and dry season yields (3.5-4.0 ton/ha in 1984-86). It is possible, given the variability of run-of-the-river supply, that the IRRI study understates dry season variability. Table 14 summarizes yield data for schemes with storage, comparing these with the average yield for the 59 NISs with complete data. Not only do schemes with storage in general have relatively high yields but the Angat-Maasim and Upper Pampanga schemes, located in a region with a pronounced dry season, have dry season yields that are indeed significantly higher than those in the wet season. The low wet season yield on the Upper Pampanga scheme reflects the flooding problem in the tail reaches (the average for District 1 in the head reaches was 3.9 ton/ha). The limited difference between wet and dry yields for the Magat scheme indicates the lack of a pronounced dry season.

Table 14: Wet and Dry Season Yields; Schemes with Reservoirs, Average 1981-86

	Wet Season t/ha	Dry Season t/ha	Ratio: DS to WS
Angat Maasim	4.18	4.48	107
Upper Pampanga	3.45	4.03	117
Magat	3.88	3.90	101
59 NISs	3.83	3.77	98

Source: NIA System Performance Data, see Table A.10

40. These yields are lower than the 'maximums' suggested above (4.7 ton/ha in the wet season an' 5.6 ton/ha in the dry season) although such maximums are approached by 'good' farmers (Table 11). Achieving the potential in NIS will thus depend on raising the yields of 'ordinary' farmers through improvements in the reliability and adequacy of irrigation, increased fertilizer use and/or improved cultural practices. Such improvements may in practice be difficult and experience during the 1980s suggests that average yields will at best grow slowly.

41. Yields on communal systems vary more than on NIS reflecting: greater differences in the quality of the water supply; poor accessibility to the site which affects farmgate prices and costs; and generally less adequate agricultural services. It has been suggested above that they currently fall short of average yields on national systems by about 1.0 t/ha. Even if this

differential can be reduced, which appears doubtful, it is unlikely that the maximum average on communal systems could exceed perhaps 4.0 t/ha in the wet season or, say, 4.5 t/ha in the dry season. As for the suggested levels for NIS, this would be an ambitious target.

42. Yields under rainfed conditions are likely to be even more uncertain. IRRI's experimental data show that maximum potential ranges from 3.7 t/ha to 5.8 t/ha during the wet season with an average potential maximum yield under rainfed conditions of 4.7 t/ha (IRRI Annual Reports for 1972 and 1973). Assuming that yields in unfavorably located rainfed areas are perhaps 20 - 25% below the levels observed experimentally, this implies a theoretical 'maximum' under rainfed conditions in the range of 3.5-3.7 t/ha (4.7 t/ha less 20-25%), with lower levels a more realistic expectation.

43. The Paddy Environment. Figure 4 compares trends in irrigated experimental yields with those obtained by farmers. Comparing 'good' farmer yields to those obtained on a neighboring experimental station, IRRI (Pingali et al, 1989) found that the difference between the two had diminished rapidly over the last two decades. In 1970, the gap in Central Luzon was about 2 t/ha. Within a decade, this gap had diminished to less than half a ton and by the mid-1980s 'good' farmers were out-yielding the experiment station. A similar trend was observed for Laguna.

44. More disturbingly, both 'good' farmer yields and yields on experiment stations appear to have peaked, displaying a slight downward trend over the past 5-8 years. Further evidence for this is given in another IRRI study which analyzed yields on national irrigation schemes between 1966-86 and concluded that on most systems yields were deteriorating (Pingali et al, 1990). Bank analysis of the same data suggests that the IRRI study may overstate this deterioration (Annex 5, Attachment 3) but there is never-the less clearly some cause for concern. A hypothesis put forward in the IRRI paper is that intensive rice cultivation both on experimental stations and in major irrigation schemes is leading to degradation in the paddy environment and that issues relating to micro-nutrient deficiencies, soil structure and other factors are undermining the potential for high yields.

45. Climatic Uncertainty. The Philippines is subject to considerable climatic uncertainty. It has the highest incidence of tropical cyclones in the world and is periodically subject to drought and other natural disasters. Data on the frequency of tropical cyclones (depressions, storms and typhoons) is given in Annex 1. Between 1948-82, their number averaged about 20 per year. Spatial incidence decreases from about five events every two years in north Luzon to only one event every 12 years in most of Mindanao. Droughts typically occur about every five years, again affecting Luzon and the Visayas more adversely than Mindanao. Since 1972 the area affected by natural calamities has averaged 491,000 ha/yr or 14% of the total harvested area (Attachment Table 14) with an annual production loss of 463,000 t or 7%.

46. Such uncertainty inevitably affect farmer willingness to apply costly inputs. This is particularly true for farmers in regions susceptible to frequent typhoons, and in locations adversely affected by flooding. Risk avoidance may impose a significant constraint on wet season yields. Similarly, drought can significantly reduce stream flow and place stress on irrigated areas dependant on run-of-the-river supply. It is difficult to

assess how fear of natural calamity affects average yields but it is clearly a factor which helps explain why yields fall short of theoretical potential. Limited growth in yields during the 1980s may have partly due to abnormal climatic conditions.

Biological Constraints

47. It has been suggested that the present yield gap is not so much between the farmer and the experimental station as between 'good' and 'ordinary' farmers. If so, strategies to increase average yields need to concentrate on persuading 'ordinary' farmers to adopt known high-yielding cultural practices rather than on introducing new technologies per se. Unwillingness of 'ordinary' farmers to adopt such practices reflects their personal circumstance (socio-economic conditions, location relative to the water source, farm management capabilities etc.), so that this may be a much more difficult task than the original green revolution.

48. Fertilizer Use. Relatively low levels of fertilizer application are a major cause of relatively low yields of fertilizer-responsive modern varieties under both rainfed and irrigated conditions in the Philippines. Table A.15 shows fertilizer distributed for paddy by region in 1988 and this is summarized in Table 15 below. Figures on nutrient fertilizer were calculated from data provided in the Rice Statistics Handbook of 1989. The Fertilizer and Pesticides Authority of the Philippines indicated that the estimates represent the fertilizers distributed to the sale point and are not necessarily the actual amount of fertilizer sold or used by farmers. In general, about 15-20% of the fertilizers distributed to the sale point remains unsold in any one season. However, given carry-over from the previous season, these estimates can be taken to approximate to actual use.

Table 15: Fertilizer Use on Irrigated and Rainfed Farms, 1988

	Irrigated			Rainfed		
	DS	WS	Total	DS	WS	Total
Harvested Area: M ha	0.88	1.07	1.95	0.49	0.95	1.44
Fertilized Area : M ha	0.75	0.85	1.60	0.23	0.60	0.83
% Area fertilized	85	79	82	47	63	58
Fertilizer use:kg/ha1/	196	188	192	137	144	142
Nutrient use: kg/ha1/	82	79	80	55	60	58

1/ Of fertilized area.
Source: See Attachment Table 15.

49. About 80% of the irrigated area and 60% of the rainfed area were fertilized in 1988. The proportion is somewhat higher in the dry season on irrigated land and somewhat lower on rainfed land. Applications on the area fertilized average about 80 kg/ha of nutrient (62-11-7:N-P-K) with irrigation, 58 kg/ha (43-9-6) on rainfed areas, and 71 kg/ha (55-10-6) overall. This is less than half the generally recommended dosage of 90-30-30. In terms of total harvested area, the average applications are proportionately even lower.

50. Not only the level of application, but inappropriate management of fertilizer also contributes to low yields. Most farmers broadcast urea two-to-four weeks after transplanting. This can result in an average of only 30% recovery of fertilizer nitrogen by the rice crop. If two thirds of the urea is broadcast before transplanting and the balance at panicle initiation, recovery increases to 40%. Agronomic evidence from experiment stations suggests that some nitrogen and all phosphorus should be applied before transplanting, and the rest of the nitrogen applied at panicle initiation. Where this was done, yields and profits were most often higher than farmers' levels with the same amount of inputs. The IRRI study already quoted (Pingali et al, 1990) confirms that poor fertilizer management is a major cause of reduced yields. While nitrogen applied by 'good' farmers exceeded that of 'ordinary' farmers in some years, in others there was little difference and a yield gap of 1.0 to 1.5 t/ha was due to inefficient fertilizer use by the plant because of irregular moisture supply and improper application method and timing.

51. Research on farmer yield constraints suggests that insufficient fertilizer and/or inappropriate fertilizer management may account for as much as one-half to two-thirds of the gap between actual and potential irrigated yields. The causes of nitrogen fertilizer inefficiency have to be clarified. Soil, variety, season, time of planting, water management, pest and disease control, cropping sequence, and fertilizer sources are among factors affecting fertilizer use efficiency. It is understood that IRRI is researching this problem in collaboration with the International Fertilizer Development Center.

52. Pest Damage. Insect and snail damage also contribute to the yield gap, estimated on occasion to account for 30-50% of the difference between the potential and actual yield. Most farmers spray their crops but, despite these efforts, considerable losses to insects are recorded, most likely because farmers use much lower application rates than actually required. Farmers may not use recommended levels because of cost . As in the case of low fertilizer applications, therefore, the present situation may reflect a financial optimum from the farmer's perspective even if this does not maximize yields. Lower cost insect control techniques are badly needed. Snail damage is mainly due to the recent introduction of an exotic edible snail. Damage can be significant, mainly affecting plant and panicle density. A satisfactory control mechanism has yet to be developed.

53. Certified Seed. The Bureau of Plant Industry (BPI) estimates that high quality paddy seed can increase paddy yields by at least 10%. At present, 10 - 15% of all rice farmers use certified seed although, under the ongoing Rice Production Enhancement Program, BPI projects that this would rise to about 30% in 1990. Assuming that 15% of the paddy area is presently supplied with certified seeds then, farmers replace their seed stocks on average about once in seven years. It is not uncommon to observe an admixture of paddy grown in wide areas in the Philippines. Sowing of mixed seeds of different varieties naturally gives uneven growth with maturity at different time. When the fields are harvested, a non-uniformity of maturity of paddy can be observed which results in lower yields and poor quality grains.

54. Regulation of the production and distribution of certified seed has been handicapped by the absence of a Seed Act. Such an Act to promote and

accelerate the development of a viable seed industry was proposed to the Congress in 1987 but is still pending approval by the Senate. The ultimate purpose of seed legislation is to ensure that farmers have a source of supply of high quality seed. A seed quality control scheme in principle provides the only safe way in which seed of high genetic purity and other desirable attributes can be passed to farmers without fear of dilution or substitution; enables a government to control the production and distribution of important crop seeds and maintain quality standards; and removes one of the risk factors associated with agricultural production by providing farmers with a source of seeds of a known quality. Despite the difficulty of enforcing such a scheme in a smallholder context, it should in principle be a government obligation to protect farmers from using unknown origin of seeds of inferior quality.

4. CONCLUSIONS

55. The recently published Agricultural Development Plan includes self-sufficiency as one of its four major objectives (DA, 1990). Rice production targets for the period 1990-95 are adopted which imply a growth rate in production of 4.1% for the period 1991-95, well above population growth and sufficient to ensure self-sufficiency in rice by 1995. Detailed policies and programs are set out in the earlier Rice Action Program (DA, 1989) which emphasize the provision of irrigation facilities and fertilizer subsidies.

56. Despite the potential that may exists, this annex suggests that such increases are ambitious. IRRI does not anticipate major increases in yield with the present generation of HYVs although pest resistance, drought tolerance and other desirable characteristics will be improved[1]. If so, this annex suggests an upper limit in the 1990s as follows:

	Probable Upper Limit of Yields: t/ha	
	Dry Season	Wet Season
National Irrigation Schemes	5.00 - 5.50	4.00 - 4.50
Communal Irrigation Schemes	4.00 - 4.50	3.50 - 4.00
Lowland Rainfed	2.75 - 3.00	3.00 - 3.50
Upland Rainfed	0.75 - 1.00	1.00 - 1.50

57. HYV adoption rates in 1988 were already 93% with irrigation and 88% under rainfed lowland conditions. Some marginal increases may occur but there

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[1] In the longer term, IRRI is hopeful that a new generation of varieties can be developed which would out-yield existing varieties significantly. These new varieties are unlikely to be released within the next ten years but could affect the outlook early in the next century. IRRI expects that such varieties would have characteristics analogous to those of corn and sorghum: fewer tillers all of which would be productive (4-5 rather than 20-25 of which 15-16 are productive in the current HYVs); larger panicles (250 grains per panicle rather than 100-120); sturdy stems with many vascular bundles; dark green, erect and thick leaves; a vigorous root system; and only 90 cm tall compared to __ cm for existing varieties. IRRI expect such an ideotype to have a harvest index (grain to total plant weight) of 0.6 compared to 0.45-0.5 for the current HYVs and perhaps 0.3-0.4 for traditional varieties (Khush, 1991).

will probably always be a market for traditional varieties -- not least as a result of farmers cultivating small patches for own consumption -- so that this potential is limited. The major source of yield growth which was associated with the green revolution is therefore no longer available.

58. There is still potential for increasing HYV yields since these are on average well below the upper limits suggested above. Enhanced fertilizer use and management, pest control, certified seed and improved irrigation management are all addressed under the Rice Action Plan. However, 'good' farmers already largely achieve their potential so that further increases will depend on extending known technologies to 'ordinary' farmers. This will be difficult since many factors are largely beyond a farmer's control (vulnerability to flooding, insecure water supplies, deterioration of the paddy environment etc.). Even if within their control, they are not readily resolved since they relate to the skills and resources available to the individual rather than to his knowledge. A working assumption might be that the underlying growth in yields during the 1990s will be in the order of 1% per annum. To this must be added theresponse to price as discussed in the Main Report and Annex 3.

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

ANNEX 2: ISSUES IN PADDY PRODUCTIVITY

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ANNEX 2
Attachment
Table A.1

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Paddy Production, Area Harvested and Yields: Irrigated and Rainfed, 1961-89

Year	Irrigated			Rainfed			Total		
	Production ('000 t)	Area ('000 ha)	Yield (t/ha)	Production ('000 t)	Area ('000 ha)	Yield (t/ha)	Production ('000 t)	Area ('000 ha)	Yield (t/ha)
1961	1,450	960	1.51	2,255	2,238	1.01	3,705	3,198	1.16
1962	1,509	987	1.53	2,401	2,192	1.10	3,910	3,179	1.23
1963	1,589	1,014	1.57	2,378	2,148	1.11	3,967	3,161	1.25
1964	1,525	930	1.64	2,317	2,158	1.07	3,843	3,087	1.24
1965	1,578	958	1.65	2,415	2,241	1.08	3,992	3,200	1.25
1966	1,734	960	1.81	2,338	2,149	1.09	4,073	3,109	1.31
1967	2,062	1,352	1.53	2,032	1,744	1.17	4,094	3,096	1.32
1968	2,271	1,309	1.73	2,290	1,995	1.15	4,561	3,304	1.38
1969	2,545	1,483	1.72	1,899	1,849	1.03	4,445	3,332	1.33
1970	2,761	1,346	2.05	2,473	1,768	1.40	5,234	3,113	1.68
1971	2,931	1,471	1.99	2,412	1,642	1.47	5,343	3,113	1.75
1972	2,617	1,332	1.96	2,483	1,914	1.30	5,100	3,246	1.57
1973	2,344	1,241	1.89	2,071	1,871	1.11	4,415	3,112	1.42
1974	3,015	1,494	2.02	2,579	1,943	1.33	5,594	3,437	1.63
1975	3,034	1,412	2.15	2,626	2,127	1.23	5,660	3,539	1.60
1976	3,350	1,495	2.24	2,757	2,085	1.32	6,017	3,579	1.71
1977	3,494	1,490	2.35	2,963	2,058	1.44	6,456	3,547	1.82
1978	3,933	1,515	2.60	2,961	1,994	1.49	6,895	3,509	1.96
1979	4,026	1,466	2.75	3,171	2,003	1.58	7,198	3,469	2.07
1980	4,507	1,609	2.80	3,190	1,862	1.69	7,647	3,471	2.16
1981	4,788	1,656	2.89	3,123	1,763	1.77	7,911	3,419	2.23
1982	5,343	1,741	3.07	2,990	1,610	1.86	8,334	3,351	2.36
1983	4,808	1,668	2.93	2,406	1,387	1.74	7,295	3,054	2.39
1984	5,136	1,755	2.93	2,693	1,408	1.91	7,829	3,162	2.50
1985	5,821	1,838	3.17	2,985	1,469	2.03	8,806	3,307	2.55
1986	5,980	1,878	3.18	3,267	1,586	2.06	9,247	3,464	2.67
1987	5,809	1,852	3.14	2,731	1,404	1.94	8,540	3,256	2.63
1988	6,106	1,956	3.12	2,865	1,437	2.00	8,971	3,393	2.64
1989	6,586	2,064	3.19	2,872	1,433	2.00	9,459	3,497	2.71

Source: Bureau of Agricultural Statistics, Department of Agriculture for 1980-89. 1966-79 estimates quoted from Howarth E. Bouis "Prospects for Rice Supply/Demand Balances in Asia", IFPRI, November 1989.

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Table A.2

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Average Paddy Yields - Selected Asian Countries: 1951 - 90/91
(t/ha)

	Asia1/	South Korea	China	Indonesia	Burma	Sri Lanka	Vietnam	Philip-pines	India	Bangla-desh	Thailand
1951-53	1.73	3.76	2.40	1.65	1.48	1.45	1.39	1.18	1.19	1.35	1.32
1954-56	1.85	3.43	2.55	1.70	1.55	1.60	1.43	1.20	1.30	1.37	1.35
1957-59	1.89	3.78	2.55	1.67	1.66	1.76	1.87	1.09	1.33	1.42	1.32
1960-62	1.86	3.80	2.17	1.77	1.66	1.89	1.96	1.22	1.49	1.62	1.59
1963-65	2.06	4.28	2.83	1.75	1.66	1.91	2.01	1.27	1.49	1.72	1.83
1966-68	2.17	4.12	3.15	1.89	1.60	2.12	1.81	1.34	1.49	1.67	1.79
1969-71	2.35	4.63	3.30	2.35	1.71	2.27	2.06	1.69	1.67	1.68	1.94
1972-74	2.42	4.90	3.40	2.54	1.71	2.00	2.19	1.58	1.63	1.70	1.86
1975-77	2.55	6.03	3.56	2.73	1.89	2.01	2.12	1.87	1.82	1.86	1.75
1988-80	2.75	5.88	4.13	3.06	2.41	2.42	1.97	2.17	1.87	1.95	1.90
1981-83	3.05	6.06	4.77	3.69	3.05	2.91	2.44	2.41	2.00	2.01	1.96
1984-86	3.36	6.04	5.31	3.94	3.13	2.96	2.80	2.61	2.22	2.19	2.04
1988/89-90/91 (p)	na	6.5	5.5	4.3	2.8	na	3.0	2.6	2.5	2.4	2.1
1980	2.81	4.31	4.15	3.29	2.77	2.59	2.11	2.23	2.00	2.02	1.91
1981	2.89	5.84	4.33	3.49	2.94	2.65	2.22	2.36	1.96	1.95	1.95
1982	3.05	6.15	4.89	3.74	3.15	2.89	2.48	2.39	1.85	2.01	1.89
1983	3.22	6.20	5.10	3.85	3.07	3.19	2.63	2.50	2.18	2.06	2.04
1984	3.32	6.48	5.37	3.91	3.10	2.72	2.75	2.48	2.14	2.16	2.07
1985	3.35	6.35	5.25	3.94	3.07	3.07	2.78	2.67	2.35	2.18	2.05
1986	3.34	6.37	5.31	3.98	3.21	3.10	2.86	2.69	2.31	2.24	2.01
1987	3.24	6.38	5.44	4.05	3.26	2.63	2.74	2.63	1.83	2.13	1.98
1988/89	na	6.6	5.3	4.3	2.8	na	2.9	2.6	2.5	2.3	2.1
1989/90	na	6.5	5.5	4.3	2.9	na	3.1	2.6	2.5	2.5	2.1
1990/91 (p)	na	6.4	5.6	4.5	2.8	na	3.0	2.7	2.5	2.4	2.1

p. Provisional
na. Data not available

1/ Including Afghanistan, Iran, Iraq, Japan, Kampuchea, Laos, Malaysia, Nepal, North Korea, Pakistan, Turkey and countries generally producing less than 100,000 tons, as well as the countries specified.

Source: IRRI World Rice Statistics 1987. US Department of Agriculture for 1988/89-90/91

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Table A.3

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Relative Position of Average Paddy Yields in Selected Asian Countries: 1951 - 90/91

A. Ranking by 3-Year Periods: 1951-53 to 88/89-90/91

	Korea	China	Indonesia	Burma	Sri Lanka	Vietnam	Philippines	India	Bangladesh	Thailand
1951-53	1	2	3	4	5	6	10	9	7	8
1954-56	1	2	3	5	4	6	10	9	7	8
1957-59	1	2	5	6	4	3	10	8	7	9
1960-62	1	2	5	6	4	3	10	9	7	8
1963-65	1	2	6	8	4	3	10	9	7	5
1966-68	1	2	4	8	3	5	10	9	7	6
1969-71	1	2	3	7	4	5	8	10	9	6
1972-74	1	2	3	7	5	4	10	9	8	6
1975-77	1	2	3	6	5	4	7	8	10	9
1978-80	1	2	3	5	4	7	6	8	9	10
1981-83	1	2	3	4	5	6	7	8	9	10
1984-86	1	2	3	4	5	6	7	8	9	10
1988/89-1990/91	1	2	3	6	5	4	7	8	9	10

B. Ranking by Year: 1980-90/91

	Korea	China	Indonesia	Burma	SriLanka	Vietnam	Philippines	India	Bangladesh	Thailand
1980	1	2	3	4	5	7	6	9	8	10
1981	1	2	3	4	5	7	6	8	9*	9*
1982	1	2	3	4	5	6	7	10	8	9
1983	1	2	3	5	4	6	7	8	9	10
1984	1	2	3	4	6	5	7	9	8	10
1985	1	2	3	4*	4*	6	7	8	9	10
1986	1	2	3	4	5	6	7	8	9	10
1987	1	2	3	4	6	5	7	10	8	9
1988/89	1	2	3	6	5#	4	7	8	9	10
1989/90	1	2	3	6	5#	4	7	8*	8*	10
1990/91	1	2	3	6	5#	4	7	8	9	10

* Equal ranking of two countries.
\# Assuming Sri Lanka retained its 1984-86 relative position in 1988/89-90/91

Source: IRRI World Rice Statistics 1987. US Department of Agriculture for 1988/89-90/91.

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Table A.4

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Paddy Harvested Area by Season: Irrigated and Rainfed; 1966-89
('000 ha)

	Irrigated			Rainfed			Total		
	Wet	Dry	Total	Wet	Dry	Total	Wet	Dry	Total
1966	631	329	960	1,593	565	2,149	2,215	895	3,109
1967	833	519	1,352	1,339	405	1,744	2,172	924	3,096
1968	748	561	1,309	1,427	567	1,995	2,176	1,128	3,304
1969	909	574	1,483	1,518	332	1,849	2,426	906	3,332
1970	791	555	1,346	1,222	409	1,768	2,150	963	3,113
1971	840	630	1,471	1,367	420	1,642	2,062	1,051	3,113
1972	745	587	1,332	1,367	547	1,914	2,112	1,134	3,246
1973	734	507	1,241	1,435	436	1,871	2,169	943	3,112
1974	904	590	1,494	1,442	501	1,943	2,346	1,091	3,437
1975	812	600	1,412	1,532	595	2,127	2,344	1,195	3,539
1976	854	640	1,498	1,488	597	2,085	2,342	1,237	3,579
1977	823	616	1,490	1,447	611	2,958	2,320	1,228	3,547
1978	893	622	1,515	1,487	507	1,994	2,380	1,129	3,509
1979	862	604	1,466	1,455	537	2,003	2,328	1,140	3,469
1980	919	690	1,609	1,287	575	1,862	2,206	1,265	3,471
1981	950	706	1,656	1,216	548	1,763	2,166	1,253	3,419
1982	992	749	1,741	1,082	528	1,610	2,074	1,277	3,351
1983	897	771	1,668	992	395	1,387	1,888	1,166	3,054
1984	990	765	1,755	920	487	1,408	1,910	1,252	3,162
1985	1,027	811	1,838	968	500	1,408	1,995	1,316	3,307
1986	999	880	1,818	1,058	528	1,586	2,056	1,408	3,464
1987	1,013	839	1,852	897	508	1,404	1,909	1,346	3,256
1988	1,074	882	1,956	949	487	1,437	2,023	1,370	3,393
1989 (p)	1,121	943	2,064	915	519	1,433	2,036	1,462	3,497

p. Provisional.

Source: Bureau of Agricultural Statistics, Department of Agriculture for 1980-89. 1966-79 estimates quoted from Howarth E. Bouis "Prospects for Rice Supply/Demand Balances in Asia", IFPRI, November 1989.

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Table A.5

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Paddy Harvested Area by Season: High Yielding Varieties (HYVs) and Traditional Varieties (TVs): 1966-88
('000 ha)

	HYVs			TVs			Total		
	Wet	Dry	Total	Wet	Dry	Total	Wet	Dry	Total
1966	na	na	na	na	na	na	2,215	895	3,109
1967	na	na	na	na	na	na	2,172	924	3,096
1968	na	na	na	na	na	na	2,176	1,128	3,304
1969	na	na	na	na	na	na	2,426	906	3,332
1970	816	538	1,354	1,334	426	1,760	2,150	963	3,113
1971	927	638	1,565	1,135	412	1,547	2,062	1,051	3,113
1972	1,104	722	1,827	1,008	412	1,420	2,112	1,134	3,246
1973	1,116	564	1,680	1,053	379	1,432	2,169	943	3,112
1974	1,416	761	2,177	930	330	1,260	2,346	1,091	3,437
1975	1,376	799	2,175	968	396	1,364	2,344	1,195	3,539
1976	1,408	892	2,300	934	346	1,280	2,342	1,237	3,579
1977	1,526	890	2,417	794	337	1,131	2,320	1,228	3,547
1978	1,578	879	2,457	803	250	1,052	2,380	1,129	3,509
1979	1,596	914	2,510	733	226	959	2,328	1,140	3,469
1980	1,675	1,011	2,686	531	253	785	2,206	1,265	3,471
1981	1,679	1,036	2,715	487	218	704	2,166	1,253	3,419
1982	1,719	1,108	2,827	354	170	524	2,074	1,277	3,351
1983	1,553	1,037	2,590	335	129	464	1,889	1,166	3,054
1984	1,654	1,101	2,754	257	151	408	1,910	1,252	3,162
1985	1,723	1,164	2,887	272	148	419	1,995	1,312	3,306
1986	1,771	1,250	3,021	285	158	443	2,057	1,408	3,464
1987	1,609	1,198	2,807	301	148	449	1,909	1,346	3,256
1988	1,774	1,182	2,956	249	188	437	2,023	1,370	3,392

na. Data not avaliable.

Source: Bureau of Agricultural Statistics, Department of Agriculture for 1980-89. 1966-79 estimates quoted from Howarth E. Bouis "Prospects for Rice Supply and Demand Balances in Asia" IFPRI, November 1989.

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Table A.6

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Paddy Harvested Area by Crop Type: Irrigated Lowland, Rainfed Lowland and Rainfed Upland: 1975-87
('000 ha)

	Irrigated Lowland			Rainfed Lowland			Rainfed Upland			All Crop Types
Year	HYV	Other Variety	Total	HYV	Other Variety	Total	HYV	Other Variety	Total	
1975	1,138	311	1,449	1,094	624	1,719	na	na	465	3,632
1976	1,239	295	1,534	1,121	618	1,740	na	na	400	3,674
1977	1,307	215	1,521	1,153	536	1,689	na	na	431	3,641
1978	1,367	183	1,550	1,146	467	1,613	43	395	439	3,601
1979	1,345	162	1,508	1,225	400	1,625	77	391	428	3,561
1980	1,430	176	1,606	1,279	377	1,655	38	338	375	3,637
1981	1,434	190	1,625	1,240	345	1,585	36	213	249	3,459
1982	1,538	161	1,699	1,218	285	1,503	31	210	241	3,443
1983	1,646	117	1,763	1,083	237	1,319	28	128	157	3,240
1984	1,521	141	1,662	1,093	197	1,291	40	148	188	3,141
1985	1,688	113	1,801	1,099	165	1,265	30	126	158	3,222
1986	1,772	134	1,906	1,178	181	1,359	22	115	137	3,403
1987	1,719	118	1,837	1,227	174	1,401	29	136	164	3,403

na. Data not avaliable.

Source: Bureau of Agricultural Statistics, Department of Agriculture.

NB. These data are derived from the "Statistical Compendium on Agriculture, Fishery and Forestry", published in 1988 and differ somewhat from those quoted in Table 4.

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Table A.7

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Paddy Yields by Season: Irrigated and Rainfed: 1966-89
(t/ha)

	Irrigated			Rainfed			Total		
	Wet	Dry	Average	Wet	Dry	Average	Wet	Dry	Average
1966	1.88	1.66	1.81	1.16	0.87	1.09	1.37	1.16	1.31
1967	1.62	1.37	1.53	1.21	1.03	1.17	1.37	1.22	1.32
1968	1.71	1.77	1.73	1.17	1.10	1.15	1.35	1.43	1.38
1969	1.72	1.70	1.72	1.09	0.75	1.03	1.33	1.36	1.33
1970	2.11	1.97	2.05	1.46	1.19	1.40	1.70	1.64	1.68
1971	2.04	1.93	1.99	1.47	1.45	1.47	1.71	1.74	1.72
1972	1.99	1.99	1.96	1.29	1.32	1.30	1.52	1.67	1.57
1973	1.82	1.99	1.89	1.19	0.91	1.11	1.39	1.49	1.42
1974	1.95	2.13	2.02	1.38	1.17	1.33	1.60	1.69	1.63
1975	1.97	2.39	2.15	1.22	1.26	1.23	1.48	1.83	1.60
1976	2.16	2.35	2.24	1.36	1.22	1.32	1.65	1.81	1.71
1977	2.16	2.61	2.35	1.48	1.34	1.44	1.74	1.98	1.82
1978	2.45	2.81	2.60	1.57	1.24	1.49	1.90	2.10	1.96
1979	2.47	3.13	2.75	1.64	1.44	1.58	1.95	2.34	2.07
1980	2.70	2.94	2.80	1.74	1.57	1.69	2.14	2.32	2.20
1981	2.84	2.96	2.89	1.81	1.68	1.77	2.26	2.40	2.31
1982	3.05	3.09	3.07	1.93	1.71	1.86	2.47	2.52	2.49
1983	3.04	2.81	2.93	1.97	1.14	1.74	2.48	2.24	2.39
1984	2.92	2.94	2.93	1.93	1.88	1.91	2.44	2.53	2.48
1985	3.14	3.20	3.17	2.11	1.88	2.03	2.64	2.69	2.66
1986	3.14	3.24	3.18	2.16	1.85	2.06	2.64	2.72	2.67
1987	3.11	3.17	3.14	2.07	1.73	1.94	2.62	2.63	3.14
1988	3.05	3.21	3.12	2.12	1.76	1.99	2.61	3.21	3.12
1989(p)	3.17	3.22	3.19	2.14	1.77	2.00	2.70	3.22	3.19

p. Provisional

Source: Bureau of Agricultural Statistics, Department of Agriculture for 1980-89. 1966-79 estimates quoted from Howarth E. Bouis "Prospects for Rice Supply/ Demand Balances in Asia", IFPRI November 1989.

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Table A.8

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Paddy Yields by Season: High Yieldsing Varieties (HYVs) and Traditional Varieties (TVs): 1966-88
('000 ha)

	HYVs			TVs			Total		
	Wet	Dry	Average	Wet	Dry	Average	Wet	Dry	Average
1966	na	na	na	na	na	na	1.37	1.16	1.31
1967	na	na	na	na	na	na	1.37	1.22	1.32
1968	na	na	na	na	na	na	1.35	1.43	1.38
1969	na	na	na	na	na	na	1.33	1.36	1.33
1970	1.95	1.81	1.90	1.54	1.43	1.52	1.70	1.64	1.68
1971	1.94	1.78	1.87	1.52	1.68	1.56	1.71	1.74	1.72
1972	1.75	1.81	1.77	1.27	1.43	1.32	1.52	1.67	1.57
1973	1.60	1.67	1.63	1.16	1.23	1.17	1.39	1.49	1.42
1974	1.82	1.81	1.82	1.26	1.41	1.30	1.60	1.69	1.63
1975	1.73	2.01	1.83	1.12	1.47	1.23	1.48	1.83	1.60
1976	1.89	1.97	1.92	1.30	1.39	1.32	1.65	1.81	1.71
1977	1.97	2.18	2.05	1.28	1.44	1.33	1.74	1.98	1.82
1978	2.19	2.34	2.24	1.34	1.28	1.32	1.90	2.10	1.96
1979	2.21	2.57	2.34	1.38	1.40	1.38	1.95	2.34	2.07
1980	2.38	2.50	2.42	1.38	1.58	1.45	2.14	2.23	2.20
1981	2.51	2.58	2.53	1.42	1.56	1.46	2.26	2.40	2.31
1982	2.67	2.66	2.67	1.47	1.60	1.51	2.47	2.52	2.49
1983	2.66	2.35	2.53	1.04	1.43	1.58	2.48	2.24	2.39
1984	2.60	2.63	2.61	1.42	1.80	1.56	2.44	2.53	2.48
1985	2.79	2.80	2.80	1.69	1.87	1.75	2.64	2.69	2.66
1986	2.79	2.82	2.80	1.71	1.91	1.78	2.64	2.72	2.67
1987	2.77	2.71	2.74	1.81	1.97	1.86	2.62	2.63	2.62
1988	2.71	2.81	2.75	1.92	1.94	1.93	2.61	2.69	2.64

na. Data not avaliable.

Source: Bureau of Agricultural Statistics, Department of Agriculture for 1980-89. 1966-79 estimates quoted from Howarth E. Bouis "Prospects for Rice Supply/ Demand Balances in Asia", IFPRI November 1989.

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Table A.9

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Paddy Yields by Crop Type: Irrigated Lowland, Rainfed Lowland and Rainfed Upland: 1975-87
(t/ha)

Year	Irrigated Lowland HYV	Irrigated Lowland Other Variety	Irrigated Lowland Total	Rainfed Lowland HYV	Rainfed Lowland Other Variety	Rainfed Lowland Total	Rainfed Upland HYV	Rainfed Upland Other Variety	Rainfed Upland Total	All Crop Types
1975	2.26	1.19	2.19	1.45	1.20	1.36	n.a.	n.a.	0.87	1.63
1976	2.36	2.03	2.29	1.54	1.35	1.47	n.a.	n.a.	0.89	1.75
1977	2.47	1.98	2.40	1.72	1.30	1.58	n.a.	n.a	0.97	1.85
1978	2.75	1.93	2.65	1.74	1.31	1.62	1.15	1.10	1.10	2.00
1979	2.89	2.14	2.81	1.84	1.42	1.74	1.16	1.06	1.07	2.11
1980	2.93	2.26	2.86	1.84	1.39	1.74	1.11	0.98	0.99	2.15
1981	2.91	2.07	2.81	1.96	1.38	1.83	1.18	0.95	0.98	2.23
1982	3.03	2.23	2.95	2.03	1.40	1.91	1.18	0.97	0.99	2.36
1983	2.99	2.29	2.95	1.91	1.33	1.80	1.30	0.93	1.00	2.39
1984	3.04	2.48	2.99	2.14	1.60	2.06	1.25	1.05	1.09	2.50
1985	3.09	2.43	3.05	2.11	1.50	2.03	1.31	0.95	1.02	2.55
1986	3.23	2.61	3.19	2.19	1.62	2.12	1.42	1.04	1.10	2.68
1987	3.19	2.55	3.15	2.18	1.70	2.11	1.25	1.20	1.21	2.63

na. Data not avaliable.

Source: Bureau of Agricultural Statistics, Department of Agriculture.

NB. These data are derived from the "Statistical Compendium on Agriculture, Fishery and Forestry", published in 1988 and differ somewhat from those quoted in Table 7.

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Table A.10

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

59 NIS with Complete Data Set: Average Paddy Yields, 1966-86
(t/ha)

Wet Season

Region	No. of schemes	66-68	69-71	72-74	75-77	78-80	81-83	84-86
1. Ilocos	11	1.92	2.35	2.71	3.08	3.57	3.86	3.92
2. Cagayan Valley	2	1.85	1.95	1.75	2.52	3.22	3.06	3.22
3. Central Luzon	11	1.86	2.23	2.07	2.23	2.89	3.82	3.32
4. S. Tagalog	11	2.47	2.68	2.65	3.02	3.07	3.46	3.34
5. Bicol	5	2.68	3.26	3.08	3.41	3.41	3.78	3.55
6. W. Visayas	6	2.36	2.44	2.50	3.41	4.15	4.56	4.26
8. E. Visayas	4	1.99	3.02	2.42	3.01	3.81	4.24	4.27
9. W. Mindanao	1	1.64	2.42	2.78	3.09	2.99	4.07	3.78
10. N. Mindanao	1	1.26	0.97	1.88	na	3.39	3.66	3.28
11. S. Mindanao	2	1.77	2.14	2.54	3.23	4.98	4.31	4.54
12. C. Mindanao	1	2.33	2.76	3.07	3.07	4.77	3.81	3.74
Philippines	59	2.16	2.55	2.55	2.92	3.44	3.85	3.68

Dry Season

Region	No. of schemes	66-68	69-71	72-74	75-77	78-80	81-83	84-86
1. Ilocos	11	1.84	2.51	2.73	3.06	3.55	4.08	3.86
2. Cagayan Valley	2	1.85	2.11	1.85	1.80	3.09	3.15	3.24
3. Central Luzon	11	1.75	2.24	2.05	2.16	3.59	3.92	3.82
4. S. Tagalog	11	2.38	2.62	2.80	3.12	3.36	3.67	3.52
5. Bicol	5	2.73	3.01	2.78	3.33	3.51	3.55	3.79
6. W. Visayas	6	2.23	2.31	2.41	3.26	4.10	4.11	4.19
7. E. Visayas	4	1.97	2.73	2.40	3.05	3.89	4.11	4.02
8. W. Mindanao	1	1.72	2.56	2.44	3.35	3.22	4.01	3.88
9. N. Mindanao	1	1.07	1.33	2.02	na	3.53	4.01	3.66
10. S. Mindanao	2	1.71	2.31	2.47	3.40	4.81	3.83	4.28
11. C. Mindanao	1	2.09	2.40	2.83	3.36	4.67	3.98	3.83
Philippines	59	2.09	2.51	2.52	2.89	3.64	3.85	3.81

na. Data not available
Source: NIA Performance Data,Systems Operation Department, NIA.

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Table A.11

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Communal Irrigation Schemes, Average Yields By Region: 1983-1986
(t/ha)

Region	No. of Schemes	Wet Season Pre-project	Wet Season After project	Dry Season Pre-project	Dry Season After project
1. Ilocos	7	2.84	3.18	2.51	3.09
2. Cagayan Valley	10	2.73	3.02	3.36	3.35
3. Central Luzon	4	3.21	3.00	3.52	3.54
4. S. Tagalog	11	2.53	2.38	2.74	2.74
5. Bicol	10	2.38	2.50	2.52	2.68
6. W. Visayas	6	2.59	2.96	2.10	2.87
7. C. Visayas	5	1.63	2.21	1.73	2.06
8. E. Visayas	6	2.01	2.43	2.32	2.62
9. W. Mindanao	6	3.31	3.63	2.95	3.53
10. N. Mindanao	4	2.06	3.21	2.11	2.54
11. S. Mindanao	7	3.24	3.67	2.94	3.34
12. C. Mindanao	5	3.76	3.72	2.55	3.67
Average	81	2.81	3.00	2.71	3.04

Source: Project Benefit Monitoring and Evaluation Unit (PBME), Communal Irrigation Dept., NIA

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Table A.12

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Harvested Area by Region, Season, Irrigated/Rainfed and Crop Type: 1988

	Harvested Area: '000 ha			% of Total Area		% of Total Area	
	Wet	Dry	Total	Irrigated	Rainfed	HYV	TV
CAR	42	32	74	78	22	60	40
1. Ilocos	261	141	312	54	46	95	5
2. Cagayan Valley	153	188	341	84	16	92	8
3. Central Luzon	323	142	465	74	26	97	3
4. S. Tagalog	240	153	393	52	48	81	19
5. Bicol	173	158	331	55	45	87	13
6. W. Visayas	266	181	447	36	64	96	4
7. C. Visayas	58	39	97	44	56	79	21
8. E. Visayas	84	122	206	38	62	80	20
9. W. Mindanao	93	51	144	43	57	76	24
10. N. Mindanao	58	64	122	73	27	79	21
11. S. Mindanao	97	107	203	66	34	81	19
12. C. Mindanao	176	81	257	57	43	77	23
Philippines	2,023	1,370	3,393	58	42	87	13

Source: Bureau of Agricultural Statistics, Department of Agriculture.

ANNEX 2
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Table A.13

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Paddy Yields by Region, Season, Irrigated/Rainfed and Crop Type: 1988
(t/ha)

	Irrigated		Rainfed		Annual by Variety		Overall
	Wet	Dry	Wet	Dry	HYV	TV	Average
CAR	2.68	2.81	1.75	1.85	3.00	1.83	2.53
1. Ilocos	2.86	2.78	2.53	1.17	2.71	2.35	2.69
2. Cagayan Valley	3.49	3.43	1.99	1.81	3.29	2.15	3.20
3. Central Luzon	2.42	3.72	2.13	1.70	2.75	2.14	2.73
4. S. Tagalog	2.79	3.25	2.07	1.99	2.74	1.70	2.54
5. Bicol	2.72	2.47	1.66	1.49	2.20	1.73	2.14
6. W. Visayas	3.27	3.01	2.34	1.84	2.54	1.66	2.57
7. C. Visayas	2.42	1.91	1.28	0.69	1.71	0.99	1.56
8. E. Visayas	2.75	2.70	1.53	1.50	2.12	1.41	1.98
9. W. Mindanao	3.20	3.92	1.61	1.78	2.71	1.66	2.46
10. N. Mindanao	3.88	3.19	1.98	2.46	3.35	2.37	3.15
11. S. Mindanao	4.08	3.45	2.93	2.27	3.46	2.94	3.36
12. C. Mindanao	3.72	3.41	2.28	1.93	3.25	2.21	3.00
Philippines	3.05	3.21	2.12	1.76	2.75	1.93	2.64

Source: Bureau of Agricultural Statistics, Department of Agriculture.

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Table A.14

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Estimated Area Affected by Damage and Production Losses: 1968-89

	Harvested Area		Area Affected as % Total Harvested Area	Production		Loss as % of Total Production
	Area Affected	Total		Est. Loss	Total	
	------'000 ha-------			----'000 tons----		
1968	643	3,304	19	411	4,561	9
1969	606	3,332	18	542	4,445	12
1970	12	3,113	...	9	5,234	...
1971	396	3,195	12	470	5,578	8
1972	223	3,332	7	319	5,325	6
1973	997	3,194	31	842	4,609	18
1974	537	3,528	15	88	5,841	2
1975	895	3,633	25	725	5,910	12
1976	345	3,674	9	439	6,431	7
1977	220	3,641	6	453	6,741	7
1978	953	3,602	26	1,054	7,199	15
1979	1,241	3,561	35	1,423	7,515	19
1980	152	3,471	4	138	7,647	2
1981	565	3,419	17	488	7,911	6
1982	300	3,351	9	325	8,334	4
1983	602	3,054	20	727	7,295	10
1984	146	3,162	5	134	7,829	2
1985	231	3,307	7	249	8,806	3
1986	476	3,464	14	397	9,247	4
1987	361	3,256	11	306	8,540	4
1988	494	3,393	15	438	8,971	5
1989	406	3,497	12	209	9,459	2
Average 1968-89	491	3,225	5	463	6,974	7

... Negligible

Source: Bureau of Agricultural Statistics, Department of Agriculture

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Table 15

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Fertilizer and Nutrient Use Per Hectare for Paddy by Region: 1988 1/ (kg/ha)

	Fertilizer			Nutrient		
	Irrigated	Non-irrigated	Average	Irrigated	Non-Irrigated	Average
CAR	161	71	152	60- 4-2 = 66	16- 4 -2 = 22	51- 4- 2 = 57
Ilocos	225	146	184	76-10-8 = 94	43- 9 -7 = 59	59-10- 8 = 77
Cagayan Valley	187	109	179	60-11-7 = 78	36- 7 -5 = 48	58-12- 7 = 77
Central Luzon	276	180	251	88-14-10 = 112	53-14 -7 = 74	79-18-10 = 107
S. Tagalog	178	138	163	66 -6-5 = 77	49- 3 -3 = 55	60- 5- 4 = 69
Bicol	121	124	121	39 -7-6 = 52	41- 7 -6 = 54	39- 7- 6 = 52
W. Visayas	211	149	173	64-14-7 = 85	49- 8 -4 = 61	55-10- 5 = 70
C. Visayas	138	84	107	39-11-7 = 57	15-10-10 = 35	26-10- 8 = 44
E. Visayas	136	105	129	42- 6-6 = 54	28 -8 -7 = 43	39- 6- 6 = 51
W. Mindanao	174	187	179	51-12-5 = 68	40-20-16 = 76	46-16-10 = 72
N. Mindanao	186	135	175	56-10-8 = 74	35-10- 2 = 47	52-10- 7 = 69
S. Mindanao	158	118	143	50- 8-5 = 63	29- 9- 8 = 46	43- 8- 6 = 57
C. Mindanao	153	122	144	49- 6-3 = 58	39- 7- 2 = 48	46- 6- 3 = 55
Philippines	192	143	175	62-11-7 = 80	43- 9- 6 = 58	55-10- 6 = 71

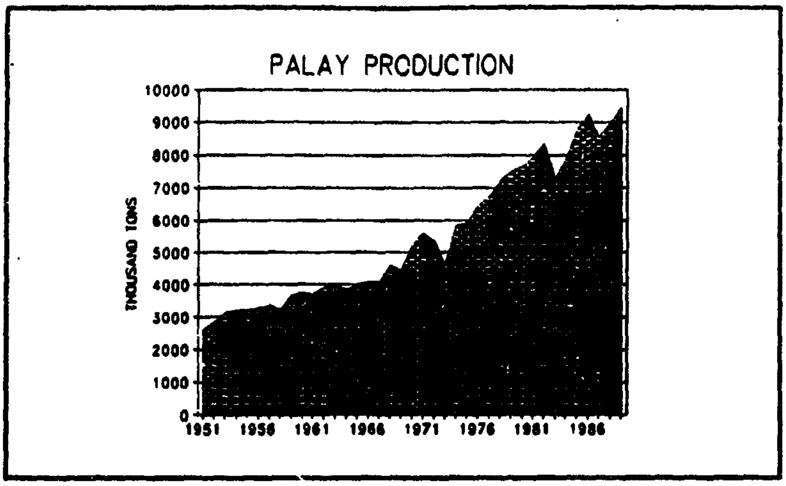
1/ Calculated from various data provided in the Rice Statistics Handbook, 1989.

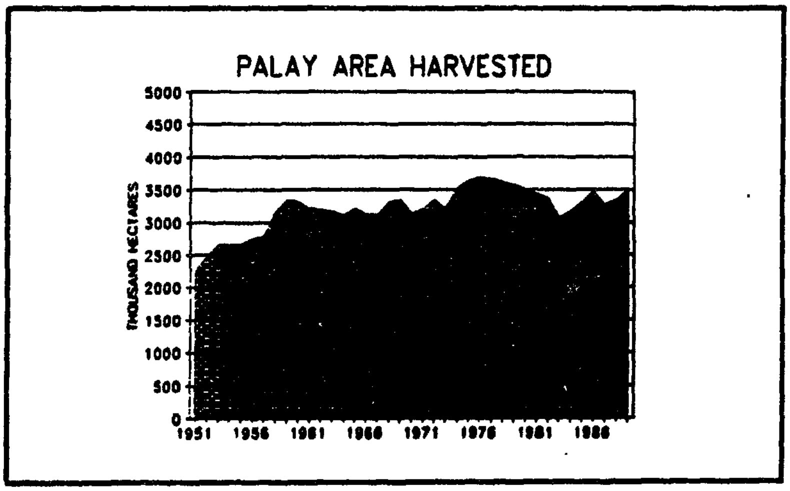
Source: Bureau of Agricultural Statistics, Department of Agriculture.

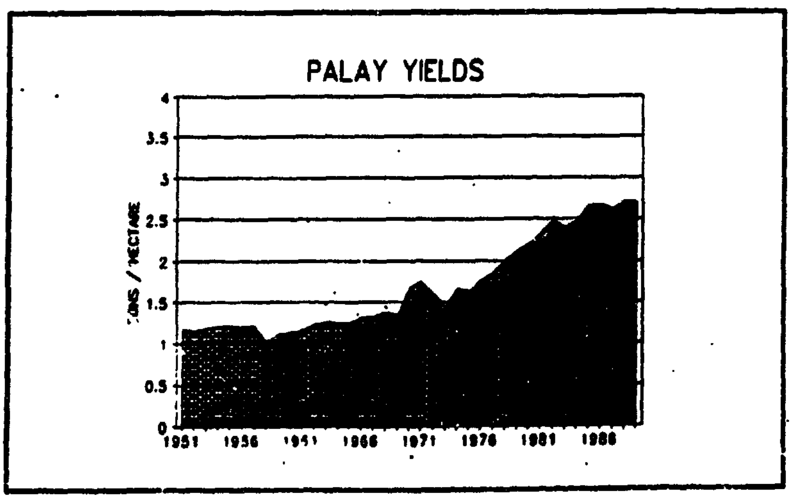
PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Rice Production, Yields and Harvested Area, 1951-89







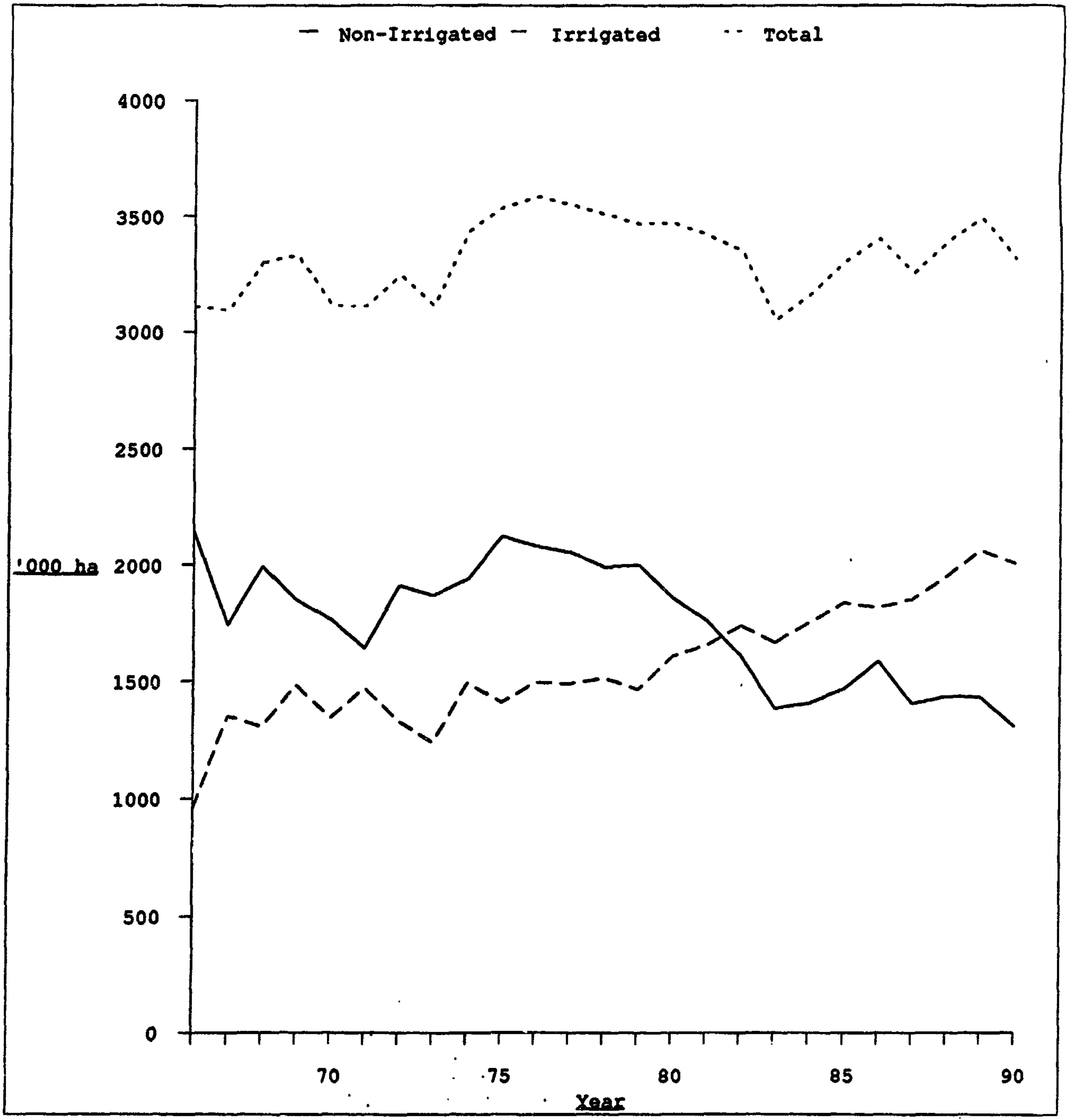
Source: Bur[illegible]u of Ag[illegible]i[illegible]ul[illegible]

ANNEX 2
Figure 2

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Paddy Harvested Area: Irrigated and Non-Irrigated, 1966-90



Source: Bureau of Agricultural Statistics (BAS)

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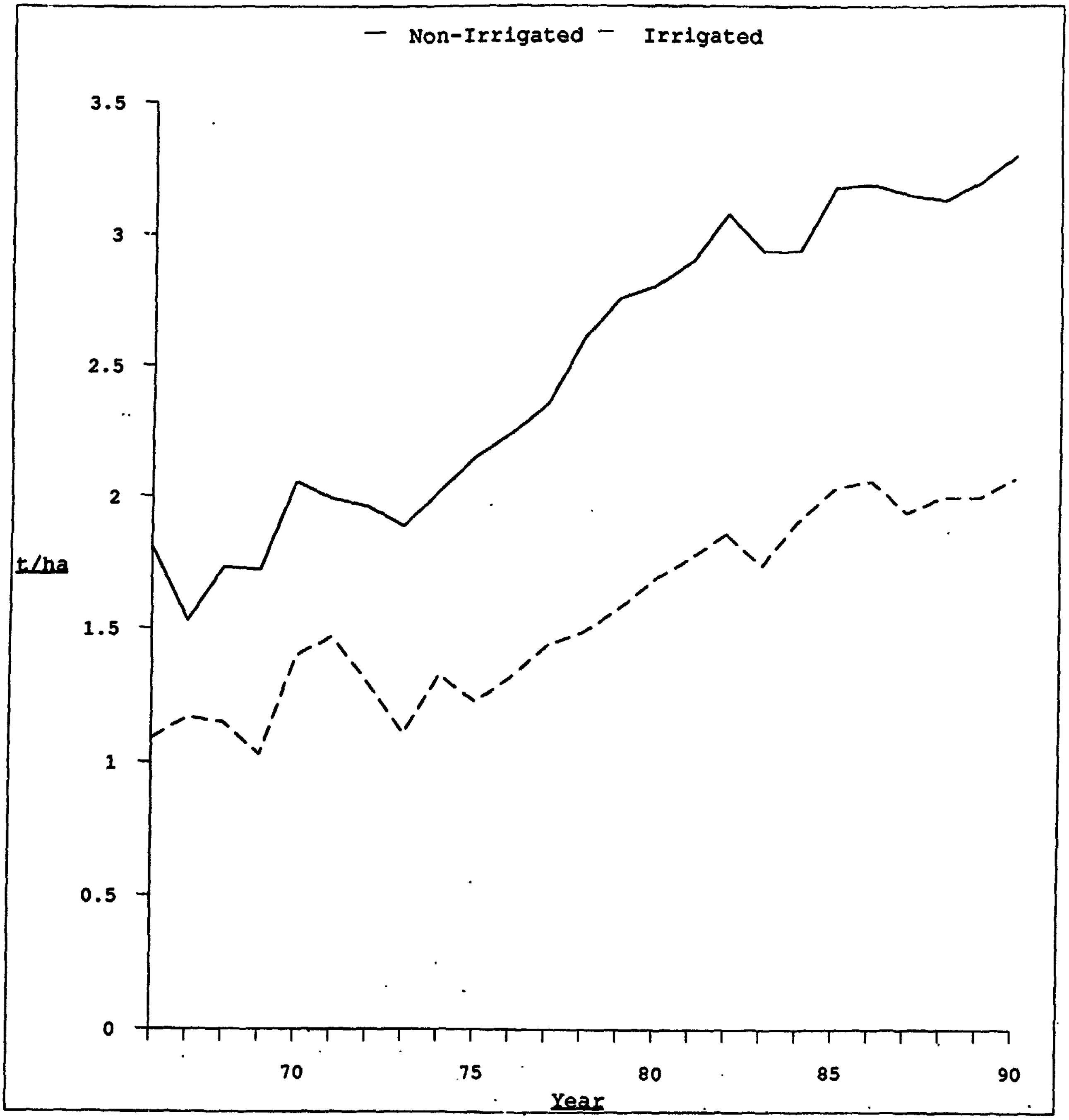
Figure 3

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Paddy Yields: Irrigated and Non-Irrigated, 1966-90



Source: Bureau of Agricultural Statistics (BAS)

ANNEX 2
Figure 4

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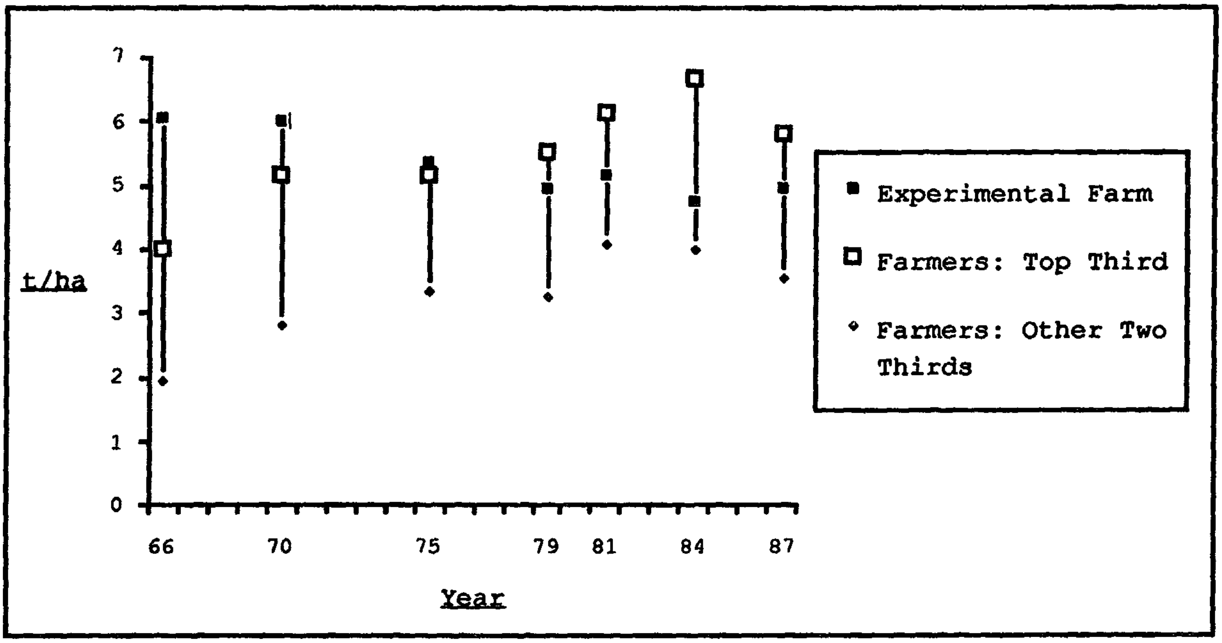
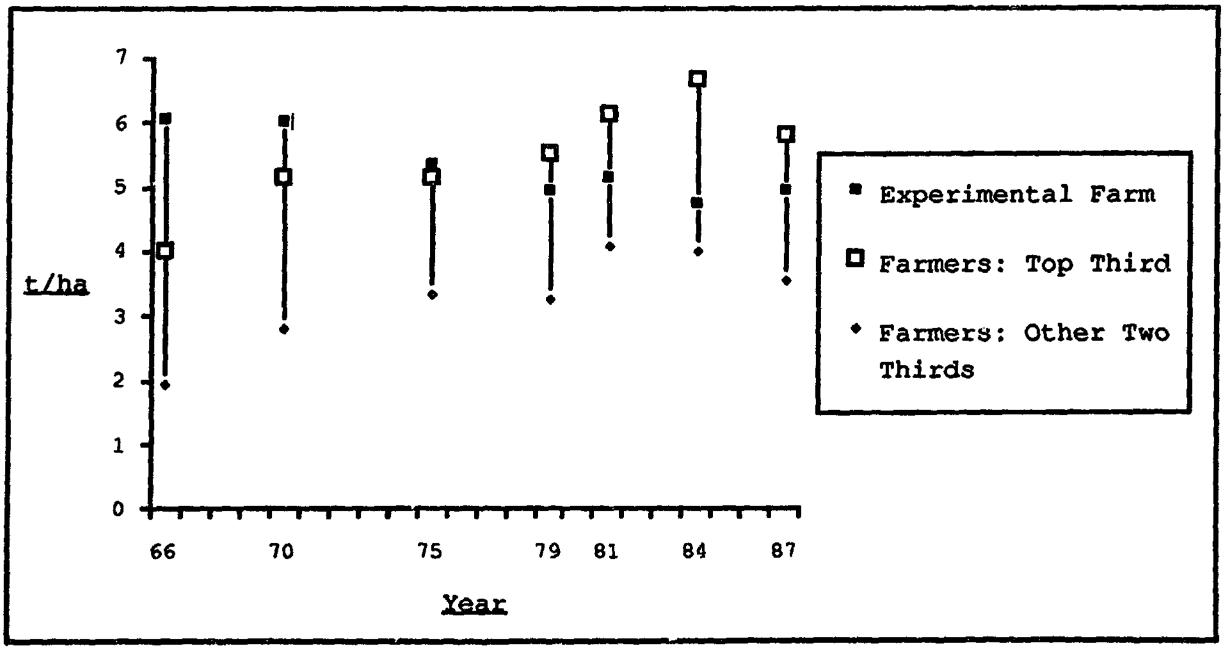
IRRIGATED AGRICULTURE SECTOR REVIEW

Trends in Experimental and Farmer's Yields

LAGUNA



NUEVA ECIJA



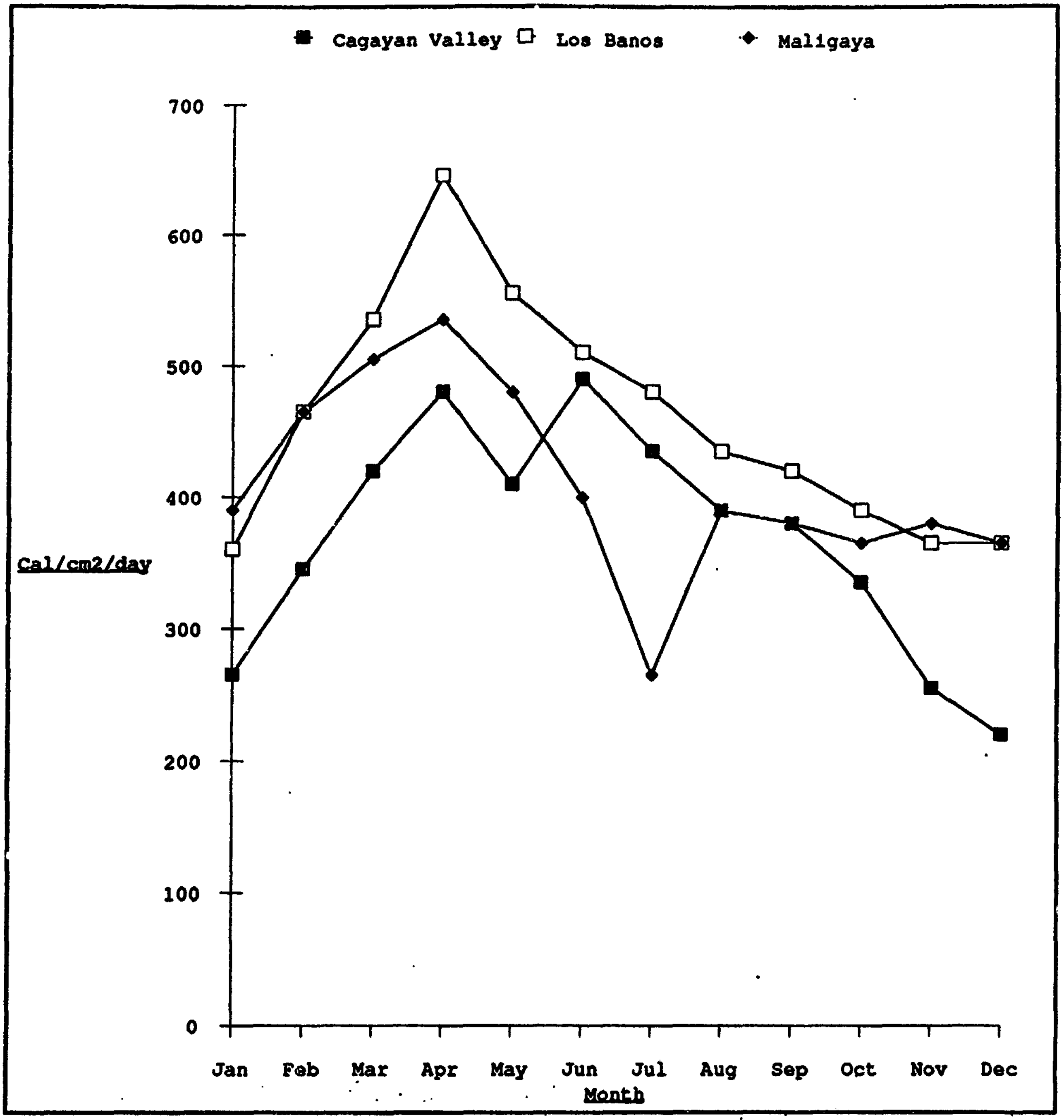
Source: Pingali P.L, Moya P.F. and Velasco L.E., 1990.

ANNEX 2
Figure 5

PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

Solar Radiation in the Major rice-Growing Areas of the Philippines



Source: Yoshida, 1978.

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IRRIGATED AGRICULTURE SECTOR REVIEW

ANNEX 3: ISSUES IN DEMAND AND SUPPLY

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PHILIPPINES

IRRIGATED AGRICULTURE SECTOR REVIEW

ANNEX 3: ISSUES IN DEMAND AND SUPPLY

1. Introduction

1. What are the prospects for demand for the main foodstuffs, particularly rice, in the Philippines? Countries which have traditionally consumed rice as the basic staple such as Thailand, the Republic of Korea, Japan, and Taiwan are eating more wheat and wheat products. There is also a shift towards increased consumption of meats, dairy products, vegetable oils, and fruits and vegetables. A recent study found rice to be an inferior good in Japan, Taiwan, Malaysia, Singapore, Thailand, and Nepal (Ito, et al 1989). Estimates of income elasticities for rice give conflicting results, but the study by Ito has caused a controversy. The income elasticity estimates by Ito et al based on time-series analysis are very low for 14 Asian countries and show significant decline from 1961 to 1984. Based on these results, Ito et al argue that there may be potential for an excess supply of rice in Asia.

2. Bouis (1989) has challenged these findings and argued that changing economic and production structures, such as the increasing commercialization of production, and not changing income may have resulted in declining rice consumption. Bouis argues that failure to account for the effects on demand for staples of decisions by semi-subsistence farmers to produce staples will lead to a downward bias in income elasticities.

3. Huang (1990) has also argued that Ito et al's results are generally implausible and noted statistical problems which may have led to underestimation of the income elasticities. Huang's study of demand for cereals in Asia using time-series data shows that for Asia as a whole, total cereal grains are a normal good with an income elasticity of 0.32. Among the nine countries studied, rice is found to be a normal good except in Japan and Thailand. The rice income elasticity estimates are as follows[1]: India (0.527), Pakistan (0.486), Indonesia (0.471), Republic of Korea (0.456), China (0.427), Bangladesh (0.379), Taiwan (0.258), Philippines (0.247), Japan (-0.214), and Thailand (-0.136).

4. However, the manner in which food demand parameters have been estimated for most developing countries makes them of limited use for policy analysis for the following reasons. First, most of these estimates are based on ad-hoc demand models, and hence lack consistency with consumer demand theory making comparability difficult. Second, most studies estimate only the demand parameters for staple cereals. No systematic linkages to demand of other major foods in the diet, such as meat, fish, and other foods have been estimated.

5. Changing government policies is usually a delicate task and therefore it is desirable for policy makers to anticipate correctly responses to any changes. In most developing countries, the part of the populations most affected by agricultural policy changes are usually near subsistence and, moreover, many consumers of food are also producers. An important set of parameters that determines the effects of policy changes is the matrix of consumer demand elasticities. Consistent measures of income, own-price, and cross-price elasticities for major food items are necessary, therefore, to evaluate

[1] Huang's study assumed weak separability of the cereals group and applied two-stage budgeting using the linear Almost Ideal Demand System (LA/AIDS) by Deaton and Muellbauer (1980). These elasticities are product of income elasticity of total cereals derived in the first-stage and the income elasticity of rice with respect to cereal expenditure in the second-stage.

adequately the effects of changes in agricultural and incomes policies.

6. In the case of the Philippines, previous studies of food demand using the systems approach have assumed separability of the group[2] (e.g. cereals). For instance, a cereal group defined to include rice, wheat, and maize or a meat group consisting of beef, poultry, and pork. In the case of the cereal group, the separability assumption implies that the demand for cereals is independent of the demand for other food in the diet and other goods outside the cereal group. In other words, the prices of other foods are assumed to be either (a) uncorrelated with cereal prices and cereal expenditure or (b) irrelevant in the cereal demand equation. However, while it simplifies empirical analysis, this assumption has important implications for the elasticity estimates, economic interpretation, predictive performance of demand equations and hypothesis testing.

7. Whether or not it is appropriate to assume separability is an empirical question. If the separability assumption is rejected, then the elasticities derived from the system estimated under this assumption will be biased. Intuitively, the marginal rate of substitution between rice and corn is not independent of the level of other major foods in the diet, such as meat or fish and vice-versa. Hence, the true structure of demand may violate the assumption of strong or even weak separability.

8. In this paper, the demand for cereals in the Philippines is analyzed. Instead of assuming separability of cereals, other major food items are included. The system includes rice, wheat, maize, meat, fish, fruits and vegetables, other foods, and non-food commodities. The Almost Ideal Demand System (AIDS) specification is used in the estimation using time-series data from 1961 to 1990.[3] The effects of urbanization and dynamic factors such as habit formation in consumption are also considered in the empirical analysis. This study complements Bouis's (1989) study which includes the same set of commodities but uses cross-section data from the 1978 Philippine nationwide nutrition survey. The effects of semi-subsistence production of cereals on consumption as described in Bouis's analysis of household cross-section data is also considered.

9. To test separability, non-nested hypothesis testing procedures are used. Alternative specifications of the demand system are evaluated based on goodness-of-fit, predictive performance, and bias in elasticity estimates. Since elasticities may not be constant over time, estimates over the period of the study are presented, in addition to the estimates based on the means of the observations.

10. The outline of the paper is as follows: the demand system is described in the next section. The various specifications are estimated using aggregated annual time-series and the tests are implemented. Then using the estimated parameters, the demand and income elasticities are estimated over the sample period. The parameters are used to generate baseline projections of cereal demand to 2000. Some policy implications and concluding remarks are given in the final section.

---

[2] Except Bouis's study which is based on cross-sectiond data and includes major food items. Data limitations often prevent explicitly including all prices in a demand model, so the assumption of weak separability is used to reduce the number of prices which must be included in empirical analysis.

[3] Other foods and non-food are combined. Changes in food expenditures by income group or by region are not accounted for in this study, given the aggregated time-series data. The effects of income levels and other demographic variables on consumption are analyzed in the cross-section study by Bouis (1989), which used the 1978 Nutrition Survey. For the purpose of evaluating aggregate demand prospects, aggregated time-series analysis is adequate. This study also aims to investigate the patterns in income and demand elasticities over time, thus requiring the use of time-series data.

2. FOOD DEMAND IN THE PHILIPPINES

Demand Model

11. Among the empirical demand systems applied in the literature, the Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980) has provided the most robust estimates. This model combines the best of the theoretical features of both the translog and Rotterdam models. Food consumption behavior in the Philippines is analyzed by estimating a complete food demand system using the AIDS model. The resulting parameter estimates are used to derive expenditure or income elasticities, own-price, and cross-price elasticities. The theoretical restrictions of adding-up, homogeneity, and Slutsky symmetry are imposed and tested.

12. An estimable variant of the Almost Ideal Demand System with the addition of dynamic factors can be specified as

$$w_{it} = \alpha_i + \sum_j \gamma_{ij} \ln P_{jt} + \beta_i \ln (Y_t/P_t) + \delta_i \ln Z_t + U_{it} \qquad (1)$$

$$i,j = 1,\ldots, n \text{ commodities}$$

where w_{it} is the average budget share of the ith commodity in time t, P_{jt} is the jth commodity price at time t, Y_t is per capita expenditure, P_t is an aggregate price index, and Z represents dynamic factors. α, γ, β, and δ are parameters to be estimated.

The aggregate price (P_t), used to normalize nominal per capita expenditure (Y_t), is defined as,

$$\ln P_t = \alpha_o + \sum \alpha_j \ln P_{jt} + \tfrac{1}{2} \sum \sum \gamma_{ij} \ln P_{it} \ln P_{jt} \qquad (2)$$

The Stone (1954) price index, $\ln P_t = \sum w_{it} \ln P_{it}$, is used to approximate (2). For the demand system to conform to consumer demand theory, the structural parameters are further constrained to satisfy the following conditions:

Adding-up condition, Engel Aggregation: $\sum \alpha_i = 1$, $\sum \beta_i = 0$,

$$\sum \gamma_{ij} = 0; \qquad (3)$$

Homogeneity: $\sum \gamma_{ij} = \theta_i = 0;$ (4)

Symmetry: $\gamma_{ij} = \gamma_{ji}$ (5)

13. Condition (3) is the budget exhaustion condition for a given income which implies that the sum of the weighted income elasticities adds to unity. Thus, only n-1 of the income elasticities are independent. Condition (4) means that the demand functions are homogenous of degree zero in prices and income. That is, an equal proportional change in prices and income will leave commodity demands unchanged.

14. The AIDS specification has several advantages for analyzing demand for food in developing countries. First, in contrast to other functional forms of demand

systems, such as the Linear Expenditure System, the AIDS is flexible enough to closely approximate demand elasticities at particular data points. Also, the possibility of inferior commodities is allowed.

15. The effects of urbanization on demand is tested by including the percentage of the population in urban cities. To account for the separate effects of changes in production structure on consumption, Bouis (1990) estimated separate demand equations for rice-consuming regions and corn-consuming semi-subsistence households using cross-section data. Bouis noted that household survey data for the Philippines show that semi-subsistence producers of a staple tend to be heavy consumers of that staple. Hence, declines (increases) in staple consumption may not be a result of income changes per se, but may be due to declines (increases) in semi-subsistence production of that staple. Corn consumption in the Philippines has increased with increases in semi-subsistence corn production. In this time-series analysis, the effects of changes in semi-subsistence farming on corn production is proxied by adding a shifter variable to represent the proportion of "corn-consumers" in the population.[4]

Data Description

16. The data needed to estimate the parameters for the commodity budget share equations include per capita expenditures, prices, and per capita consumption. The data come from several sources. Data for domestic food consumption for each commodity are taken from the FAO Supply and Utilization Accounts Database. Data from the FAO provides a consistent time-series back to 1961. The data from the Philippines Bureau of Agricultural Statistics (BAS) covers only the calendar years 1978-90. Some difficulties were encountered in combining the BAS data on food consumption with that from the former Integrated Agricultural Production and Marketing Project in the Ministry of Agriculture since the latter were on a crop years basis. The FAO data on corn per capita consumption appears inconsistent with the BAS data. Hence, the FAO corn consumption data in 1961-79 were adjusted to be consistent with later estimates by BAS.

17. The price data are taken from several sources. The price data from BAS were combined with data from the National Statistics Office (NSO) and the Central Bank. Total personal consumption expenditure is used as the income variable and is taken from the national income accounts prepared by the National Economic Development Authority. Population data were taken from the Bureau of Census. The number of "corn-consumers" is proxied by population in Cagayan, Western and Eastern Visayas, and Northern and Southern Mindanao.

Estimation Procedure

18. To estimate the parameters of the budget share equations, additive disturbances are postulated. The disturbances (U_i) for each equation are assumed to satisfy the standard assumptions of normality, zero mean, and constant variance. Because of possible interactions of expenditures on commodities within the system, the error terms across equations are assumed to be contemporaneously correlated. Since the budget shares sum to one and the disturbances must sum to zero across commodities for each observation, the covariance matrix for the original disturbances is thus singular. Hence, the budget share equation for "other goods" (other food and non-food commodities) is arbitrarily deleted and the non-linear Zellner estimation procedure is applied to the remaining budget share equations. The iterative Zellner estimation is invariant to whichever

[4] An indirect measure of subsistence agriculture can be derived by estimating the value of consumption that is not included in the national accounts.

budget share equation is deleted and asymptotically equivalent to the maximum likelihood estimation.

19. The monotonicity condition is equivalent to requiring the budget share equations to be non-negative. The quasi-convexity condition is equivalent to requiring the NxN matrix of Slutsky price derivatives to be negative semi-definite. Neither one of these conditions is imposed directly in estimation, but they are verified by checking the estimated parameters at selected data points.

3. EMPIRICAL RESULTS

Food Demand System

20. The variables included in equation (1) were defined to agree with per capita total consumption expenditure. That is, the average shares of total expenditures were used as the dependent variables. Alternative ways of incorporating "other goods" in the system were considered by first, deflating all prices using the consumer price index for all goods, and second, by including an index of prices of other items (excluding food) as a separate explanatory variable. The first specification is usually preferred to save degrees of freedom. The estimation was carried out with aggregation, homogeneity, and symmetry restrictions imposed. The structural parameters as well as the elasticities are evaluated and compared with similar system estimates from other studies.

21. Results of estimation of the demand system for cereals under the separability assumption gives poor statistical properties. The Durbin-Watson statistic shows autocorrelation in the demand for rice and corn, indicating model mis-specification. In general, the alternative model which includes other major items as well as other goods gives better statistical properties. The parameter estimates for the alternative model are shown in Table 1.

22. In Table 1, meat is classified as a relative luxury good (β>0) and rice, corn, wheat, fish, and fruits and vegetables are classified as relative necessities (β<0). These results imply that increased real per capita expenditure income led to an increased budget shares for meat and decreased shares for the rest of the rest of the commodities. Most of the estimated demand coefficients have t-values that are equal to or greater than 2.0, indicating that the budget shares for each commodity are responsive to prices and income. The food budget shares are strongly responsive to own-prices and real per capita expenditure. The nature of the demand for food commodities can be directly inferred from the signs of the structural parameters. Commodities with negative expenditure parameters (β_i < 0) have income elasticities less than unity, and those with positive parameters (β_i > 0) have income elasticities greater than unity. Commodities with positive own-price parameters (γ_{ii} > 0) are price inelastic and those with negative parameters (γ_{ii} < 0) are price elastic.

23. Own-prices in the main have positive marginal effects on the budget shares. For the shares to increase with increases in the own-price, the proportionate change in quantity demanded had to be less than the proportionate change in own-price, given the level of income. Own-price elasticities for these food commodities were expected to be less than unity. The number of "corn-consumers" has a positive effect on corn food consumption. Urbanization, as measured by the proportion of the population in urban areas, has a positive effect on the consumption of wheat, fish, and fruits and vegetables and a small negative effect on rice consumption. Habit formation, specified by including lagged consumption, is found to have a small positive effect on consumption of rice and corn, but did not have significant effect on the other commodities.

able 1: Parameter Estimates for the AIDS Model, Homogeneity and Symmetry Imposed.

quation	Intercept	Prices: Rice	Corn	Wheat	Meat	Fish	Fr & Veg	Other Goods	Total Expend-iture	Urbani-zation	Habit Form-ation	Proportion Of "Corn-Eaters"	Summary Statistics: SSE	R2	DW
ice	0.0771 (2.77)	0.0263 (6.13)	0.0010 (1.42)	0.0031 (2.2)	0.0026 (1.76)	0.0009 (0.98)	-0.0136 (-6.96)	-0.0203	-0.0240 (-2.36)	-0.00078 (-3.11)	0.1227 (1.35)		0.0001	0.89	1.74
orn	0.0016 (1.6)	0.0010 (1.42)	0.0020 (3.74)	0.0002 (1.48)	G.0005 (1.15)	0.0010 (1.11)	-0.0004 (-1.1)	-0.0043	-0.0024 (-1.98)		0.0004 (4.92)	0.0003 (1.92)	7.72E-09	0.95	1.76
heat	0.0050 (0.57)	0.0031 (2.2)	0.0002 (1.48)	0.0014 (1.7)	-0.0014 (-1.05)	0.0023 (2.07)	-0.0009 (-1.28)	-0.0047	-0.0067 (-1.6)	4.50E-04 (1.33)			5.26E-06	0.61	2.10
eat	0.0042 (1.05)	0.0026 (1.76)	0.0005 (1.15)	-0.0014 (-1.05)	0.0017 (2.27)	0.0022 (1.5)	-0.0002 (-1.33)	-0.0054	0.0032 (1.83)	6.12E-06 (1.17)			7.71E-06	0.62	1.30
ish	0.0226 (1.71)	0.0009 (0.98)	0.0010 (1.11)	0.0023 (2.07)	0.0022 (1.5)	0.0052 (4.29)	0.0057 (2.49)	-0.0173	-0.0041 (-1.14)	0.0001 (1.37)			1.62E-05	0.87	1.50
ruits Veg	0.0475 (2.91)	-0.0136 (-6.96)	-0.0004 (-1.1)	-0.0009 (-1.28)	-0.0002 (-1.33)	0.0057 (2.49)	0.0147 (5.79)	-C.0053	-0.0140 (-2.26)	0.00057 (3.48)			2.3E-05	0.97	1.53

-values are in parenthesis.

Testing of Restrictions[5]

24. The demand system model described above may be expressed more compactly as

$$W_t = \Gamma X_t + U_t \tag{6}$$

where W_t is a vector of the shares, X_t is a vector of explanatory variables, Γ is the matrix of preference parameters, and U_t is a vector of random disturbances. The theoretical restrictions to be tested are expressed in terms of the elements of the matrix Γ. The elements of the matrix X_t are assumed exogenous.[6]

25. U_t is assumed to be distributed normally with covariance matrix Ω. As noted above, Ω is singular due to the additivity contraint; hence, the nth equation (other goods) is deleted in the estimation which renders the resulting (n-1)x(n-1) covariance matrix nonsingular. To test the restrictions, the log-likelihoods for the restricted and unrestricted models may be calculated and the null hypothesis is tested using the likelihood ratio test as follows

$$T^1 = -2 \; (\log L^r - \log L^u), \tag{7}$$

where $\log L^r$ and $\log L^u$ are the maximized log-likelihood values with and without the restrictions imposed, respectively. Although the likelihood ratio test is asymptotically most powerful, properties in small samples are often difficult to define. Small-sample distributions are usually characterized to have more mass in the tails than the corresponding limit distributions, so that the use of the asymptotic criteria leads to a bias towards rejection of the null hypothesis in small samples. Meisner (1979) has shown that tests based on (6) are biased towards rejection of the null hypothesis. Baldwin et al (1983) and Chambers (1990) proposed the use of adjusted statistics to attempt to correct this bias in finite samples. Following Baldwin et al and Chambers, the following statistics are also used in testing the restrictions:

$$T^2 = T \, tr(\Omega^r)^{-1} \; (\Omega^r - \Omega^u), \tag{8}$$

$$T^3 = \frac{tr(\Omega^r)^{-1} \; (\Omega^r - \Omega^u)/q}{tr(\Omega^r)^{-1} \, \Omega^u \, /(n-1)(T-K)}, \tag{9}$$

[5] Material in this section was based from Chambers (1990).

[6] Given the use of aggregate data, this assumption may not hold in practice. However, Attfield (1985) has shown that "a model in which homogeneity is tested with expenditure assumed exogenous is exactly equivalent to a model in which the exogeneity of expenditure is tested with homogeneity imposed". He also noted that earlier studies which have rejected homogeneity could be interpreted as rejecting the exogeneity of expenditure under assumed homogeneity. It would be interesting to test whether the demand system model estimated rejects homogeneity. If we fail to reject the null hypothesis of homogeneity, then the exogeneity assumption on the elements of X_t is valid.

$$T^4 = \frac{tr(\Omega^r)^{-1} \; (\Omega^r - \Omega^u)}{tr(\Omega^r)^{-1} \; \Omega^u \;/(n-1)(T-K)} , \qquad (10)$$

where Ω^r and Ω^u are the estimated covariance matrices from the models with and without the restrictions, respectively. q refers to the number of restrictions, T is the sample size, and K is the number of explanatory variables. Statistics T^1, T^2, and T^4 are asymptotically distributed as χ^2 with q degrees of freedom under the null hypothesis. T^3 has an approximate F distribution with q and (n-1)(T-K) degrees of freedom. These four test statistics were estimated and used to test the null hypotheses of homogeneity and symmetry in the demand models.

26. The calculated values of the test statistics are shown in Table 2. The tests indicate the failure to reject homogeneity and symmetry when the alternative statistics are considered. The conclusion therefore is that the restrictions proposed by demand theory are applicable to the commodity groups used in this analysis. In view of these results, it is not unreasonable to impose homogeneity and symmetry on the food demand systems and to assume that the explanatory variables are exogenous.

Table 2: Test Statistics for Homogeneity and Symmetry.

Test Statistics	Calculated Value	Critical Value significance level 1%	5%
	1) Test For Homogeneity		
T^1			
T^2	3.336	16.812	12.592
T^3	0.219	2.960	2.180
T^4	1.311	16.812	12.592
	2) Test For Symmetry[1]		
T^1	16.320	30.500	24.900
T^2	6.601	30.500	24.900
T^3	0.184	2.190	1.750
T^4	2.765	30.500	24.900

[1] The unrestricted model used to test symmetry has homogeneity imposed.

Price and Income Elasticities

27. The uncompensated (Marshallian) demand elasticities were computed using the following formulae:

income or expenditure elasticity: $\eta_{iy} = \beta_i / w_i + 1$ (6)

own-price elasticity: $\epsilon_{ii} = \gamma_{ii} / w_i - (1 + \beta_i)$ and (7)

cross-price elasticity: $\epsilon_{ij} = \gamma_{ij} / w_i - \beta_i (w_j / w_i)$ (8)

28. The income elasticity estimates based on the full model are presented in Table 3. The Marshallian and Hicksian (income-compensated) elasticities based on the sample means are shown in Table 4 and 5. The elasticities over the sample period are also calculated for each commodity and are presented in Appendix tables A1 to A7.

29. The income elasticities were less than unity for all commodities, except for meat. Among the cereals, rice and wheat have positive income elasticities, while corn was found to be an inferior good. The estimates indicate that wheat is preferred over rice. The high-priced foods such as meat, fish, and fruits and vegetables tend to have higher income elasticities than the staple cereals.

30. The income elasticities for the three cereals appear to change over time, with the rice income elasticity declining during periods of income growth. The income elasticity of demand for rice and income is plotted in Figure 1. The figure suggests a high negative correlation, with some lagged response, between income and the magnitude of the income elasticity for rice. The income elasticity for rice appears to decline from about 0.5 in the mid-1960s to about 0.25 during the late-1980s. The income elasticity for corn shows the opposite pattern. That is, the values become more negative during periods of increases in incomes and less negative during periods of income declines (1983-85). The income elasticity of demand for wheat does not exhibit any marked change over most of the period. Similarly, the income elasticities for meat does not show much change over the period of the study.

31. All the uncompensated (Marshallian) own-price elasticities are negative, while most of the compensated cross-price elasticities (Hicksian) are positive (see Appendix). That is, changes in own-price indexes had inverse effects on quantities demanded. All the estimated own-price elasticities are less than unity. Rice and corn, are the least responsive to changes in own-prices. In contrast, the demand for wheat, meat, and fruits and vegetables are generally more responsive to own-price changes than the staple cereals, with meat having the largest own-price elasticity. The absolute values of the own-price elasticities tend to move closely with the income elasticities, suggesting that the uncompensated own-price elasticities include substantial income effects.

32. The values of the estimated cross-price elasticities suggest that food demand is responsive to relative price changes. Most of the food groups are particularly responsive to changes in rice prices. However, changes in the price indexes of the other food groups had less effect on the demand for rice. This asymmetry in cross-price effects partly reflects the relatively large share of rice in expenditure.

33. The demand for rice appears to become less responsive to its own-price over time, with the own-price elasticity declining from about -0.4081 in 1965 to about

-0.1524 in 1990. The cross-price elasticity of demand for rice with respect to wheat tends to increase over the period of the study. Its magnitude slightly increased from about 0.07 during the mid-1960s to mid 1970s to about 0.11 during the late-1980s. This suggests that wheat is becoming more of a substitute for rice.

34. Wheat demand is the most price-responsive of the cereals, with an own-price elasticity of about -0.69 (at the sample means). Over time, the own-price elasticity of wheat demand has changed slightly, with some declines to about -0.55 in 1985. After 1985, the magnitude appears to return to earlier levels. Wheat demand is very responsive to changes in prices of other cereals, particularly changes in rice prices. It is interesting to note the complementarity between wheat and meat. This is plausible given the tendency towards higher consumption of both meat and wheat flour products (hamburgers, bread and noodles) particularly in restaurants and fast food chains such as MCDonalds, and Jolly Bees, etc.

35. The compensated price elasticities, adjusted for changes in real total expenditure (see appendix) suggest that rice, corn, wheat, and meat are net substitutes; rice and fruits and vegetables are net complements. Wheat is a net substitute for rice, corn, fish, and fruits and vegetables, but a net complement to meat.

Table 3: Income Elasticities of Demand, 1965-1990.

Year	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965-67	0.4832	0.1785	0.8463	1.4448	0.4197	-0.0187
1968-72	0.3620	0.1757	0.8671	1.4665	0.6010	0.0933
1973-76	0.4481	-0.3380	0.8673	1.4310	0.6872	0.2344
1977-79	0.2796	-0.0368	0.8445	1.5500	0.6432	0.3845
1980-83	0.1403	-0.3723	0.8333	1.5257	0.6633	0.4819
1984-86	0.2940	-0.2732	0.8413	1.5857	0.6527	0.4191
1987-90	0.2454	-0.5574	0.8555	1.4899	0.6409	0.4592
At Sample Means	0.3508	-0.2155	0.8492	1.4955	0.6053	0.2932

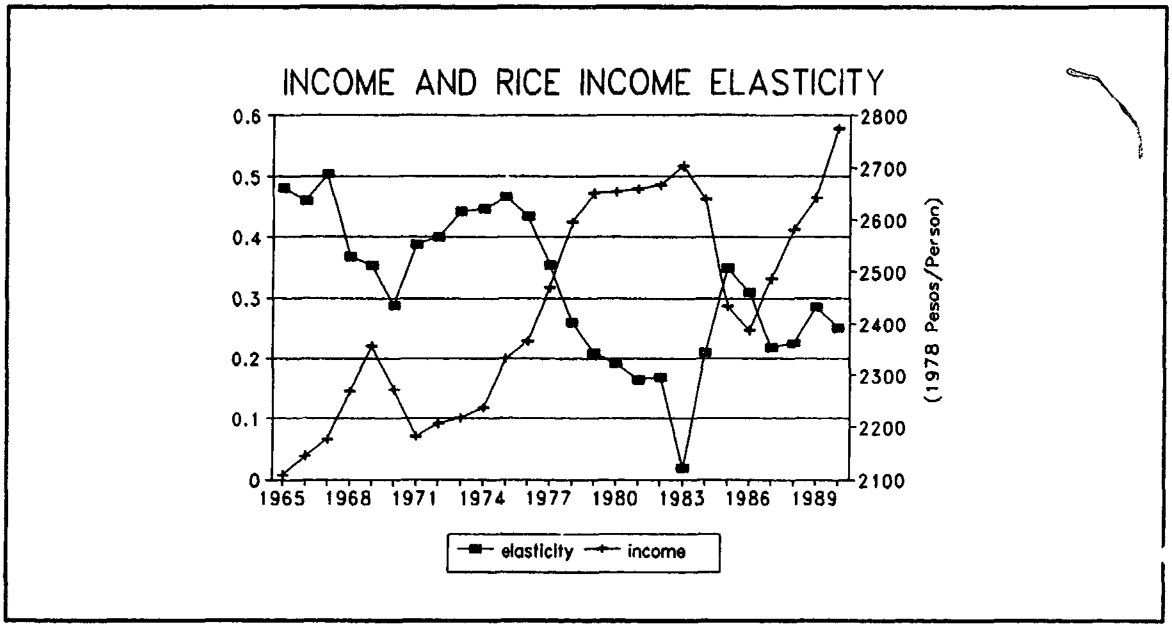
INCOME AND RICE INCOME ELASTICITY
0.6
0.5
0.4
0.3
0.2
0.1
0
2800
2700
2600
2500
2400
2300
2200
2100
(1978 Pesos/Person)
1965 1968 1971 1974 1977 1980 1983 1986 1989
elasticity
income

Figure 1

Table 4: Marshallian (Ordinary) Elasticity Matrix.

Commodity	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
Rice	-0.2636	0.0029	0.0856	0.0752	0.0299	-0.3558
Corn	0.4392	-0.2026	0.0916	0.0624	0.4083	-0.1367
Wheat	0.6951	0.0049	-0.6882	-0.3221	0.7518	-0.2014
Meat	0.3824	0.0028	-0.2213	-0.7369	0.3465	-0.0328
Fish	0.0962	0.0096	0.3201	0.2111	-0.4955	0.5569
Fruits & Veg.	-0.6633	-0.0018	-0.0427	-0.0030	0.2978	-0.2417

Elasticities calculated at sample means.

Table 5: Hicksian (Compensated) Elasticity Matrix.

Commodity	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
Rice	-0.25061	0.0030	0.0872	0.0775	0.0335	-0.3489
Corn	0.44008	-0.2026	0.0917	0.0623	0.4085	-0.1362
Wheat	0.72649	0.0052	-0.6845	-0.3166	0.7606	-0.1846
Meat	0.43765	0.0024	-0.2146	-0.7271	0.3309	-0.0033
Fish	0.11859	0.0097	0.3228	0.2071	-0.5018	0.5689
Fruits & Veg.	-0.65247	-0.0017	-0.0414	-0.0011	0.3009	-0.2359

Elasticities calculated at sample means.

Comparisons

36. Demand elasticities for selected foods from recent studies of the Philippines are given in Table 6. Since these studies vary in terms of data bases, reference periods, definition and aggregation of commodities, demand structure, and method of estimation used, the comparisons must be made cautiously. Nevertheless, if the purpose is to use these estimates for policy analysis, it is important to develop the proper perspective about the signs and order of magnitude of effects. Results of studies by Bouis (1989) and Huang (1990) were selected since they both use demand systems approaches.

Table 6: Income Elasticities from Other Studies

Commodity	Bouis (1989)[1]		Huang(1990)[2]
	Urban	Rural	Aggregate
Rice	-0.200	0.200	0.247
Corn	-0.450	-0.449	0.102
Wheat/other cereals	0.475	0.881	0.061
Meat	0.712	0.934	
Fish	0.595	0.790	
Fruits & Vegetables	0.186	0.327	

[1] Estimates based on cross-section data from 1978 Philippine nutrition survey.

[2] Based on sample means using time-series data from 1960-1988.

37. Bouis used a "characteristic food demand methodology" in estimating the elasticities. The method required a prespecification of some of the elasticities. Thus, the values for the rice and corn income elasticities were specified a priori. These estimates were obtained from an earlier study (Bouis, 1982) which was also based on household food expenditure survey data. Huang used the linear Almost Ideal System assuming weak separability of cereals from other foods and other goods.

38. The method used in this study allowed the estimation of all the elasticities for the commodities included in the system. Cereals are not assumed separable from other foods and other commodities.

39. The income elasticity for rice estimated in this study is slightly larger than those from Bouis and Huang. The estimates presented in Table 3 are based on the model with the proportion of "corn-consumers" in the total population included in the corn demand function. The income elasticities for corn estimated in this study are consistent with those derived from cross-section data, confirming that corn is an inferior good for human consumption in the Philippines. The estimate of the income elasticity of demand for wheat is also consistent with those from cross-section results, indicating that wheat is generally preferred over rice and corn.

4. RICE SUPPLY RESPONSE

Previous Estimates

40. Previous estimates of rice supply response to prices are summarized in Table 1. Given that different function forms and time periods were used in the analyses, these estimates are not directly comparable. However, they provide some basis for evaluating supply behavior to price changes. Most of the empirical studies were based on duality theory where a system of output supply and input demand functions are derived from a cost or profit function (Quizon (1981), Evenson (1985), Kalirajan and Flinn (1981), and Bantilan (1989)). Estimates by Intal and Power (1990) were based on an area hectarage response equation.

41. The range of values showed in different studies indicate that the estimates are sensitive to the time period used and regional coverage. The use of micro-level data versus aggregate data could also explain the differences. Estimates based on panel data of periodic surveys of rice farmers in Laguna and Central Luzon from 1965 to 1984 (Bantilan, 1989; and Kalirajan and Flinn, 1983) provided relatively large supply response to changes in rice prices; however; estimates for the whole Philippines (Quizon, 1981; Intal and Power, 1990), except those by Evenson (1985) are relatively low.

Table 7: Various Supply Response Estimates.

Study	Data & Time Period	Functional Form	Rice Supply Elasticity with respect to			
			Rice Price	Corn Price	Fertilizer Price	Wage Rate
Quizon (1981)	Philippines Regional Data 1948-1974	Generalized Leontief	0.10	na	-0.01	-0.09
Kalirajan & Flinn (1983)	Laguna Survey (IRRI) 1978	Translog	0.95	na	-0.16	-0.63
Evenson (1985)	Philippines Regional Data 1948-1974	Normalized Quadratic	1.25	na	-0.49	-0.15
Bantilan (1989)	Laguna Survey 1970-1984	Translog	0.33	na	-0.07	-0.15
	Central Luzon 1966-1984	Translog	0.95	na	-0.26	-0.46
Intal & Power (1990)	Philippines 1957-1983	Double-Log (Area Equation)	0.17 (short-run) 0.30 (long-run)	-0.02 -0.04	na	na

Mission Preliminary Estimates

42. For the purpose of the current study, an up-to-date supply response estimate is needed. Previous studies were based on the period when the green revolution was dominant. There has been increasing evidence of the maturing of the green revolution in Asian developing countries during the 1980s. The slowing of growth in rice yields and the post-green revolution phase of declining output and productivity growth in these countries is well documented (Byerlee, 1987; Herdt, 1988; Barker and Chapman, 1988; and Pingali, Moya, and Velasco, 1990).

Methods

43. Production analysis is usually based on one of two methods, the primal or the dual approach (Chambers, 1988). The latter is based on duality theory. Given a cost or profit function, a system of output supply and input demand can be derived. This approach usually provides estimates of production parameters under reasonable and less restrictive assumptions than those required by the former (production function approach). The foundations of duality between production functions and indirect profit functions are based on two hypothesis. First, exogeneity of prices; and second, all producers maximize profits subject to the same prices and production function approach. Apart from weak regularity conditions, the dual approach requires no formal specification of the underlying production function. However, all the information about the technology that are given by the production approach can also be derived from the profit function. Prices which assumed to be exogenous and common to all producers in any given region are taken as explaratory variables. Aggregate quantities of outputs and inputs are the decision variables. The dual approach is used in the present study. Effects of technology (e.g. adoption rates of high-yielding varieties) and irrigation are also considered.

44. Since time-series data on the regional use of most inputs are scant and generally not reliable (ie. use estimates are based on sales in the case of fertilizer), only the output supply function is estimated. The results are highly preliminary. The output supply equation is specified as follows:

$$Q_{ir} = \beta_{ir} + \sum_{j=1}^{n-1} \beta_{ijr} P_{ijr} + \sum_{k=1}^{m} \theta_{kr} Z_{kr}$$

where

Q_{ir} - output of ith commodity in region r

P_{ijr} - normalized output and input prices obtained by deflating each price by the wage rate.

Z_{kr} - technology variables, such as adoption rates of high-yielding varieties.

β_{ij} and θ_{kr} are parameters to be estimated.

Data Description and Sources

45. The data used include aggregate regional data on area, yields, output, and input prices for rice from 1970 to 1990. The data are from the Bureau of Agricultural Economics (BAS). The data are disaggregated by variety (high-yielding and traditional) with and without irrigation. The data are aggregated into three geographical areas (Luzon, Visayas, and Mindanao).

Results

46. The supply response estimates are presented in Table 2. The output price estimates are lower than those from previous studies. One reason may be the different time period used. Earlier work included the period of the rapid spread of the green revolution. This may have caused some difficulty to separate the effects of prices changes and rapid growth in technology during the 1960s and 1970s. Also, the supply rcsponse may have changed over time. Clearly, more analysis is needed tc clarify these issues.

Table 8: Regional Rice Supply Response Parameters: Preliminary Estimates

Region	Rice Supply Response with respect to the price of		
	Rice	Corn	Fertilizer
Luzon	0.2952	-0.121	-0.156
Visayas	0.2376	-0.178	-0.025
Mindanao	0.1795	-0.143	-0.011
Weighted Average (by 1989 production)	0.2499	-0.141	-0.085

5. CONCLUSIONS AND POLICY IMPLICATIONS

47. The demand estimates presented in this paper provide new information about the characteristics of food demand in the Philippines. The food budget shares are seen to be strongly responsive to changes in relative prices and income. The results indicate that rice is still a normal good in the Philippines, although its income elasticity appears to have declined slightly over time. The magnitude of the estimated income elasticity for rice is larger than that found by Ito et al (1989). This provides support to the results of Bouis' analysis of household demand in the Philippines using cross-section data.

48. The estimated set of income and demand elasticities generates important policy implications. A general increase in per capita incomes or a shift in the income distribution skewed to high-income groups is likely to be accompanied by a relative increase in demand for commodities with high income elasticities, such as wheat, meat, and fruits and vegetables, relative to the staple foodstuffs.

49. The results of the analysis are useful for evaluating the demand prospects for major food items in the Philippines and for assessing the impacts of alternative price policies. Since rice remains a "normal" good (a positive income elasticity), continuing growth in rice per capita consumption can be expected. Per capita consumption of corn should decline slightly, reflecting the small negative income elasticity. Given the high income elasticity of demand for wheat and positive urbanization effects, wheat per capita consumption is expected to continue to increase.

50. The results suggest that policy makers should consider consumer adjustments to policy changes in their totality. The cross-price elasticity estimates suggest that a policy change targeted to changes in the price of a food item, such as rice, will have simultaneous impacts on consumption of related commodities. Based on the estimates of price and income elasticities presented in this paper, small changes in relative cereal prices can shift the pattern of food demand significantly.

51. The declining trend in the income elasticity of demand for rice and the long-term trend toward increasing diversity in food consumption have important implications for food policy, research, and investments in agriculture. Historically, agricultural development in the Philippines has concentrated on cereal production, particularly rice production. This emphasis is due to the importance of rice in food consumption and as a source of farmers incomes. In the long-term, income growth will fuel an expansion in demand for meat and livestock products. This and the accompanying diversification in food consumption and the shift from staple cereal to other grains will affect the overall pattern of agricultural production and consumption. The likely continued growth in meat consumption, particularly pork and poultry, will fuel the demand for cereals as livestock feed. This is already occurring in corn, soybeans, and wheat. Given these trends, an integrated approach to policy making and analyses is required. The piecemeal approach to policy has ignored the important linkages in the cereals, feed, and livestock-meat sectors. More importantly, an evaluation of economic effects of present pricing and trade policies, including tariff and import/export policies on cereal feeds, livestock and poultry sector is needed.

52. Policy formation without considering these linkages have adversely affected the performance of these sectors. For instance, the open import policy on wheat relative to corn has encouraged the utilization of wheat as livestock feed since wheat and corn are direct substitutes in animal feeding. As more wheat is diverted for animal feeds, wheat available for human consumption remain limited and prices of wheat flour products (e.g. noodles, bread, etc.) remain high

despite the large declines in real prices of wheat flour in recent years. Meanwhile, the high degree of protection and the restrictive import policy on corn have entailed significant costs to the livestock-meat sector and have penalized consumers through high prices. The distortions in the corn sector have adversely affected the performance of the livestock-meat industry and may have limited the welfare gains from the liberalization of the wheat market. Thus, elimination of protection and trade barriers in the corn sector will improve the efficiency of the corn-livestock industry and will improve net welfare gains. This will also improve the efficiency and competitiveness of the wheat milling industry and should result in lower prices of wheat flour products, thus improving consumer welfare. Given the high real cost of irrigation, and the relatively higher cost of rice imports compared to wheat, this may be a cost-effective policy option to meet food demand. [7]

53. Finally, the long-term trends in food consumption patterns should be considered in evaluating the costs and benefits of future irrigation investments in the rice sector. The trends in food demand suggest that as incomes rise, the share of rice in the diet will decline and the demand for meat and wheat products will increase. Since these trends will likely continue, the concern about future rice shortages and famine due to decline or lack of new irrigation investments may not be warranted. What will be more important is the alignment of food and trade policy to account for these trends and to improve food system performance. Further investments in irrigation should be carefully evaluated. More importantly, the role of improved trade policy should be evaluated in improving the food supply-demand balance.

[7] Border prices for rice have generally been higher than domestic prices since the mid-1970s. In the IFPRI report on the Food Crop Sector, Rosegrant, et al (1987) calculate nominal protection rates for rice for the 1971 to 1985 period. On average, the nominal protection rate was +21% during rice importing years and -11% during years of surplus. Over the 1971-85 period, the average nominal rate of protection for rice was 5.6%.

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IRRIGATED AGRICULTURE SECTOR REVIEW

Table A.1: Income Elasticities of Demand, 1965-1990.

Year	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	0.4825	0.1875	0.8016	1.4749	0.4088	0.0979
1966	0.4607	0.2137	0.8567	1.4269	0.3995	0.0311
1967	0.5045	0.1297	0.8666	1.4356	0.4484	0.0605
1968	0.3680	0.0877	0.8730	1.4347	0.5089	0.0272
1969	0.3536	0.0722	0.8728	1.4574	0.5044	0.0606
1970	0.2876	0.0156	0.8501	1.4917	0.5851	0.0789
1971	0.3385	-0.3109	0.8712	1.4647	0.6532	0.1089
1972	0.4007	-0.2981	0.8660	1.4887	0.6858	0.2809
1973	0.4429	-0.2854	0.8673	1.4342	0.6730	0.1319
1974	0.4471	-0.3085	0.8696	1.3476	0.6925	0.2494
1975	0.4672	-0.3685	0.8509	1.4538	0.7037	0.2094
1976	0.4343	-0.3802	0.8786	1.5273	0.6778	0.3225
1977	0.3555	-0.2028	0.8488	1.5912	0.6614	0.2942
1978	0.2596	-0.0097	0.8414	1.5756	0.6380	0.4183
1979	0.2078	-0.1759	0.8431	1.4937	0.6287	0.4248
1980	0.1903	-0.2681	0.8448	1.4936	0.6489	0.4902
1981	0.1644	-0.3054	0.8363	1.4972	0.6712	0.5051
1982	0.1684	-0.3787	0.8439	1.5521	0.6748	0.4532
1983	0.0180	-0.5753	0.8014	1.5681	0.6568	0.4766
1984	0.2090	-0.3766	0.8078	1.5496	0.6465	0.4243
1985	0.3494	-0.1468	0.7857	1.6605	0.6395	0.3712
1986	0.3094	-0.3195	0.8894	1.5592	0.6705	0.4556
1987	0.2175	-0.3223	0.8178	1.5345	0.6501	0.4608
1988	0.2249	-0.4869	0.8661	1.5125	0.6597	0.4962
1989	0.2856	-0.5888	0.8647	1.4564	0.6183	0.4430
1990	0.2495	-0.9599	0.8637	1.4647	0.6327	0.4322
Average 1987-90	0.2454	-0.5574	0.8555	1.4899	0.6409	0.4592
At Sample Means	0.3508	-0.2155	0.8492	1.4955	0.6053	0.2932

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IRRIGATED AGRICULTURE SECTOR REVIEW

Table A.2: Rice: Marshallian Demand Elasticities, 1965-90.

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	-0.4081	0.0023	0.0677	0.0601	0.0220	-0.2873
1966	-0.3841	0.0024	0.0713	0.0630	0.0229	-0.2990
1967	-0.4322	0.0022	0.0656	0.0578	0.0213	-0.2740
1968	-0.2825	0.0028	0.0839	0.0737	0.0278	-0.3503
1969	-0.2666	0.0029	0.0858	0.0752	0.0284	-0.3585
1970	-0.1942	0.0032	0.0940	0.0825	0.0324	-0.3937
1971	-0.3049	0.0028	0.0811	0.0711	0.0290	-0.3377
1972	-0.3183	0.0027	0.0794	0.0694	0.0292	-0.3287
1973	-0.3646	0.0025	0.0738	0.0650	0.0268	-0.3074
1974	-0.3692	0.0025	0.0733	0.0656	0.0271	-0.3037
1975	-0.3913	0.0024	0.0703	0.0620	0.0264	-0.2931
1976	-0.3552	0.0026	0.0752	0.0653	0.0274	-0.3095
1977	-0.2687	0.0029	0.0850	0.0739	0.0308	-0.3532
1978	-0.1635	0.0033	0.0975	0.0850	0.0348	-0.4026
1979	-0.1066	0.0035	0.1043	0.0917	0.0370	-0.4306
1980	-0.0874	0.0035	0.1067	0.0938	0.0383	-0.4376
1981	-0.0590	0.0037	0.1099	0.0967	0.0402	-0.4509
1982	-0.0634	0.0036	0.1096	0.0957	0.0401	-0.4510
1983	0.1017	0.0043	0.1285	0.1129	0.0467	-0.5314
1984	-0.1079	0.0035	0.1036	0.0911	0.0374	-0.4300
1985	-0.2620	0.0029	0.0850	0.0743	0.0306	-0.3550
1986	-0.2181	0.0030	0.0922	0.0794	0.0332	-0.3745
1987	-0.1172	0.0034	0.1026	0.0902	0.0371	-0.4241
1988	-0.1254	0.0034	0.1027	0.0896	0.0370	-0.4186
1989	-0.1921	0.0031	0.0946	0.0831	0.0331	-0.3877
1990	-0.1524	0.0032	0.0993	0.0872	0.0351	-0.4077
Average 1987-90	-0.14783	0.0033	0.0997	0.0874	0.0355	-0.4090
At Sample Means	-0.2636	0.0029	0.0856	0.0752	0.0299	-0.3558

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IRRIGATED AGRICULTURE SECTOR REVIEW

Table A.3: Corn For Food: Marshallian Demand Elasticities, 1965-

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	0.3728	-0.3371	0.0753	0.0517	0.3366	-0.1193
1966	0.3593	-0.3584	0.0739	0.0494	0.3256	-0.1148
1967	0.4011	-0.2899	0.0821	0.0548	0.3610	-0.1260
1968	0.4110	-0.2556	0.0863	0.0575	0.3792	-0.1332
1969	0.4172	-0.2430	0.0878	0.0588	0.3856	-0.1359
1970	0.4392	-0.1968	0.0923	0.0629	0.4107	-0.1422
1971	0.3113	-0.4377	0.0651	0.0437	0.2889	-0.0992
1972	0.3177	-0.4272	0.0662	0.0448	0.2951	-0.0984
1973	0.3255	-0.4169	0.0674	0.0450	0.3001	-0.1026
1974	0.3152	-0.4357	0.0653	0.0423	0.2909	-0.0975
1975	0.2889	-0.4846	0.0592	0.0400	0.2660	-0.0896
1976	0.2820	-0.4942	0.0588	0.0399	0.2604	-0.0861
1977	0.3585	-0.3495	0.0747	0.0518	0.3344	-0.1115
1978	0.4406	-0.1920	0.0926	0.0642	0.4146	-0.1343
1979	0.5207	-0.0406	0.1101	0.0751	0.4920	-0.1591
1980	0.5607	-0.0346	0.1187	0.0810	0.5314	-0.1677
1981	0.5760	-0.0650	0.1219	0.0834	0.5481	-0.1715
1982	0.6085	-0.1248	0.1291	0.0890	0.5790	-0.1848
1983	0.6883	-0.2852	0.1460	0.1020	0.6606	-0.2094
1984	0.6096	-0.1231	0.1278	0.0888	0.5768	-0.1863
1985	0.5153	-0.0644	0.1060	0.0751	0.4802	-0.1576
1986	0.5901	-0.0765	0.1258	0.0853	0.5539	-0.1767
1987	0.5860	-0.0788	0.1230	0.0851	0.5541	-0.1768
1988	0.6594	-0.2131	0.1402	0.0953	0.6236	-0.1961
1989	0.7088	-0.2962	0.1498	0.1006	0.6643	-0.2137
1990	0.8711	-0.5989	0.1847	0.1244	0.8203	-0.2646
Average 1987-90	0.6919	-0.2705	0.1463	0.0994	0.6522	-0.2083
At Sample Means	0.4392	-0.2026	0.0916	0.0624	0.4083	-0.1367

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IRRIGATED AGRICULTURE SECTOR REVIEW

Table A.4: Wheat: Marshallian Demand Elasticities, 1965-90.

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	0.9162	0.0065	-0.5901	-0.4237	0.9882	-0.2663
1966	0.6615	0.0047	-0.7038	-0.3059	0.7137	-0.1922
1967	0.6162	0.0044	-0.7242	-0.2848	0.6644	-0.1787
1968	0.5854	0.0042	-0.7374	-0.2711	0.6327	-0.1703
1969	0.5863	0.0042	-0.7370	-0.2716	0.6337	-0.1707
1970	0.6905	0.0049	-0.6901	-0.3202	0.7472	-0.2009
1971	0.5939	0.0042	-0.7337	-0.2751	0.6422	-0.1725
1972	0.6181	0.0044	-0.7229	-0.2862	0.6684	-0.1790
1973	0.6123	0.0044	-0.7257	-0.2833	0.6617	-0.1776
1974	0.6019	0.0043	-0.7303	-0.2782	0.6504	-0.1743
1975	0.6884	0.0049	-0.6918	-0.3184	0.7438	-0.1994
1976	0.5602	0.0040	-0.7489	-0.2593	0.6054	-0.1620
1977	0.6967	0.0050	-0.6876	-0.3230	0.7537	-0.2018
1978	0.7304	0.0052	-0.6721	-0.3390	0.7909	-0.2111
1979	0.7221	0.0051	-0.6757	-0.3351	0.7822	-0.2088
1980	0.7143	0.0051	-0.6792	-0.3316	0.7740	-0.2061
1981	0.7533	0.0054	-0.6616	-0.3497	0.8165	-0.2172
1982	0.7180	0.0051	-0.6774	-0.3335	0.7783	-0.2075
1983	0.9130	0.0065	-0.5896	-0.4244	0.9904	-0.2638
1984	0.8847	0.0063	-0.6028	-0.4107	0.9584	-0.2558
1985	0.9875	0.0070	-0.5574	-0.4580	1.0682	-0.2855
1986	0.5097	0.0036	-0.7711	-0.2364	0.5517	-0.1471
1987	0.8388	0.0060	-0.6234	-0.3893	0.9086	-0.2422
1988	0.6164	0.0044	-0.7231	-0.2861	0.6677	-0.1777
1989	0.6231	0.0044	-0.7203	-0.2889	0.6745	-0.1799
1990	0.6274	0.0045	-0.7182	-0.2910	0.6794	-0.1813
Average 1987-90	0.6652	0.0047	-0.7013	-0.3086	0.7204	-0.1920
At Sample Means	0.6951	0.0049	-0.6882	-0.3221	0.7518	-0.2014

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Table A.5: Meat: Marshallian Demand Elasticities, 1965-90.

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	0.3620	0.0027	-0.2116	-0.7479	0.3305	-0.0281
1966	0.3262	0.0024	-0.1907	-0.7737	0.2970	-0.0256
1967	0.3311	0.0024	-0.1948	-0.7691	0.3033	-0.0267
1968	0.3350	0.0024	-0.1945	-0.7695	0.3031	-0.0261
1969	0.3529	0.0025	-0.2046	-0.7574	0.3189	-0.0273
1970	0.3810	0.0027	-0.2196	-0.7389	0.3436	-0.0303
1971	0.3576	0.0026	-0.2079	-0.7534	0.3257	-0.0289
1972	0.3756	0.0028	-0.2185	-0.7405	0.3431	-0.0322
1973	0.3324	0.0025	-0.1942	-0.7698	0.3046	-0.0272
1974	0.2660	0.0020	-0.1555	-0.8164	0.2441	-0.0226
1975	0.3466	0.0026	-0.2027	-0.7593	0.3190	-0.0291
1976	0.4041	0.0030	-0.2361	-0.7197	0.3700	-0.0354
1977	0.4561	0.0033	-0.2640	-0.6854	0.4145	-0.0392
1978	0.4468	0.0032	-0.2569	-0.6938	0.4031	-0.0406
1979	0.3843	0.0027	-0.2204	-0.7378	0.3456	-0.0349
1980	0.3845	0.0027	-0.2204	-0.7379	0.3458	-0.0365
1981	0.3878	0.0027	-0.2219	-0.7359	0.3488	-0.0372
1982	0.4306	0.0030	-0.2465	-0.7064	0.3874	-0.0398
1983	0.4455	0.0031	-0.2531	-0.6978	0.3982	-0.0416
1984	0.4278	0.0030	-0.2449	-0.7078	0.3850	-0.0389
1985	0.5098	0.0036	-0.2941	-0.6481	0.4626	-0.0454
1986	0.4328	0.0031	-0.2506	-0.7026	0.3923	-0.0404
1987	0.4159	0.0029	-0.2383	-0.7159	0.3746	-0.0387
1988	0.3986	0.0028	-0.2292	-0.7277	0.3593	-0.0380
1989	0.3537	0.0025	-0.2040	-0.7579	0.3193	-0.0327
1990	0.3609	0.0025	-0.2077	-0.7534	0.3254	-0.0330
Average 1987-90	0.3806	0.0027	-0.2189	-0.7399	0.3431	-0.0354
At Sample Means	0.3824	0.0028	-0.2213	-0.7369	0.3465	-0.0328

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Table A.6: Fish: Marshallian Demand Elasticities, 1965-90.

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	0.1497	0.0144	0.4789	0.3160	-1.2381	0.8301
1966	0.1509	0.0146	0.4872	0.3205	-1.2732	0.8436
1967	0.1408	0.0134	0.4477	0.2945	-1.0884	0.7756
1968	0.1202	0.0120	0.3988	0.2622	-0.8601	0.6900
1969	0.1209	0.0121	0.4024	0.2648	-0.8770	0.6961
1970	0.0998	0.0101	0.3365	0.2219	-0.5718	0.5835
1971	0.0853	0.0085	0.2815	0.1853	-0.3145	0.4879
1972	0.0776	0.0077	0.2550	0.1680	-0.1913	0.4432
1973	0.0817	0.0080	0.2654	0.1746	-0.2398	0.4602
1974	0.0770	0.0075	0.2496	0.1636	-0.1661	0.4336
1975	0.0746	0.0072	0.2404	0.1583	-0.1239	0.4176
1976	0.0803	0.0079	0.2617	0.1725	-0.2218	0.4550
1977	0.0827	0.0083	0.2747	0.1815	-0.2838	0.4779
1978	0.0866	0.0088	0.2935	0.1939	-0.3721	0.5124
1979	0.0881	0.0090	0.3011	0.1986	-0.4073	0.5257
1980	0.0830	0.0085	0.2847	0.1878	-0.3308	0.4981
1981	0.0774	0.0080	0.2665	0.1758	-0.2464	0.4667
1982	0.0767	0.0079	0.2637	0.1741	-0.2330	0.4608
1983	0.0794	0.0083	0.2780	0.1839	-0.3012	0.4867
1984	0.0838	0.0086	0.2864	0.1893	-0.3400	0.5004
1985	0.0879	0.0088	0.2919	0.1934	-0.3665	0.5096
1986	0.0796	0.0080	0.2678	0.1765	-0.2494	0.4670
1987	0.0831	0.0085	0.2835	0.1873	-0.3264	0.4959
1988	0.0809	0.0082	0.2762	0.1821	-0.2901	0.4829
1989	0.0918	0.0092	0.3098	0.2039	-0.4464	0.5406
1990	0.0877	0.0089	0.2981	0.1963	-0.3922	0.5201
Average 1987-90	0.0857	0.0087	0.2913	0.1920	-0.3612	0.5089
At Sample Means	0.0962	0.0096	0.3201	0.2111	-0.4955	0.5569

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Table A.7: Fruits & Veg.: Marshallian Demand Elasticities, 1965-

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	-1.0200	-0.0027	-0.0675	-0.0044	0.4587	-0.1702
1966	-0.9598	-0.0026	-0.0621	-0.0033	0.4307	-0.0998
1967	-0.8709	-0.0024	-0.0562	-0.0032	0.3930	-0.0034
1968	-0.9629	-0.0026	-0.0612	-0.0034	0.4307	-0.0957
1969	-0.9951	-0.0027	-0.0632	-0.0039	0.4446	-0.1308
1970	-0.8674	-0.0023	-0.0557	-0.0039	0.3876	-0.0160
1971	-0.8342	-0.0022	-0.0532	-0.0034	0.3767	-0.0477
1972	-0.6726	-0.0018	-0.0431	-0.0030	0.3049	-0.2288
1973	-0.8093	-0.0021	-0.0519	-0.0029	0.3676	-0.0719
1974	-0.6996	-0.0018	-0.0449	-0.0011	0.3185	-0.1956
1975	-0.7356	-0.0019	-0.0478	-0.0029	0.3358	-0.1534
1976	-0.6321	-0.0016	-0.0402	-0.0032	0.2870	-0.2725
1977	-0.6621	-0.0018	-0.0427	-0.0038	0.2986	-0.2428
1978	-0.5486	-0.0015	-0.0353	-0.0030	0.2456	-0.3734
1979	-0.5436	-0.0015	-0.0349	-0.0024	0.2427	-0.3803
1980	-0.4822	-0.0013	-0.0309	-0.0022	0.2154	-0.4492
1981	-0.4685	-0.0013	-0.0301	-0.0021	0.2096	-0.4648
1982	-0.5176	-0.0014	-0.0331	-0.0027	0.2316	-0.4102
1983	-0.4978	-0.0014	-0.0322	-0.0027	0.2213	-0.4348
1984	-0.5441	-0.0015	-0.0354	-0.0028	0.2432	-0.3798
1985	-0.5902	-0.0016	-0.0388	-0.0037	0.2656	-0.3238
1986	-0.5121	-0.0014	-0.0320	-0.0027	0.2305	-0.4128
1987	-0.5094	-0.0014	-0.0330	-0.0026	0.2279	-0.4182
1988	-0.4758	-0.0013	-0.0302	-0.0023	0.2131	-0.4555
1989	-0.5246	-0.0015	-0.0334	-0.0021	0.2349	-0.3995
1990	-0.5357	-0.0015	-0.0341	-0.0022	0.2397	-0.3881
Average 1987-90	-0.5103	-0.0014	-0.0326	-0.0023	0.2284	-0.4165
At Sample Means	-0.6633	-0.0018	-0.0427	-0.0030	0.2978	-0.2417

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Table A.8: Rice: Hicksian Demand Elasticities, 1965-90.

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	-0.3857	0.0025	0.0693	0.0634	0.0254	-0.2811
1966	-0.3636	0.0026	0.0734	0.0665	0.0261	-0.2927
1967	-0.4078	0.0024	0.0682	0.0616	0.0251	-0.2665
1968	-0.2685	0.0029	0.0858	0.0765	0.0309	-0.3453
1969	-0.2535	0.0030	0.0876	0.0777	0.0313	-0.3539
1970	-0.1845	0.0032	0.0953	0.0844	0.0353	-0.3894
1971	-0.2896	0.0029	0.0831	0.0738	0.0336	-0.3316
1972	-0.3023	0.0029	0.0814	0.0721	0.0344	-0.3209
1973	-0.3455	0.0027	0.0761	0.0683	0.0324	-0.3003
1974	-0.3498	0.0027	0.0756	0.0697	0.0331	-0.2954
1975	-0.3702	0.0026	0.0724	0.0653	0.0329	-0.2849
1976	-0.3368	0.0028	0.0776	0.0679	0.0329	-0.3006
1977	-0.2555	0.0030	0.0866	0.0759	0.0351	-0.3462
1978	-0.1551	0.0034	0.0986	0.0865	0.0377	-0.3964
1979	-0.1003	0.0035	0.1052	0.0931	0.0393	-0.4256
1980	-0.0818	0.0036	0.1075	0.0950	0.0405	-0.4323
1981	-0.0543	0.0037	0.1106	0.0978	0.0423	-0.4462
1982	-0.0585	0.0037	0.1103	0.0967	0.0423	-0.4467
1983	-0.1021	0.0043	0.1285	0.1130	0.0469	-0.5309
1984	-0.1016	0.0035	0.1043	0.0923	0.0398	-0.4249
1985	-0.2492	0.0029	0.0860	0.0760	0.0346	-0.3472
1986	-0.2073	0.0031	0.0941	0.0812	0.0371	-0.3665
1987	-0.1106	0.0035	0.1034	0.0915	0.0396	-0.4184
1988	-0.1184	0.0034	0.1038	0.0910	0.0397	-0.4124
1989	-0.1825	0.0032	0.0960	0.0851	0.0362	-0.3806
1990	-0.1445	0.0033	0.1006	0.0890	0.0379	-0.4015
Average 1987-90	-0.1400	0.0033	0.1008	0.0891	0.0383	-0.4027
At Sample Means	-0.2506	0.0030	0.0872	0.0775	0.0335	-0.3489

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Table A.9: Corn for Food: Hicksian Demand Elasticities, 1965-90.

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	0.3815	-0.3370	0.0759	0.0504	0.3379	-0.1170
1966	0.3688	-0.3584	0.0749	0.0478	0.3271	-0.1119
1967	0.4074	-0.2899	0.0828	0.0539	0.3619	-0.1240
1968	0.4143	-0.2556	0.0868	0.0568	0.3800	-0.1320
1969	0.4198	-0.2429	0.0881	0.0583	0.3862	-0.1349
1970	0.4398	-0.1968	0.0924	0.0627	0.4109	-0.1420
1971	0.3235	-0.4376	0.0667	0.0416	0.2926	-0.0943
1972	0.3296	-0.4271	0.0677	0.0428	0.2990	-0.0926
1973	0.3378	-0.4168	0.0689	0.0429	0.3037	-0.0980
1974	0.3286	-0.4356	0.0669	0.0394	0.2951	-0.0918
1975	0.3055	-0.4845	0.0609	0.0373	0.2711	-0.0831
1976	0.2981	-0.4940	0.0609	0.0375	0.2653	-0.0783
1977	0.3661	-0.3494	0.0756	0.0507	0.3369	-0.1074
1978	0.4409	-0.1920	0.0927	0.0641	0.4148	-0.1340
1979	0.5154	-0.0406	0.1093	0.0763	0.4901	-0.1634
1980	0.5527	-0.0346	0.1176	0.0828	0.5283	-0.1750
1981	0.5672	-0.0650	0.1207	0.0854	0.5442	-0.1801
1982	0.5975	-0.1247	0.1274	0.0912	0.5742	-0.1945
1983	0.6742	-0.2851	0.1441	0.1053	0.6536	-0.2247
1984	0.5982	-0.1230	0.1264	0.0911	0.5724	-0.1954
1985	0.5099	-0.0644	0.1056	0.0759	0.4785	-0.1608
1986	0.5790	-0.0765	0.1239	0.0871	0.5499	-0.1849
1987	0.5761	-0.0787	0.1218	0.0871	0.5503	-0.1851
1988	0.6443	-0.2130	0.1378	0.0984	0.6177	-0.2096
1989	0.6890	-0.2961	0.1469	0.1048	0.6579	-0.2285
1990	0.8404	-0.5987	0.1800	0.1311	0.8095	-0.2882
Average 1987-90	0.6742	-0.2705	0.1437	0.1031	0.6458	-0.2227
At Sample Means	0.4401	-0.2026	0.0917	0.0623	0.4085	-0.1362

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Table A.10: Wheat: Hicksian Demand Elasticities, 1965-90.

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	0.9534	0.0068	-0.5874	-0.4182	0.9938	-0.2561
1966	0.6996	0.0050	-0.6998	-0.2994	0.7196	-0.1806
1967	0.6582	0.0046	-0.7199	-0.2783	0.6709	-0.1658
1968	0.6185	0.0044	-0.7328	-0.2646	0.6400	-0.1584
1969	0.6186	0.0044	-0.7324	-0.2654	0.6410	-0.1592
1970	0.7191	0.0051	-0.6863	-0.3146	0.7557	-0.1880
1971	0.6281	0.0045	-0.7291	-0.2690	0.6526	-0.1588
1972	0.6528	0.0047	-0.7186	-0.2805	0.6798	-0.1621
1973	0.6497	0.0047	-0.7213	-0.2768	0.6726	-0.1637
1974	0.6396	0.0046	-0.7259	-0.2701	0.6621	-0.1581
1975	0.7268	0.0052	-0.6880	-0.3123	0.7556	-0.1844
1976	0.5975	0.0043	-0.7441	-0.2540	0.6167	-0.1439
1977	0.7283	0.0052	-0.6838	-0.3184	0.7640	-0.1850
1978	0.7577	0.0054	-0.6686	-0.3342	0.8005	-0.1909
1979	0.7476	0.0053	-0.6721	-0.3296	0.7916	-0.1883
1980	0.7393	0.0052	-0.6755	-0.3260	0.7839	-0.1829
1981	0.7773	0.0055	-0.6582	-0.3443	0.8270	-0.1936
1982	0.7424	0.0053	-0.6738	-0.3285	0.7890	-0.1859
1983	0.9326	0.0066	-0.5869	-0.4198	1.0000	-0.2424
1984	0.9092	0.0064	-0.6000	-0.4059	0.9678	-0.2362
1985	1.0165	0.0072	-0.5549	-0.4541	1.0772	-0.2681
1986	0.5406	0.0038	-0.7657	-0.2313	0.5629	-0.1242
1987	0.8638	0.0061	-0.6204	-0.3844	0.9183	-0.2210
1988	0.6432	0.0045	-0.7188	-0.2806	0.6782	-0.1537
1989	0.6522	0.0046	-0.7160	-0.2828	0.6838	-0.1582
1990	0.6551	0.0046	-0.7140	-0.2850	0.6891	-0.1600
Average 1987-90	0.6924	0.0049	-0.6973	-0.3030	0.7302	-0.1699
At Sample Means	0.7265	0.0052	-0.6845	-0.3166	0.7606	-0.1846

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Table A.11: Meat: Hicksian Demand Elasticities, 1965-90.

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	0.4304	0.0022	-0.2066	-0.7379	0.3202	-0.0094
1966	0.3897	0.0020	-0.1841	-0.7629	0.2872	-0.0063
1967	0.4007	0.0020	-0.1876	-0.7584	0.2926	-0.0054
1968	0.3895	0.0020	-0.1869	-0.7588	0.2911	-0.0066
1969	0.4070	0.0022	-0.1970	-0.7470	0.3068	-0.0081
1970	0.4313	0.0024	-0.2129	-0.7291	0.3288	-0.0077
1971	0.4150	0.0021	-0.2003	-0.7432	0.3083	-0.0059
1972	0.4352	0.0022	-0.2111	-0.7306	0.3236	-0.0033
1973	0.3942	0.0020	-0.1869	-0.7591	0.2865	-0.0041
1974	0.3245	0.0015	-0.1486	-0.8038	0.2260	-0.0025
1975	0.4120	0.0020	-0.1962	-0.7489	0.2987	-0.0034
1976	0.4689	0.0024	-0.2276	-0.7104	0.3505	-0.0039
1977	0.5153	0.0028	-0.2570	-0.6767	0.3951	-0.0077
1978	0.4978	0.0028	-0.2503	-0.6849	0.3851	-0.0028
1979	0.4295	0.0024	-0.2140	-0.7280	0.3290	-0.0013
1980	0.4288	0.0024	-0.2139	-0.7281	0.3283	-0.0045
1981	0.4308	0.0024	-0.2157	-0.7262	0.3300	-0.0051
1982	0.4753	0.0028	-0.2398	-0.6973	0.3677	-0.0001
1983	0.4839	0.0029	-0.2478	-0.6889	0.3794	-0.0003
1984	0.4748	0.0027	-0.2395	-0.6986	0.3670	-0.0013
1985	0.5710	0.0033	-0.2889	-0.6400	0.4436	-0.0085
1986	0.4869	0.0028	-0.2412	-0.6936	0.3727	-0.0003
1987	0.4629	0.0026	-0.2327	-0.7066	0.3565	-0.0011
1988	0.4454	0.0026	-0.2216	-0.7181	0.3410	-0.0039
1989	0.4026	0.0023	-0.1968	-0.7475	0.3036	-0.0039
1990	0.4077	0.0023	-0.2006	-0.7432	0.3089	-0.0030
Average 1987-90	0.4280	0.0024	-0.2120	-0.7300	-0.3260	-0.0031
At Sample Means	0.4377	0.0024	-0.2146	-0.7271	-0.3309	-0.0033

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Table A.12: Fish: Hicksian Demand Elasticities, 1965-90.

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	0.1687	0.0145	0.4802	0.3132	-1.2409	0.8353
1966	0.1687	0.0148	0.4890	0.3175	-1.2759	0.8490
1967	0.1625	0.0136	0.4499	0.2911	-1.0917	0.7823
1968	0.1396	0.0121	0.4014	0.2584	-0.8644	0.6970
1969	0.1396	0.0122	0.4050	0.2612	-0.8812	0.7028
1970	0.1195	0.0102	0.3391	0.2180	-0.5776	0.5924
1971	0.1110	0.0087	0.2849	0.1808	-0.3223	0.4982
1972	0.1050	0.0079	0.2584	0.1634	-0.2003	0.4565
1973	0.1107	0.0082	0.2688	0.1696	-0.2482	0.4710
1974	0.1070	0.0078	0.2532	0.1571	-0.1754	0.4464
1975	0.1063	0.0075	0.2435	0.1533	-0.1337	0.4300
1976	0.1091	0.0082	0.2654	0.1683	-0.2305	0.4690
1977	0.1073	0.0085	0.2776	0.1778	-0.2918	0.4910
1978	0.1073	0.0090	0.2962	0.1904	-0.3794	0.5277
1979	0.1071	0.0091	0.3038	0.1945	-0.4143	0.5409
1980	0.1023	0.0086	0.2875	0.1835	-0.3384	0.5159
1981	0.0967	0.0081	0.2693	0.1715	-0.2549	0.4856
1982	0.0961	0.0080	0.2666	0.1702	-0.2415	0.4780
1983	0.0954	0.0084	0.2802	0.1801	-0.3091	0.5043
1984	0.1035	0.0087	0.2886	0.1855	-0.3475	0.5161
1985	0.1115	0.0089	0.2939	0.1903	-0.3739	0.5239
1986	0.1029	0.0081	0.2719	0.1726	-0.2578	0.4842
1987	0.1030	0.0086	0.2859	0.1834	-0.3340	0.5128
1988	0.1014	0.0084	0.2795	0.1779	-0.2981	0.5012
1989	0.1125	0.0093	0.3128	0.1995	-0.4531	0.5561
1990	0.1080	0.0090	0.3012	0.1919	-0.3994	0.5357
Average 1987-90	0.1061	0.0088	0.2943	0.1878	-0.3685	0.5255
At Sample Means	0.1186	0.0097	0.3228	0.2071	-0.5018	0.5689

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Table A.13: Fruits & Veg: Hicksian Demand Elasticities, 1965-90.

Year	With Respect To The Price Of					
	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg.
1965	-1.0245	-0.0028	-0.0679	-0.0050	0.4581	-0.1689
1966	-0.9612	-0.0026	-0.0622	-0.0035	0.4305	-0.0994
1967	-0.8680	-0.0023	-0.0559	-0.0027	0.3935	-0.0043
1968	-0.9640	-0.0026	-0.0614	-0.0036	0.4304	-0.0953
1969	-0.9974	-0.0027	-0.0636	-0.0044	0.4441	-0.1300
1970	-0.8648	-0.0023	-0.0553	-0.0034	0.3884	-0.0148
1971	-0.8299	-0.0021	-0.0526	-0.0026	0.3780	-0.0460
1972	-0.6614	-0.0017	-0.0417	-0.0011	0.3086	-0.2233
1973	-0.8037	-0.0021	-0.0513	-0.0019	0.3693	-0.0698
1974	-0.6888	-0.0017	-0.0436	-0.0012	0.3218	-0.1909
1975	-0.7262	-0.0018	-0.0468	-0.0014	0.3388	-0.1497
1976	-0.6185	-0.0015	-0.0385	-0.0012	0.2912	-0.2659
1977	-0.6512	-0.0017	-0.0414	-0.0021	0.3022	-0.2370
1978	-0.5350	-0.0014	-0.0335	-0.0007	0.2504	-0.3634
1979	-0.5307	-0.0014	-0.0331	-0.0004	0.2474	-0.3700
1980	-0.4676	-0.0012	-0.0288	-0.0011	0.2212	-0.4357
1981	-0.4540	-0.0012	-0.0280	-0.0012	0.2159	-0.4506
1982	-0.5045	-0.0014	-0.0312	-0.0000	0.2374	-0.3986
1983	-0.4861	-0.0013	-0.0306	-0.0001	0.2271	-0.4221
1984	-0.5312	-0.0014	-0.0339	-0.0003	0.2482	-0.3695
1985	-0.5765	-0.0015	-0.0377	-0.0019	0.2698	-0.3156
1986	-0.4962	-0.0013	-0.0293	-0.0001	0.2362	-0.4011
1987	-0.4953	-0.0013	-0.0313	-0.0003	0.2333	-0.4063
1988	-0.4604	-0.0012	-0.0277	-0.0009	0.2191	-0.4417
1989	-0.5097	-0.0014	-0.0312	-0.0011	0.2397	-0.3884
1990	-0.5218	-0.0015	-0.0319	-0.0009	0.2445	-0.3775
Average 1987-90	-0.4957	-0.0014	-0.0305	-0.0008	0.2337	-0.4046
At Sample Means	-0.6525	-0.0017	-0.0414	-0.0011	0.3009	-0.2359

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Table A.14: Retail Prices of Grains, Philippines, 1961-89.

Year	Rice	Corn	Wheat
	(Kg/Person)		
1961	0.47	0.30	0.86
1962	0.44	0.30	0.90
1963	0.52	0.37	1.05
1964	0.64	0.40	1.25
1965	0.61	0.45	1.28
1966	0.75	0.50	1.38
1967	0.84	0.46	1.50
1968	0.73	0.46	1.52
1969	0.75	0.46	1.82
1970	0.80	0.50	1.92
1971	1.08	0.81	2.22
1972	1.24	0.92	2.28
1973	1.56	1.06	3.42
1974	1.96	1.46	4.68
1975	1.94	1.46	4.85
1976	2.05	1.53	5.20
1977	2.12	1.59	5.30
1978	2.09	1.57	5.70
1979	2.29	1.63	6.68
1980	2.47	1.84	7.52
1981	2.70	2.11	8.12
1982	2.96	2.25	8.34
1983	3.19	2.35	8.70
1984	5.10	4.05	14.11
1985	7.00	5.37	16.37
1986	6.56	4.88	20.71
1987	6.61	5.13	20.56
1988	7.23	5.27	20.25
1989	8.41	5.45	20.62
1990	9.44	6.51	21.69

Source: Bureau of Agricultural Statistics and National Statistics Office.

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Table A.15: Per Capita Consumption of Major Foods Items, 1961-90.

Year	Rice	Corn	Wheat	Meat	Fish	Fruits & Veg
	(Kg/Person)					
1961	81.21	16.44	9.11	13.11	14.55	41.10
1962	76.82	17.62	8.73	14.28	14.55	41.60
1963	77.96	18.20	10.70	14.40	16.19	41.38
1964	81.06	19.44	9.91	14.41	17.08	40.95
1965	89.74	20.22	8.48	15.35	18.73	40.93
1966	74.70	20.02	11.62	17.17	19.01	41.17
1967	77.90	21.06	12.32	17.04	19.89	40.70
1968	74.72	21.32	13.58	18.07	24.35	39.81
1969	74.84	22.03	11.92	17.90	24.35	40.43
1970	70.56	21.13	10.62	16.44	26.90	42.82
1971	71.24	21.84	12.51	16.41	28.01	41.72
1972	69.25	20.67	12.80	15.07	29.32	42.12
1973	69.38	20.67	10.10	16.84	31.02	41.00
1974	75.29	21.00	10.16	19.25	31.82	43.89
1975	87.82	25.87	9.54	15.86	33.07	46.97
1976	86.78	27.78	12.12	14.93	30.58	52.51
1977	84.48	23.86	10.96	13.75	30.91	56.46
1978	84.11	21.95	10.94	14.62	29.57	62.32
1979	86.13	21.39	11.33	17.00	27.27	66.57
1980	92.42	20.80	12.04	17.82	28.27	76.87
1981	92.84	19.95	11.98	18.15	30.38	75.83
1982	94.07	19.57	13.53	16.92	31.35	75.57
1983	82.46	18.28	11.37	17.44	32.50	72.67
1984	93.99	17.81	10.63	17.19	30.94	66.95
1985	94.49	18.29	9.33	13.75	29.46	65.49
1986	93.88	17.29	14.11	15.03	30.11	66.83
1987	88.91	17.75	9.33	15.92	29.39	68.13
1988	92.64	17.49	14.56	17.64	28.71	67.06
1989	97.85	17.50	16.02	19.40	26.74	71.42
1990	98.13	13.97	17.88	20.61	29.51	73.67

Source: 1961-88 are from FAO Supply and Utilization Databases, except for corn. 1989 and 1990 are from the Bureau of Agricultural Statistics (BAS). 1978-90 data for corn are from BAS Corn consumption in 1965-79 has been adjusted to be consistent with BAS estimates in 1978-90.

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ANNEX 3: ISSUES IN DEMAND AND SUPPLY

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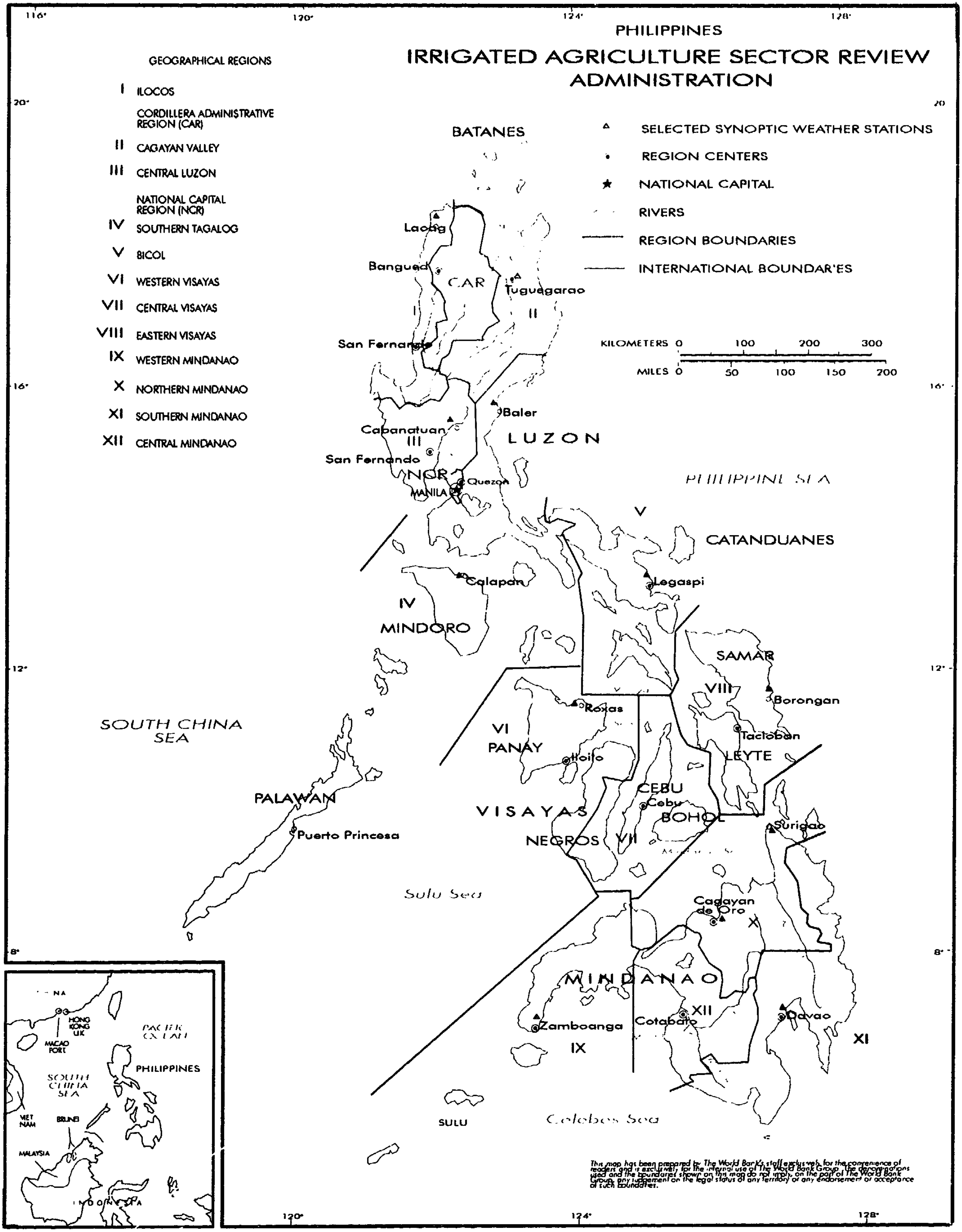
MAP SECTION



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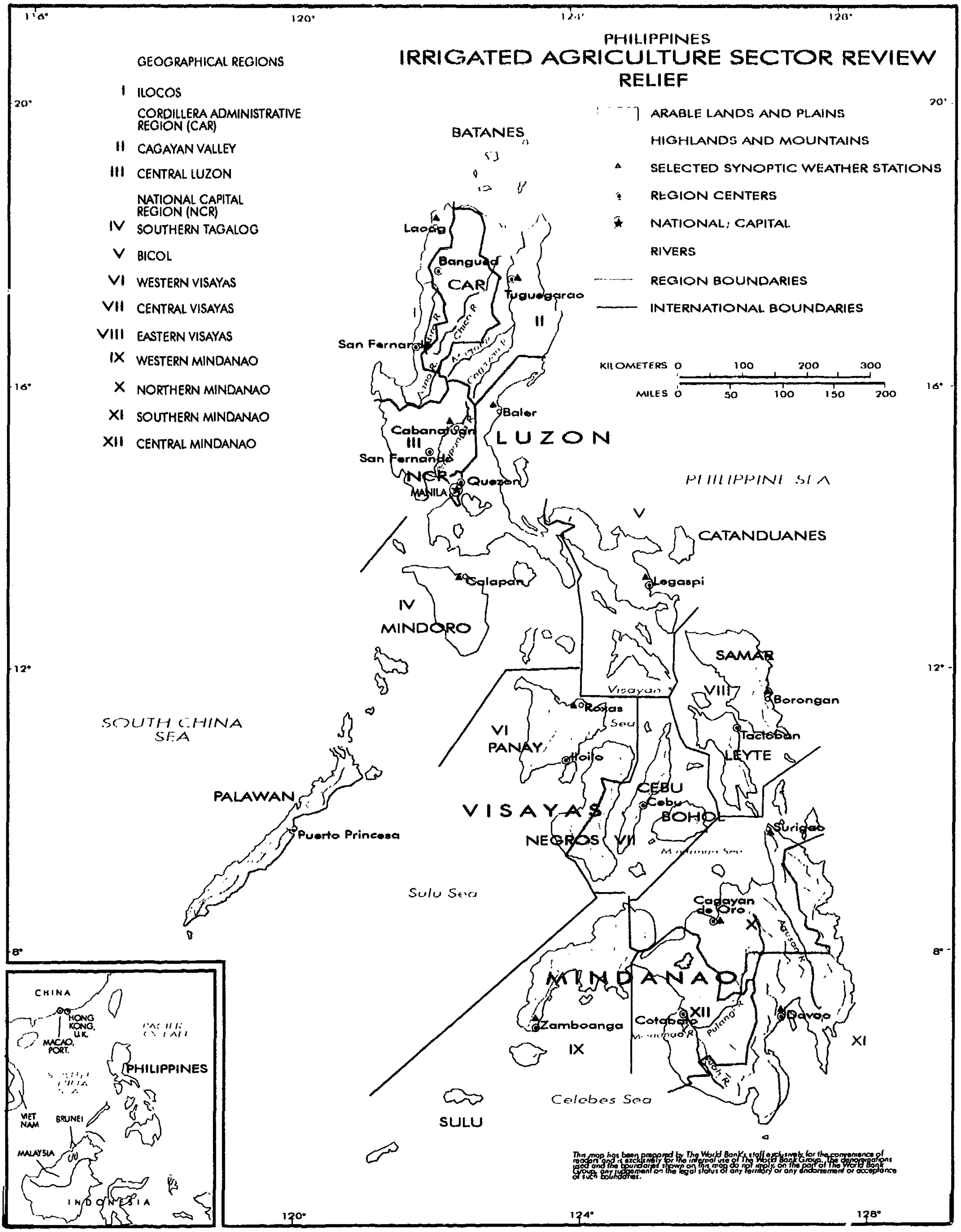

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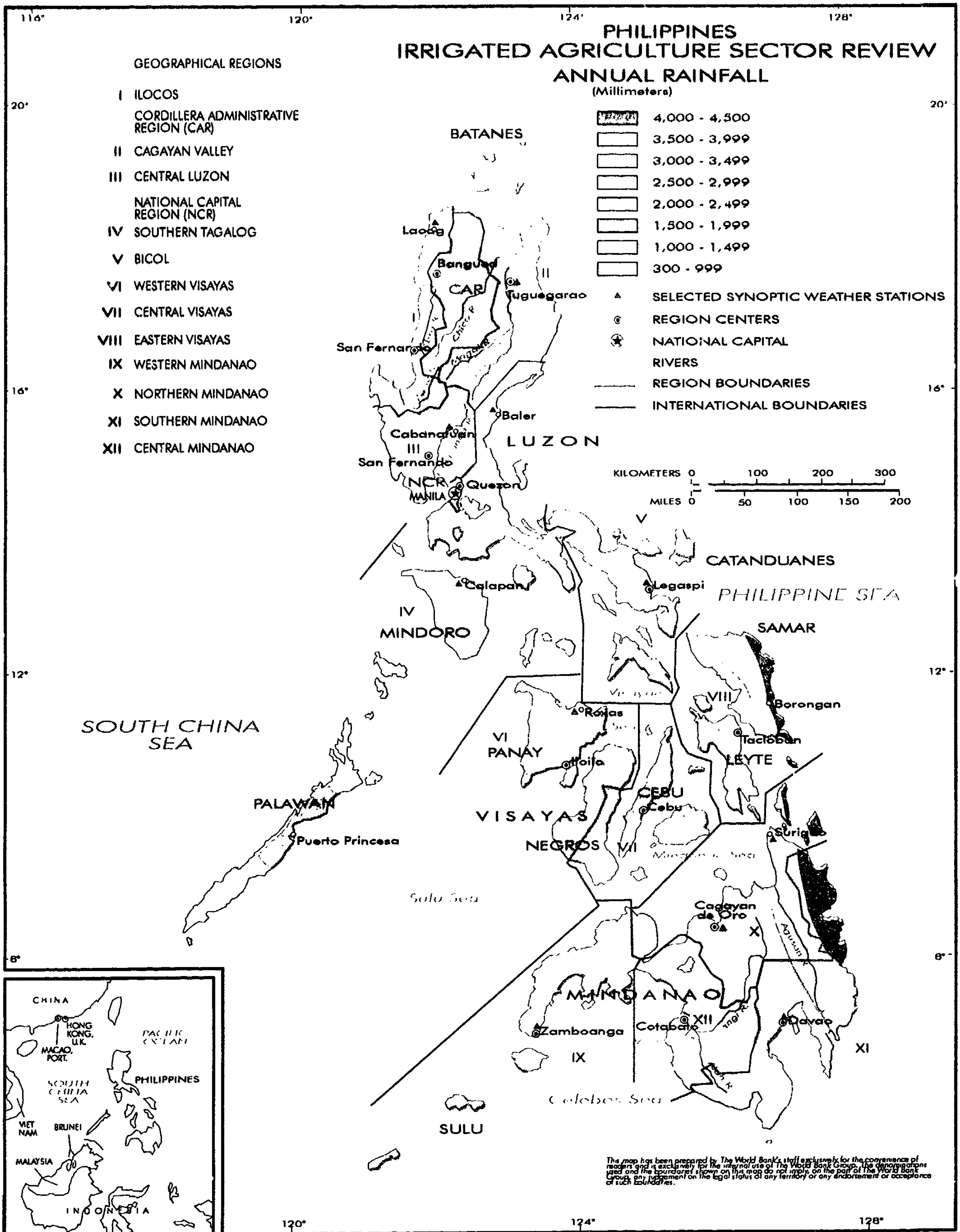

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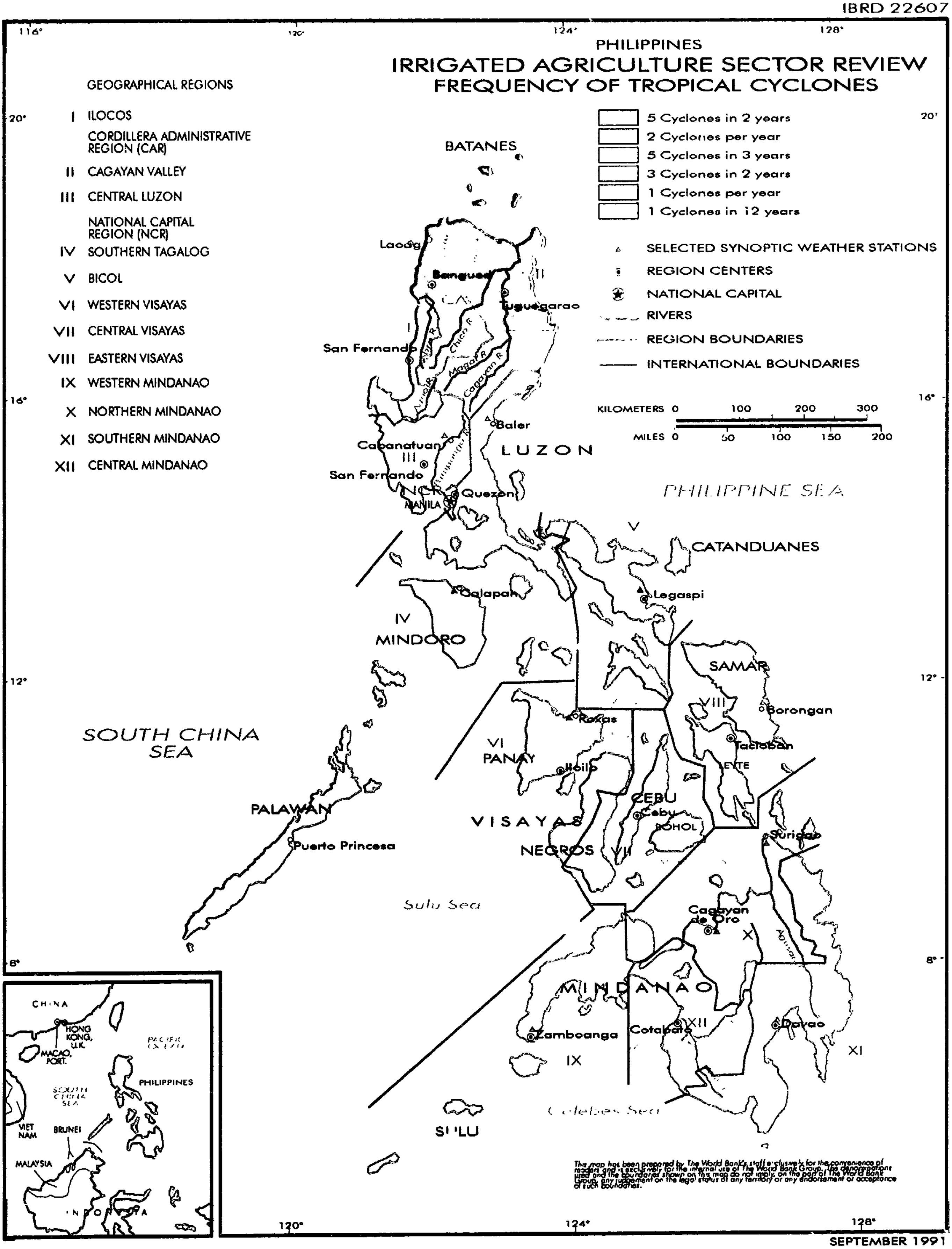

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PHILIPPINES
IRRIGATED AGRICULTURE SECTOR REVIEW
FREQUENCY OF TROPICAL CYCLONES
GEOGRAPHICAL REGIONS
I ILOCOS
CORDILLERA ADMINISTRATIVE REGION (CAR)
II CAGAYAN VALLEY
III CENTRAL LUZON
NATIONAL CAPITAL REGION (NCR)
IV SOUTHERN TAGALOG
V BICOL
VI WESTERN VISAYAS
VII CENTRAL VISAYAS
VIII EASTERN VISAYAS
IX WESTERN MINDANAO
X NORTHERN MINDANAO
XI SOUTHERN MINDANAO
XII CENTRAL MINDANAO
5 Cyclones in 2 years
2 Cyclones per year
5 Cyclones in 3 years
3 Cyclones in 2 years
1 Cyclones per year
1 Cyclones in 12 years
SELECTED SYNOPTIC WEATHER STATIONS
REGION CENTERS
NATIONAL CAPITAL
RIVERS
REGION BOUNDARIES
INTERNATIONAL BOUNDARIES
KILOMETERS 0 100 200 300
MILES 0 50 100 150 200
BATANES
Laoag
Bangued
Tuguegarao
San Fernando
Baler
LUZON
Cabanatuan
San Fernando
Quezon
MANILA
PHILIPPINE SEA
CATANDUANES
Calapan
Legaspi
MINDORO
SAMAR
Borongan
Roxas
Tacloban
LEYTE
SOUTH CHINA SEA
PANAY
Iloilo
CEBU
Cebu
BOHOL
PALAWAN
VISAYAS
Puerto Princesa
NEGROS
Surigao
Sulu Sea
Cagayan de Oro
MINDANAO
Zamboanga
Cotabato
Davao
Celebes Sea
SULU
CHINA
HONG KONG, U.K.
MACAO, PORT.
PHILIPPINES
VIET NAM
BRUNEI
MALAYSIA
116° 120° 124° 128°
20° 16° 12° 8°
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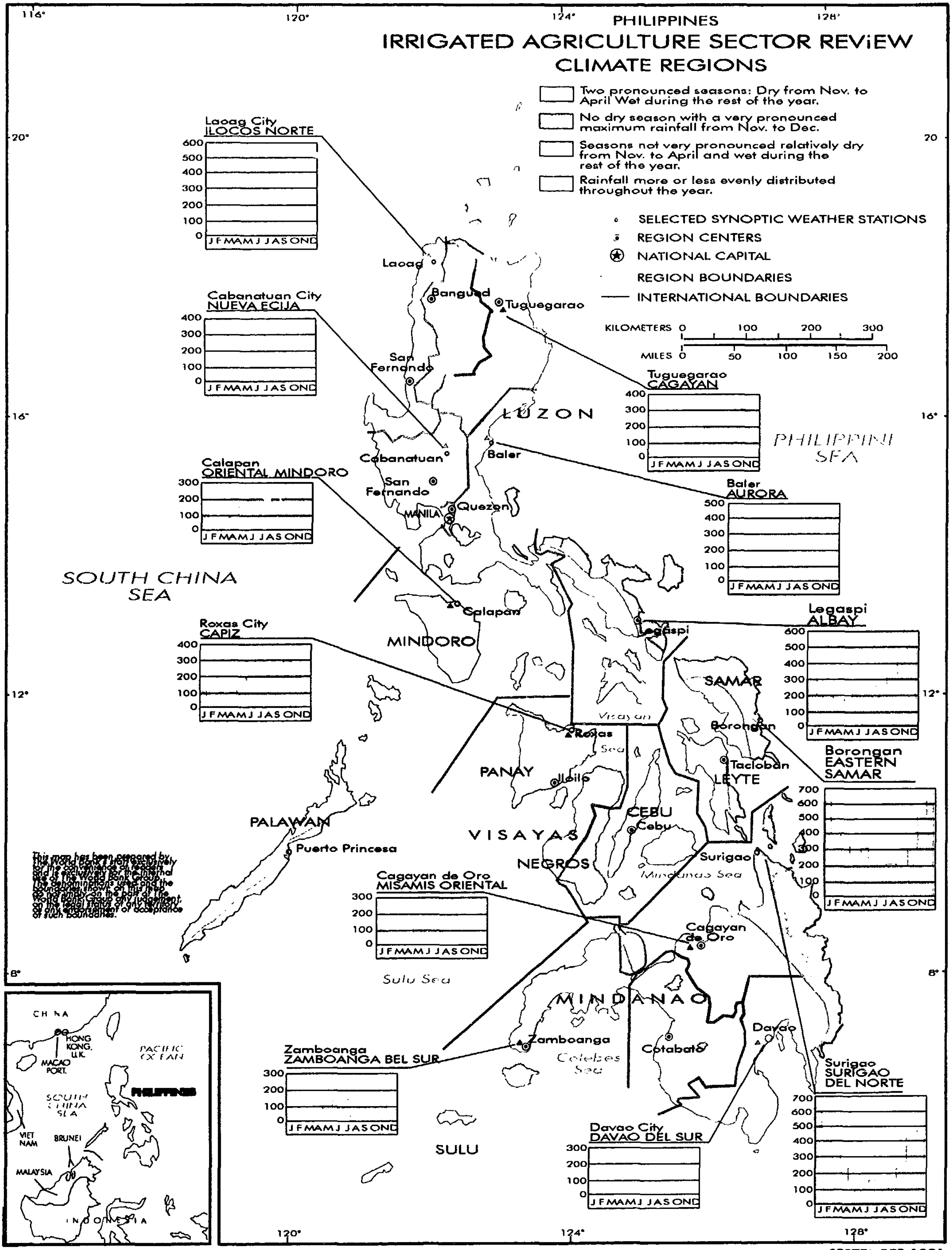

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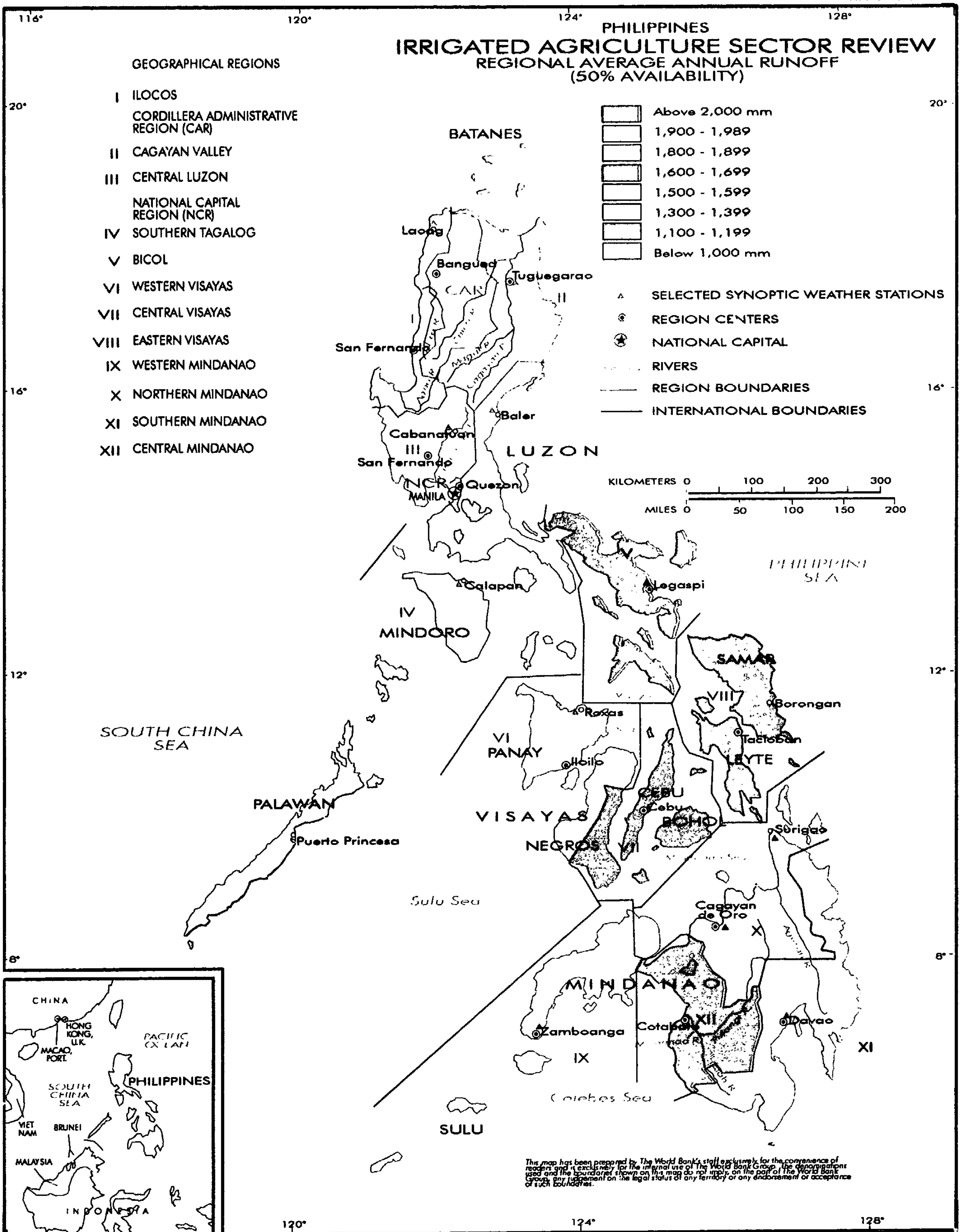

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