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Production Systems, Constraints, and Research Priorities

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CIMMYT® (www.cimmyt.org) is an internationally funded, not-for-profit organization that conducts research and training related to maize and wheat throughout the developing world. Drawing on strong science and effective partnerships, CIMMYT works to create, share, and use knowledge and technology to increase food security, improve the productivity and profitability of farming systems, and sustain natural resources. Financial support for CIMMYT's work comes from many sources, including the members of the Consultative Group on International Agricultural Research (CGIAR) (www.cgiar.org), national governments, foundations, development banks, and other public and private agencies.

Abstract: This is one of a series of country studies on maize production systems in Asia. It is part of a project designed to promote sustainable intensification of maize production systems while ensuring equitable income growth and improved food security for poor households that depend on maize. Maize is the second most important food crop (after rice) in the Philippines, and the major source of income for one-third of farmers (1.8 million). It is also the primary source of feed for the Filipino poultry and livestock industry, and is being increasingly used in the manufacturing sector. Rapid economic growth and urbanization are expected to create an even higher demand for maize in the Philippines. The challenge is to provide more maize for an expanding market, while preserving the natural resource base and the environment. Effective policy design and implementation must be based on comprehensive, accurate data on the current state of maize-based farming systems. The goal of this study was to clarify the probable response of the social and biophysical environments of the Philippines to future growth in demand for maize by determining the constraints to productivity growth and the potential environmental consequences, by collecting information on the available options for promoting sustainable growth.

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Contents

Tables

Page No.

Figure

Page No.

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This manuscript reports on the results of the rapid rural appraisal (RRA) and participatory rural appraisal (PRA) surveys conducted in 24 villages across eight provinces of the Philippines from July 2001 to March 2002. It also includes discussions from the National Maize Research and Development Priority-Setting Workshop, held at the International Rice Research Institute (IRRI), Los Banos, Laguna, on 12-15 March, 2002, and from the Fifth Annual Workshop of the Asian Maize Socio-Economic Working Group held in Bangkok, Thailand, on 1-4 August 2002.

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1. Introduction

1.1 Background

Maize is second to rice as the most important crop in the Philippines, with one-third of Filipino farmers, or 1.8 million, depending on maize as their major source of livelihood. White maize is the most important substitute staple in periods of rice shortage, especially for people in rural areas. Yellow maize is the primary source of feed for the Philippines' animal industry, and is being increasingly used by the manufacturing sector.

Maize production in the Philippines increased at an annual rate of 1.7% over a 20-year period (1980-2000) (Table 8, Annex 1). After production peaked in 1990 at 4.9 million metric tons, a sharp decline was posted in 1998 when the El Niño phenomenon affected the region. Total area planted to maize was also highest in 1990, at 3.8 million hectares, but was observed to be on the decline at 1.9% per year from 1985 to 2001 (Gonzales and Lapiña, 2003). These long-term figures reflect a sharper decline in white maize area in contrast to that planted to yellow maize. Further, while average yields for white maize are consistently low, yellow maize yields increased by an annual rate of 4.9% over a 17-year period beginning in 1985 (Gonzales and Lapiña, 2003). The adoption of improved technology for yellow maize production has resulted in significant yield increases. Yellow maize accounted for 23% of total maize production in 1985, and for 58% by 2001. It should be noted, however, that the national average yield of 1.82 tons per hectare for white and yellow maize (in 2001) is low when compared to maize yields in other Asian countries (Gonzales and Lapiña, 2003).

Most common in upland areas, maize production peaks from July to September; the lean months are from January to June. The upland regions of Mindanao have the most area planted to maize, and the highest production in the Philippines. Maize is also grown in the rainfed lowlands, where it is planted during the dry season after the rice crop has been harvested. The production of maize after rice increases the productivity of irrigation systems during the dry season, while supplying needed grain during an otherwise lean period. Integrating livestock into the system provides high value products and increases the income of maize farmers with small landholdings (FSSRI, 2000; Eusebio and Labios, 2001).

1.2 Objective

The three-year IFAD-CIMMYT Project was designed to promote the sustainable intensification of maize production systems in the uplands of selected countries in Asia, to enhance maize supplies while ensuring growth and improved food security for the poor households that subsist on maize. More specifically, the study aimed to:

- Gather detailed information on the different maize production systems by agro-ecological zones;
- Identify maize production constraints in these zones;
- Prioritize these constraints and develop potential solutions; and
- Make recommendations for research and development and policy change to promote sustainable maize production.

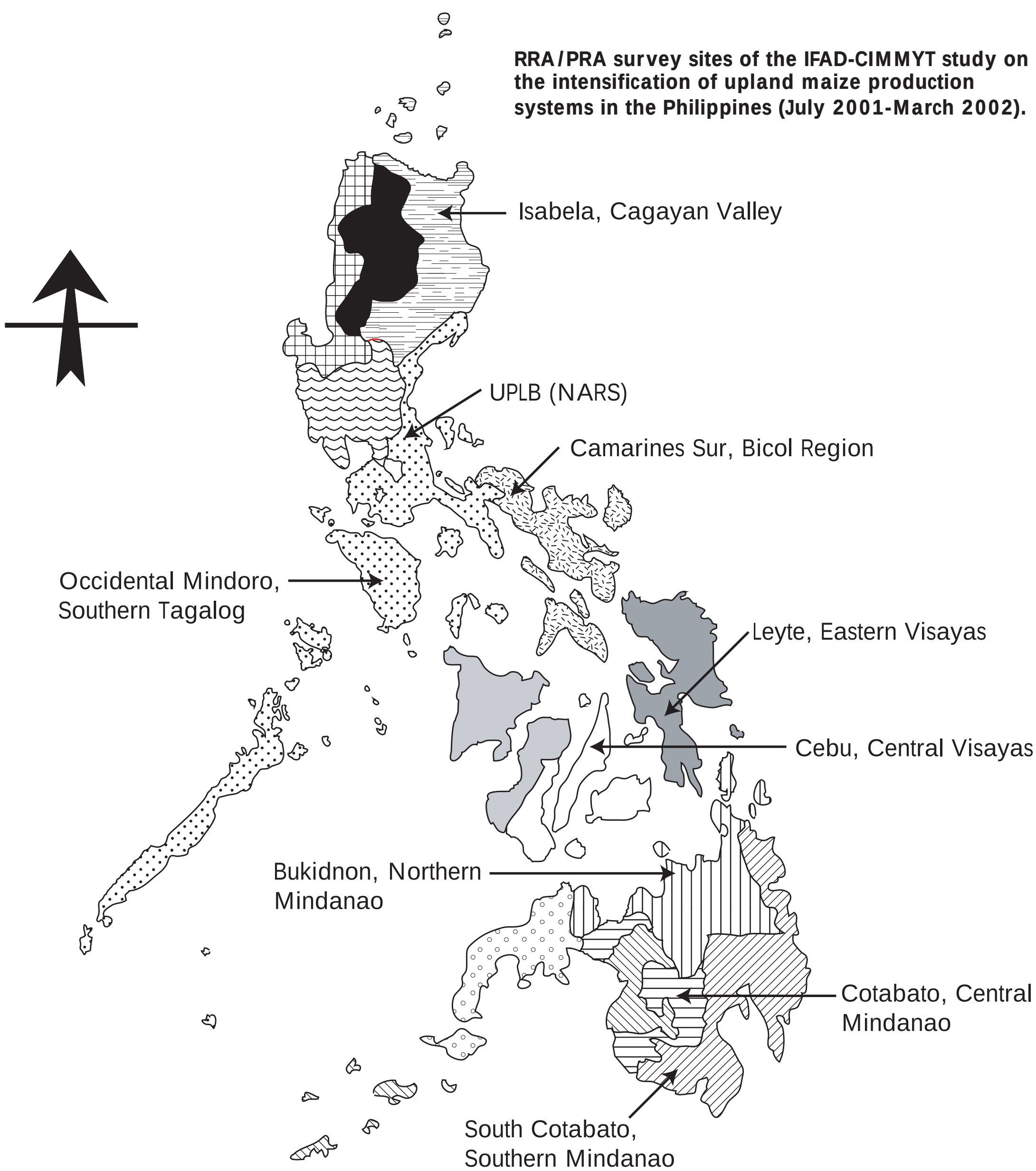
New data from this study suggest that research and development agendas as well as funding priorities be changed to better serve the needs of maize farmers and consumers. Results also indicate that socioeconomic and policy-related constraints impact maize productivity more than technical constraints do.

1.3 Methodology

The detailed characterization of upland maize production systems was conducted through a two-stage survey: the first stage involved a rapid rural appraisal (RRA), and the second stage, a participatory rural appraisal (PRA). RRA and PRA are quick methods of collecting primary data, providing a wealth of information at low cost, and are generally very effective when system-level information is required from several countries or agro-ecological zones. Primary data were collected from maize farmers themselves, and secondary data from sources that include Philippine government offices at local and national levels, international agricultural organizations, and national educational institutions of agriculture.

Twenty-four villages across eight major maize-growing regions in the Philippines were selected for the survey, based on dominant maize production systems in the country. A general RRA/PRA questionnaire prepared by CIMMYT was developed to fit the country's specific maize production conditions. Information was collected on the physical, biological, institutional, and socioeconomic environments, among others. Fieldwork was conducted throughout 2001 by maize scientists from national and international organizations.

Figure 1. Map of the Philippines.



2. Maize Agro-ecologies of the Philippines

2.1 General Characteristics

Maize production agro-ecologies in the Philippines are classified based on the shape of the landscape and topography of the areas where maize is largely grown—the rainfed lowland, the upland plain, and the rolling-to-hilly agro-ecologies. By definition, *rainfed lowlands* are contiguous, level-to-slightly-sloping bunded or diked fields with variable depth and duration of flooding, depending on rainfall (Eusebio and Labios, 2001). The *upland plains* are contiguous, level, unbunded areas where a maximum of 30% of the landforms have less than a 15% slope (NAREA, 1988-1992). In the Philippines, this agro-ecology is generally rainfed. *Hilly lands* are areas of at least one square kilometer (100 ha) in which 70% of the landforms have a 16-32% slope.

The agro-ecological classification of the 24 villages (*barangays*) surveyed in this study (Table 1) are described in subsequent sections. Geographical regions and even villages may have a combination of agro-ecologies grown to maize. In Northern Mindanao, for example, two survey villages represent the upland plain maize agro-ecology while one village is classified as a rolling-to-hilly agro-ecology. In Carmen and Tulunan, North Cotabato, maize is grown in both upland plains and rolling-to-hilly agro-ecozones.

2.1.1 Rainfed lowlands

In this study, the three sites surveyed in Mindoro Occidental province, Southern Tagalog region (Region IV), represent the rainfed lowland agro-ecozone where

Table 1. Agro-ecological classification of 24 surveyed villages in the Philippines.

		Agro-ecological classification of surveyed villages		
Province, region	**Village, municipality**	**Rainfed lowlands**	**Upland plains**	**Rolling-to-hilly areas**
Isabela, Cagayan Valley	Fermeldy, Tumauini		√	
	Villaluz, Benito Soliven			√
	Palutan, San Mariano	√		
Mindoro Occidental,	Lagnas, Sablayan	√		
Southern Tagalog	Barahan, Sta. Cruz	√		
	Cabacao, Abra de Ilog	√		
Camarines Sur, Bicol Region	Sta. Maria, Iriga City			√
	Burocbusoc, Buhi			√
	Tinawagan, Tigaon		√	
Cebu, Central Visayas	Toong, Remigio			√
	Bae, Sibonga			√
	Capitan Claudio, Toledo City			√
Leyte, Eastern Visayas	Mabunga, Mahaplag			√
	Pres. Garcia, Matalom			√
	Manlawaan, Tabango			√
Bukidnon, Northern Mindanao	Sibonga, Kadingilan		√	
	Silae, Malaybalay City			√
	Sto. Nino, Talakag		√	
South Cotabato,	Lambayaong, Tampakan		√	
Southern Mindanao	Laconon, T'Boli			√
	Colongolo, Surallah			√
North Cotabato,	Liliongan, Carmen		√	√
Central Mindanao	Dungoan, M'lang		√	
	New Caridad, Tulunan		√	√

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

maize is grown as a dry season crop after wet season lowland rice. Vegetables can also be grown after rice, but maize is preferred for its assured commercial value. Planting is done towards the end of the rainy season and before the onset of the dry season (October-December) when conditions are not too wet or too dry. Maize cropping in this region is almost totally dependent on rainfall, and only a few farmers have their own irrigation water pumped from ground or surface water sources, or from government supplied shallow tube wells. Farmers report having used local/traditional maize varieties in the past, but have now shifted completely to using hybrid maize varieties. As a result, local traditional varieties are now difficult to find in Mindoro Occidental.

There are no primary markets in the villages around the maize growing areas. Farmers sell their maize to secondary markets, or private traders, who come from an average of 35 km away to pick up the maize from the farms or in the village. A transport system is available, mostly during good weather, as villages are accessible by seasonal rough roads.

2.1.2 Upland plains

Rainfed upland plain maize areas, located in Luzon and Mindanao, were represented by eight of the 24 sites surveyed. Rainfall patterns in these areas vary with geographical locations but generally allow two to three maize crops per year. Local/traditional varieties are still grown by some farmers along with improved open-pollinated varieties (OPVs) and hybrids. Villages are accessible through all-season gravel roads. The villages in the upland plains in Luzon are close to primary and secondary markets, which are usually less than 10 km away, while the villages in Mindanao can be as far away as 21 km from the primary markets. Secondary markets can be much farther away from the villages, with one market in the survey being 183 km away.

2.1.3 Rolling-to-hilly areas

The rolling-to-hilly maize agro-ecologies can be found across Luzon, Visayas, and Mindanao islands and are represented by 14 of the 24 sites surveyed. As in the upland plains, these areas are rainfed and maize is grown twice a year, with a third crop of maize or another upland crop being planted if weather conditions are good. Soil erosion is a common problem here, due to the natural hilly topography. Most villages in these areas can be reached through gravel roads, and public transport is generally available.

Maize production in these areas is either for home consumption or selling for cash income. Consequently, the maize varieties grown and the production management systems including input use, differ according to end-use goals. In Cebu and Leyte in the Visayas, maize is grown largely for food and farmers prefer local/traditional varieties and the improved OPVs, which have lower input and management requirements. In Luzon and Mindanao, where maize is grown for income, improved OPVs and hybrids are preferred over local/traditional varieties.

2.2 Biophysical Environment

2.2.1 Rainfall

The Corona System of climate classification is the most widely used in the Philippines, with the four types of climate defined as follows (National Rain Stimulation Office, BSWM, 1991):

- Type I—two pronounced seasons, dry from November to April; wet during the rest of the year;
- Type II—no dry season, with a very pronounced rainfall from November to January;
- Type III—seasons not very pronounced, dry from November to April and wet during the rest of the year, and
- Type IV—rainfall more or less evenly distributed throughout the year.

Variability in climatic characteristics exists even within geographical regions. Annual rainfall in all study sites (except Southern Mindanao) is sufficient for maize production, but seasonal distribution regulates planting (Table 2). Maize farmers who are partially or totally dependent on rainfall adjust the cropping calendar to coincide with months when precipitation will be sufficient to supply crop water requirements.

In Mindoro Occidental (Southern Tagalog, Type I climate) rice is grown during the wet season and followed by a maize planting supported by residual soil moisture and supplementary irrigation, if sowing is timed properly. This is commonly done in October to November, and farmers who plant their maize earlier (September) risk flooding from the tail end of the rainy season. Maize can be affected by dry periods at critical growth stages during years when the dry season comes earlier than expected. South Cotabato has the lowest annual average rainfall among the study sites, yet three crops of maize are planted. Rainfall in this province/region is lowest during planting of the first maize crop and highest during the third maize cropping.

In Camarines Sur (Bicol) and Leyte (Eastern Visayas), both of Type II climate, there is no pronounced dry season, and rainfall can support two to three maize crops per year. Typhoons, however, provide a significant risk factor for farmers, who may lose their standing crops to any of the five to eight typhoons that affect these areas each year.

The Type III climate of Isabela, in Cagayan Valley, has an average rainfall of only 47 mm in the first maize crop season at planting time, but reaches >100 mm during the tasseling-to-harvest period. It is a wetter period for the second and third crops, with >200 mm mean monthly rainfall throughout these two growing seasons. Bukidnon in Northern Mindanao also produces three crops of maize per year, with rainfall at <100 mm before planting in the first cropping, but peaking to an average 173 mm during the cropping season. The second crop is planted in a wetter environment at an average >100 mm per month during the growing season, and rainfall declines toward harvest time for the third crop.

There is Type IV climate in Cebu in Central Visayas and Cotabato in Central Mindanao, where even rainfall distribution allows two to three crops of maize to be produced, followed by a short dry season. Tropical storms are a low risk factor in Mindanao.

2.2.2 Temperature

The annual air temperature averages 27^{0}C across the eight regions studied, with a high of 33^{0}C during summer (Table 2). In the Philippines, temperature variations during the maize cropping seasons do not critically affect the maize crop as do rainfall variations.

2.2.3 Types of soil

Secondary data describing soil characteristics in the survey areas are very limited. Parent or origin materials of soil are shown in soil maps, but information on the current status of soil fertility, degradation, or management requirements in the research sites is lacking. Primary soil data were therefore derived almost entirely from farmer interviews during the RRA/PRA.

Farmer-respondents assessed the advantages and disadvantages of each of five soil types based on fertility level, drainage characteristics, susceptibility to erosion, and suitability for crop production or other agricultural use. The most common soil types in the surveyed provinces are clay loam and sandy loam soils consistently described by the farmers as the most fertile soils, generally suited to most crops (Table 3).

Farmer assessments of soils include the following observations:

- Sandy loams are not waterlogged but more susceptible to drought;
- Clay loam soils retain soil water better, but can be poorly drained;
- Clay loam soils of Isabela can make land preparation difficult during the wet season;
- Clay and calcareous soils identified in the hilly maize areas of Cebu are only marginally suitable for crops;
- Clay soil in the hilly agro-ecozone in Leyte is eroded, and
- Soils in the upland plain and hilly maize agro-ecologies in Cotabato are already slightly eroded, although still good for crop production.

Table 2. Average annual rainfall and temperature in maize production areas of the Philippines, 1990-1999.

Province, region	Type of climate	Cropping season	Annual rainfall (mm)			Annual air temperature (^{o}C)		
			Average	Minimum	Maximum	Average	Minimum	Maximum
Isabela, Cagayan Valley	III	1, 2, 3	1,705.1	3.0	296.6	27.3	21.9	32.6
Mindoro Occidental, Southern Tagalog	I	2	2,350.8	5.3	482.1	28.0	23.7	32.3
Camarines Sur, Bicol	II	1, 2	2.028.0	35.9	279.9	27.2	23.6	30.7
Cebu, Central Visayas	IV	1, 2, 3	1,588.6	3.7	493.7	28.0	24.7	31.3
Leyte, Eastern Visayas	II	1, 2	1,776.6	65.1	219.2	27.1	23.3	30.9
Bukidnon, Northern Mindanao	III	1, 2	2,556.3	107.9	321.8	23.9	18.5	29.2
South Cotabato, Southern Mindanao	I	1, 2, 3	916.5	44.2	109.9	27.5	22.4	32.6
Cotabato, Central Mindanao	IV	1, 2, 3	2,125.8	74.1	276.1	28.0	23.1	32.8

Source: Regional and Provincial Station, Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), 2000.

Table 3. Advantages and disadvantages of different soil types as reported by farmers in maize production areas of the Philippines.

Soil type	Local name	Advantages	Disadvantages
Clay loam	*Malagkit or Pilit-pilit*	• Good for cereal crops • Generally suitable for growing many crops, including high value crops • Fertile • Good water retention • Excellent for lowland rice production	• Land preparation is difficult in the wet season • Limited source of moisture for crops
Sandy loam	*Buhaghag, Banlikan, or Balod*	• Good for maize, legumes and vegetable production • Generally suitable for growing many crops • Does not become waterlogged	• Poor water holding capacity, drains easily • Susceptible to drought • Low fertility
Clay		• Good water retention • Good for contour farming and has potential to support forest trees • Generally suitable for growing many crops • Excellent for pasture	• Tendency to flood, not good for crops • Susceptible to soil erosion • Not suitable for maize production • Needs proper soil fertility management practices • Poor drainage
Sandy clay loam		• Good for crop production and pasture	• Slightly susceptible to soil erosion
Alluvial soil		—-	—-

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

2.3 Institutional Environment

2.3.1 Line agencies

Government extension offices from the Department of Agriculture (DA) play a vital role in technology information dissemination to farmers in the surveyed villages. DA agricultural technicians regularly conduct farmers' field schools and training sessions, which provide farmers with updated technology for maize farming. Neighbors and other farmers within the community share knowledge and are regarded as valuable sources of information. Seed company field technicians also provide information to maize farmers, but it is generally limited to the product they are selling. There is little or no extension service provided by agricultural state universities or colleges (SUCs) near the survey areas. Non-government organizations (NGOs) and international agricultural research centers (IARCs) have not yet reached many of the surveyed areas.

2.3.2. Farmer cooperatives and user groups

Working together to increase productivity and help each other, known as the 'bayanihan' system, is natural to Filipino culture. Several help organizations exist in the surveyed villages including farmers' associations, cooperatives, government and non-government organizations, and the Rural Improvement Council. These groups provide technical, financial, or livelihood assistance to their members, in the form of livestock dissemination programs, small handiwork business assistance, and help in establishing small consumer (*sari-sari*) stores. Barangay or neighborhood officials, as well as women's, youth, and church organizations are also active in providing livelihood, leadership, and religious programs and seminars in their respective communities.

2.3.3 Sources of material inputs

The many agricultural stores in the countryside and cities make material inputs for crop production such as seeds, fertilizers, and pesticides readily available to farmers. Some maize farmers, however, cannot pay cash for production inputs and instead obtain their supplies from private trader-financiers in their area on a charge-to-crop credit arrangement.

The DA sometimes provides maize farmers free or subsidized hybrid seeds and fertilizers through agricultural production intensification programs. Farmers complain, however, that maize seeds received through government programs often have poor germination, show poor field performance, and give low yields.

Farmers recycled OPV seeds from their previous harvest, while others exchanged or bought OPV seed from their neighbors. Other farmers who grow white improved OPVs obtain seeds from the DA, agricultural dealers or local cooperatives, or from state universities or colleges with maize breeding and seed production programs.

2.3.4 Credit institutions

The majority of farmer-respondents (~90%) state that they lack sufficient capital for their farm operations and have to borrow from private moneylenders on a charge-to-crop scheme with a 10-20% interest rate. The lenders sell farmers agricultural input products at higher than market value, and later buy back the harvests at lower than market value. In this lending scheme, the loans for agricultural inputs, as well as interest due for one cropping season, are deducted from the total value of the harvest that is in turn sold to the lender. When asked why they continued to support this seemingly costly and unfair arrangement, the farmer-respondents report that going to the private trader-financiers is more convenient than going to formal credit institutions for three reasons—private loans do not require collateral, the trader-financiers are always accessible, and inputs were readily available. Farmer-respondents also state that they continue to use the services of the trader-financiers because income from a harvest is usually insufficient to pay for loans taken during the previous cropping season.

About 10% of the surveyed farmers did not use the trader-financiers. About 8% of them obtained credit from cooperatives, and only 2% had enough capital themselves. While formal credit programs and facilities were available from some government and private banks, no farmer used these sources because they found the paper work too tedious and the requirements (especially collateral) too stiff. Farmers also noted that financial institutions only extend agricultural loans to farmer associations, not to individual farmers.

2.3.5 Prices of inputs and outputs

Table 4 summarizes the range of input and output prices as well as prices of competing crops and livestock in the survey areas. Price variations between sites are due to differences in transportation and

Table 4. Range of prices in Filipino pesos (PhP) of farm inputs, outputs, and competing and complementary products in 24 surveyed villages, the Philippines.[a]

	Isabela	Mindoro Occidental	Camarines Sur	Cebu	Leyte	Bukidnon	South Cotabato	Cotabato
Land rent (PhP/ha/year)	2,100.00 (42.00)	500.00 (10.00)	1,000-2,500.00 (20-50.00)	175-250.00 (3.50-5.00)	Nil	400-5,000.00 (8.00-100.00)	2,240-2,725.00 (44.80-54.50)	1,500-3,500.00 (30-70.00)
Land tax paid (PhP/ha/year)	112-200.00 (2.24-4.00)	200-250.00 (4.00-5.00)	—-	—-	—-	85-160.00 (1.70-3.20)	49-319.00 (0.98-6.38)	100-400.00 (2.00-8.00)
Maize seed:								
Local/traditional (PhP/kg)	—-	7.50 (0.15)	—-	10-23.00 (0.46)	25-34.00 (0.50-0.68)	6.00 (0.12)	5.00-7.50 (0.10-0.15)	6.50-7.20 (0.13-0.14)
Local/Improved OPVs (PhP/kg)	20.00 (0.40)	—-	(bartered)	23.00 (0.20-0.46)	—-	3.00 (0.06)	6.50 (0.12)	30.00 (0.60)
Hybrid (PhP/18-kg bag)	1,500–1,850.00 (30.00-37.00)	1,900–2,200.00 (38.00-44.00)	1,900-1,980.00 (38.00-39.60)	(not planted)	(not planted)	1,600-1,825.00 (32.00-36.50)	2,000-2,225.00 (40.00-44.50)	1,500-1,900.00 (30.00-38.00)
Most common fertilizers used (PhP/50-kg bag):								
Urea (46-0-0)	405-425.00 (8.10-8.50)	440-480.00 (8.80-9.60)	430-440.00 (8.60-8.80)	405-430.00 (8.10-8.60)	450-460.00 (9.00-9.20)	430-500.00 (8.60-10.00)	380-385.00 (7.60-7.70)	385-405.00 (7.70-8.10)
Complete (14-14-14)	395-440.00 (7.90-8.80)	440-480.00 (8.80-9.60)	430-440.00 (8.60-8.80)	405-420.0 (8.10-8.40)	430.00 (8.60)	415-500.00 (8.30-10.00)	420-430.00 (8.40-8.60)	405-420.00 (8.10-8.40)
Ammonium sulfate (21-0-0)	260.00 (5.20)	275-300.00 (5.50-6.00)	285-290.00 (5.70-5.80)	280.00 (5.60)	—-	—-	—-	—-
Ammonium phosphate (16-20-0)	395.00 (7.90)	—-	500.00 (10.00)	—-	—-	360-530.00 (7.20-10.60)	—-	400.00 (8.00)
Muriate of potash (0-0-60)	—-	—-	—-	—-	—-	360-450.00 (7.20-9.00)	435.00 (8.70)	—-
Most common pesticides used								
Herbicides	2,4-D	2,4-D	2,4-D	—-	—-	—-	2,4-D	—-
Insecticides		Cymbush, Furadan, Decis, Magnum, Larvin	Larvin, Furadan, Karate,Decis, Cymbush, Fenom D	Decis	Karate	Daconil,Lannate, Larvin,Furadan	Furadan,Lorsban, Larvin	Karate,Brodan, Hostalum 40 EC
Fungicide	None	None	None	None	None	None	None	None
Labor wage rate (P/person-day):								
Farm labor								
Male	75-160.00 (1.50-3.20)	80-100.00 (1.60-2.00)	100.00 (2.00)	50.00 or in kind (1.00)	80.00 (1.60)	60-70.00 (1.20-1.40)	70-85.00 (1.40-1.70)	70-80.00 (1.40-1.60)
Female	75-150.00 (1.50-3.00)	80-100.00 (1.60-2.00)	—-	40.00 or in kind (0.80)	50-100.00 (1.00-2.00)	60-70.00 (1.20-1.40)	70-85.00 (1.40-1.70)	70-80.00 (1.40-1.60)

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

[a] US$ equivalent given in parentheses; US$1.00 =PhP 50.00.

Table 4. Cont'd.

	Isabela	Mindoro Occidental	Camarines Sur	Cebu	Leyte	Bukidnon	South Cotabato	Cotabato
Non-farm labor								
Male	200-225.00 (4.00-4.50)	150-250.00 (3.00-5.00)	175.00 (3.50)	150-160.00 (3.00-3.20)	70.00 (1.40)	—	150-175.00 (3.00-3.50)	150.00 (3.00)
Female	100-150.00 (2.00-3.00)	100.00 (2.00)	—	—	—	—	60-140.00 (1.20-2.80)	70.00 (1.40)
Labor compensation								
Arrangements at harvest								
In cash (PhP/sack of cobs)	—	—	10.00 (0.20)	—	—	—	10.00-13.00 (0.20-0.26)	12.00-13.50 (0.24-0.27)
In kind (sharing of harvest)	—	10:1	—	9 or 10:1	—	10:1	10:1	10:1
Power rental cost:								
Animal only (PhP/day)	60.00 (1.20)	—	75-100 (1.50-2.00)	50.00-60.00 (1.00-1.20)	40-100 (0.80-2.00)	60.00-70.00 (1.20-1.40)	60.00 (1.20)	—
Animal with operator (PhP/ person-animal day)	120-200.00 (2.40-4.00)	150.00 (3.00)	150.00 (3.00)	120-150.00 (2.40-3.00)	80-200.00 (1.60-4.00)	120-140.00 (2.40-2.80)	125.00 (2.50)	150.00 (3.00)
Four-wheel tractor (PhP/pass)	700-800.00 (14.00-16.00)	1,200-1,300.00 (24.00-26.00)	800.00 (16.00)	—	—	1,200.00 (24.00)	650-710.00 (13.00-14.20)	950-1,200.00 (19.00-24.00)
Drying costs:								
Dryer fees (PhP/50 kg sack)	—	10.00 (0.20)	0.50 (0.01)	Paid in kind	—	0.50-5.00 (0.01-1.00)	10.00-16.00 (0.20-0.32)	1.00-6.00 (0.02-0.12)
Labor cost (PhP/day)	100-130.00 (2.00-2.60)	10.00 (0.20)	100.00 (2.00)	Paid in kind	50-100.00 (1.00-2.00)	—	—	80.00 (1.60)
Shelling costs (PhP/cavan)	10.00-13.00 (0.20-0.26)	20.00 (0.40)	8.00-12.50 (0.16-0.25)	10.00-16.00 (0.20-0.32)	—	5.00-9.00 (0.10-0.18)	7.00-8.00 (0.14-0.16)	5.00-16.00 (0.10-0.32
Milling costs (PhP/unit)	Grains sold unmilled	Grains sold unmilled	Grains sold unmilled	—	—	—	—	—
Maize grain prices (PhP/kg)								
At farm gate:								
White maize	—	—	—	5.00-7.50 (0.10-0.15)	5.50-8.00 (0.11-0.16)	5.00-6.00 (0.10-0.12)	6.50-7.00	—
Yellow maize	6.30-7.50 (0.13-0.15)	6.50-9.50 (0.13-0.19)	6.10-8.00 (0.12-0.16)	—	—	6.00-7.00 (0.12-0.14)	5.40-6.60 (0.11-0.13)	—
At the nearest market:								
White maize	—	—	—	6.00-8.50 (0.12-0.17)	—	5.00-7.00 (0.10-0.14)	4.50-10.00 (0.09-0.20)	6.00-10.00 (0.12-0.20)
Yellow maize	7.15-9.00 (0.14-0.18)	—	6.00-8.50 (0.12-0.17)	—	—	6.00-8.00 (0.12-0.16)	3.50-8.50 (0.07-0.17)	5.00-9.00 (0.10-0.18)
Prices of competing crops (PhP/unit)								
Rice	8.50-10.00/kg (0.17-0.20)	—	—	—	250.00/sack (5.00/sack)	—	6-20.00/kg (0.12-0.40/kg)	7.50-10.50/kg (0.15-0.21/kg)
Vegetables: Eggplant	—	—	10-12.00/kg (0.20-0.24)	5-10.00/kg (0.10-0.20)	—	—	5-6.00/kg (0.10-0.12)	2-3.00/kg (0.04-0.06)
Snap beans	—	—	12-20.00/kg (0.24-0.40)	6-25.00/kg (0.12-0.50)	—	4-6.00/kg (0.08-0.12)	—	—
Tomato	—	—	—	5-15.00/kg (0.10-0.30)	— —	80-250.00/crate (1.60-5.00)	80-200.00/crate (1.60-4.00)	— —
Squash	—	—	350-800.00/sack (7.00-16.00)	5-10.00/kg (0.10-0.20)	—	2-16.00/kg (0.04-0.32)	—	—
Okra	—	—	—	2-12.00/kg (0.04-0.24)	—	—	—	—
Sweet pepper	—	—	—	10-20.00/kg (0.10-0.40)	—	30-90.00/kg (0.60-1.80)	—	15-35.00/kg (0.30-0.70)
Root crops: Peanut	—	—	—	15-21.00/kg (0.30-0.42)	30.00/kg (0.60)	12.50/kg (0.25)	100-200.00/can (2.00-4.00)	35-40.00/kg (0.70-0.80)
Sweet potato	—	—	—	8-12.00/kg (0.16-0.24)	100.00/15kg (2.00)	—	—	—
Prices of livestock products (PhP/unit)								
Poultry	80-100.00/hd (1.60-2.00)	80.00/hd (1.60)	67-80.00/hd (1.34-1.60)	70-75.00/hd (1.40-1.50)	65-70.00/kg (1.30-1.40)	60-70.00/kg (1.20-1.40)	67-70.00/kg (1.34-1.40)	60-75.00/kg (1.20-1.50)
Pig	63-65.00/kg (1.26-1.30)	55-70.00/kg (1.10-1.40)	52-70.00/kg (1.04-1.40)	50.00/kg (1.40)	50-55.00/kg (1.00-1.10)	40-55.00/kg (0.80-1.10)	40-49.00/kg (0.80-0.98)	37-40.00/kg (0.74-0.80)
Cow/carabao	68-100.00/kg (1.36-2.00)	9,000-18,000.00/hd (180-360.00)	10,000-16,000.00/hd (200-320.00)	7,000-15,000.00/hd (140-300).00	—	8,000-9,000.00/hd (160-180.00)	7,500.00/hd (150.00)	90.00/kg (1.80)
Goat	—	750.00/hd (15.00)	50.00/kg (1.00)	200-1,000.00/hd (4.00-20.00)	—	550-800.00/hd (11.00-16.00)	—	—

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

[a] US$ equivalent given in parentheses; US$1.00 =PhP 50.00.

handling facilities provided by suppliers. Seed, fertilizers, and pesticides are the most common material inputs bought by maize farmers. Seeds of local/traditional varieties and improved OPVs are often recycled or exchanged with other farmers within the village. If bought, seed of local/traditional varieties costs anywhere from (Philippine peso) PhP10-36/kg (US$0.50-0.72/kg) in Visayas, to PhP4.50-7.20/kg (US$ 0.09-0.14/kg) in Mindanao, while that of the local/improved OPVs ranged from PhP3-30/kg (US$ 0.06-0.60/kg) across the survey sites. Hybrid seeds ranged from PhP1,500-2,225/bag or about PhP80-125/kg (US$ 0.10-0.12/kg).

The most common fertilizers used in maize production as reported by interviewed farmers are urea (46-0-0), complete (14-14-14) and ammonium sulfate (21-0-0) fertilizers, which cost PhP380-500 (US$ 7.60-10.00), PhP395-500 (US$7.90-10.00) and PhP260-300 (US$ 5.20-6.00) per 50-kg bag, respectively. Other fertilizers in use include muriate of potash (0-0-60) at PhP360-450 (US$7.20-9.00) and ammonium phosphate (16-20-0) at PhP360-530 (US$ 7.20-10.60) per 50-kg bag. Fertilizer costs do not vary much across the eight regions surveyed, but sulfate is the cheapest source of nitrogen at about PhP260-290/bag or PhP5.20-5.80/kg (US$ 5.20-5.80/bag or US$ 0.10-0.12/kg) (Table 4). Organic fertilizers like farmyard manure (FYM) and chicken dung are also reported to be in use in some survey sites.

The most common pesticides in use are Karate, Furadan, Decis, and 2, 4-D. Of these, 2, 4-D (a herbicide) is the cheapest at PhP248-280/liter (US$4.96-5.60), and Furadan (an insecticide) is the most expensive at PhP700-1,000 (US$ 14-20.00)/1-kg box. Seeds are commonly treated with Larvin to protect them against weevils. The use of pesticides is highest among the survey sites in the hybrid-growing maize areas of Luzon and Mindanao; none of the surveyed sites reports using fungicides.

Average daily wages for agricultural farm labor are not gender biased, whereas non-farm labor is. Non-agricultural male labor enjoys a higher daily wage rate of PhP70-250 (US$1.40-5.00) (depending on the task), compared to the female labor wage rate of PhP60-150 (US$1.20-3.00)/day. Agricultural laborers of either sex receive wages ranging from PhP75-100 (US$1.50-2.00)/person-day in Luzon, to PhP50-80 (US$1.00-1.60)/person-day in the Visayas and PhP60-85 (US$1.20-1.70)/person-day in Mindanao (Table 4). Snacks and/or lunch are sometimes also provided for the farm workers, especially during planting and harvest operations. Groups of farm laborers can also be contracted for either planting or harvesting maize. The contract arrangement is locally called the '*pakyaw*' system where total labor is normally paid on a per-hectare rate during planting. Harvesters are paid either in cash at per-sack rate or in kind, getting a share of the total harvested cobs (Table 4). The most common harvest-sharing scheme is 10:1, where for every 10 sacks of harvested maize, the owner gets 9 sacks and the harvesters get 1.

For land preparation, some farmers contract four-wheel tractors at a rate ranging from PhP650-1,200 (US$13-24.00) per passing in Isabela, Bukidnon, South Cotabato and Cotabato, or ranging from PhP1,200-1,300 (US$24-26.00)/ha in Mindoro Occidental. Animal power with operators can also be contracted for land preparation especially in hilly areas at PhP80-200 (US$1.60-4.00)/person-animal day. However, in Lambayong, South Cotabato, animal power and animal power with operator are rented at PhP60 (US$1.20)/animal-day and PhP125 (US$2.50)/person-animal day or at PhP800 and PhP1000 (US$16-20.00) per passing respectively. Farmers with no draft animals can also rent them at PhP40-100 (US$0.80-2.00)/animal-day.

Post-harvest operations are limited to solar drying, shelling and milling. Shelling is done using the mechanical sheller and costs PhP8-20.00 (US$0.16-0.40)/50-kg sack across the survey sites. Manual shelling is also practiced, but only for grain to be used at home. The grain is shelled, then sun-dried for 2-3 days on multipurpose cement pavements. Farmers report paying anywhere from the minimal PhP0.50 to as high as PhP16.00 (US$0.01-0.32)/50-kg sack of maize for the use of these pavements. Due to lack of drying facilities, barangay roads and highways are commonly used as drying pavements during peak harvest season. In Visayas, maize is dried in the husk to allow for longer storage (as maize is mostly for home consumption), whereas maize grain in Luzon and Mindanao is sold immediately after drying to eliminate the need for storage. Milling is practiced only in surveyed sites where maize was for home use. In these areas, maize grain is milled in batches whenever needed and stored for a certain period.

Maize grain prices vary little within and across the regions surveyed. In general, maize grain prices are higher by at least PhP1.00/kg in the nearest markets than at the farm gate. During the 2001 RRA/PRA survey, maize grain prices ranged from PhP5.00-9.50 (US$0.10-0.19)/kg at the farm gate to PhP5.00-10.00 (US$0.10-0.20)/kg in the nearest markets. Some maize farmers in Cebu and Leyte kept most of their grains for home consumption; however, the few farmers who sold their white maize earned between PhP5.00-8.00 (US$0.10-0.16)/kg at the farm gate and PhP6.00-8.50 (US$0.12-0.17)/kg at the nearest market. Yellow maize (usually hybrids) commanded a higher price than white (local/traditional) maize in most surveyed sites, except South Cotabato and Cotabato. In these areas, prices of white maize ranged from PhP4.50-10.00 (US$0.09-0.20)/kg as compared to only PhP3.50-9.00 (US$0.07-0.18)/kg of yellow maize.

Across the surveyed sites, farmers identified several crops they would plant if they could not plant maize (Table 4). These crops include rice, vegetables (eggplant, squash, snap beans, tomatoes, okra, sweet peppers) and root crops such as sweet potato and peanuts. Rice was the main competing crop of maize in Isabela, Leyte, South Cotabato, and Cotabato, with prices that ranged from PhP6-20/kg or PhP250/50 kg sack (US$0.12-0.40/kg or US$5.00/50-kg sack). During peak harvest season, vegetables in Camarines Sur, Cebu, Bukidnon, South Cotabato, and Cotabato provinces were on average sold at PhP2-90.00 (US$0.04-1.80)/kg; peanut was sold at PhP12.50-40.00(US$0.25-0.80)/kg. Farmers enjoy higher profits from these alternative crops, as they mature earlier and can be sold at higher prices than maize.

To add to income generated by maize production, farmers also raise livestock and poultry in their backyards. The most common animals raised among the surveyed farmers were poultry and swine with market prices ranging from PhP60-75 (US$1.20-1.50)/kg or PhP67-100 (US$1.34-2.00)/head and PhP37-70 (US$0.74-1.40)/kg, respectively. Carabao and cattle sold at an average of PhP7,500-18,000 (US$150.00-360.00)/head, while goats sold for PhP550-1,000 (US$11-20.00)/head. These animals are usually sold when cash is much needed, as at the start of the school year. Animals are also slaughtered for home consumption when there are special occasions.

2.4 Infrastructure

2.4.1 Physical accessibility and irrigation facilities

The road networks in the municipalities surveyed are accessible by all kinds of land transportation. Most villages surveyed have graded and gravel roads that can be used throughout the year (Table 5). Some interior villages, however, are not accessible to motor vehicles, especially during the rainy season. Farmers in these villages use animal drawn carts to haul their products to the nearest market.

Most villages surveyed in this study have no major irrigation projects or facilities, and farmers depend largely on rainfall as the source of water for their crops. A few areas with irrigation, like Leyte, Bukidnon, South Cotabato, and Cotabato, obtain most of their water from springs and rivers, but save it for high value crops like rice or vegetables rather than maize.

Table 5. Infrastructure status in 24 surveyed villages, the Philippines.

	Isabela	Mindoro Occidental	Camarines Sur	Cebu	Leyte	Bukidnon	South Cotabato	Cotabato
A. Road condition (km)								
Cement/paved	0.07-2.0	0.2 - 1.2	0.1 to >1.0	—	0.2 – 1.2	0.08-0.1	0.3-5.0	5.0
Gravel/asphalt	0.12-5.0	0.3 – 12.0	1.5 – 6.0	5.0-8.0	7.0-9.1	2.0-7.0	5.7	1.5-8.5
Seasonal/fairweather	—	50.0	3.0 – 5.0	5.0	—	5.0-14.0	12.0	1.5
B. Markets and marketing								
1. Means of transporting farm products	Jeepneys, tricycles, trucks	Jeepneys, tricycles	Motorcycles, jeepneys, tricycles	Jeepneys, tricycles	Motorcycles, jeepneys	Motorcycles, multicab, trucks	Motorcycles, multicab, trucks	Motorcycles, multicab, trucks
2. Primary market								
Distance from village (km)	7.0-10.0	—	2.0 – 15.0	4.0 – 8.0	1.5-10.0	5.0 – 57.0	4.0 – 8.0	18.0 – 21.0
Estimated % of output sold	5-100	—	20 - 25	10 - 80	20-80	5-40	30-90	90-95
Reasons for choice of market	For immediate income, tied up with traders	—	Higher price, tied up with traders	Less or no transport cost, for immediate income	Higher price, tied up with traders	For immediate income, regular buyer	Tied up with traders	Higher price of produce, near and accessible
3. Secondary market								
Distance from village (km)	9.0 – 10.0	35.0 – 36.0	12.0 – 28.5	15.0 – 70.0	4.0-28.0	95.0 – 183.0	33.0-68.0	2.5 – 34.0
Estimated % of output sold	6-90	100	10 - 80	20 - 90	80	60-95	10-100	5-10
Reasons for choice of market	Higher price, tied up with traders	Provides credit, buy in bigger quantities, higher price	Provides credit, higher price, tied up with traders	Good price, buy in bigger quantities	Higher price, provides credit	Higher price, buy in bigger quantities, paid in cash, tied up with traders	Higher price, no loans from traders	Higher price, have other business in the area, not strict in quality
C. Post-harvest facilities								
Solar dryer (cement pavement)	√	√	√	√	√	√	√	√
Storage facilities	At home	Some	Some	√	√	Some	Some	Some
Mechanical sheller	√	√	√	√	√	√	√	√
Rice/maize mill	Rice mill	√	none	√	√	√	√	√

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

2.4.2 Post-harvest facilities

In the study areas, post-harvest facilities present are limited to solar dryers (usually cement pavement), mechanical shellers, and mills (Table 5).

A roving mechanical maize sheller comes to the villages during harvest, or farmers can have their maize shelled at a few privately operated stationary shellers. Some areas use manually operated maize shellers to process grain intended for home use. Grain is dried on cement pavement and even national roads, for two to three days. In Leyte and Cebu, maize is dried, then stored and shelled only as needed for home consumption. Mechanical maize mills and traditional manual grinding stones are commonly used to process maize grain into grits.

Since most grain is sold immediately after drying, storage facilities do not receive high priority as a post-harvest requirement in the survey areas. In most survey sites, small quantities of grain intended for future use are stored in the home. Storage facilities do exist, however, in Cebu and Leyte and in the provinces of Mindoro Occidental and Camarines Sur.

2.4.3 Proximity to markets and marketing practices

Maize farmers sell their grain and other farm products either directly in public markets or to traders who come to the villages. Among the survey sites, barangay Silae in Bukidnon, 57 km away from Malaybalay City, is farthest from the nearest/primary market. Cagayan de Oro City, 183 km away from barangay Sibonga in Kadingilan, Bukidnon, is the farthest secondary market used by maize farmers in the study (Table 5). In general, self-financed maize farmers sell their grain in secondary markets, where prices are often high. Maize farmers with loans from trader-financiers have to sell their grain to the financiers despite the low prices they often get. The trader-financiers come to the villages during harvest and haul the grain in volume. Trucking services (transportation costs) may be charged to the farmers, shouldered by the traders, or shared by both parties. A few farmers sell their production to feed millers in nearby areas. Farmers consider feed millers good market outlets because grain may fetch higher than market prices, and some feed mills do not have very strict grain quality standards.

2.5 Socioeconomic Characteristics

2.5.1 Households and ethnicity

Of the eight regions surveyed, South Cotabato has the highest combined population of the three study villages, followed by Cotabato and Camarines Sur (Table 6), while Leyte (Region VIII) has the lowest combined population. Average household size ranges from 3.3 in Mindoro Occidental to 5.4 in Bukidnon; provinces surveyed in Mindanao tend to have higher average household sizes than those in Luzon and Visayas.

Ethnic grouping is localized in the regions or provinces. The *Ibanag* and *Ilocano* groups are prominent in Isabela province, and the *Mangyans* in Mindoro Occidental and Camarines Sur. The study areas in Mindanao (Bukidnon, South Cotabato, and Cotabato) had the highest number of ethnic groups in their communities, with the *Cebuanos*, *Lumads*, and *T'bolis* being the top three (Table 6).

Most households in the surveyed villages were headed by men (Table 6), but survey respondents report that husband and wife play an equal role in making farming decisions since agriculture is considered to be a family enterprise. Interestingly, up to 14% of households in the study areas of Mindanao are led by females, as the male household heads have sought employment in urban areas.

2.5.2 Literacy and level of education

Most Filipinos consider education for their children to be a top priority, and even resource-poor families will strive to send their children to school. The majority of the population in the surveyed villages has attended or completed primary schooling, with a significant number having attended secondary school and some going on to university (Table 6). About 66% of those in Isabela have attended or completed elementary school, 45% of those in Cotabato have attended or completed secondary school, and 25% of those in Bukidnon have attended or completed tertiary (college) education. In contrast, 80% of the population in Laconon, T'boli, South Cotabato cannot read or write. Education can encourage farming households to try out and adopt modern technologies that improve farm production.

2.5.3 Landholdings and tenure

The average farm size across the 24 surveyed villages ranges from 0.8-4.3 ha (Table 6). Mindoro Occidental has the largest average farm size (2.2-4.3 ha) while Cotabato has the smallest farms (0.8-1.0 ha). The villages surveyed in Leyte and South Cotabato have no recorded data on agricultural landholdings.

Most maize farmers in the surveyed villages are landowners, with the highest proportion (78%) living in Mindoro Occidental (Table 6). Leyte and Camarines Sur, meanwhile, had the most tenant/sharecropper farmers (64%) and mortgage payers (91%). Other maize farmers had land awarded to them as agrarian reform beneficiaries (ARBs) and hold Certificates of Land Transfer (CLT). A last group is made up of landless laborers. Interestingly, Isabela (where maize is commonly grown for commercial purposes) has more tenants/share-croppers than landowners, although it also has the highest proportion of CLT awardees. Another noticeable finding is the complete absence of landless laborers being reported in the villages of Mindoro Occidental and Leyte, which is quite unusual in the country.

Table 6. Demographic and socioeconomic characteristics of 24 surveyed villages, the Philippines.

	Isabela	Mindoro Occidental	Camarines Sur	Cebu	Leyte	Bukidnon	South Cotabato	Cotabato
Total population across surveyed villages	4,005	5,497	5,999	5,884	3,974	5,486	13,122	6,357
Number of households	824	1,665	1,239	1,176	928	1,017	2,664	1,264
% Male-headed households	90-95	100	75-95	90	94-100	90	90	86-97
Average household size	4.9	3.3	4.8	5.0	4.3	5.4	4.9	5.0
Major ethnic groups present in the surveyed villages	Ibanag, Ilocano, Pangasinense	Mangyan, Iraya	Mangyan	––	Waray, Cebuano	Cebuano Boholano, Ilonggo, Manobo, Lumad	Cebuano B'laan, Ilonggo, T'boli	Cebuano Ilonggo, Manobo, B'laan, Maguindanao
Educational level (as % of population)								
Illiterate	9.1	11.9	––	10.9	7.5	3.1	––	0.0
Elementary level or graduate	65.6	33.2	––	48.3	31.8	42.2	––	40.7
High school level or graduate	19.4	37.0	––	31.8	54.7	29.7	––	44.8
College level or graduate	5.9	17.9	––	9.0	5.9	24.9	––	14.5
Average farm size (ha/household)	1.8 – 2.2	2.2 – 4.3	1.7 – 2.3	1.3 – 2.3	––	1.9 – 3.0	––	0.8 – 1.0
Tenure status (as % of households)								
Landowners	23.2	78.2	0.0	––	36.2	40.0	53.2	56.5
Tenants/sharecroppers	34.3	9.5	1.7	––	63.8	4.3	17.6	28.1
Fixed rent payers	1.7	0.0	1.8	––	0.0	21.8	3.0	2.4
Mortgage payers	9.6	0.0	91.5	––	0.0	6.4	7.4	6.2
Landless laborers	13.9	0.0	5.0	––	0.0	14.9	15.7	2.1
Others (CLT)	17.3	12.3	0.0	––	0.0	12.6	3.1	4.7
Maize utilization (%)								
Sold	94 – 96	100	94 – 100	2 – 3	––	85 - 95	91 – 97	77 – 97
Kept for food	0 – 1	0	0	45 – 97	80 - 90	5 – 10	0.5 – 6	10
Feed	1 – 2	0	1 - 2	1 – 2	––	0	1	1 – 10
Retained as seed	1 – 2	0	1	1 – 53	––	0	0.5 – 1	0.5 – 7
Others	0 - 5	0	1 - 2	1 - 16	––	0 - 5	1	1 - 3
Average per capita income (pesos, 2000) [a/]	24,278	23,876	20,798	21,843	24,183	29,817	32,101	19,443
Poverty incidence (%) [a/]								
1997	36.1	17.3	35.1	31.9	41.9	23.1	25.4	42.7
2000	32.6	23.4	44.1	35.7	44.3	24.7	25.2	34.8

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

[a/] Philippine Human Development Report 2002.

2.5.4 Maize utilization

Most maize produced in the hybrid-growing areas of Luzon and Mindanao is sold to livestock and poultry feed mill industries almost immediately after drying, but farmers in Mindanao keep a higher proportion of their harvest for home consumption than do farmers in Luzon. In Bukidnon, farmers report that even yellow maize is processed and consumed as food in times of very poor harvest.

On the other hand, harvests of local/traditional white maize varieties that predominate in the Visayas provinces of Cebu and Leyte, are mostly retained at home for human consumption and animal feed. In these villages, maize cobs are dried with or without husks, stored and milled as needed for immediate use. Farmers in these provinces also retain a significant percentage of their maize harvests for seed purposes.

Across all survey sites, only a minimal proportion of total maize production is reported as allocated to other purposes (Table 6).

Table 7. Farmer characteristics by economic status in 24 surveyed villages, the Philippines.

Maize agro-ecozone and parameters	Farmer classification		
	Poor	Intermediate	Rich
Rainfed lowlands			
Average farm size (ha)	0 – 1.0	1.0 – 5.0	> 5.0
Income by source (%)			
Maize production	76	54	56
Other agricultural income	24	40	40
Non-agricultural income	0	6	4
Upland plains			
Average farm size (ha)	0.5 – 2.0	2.0 – 5.0	> 5.0
Income by source (%)			
Maize production	73	65	54
Other agricultural income	27	21	34
Non-agricultural income	0	14	12
Rolling-to-hilly areas			
Average farm size (ha)	0 – 2.0	2.0 – 5.0	> 5.0
Income by source (%)			
Maize production	59	48	29
Other agricultural income	41	45	49
Non-agricultural income	0	7	22

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

2.5.5 Farmer classification

One exercise conducted in this study was classifying maize farmers within the community by income group and asking farmer-respondents to provide descriptions and general characteristics of each group. Farmers in the survey sites were classified as either poor, medium-intermediate, or rich, with each group being characterized by such parameters as farm size, income by source, household size, and number of livestock owned (Table 7).

The poor group is typically made up of farmers who are tenants or sharecroppers, with large households, and little or no education. If they own their land, these farmers tend to have small farms of up to 2.0 ha only. They also characteristically earn most of their income from maize production and other agricultural enterprises (usually as hired labor in other farms) rather than from non-agricultural or non-farm activities. These farmers earn an estimated 59-76% of their income from maize production and none from non-agricultural activities. Meanwhile, the medium-rich (intermediate) farmers, many of whom own their farms, typically own about 2-5.0 ha of farmland and have more sources of income than the poorer farmers. Maize production provides an estimated 48-65% of this farmer group's total household income, and non-farm activities provide about 6-14% of their total income. Typical non-farm income-earning activities for these farmers include buy and sell enterprises, driving public vehicles for hire, working in factories or stores in nearby cities, and working as construction laborers within or outside the community. Farmers in the relatively rich farmer group tend to have smaller households, and larger farms (at least 5.0 ha) where more than one kind of crop is grown. These farmers tend to be less economically dependent on maize production, which provides only about 29-56% of their household income; of the three income groups, they characteristically receive the highest proportion of their incomes (4-22%) from non-agricultural enterprises. These rich farmers or members of their family may have skills or education that allows them to hold white-collar jobs in bigger cities like Metro Manila, or to work overseas and send remittances home.

3. Maize Production Trends and Systems

3.1 Maize Production Trends

In 1980, total maize production in the Philippines was about 3 million metric tons (t) harvested from about 3.2 million hectares (ha), posting an average yield of 0.9 t/ha. In 1990, maize production peaked at 4.8 million tons from 3.8 million ha, for a yield level of 1.3 t/ha. In 2000, the country produced 4.5 million tons of maize from 2.5 million ha with a peak average yield of 1.8 t/ha. During this 20-year period, harvested maize area declined by about 1.6% per year while average maize yield increased by 3.2% per year, resulting in only a slight annual increase of 1.7% in total production (Table 8; see Annex 1 for details).

These figures reflect contrasting trends in yellow and white maize production in the country. Production of yellow maize increased from about 332,000 tons in 1980 to 2.6 million tons in 2000, a growth of 8.7% per year. On the other hand, white maize yield declined at 2.4% annually from 2.7 million tons in 1980 to 1.9 million tons in 2000 (Table 8). Yield and area planted to yellow maize increased significantly from 1980-2000, while those parameters for white maize decreased. The increase in yellow maize production is due to wider adoption of higher-yielding maize varieties, which were developed in response to the increasing demand for maize grain from livestock feed industries. Meanwhile, white maize production declined because of low yields and a shift in the area that used to be planted to white maize, to yellow maize and/or higher-value crops like sugarcane and vegetables.

The eight major maize-producing provinces in the Philippines that were surveyed for this study showed maize production trends similar to those at the national level. During 1980-2000, Isabela, Mindoro Occidental, Camarines Sur and Bukidnon showed growth in maize production, spurred by the huge growth in yellow maize production (Table 8). Among these four provinces, Isabela posted a declining trend in total area planted to maize, which was in turn due to the huge decline in area planted to white maize. Average maize yield in all four provinces grew positively due to the increase of farmer adoption of higher-yielding maize varieties, especially hybrids.

Figures from the period 1996-2000 show Bukidnon, Isabela, South Cotabato and Cotabato, in this order, to be the top four maize-producing provinces in the Philippines, contributing 41% of the total national maize production. Yellow maize comprised at least 57% of the total maize produced and covered at least 46% of the total harvested maize area in these provinces. In terms of average maize yield, Isabela ranked first with 2.8 t/ha, followed by Bukidnon and South Cotabato with 2.6 t/ha and 2.3 t/ha, respectively (Annex 1). These yield

Table 8. Long-term trends of maize area, yield, and production in the Philippines, 1980-2000.

	Annual growth rates for the period 1980-2000 (%)								
	Maize area			Maize yield			Maize production		
Province, region	Total	White	Yellow	Total	White	Yellow	Total	White	Yellow
Isabela, Cagayan Valley	(2.3)	(18.2)	10.3	8.6	5.7	5.4	5.8	(12.4)	15.7
Mindoro Occidental, Southern Tagalog	5.5	—-	6.5	4.0	—-	4.0	9.1	—-	10.5
Camarines Sur, Bicol	1.4	(4.1)	1.8	5.2	4.1	5.1	6.6	(0.1)	6.9
Cebu, Central Visayas	(6.6)	(6.6)	(6.8)	0.8	0.8	1.2	(5.8)	(5.8)	(5.7)
Leyte, Eastern Visayas	(8.9)	(8.8)	—-	(1.5)	(1.6)	—-	(10.5)	(10.5)	—-
Bukidnon, Northern Mindanao	2.1	(4.7)	16.6	6.2	3.8	4.8	8.4	(0.8)	21.4
South Cotabato, Southern Mindanao	(5.9)	(9.9)	2.2	1.5	1.5	1.5	(3.8)	(8.5)	3.7
Cotabato, Central Mindanao	(1.7)	(5.6)	—-	0.6	(0.8)	—-	(1.1)	(6.4)	—-
Philippines	(1.6)	(3.4)	(3.7)	3.2	1.1	5.0	1.7	(2.4)	8.7

Source: Bureau of Agricultural Statistics (BAS), 2000.

levels, as well as those in Cotabato and Mindoro Occidental, exceeded the national average yield level of 1.6 t/ha.

During 1980-2000, however, the maize-consuming provinces of Cebu and Leyte posted negative growth rates in total maize production, due to continuously declining production of both yellow and white maize. These trends resulted from the continuous decline in area planted to maize, especially white maize, as well as from almost stagnant maize yield levels. In the period 1996-2000, Mindoro Occidental and Leyte produced only 20,000 and 27,000 tons of maize respectively, with most of the maize produced in Mindoro Occidental being yellow, while maize produced in Leyte was mostly white.

3.2 Maize Production Systems

3.2.1 Major farm enterprises

The major agricultural enterprise across the study area is crop production, and maize is the primary crop grown. Vegetables, legumes, root crops, and other cash crops are also planted as relay crops or intercrops to maize, usually as a small percentage of the total cultivated area. Most farm households also engage in small-scale (backyard) poultry and livestock production to augment income and supply home needs. Non-farm activities and enterprises, such as operating small *sari-sari* stores or driving tricycles or jeepneys for hire, also provide additional income in many of the surveyed sites.

Animals commonly raised by maize farmers include cattle, carabaos (water buffaloes), goats, swine, and poultry, with wealthier farmers owning more animal types and units. Water buffaloes are kept as work animals, while cattle, goats, and swine are kept to sell as necessary, especially during lean months. Poultry is kept for home consumption, especially in lower-income farm households.

3.2.2 Crops and cropping patterns

The rainfed lowlands maize agro-ecozone in the Philippines has two cropping seasons, with maize grown either as the main crop (in Isabela) or as the dry season crop (in Mindoro Occidental) after transplanted rice (Table 9). In the latter case, rice is grown during the wet season, when rainfall can support the crop, while 70-100% of the same areas is planted to maize during the dry season.

The upland plains maize agro-ecozone can be found in Isabela, Camarines Sur, Bukidnon, South Cotabato, and Cotabato. In this agro-ecozone, two crops of maize are commonly grown in at least 75% of the cultivated area, sometimes with the second crop of maize intercropped with vegetables (Table 9). In some areas, a third crop of maize, tobacco (in Isabela), or mung bean can be grown with sufficient rainfall and favorable weather conditions.

In the upland sloping, rolling-to-hilly maize agro-ecozone, farmers often grow two crops of maize, with a few farmers planting a third crop of maize, legumes, vegetables, or a combination thereof (Table 9). In Isabela, about 85% of the cultivated area in the surveyed barangays is devoted to this cropping pattern, using legumes in the third cropping. In Cebu, at least 90% of the cultivated area in this agro-ecozone is devoted to maize in the first season, with a few farmers intercropping legumes with it. During the second cropping, when there is extremely high rainfall and some typhoons, more farmers intercrop vegetables and other cash crops with maize, although some still risk a maize crop. With intercrops, maize is planted in only 50-75% of the total cultivated area. Some farmers in this agro-ecozone in Cebu and Leyte fallow their fields during the third cropping to avoid crop failure. In Bukidnon, farmers consider upland rice and vegetables as the second and third most important crops after maize, and these are usually intercropped or relay cropped with maize (upland rice is often planted in a separate parcel of land). In South Cotabato, farmers may risk a third maize crop, which often fails due to unfavorable weather. Farmers estimate that 63% to 85% of their cultivated area is grown to maize, while the rest may be planted to rice, peanut, cotton, and sugarcane.

Table 9. Cropping patterns found across the 24 surveyed villages, the Philippines.

Maize agro-ecozone	Cropping pattern (s)	Estimated % of total area planted to maize
Rainfed lowland	Maize – upland rice	70 - 100
	Transplanted rice – maize	
	Maize – maize	75 - 100
Upland plains	Maize – maize – maize	
	Maize – maize – tobacco (Isabela)	
	Maize – maize+vegetables	
	Maize – maize / legume	35 - 100
	Maize – maize	
Rolling-to-hilly areas	Maize – maize - maize	
	Maize+legumes – maize – vegetables	
	Maize – maize+vegetables - maize	
	Maize – maize – legumes, vegetables	
	Maize – maize – maize+legumes/vegetables	
	Upland rice, maize – vegetables	

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

3.2.3 Maize cropping calendar

In Luzon, maize cropping starts with the first monsoon rains in the summer months. Planting season for the first crop starts in April/May in Isabela and in May/June in Camarines Sur (Table 10). Farmers in Isabela plant their second maize crop in September/October, almost immediately after harvesting the first crop, while farmers in Camarines Sur will wait until November/December to establish their second crop. This cropping calendar is similar across the upland plains and the rolling-to-hilly maize production environments. In Mindoro Occidental, maize is grown as a second crop after rice and is planted in October/November when the monsoon rains have subsided. Farmers are careful not to delay maize planting until December, because drought may occur during the later growth stages of the crop.

In Cebu and Leyte, the first maize crop is planted from April/May until July. The second cropping is from August/September until November/December. With fair weather and good rainfall, a third crop of vegetables or root crops may be grown from December to March, right before the onset of summer.

In the Mindanao provinces surveyed, the first crop of maize is planted in February/March and harvested in June/July. The second maize crop is sown in July/August and harvested in November/December. In the upland sloping, rolling-to-hilly environments in South Cotabato and Cotabato, farmers may plant a third crop of maize or legumes in November/December and harvest it in February, March or April.

In summary, the maize crop calendar for the Philippines indicates that the supply of locally produced maize grain is leanest during January, April-May, and October. In different provinces, maize is harvested a month or two before or after these lean months. Farmer-respondents in this study often stated that it is important that appropriate drying, processing, and storage facilities in the maize regions are provided to ensure that a good supply of grain exists throughout the year.

3.2.4 Maize varieties grown and farmers' preferences

Farmers choose the maize varieties they grow based on their intended use. For home food and feed needs, farmers prefer to grow local/traditional white maize varieties for their good eating quality, low material inputs requirement (especially fertilizers), and low production cost as the seed can be recycled. If maize is grown purely for cash income, farmers are more likely to grow hybrid varieties, as long as they have access to capital for material and labor inputs. Farmers are aware that higher yields can be expected from these improved varieties if proper quantities of inputs are supplied.

Table 10. General maize cropping calendar (17 months) in the 24 surveyed villages, the Philippines.

Province, region	Season	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M
Isabela, Cagayan Valley	First				X	X	X	X	X									
	Second										X	X	X	X	X			
	Third									X	X	X	X					
Mindoro Occ., Southern Tagalog	Second										X	X	X	X	X	X		
Camarines Sur, Bicol	First (Wet)					X	X	X	X									
	Second (Dry)										X	X	X	X	X	X		
Cebu, Central Visayas	First					X	X	X										
	Second								X	X	X	X						
	Third												X	X	X	X		
Leyte, Eastern Visayas	First				X	X	X	X										
	Second									X	X	X	X					
Bukidnon, N. Mindanao	First		X	X	X	X	X											
	Second								X	X	X	X	X					
South Cotabato, S. Mindanao	First			X	X	X	X	X										
	Second								X	X	X	X	X					
	Third												X	X	X	X	X	
Cotabato, Central Mindanao	First			X	X	X	X	X										
	Second								X	X	X	X						
	Third											X	X	X	X	X		

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

In Cebu and Leyte, where white maize is grown largely for human consumption, farmers grow mostly local/ traditional varieties (the most popular of which is *Tiniguib*), and improved OPVs. In addition to factors and preferences discussed above, farmers will choose to plant local/traditional and improved OPVs that have good grain yield and high milling recovery, are resistant to pests and diseases, and are suited to marginal soils (Table 11). However, farmers report that these varieties have small ears, are susceptible to lodging, and are difficult to husk and shell. Some farmers who tried growing hybrid varieties observed pest resistance and larger ears, but also reported low milling recovery, susceptibility to weevils, and low market demand for the grain.

The extent of adoption of local/traditional and improved OPVs has generally been constant through the years, although some specific varieties are no longer planted primarily because seed has become unavailable.

In Camarines Sur, adoption of yellow hybrid varieties is reported to be declining because farmers cannot afford the high costs of seed and required fertilizers. Farmers are gradually shifting to improved OPVs, as their seeds are readily available through barter, sale or from recycling of the last harvest. However, these varieties are late maturing, produce small ears, and are susceptible to fungus infection, corn borers, and lodging.

Table 11. Maize varieties grown in the 24 surveyed villages, the Philippines.

Maize type and variety[a/]	Farmer-identified advantages of the variety	Farmer-identified disadvantages of the variety	Level of farmer adoption	Trend of farmer adoption
Hybrids				
Cargill	High yielding; resistant to lodging, pests and diseases; full cobs at maturity; heavy grain; big ears; long cob; loaned by traders; high shelling recovery; easy to harvest (soft ear shaft)	Expensive seed; susceptible to stalk rot, corn borer, aphids; thin stalks; small kernels; high input requirements; poor eating quality	Medium to high	Constant to increasing (decreasing in Camarines Sur, South Cotabato and Cotabato)
Pioneer	High yielding; resistant to drought, lodging, pests and diseases; full cobs at maturity, heavy grain; loaned by traders; high shelling recovery	Expensive seed; susceptible to stalk rot, weeds, aphids, lodging; thin stalks; high input requirements; vivipary character; small kernels; yield lower than that of Cargill hybrids	Medium to very high	Constant to increasing (decreasing in Camarines Sur, South Cotabato and Cotabato)
Cornworld	Big ears; free from DA; heavy grain	Poor germination; susceptible to molds, lodging; light grain	Low	Not planted anymore in some areas
Mariana (Ayala)	Provided by DA with a subsidy through production program; long cobs; heavy grain; good yield; big grain-filled ear; loaned by traders	Poor germination; susceptible to pests, stalk rot, lodging; light colored grain; low yield; small grain; short stature	Low	Decreasing (not planted anymore in Isabela, Camarines Sur, Bukidnon, South Cotabato)
GSI 40	Big cobs; provided free by DA; resistant to pests; good germination	Poor germination; small and unfilled cobs; light grain; low yielding; difficult to husk; susceptible to mold; low shelling recovery	Low	Decreasing (not planted anymore in Isabela, Bukidnon, Cotabato)
SMC	High yielding; big ears; resistant to lodging	Vivipary character; susceptible to lodging and weeds; small grain	High	Decreasing
Far East	Resistant to lodging	Light grain; susceptible to ear rot	Low	Decreasing
Bioseed	High yielding; high shelling recovery; resistant to drought; cheaper seed than Cargill and Pioneer varieties	Poor germination	Low	Not planted anymore (in Cotabato)
Improved OPVs				
IPB	Cheaper seed; large ears; heavy grain; resistant to pests	Susceptible to lodging	Low	Decreasing (not used anymore in Camarines Sur)
VM 2	High calorie content; compact kernels in the cob; good eating quality	—-	—-	—-
Composite/DMR	Seed can be recycled; big heavy grain; does not rot easily	Susceptible to fungal infection in the field, corn borers and lodging; small ears; late maturing	Very high	Constant

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

[a/] Maize farmer-respondents could not remember the specific variety name (or numbers of hybrids) they use.

The commercial maize growing areas of Mindoro Occidental, Isabela, Bukidnon, South Cotabato, and Cotabato are dominated by modern yellow hybrid varieties. Some local/traditional varieties and improved OPVs are still grown but in smaller areas and commonly for home consumption. Farmers cited favorable characteristics of hybrid varieties, such as: high yields, heavy grain, general resistance to pests and diseases, tolerance to drought and other climatic stresses, and high shelling recovery (Table 11). On the other hand, they listed high seed cost and high input requirements as disadvantages in the use of hybrid varieties. Farmers also report that hybrid seed provided by the DA through maize production intensification programs often shows poor germination and field performance.

Farmers were also asked to rank varietal characteristics according to importance. High yield was the most important parameter across all surveyed barangays but two. In Cebu, where maize is grown for food, farmers considered good eating quality to be the most important characteristic of a variety, while farmers in Mindoro Occidental chose good quality of plants to be the most important (Table 12). Disease and pest resistance consistently ranked as the second, third or fourth most important characteristic, followed by heavy grain weight or full maize cob/ear. Other characteristics differ in their ranking across sites but mostly reflect the cited advantages of varieties identified.

Table 11. continued

Maize type and variety[a/]	Farmer-identified advantages of the variety	Farmer-identified disadvantages of the variety	Level of farmer adoption	Trend of farmer adoption
Local / traditional (native) varieties				
Sinabmit	Early maturing; heavy grain; good market price	Low yield; susceptible to downy mildew	High	Not planted anymore (in Mindoro Occidental)
Wonder	Big cobs and grain; fewer inputs required	Low yield; light grain	High	Not planted anymore (in Mindoro Occidental)
Tiniguib (yellow and white)	Good eating quality; high milling recovery; resistant to pests and diseases; suitable for marginal soils; tolerant of weeds; good storing ability; high calorie content; compact kernels; readily available seed; requires less fertilizer; longer cob and bigger grain; heavy grain; good market price; good yields	Difficult to husk and shell; susceptible to lodging and to downy mildew; low yields; requires more fertilizer; shorter storage life	Medium to high Medium to very high	Constant to decreasing in Cebu, Bukidnon, South Cotabato Constant to increasing (in Cotabato)
Mimis, Jolo	Good eating quality; high milling recovery; pest resistant; suited to marginal soils; weed tolerant; stores well; high calorie content; compact kernels; readily available seed	—-	—-	—-
Kalimpos, Takuro	High milling recovery; large ears; good eating quality; suited to marginal soils; easy to shell; weed tolerant; stores well; high calorie content; compact kernels; readily available seed	—-	Low	Constant (in Cebu)
Minantika	Good eating quality; high milling recovery; pest resistant; early maturing	Small ears	High	Constant (in Cebu)
Java	Good eating quality	Tall and susceptible to lodging	Low	Not planted anymore (in Cebu)
Kantitik	Large ears; resistant to weevils; high milling recovery; suited to marginal soils; easy to shell; good eating quality	Susceptible to weevils when harvested early	Low	Constant (in Cebu)
Bisaya	Resistant to weevils; high milling recovery; suited to marginal soils; good eating quality; early maturing	Small ears; hard to shell	High	Decreasing (in Cebu)
Tikod-tikod	Big ears; short plants	Susceptible to weevils	Low	Not planted anymore (in Cebu)
Masiao	Big kernels; requires less fertilizer; high yields	Poor eating quality; susceptible to lodging	Low	Not planted anymore (in Bukidnon)
Banlon	Good yield; requires less fertilizer; insect resistant	—-	Medium	Decreasing (in Bukidnon)

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

[a/] Maize farmer-respondents could not remember the specific variety name (or numbers of hybrids) they use.

3.2.5 Land preparation and crop management practices

Across all survey sites, land preparation consists of one or two plowing operations, harrowing to level the field and reduce the size of soil clods, and furrowing. The timing of these operations depends on soil moisture conditions. The first plowing is generally done soon after harvesting the previous crop to prevent weed growth and incorporate residues. These land preparation operations are often done with animal power, but may be mechanized on level terrain, especially if capital is available to pay for tractor rental.

Table 12. Ranking of maize characteristics based on farmers' preferences.

Province	Characteristics	Ranking	% of farmer-respondents who gave rankings
Isabela	High yielding	1	100
	Full and heavy grain and cobs	2	50
	Resistant to lodging	3	41
	Resistant to pests and diseases	4	35
	Tolerance to high density	5	14
Mindoro Occidental	Good quality of plants	1	100
	Big ears/cobs; heavy grain	2	100
	Resistant to lodging	3	54
	Resistant to pests and diseases	4	100
	High yielding	5	46
Camarines Sur	High yielding	1	78
	Do not require so much fertilizer	2	83
	Can be recycled	3	78
	Resistant to wind/rain damage	4	100
	Big grain	5	100
Cebu	Good eating quality	1	—
	High milling recovery	2	—
	Resistant to pests	3	—
	Suited to marginal soils	4	—
	Big ears	5	—
Leyte	High yielding; big ears, and compact kernels	1	—
	Resistant to pests and diseases	2	—
	Tolerance to drought	3	—
	Suited to marginal soils	4	—
	Readily available seed	5	—
Bukidnon	High yielding	1	100
	Seed can be recycled	2	92
	Resistant to pests and diseases	3	57
	Heavy grains	4	95
	Resistant to drought; tolerates acid soils	5	76
South Cotabato	High yielding	1	83
	Resistant to lodging	2	79
	Resistant to pest and diseases	3	94
	High shelling recovery	3	100
	Heavy grain weight	4	98
	Early maturing	5	87
Cotabato	High yielding	1	62
	Heavy grain weight/ears	2	57
	High shelling recovery	3	90
	Resistant to pests and diseases	4	90
	Resistant to lodging	5	67

Source: IFAD-CIMMYT-Philippines PRA Survey 2001.

In the rainfed lowlands, the field is plowed once and harrowed twice to prepare the land for the dry-season maize crop after wet-season rice is harvested. The extent of farm mechanization is 70-95% (usually during land preparation), and farmers cite heavy labor use (both family and hired labor) during planting and harvesting. Furrowing is immediately followed by sowing and basal fertilizer application. Inorganic fertilizers are generally applied 25-30 days after planting. Some farmers also use chemical pesticides to control insect pests. Off-barring, hilling-up, and manual/hand weeding are practiced to control weeds. Harvesting, dehusking, drying ,and sometimes shelling are done manually with both family and hired labor.

In the upland plains where maize mono-cropping is practiced, plowing is generally mechanized, while animal draft power is used in harrowing and furrowing. The field is plowed two to three times and harrowed once or twice depending on soil conditions. Furrowing is done at planting. For hybrids, one seed per hill is sown at a distance of 60-75 cm between furrows and 20-25 cm between hills. For OPVs, two seeds per hill are sown at 60 cm between furrows and 30-40 cm between hills. Weeds are commonly controlled through combined manual or hand weeding and off-barring and hilling-up at 20-25 days after planting. Herbicides are very seldom used, although in Isabela pre- and post-emergence herbicides may be applied when labor is scarce. Fertilizers and pesticides are also applied but often at rates lower than what is recommended or required by the crop. Only maize farmers in Camarines Sur report using farmyard manure on their crop. Most farmers have been introduced to integrated pest management (IPM) technology, but its use has been limited. For example, farmers were trained in the use of *Trichogramma*, a biological control for Asian corn borer, yet in only a few of the survey sites is it actually used; farmers reported limited availability constrained their use of the pesticide. Harvesting is done manually in all sites.

In the rolling-to-hilly agro-ecologies, land preparation is done manually or with the use of draft animal. Other crop management practices are similar to those in the upland plains, although input use in these agro-ecologies (particularly in Cebu and Leyte) is lower than in the upland plains. Maize farmers grow mostly local/traditional varieties, sown three to five seeds per hill at distances of 30 cm x 60 cm, 45 cm x 45 cm, or 50 cm x 100 cm. Farmers use wider planting distances than when planting improved OPVs or hybrids in other environments, primarily to accommodate intercrops.

3.2.6 Level of labor and material input use

The average labor and material input use of maize farmers does not differ much across the different maize production environments in the Philippines. Maize farmers in the rainfed lowlands of Isabela, upland plains of Mindanao, and rolling-to-hilly areas of South Cotabato grow all three types of maize varieties. The rainfed lowlands of Mindoro Occidental grow only hybrids and the rolling-to-hilly areas of Cebu and Leyte grow only local/traditional maize varieties. Improved OPVs are sown at 18 kg/ha and hybrids at 16-22 kg/ha in the rainfed lowlands. Seeding rates in the rolling-to-hilly agro-ecozone, especially where local/traditional varieties are grown, are lower than those used in the rainfed lowlands and upland plains (Table 13).

The national fertilizer recommendation is 100 kg/ha urea (45-0-0) plus 200 kg/ha complete fertilizer (14-14-14) for OPVs, and 150 kg/ha urea plus 300 kg/ha complete fertilizer for hybrids. Complete fertilizer is used for basal application, while urea is applied as side dressing 25-30 days after planting. Based on these recommendations, the fertilizer application rates used by farmers in Isabela, Bicol, Bukidnon, South Cotabato, and Cotabato are sufficient. Farmers, however, tend to apply more urea (at 150-325 kg/ha), and less complete fertilizer (at 50-325 kg/ha). The benefits of soil analysis and proper fertilizer recommendations are not realized in many areas. While farmers in Mindoro Occidental may overuse fertilizers for their maize (at 100-600 kg/ha urea plus 150-350 kg/ha complete fertilizer), those in the rolling-to-hilly areas of Cebu and Leyte do not apply enough fertilizer. Only a few farmers in the upland plains and rolling-to-hilly areas use organic fertilizers (particularly farmyard manure), and lime to address soil acidity problems (Table 13). Farmers in the hybrid growing areas commonly use pesticides for insect control, while those in the maize consuming areas of Cebu and Leyte do not. Farmers who do use pesticides, however, state they apply minimal amounts and only when infestation is heavy.

Labor use in maize production ranges from a low 28 person-days per hectare (PD/ha), in the generally mechanized upland plains of South Cotabato, to a high 111 PD/ha in the rolling-to-hilly villages of Cebu where manual labor is mostly used. Women farmers (mostly hired labor), provide 10-45% of the total labor used in maize production, and are employed during planting, manual weeding and harvesting. As expected, labor use and animal power use are highest in the rolling-to-hilly maize agro-ecozones of Cebu and Leyte (Table 13).

Table 13. Average labor and material inputs use in 24 surveyed villages, the Philippines.

	Maize agro-ecozone		
Inputs (unit/ha)	Rainfed lowlands	Upland plains	Rolling-to-hilly
Maize seed (kg)			
Local/traditional	—	15 – 20	9 – 14
Improved OPVs	18	16 – 20	14 – 20
Hybrids	16 – 22	16 – 18.5	16 – 21
Inorganic fertilizers (kg)			
Urea (45-0-0)	100 – 600	150 – 325	50 – 325
Complete (14-14-14)	150 – 350	100 – 300	50 – 325
Ammonium phosphate (16-20-0)	150 – 350	0 – 200	0 – 100
Di-ammonium phosphate (18-46-0)	—	0 – 100	0 – 150
Muriate of potash (0-0-60)	—	0 – 100	0 – 125
Ammonium sulfate (21-0-0)	—	175 - 300	—
Inorganic fertilizers (kg)			
Nitrogen	90-375	119-301	30-235
Phosphorus	41-119	14-128	7-135
Potassium	21-49	14-102	7-121
Farmyard manure (t)	0	0 – 4	0 – 10
Lime (t)	0	0 – 2.5	0 – 2.5
Trichogramma (cards)	0	0 – 200	0 – 45
Human labor			
Total (person-days)	54 – 89	28 – 68	40 – 111
Men (%)	63 – 71	55 – 86	55 – 100
Women (%)	27 – 33	14 – 45	0 – 45
Person-animal days	0 – 10	5 – 10	6 – 25

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

3.2.7 Post-harvest practices

Maize is sun-dried immediately after harvest, usually on drying pavements at home or in common areas in the community. Big, well-developed ears of local/traditional and improved OPVs are selected for planting in the next cropping season. Dried maize ears intended for the market, especially for the feed industry, are shelled using mechanical shellers contracted through cooperatives or individual entrepreneurs in the community. Dried and shelled maize grain is immediately sold, making storage unimportant. Maize grain is sold soon after drying for several reasons– weevils often attack stored grain, lowering grain quality; grain that is not dried to optimum moisture content, especially during the wet season, can develop molds; and farmers have to sell their harvest immediately to pay back loans taken from trader-financiers.

Maize harvested for home use is sorted, smaller ears are milled, and bigger ones are kept for seed. Ears are sun-dried with or without husks and stored in dry areas in the house or in a separate storage shed. Farmers report that ears with husks store better because weevils, the common storage pests, do not easily infest them. Ears are shelled manually, shortly before use.

Better-off farmers bring their produce to commercial maize mills for milling, while poorer farmers use their wooden or stone mills. Farmers reported that mechanical milling produce maize grits of better quality.

3.2.8 Yields and yield gap

The highest yields are obtained from hybrid maize compared to those of local/traditional and improved OPVs, with the rainfed lowland environments producing much better yields than the upland plains and rolling-to-hilly areas (Table 14). Across agro-ecozones, hybrids commonly yield 1.6-6.0 t/ha. Hybrid yields are highest in the rainfed lowland environments of Mindoro Occidental and reach maximum levels of 5.5-9.0 t/ha. The most common yield of local/traditional varieties ranges from 0.1-2.5 t/ha in the rolling-to-hilly areas, and 1.0-2.0 t/ha in the upland plains.

In Cebu and Leyte, maize yields are highest during the first cropping, and decline by 70-87% during the third cropping when conditions become marginal due to drought stress. Yields of hybrid maize grown in Isabela and Mindoro Occidental are notably higher than those in Bukidnon, South Cotabato, and Cotabato.

Farmers are aware that the productivity of their maize crops can still be improved and report several reasons for the yield gap. They claim that erratic, unpredictable weather conditions affect crop growth, and tropical storms, like those that often occur in Camarines Sur and Leyte, can destroy crops. In the rainfed lowlands of Mindoro Occidental, weather extremes–heavy rains and flooding at the start of maize cropping and drought toward the later stages of crop growth–can adversely affect maize production. Secondly, farmers tend to use less than recommended amounts of fertilizers because they lack the capital to purchase the inputs. Thirdly, farmers cite soil acidity and declining soil fertility as a problem. In the rolling-to-hilly agro-ecozones, the continued loss of fertile topsoil due to erosion constrains maize production. Other constraints stated by farmer-respondents include pest incidence, farmers' lack of or insufficient access to technical information or technology, and poor crop management practices.

Table 14. Maize yield by type of material and maize agro-ecozone, 24 surveyed villages, the Philippines.

	Range of maize yield by agro-ecozone (t/ha)		
Type of maize material	Rainfed lowlands	Upland plains	Rolling-to-hilly
Local/traditional			
Most common	—-	1.0 – 2.0	0.1 – 2.5
Minimum attained	—-	0.5 – 1.5	0.1 – 3.0
Maximum attained	—-	1.0 – 2.0	0.2 – 3.8
Improved OPVs			
Most common	—-	2.0 – 4.0	0.9 – 2.4
Minimum attained	—-	1.0 – 3.5	1.0 – 2.1
Maximum attained	—-	2.0 – 4.5	2.0 – 4.5
Hybrids			
Most common	4.6 – 6.0	3.0 – 5.7	1.6 – 5.0
Minimum attained	3.0 – 5.0	1.5 – 5.0	2.0 – 4.3
Maximum attained	5.5 – 9.0	4.0 – 7.0	4.0 – 7.0

Source: IFAD-CIMMYT-Philippines RRA/PRA Survey 2001.

4. Maize Production Constraints

4.1 Biotic and Abiotic Constraints

Most farmer-respondents in the study mentioned the Asian corn borer (*Ostrinia furnacalis* Guenee), corn earworm (*Helicoverpa armigera* Hubn.), and white grubs (*Leucopholis irrorata* Chev.) as annual problems. The Asian corn borer, considered the most destructive pest of maize in the Philippines (Morallo-Rejesus, 2002), occurs yearly in all study sites; its incidence has been constant to increasing during the last 10 years, with farmers reporting yield losses of 30-100%. Significant efforts have been directed at developing biological means to manage this pest, specifically mass rearing of controls for field release. Other pests occurring less frequently but causing moderate-to-high yield losses are armyworm (*Mythimna separata* Walker) and common cutworm (*Spodoptera litura* Fabr.). Weevils (*Sitophilus* spp.) are a serious storage pest, especially in Cebu and Leyte, where farmers store maize grain for home use.

Weeds are a substantial problem in maize production across the survey sites. Several species are persistent and recur every cropping season, causing yield losses as high as 100% if no hand weeding or herbicide is used. Farmer-respondents mention *aguingay* (*Rottboellia cochichinensis*), *mote-mote* (*Ipomoeia triloba*), *makahiya* (*Mimosa pudica*), *Amaranthus spinosus,* and *cogon* (*Cynodon dactylon*) as the species causing the most damage.

Maize downy mildew (*Perona sclerospora sorghi)* is a major disease in the survey sites, including areas planted to hybrid maize varieties. While its occurrence is observed to be decreasing in some locations, downy mildew is reported to be increasing in Cotabato, with reported yield losses as high as 40%. In other developing countries, most commercial cultivars sold by the private sector in mildew prone areas are treated with the systemic fungicide Ridomil™, and only recently has the private sector begun to develop resistant cultivars (Pingali and Pandey, 2001). Seed treated with Ridomil™, however, is generally too expensive for resource-poor farmers, which precludes its widespread use. Other diseases observed by maize farmers are ear rot (*Diplodia* spp.) and stalk rot (*Erwinia carotovora*), both of which are prevalent in the wet season.

Soil fertility constraints seriously affect the maize areas surveyed in the study. Decline in soil fertility is a result of soil erosion, intensive and continuous cropping without proper nutrient management, and intensive use of inorganic fertilizer sources that cause soil acidity.

Improper fertilizer use and nutrient management practices, including imbalance in the nutrients provided, are serious concerns in the survey areas. Often due to lack of capital, the farmer-respondents apply fertilizers at lower-than-recommended rates and do not practice regular soil testing and monitoring. Organic fertilizers, like farmyard manure, are rarely used because farmers perceive these to be less effective and more labor intensive, and because the large amount of organic fertilizer needed for maize production is not usually available. Incorporation of crop residues into the soil is practiced only where land preparation is mechanized.

In rolling-to-hilly agro-ecologies, farmers are keenly aware of the loss of fertile topsoil due to erosion, yet erosion reducing technologies are not widely practiced. Some farmers in Leyte establish rock walls and follow contour plowing, but the adoption of contour hedgerow technology is often not sustained because of the intensive labor required and the farmers' perception that shading may affect their maize crop.

Maize productivity constraints associated with climatic extremes are either flooding during wet season cropping and/or drought during dry season cropping. Drought at any stage of crop development affects production, but maximum damage is inflicted when it occurs around flowering (Pingali and Pandey, 2001). Farmers may respond to drought at the seedling stage by replanting their crop, but drought at flowering stage can be mitigated only by irrigation. These abiotic constraints were identified in Isabela, Mindoro Occidental, Leyte, and Bukidnon.

4.2 Institutional Constraints

The Local Government Code of 1992 caused the Department of Agriculture to devolve its extension service mandate to local government units (LGUs), particularly the Municipal Agriculture Offices (MAOs). Operationally, this transfer of responsibilities led to wide variation in the quality and effectiveness of government extension services across the many municipalities. MAOs have limited human and financial resources to bring sufficient and timely extension services to all barangays, and farmers report insufficient agricultural extension assistance from them. There is also concern about the need for government agricultural technicians to be better trained to address specific production problems and provide information. Farmers comment that the inability of government extension services to provide sufficient and updated information on agricultural technologies contributes to poor farm productivity.

4.3 Input Supply Constraints

In general, the cost of inputs is a major concern to maize farmers, as is the timely availability of inputs. Material farm inputs from agricultural supply dealers, agricultural cooperatives, and private traders are available across all 24 surveyed areas. Farmers with resources buy material inputs directly from agricultural supply stores/dealers. Most farmer-respondents report insufficient capital to directly purchase inputs, and instead obtain them from private trader-financiers who provide inputs on loan, with high interest rates. This arrangement does not always allow farmers to choose among materials available, e.g., fertilizers, pesticides, or even maize seed. With private traders, material inputs are often priced higher than the prevailing market retail price. Farmers who use recycled seed may have less financial stress as they have set aside their own planting materials, and the lack of capital at planting time may not seriously hamper their planting schedule. However,

Table 15. Farmer-identified technological and socioeconomic constraints to maize productivity, 24 surveyed villages, the Philippines, 2001.

Region, province	Rainfed lowland	Upland plains	Rolling to hilly
Region II - Isabela		Lack of capital/low inputs; absence of input/output price policies; drought; lack of efficient mechanical dryer; weeds; pests and diseases (corn borer, stalk rot; cut/army-worms, rodents, aphids); flooding	Soil erosion
Region IV – Mindoro Occidental	Corn borer/earworm; insufficient water supply; insufficient technical know-how on INM; lack of capital/ inadequate credit support; lack of price support; inadequate pH facilities; trader monopoly; soil acidity; inadequate farm-to-market roads; flooding and silting		
Region V – Camarines Sur		Poor marketing systems; lack of capital/low income; soil erosion/acidity; low adoption of modern technology; lack of lodging-resistant varieties; weeds; storage pests; lack of low- interest credit source; lack of post-harvest facilities	Weeds
Region VII – Cebu		Limited knowledge on variety use/seeds; limited knowledge on proper fertilizer management; improper crop production management (planting distance/density); limited access to market outlets; high pest incidence during production and post-harvest; low soil fertility; low grain price; lack of improved post-harvest facilities	
Region VIII – Leyte		Limited knowledge on seeds/variety to use; limited knowledge on proper fertilizer management; improper crop production management (planting distance/density); limited access to market outlets; high pest incidence during production and post-harvest; low soil fertility; low grain price; lack of improved post-harvest facilities	
Region X – Bukidnon		Soil infertility and acidity; soil erosion; limited capital; low grain prices; high input prices; pests and diseases (ear rot, stalk rot); lack of post-harvest facilities; limited access to credit institutions; limited farmers' access to technology; poor government extension services	
Region XI – South Cotabato		Pests and diseases (ear rot, corn borer, stalk rot, whorl maggot, downy mildew, armyworm, BLSB, leaf blight, rust); limited capital and technical information; limited access to credit; high price of hybrid seeds; high transport costs; poor quality of hybrid seeds; soil acidity/erosion/infertility; drought; flash floods; limited improved post-harvest technology	
Region XII – Cotabato		Pests and diseases (whorl maggots, downy mildew, borers); weeds; drought; poor information transfer; limited support from DA & LGUs; low adoption of modern technology; soil acidity/erosion; limited capital/access to credit; high input and transport costs; low quality seeds; poor post-harvest facilities	

Source: IFAD-CIMMYT-Philippines RRA/PRA Surveys 2001.

these farmers are aware that much lower yields are obtained from recycled seed, especially if no fertilizer is applied. Farmers' cooperatives are the optimal source of production inputs, but few are successful enough to support the needs of their members.

Maize farmers are also constrained by lack of farm labor, especially during peak periods of land preparation, planting, and harvesting. A growing number of maize farmers in Isabela, for example, have resorted to the use of mechanized power, especially for land preparation.

4.4 Other Socioeconomic Constraints

Other constraints mentioned by farmers can be characterized as socioeconomic and institutional, namely:

- Lack of access to formal credit sources (government institutions, cooperatives, etc.);
- Insufficient access to fair market and price information;
- Inefficient marketing system for farm inputs and products, and
- Poor infrastructure (roads, irrigation, post-harvest facilities, etc.).

5. Priority Research Constraints

5.1 Methodology for Identifying Priority Constraints

This study used the methodology developed at CIMMYT (Pingali and Pandey, 2001) to prioritize maize productivity constraints that farmer-respondents identified during the RRA/PRA surveys. Three criteria were used for prioritizing the list of farmer-identified constraints: efficiency, the extent of poverty, and the extent of marginality of the production agro-environment. Details on how each of the indices was created and the weights used for deriving a composite index that includes all three criteria are found in Table 16.

The efficiency index prioritizes constraints in terms of getting the biggest "bang for the research buck." It estimates the expected production gain associated with alleviating the constraint, and prioritizes the constraints in terms of getting the highest return for the investment. The inherent risk associated with research investments is quantified in terms of the probability of success in finding a technological solution that will alleviate the constraint, based on the maize scientists' knowledge of the alleviating technologies.

Even where appropriate technologies are available, their adoption by farmers is not guaranteed. To quantify the probability that farmers in a particular location will adopt a technology, CIMMYT drew on the farmer history of technology adoption and patterns of adoption for that ecology or region. In the Philippines, this was based on the most informed knowledge of regional maize scientists who participated in the priority setting exercise.

The poverty index redirects the focus of the efficiency criteria by targeting investments to areas where rural poverty is highest. The commonly accepted measure of absolute poverty is the proportion of the population living below the poverty line, measured as the lowest annual income level required for a citizen to have the basic necessities of food, housing, and clothing. Secondary data on regional rural-urban poverty were used to calculate the poverty index. The marginality index modifies the efficiency index by targeting investments toward the more marginal agro-environmental areas, on the assumption that more commercial areas are being served by the private sector. The inverse of the estimated average maize yield in a particular maize-producing geographic region or ecology was used as a measure of marginality index.

At the country level, the constraints identified from the RRA/PRA work were ranked across all maize ecologies and geographic regions using the above three indices, plus a composite index (Table 16). The weights used in computing the composite index may vary depending on the relative importance of each index and on the mission and perspective of the user. As the objective of the national study on maize was to delineate research and development guidelines, efficiency was used as the primary determining factor in allocating scarce public resources, with important consideration given to the extent of poverty within the ecology and geographic region.

The planning process took place primarily during a national maize research and development priority-setting workshop, attended by senior maize researchers from the public and private sectors, regional maize

Table 16. Prioritizing constraints across maize ecologies and geographic regions.

Efficiency index	Poverty index	Marginality index	Combined index
Is a product of: —Importance of constraint —Yield gain associated with constraint alleviation —Total production by maize ecology and region —Probability of success in finding a solution —Adoption history (% farmers who adopted new technologies in the past)	Is a product of: —The efficiency index and share of the global population living below the poverty line (in the particular ecology and geographical region)	Is a product of: — The efficiency index and inverse of the average maize yield in the particular ecology and geographical region	Is equal to: 0.5*Efficiency index + 0.3*Poverty index + 0.2*Marginality index

program directors, and other stakeholders in the Philippines. The four-day national maize workshop was held at the International Rice Research Institute (IRRI) on the campus of the University of the Philippines Los Baños, in March 2002. The workshop presented the findings from the RRA/PRA work, inventoried current and potential technologies for alleviating the identified constraints, and identified technologies currently not available in the country, but that may be brought in from outside. The workshop ranked the proposed solutions based on their potential for alleviating the constraints, and identified policies needed for the rapid promotion, deployment, and adoption of the proposed solutions.

Workshop participants were divided into working groups based on geographical regions. Each group discussed the maize productivity constraints identified by the farmer-respondents as affecting the region and maize production environment, then prioritized the constraints and identified potential technical and/or policy change solutions. The results from all groups were consolidated to produce the country-level priority constraints discussed in the next section.

5.2 Priority Constraints

5.2.1 Major findings

The constraints presented in Table 15 were ranked across geographical regions and maize agro-ecozones using the efficiency, poverty, marginality, and combined indices. Annex 2 shows the full list of 145 prioritized maize productivity constraints from the different geographical regions. It is important to note that the constraints given priority vary depending on the index used. Table 17 shows the top 10 constraints, associated by geographical region and maize agro-ecozone, based on the indices for efficiency and poverty. These results indicate that, based on the efficiency index alone, first addressing the farmers' lack of capital and the absence of input/output price policies in the broad plains and hilly areas of Isabela would provide the highest returns to maize research and development investments in the Philippines. On the other hand, based on poverty index alone, limited farming capital and soil infertility and acidity in the rolling-to-hilly areas of Bukidnon receive the highest priority.

Based on the efficiency index ranking, the needs of Isabela dominate the top 10 priority maize productivity constraints. These priority constraints also include biotic and abiotic constraints such as corn borers, weeds, stalk rot, and drought. Based on the poverty index ranking, the needs of South Cotabato and Bukidnon comprise the top 10 priority constraints. The poor rural population in these two provinces comprise 8.6% and 7.6%, respectively, of all the rural poor in the country. In contrast to priorities based on the efficiency index, those based on the poverty index generally consisted of socioeconomic and policy-related productivity constraints associated with agricultural extension/ technology transfer services, farmers' access to agricultural credit, and input or output price policies.

These results confirm the farmers' perception that socioeconomic and policy-related constraints impact maize productivity more than technical constraints do.

5.2.2 Regional priorities

The top 25 priority constraints that should be addressed according to the efficiency, poverty, marginality, and combined indices are presented in Table 18. Most priority maize productivity constraints measured by the efficiency index alone, and measured using the combined index, are identical. About half of those priority constraints, however, rank much lower when the poverty and marginality indices are used individually.

Table 17. Top 10 priority constraints to maize productivity based on efficiency vs. poverty rankings, the Philippines.

Efficiency ranking			Poverty ranking		
Province	Agro-ecozone	Constraint	Province	Agro-ecozone	Constraint
1. Isabela	Broad plains & hilly	Lack of capital (low inputs applied)	1. Bukidnon	Rolling-to-hilly	Limited capital for farming
2. Isabela	Broad plains & hilly	Absence of pricing policy for agricultural inputs and outputs	2. Bukidnon	Rolling-to-hilly	Soil infertility and acidity
3. Isabela	Upland, broad plains & hilly	Corn borers	3. South Cotabato	Rolling-to-hilly, uplands	'Aguingay' (*Rottboellia cochichinensis*)
4. Isabela	Broad plains & hilly	Lack of more efficient mechanical dryers	4. South Cotabato	Rolling-to-hilly, uplands	Limited capital for farming
5. Isabela	Broad plains & hilly	Drought	5. South Cotabato	Rolling-to-hilly, uplands	Limited technical information
6. Isabela	Upland, broad plains & hilly	Weeds	6. Bukidnon	Rolling-to-hilly, uplands	Low market price of maize grains
7. Isabela	Upland, broad plains & hilly	Stalk rot	7. South Cotabato	Rolling-to-hilly, uplands	Limited access to agricultural credit
8. Isabela	Upland, broad plains & hilly	Cutworms, armyworms	8. South Cotabato	Rolling-to-hilly, uplands	Non-adoption of improved agricultural technology
9. Isabela	Upland, broad plains & hilly	Rodents	9. Bukidnon	Rolling-to-hilly, uplands	High costs of agricultural inputs
10. Isabela	Upland, broad plains & hilly	Aphids	10. South Cotabato	Rolling-to-hilly, uplands	High costs of hybrid maize seeds

While the combined index provides a balance of efficiency, poverty, and marginality considerations, it should be noted that 8 of the top 10 constraints of the combined ranking are among the top 10 constraints in the efficiency index (Table 18), and that all of the top 10 constraints in the poverty index also appear in the combined rankings, although they rank lower.

Of the top 25 priority constraints, 12 are specific to Isabela, 5 to South Cotabato, 4 to Bukidnon, and 3 to Cotabato (Table 19). Looking more closely at the list, the constraints are noticeably similar regardless of the type of maize production environment. As such, addressing the production constraints in one specific region or environment first can have enormous spillover effects to other regions and environments where maize farmers experience the same constraint.

However, none of the constraints from the maize-consuming provinces of Cebu and Leyte (in the regions of Central and Eastern Visayas, respectively) appeared in the top 25 constraints. Why? Total maize production in these regions is small compared to the more commercial areas of Cagayan Valley and Mindanao. The Visayas nevertheless remain important on a regional basis, especially in white maize, which is the staple food of maize-consuming communities in the regions. It is therefore advisable to continue investing moderately in white maize research, with an emphasis on the Central and Eastern Visayas regions.

Priority constraints based on the combined index can be classified into two major groups: biotic/abiotic constraints and socioeconomic constraints. Maize pests and diseases (corn borer, ear rot, stalk rot) and some weed species rank high among the top biotic/abiotic

Table 18. Top 25 maize priority constraints according to priority indices, the Philippines.

Region, province	Maize agro-ecozone	Maize productivity constraint	Priority indices			
			Efficiency	Poverty	Marginality	Combined
II – Isabela	Broad plains and hilly	Lack of capital (low inputs applied)	1	14	2	1
II – Isabela	Broad plains and hilly	Absence of pricing policy for agricultural inputs and outputs	2	16	4	2
II – Isabela	Upland, broad plains and hilly	Corn borers	3	20	7	3
II – Isabela	Broad plains and hilly	Lack of more efficient mechanical dryers	4	21	8	4
II – Isabela	Broad plains and hilly	Drought	5	30	18	5
II – Isabela	Upland, broad plains and hilly	Weeds	6	38	23	6
II – Isabela	Upland, broad plains and hilly	Stalk rot	7	51	37	7
X – Northern Mindanao	Rolling-to-hilly, uplands	Limited capital for farming	12	1	13	8
X – Northern Mindanao	Rolling-to-hilly, uplands	Soil infertility and acidity	13	2	15	9
II – Isabela	Upland, broad plains and hilly	Cutworms, armyworms	8	53	39	10
II – Isabela	Upland, broad plains and hilly	Rodents	9	54	40	11
II – Isabela	Upland, broad plains and hilly	Aphids	10	55	43	12
II – Isabela	Broad plains	Flooding	11	57	48	13
XI – Central Mindanao	Rolling-to-hilly, uplands	Poor technology and information transfer	14	25	10	14
XII – Southern Mindanao	Rolling-to-hilly, uplands	Aguingay *(Rottboellia cochichinensis)*	18	3	1	15
XI – Central Mindanao	Rolling-to-hilly, uplands	Drought	16	28	12	16
X – Northern Mindanao	Rolling-to-hilly, uplands	Low price of maize grain	17	6	20	17
XII – Southern Mindanao	Rolling-to-hilly, uplands	Limited capital for farming	20	4	3	18
II – Isabela	Hilly	Soil erosion	15	67	57	19
XII – Southern Mindanao	Rolling-to-hilly, uplands	Limited technical information	21	5	5	20
X – Northern Mindanao	Rolling-to-hilly, uplands	High price of agricultural inputs	19	9	28	21
XII – Southern Mindanao	Rolling-to-hilly, uplands	Limited access to credit	23	7	6	22
XII – Southern Mindanao	Rolling-to-hilly, uplands	Non-adoption of improved agricultural technology	27	8	9	23
XI – Central Mindanao	Rolling-to-hilly, uplands	Low adoption of improved agricultural technology	22	39	24	24
XII – Southern Mindanao	Rolling-to-hilly, uplands	High price of hybrid maize seed	31	10	11	25

Table 19. Top 25 prioritized technological and socioeconomic constraints, the Philippines.

Region, province	Rainfed lowland	Upland plains	Rolling to hilly
Region II - Isabela		Lack of capital/low inputs;absence of input/output price policies; corn borer;Lack of more efficient mechanical dryer;drought; weeds; stalk rot;cutworms, armyworms;rodents;aphids;flooding;soil erosion	
Region X – Bukidnon		Limited capital for farming;Soil infertility and acidity;low maize grain prices;high input prices	
Region XI – South Cotabato		Aguingay;limited capital and technical information;limited access to credit;poor adoption of new/modern technology;high price of hybrid seed	
Region XII – Cotabato		Poor information transfer;drought;low adoption of modern technology	

constraints. Socioeconomic constraints include farmers' lack of capital, limited access to formal credit and updated technical information, absence of support price policies for inputs and outputs, and low grain prices. During the RRA/PRA surveys, farmer-respondents felt that the identified socioeconomic constraints had a larger negative impact on maize production than the biotic/abiotic constraints. For example, farmers felt that they could have applied improved nutrient and pest management practices if they had had enough capital to purchase the required material inputs. Sufficient capital, or at least better access to low-interest agricultural credit, would allow maize farmers to buy and plant better quality higher-yielding maize varieties. With higher yields, low input costs, and a good grain price, maize farmers could have a chance to break the cycle of rural poverty and improve their living conditions.

5.2.3 Technology development and dissemination

The constraints prioritization exercise also identified the most effective means of alleviating the constraints cited, as well as suppliers that have a comparative advantage in delivering the particular research product or technology. This section briefly presents viable technological and socioeconomic interventions that maize scientists listed during the priority-setting workshop for selected priority constraints (Table 20).

Potential solutions were classified as either technological ones that address biotic/abiotic constraints to maize production, or policy/program options that address socioeconomic constraints. The technological options have been widely presented in other publications (project reports, scientific papers, journal articles, etc.) and will not be discussed here. Also, farmer-respondents expressed feelings that concerned public and private agencies having enough updated technology to alleviate biotic/abiotic constraints.

Although the pipeline of relevant agricultural technologies has not yet run dry, what is more important for farmers is an economic climate conducive to agricultural production, comprised of higher maize grain prices, low input costs, easier access to farm capital, and updated information on affordable technologies. Attractive maize grain prices will provide an incentive for farmers to expand the area planted to maize or adopt modern varieties to raise production. With lower input costs, maize farmers could enjoy higher returns from their enterprise.

Table 20. Technology options and research approaches that will help alleviate major maize production constraints, the Philippines.

Production constraint	Technological options or research strategy	Suppliers/responsible agency (ies)
Biotic constraints		
Pest and diseases	- pest monitoring and surveillance	Department of Agriculture
	- use of biological control such as *Trichogrammma* for corn borer	Local government units
	- use of resistant varieties	Private sector
	- promotion of appropriate cultural management practices	
Abiotic constraints		
Soil erosion	- promotion of improved soil conservation tillage	Department of Agriculture/RIARCs
	- development of alternative soil management technology	Local government units, NARS
Soil infertility and acidity	- promotion of balanced fertilization	Department of Agriculture/AIARCs
	- liming	Local government units
	- promotion of organic fertilizer use	NARS
Drought	- development and use of resistant varieties	Department of Agriculture, state colleges and universities, private sector, NGOs
Socioeconomic constraints		
Limited capital for farming	- credit assistance from public and private sector	Public and private credit institutions
Absence of input/output	- policy formation/review	Department of Agriculture
price policies	- price monitoring	Local government units
Limited access to credit	- formation of farmer cooperatives	Department of Agriculture
	- development of pro-poor credit scheme	Local government units
Poor adoption of new/	- farmers' field school (FFS)	Department of Agriculture
modern technology	- technology demonstration	Local government units
	- enhancement of extension activities	State colleges and universities
	- on-farm-research trials	Private sector
Poor farm-to-market roads	- development of appropriate cost-effective post-harvest facilities	

In recent years, the Philippine government has had to confront two major challenges–increasing farmer demand for improved maize technologies, and a stagnant or declining resource base that has constrained the ability of public research organizations to develop and disseminate improved technology. In response to these challenges, more active private sector participation in the maize seed industry has been encouraged.

Private seed companies have responded to policy reforms by increasing their maize research and development investment (Gerpacio, 2003). To avoid competition with the private sector, public breeding programs have concentrated on activities that are unlikely to attract profit-oriented firms, such as genetic resource conservation, pre-breeding, population improvement, development of special trait materials, and OPV development. Private seed companies, meanwhile, have emphasized inbreeding, hybrid development, hybrid seed production and distribution. Despite increasing specialization, however, public and private maize seed organizations continue to be linked through international germplasm exchanges, public-private germplasm transfers, and collaborative varietal testing networks.

6. Recommendations for Maize Research and Development in the Philippines

How will the relationship between public organizations and private seed companies evolve in the future? CIMMYT convened a meeting of experts (scientists from the public and private sectors, development agency officials, NGO representatives, media specialists, and farmers) in Tlaxcala, Mexico, to discuss the conditions necessary for productive and harmonious collaboration between the public and private sectors with respect to research and development options for maize (and wheat and rice). The consensus of the participants resulted in the following suggestions, as printed in the *Tlaxcala statement on public/private sector alliances in agricultural research* (CIMMYT 1999):

- Public organizations can and should continue to play an active role in maize research and seed production; public-sector involvement will help to reduce research and development costs for private firms (for example by generating improved germplasm that can be used as inputs into commercial breeding programs and by training researchers).
- Where conditions permit the existence of competitive seed markets, the public sector should complement and support rather than compete with the private sector in providing improved seed and related technology to farmers.
- The public sector has a particularly important role to play in supporting local private seed companies, which can enhance competition in seed markets.
- Where technical, economic, or institutional conditions discourage private companies from providing improved seed technology to farmers, public agencies may be called upon to assume responsibility for meeting farmers' needs.
- Even where international research organizations and private seed companies are active, strong national public research programs will often be needed to adapt privately and internationally developed research products to local conditions.

How might the public sector roles and responsibilities develop in the future to accommodate the needs of millions of subsistence farmers who until now have attracted limited attention from private seed companies? The anticipated increase in maize demand in the Philippines will lead to the intensification and commercialization of existing production systems, as well as expansion into less favorable maize production environments. The public sector can work on identifying the principal technological constraints to increasing maize productivity in those areas; design crop and resource management technologies to alleviate the principal constraints and support sustainable practices in fragile environments; and develop technology dissemination plans and more effective agricultural extension strategies.

The strong likelihood that the private sector will be reluctant to address the needs of farmers in marginal areas should encourage the public sector to continue their active role in maize research and development and seed production, particularly for improved OPVs. The public sector should assume a more complementary and supportive role to the private sector by developing policies that facilitate private sector operations. Along these lines, the Philippine DA-BAR recently charted a seven-point agenda to strengthen the government's general research and development system (*The Philippine Star*, May 18, 2003):

1. Appropriate more resources for conducting applied and on-farm research (OFR) following the farming systems perspective to fast-track technology promotion and adoption and create immediate impact on beneficiaries (farmers and fishermen);
2. Support priority high-impact research and development projects that have direct bearing on small and medium enterprises and, more important, on the income-generating capabilities of resource-poor farmers and fishermen, with focus on six basic commodities, namely rice, maize, coconut, sugarcane, vegetables, and aquaculture;

3. Develop and strengthen collaboration among existing research and development systems, consortia, networks, state colleges, and universities at the national and local levels to enhance sustained growth in agriculture;

4. Strengthen the capability of the DA research and development system and foster active partnerships with the local government units (LGUs) and other concerned institutions in the regions;

5. Institutionalize the planning and implementation of an integrated and unified research and development agenda of both DA-BAR and two research agencies of the Department of Science and Technology (DOST): Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), and Philippine Council for Aquatic and Marine Research and Development (PCAMRD);

6. Develop mechanisms using information technology (ICT) and other means to enhance decision-making and technology adoption; and

7. Advocate policies that promote sustained growth in agriculture and develop strategies to increase investments in research and development by both government and private sector here and abroad.

Finally, it is important to recognize that improved agricultural technology is not the only key to increasing maize productivity and bettering living conditions of resource-poor maize farmers in the Philippines. No amount of advanced public- or private-sector maize research will help the most disadvantaged farmers unless substantial parallel investments are made in infrastructure, agricultural extension, input production and distribution systems, grain harvest and post-harvest facilities, and grain marketing. In the end, the role and impact of appropriate government policies–from input and grain pricing policies to policies on intellectual property rights–should certainly not be overlooked.

7. Annexes

Annex 1. Maize production, area harvested, and yield, the Philippines, 1980-2002.

	Production ('000 mt)			Area harvested ('000 ha)			Yield/hectare (mt)		
Year	White	Yellow	Total	White	Yellow	Total	White	Yellow	Average
1980	2,718	332	3,050	2,850	349	3,199	0.95	0.95	0.95
1981	2,711	585	3,296	2,683	611	3,295	1.01	0.96	1.00
1982	2,776	628	3,404	2,812	571	3,383	0.99	1.10	1.01
1983	2,356	778	3,134	2,544	588	3,132	0.93	1.32	1.00
1984	2,289	962	3,250	2,538	689	3,227	0.90	1.40	1.01
1985	2,978	885	3,863	2,843	667	3,511	1.05	1.33	1.10
1986	2,925	1,166	4,091	2,763	832	3,595	1.06	1.40	1.14
1987	2,765	1,513	4,278	2,693	990	3,683	1.03	1.53	1.16
1988	2,859	1,569	4,428	2,745	1,000	3,745	1.04	1.57	1.18
1989	2,923	1,599	4,522	2,702	987	3,689	1.08	1.62	1.23
1990	2,966	1,888	4,854	2,739	1,081	3,820	1.08	1.75	1.27
1991	2,906	1,749	4,655	2,583	1,006	3,589	1.12	1.74	1.30
1992	2,700	1,919	4,619	2,351	981	3,331	1.15	1.96	1.39
1993	2,627	2,171	4,798	2,098	1,051	3,149	1.25	2.07	1.52
1994	2,090	2,429	4,519	1,866	1,140	3,006	1.12	2.13	1.50
1995	1,862	2,266	4,129	1,670	1,022	2,692	1.12	2.22	1.53
1996	1,883	2,268	4,151	1,696	1,040	2,736	1.11	2.18	1.52
1997	1,879	2,453	4,332	1,699	1,027	2,726	1.11	2.39	1.59
1998	1,620	2,203	3,823	1,451	903	2,354	1.12	2.44	1.62
1999	1,824	2,761	4,585	1,608	1,034	2,642	1.13	2.67	1.74
2000	1,889	2,622	4,511	1,573	937	2,510	1.20	2.80	1.80
2001	1,918	2,607	4,525	1,565	921	2,487	1.23	2.83	1.82
2002	1,797	2,522	4,319	1,503	892	2,395	1.20	2.83	1.80

Source: Bureau of Agricultural Statistics (BAS), 2003.

Annex 2. Maize research prioritization for the Philippines, by region

Region	Production environment	Productivity constraint	Efficiency rank	Poverty rank	Marginality rank	Combined rank
Bicol Region	Upland plain	Poor marketing systems	82	82	73	82
Bicol Region	Upland plain	Lack of capital/low income	83	83	79	83
Bicol Region	Upland plain	Unstable price of corn	84	84	84	84
Bicol Region	Upland plain	Bad weather condition	85	85	85	85
Bicol Region	Upland plain	High costs of inputs	86	86	86	86
Bicol Region	Upland plain	Low adoption of technology	87	87	87	87
Bicol Region	Upland plain	Lack of lodging-resistant varieties	89	89	88	88
Bicol Region	Upland plain	Misuse of fertilizer/low fertilizer use	88	88	89	89
Bicol Region	Upland plain	Soil erosion/siltation/acidic soil	90	90	90	90
Bicol Region	Upland plain	Weeds	91	91	91	91
Bicol Region	Upland plain	Lack of low interest credit source	92	92	92	92
Bicol Region	Upland plain	Storage insect pests	93	93	93	93
Bicol Region	Upland plain	Lack of post-harvest facilities	94	94	94	94
Bicol Region	Upland plain	Absence of strong farmers organization	95	95	95	95
Bicol Region	Upland plain	Rodents	96	96	96	96
Bicol Region	Upland plain	Limited farm work/job opportunities	97	97	97	97
Bicol Region	Upland plain	Poor farming systems	99	98	98	98
Bicol Region	Upland plain	Soil acidity/poor soil fertility	101	99	99	99
Bicol Region	Rolling-Hilly	Weeds	144	141	144	144
Bicol Region	Rolling-Hilly	Poor farm to market roads	145	145	145	145
C. Mindanao	Rolling-Hilly, Upland	Poor information transfer	14	25	10	14
C. Mindanao	Rolling-Hilly, Upland	Drought	16	28	12	16
C. Mindanao	Rolling-Hilly, Upland	Low adoption of technology	22	39	24	24
C. Mindanao	Rolling-Hilly, Upland	Hagonoy	24	41	25	26
C. Mindanao	Rolling-Hilly, Upland	High costs of inputs	25	42	26	27
C. Mindanao	Rolling-Hilly, Upland	Aguingay	26	45	27	28
C. Mindanao	Rolling-Hilly, Upland	Soil fertilization problem	28	46	29	32
C. Mindanao	Rolling-Hilly, Upland	Limited capital	29	47	32	33
C. Mindanao	Rolling-Hilly, Upland	Limited access to credit	37	58	38	39
C. Mindanao	Rolling-Hilly, Upland	Limited support of DA-LGU	40	62	46	41
C. Mindanao	Rolling-Hilly, Upland	Soil acidity	39	61	47	42
C. Mindanao	Rolling-Hilly, Upland	Downy mildew	43	63	49	45
C. Mindanao	Rolling-Hilly, Upland	Soil erosion	44	65	53	46
C. Mindanao	Rolling-Hilly, Upland	Whorl maggots	50	68	56	52
C. Mindanao	Rolling-Hilly, Upland	Corn borer	52	69	58	53
C. Mindanao	Rolling-Hilly, Upland	Ear rot	54	71	63	58
C. Mindanao	Rolling-Hilly, Upland	Paragrass	55	72	64	59
C. Mindanao	Rolling-Hilly, Upland	Use of low quality seeds	56	73	65	60
C. Mindanao	Rolling-Hilly, Upland	High transportation costs	57	74	67	61
C. Mindanao	Rolling-Hilly, Upland	*Triloba*	62	75	70	64
C. Mindanao	Rolling-Hilly, Upland	Egg blight	64	76	74	66
C. Mindanao	Rolling-Hilly, Upland	High interest rate of traders	65	77	75	67
C. Mindanao	Rolling-Hilly, Upland	Poor quality of grain	69	79	76	68
C. Mindanao	Rolling-Hilly, Upland	Stalk rot	68	78	77	69
C. Mindanao	Rolling-Hilly, Upland	Rats	70	80	80	71
C. Mindanao	Rolling-Hilly, Upland	Weevil	72	81	82	75
Cagayan Valley	Broad plain & hilly	Lack of capital / low inputs	1	14	2	1
Cagayan Valley	Broad plain & hilly	Absence of pricing policy for input & output	2	16	4	2
Cagayan Valley	UP, BP & hilly	Corn borer	3	20	7	3
Cagayan Valley	Broad plain & hilly	Lack of more efficient mechanical dryer	4	21	8	4
Cagayan Valley	Broad plain & hilly	Drought	5	30	18	5
Cagayan Valley	UP, BP & hilly	Weeds	6	38	23	6
Cagayan Valley	UP, BP & hilly	Stalk rot	7	51	37	7
Cagayan Valley	UP, BP & hilly	Cutworms/Armyworms	8	53	39	10
Cagayan Valley	UP, BP & hilly	Rodents	9	54	40	11
Cagayan Valley	UP, BP & hilly	Aphids	10	55	43	12
Cagayan Valley	Broad plain	Flooding	11	57	48	13
Cagayan Valley	Hilly	Soil erosion	15	67	57	19
Central Visayas	Rolling-Hilly, Upland	Limited knowledge on proper fertilizer management	121	119	100	114

Source: IFAD-CIMMYT-Philippines National Maize RD&E Priority-Setting Workshop 2003.

Note: UP – upland ; BP – broad plains; P-U-R-H-M – plains, upland, rolling, hilly, mountainous.

Annex 2. cont'd....

Region	Production environment	Productivity constraint	Efficiency rank	Poverty rank	Marginality rank	Combined rank
Central Visayas	Rolling-Hilly, Upland	Limited knowledge on variety use/seeds	120	118	101	115
Central Visayas	Rolling-Hilly, Upland	Ineffective financial scheme	123	120	102	121
Central Visayas	Rolling-Hilly, Upland	Crop production management	129	125	105	124
Central Visayas	Rolling-Hilly, Upland	Planting density	128	124	106	125
Central Visayas	Rolling-Hilly, Upland	Planting distance	127	123	107	126
Central Visayas	Rolling-Hilly, Upland	Limited access to market outlets	132	127	109	127
Central Visayas	Rolling-Hilly, Upland	Low price	133	128	110	128
Central Visayas	Rolling-Hilly, Upland	Low soil fertility	135	134	119	134
Central Visayas	Rolling-Hilly, Upland	High production pests incidence	137	135	121	135
Central Visayas	Rolling-Hilly, Upland	Poor farm-to-market roads	140	136	125	136
Central Visayas	Rolling-Hilly, Upland	High pests incidence (post-harvest)	141	137	127	137
Central Visayas	Rolling-Hilly, Upland	Lack of improved post harvest facilities/equipment	143	140	134	140
Eastern Visayas	Rolling-Hilly, Upland	Limited knowledge on proper fertilizer management	119	122	111	119
Eastern Visayas	Rolling-Hilly, Upland	Limited knowledge on variety use/seeds	118	121	112	120
Eastern Visayas	Rolling-Hilly, Upland	Ineffective financial scheme	122	126	116	123
Eastern Visayas	Rolling-Hilly, Upland	Crop production management	126	131	122	129
Eastern Visayas	Rolling-Hilly, Upland	Planting density	125	130	123	130
Eastern Visayas	Rolling-Hilly, Upland	Planting distance	124	129	124	131
Eastern Visayas	Rolling-Hilly, Upland	Limited access to market outlets	130	132	129	132
Eastern Visayas	Rolling-Hilly, Upland	Low price	131	133	130	133
Eastern Visayas	Rolling-Hilly, Upland	Low soil fertility	134	138	138	138
Eastern Visayas	Rolling-Hilly, Upland	High production pests incidence	136	139	140	139
Eastern Visayas	Rolling-Hilly, Upland	Poor farm-to-market roads	138	142	141	141
Eastern Visayas	Rolling-Hilly, Upland	High pests incidence (post-harvest)	139	143	142	142
Eastern Visayas	Rolling-Hilly, Upland	Lack of improved post harvest facilities/equipment	142	144	143	143
N. Mindanao	Rolling-Hilly, Upland	Limited capital for farming	12	1	13	8
N. Mindanao	Rolling-Hilly, Upland	Soil infertility and acidity	13	2	15	9
N. Mindanao	Rolling-Hilly, Upland	Low price of maize grains	17	6	20	17
N. Mindanao	Rolling-Hilly, Upland	High price of inputs	19	9	28	21
N. Mindanao	Rolling-Hilly, Upland	Pests and diseases (ear rot, stalk rot)	30	17	36	34
N. Mindanao	Rolling-Hilly, Upland	Limited access to credit institution	35	22	50	36
N. Mindanao	Rolling-Hilly, Upland	Soil erosion	38	27	55	40
N. Mindanao	Rolling-Hilly, Upland	Lack of post-harvest facilities	45	32	62	48
N. Mindanao	Rolling-Hilly, Upland	Limited access to technology at farmers level due to poor extension	48	33	66	50
S. Mindanao	P-U-R-H-M	Aguingay	18	3	1	15
S. Mindanao	P-U-R-H-M	Limited capital	20	4	3	18
S. Mindanao	P-U-R-H-M	Limited technical information	21	5	5	20
S. Mindanao	P-U-R-H-M	Limited access to credit	23	7	6	22
S. Mindanao	P-U-R-H-M	Non-adoption of new technology	27	8	9	23
S. Mindanao	P-U-R-H-M	High price of hybrid seeds	31	10	11	25
S. Mindanao	P-U-R-H-M	Drought	32	11	14	29
S. Mindanao	P-U-R-H-M	Soil fertility problem	33	12	16	30
S. Mindanao	P-U-R-H-M	*C. odorata*	34	13	17	31
S. Mindanao	P-U-R-H-M	Soil acidity	36	15	19	35
S. Mindanao	P-U-R-H-M	Soil erosion	41	18	21	37
S. Mindanao	P-U-R-H-M	Poor quality of hybrid seeds	42	19	22	38
S. Mindanao	P-U-R-H-M	Ear rot	46	23	30	43
S. Mindanao	P-U-R-H-M	Poor cultural management	47	24	31	44
S. Mindanao	P-U-R-H-M	Corn borer	49	26	33	47
S. Mindanao	P-U-R-H-M	Stalk rot	51	29	34	49
S. Mindanao	P-U-R-H-M	Low quality/yield of recycled seeds	53	31	35	51
S. Mindanao	P-U-R-H-M	Whorl maggot	58	34	41	54
S. Mindanao	P-U-R-H-M	Flash floods	59	35	42	55
S. Mindanao	P-U-R-H-M	*I. triloba*	60	36	44	56
S. Mindanao	P-U-R-H-M	Strong winds	61	37	45	57
S. Mindanao	P-U-R-H-M	Downy mildew	63	40	51	62
S. Mindanao	P-U-R-H-M	High transport cost	66	43	52	63
S. Mindanao	P-U-R-H-M	Limited support from DA-LGUs	67	44	54	65

Source: IFAD-CIMMYT-Philippines National Maize RD&E Priority-Setting Workshop 2003.
Note: UP – upland ; BP – broad plains; P-U-R-H-M – plains, upland, rolling, hilly, mountainous.

Annex 2. cont'd....

Region	Production environment	Productivity constraint	Efficiency rank	Poverty rank	Marginality rank	Combined rank
S. Mindanao	P-U-R-H-M	Army worm	71	48	59	70
S. Mindanao	P-U-R-H-M	*A. spinosus*	74	50	60	72
S. Mindanao	P-U-R-H-M	BLSB	73	49	61	73
S. Mindanao	P-U-R-H-M	Rats	75	52	68	74
S. Mindanao	P-U-R-H-M	Leaf blight	76	56	69	76
S. Mindanao	P-U-R-H-M	Landslides	77	59	71	77
S. Mindanao	P-U-R-H-M	Limited statistical information	78	60	72	78
S. Mindanao	P-U-R-H-M	Poor quality of grains	79	64	78	79
S. Mindanao	P-U-R-H-M	Rust	80	66	81	80
S. Mindanao	P-U-R-H-M	Limited pH technology	81	70	83	81
S. Tagalog	Rainfed lowland	Insufficient water supply	98	100	103	100
S. Tagalog	Rainfed lowland	Lack of capital and inadequate credit support	100	101	104	101
S. Tagalog	Rainfed lowland	Lack of price support	102	102	108	102
S. Tagalog	Rainfed lowland	Corn borer	103	103	113	103
S. Tagalog	Rainfed lowland	Rodents	104	104	114	104
S. Tagalog	Rainfed lowland	Trader monopoly	105	105	115	105
S. Tagalog	Rainfed lowland	Insufficient technical know-how on integrated nutrient management	106	106	117	106
S. Tagalog	Rainfed lowland	Sandy soils	107	107	118	107
S. Tagalog	Rainfed lowland	Flooding and siltation	108	108	120	108
S. Tagalog	Rainfed lowland	Insufficient technical know-how on planting distance	109	109	126	109
S. Tagalog	Rainfed lowland	Acidic soils	110	110	128	110
S. Tagalog	Rainfed lowland	Inadequate post-harvest facilities	111	111	131	111
S. Tagalog	Rainfed lowland	Inadequate farm to market roads	112	112	132	112
S. Tagalog	Rainfed lowland	Lack of market outlets	113	113	133	113
S. Tagalog	Rainfed lowland	Weeds (sedges and broad leaves)	114	114	135	116
S. Tagalog	Rainfed lowland	Inactive cooperatives and farmers' association	115	115	136	117
S. Tagalog	Rainfed lowland	Corn earworm	116	116	137	118
S. Tagalog	Rainfed lowland	Declining production area due to industrialization	117	117	139	122

Source: IFAD-CIMMYT-Philippines National Maize RD&E Priority-Setting Workshop 2003.
Note: UP – upland ; BP – broad plains; P-U-R-H-M – plains, upland, rolling, hilly, mountainous.

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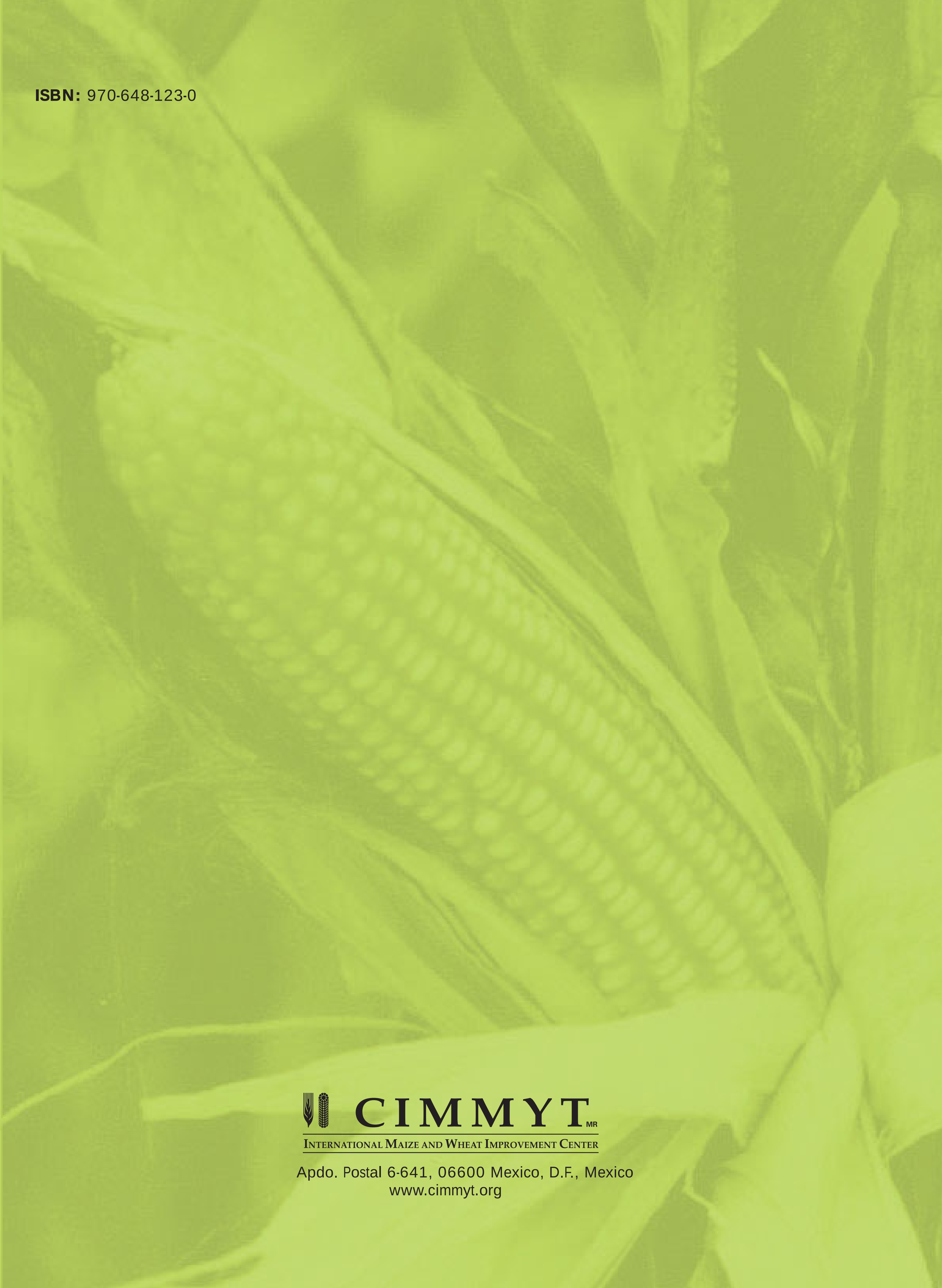

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