社会開発調査部報告書

No. 202

Japan International Cooperation Agency

Department of Trade and Industry
Republic of the Philippines

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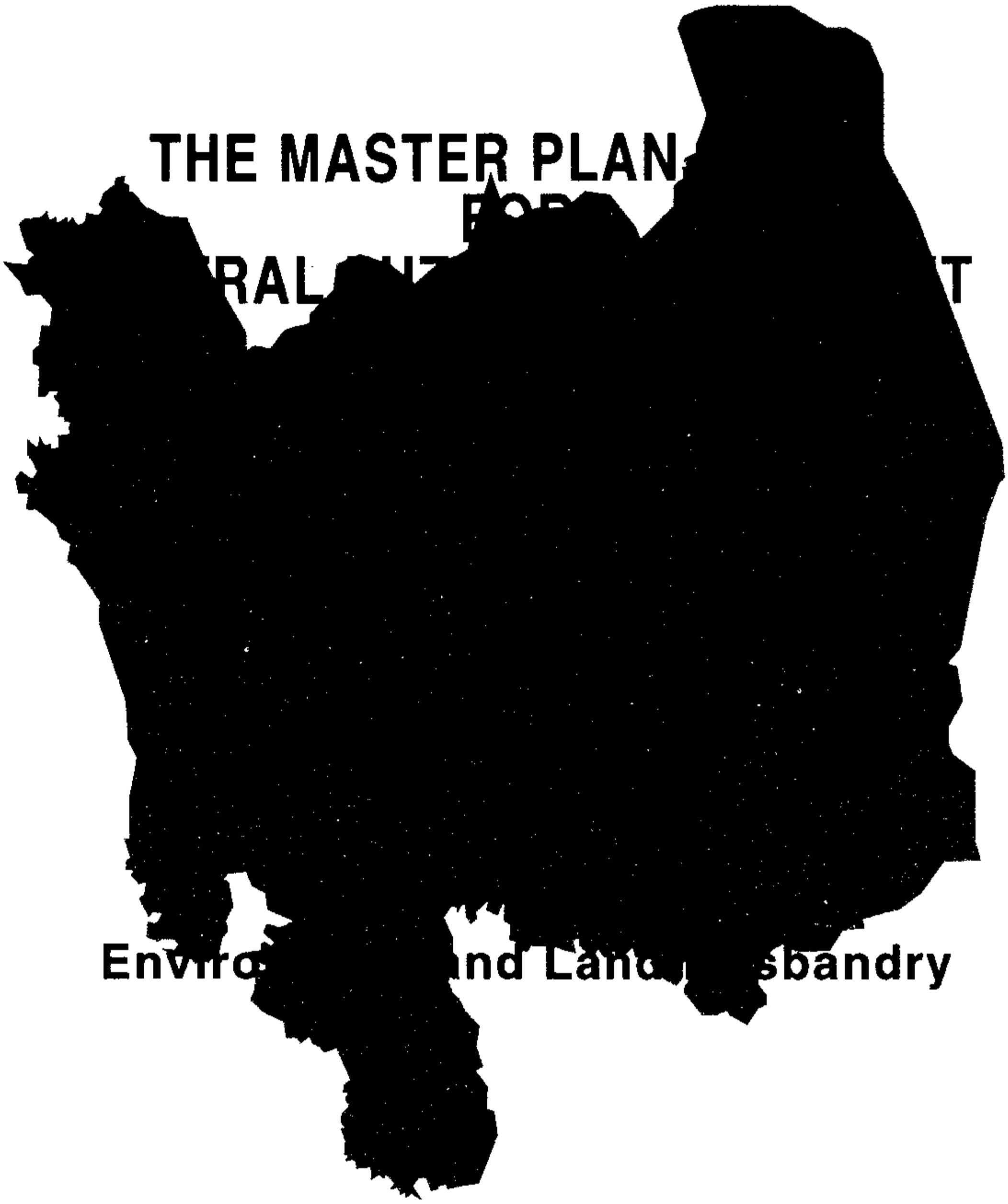

Enviro nd Land sbandry

September 1995

Nippon Koei Co., Ltd.
Pacific Consultants International

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THE MASTER PLAN STUDY FOR

FINAL REPORT Volume VI

September

Exchange Rate

(as of August 1995)

US$ = P 26.0

US$ = ¥90.0

Japan International Cooperation Agency

Department of Trade and Industry
Republic of the Philippines

THE MASTER PLAN STUDY FOR CENTRAL LUZON DEVELOPMENT PROGRAM

FINAL REPORT

Volume VI

Sector Report 4

Environment and Land Husbandry

September 1995

Nippon Koei Co., Ltd.
Pacific Consultants International

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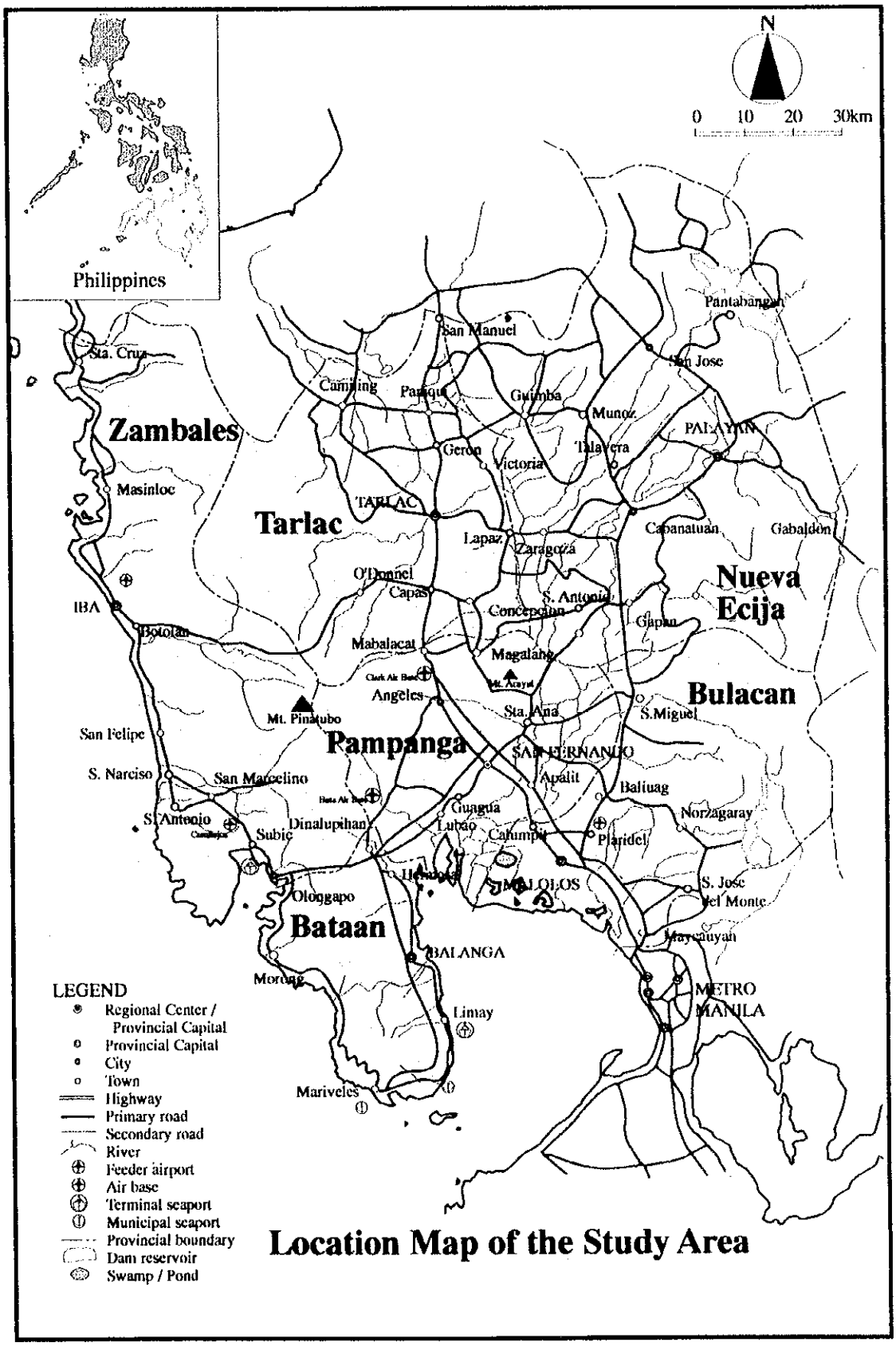

Location Map of the Study Area

SECTOR REPORT 4: ENVIRONMENT and LAND HUSBANDRY

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List of Abbreviations

AFTA	-	Asean Free Trade Area
APEC	-	Asian Pacific Economic Cooperation
ARCs	-	Agrarian Reform Communities
ASEAN	-	Association of South East Asian Nations
BEPZ	-	Bataan Export Proceesing Zone
BOI	-	Board of Investments
BSWM	-	Bureau of Soil and Water Management
CAR	-	Cordillera Autonomous Region
CDC	-	Clark Development Corporation
CENRO	-	Community Environment and Natural Resources Office
CFPI	-	Cooperative Foundation of the Philippines Inc.
CLDP	-	Central Luzon Development Program
CLSU	-	Central Luzon State University
DA	-	Department of Agriculture
DAR	-	Department of Agrarian Reform
DECS	-	Department of Education, Culture and Sports
DENR	-	Department of Environment and Natural Resources
DILG	-	Department of Interior and Local Government
DOH	-	Department of Health
DOLE	-	Department of Labor and Employment
DOST	-	Department of Science and Technology
DOT	-	Department of Tourism
DOTC	-	Department of Transportation and Communications
DPWH	-	Department of Public Works and Highways
DSWD	-	Department of Social Welfare and Development
DTI	-	Department of Trade and Industry
EIA	-	Environmental Impact Assessment
EPZ	-	Export Processing Zone
EU	-	European Union
GDP	-	Gross Domestic Products
GIS	-	Geographic Information System
GNP	-	Gross National Product
GO	-	Government Organizations
GRDP	-	Gross Regional Domestic Products
GVA	-	Gross Value Added
HAIE	-	Hermosa Agro-Industrial Estate
IAs	-	Industrial Associations
IE	-	Industrial Estate
IRA	-	Internal REvenue Allotment
JICA	-	Japan International Cooperation Agency
LGU	-	Local Government Unit
LMU	-	Land Management Units
LWUA	-	Local Water Utilities Administration
MPC	-	Mount Pinatubo Commission
MSC	-	Manila-Subic-Clark
NAFTA	-	North American Free Trade Area
NCR	-	National Capital Region
NEDA	-	National Economic Development Authority
NFA	-	National Food Authority
NGO	-	Non-Government Organization
NIA	-	National Irrigation Administration
NIC	-	Newly Industrialized Country
NIPAS	-	National Integrated Protected Area System
NSO	-	National Statistics Office

NWRC	-	National Water Resources Council
PENRO	-	Provincial Environment and Natural Resources Office
PO	-	People's Organization
POS	-	Point of Sale
PRRM	-	Philippine Rural Reconstruction Movement
RDC	-	Regional Development Council
RSCs	-	Regional Service Centers
SBMA	-	Subic Bay Metropolitan Authortiy
SEPZ	-	Special Economic and Freeport Zone
SEZ	-	Special Economic Zone
SME	-	Small and Medium Enterprise
SRS	-	Social Reconnaissance Survey

Abbreviations of Measures

Length			Weight		
mm	=	milimrter	mg	=	miligram
cm	=	centimeter	g	=	gram
m	=	meter	kg	=	kilogram
km	=	kilometer	ton (MT)	=	metric ton
mbgs	=	meter below grounf surface	1 cavan	=	50 kilograms
Area			**Volume**		
cm^2	=	square centimeter	cm^3	=	cubic centimeter (cu. m)
m2	=	square meter	lit	=	liter
Km2	=	square kilometer (sq. km)	lb	=	pound
ha	=	hectare	m3	=	cubic meter
			MCM	=	million cubic meter
Other Measures			**Money**		
%	=	percent	P	=	Philippine Peso
m^3 /s	=	cubic meter per second	¥	=	Japanese Yen
lit /s	=	liter per second	US$	=	US Dollor

Government of the Philippines Fiscal Year

From January 1 to December 31

CHAPTER 1

SECTOR REPORT 4: ENVIRONMENT and LAND HUSBANDRY

CHAPTER 1 POLICIES AND INSTITUTIONS

1.1 Legal Land Classification

Two major legal classifications of land in the Philippines are the alienable and disposable (A & D) lands and the forest lands, both of which are considered lands of the public domain. A & D lands refer to those which have been declared as not needed for forest purposes. Forest lands are those which have not been declared as A & D and include areas such as public forest, permanent forest or reserves, forest reservations, timberlands, grazing lands, game refuge and bird sanctuaries. Under the national policy enshrined in the 1987 Constitution, only agricultural land of the public domain may be privately titled, whereas forest land is reserved to public ownership in perpetuity.

In Central Luzon, 57.7% of the total area is classified as A & D (compared to 47.1% for the entire Philippines), and 40% as forest lands (Table 1.1). The remaining 3% unclassified land by default is also considered as forest lands until its classification is completed. Pampanga, Bulacan, Nueva Ecija and Tarlac have over 60% of their respective areas classified as A & D. Zambales has almost 69% of its total area classified as forest lands.

1.2 Policies and Related Agencies

(1) Land use

The inter-agency National Land Use Committee (NLUC) is the supreme land use planning organ at the national level and serves as the coordinating mechanism for preparation of the National Physical Framework Plan (NPFP). The National Economic and Development Agency (NEDA) acts as the secretariat for NLUC. It is responsible for physical planning at the national and regional levels. It formulates and prescribes regional standards and guidelines for regional physical framework plans to be prepared by the Regional Development Councils (RDCs).

The Department of Environment and Natural Resources (DENR) is responsible for the conservation, management, development and use of forest and grazing lands, coastal mangroves, mineral resources and other lands in the public domain (forest lands). It is the lead natural resource and environmental agency. The Department of Agriculture (DA) aims to "improve farm income and generate work opportunities for farmers, fishermen and other rural workers" and its efforts are confined to A & D lands. The Bureau of Soils and Water Management (BSWM) in DA is the lead agency involved in research and planning of soils and land capability analysis, water resources planning and agricultural planning in A & D

areas. Management of coastal fishery areas by default is largely within the authority of DA's Bureau of Fisheries and Aquatic Resources (BFAR), although, in principle, small scale and near shore fisheries are supposed to be under municipal control. The Department of Agrarian Reform (DAR) is carrying out a Comprehensive Agrarian Reform Program (CARP) since 1988, on all private agricultural lands, regardless of tenure or commodity produced, as well as for selected lands in the public domain.

The NPFP prepared by NLUC reflects the importance of physical planning in the Country's overall planning system. It responds to the urgent need for rational land use and physical development. It proposes a multisectoral policy agenda that will guide land use activities, settlement patterns, environmental management and development of the Country's physical resources within 1993-2022.

In line with the NPFP, the Regional Physical Framework Plan (RPFP) is in preparation in each region by the respective Regional Development Council (RDC). It will set out the land use policies and determine the appropriate spatial arrangements of land use activities in the region, covering a fairly long term period (1993-2022).

Integrated land use planning is a recent phenomenon in the Philippines and linkages between various planning levels as well as development of land use plans at the provincial and municipal levels have not been completed yet. Issues concerning institutional development of local governmental units (LGUs) as well as land development councils at different planning levels are critical issues that need to be urgently addressed.

(2) Environment

The Philippine Environmental Policy was declared under the Presidential Decree No. 1151 on June 6, 1977. The Medium Term Environmental and Natural Resources Sector Development Plan (1993-1998) for Central Luzon was established by the RDC. This regional environmental plan is systematically drawn in order that specific targets can be defined for a short term period. This allows planning and decision making to reach immediate end results.

In line with the process of decentralization as per the mandate of the Local Government Code (1992), DENR Region III has drawn up plans for streamlining operations in the region, for strengthening of field operations by decentralizing functions of the regional office.

DENR is the primary governmental agency responsible for sustainable development of natural resources and ecosystems. DENR is composed of the central, regional, provincial and town level offices. At the provincial level in each region, the Community Environment and Natural Resources Office (CENRO) established under and by DENR, and the Provincial

Environment and Natural Resource Office (PENRO) under the provincial government have been established. There are 13 CENRO offices in Central Luzon.

1.3 Environmental Standards and Regulations

Ambient and effluent environmental standards are established by the Central Government. Ambient air quality standards, emission gas standards, surface water quality standards, efficient water quality standards and standards for ambient noise quality are well defined.

The Government established the "National Integrated Protected Area System (NIPAS)" in 1992. The NIPAS defines areas in the Country which need to be protected by cooperation among national and local governments, and private organizations. Figure 1.1 shows the location of conservation areas in Central Luzon. Guidelines and procedures for Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) of development projects are also well established.

CHAPTER 1

TABLES

Table 1.1 Status of Land Classification by Province, 1991 (Area in Ha.)

Province	Total Area	Certified A & D	CLASSIFIED FOREST LAND							Unclassified Forest
			Established for Resettlement	Established Timberland	National Park GRBS/WA	Military & Naval Reservation	Civil Reservation	Fishpond	Total	
Philippines	30,000,000	14,117,729	3,272,912	10,015,381	1,340,997	130,330	165,946	75,548	15,001,114	
Region III	1,823,082	1,051,908	166,104	422,729	32,780	117,019	804	4,864	744,300	26,874
Bataan	137,296	69,325	9,284	33,020	25,188	479	0	0	67,971	0
Bulacan	262,500	185,333	8,019	64,890	368	0	0	3,476	76,753	414
Nueva Ecija	528,433	330,985	84,500	31,679	3,504	63,900	139	0	183,722	1,376
Pampanga	218,068	164,912	12,484	16,777	3,709	7,452	0	0	40,422	12,734
Tarlac	305,345	184,975	0	83,115	2	36,588	665	0	120,370	0
Zambales	371,440	116,378	51,817	193,248	9	8,600	0	1,388	255,062	0

Province	Total Area	Certified A & D	CLASSIFIED FOREST LAND							Unclassified Forest Land
			Established for Resettlement	Established Timberland	National Park GRBS/WA	Military & Naval Reservation	Civil Reservation	Fishpond	Total	
		%	%	%	%	%	%	%	%	%
Philippines	100.00	47.06	10.91	33.38	4.47	0.43	0.55	0.25	50.00	
Region III	100.00	57.70	9.11	23.19	1.80	6.42	0.04	0.27	40.83	1.47
Bataan	100.00	50.49	6.76	24.05	18.35	0.35	0.00	0.00	49.51	0.00
Bulacan	100.00	70.60	3.05	24.72	0.14	0.00	0.00	1.32	29.24	0.16
Nueva Ecija	100.00	62.64	15.99	5.99	0.66	12.09	0.03	0.00	34.77	0.26
Pampanga	100.00	75.62	5.72	7.69	1.70	3.42	0.00	0.00	18.54	5.84
Tarlac	100.00	60.58	0.00	27.22	0.00	11.98	0.22	0.00	39.42	0.00
Zambales	100.00	31.33	13.95	52.03	0.00	2.32	0.00	0.37	68.67	0.00

SOURCE: Department of Environmental and Natural Resources Statistical Profile (13)

CHAPTER 1

FIGURES

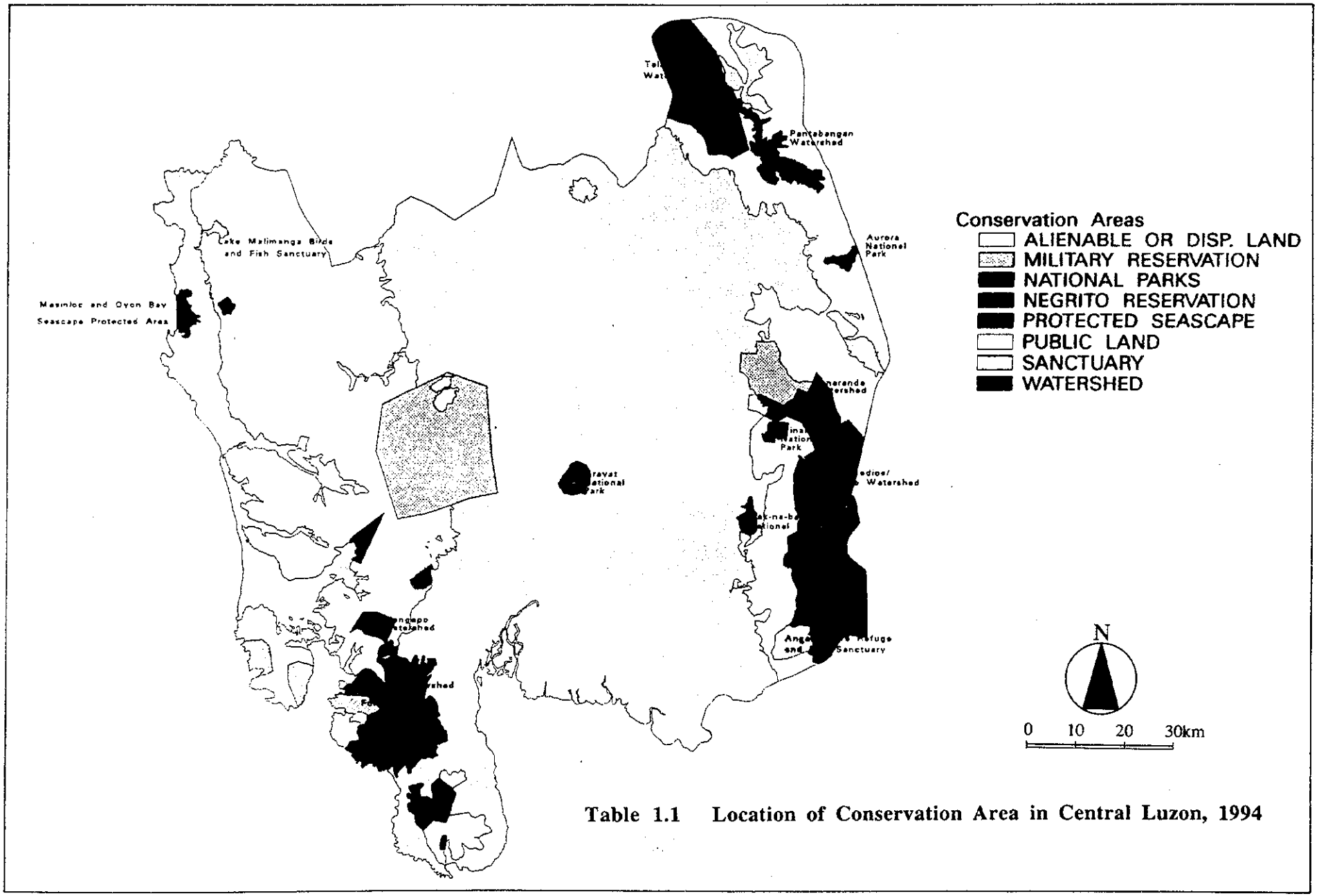


Table 1.1 Location of Conservation Area in Central Luzon, 1994

CHAPTER 2

CHAPTER 2 EXISTING CONDITIONS, PROBLEMS AND ISSUES

Several documents and maps (reference nos. 3, 4, 9, 13, 16) are available which comprehensively document the natural resources and ecological profile of Central Luzon. Some environmental data of Central Luzon are summarized in Appendix A. A comprehensive digital database and resources atlas of the region (Map Book) has also been prepared using a geographic information system (GIS) by the JICA Study Team. The present chapter therefore focuses on detailing out existing environmental problems and their underlying causes and constraints.

Existing conditions, problems and issues in Central Luzon are discussed under three broad categories: natural disaster related, economic and other human activities related, and organizational issues related.

2.1 Natural Disaster Related Issues

Central Luzon is a disaster prone area (Table 2.1). In addition to habitual typhoons and flooding, it suffered recently from a major earthquake and the Mt. Pinatubo volcano eruption.

(1) Mt. Pinatubo eruption

According to the Mt. Pinatubo Interim Action Plan (US Army Crop of Engineers, 1993), pyroclastic materials generated by Mt. Pinatubo were about 8 million m^3. Ash fall covered 550,000 ha (ADB Report of the Task Force on the damage caused by the eruption of Mt. Pinatubo and proposed rehabilitation/restoration measures, 1991). It is estimated by the US Army Corp of Engineers that 25% of the pyroclastic deposit will erode during the next three years, and upto 50% during the next 10 years.

The eruption and subsequent lahar hazard caused 32,000 rural families and 192,000 persons to be evacuated and resettled in some 300 evacuation centers. Damages to agriculture are estimated at 385,000 ha productive area and $230 million.

(2) Earthquake

A major earthquake hit Northern Luzon in 1990. It caused widespread damages to infrastructure and human lives in Central Luzon directly, and also through land slides, erosion and aggravated health and sanitary conditions, although the region itself is not identified as earthquake-prone.

(3) Typhoons

During the period 1980-90, a total of 213 typhoons crossed the Philippines affecting over 25 million persons and resulting in 5,952 deaths, about 14,000 missing or injured, and environmental and property damages of ₱45 million. In Central Luzon, the damages tend to be aggravated by lahar and flooding.

(4) Floods

Flood prone areas in Central Luzon cover 4,321 km^2, including 405 km^2 of urban centers and rural settlements. The massive deposits of lahar in Pampanga, Tarlac and Zambales make flooding and damages to be aggravated.

(5) Droughts

During 1982-90, three major droughts affected some parts of the Philippines. They affected 22,700 farmers and a total of 987,000 ha of agricultural lands, and caused damages to production amounting to over ₱763 million. Central Luzon, however, is not among the seriously affected.

(6) Land cover after Mt. Pinatubo eruption

In view of the calamity struck status of Central Luzon, it was determined necessary to update existing land use data. A current land use and land cover map covering broad land cover categories was prepared by interpretation of 1993 Landsat TM satellite imageries along with limited field surveys. Existing land use data of the region, indicating several agricultural land use sub-classes available for the period before the Mount Pinatubo eruption, was updated using subsequent land cover data, mainly with respect to pyroclastic deposits and lahar affected areas upto 1993. A GIS was used to put together the comprehensive land use and land cover data.

Agricultural areas account for 35.6% of the total area of Central Luzon. Grasslands/shrub land areas cover 32.5%, woodlands areas (all kinds of forests - both virgin and residual) 18.8%, wetland areas 3.0%, and miscellaneous land use including built-up areas, water bodies, roads and rivers 7.1% (Figure 2.1 and Table 2.2).

The Mt. Pinatubo derived pyroclastic material and lahar covers 52,322 ha or 2.91% of the total area of Central Luzon. Of this, 17,933 ha are covered grassland/shrub land areas and 19,012 ha are covered agricultural areas. Zambales, Tarlac and Pampanga were most affected by the lahar flow.

2.2 Economic and Human Activities Related Issues

2.2.1 Population pressure

(1) Migration to uplands and land degradation

Central Luzon's population of 3,615,496 in 1970 was 9.85% of the national population. This roughly doubled to 6,198,829 persons twenty years later when the proportion of the region's population to the Country's increased to 10.2%. In all the censal years of 1970, 1975, 1980 and 1990, Central Luzon's population ranked third after Region IV and NCR (Metro Manila). In 1975, Central Luzon had the second highest density among the 12 regions.

This rapid increase in population has exerted significant pressure on land resources for both subsistence and commercial needs. The rapid population growth, resulting diminution of unoccupied lowland arable land, inequitable land distribution and landlessness, and general impoverishment have created a pressure for migration. Because of the availability of semi-cleared land in the uplands on which immigrants can build a better livelihood, the direction of migration is to the uplands, as well as to urban areas.

Shifting cultivation called 'kaingin' in the Philippines is employed by immigrating farmers because it minimizes labor and cash input requirements, by substituting land for labor and fertilizer. Shifting cultivation can be damaging or sustaining according to how it is carried out. With small areas of ground cleared for crops, and long fallow periods between cropping, the system is efficient in terms of labor use, and long term average soil loss need not be excessive. The problem in Central Luzon has been that population pressure on the land has led to large areas being cleared with short fallow periods between the cropping, resulting in the land not recovering during the fallow, and consequently being abandoned for new land.

(2) Upstream watershed - soil erosion

This land degradation results in very high rates of erosion in the upstream area of watersheds, and soil loss and land productivity decrease occur. Undisturbed forest lands are the best soil conservers. With decreasing vegetative cover, soil loss rises exponentially with consequent decrease in land productivity. A combination of high intensity rainfall, steep slopes, erodible soil and poor vegetation cover in "kaigin" plots can lead to soil loss rates 300 to 400 times that for undisturbed forest lands. Figure 2.2 shows the extent of erosion in conservation areas constituting important watersheds in Central Luzon.

(3) Downstream watershed effects

Erosion and unchecked runoff occurring in upstream watersheds result in siltation, alternating flooding and water shortage problems in the downstreams, and reduction in efficiency of water use. In combination, these effects are damaging to water conservation systems in the lowlands, reducing productivity and increasing costs of maintenance and restoration of the irrigation and hydropower systems. Deteriorating productivity in the lowlands in turn contributes to the migration tendencies to urban and upland areas. Thus, the degradation of the uplands due to the widespread use of poor and inappropriate land practices results in very high social costs.

(4) Possibility of increased fertilizer and pesticide use

The quest for meeting rapidly growing food needs with agricultural practices and policies favoring increased use of fertilizers and pesticides also leads to land degradation. Excessive use of chemical fertilizers adversely affects soil fertility and causes degradation in quality of surface water and groundwater. Fertilizer and pesticide use in Central Luzon is relatively low at present. Programs which promote organic farming and natural farming methods need to be the backbone of future agricultural policies rather than those promoting use of chemical fertilizer and pesticides.

(5) Degradation of coastal and near shore fishery areas

Coastlines of Manila Bay consist of coral reefs, seagrass bed areas, mangrove areas, tidal flats and estuary areas. Coral reef areas are located at the mouth of Manila Bay including Coregidor islands. The total mangrove area of Manila Bay is 1,260 ha, consisting of 220 ha in Bataan, 748 ha in Pampanga, and 294 ha in Bulacan (Manila Bay Environmental Profile, Region III). Tidal flats in Manila Bay occupy some 2,500 ha. The largest one is Bangkong Malaped in Sasman, Pampanga which has become shallower by deposits of volcanic materials from the Porac-Guman river via the Pasong river.

Excessive population pressure has also resulted in degradation of coastal and near-shore fisheries areas of Central Luzon, which like the uplands are an open access public resource. Impoverished coastal populations tend to use non-sustainable fishing methods in the near shore (municipal) fishing areas. Overfishing is another cause. Competition between commercial fisheries (mainly larger boats, supposed to keep well off-shore) and the small scale municipal fisheries in the near shore areas is also severe.

Accelerated cutting of mangrove forests for fuelwood needs and subsequent conversion to brackish fishing of these areas, as well as destruction of coral reefs due to commercial exploitation and improper fishing techniques, are major causes of coastal area degradation.

Coral reefs and mangroves are important elements in the life cycle of various fish. Near shore habitats are also ecologically linked with the inland and upland areas. Increased water turbidity and reduced light penetration due to soil erosion reduce growth and even kill off shore coral reefs and sea weed beds. Destruction of coastal mangrove forests opens interior areas to increased typhoon damages.

(6) Central Luzon - 'food bowl' of the Philippines

Further increase in regional population (projected to be over 10 million in 2010) along with Central Luzon being the "food bowl" of the Country imposes the need for even more intensified use of available land resources to meet regional and national food requirements.

2.2.2 Deforestation

(1) Recent changes

Provinces of Central Luzon were extensively covered with verdant dipterocarp forests (one of the three main tropical forest types) until the early 1970s. Extensive logging operations, illegal cutting of trees for fuelwood and charcoal, and upland farming as well as "kaingin" have intensified thereafter. Together with forest fires, erosion, grazing, pests and diseases, and most recently natural disasters like the eruption of Mt. Pinatubo and subsequent lahar and mudflow, virgin dipterocarp forests in the region have been almost completely lost.

In Bataan, only 900 ha of virgin forests and residual forests of 23,600 ha are available. Bulacan has 14,800 ha of virgin forests and 30,700 ha of second growth forests. Nueva Ecija has only 5,200 ha of old dipterocarp forests. The area of forest lands in Nueva Ecija decreased by 30,000 ha, from 103,600 ha to 73,600 ha in a span of 12 years (1969-1981). The area of virgin forests was reduced from 46,200 ha in 1969 to 13,400 ha in 1981, equivalent to 2,700 ha per year, and as of 1990, the remaining virgin and second growth forests area is about 39,600 ha.

Pampanga's remnants of the once virgin forests are small and can be found in the mountainous area of Porac and the non-commercial forest of Mt. Arayat. The recent eruptions of Mt. Pinatubo destroyed part of the remaining forests of the province especially in Porac. In Tarlac, only 3,300 ha of virgin forests and 31,600 ha of residual forest area remained in 1990.

In 1987, the total area under forest cover (both virgin and residual dipterocarp, pine, sub-marginal, mossy and mangrove forests) was 239,651 ha or 13.2% of the total area. In 1992, this decreased to 215,400 ha or 11.8% of the total area. Brush or grass/shrub lands also decreased from 79,991 ha (4.39%) in 1987 to 68,700 ha (3.77%) in 1992. It is clear that

most of the deforestation in Central Luzon occurred prior to 1987 (in the period 1969-1981 in particular).

(2) Constraints and limitations in development of forestry products

Central Luzon is in short supply of all the forestry products, including fuel wood, lumber, poles, plywood and firebrand, bamboo and rattan. The situation may get worse in the next decades except bamboo (Table 2.3).

The fuel requirements of the population will put much pressure in the management and conservation of existing and newly planted forests. This may be the most serious problem from an environmental viewpoint. Fuelwood is thought to account for 70% of all wood used, and about one third of all commercial and non-commercial energy consumed (or roughly equivalent to total oil consumption). This large scale consumption is fostered in part by the low cost of fuelwood relative to most other energy sources - as low as a ratio of 1:4 for the same energy level.

Lumber supply from Central Luzon is nil because of the imposition of logging ban in the area. The need for lumber has to be met from Regions II, IV and VIII where the region's sawmill owners have obtained log supply contracts. Because of the limited timber stand of the region as the forests are mostly very poor secondary growth, and because of the increasing population and demand of the wood-based industries, the need for wood and wood products is great and increasing.

Poles are in great demand for the electrification program of the Government mainly in rural areas. Imported poles are too expensive to procure.

Non-wood based products - bamboo and rattan have important uses in Central Luzon. Bamboo has many different uses for construction, furniture, handicraft, pulp, food and many more. A total of 103, 272,000 poles are needed in the next 25 years and the supply may be expanded to 180,326,000 poles leaving a surplus of 77,000,000 poles. To achieve this, the bamboo plantation area will have to increase from 674 ha in 1990 to 16,162 ha in 2015.

Rattan has varied uses especially for making furniture and handicraft because of its flexibility, resilience and aesthetic quality. In the Philippines, export of rattan in its raw form is banned and only finished products can be exported. In 1990, rattan plantation establishments were carried out in the secondary growth forests of Bulacan (225 ha), Pampanga (557 ha) and Zambales (2 ha). Towards this end, the region has envisioned to establish 11,817 ha within the next 25 years in the six provinces to produce 51.4 million poles. This will partially meet the expected demand of 673 million poles until 2015.

(3) Market and policy failures

Market and policy failures in the past decades, such as under pricing of resources and input subsidies combined with population pressures have led to over-exploitation of land, forest and coastal resources, and discouraged interest in reforestation, plantation forestry, conservation farming and appropriate fishing practices. Failure of both the timber pricing system and the logging concession system practiced in the period 1970-1990 has resulted in virtual extinction of primary forest resources in Central Luzon, leaving large areas of grasslands or poorly vegetated secondary growth forests. Government charges and potential rents from the forestry sector in the years 1979 to 1981 for the entire Philippines (percentage of charges to rent are less than 17.4%) are clearly indicative of the market and policy failures in the forestry sector. Deforestation further impoverishes rural populations dependent on nearby forests for their basic needs including non-wood products like protein and shelter, fuelwood and fodder.

2.2.3 Land tenure issues

Land tenure includes the formal (state recognized) and informal (customary) rights of access to land, the rights to control products of the land, obligations to maintain the land, the rights of transfer, and the rights to determine changes in the use of that land. Land tenure problems in Central Luzon can be classified into two types: land tenure problems in A & D lands and land tenure problems in public forest lands (forested and unforested).

(1) Land tenure issues in A & D lands

In A& D lands, dominance of the market by traders/usurers who control credit and post-harvest facilities, and keep farm commodity prices suppressed, is a major factor in Central Luzon for widespread poverty and lack of capital accumulation for majority of farmers. Further, some farmers face the risk of losing their farmlands by default to usurers, furthering the inequitable land tenure situation. Thus in A & D lands, land ownership alone is not enough in inducing farmers to adopting conservation oriented investments. In such a situation, unless land tenure reform is accompanied by asset reform (access to capital, post-harvest facilities and market), farmers will have no incentive to make conservation-oriented investments and existing problems of land degradation will only worsen.

(2) Land tenure issues in forest lands

Land tenure situation in forest lands (by definition all lands having more than 18% slope) are even more insecure and problematic. By legal land classification, all forest lands belong to the State. Tenure rights in public forest land (recognized and issued by the Central Government) are very restrictive and of temporary nature such as the certified stewardship

contract (CSC). The Constitution restricts leaseholds on public land to terms of 25 years, renewable up to 50 years. In reality, the definition of the terms of CSC and similar leases falls within the administrative discretion of DENR. Thus, upland communities in the absence of secure, transferable or bankable land ownership titles have limited access to credit and extension support. This in turn results in minimal investment of cash inputs and lack of incentive and information in adopting appropriate sustainable cultivation practices.

Another major problem in forest lands is the problem of illegal tenancies. Tenancies based on landlord claim to ownership of public land established through tax declarations are already prevalent, and instances where CSCs have been extended to pseudo-landlords rather than land occupants have been reported. Such land claims are unrecognized under national law, although recognized by local governments (as they can be an important source of tax revenue), local courts, and even local banks. As a result, they are not subject to restrictions on land holding size under Republic Act No. 6657 or prohibitions of share rental forms of tenancy under national law. The existence of such potentially-conflicting claims is a formidable obstacle to programs aiming at improved land use practices.

Cultivators in forest lands covering large proportions of forested and unforested lands include ethnic minorities such as the Aetas who have a long standing land use tradition and informal tenure based on ancestral rights, settlers, and recent migrants on newly cleared land. Fulfilling basic subsistence needs through cultivation is the first priority of these communities. Resolving land tenure and ownership issues as well as development and information dissemination of location-specific technologies for cultivation in uplands and steep slope areas is very important.

(3) Forest occupants and land use permits in forest lands

Forest lands under the management of DENR can be leased out to the private sector or individuals for exploitation, for instance under the DENR's Integrated Social Forestry (ISF) program or the logging concession program, through issue of CSCs and, permit or license agreements, not exceeding 25 years (renewable for an additional 25 years). DENR is responsible for providing CSCs, permits or license agreements.

The total number of CSCs awarded under the ISF program in Central Luzon was 13,607 until 1992 covering an area of 25,053 ha. The number of rattan cutting permits issued were only four, but the area coverage was 76,670 ha. Pasture lease/permits issued in 1992 were 75 in all covering an area of 28,210 ha. Official DENR figures indicate forest occupants to be 76,369 in all as of 1989 and the number of farmlots within the forest lands were 16,041 covering an area of 40,459 ha. Nueva Ecija, Bataan and Bulacan together account for almost 80% of the total forest occupants in Central Luzon. For grazing, 81 permits were issued

covering an area of 31,800 ha, led by Zambales covering 17,545 ha and Nueva Ecija 9,612 ha.

Population figures and estimations in uplands (uplands unless otherwise stated in this report are all lands having slope greater than 8 % and hence may include both A & D lands and forest lands) in a World Bank Study Report (reference no. 18), are much larger than those disclosed by DENR given above (605,556 in 1980 and estimated 1,036,000 in 1988). The statistics indicate 34 municipalities to be classified in the upland zone in Central Luzon of which 17 were in the forest zone in 1980. The apparent extremely large discrepancy in the population figures in uplands highlights the large number of land tenure problems in these areas, with government census of forest occupants only indicating or including perhaps the population which has some sort of permit or licensing arrangements with DENR.

2.2.4 Air pollution

Table 2.4 summarizes air pollution sources in Central Luzon. Major sources of air pollution may be classified into stationary sources (industrial) and mobile sources (vehicles). The main source of air pollution in Central Luzon other than vehicles, is cement factories in Bulacan (three factories of Norzagaray and one of Akle). Due to their location on the hill side, however, effects of the air pollution on local residents are limited.

2.2.5 Water pollution

(1) Water pollution in rivers

Major pollution sources of the Pampanga and other rivers in Central Luzon are identified as follows:

- Solid waste open dumps in and along rivers by residents and local governments,
- Piggeries and poultry farming,
- Sedimentation caused by soil erosion,
- Domestic wastewater,
- Industrial effluents from alcohol plants, tanneries and others, and
- Chemicals used in fish ponds and agriculture.

The alcohol plant in Apalit discharges wastewater containing high concentration of organic matters (BOD of 45,000-55,000 mg/l) directly in the Pampanga river. Tanneries in Bulacan discharge their wastewater into the Meycauayan and Marilao rivers.

(2) Coastal water pollution

Oil balls are observed along the coast of Bataan. Red tide was observed first in Central Luzon in 1987 in the Subic Bay and Masinloc. Shellfish poisoning by red tide at that time killed 20 persons. The first reported red tide in the Manila Bay was in 1988. Occurrence of red tide thereafter is most frequent in the Manila Bay and Masinloc.

2.2.6 Solid waste management

Solid waste disposal methods in Central Luzon are rudimentary. Poorly managed open dump sites are common in urban municipalities and cities. Table 2.5 classifies the households in Central Luzon in terms of garbage disposal methods adopted by them. Garbage is hardly ever composted or used as animal feed.

2.3 Organizational Issues

(1) General issues

The most significant organizational issues are a direct result of inappropriate mandates, resource limitations, confusion arising from reorganization, potential for corruption of the line agencies charged with managing land resources, and ineffectiveness of local government units and user groups. Public institutions devoted to land and natural resources management have directly contributed to unsustainable practices in agriculture, forestry, and degradation of habitats in protected areas. In agriculture, examples are irrigation authorities with a bias towards investment over management, and agricultural institutions largely neglecting training and extension services for upland communities, and research and development of conservation oriented upland cultivation practices and models.

(2) Issues in forestry sector

The World Bank Study (reference no. 18) demarcates forestry issues in the Philippines and Central Luzon which are summarized below. In the forestry sector, DENR in the past tended to be a regulatory agency and tended to manage forests as a source of raw materials for large industry. Their emphasis was on revenue maximization, enforcing technical regulations on loggers, collecting licensing fees, and preventing people from trespassing. DENR in the past has tended to view the management of public forest land as its exclusive responsibility, and has been unwilling to recognize ancestral rights of indigenous Filipinos, nor include upland communities adequately in management of land resources in upland areas. DENR has made very limited effort in the past to embark into new areas of forest management as involving local people in managing forests, mediating in conflicting demands between agriculture, industry, and ecological needs, or conducting research in sustainable forestry practices. In

the Philippines, attempts to improve forestry management by a proliferation of legislation have not been very effective and in many instances, often been counter productive, putting unintended obstacles in the way of responsible private investment, rights of forest dwellers and local people like the Aetas, and activities of NGOs. Research and adoption of new technologies in forestry lag far behind agriculture. Forestry policies are largely based on inadequate understanding of forest ecosystems, and of exclusion of local communities living in or adjacent to forest lands, which are predominantly state owned. DENR is not equipped to provide the range of services required under its current mandate, especially in meeting the needs of upland communities.

(3) Neglect of agricultural development in uplands and steep lands

DA, although long developmental in orientation has concentrated in the lowlands and largely lacks the expertise, staff, travel budget, transport and communication equipment, required to contribute to agricultural development in uplands or steep lands, as well as in coastal areas.

(4) Necessity for provision of local revenue base

Power and authority in the Philippines are concentrated at the apex of the administrative hierarchy. Ongoing government reorganization in line with the 1991 Local Government Code is a positive development. This has involved a commitment to regionalized management of line agencies, increased empowerment of local governments, and improved collaboration between governments and NGOs. At present, local governments are at a crossroad of steering towards greater local autonomy and decentralization while, at the same time, assuming increasing roles in national development and increasingly complex responsibilities in the delivery of basic services. This empowerment of local governments needs to be followed up by the provision of a local revenue base also.

(5) Protected areas management

Agencies charged with managing parks and protected areas are hampered by weak legal frameworks, extremely limited operational capabilities and political influence, insufficient prestige to resolve local conflicts, inadequate financial resources and inadequately trained staff.

(6) Lack of involvement of local population

Limitations of the "top down" approach being the cause of failure in implementation of land conservation programmes and projects are slowly being recognized. Local farming communities (in A & D lands and forest-lands) need to be involved right from the very earliest stages, first to establish their aims, objectives and aspirations, and then to plan jointly

from the beginning measurs to achieve their objectives, not those of experts or planners. Throughout the implementation of the programme it is essential for all the players to fully understand and support the objectives, to avoid the old situation of reluctant participation in a programme which they did not really understand. Local communities need to be involved in the protection and productive use of the forest lands, and any development process which fails to recognize this is bound to fail.

The importance of the role of women in agriculture and land resources management needs to be appreciated. Women are also involved in planting and cultivation of crops. Extension work may be more effective by using more women extension workers, or by targeting groups of women farmers.

CHAPTER 2

TABLES

Table 2.1 Major Natural Disasters in Central Luzon, 1981 - 1991

Year	Natural Disaster/Calamity	Date
1981	Typhoon (Anding)	November 22 - 27
1982	–	–
1983	Drought	January – March
	Typhoon (Bebeng)	July 14 – 16
1984	–	–
1985	Typhoon (Sailing)	October 15 – 20
1986	Typhoon (Gading)	July 6 – 10
1987	Drought	January – March
1988	Typhoon (Unsang)	October 21 – 26
1989	Typhoon (Goring)	July 14 – 17
	Typhoon (Sailing)	October 9 – 10
1990	Drought	January – April
	Earthquake	July 16
	Typhoon (Iliang)	August 28 – 30
1991	Volcanic Eruption	June 12 – 15
	(Mt. Pinatubo)	

Table 2.2 Existing Land Use (1993)

CODE	N_ECIJA	TARLAC	ZAMBALES	PAMPANGA	BULACAN	BATAAN	REGION 3
Paddy rice irrigated	150,802	73,626	5,170	36,667	44,076	13,707	324,047
Paddy rice non irrigated	83,301	29,117	28,882	41,820	43,029	4,329	230,477
Upland rice	0	0	334	0	0	0	334
Corn	0	0	553	0	290	0	843
Dry season diversified & upland crops							
Vegetable crops	2,782	7,571	3,382	0	29	0	13,765
Industrial crops	3,775	26,909	1,773	34,426	247	2,866	69,996
Tree crops	49	0	698	0	674	256	1,676
Grasslands/shrublands	147,210	69,493	242,513	18,045	38,358	70,341	585,961
Forest or woodlands	103,142	65,446	36,483	16,454	85,992	30,824	338,341
Wetland areas							
Mangrove areas	0	0	819	126	905	0	1,850
Fishponds	0	0	1,325	20,628	24,350	2,999	49,303
Swamp, marshland, nipa	2,267	263	81	1,118	0	0	3,727
Miscellaneous							
Built-up areas & industrial sites	14,403	7,415	6,863	11,813	23,383	2,490	66,367
Others (beach sand, quarry, riverwash, river, lakes, water bodies, rockland, gorge)	30,114	12,057	12,464	2,704	3,596	772	61,707
Lahar covered areas (till 1993)	41	11,550	23,964	16,546	0	222	52,322
TOTAL	537,885	303,446	365,302	200,347	264,930	128,807	1,800,716
Paddy rice irrigated	28.04%	24.26%	1.42%	18.30%	16.64%	10.64%	18.00%
Paddy rice non irrigated	15.49%	9.60%	7.91%	20.87%	16.24%	3.36%	12.80%
Upland rice	0.00%	0.00%	0.09%	0.00%	0.00%	0.00%	0.02%
Corn	0.00%	0.00%	0.15%	0.00%	0.11%	0.00%	0.05%
Dry season diversified & upland crops							
Vegetable crops	0.52%	2.50%	0.93%	0.00%	0.01%	0.00%	0.76%
Industrial crops	0.70%	8.87%	0.49%	17.18%	0.09%	2.23%	3.89%
Tree crops	0.01%	0.00%	0.19%	0.00%	0.25%	0.20%	0.09%
Grasslands/shrublands	27.37%	22.90%	66.39%	9.01%	14.48%	54.61%	32.54%
Forest or woodlands	19.18%	21.57%	9.99%	8.21%	32.46%	23.93%	18.79%
Wetland areas							
Mangrove areas	0.00%	0.00%	0.22%	0.06%	0.34%	0.00%	0.10%
Fishponds	0.00%	0.00%	0.36%	10.30%	9.19%	2.33%	2.74%
Swamp, marshland, nipa	0.42%	0.09%	0.02%	0.56%	0.00%	0.00%	0.21%
Miscellaneous							
Built-up areas & industrial sites	2.68%	2.44%	1.88%	5.90%	8.83%	1.93%	3.69%
Others (beach sand, quarry, riverwash, river, lakes, water bodies, rockland, gorge)	5.60%	3.97%	3.41%	1.35%	1.36%	0.60%	3.43%
Lahar covered areas (till 1993)	0.01%	3.81%	6.56%	8.26%	0.00%	0.17%	2.91%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: GIS database of present study.

Table 2.3 Demand and Supply Balance of Wood Products Based on Per Capita From 1991 - 2015 at 5-Year Intervals ('000 cu.m.)

	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	Total
1) Fuel wood						
Demand	18,290.00	20,368.00	22,494.00	24,846.00	27,450.00	113,448.00
Supply	3,500.82	4,281.13	5,505.42	6,891.49	8,801.79	28,980.65
Balance	-14,789.15	-16,086.75	-16,988.00	-17,954.49	-18,780.59	-84,598.98
2) Lumber						
Demand	463.60	510.60	562.40	619.60	682.80	2,839.00
Supply	0.00	207.00	15.00	260.90	552.80	1,035.70
Balance	-463.60	-303.60	-547.40	-358.70	-130.00	-1,803.30
3) Poles						
Demand	3,282.20	5,879.50	6,448.80	7,073.90	7,791.10	30,475.50
Supply	0.00	27.50	17.40	31.00	39.90	115.80
Balance	-5,282.20	-5,652.00	-6,421.40	-7,042.90	-7,721.20	-32,119.70
4) Plywood and fiberband						
Demand	618.30	198.10	217.90	239.90	264.10	1,538.30
Supply	0.00	0.00	0.00	0.00	0.00	0.00
Balance	-618.00	-198.10	-217.90	-239.90	-264.10	-1,538.00
5) Bamboo						
Demand	16,687.00	18,463.47	20,437.00	22,626.97	25,057.76	103,272.20
Supply	1,667.80	11,559.60	35,221.80	54,934.50	76,942.20	180,325.90
Balance	-15,019.20	-6,904.00	14,784.80	32,307.70	51,884.40	77,053.70
6) Rattan						
Demand	109,926.00	121,033.60	133,313.00	146,878.80	161,870.10	673,021.50
Supply	5,181.00	5,183.00	7,019.20	13,743.20	21,945.20	53,071.60
Balance	-104,743.00	-115,850.60	-126,293.80	-133,135.60	-139,924.90	-619,947.90

Source: Forestry Master Plan, Department of Environment and Natural Resources, 1993

Table 2.4 Sources of Air Pollution in Central Luzon

Stationary Sources (Industrial)		
No. of Air Pollutant Firms	-	625
No. of Firm with APCD		
with permit to operate	-	449
without permit to operate	-	175
No. of firms without APCD	-	63
Percentage Compliance by Industries To Pollutant Control Requirements		
(%) Firms fully complying (within standard)	-	80.9 %
(%) Firms partially complying	-	8.8 %
(%) Firms not complying	-	10.3 %

Mobile Sources (Motor Vehicle)

Registered vehicles

Year	1986	1987	1988	1989	1990	1991	1992	1993
Number of Motor Vehicles	157,020	161,509	171,537	186,695	197,313	199,473	207,474	228,855
Average Annual Growth Rate			5.5%					

APCD: Air Pollution Control Device
Source: Statistical Profile, Region III, DENR, 1992

Table 2.5 Classification of Households by Usual Means of Garbage Disposal, 1990

Province	Total Household	Picked up by Garbage Truck	Dumping in Individual Pit (not burned)	Burning	Composing (Later Used as Fertilizer)	Burying	Feeding to Animals	Others
Region III	1,163,205	134,202	118,288	802,508	21,065	41,644	22,401	23,097
Bataan	81,343	12,054	9,969	46,934	846	2,210	2,175	7,155
Bulacan	287,890	25,003	22,030	219,839	3,362	7,114	4,049	6,493
Nueva Ecija	250,978	12,959	21,912	199,526	4,701	8,862	2,065	953
Pampanga	268,007	39,590	31,224	168,218	5,335	12,282	5,247	6,111
Tarlac	159,344	8,606	21,115	111,527	5,117	6,200	5,194	1,585
Zambales	115,643	35,990	12,038	45,464	1,704	4,976	3,671	800

Source: 1990 Census of Population and Housing, National Statistics Office

CHAPTER 2

FIGURES

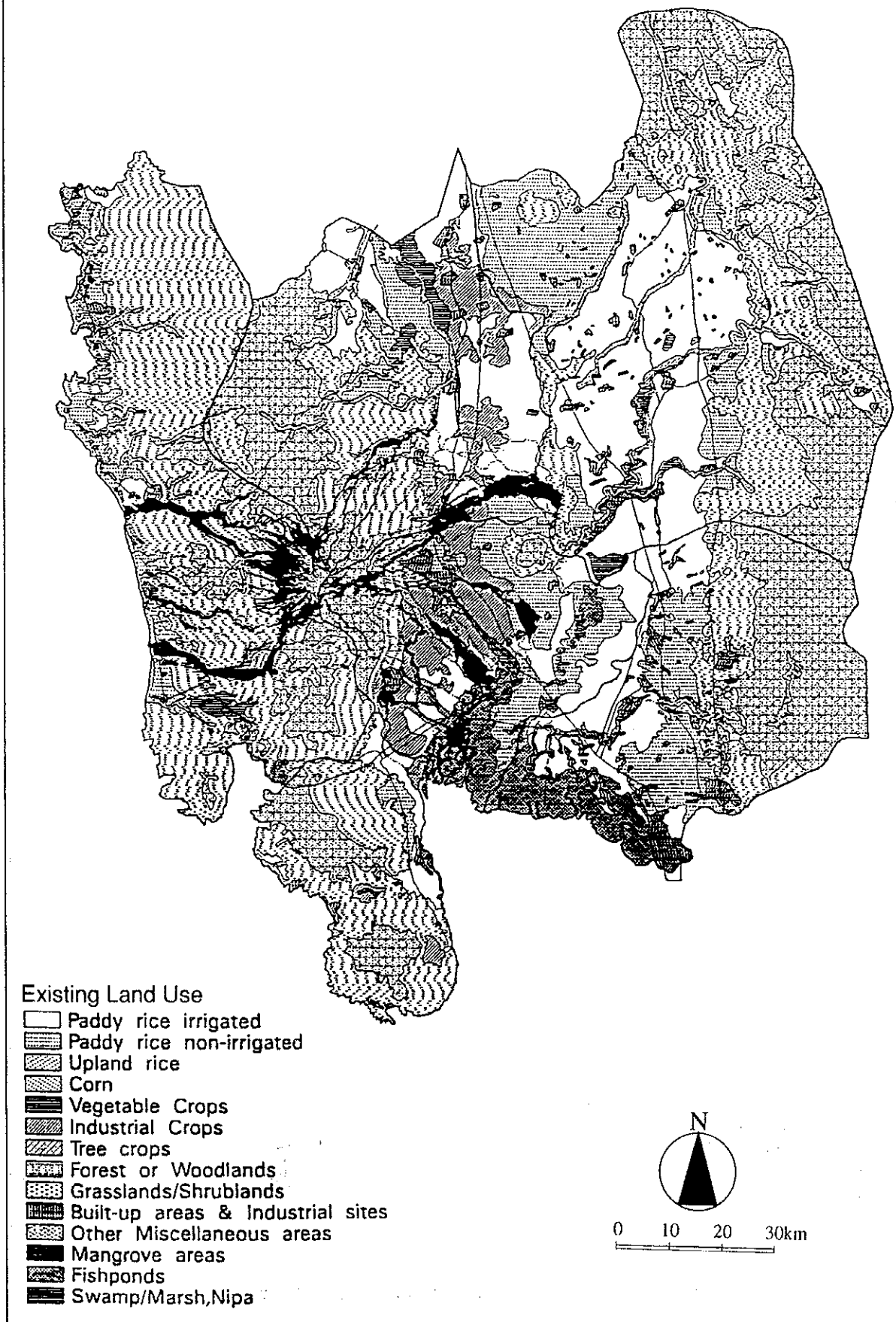


Figure 2.1 Existing Land Use and Land Cover (1993)

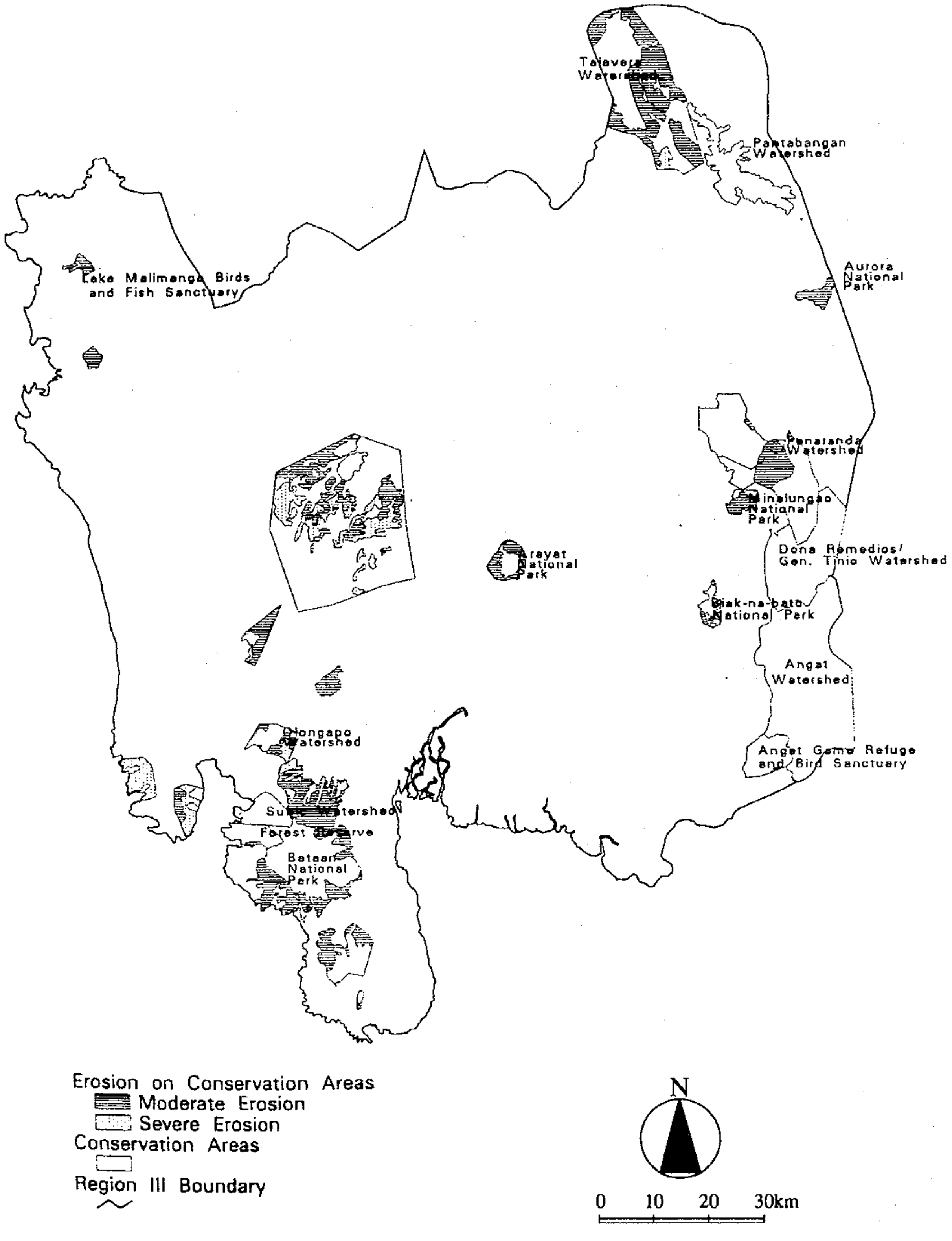


Figure 2.2 Erosion in Consetvation Areas

CHAPTER 3

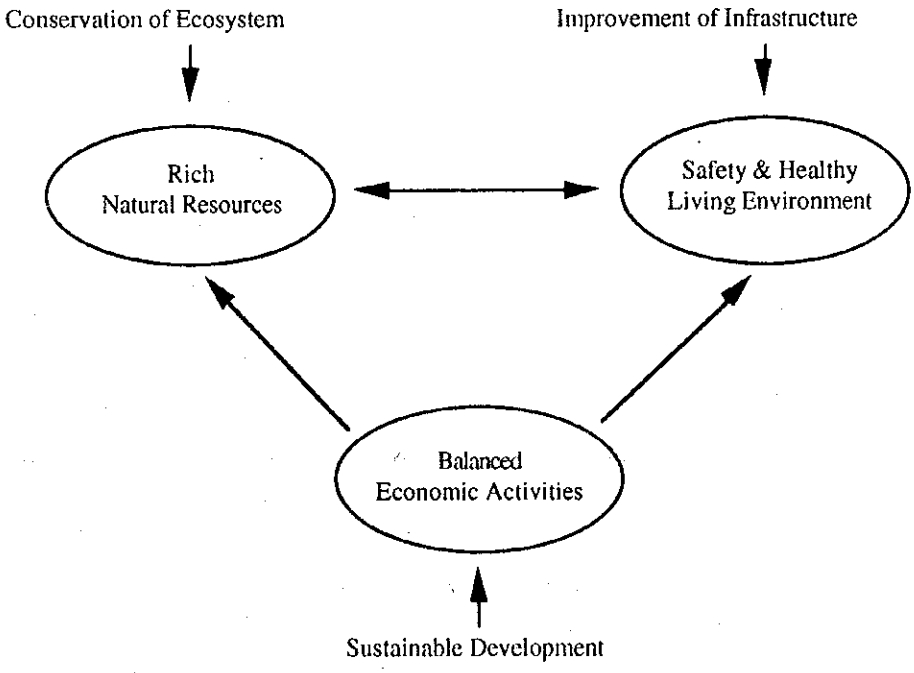
CHAPTER 3 ENVIRONMENTAL DEVELOPMENT AND MANAGEMENT PLAN

3.1 Vision and Directions for Environmental Development

3.1.1 Vision for environmental development

Environmental quality is an essential part of the CLDP paradigm. A basic principle of the paradigm is the growth within resources or environmental capacity. Another principle is the community-based resource management. Degrading environmental quality, therefore, signifies that the environmental capacity is exceeded and/or the community-based resource management has not been effected.

Two directions for environmental development are (1) to enhance the environmental capacity, and (2) to ensure the use of environmental quality for the benefit of local people and communities. The first is related primarily to enriching and conserving natural environment. The second means the creation of better living environment with safety, health and comfort. These are linked by various socio-economic activities. The vision for environmental development in Central Luzon seeks a sustainable balance between these three components as illustrated below.



3.1.2 Directions for environmental management

In line with the vision, specific directions to pursue for environmental development and management are clarified as follows. They cover environmental administration, measures to improve the living environment, and environmental management of development.

Environmental administration

The following should be pursued related to environmental administration.

- Clarification/establishment of functions of LGUs at different levels related to environmental management;
- Development of human resources for LGUs;
- Organized technical and financial supports to small and medium enterprises in their efforts to control pollution; and
- Improvement of communication between DENR and the industrial sector, and between DENR and local communities.

Environmental improvement

The following need to be pursued to improve the living environment.

- Conservation/restoration of ecologically sensitive areas;
- Cost effective water pollution control;
- Management of land development and transportation network;
- Appropriate levels and measures for solid waste management; and
- Protection from the effects of natural disasters.

Directions for environmental management of development activities

The following provide aspects to be considered for environmental management of development.

- Enforcement of environmental law and regulations;
- Management of various natural resources to ensure sustainability;
- Effective monitoring of impact on socio-economic, cultural and natural environment; and
- Promotion of environmental awareness.

3.2 Objectives for Environmental Development

3.2.1 Existing environmental policies and objectives

The Government established the Philippines Environmental Policy (Presidential Decree No. 1151, 1977). According to this, the Government aims:

- to create, develop, maintain and improve conditions under which man and nature can thrive in productive and enjoyable harmony with each other,
- to fulfill the social, economic and other requirements of present and future generations of Filipinos, and
- to ensure the attainment of an environmental quality that is conducive to a life of dignity and well-being.

DENR also prepared a medium-term environmental development plan for Cental Luzon, named the Central Luzon Environment and Natural Resources Medium Term Development Plan (1993-1998). This plan aims at sustainability, environmental management and protection, social-equity and poverty alleviation, resources use efficiency and economic growth, institution building and political stability.

3.2.2 Environmental development objectives for CLDP

Environmental objectives for Central Luzon have three dimensions representing economic, social and environmental aspects to support the overall objectives for Central Luzon regional development.

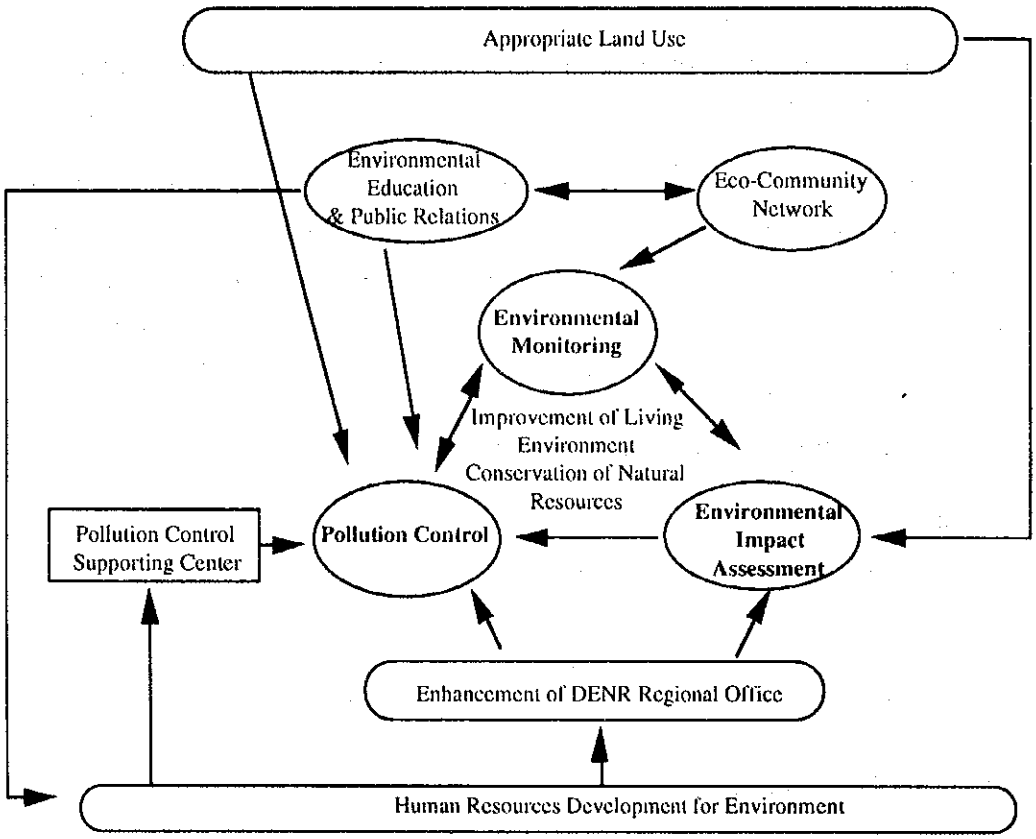
- To support various economic activities by providing a sustainable base of rich, diverse and renewable resources and to promote environmentally sound agro-industrial development;
- To provide safe, healthy and comfortable living environment for local people through community-based approach to natural resources management; and
- To restore and preserve bio-diversity as an inherited asset of human beings and a sort of insurance against unforeseable future changes as well as part of the life support system of people and communities.

3.3 Strategy and Management Measures

Along the directions set for environmental management (subsection 3.1.2), main environmental problems identified (Chapter 2) are addressed collectively in the six areas: (1)

improvement of pollution control enforcement, (2) improvement of living environment, (3) conservation and effective use of natural resources, (4) enhancement of environmental monitoring, (5) promotion of environmental awareness, and (6) strengthening of environmental administration.

Specific strategy and broad measures in each of these areas are discussed below and summarized in Table 3.1. Essential conditions of these strategy and measures are appropriate land use and human resources development. Key elements for these conditions are illustrated below as the structure of environmental management plan. The process of arriving at an appropriate land use plan for Central Luzon is presented comprehensively in Chapter 4.



3.3.1 Pollution control enforcement

Major pollution problems in Central Luzon are caused by effluents and emission gas from industrial plants, and household wastes and wastewater. The following are key elements for improving pollution control enforcement.

Factories relocation

The same kind of factories, especially polluting ones, would better locate in the same area. Common wastewater treatment facilities can be provided to treat effluents of similar quality effectively. A prerequisite is the preparation of a land use plan by the municipality.

Municipal land use plans should be integrated province wise to avoid residential areas of one municipality to be located next to industrial areas of a neighbouring municipality.

Enforcement of penalties

DENR imposes penalties on violators of environmental laws and regulations, not exceeding ₱5,000 per day during a violation period. However, DENR faces difficulties in detecting violators due to lack of monitoring system, inadequate expertise, and insufficient human resources, funds and equipment. Collected penalties should better be used directly for improving monitoring and enforcement, rather than paying to the National Treasury through DENR as is presently the case.

Supporting SMEs

Small and medium size enterprises(SMEs) find it difficult to install pollution control facilities due to high initial costs and difficult and costly operation. A Pollution Control Cooperation Fund may be established to support SMEs. The Fund would support the provision of technical assistance to SMEs in planning and design of pollution control facilities, training for pollution control management, and training for monitoring of effluent and emission gas. The Fund would also provide concessional loans for the installation of pollution control facilities.

EIA

Implementation of an environmental impact assessment (EIA) suffers from lack of human resources, weak enforcement of penalties against the lack of environmental compliance certificate (ECC), and lack of knowledge of the EIA system on the part of industries and communities. Stiffer penalties for the violations of ECC and dissemination of information on the EIA system are necessary.

Development of human resources

DENR or DTI should train candidates as Pollution Control Officers required for private establishments by a DENR Administrative Order.

3.3.2 Living environment

Improving living environment in urban areas is increasingly more important as urbanization proceeds rapidly in Central Luzon. It is desirable to provide urban infrastructure in anticipation of future urbanization based on appropriate land use plans. To realize this effectively under financial constraints, guidelines need to be established to prioritize the provision of urban infrastructure in a step-wise manner.

Improvement of solid waste systems

A solid waste management system consists of collection and haulage, treatment and disposal. Service coverage of collection needs to be established for different classes of urban centers.

For treatment, incineration is not recommendable for Central Luzon since calorific value of wastes is low, and operation and maintenance are technically difficult and costly. Recycling should be encouraged.

For disposal, selective and step-wise introduction of sanitary landfill is recommended. For this, three levels of landfill may be defined as follows.

Operation	Level A	Level B	Level C
Embankment	x	x	x
Soil cover	x	x	
Lining	x		
Leachate treatment	x		
Gas ventilation	x		

Service coverage and landfill levels should be defined for different urban centers, depending on their characteristics. The following provide just a possible way.

Characteristics of municipalities	Service coverage for collection	Disposal Level
Rapid urbanization	Urbanized area	A
Restrained urbanization	Urbanized area	B
Potential urbanization	Urbanized area and suburbs	B
Slow urbanization	Urbanized area	C
Minimal urbanization	Town proper	C

To give incentives for better solid waste management, DENR-III may establish the Best Solid Waste Management Award, which could be given to several municipalities every year. Also, a solid waste management training center should be established to train local government staff.

3.3.3 Natural resources

Conservation and effective use of natural resources involve (1) designation and establishment of conservation areas, (2) conservation activities, (3) establishment of management system for appropriate and effective use of natural resources, and (4) monitoring of conservation areas and natural resources use. A key criterion for both conservation and use is to restore

and preserve bio-diversity. For instance, reforestation as a conservation activity should be conducted to establish an appropriate mix of vegetation rather than single tree species. Use of natural resources, similarly should not deplete any original elements constituting the resources base. Community-based approaches should be effected for management of natural resources.

3.3.4 Environmental monitoring

Strengthening monitoring capacity

Monitoring capacity of DENR-III should be strengthened. A Regional Environmental Monitoring Center may be established under DENR-III with a staff training component, and an environmental data base needs to be established.

Training for environmental monitoring

The existing Training Center for Forest Conservation in Nueva Ecija, under DENR, should be restructured. In addition to existing courses on reforestation planning, watershed management (or soil erosion control), and social forestry, new courses should be offered concerning environmental monitoring. Pollution Control Officers of the private sector may also be trained at the center.

Monitoring of water and air quality

Monitoring needs in Central Luzon are extensive for both water and air quality. To allow efficient and timely monitoring, proper methods of analysis should be established, consisting of precise analysis and summary analysis. These methods are combined to identify more serious problems at smaller costs. Methods of monitoring are proposed in Table 3.2, covering water and air quality, natural resources or ecosystem, and land use.

3.3.5 Environmental awareness

Environmental public relations

Various information related to environment needs to be conveyed among communities, government agencies and the industrial sector. Effective means of communication vary depending on the kind of information and entities involved. Appropriate public relations means are indicated in Table 3.3 for different target levels. Face to face communications and seminar/workshop are effective for people/community levels. For a wider communication, radio may be most effective as 70% of households in Central Luzon already own radios. A mobile communication system with TV and video would offer another effective tool for government agencies to disseminate various messages.

Environmental education

Central Luzon has three major assets for environmental education. Two of them are natural resources: the Candaba swamp and the Subic rainforest. Third is the presence of native upland people, Aetas, who have extensive knowledge and experience on resource use and survival in forest areas. Additional resources include the Subic Bay and Zambales coasts with well preserved coral reefs and marine environment, Mt. Pinatubo and its influence areas, and even traditional craftmanship that makes effective use of natural resources to enrich living environment.

These resources make Central Luzon an ideal location as a center for environmental education. A World University of Environment may be established. Also, eco-tourism should be promoted as a tool for environmental education.

Eco-community network

To facilitate the communication between communities, government agencies, and the industrial sector, an Eco-Community Network should be established by DENR-III. The structure of the network and information to be conveyed between the entities involved are shown in Figure 3.1.

3.3.6 Environmental administration

Environmental administration needs to be strengthened at the regional and local levels. Monitoring capacity of provincial governments should be strengthened by training of staff for monitoring techniques. Development of human resources is important at all levels, and in particular the number of environmental specialists should be increased at PENROs and CENROs. It is also important to improve mobility and communication at the field level, to strengthen policy formation and planning for field operation, to upgrade in-service training and skills, and to promote environmental awareness. Environment should be integrated into planning, monitoring and evaluation processes of all development activities.

CHAPTER 3

TABLES

Table 3.1 Environmental Strategy for Central Luzon (1/2)

Classification	Measures	Strategies
A. Enhancement of Pollution Control	o to designate appropriate place for new industries o to strengthen control and monitoring of effluent and gas emission standards o to support technically and financially small and medium size industries o to enforce implementation of EIA o to develop human resources of the private sector such as a Pollution Control Officer	o Transfer of appropriate sites for factories removal o Enforcement of penalty o Establishment of Pollution Control Support Organization for Small and Medium Size Industries o Enhancement of EIA o Enhancement of Environmental Monitoring o Formulation of Eco-Community Networks o Formulation of Land Use Plan o Improvement of Solid Waste Management System o Promotion of Environmental Education and Public Relations o Enhancement of DENR Regional Office
B. Improvement of Living Environment	o to develop appropriate urban management o to implement appropriate land use o to enhance pollution control o to improve and manage traffic o to introduce appropriate solid waste management	o Enhancement of Environmental Monitoring o Formulation of Eco-Community Networks o Formulation of Land Use Plan o Improvement of Solid Waste Management System o Promotion of Environment Education and Public Relations o Enhancement of DENR Regional Office o Formulation of Natural Disaster Measures o Promotion on Preventive Measures of Natural Disaster
C. Conservation and Effective Use of Natural Resources	o to conserve ecosystem o to effect community participation in management of natural resources o to conserve and restore natural resources o to forward appropriate and efficient natural resources use o to monitor natural resources	o Enhancement of Environmental Monitoring o Formulation of Land Use Plan o Promotion of Environmental Education and Public Relations o Enhancement of DENR Regional Office o Formulation of Natural Disaster Measures o Promotion on Preventive Measures of Natural Disaster

Table 3.1 Environmental Strategy for Central Luzon (2/2)

Classification	Measures	Strategies
D. Implementation of Environmental Monitoring	o to enhance monitoring of effluent and gas emission from factories o to monitor natural resources o to introduce simple and cost effective environmental monitoring system for water quality and air quality o to improve DENR Regional Office's Laboratory o to develop human resources for environmental monitoring	o Enhancement of Environmental Monitoring o Restructure "RP-Japan Training Center" for Human Resources Development o Formulation of Eco-Community Networks
E. Promotion of Environmental Awareness	o to strengthen environmental awareness of communities o to strengthen citizen's participation o to promote environmental education o to have common environmental information and issues o to disseminate environmental information such as preventive measures of pollution at community level o to ensure regular flow of environmental information from community level to local government o to establish a community-based resource information system	o Formulation of Eco-Community Networks o Promotion of Environmental Education and Public Relations
F. Enhancement of Administration	o to improve environmental administration and management for Regional and Provincial level o to improve environmental monitoring technique and capacity of Regional and Provincial government o to improve mobility and communication at the field level o to develop enviornmental specialists for Regional and Provincial governments o to achieve appropriate land use o to systematically strengthen policy formation and planning of field operation o to upgrade in-service training and skills	o Promotion of Environmental Education and Public Relations o Enhancement of DENR Regional Office o Human Resources Development for Environment

Table 3.2 Proposed Environmental Monitoring Plan for Central Luzon

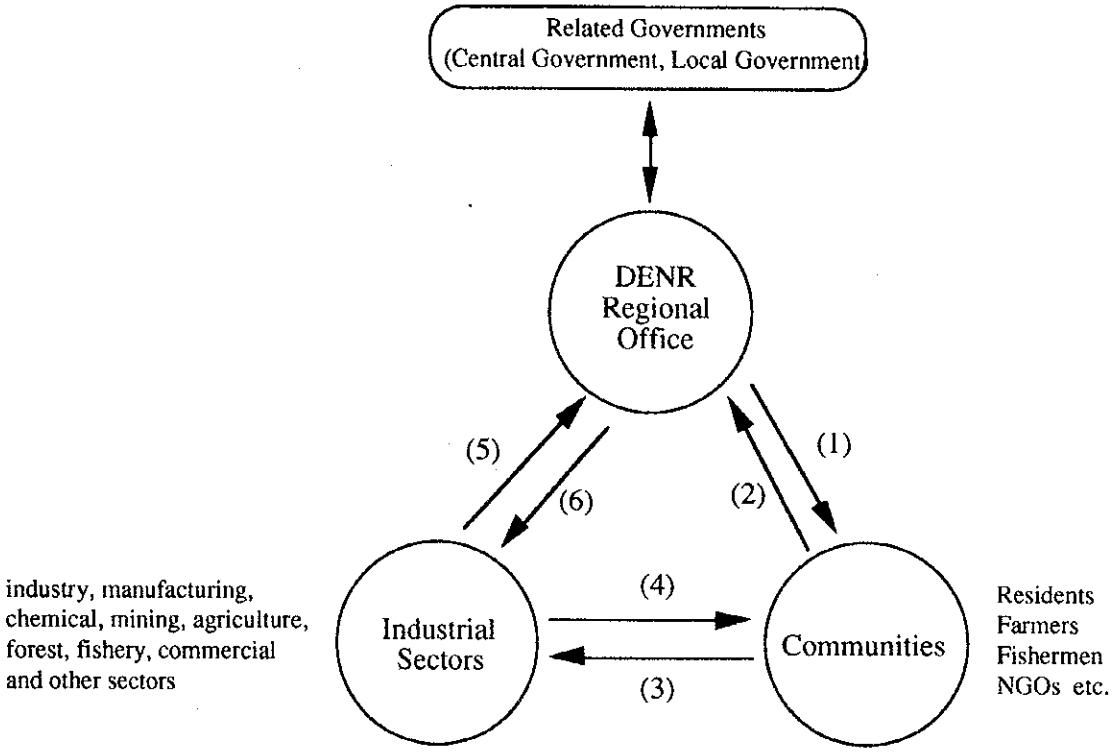
Targets	Elements	Indicators	Method	Frequency	Implementation Agencies
Water Quality	Surface Water Quality	**Basic Indicator** water temperature, Cl-, pH, DO, COD, BOD, SS Nitrate, Nitrite, Phospate, colibacillus	field survey	4~6 times/year	DENR/Provincial Government
		Other Indicators of DENR AO No. 34		1~4 times/year	
	Effluent	refer to DENR AO No. 35	sampling from discharge pipe	based on regulations	Private Sectors (Pollution Control Officer)
Air Quality	Ambient Air Quality	Basic Indicator CO, NOx, SO2, SPM Other Indicators of DENR AO No. 14	field survey	1~6 times/year	DENR/Provincial Government
	Emission Gas from Factory	refer to DENR AO No. 14	sampling from stack	based on regulations	Private Sectors (Pollution Control Officer)
Natural Resources	Vegetation	coverage area	field survey/remote sensing	1 time/year	DENR
	Inventory of fauna & flora	species	field survey	1 time/year	DENR
	Invaluable fauna & flora	species/habitat	field survey	1 time/year	DENR
	Soil erosion	area/location	field survey/remote sensing	1 time/year	DENR
Land Use	Land use	coverage area	field survey/remote sensing	1 time/year	Monitoring-DENR Control-Related Agencies

Table 3.3 Proposed Public Relations Tools for Environmental Information

Targets / PR tools	Provincial Level	Municipality Level	Barangay Level	Community Level	Individual Level	NGO's	Industrial Sector	Agriculture/ Fishery Sectors
TV	X							
Radio	X	X					X	X
Newspaper	X						X	
Newsletter	X	X	X	X		X	X	X
Pamphlet	X	X	X				X	X
Poster	X	X	X	X			X	
Video	X	X	X	X			X	X
Seminar/Workshop	X	X	X			X	X	X
Events	X	X	X	X		X	X	X
Bulletin Board			X	X	X			X
Face to face			X	X	X			X

CHAPTER 3

FIGURES



(1) Government to Communities
- to provide environmental information
- to promote environmental education
- to conduct training and seminars

(2) Communities to Government
- to give suggestions/ideas/opinions/ on how to improve their environment
- to report illegal activities (environmental problems) by citizen watch
- to participate in planning and decision-making about project
- to cooperate/participate in Government programs

(3) Communities to Industrial Sectors
- to actively participate with the environmental project/program
- to report/complain illegal activities (environmental problems)by citizen watch groups

(4) Industrial Sectors to Communities
- to initiate environmental project/program (tree plantation, distribution of waste receptables, clean up river, etc.)
- to provide information about pollution abatement

(5) Industrial Sectors to Government
- to report operation and pollution control
- to conduct dialogues with government regarding their problems

(6) Government to Industrial Sectors
- to provide pollution control information
- to promote environmental education
- to conduct training and seminars
- to control operation of factories in compliance with regulations

Figure 3.1 Structure of Eco-Community Network

CHAPTER 4

CHAPTER 4 LAND SUITABILITY AND LAND USE PLANS

4.1 Regional Development Strategy and Alternatives

4.1.1 Regional development strategy

Central Luzon is expected to grow at high rates to contribute to the national development goals as visualized by the Philippine 2000. At the same time, Central Luzon should pursue an alternative development paradigm on the balance between economic efficiency, social development, and environmental management. A real challenge for Central Luzon is how to attain high growth rates without causing environmental degradation and social disruption.

To meet this challenge, a two-pronged strategy is conceived, consisting of the following components:

- To promote people/community-based development for socially and environmentally sound and sustainable development; and
- To drive internationalization for integrated and competitive local and regional socio-economies.

The first component means the utilization of indigenous resources for the benefit of local communities and people. The second component utilizes the industrial/trade anchors to induce re-vitalization of local economies.

The two components could also be complementary. For instance, the concentrated industrialization/urbanization in the industrial/trade anchors would allow easier protection of productive agricultural lands and vulnerable coastal environment. Also, the concentrated urbanization patterns would make the treatment of waste and wastewater more manageable and infrastructure and utility costs smaller.

4.1.2 Alternative development scenarios

Development alternatives may be defined by varying emphasis on the components of the two-pronged strategy presented above. The one emphasizing the first component may be called a localization alternative, while a globalization alternative may be defined by emphasizing the second component. An ideal mix of these alternatives may be defined under the name of glocalization.

(1) Localization scenario

This is the community-based development scenario. To utilize indigenous resources effectively, agricultural productivity should be enhanced through crop diversification.

Emphasis, however, should be placed on those crops that are adaptable to multi-storey farming (e.g. coffee, cashew and fruit trees) and mixed farming (e.g. vegetables and pulses) by small farmers. Organization of farmers and marketing hold a key. These forms of farming may also expand the base for a range of rural industries for simple processing. In both ways, small farmers can earn extra income, while staying in rural areas.

Localization of industries will be based on human and other indigenous resources. In addition to agro-industries, handicraft and apparel industries would become more important although their export performance may not improve much.

(2) Globalization scenario

This scenario is based on the maximum utilization of the industrial/trade anchors mainly for export-oriented, labour-intensive industries. The existing BEPZ and other industrial estates would be linked and streamlined with better provision of infrastructure and utilities to improve their competitive edge. In agriculture, Central Luzon may be specialized in a few selected crops, other than rice and other traditional crops, that can be exported either directly or after processing. Naturally, commercial scale operation will dominate.

This scenario may be a volatile one, easily affected by changes in international markets. To maintain the competitive edge in manufacturing, skills need to be upgraded consistently, and products and technology development undertaken, or otherwise labour costs suppressed. Commercial operation of agriculture may involve more serious soil degradation.

(3) Glocalization scenario

This scenario combines advantages of the first two alternatives, while minimizing adverse social and environmental effects. A key is to link localization and globalization activities by various linkage industries and non-industrial services. A full range of inter-related production activities should be established within the region by using indigenous resources with minimal wastes. This would increase value-added and expand markets. Some existing industries, possibly including traditional ones, may be transformed into internationally competitive ones through market specific and branded products development.

Promising industries under this scenario include aviation industry, electronics, precision instruments, software and information industry. Links with tourism would also be important. Non-industrial services are those services contracted by manufacturers such as banking, rental, freight services, professional services and others.

Crop diversification would be important under this scenario as well. Emphasis should be on those that can be processed within the region into final products and those that would supply

to Metro Manila and export markets. Crop diversification towards high value added crops as well as improved and diversified use of all commodities is important in all scenarios.

The agri-based industry sector which transforms raw agricultural products into finished products will play a key role in all scenarios. Table 4.1 summarizes some of the possible raw agricultural products and the diverse finished products that could be realized from them.

4.2 Frameworks for Land Husbandry

4.2.1 Objectives

Unwise or inappropriate land use, as well as excessive use of land beyond its supportive capacity for development and assimilitative capacity for maintenance of acceptable quality of environment, are the root causes of land resources degradation. By applying land husbandry, which means "working towards improved care and management of land resources in line with its potential and carrying capacity", sustainable land use could be realized. Table 4.2 defines a broad framework for improving land husbandry. Key elements or strategic areas are identified and elaborated from the point of view of a "top-down" policy approach and a "bottom-up" policy approach. The framework calls for inclusion of both top-down and bottom-up components in pursuing improved land husbandry as the two components collectively encompass the full geographic and administrative scope of the land use development strategy. Several priority projects and programs encompassing various elements of the framework are also identified in Table 4.2. Project profiles are presented in Volume VIII: Project Report

The proposed land use development framework elements basically define 'what' strategies are needed to address the identified land husbandry problem. The 'how' aspect, namely that of implementing these strategies, is most important and enumerated upon in a subsequent section. Technical approaches to land management are again discussed separately.

4.2.2 Elements of proposed framework

(1) Setting priorities

The first element of any framework is to set priorities which in the current case translates into determination of proposed landuse targeted for achievement in 2010 for Central Luzon provinces. This in turn involved first a land use potential analysis followed by determination of proposed land use in the three different scenarios considered. The sustainable development paradigm proposed in the CLDP calls for a shift from the development paradigms of scientific materialism and economic determinism, to a development paradigm of ecological determinism, so as to achieve qualitative growth within the limits of the land's

carrying capacity. The carrying capacity concept applied to land resources translates into determining and minimizing the differentials between desired or targeted land use and that which can be realized, keeping in view the land's supportative capacity and the environment's assimilitative capacity. The proposed land use for the year 2010 is analyzed in terms of the implications to the land's carrying capacity. This is done by linking the spatial development (land use plan) with macro socio-economic planning.

(2) Policy and regulatory framework reform

The second element in the framework is to design cost effective policy instruments that minimize costs, economize on scarce administrative skills, and are broadly acceptable to society. Policy reforms used to improve sustainability can be grouped into three complementary groups: market based policies, regulatory or administrative policies, and extra-regulatory approaches to pollution control.

In the Philippines, emphasis on regulatory or administrative policies have had relatively high administrative costs as well as relatively low economic efficiency. Market based policies need to be implemented in the agricultural and forestry sectors. Water is often treated as free goods by farmers. Water conservation can be directly affected through the higher pricing of irrigated water. Forest concessions and stumpage fees have been too low in the past, leading to massive deforestation with excessive social costs. The use of public lands for grazing and social forestry can also be made more sustainable through pricing, enforcement of access, and more clearly defined property rights. Government policy thrust to deal with conflicting demands on public lands involves a reduction of areas under direct government control and corresponding increase in local or private management.

Non-market based policies include public efforts to promote better adapted technologies through the dessimination of technical information, applied research, and improved extension services. Extra-regulatory policies of pollution control leading to reduction in land degradation include requirements of public disclosure of point-source pollution data. This can lead to direct negotiations between polluters and communities, consumer boycotts, and/or liability court cases. Disclosure involves relatively low cost, requires relatively little direct government involvement, and invokes the power of the market into the environmental arena.

(3) Strengthened land tenure

Clarification of property tights is critical as population pressure increases, open access and communal property rights systems break down, and land values increase. A social reconnaissance survey conducted as part of this study indicated that in A & D lands, social problems associated with farm land use would only aggravate, unless the situation at present with control of post harvest facilities, market prices of farm commodities and credit by

middlemen and rich land lords is reformed. Unless the system of control and ownership of basic means of production (land, capital and post harvest facilities) is transferred into the hands of farmers through an efficient asset reform, genuine land reform would not be achieved, and poverty level of farmers in the region would remain unchanged.

Land tenure issues in forest lands also need to be addressed in various ways. These include strong governmental actions to address the problem of illegal tenancies based on tax claims, reform of land use permits like CSC to strengthen their incentive value in promoting sound land use practices and in providing tenurial security, and development of communal land tenure systems in land use conflict areas involving ethnic minorities.

(4) Institutional strengthening

In order to accomplish the proposed land use plan in addition to policy reform and strengthened land tenure, sufficient institutional capacity needs to be strengthened. Weak institutions typically lack both technical skills and political authority to change the behaviours of firms, households and farmers. "Best Practices" and innovative approaches to strengthening institutions involved in land and natural resources management need to be determined.

(5) Technology improvement and transfer

This element of the basic land husbandry framwork calls for the need to foster technological improvements and efficiency gains, even when research, development and demonstrative costs are not fully borne by the market. Public sector involvement in technological research, development and demonstration has a high priority in the agriculture and the forestry sectors due to less commercialized and more site specific nature of the technologies. In agriculture, new farming practices and technologies are essential to maintaining the momentum of "intensification" for increasing food production and reducing pressures on marginal lands and forests. On marginal lands, diversified cropping models and techniques to upgrade degraded lands need to be researched and applied.

(6) Public participation

This element of the framework reflects the increasing realization by development planners of the circumstances under which "top-down" approach is helpful and where it is counter-productive. Further, it reinforces the important change in attitude towards addressing land husbandry i.e. the realization that people participation is absolutely necessary at all stages of land use planning and vital for successful implementation of projects. The need to develop a community infrastructure which can provide a vehicle for popular participation in the planning process is also being increasingly recognized. Encouragement of public

participation in decision making through the promotion of education, mass media coverage, NGO involvement, consultation with community based farmers and land management groups, and local conflict resolution are sub-elements of this strategy.

(7) Social programs for rural populations

This important element of the land use development framework calls for the promotion of social programs in education, health and population planning to help settle rural populations and provide options that enable them to take a longer term perspective in managing their families and resources. Any strategy for sustainable development of natural resources will founder if it does not simultaneously address the issues of population growth, impoverishment and unequal access to resources, and the absorption of labor into manufacturing and intensified lowland agriculture. A strong social program to reduce population grwoth rates, especially in rural areas, effective resolution of land tenure issues and measures to increase livelihood opportunities for rural residents will be crucial to the long term prospect for reducing the rate of environmental degradation and depletion.

(8) Financing for public and private sector investments

This element of the framework is to mobilize private sector investments, in line with more sustainable pricing policies, and public sector investments, and environmental priorities. The projected investment costs needed for natural resource management are extremely high and are difficult to meet by individual country government and donor agencies, and require the involvement of the private sector. Increased private sector investments should be promoted through pricing and policy reform, and through improved access of the private sector to information, commercial loans, supplier credits, and, under special circumstances, to government incentives. Donor supports for infrastructure projects should be made contingent on financial plans that encourage project cost recovery to the extent possible. Even if capital costs cannot be recovered, user fees and taxes should try to cover operating and maintenance costs.

(9) Need for resource inventories

The starting point for any land or natural resources policy has to be an inventory of the resources. The inventory of resources should be useful to help national and regional policy and strategy for development. This will not only include the obvious physical data such as land cover, soil, geology and climate but also data on social aspects concerning human resources: what farmers are cultivating, what farming systems are employed, what problems they are facing, what they want to do with the land and why, and what social and economic constraints exist that could hinder agricultural development such as prices, market outlets, or land tenure.

(10) Improved projects' monitoring and evaluation

This element calls for monitoring and evaluation of all projects regularly in order to determine how they are performing, and for improving on them as experience is gained. This needs to be achieved by improvements in the public sector capacity to design, target, implement and ensure compliance with resource management programs.

4.3 Land Suitability and Alternative Land Use Plans

4.3.1 Land potential

(1) Land management units

Land management units (LMUs) are the operational resources units that represent the functional management subdivisions of land types in each defined pedo-ecological zone. Each LMU is identified for its distinct and recurring land management-related properties such as land use, drainage, soil texture, soil depth, elevation, flooding and erosion hazards.

Soil resources of Central Luzon are divided into three broad groups according to origin and formation: viz. alluvial soil of the flood plain and related areas, volcanic soil of the piedmont and upland areas and residual soil derived from sedimentary rocks in the mountains and upland areas. Broad landforms of Central Luzon are classified by several parameters like soil type, texture, column depth, drainage and flooding for hills and mountains. Seven major landforms are identified - coastal or littoral, broad alluvial plains, minor alluvial plains, residual soils, hills, mountains and miscellaneous. Table 4.3 summarizes the pedoecological zones and LMUs in Central Luzon.

(2) Lahar and flood prone areas

As of 1993, a total area of 52,320 ha or 2.9% of the Central Luzon land was covered by lahar. Of this, 24,791 ha or 47% was in the warm lowland, corresponding to 3.4% of the total area in this LMU category.

Additional 47,625 ha have been determined to be lahar hazard prone. The combined area of lahar covered and lahar hazard prone lands corresponds to 5.6% of the total land in Central Luzon. Moreover, 35,055 ha have been identified as siltation and flooding prone. The distribution of these areas are summarized by province in Table 4.4, and illustrated in Figure 4.1.

(3) Land use limitation

A little over one third of the total area of Central Luzon has no physical limitation. Large part of these areas are located in Pampanga (56.4%), Bulacan (55.2%) and Bataan (53.2%). About 9.0% of the total area of Central Luzon has very steep slope, 14.3% is prone to moderate or severe erosion, 13.9% is prone to poor drainage, and another 8.4% is subject to flooding and poor drainage.

4.3.2 Land suitability for crop cultivation

The Bureau of Soil and Water Management (BSWM) has analyzed and classified the LMUs into five suitability classes for eleven groups of crops following the FAO methodology and guidelines for crop suitability analysis. For purposes of the present study, the eleven crop groups were regrouped into seven: lowland paddy, grains, vegetables, industrial crops, managed pasture/agro-forestry, tree crops and fishponds (Table 4.5). The five suitability classes were simplified into three: good land potential, moderate to marginal land potential, and no potential or not relevant.

The LMUs were classified by using a GIS into these three suitability classes for each of the seven crop groups (Table 4.6). It has been found out that Central Luzon has very good potential for a very wide range of crops in both the lowland and upland pedo-ecological zones.

4.3.3 Land use plans for alternative scenarios

A land use plan has been prepared for each of the three alternative development scenarios. Basic concepts of each scenario have been interpreted into specific crops and livestock/poultry activities to be emphasized as summarized in Table 4.7. Correspondence between pedo-ecological zones, existing and potential land use and proposed land use is illustrated in Figure 4.2. Proposed land use plans for the three scenarios prepared by a GIS are presented in Table 4.8 and Figures 4.3, 4.4 and 4.5.

(1) Characteristic of alternative land use plans

The proposed land use under the localization largely maintains the existing land use pattern. Main differences are : (1) rain-fed paddy areas in lowland will be converted to mixed farming, and (2) upland areas will be used for multi-storey farming. Also agro-forestry will be introduced in areas designated as the production forest.

Under the globalization, the entire lowland, except areas for irrigated paddy, will be devoted to commercial crops. Upland areas will be used partly for managed pasture as well as multi-storey farming. Tree crops will be established in the production forest area.

The land use proposed for the glocalization will realize the balanced use of lowland for irrigated paddy, mixed farming, commercial crops and other diversified crops. Upland areas will be used for multi-storey farming and managed pasture. In the production forest area, agro-forestry and tree crops will be established.

(2) Common features

The three alternative land use plans have the following common features.

1) Lowland prime irrigated paddy cultivation areas occupy 281,000 ha. These areas match existing land use. Increasing the cropping intensity and yield are the main objectives of land management for areas under this category. Nueva Ecija (145,000 ha), Tarlac (55,000 ha), Pampanga (31,000 ha) and Bulacan (38,000 ha) have large areas under irrigated paddy cultivation.

2) Diversified upland crops and tree crops in prime upland areas cover 96,000 ha for multi-storey farming. Existing land use is mostly grasslands/shrublands. Nueva Ecija (22,000 ha), Tarlac (34,000 ha) and Bataan (18,000 ha) have significant area under this category.

3) The remaining upland area of 85,000 ha is planned for managed pasture (prime suitability) and/or agroforestry and agro-industrial crops (moderate to marginal suitability). A part of this land use category is also determined suitable for future urban/industrial needs. The existing land use in these areas is grasslands/shrublands. These areas are large in Tarlac (17,000 ha), Bulacan (33,000 ha) and Bataan (18,000 ha).

4) Large area of 223,000 ha in Production Forest area is moderately to marginally suitable for tree crops and/or agroforestry. Existing land use is secondary residual forest or grasslands/shrublands. Zambales has very large area under this category (129,000 ha) followed by Tarlac (33,000 ha) and Nueva Ecija (21,000 ha).

(3) Differences between scenarios

The proposed land use plans differ between the scenarios mainly in the following areas.

1) Rainfed mixed farming area is 199,000 ha (93,000 ha in Nueva Ecija; 28,000 ha in Zambales; 33,000 ha in Pampanga; 33,000 ha in Bulacan) in the localization scenario (rice or corn mixed with vegetables and pulses). This entire area is diverted to commercial/industrial crops in the globalization scenario. In the glocalization scenario, about 117,000 ha (Nueva Ecija - 49,000 ha; Zambales 27,000 ha; Pampanga - 22,000 ha) are classified under mixed farming (mostly corn with

vegetables and pulses). The existing land use in these areas is rainfed paddy or grasslands/shrublands.

2) Rainfed diversified crops are to be cultivated in 65,000 ha in the localization and the glocalization. These areas are mostly located in Tarlac (28,000 ha) and Pampanga (28,000 ha). In case of the globalization, this entire area is diverted to cultivation of selective commercial/industrial crops. These areas are presently under cultivation to a wide variety of crops including corn, sugarcane, vegetable crops, tree crops and industrial crops. Cropping intensity increase along with yield increase are the main objectives of these areas in the localization and the glocalization. Crop diversification to commercial crops becomes the objective of these areas in case of the globalization.

3) The area for diversified commercial crops and tree crops is the largest in case of the globalization at 265,000 ha (Nueva Ecija 99,000 ha; Tarlac 35,000 ha; Zambales 30,000 ha; Pampanga 61,000 ha; Bulacan 33,000 ha). This is 82,000 ha in the glocalization (43,000 ha in Nueva Ecija, 22,000 ha in Bulacan and 11,000 ha in Pampanga). There is no cultivable area under this crop category in case of the localization. Existing land use in these areas is non-irrigated or rainfed paddy or grasslands/shrublands. As such, crop diversification with increased cropping intensity and yield increases are the objectives under all scenarios for land area under this category.

4.3.4 Potential urban/industrial lands

Potential urban and industrial lands have been identified by using a GIS. They are defined as follows:

- areas of slope less than 8% (lowland) and/or slope less than 18% (lowland and upland),
- areas having accessibility within 15 km from major urban centers, within 7.5 km from secondary urban centers, within 4 km along major highways, or within 2 km along secondary highways,
- non-prime agricultural lands not susceptible to severe flooding and not within vulnerable coastal areas, and
- areas not covered by lahar or prone to lahar hazard or siltation threat.

Existing built-up areas and industrial areas were excluded from the analysis. The identified potential urban and industrial lands are distributed in the region as shown in Figure 4.6. The

potential areas by province are summarized in Table 4.9. The total potential urban and industrial area is 37,272 ha, consisting of 5,390 ha in lowland and 31,881 ha in upland. This corresponds to 56% of the existing urban and industrial areas.

4.4 Socio Economic Implications of Land Use Plans

4.4.1 Food sufficiency

Table 4.10 summarizes an estimation of crop demand and equivalent land area requirements using a target potential yield and cropping index. These estimations were done by the Agricultural Land Management and Evaluation Division (ALMED) of BSWM. All assumptions and figures used in deriving the estimations are given in the ALMED publication "Crop Development and Soil Conservation Framework for Luzon Island". Some of the assumptions or definitions are as follows.

(1) Yield

The present yield is the seasonal average yield computed for the region. The experimental yield from secondary sources is assumed to be the potential yield of the crop.

(2) Population projection

The population was projected using the geometric method. The base population and annual growth rate were taken from the National Statistics Office (NSO) 1990 Census of population.

(3) Cropping index

The present cropping index was derived by dividing the effective crop area by the physical crop area. The recommended cropping index based on water balance was assumed to be equal to the recommended cropping index in the provinces with short recurrence period of typhoon.

(4) Demand estimations

Rice and corn demands are in milled form. Real demand was computed using the same formula used for estimating effective demand but the recommended intake was used instead of the mean per capita consumption.

A comparision of the equivalent rice cultivation area in 2010 with the proposed prime irrigated rice cultivation area in the three scenarios indicates the equivalent rice area to be 64% of the proposed prime irrigated rice cultivation area. In other words, if the assumed irrigated rice cropping index of 2.5 and target yield of 5,315 kg/ha (present cropping index and yield are 1.87 and 2,948 kg/ha respectively) is achieved by 2010, only 64% of the proposed

irrigated rice cultivation area is sufficient to meet the subsistence needs (based on effective demand) of Central Luzon in 2010. Thus, the region would still have a sufficient export margin of rice cultivable in the remaining 36% (102,000 ha) of proposed irrigated lands. The required equivalent rice cultivation area in 2010 with the assumed rice cropping index of 2.5 and target yield of 5,315 kg/ha is only 33% of the total existing rice cultivation area (irrigated and non-irrigated).

The equivalent area requirement of coconut, vegetables, rootcrops and fruits in 2010 of a maximum of 61,000 ha can be easily met by cultivation only in the prime lands in all the three scenarios. However, the equivalent land area requirement of 209,000 ha for corn production in 2010 assuming a cropping index of 2 and yield of 1,308 kg/ha (present cropping index is 2 and yield 1,006 kg/ha) is not met by cultivation only in prime lands (uplands and lowlands) in case of the globalization scenario. For the localization and the glocalization scenarios, in addition to a large portion of upland prime areas of 96,000 ha, if the rainfed mixed farming areas (117,000 ha in the glocalization scenario and 199,000 ha in the localization scenario) cultivate corn instead of rice as the main crop, Central Luzon needs in corn sufficiency can be fulfilled. Again, since only backyard livestock or poultry farming is done in the localization scenario, the corn requirements as feed would be much lower than in case of the globalization or the glocalization where managed pasture for livestock raising is an objective.

The above discussion clarifies that Central Luzon does not face any limitations due to lack of productive agriculture lands. The important issue is how is achieve higher yields and production from the lands on a sustained basis while minimizing inputs in the form of chemical fertilizer and pesticide use as well as promoting farm mechanization. These are largely technical issues of farming methods which are discussed in a subsequent section.

4.4.2 Socio-economic framework and land use planning

In order to link macro level socio-economic planning with land use planning as a first step, the value added in agriculture was projected based on the proposed land use in the three scenarios. The annual growth rate in production of various crops and projected sufficiency levels in 2010 was determined from proposed land use, projected agricultural value added (VA) and production data (VA/ton). Results are shown in Table 4.11. This is very useful in analyzing and answering various questions: whether the targeted production levels for various crops are reasonable or too ambitious; what implications each scenario has in terms of necessary inputs to agriculture or in terms of necessary land use practices; and whether the proposed land use is within the carrying capacity of the land.

In the glocalization scenario, the value added due to livestock and poultry would record the highest growth of 5% per annum, followed by the crop value added at 4.4% and the fishery value added at 4.1% per annum.

The production of rice would increase at 2.85% per annum to keep pace with the population increase, and exceed the self-sufficiency level by 50%. Corn production would increase significantly to support the boosting livestock production. Commercial crops with very limited production at present would attain high growth rates of production exceeding 10% per annum. These are cashew, peanut, coffee and cacao. Fruits would increase marketable production due to reduction in losses as well as increase in cultivated area. Vegetable production would increase at 7.1% per annum, represented by eggplant, tomato, onion, squash and okra. Some specialized high value vegetables would also expand production such as asparagus and garlic.

CHAPTER 4

TABLES

Table 4.1 Agro-processing Industries

Crop or Commodity	Primary Product	Derived Products
Paddy	milled rice (consumption)	snack items, wine
	rice bran (used as animal feed)	rice bran oil, rice bran cakes
	rice husk	combustion and cleaner fuel husk ash (for making insulated boards and in pulp and paper making)
	rice straw (used as animal feed and as fertilizer)	
Corn	milled corn (human consumption, livestock and poultry feed)	Corn starch, gluten, alcohol, food snacks, tinned corn, corn oil
Vegetables & Fruits	Processed vegetables/fruits	canned/bottled products; snack items
Sugarcane	Sugar, Baggasse	
	Molasses	Alcohol
Oil crops	raw oils	refined edible oils, margerine
	oil cakes	animal feed
Coffee	processed coffee	packaged products
Cashew	processed cashew, cashew oil	food industry; oil- industrial uses
Coconut	coir fiber	ropes, twines, brushes
	charcoal	cooking fuel, ammonia
	coconut water	beverage, yeast culture for feeds and in making Nata de coco
	coconut timber	construction material
	leaves	cocoshell
	husk trunk	cottage handicrafts
	coir dust	hollow black, plastic board, wall board
Abaca	fiber	speciality paper, cordage and fibercraft (tissue paper, twines, ropes, filter paper, coffee bags, abaca footwear, fabrics, doormats, curtains etc.)
	leaves	wrapping and shading
	leafsheaths	roofing and shading transplanted seedlings, food containers
banana	fruit, stem (food and feed)	
	fiber	paper and handicraft
Livestock	meat	meat products, packaged products
	raw leather	tanned leather and leather products

Table 4.2 A Framework for Improving Land Husbandry (1/2)

Key Elements	National and Regional Level (Top down approach)	Local (Barangay, municipality, province) Level (Bottom-up approach)	Project Proposals
1. Setting priorities - determination of rational land use	National and regional priorities, as expressed in NPFP and RPFP, and other national and regional sectoral planning documents; openness in decision making.	Local determination of local problems and priorities; decentralized capacity to address local issues; local participation.	(3), (9), (10)
2. Policy and regulatory framework reform.	Sound Economic policies; Modification of policy frameworks (pricing and taxation) that encourage inappropriate land use, such as price distortions in agriculture and forestry; Regulatory and legal reforms Public disclosure	- Policies for encouraging local development, improvement and adoption of improved land use practices i.e. incentives and regulations based on better understanding of local land issues and problems. - Adequate data collection and monitoring	(9), (10)
3. Strengthened land tenure	Classification of property rights through accelerated land reform	- Encouragement and support for NGOs and LGUs for alternative people's development initiatives to achieving asset reform as well as land reform.	(5), (6), (10), (11)
4. Institutional strengthening	Capacity building for national/regional level policy analysis and implementation (e.g. tax, pricing and legal reforms); choice of policy instruments in light of institutional capacities.	- Capacity building for local level policy implementation, monitoring and consistent and fair enforcement. Strengthening of community organizations and NGOs.	(5), (6), (7), (11)

Table 4.2 A Framework for Improving Land Husbandry (2/2)

Key Elements	National and Regional Level (Top down approach)	Local (Barangay, municipality, province) Level (Bottom-up approach)	Project Proposals
5. Technology improvement and technology transfer	Open trade policies Favourable business environment for technology transfer	Public and donor involvement in development and promotion of locally relevant technical innovations that promote sustainable resource management, primarily through better targeted research, technology transfer, extension services and expanded roles fro farmers, community groups, local universities and research centers in these areas.	(1), (2), (4), (8), (9)
6. Public participation	Public disclosure Openness in decision making Information dissemination through promotion of education, mass-media coverage	Encouragement of public participation in decision making through the promotion of education, mass-media coverage, NGO involvement, consultation with community-based farmer and land management groups and local conflict resolution.	(1), (2), (5), (6), (8), (11)
7. Social programs for rural population	Promotion of social programs in education, health and population planning to help settle rural populations, and provide options that enable them to take a longer term perspective in managing their family and resources. Effective implementation of CARP	Promotion of social programs in education, health and population planning to help settle rural populations, and provide options that enable them to take a longer term perspective in managing their family and resources.	
8. Financing for public and private sector investment	Favourable business environment Donor lending for sector adjustment and policy reform	- Pricing and institutional reform to increase the viability of investments favouring better resources management - Increased "commercialization" of public infrastructure to increase LG revenue base	

(1) On farm research and development
(2) Research an development into use of artificial reefs and reef santuaries, and mariculture
(3) Delineation and classification of mining areas
(4) Lahar area rehabilitation and reuse
(5) Community afforestation project
(6) Community coastal fishery development
(7) Institution and extension services development
(8) Upland area cultivation - R & D into technical alternatives
(9) Land resources information system
(10) Regional rural database development plan
(11) Project for promotion of localization initiatives in forest protection and uplands management

TABLE 4.3 PEDOECOLOGICAL ZONES AND LAND MANAGEMENT UNIT (LMU);(1/3)

area in ha (source GIS database of present study)

LMU	CODE	N_ECIJA	TARLAC	ZAMBALES	PAMPANGA	BULACAN	BATAAN	REGION 3
WARM LOWLAND (< 8% slope, < 100 m elevation, > 25 C)		**265,331**	**118,885**	**73,956**	**146,251**	**98,062**	**23,146**	**725,632**
Broad alluvial plains (slightly flooded, medium textured); Collu-alluvial fans	09J,09JE,18	19,268	0	2,225	315	20,967	0	42,775
Lower river terraces	12	2,805	0	2,422	575	2,347	0	8,149
Lower river terraces, coarse to medium textured, slight to moderate flooded	12EJ-K,12J,12D	0	3,780	0	0	1,168	0	4,948
Upper river terraces	13J,13,13K	10,982	0	8,815	0	3,101	1,928	24,826
Narrow alluvial plains	19	0	0	0	0	0	1,653	1,653
Residual terraces; lower footslopes	25,26	15,177	0	0	0	2,376	0	17,553
Broad alluvial plains (moderately flooded)	09 FK,09 K	0	6	0	1,101	4,266	0	5,373
Broad alluvial plains (severely flooded); lower river terraces (mod. flooding)	09 FL,09L,12K	17,617	13,893	0	11,001	1,145	0	43,657
Lower river terraces (severely flooded); inland stream/enclosed valleys	12L,17	0	0	0	0	9,379	93	9,472
Infilled valleys	16	1,424	0	0	356	0	0	1,780
Broad alluvial plains (heavy textured, slightly to moderately flooded)	09FJ,09FJ-K,09I	184,534	41,979	14,647	23,274	584	30	265,048
Broad alluvial plains (medium to heavy textured)	09EF	10,238	144	6,539	0	0	0	16,922
Broad alluvial plains	09	0	0	1,030	0	9,470	9,033	19,534
Piedmont plains	27	0	0	14,195	2,547	19,657	2,482	38,882
Marshes (grassy type)	04	1,993	364	0	1,377	0	0	3,734
Former old tidal flats (slightly to moderately flooded)	10J,10,10K	0	0	0	0	1,327	3,498	4,825
Inland valleys, medium to heavy textured, slightly flooded	17E-FJ	0	2,140	0	0	0	0	2,140
Former old tidal flats (severely flooded)	10L	0	0	0	12	2,472	0	2,484
Active tidal flats, developed (fishpond)	01	0	0	515	19,738	18,678	4,232	43,164
Active tidal flats (mangrove, nipa)	02	0	0	2,317	332	718	0	3,367
Beach ridges and swales	08	0	0	852	0	0	0	852
Broad alluvial plains (coarsely textured)	09D	0	0	5,985	0	0	0	5,985
Broad alluvial plains (coarse to medium textured)	09DE,09D-EJ	1,293	56,578	14,413	85,623	406	196	158,510

TABLE 4.3 PEDOECOLOGICAL ZONES AND LAND MANAGEMENT UNIT (LMU): (2/3)

area in ha (source GIS database of present study)

LMU	CODE	N_ECIJA	TARLAC	ZAMBALES	PAMPANGA	BULACAN	BATAAN	REGION 3
WARM COOL UPLAND (< 18 % slope, 100-500 m elevation, 22.5 -25 C or 8-18% slope , < 100 m elevation and > 25 C)		**76,605**	**72,498**	**21,078**	**18,445**	**49,673**	**42,812**	**281,112**
Karst plateau with isolated limestone hills	67	0	0	0	0	1,337	0	1,337
Basaltic plateau	69	0	0	0	0	42	0	42
Residual terraces (sloping to undulating & nearly level to undulating)	49,49N	783	6,690	533	0	0	0	8,006
Residual terraces (3-8% slope, slightly dissected)	49N OS	0	23,744	0	0	0	0	23,744
Low calcareous sandstone/shalestone hills	75,76N-OS	0	0	0	0	390	0	390
Low shalestone/sandstone hills	76	58,033	6,212	3,300	0	6,337	0	73,883
Low conglomerate hills	77	0	0	5,410	0	3,963	0	9,373
Undulating volcanic hills	96	0	0	0	0	0	20,542	20,542
Infilled valleys	44	5,877	0	0	0	0	0	5,877
Low volcanic aglomerate hills	81	0	0	0	0	2,301	0	2,301
Lower footslopes(volcanic hills or mountains)	51	0	0	0	0	7,674	15,775	23,449
Upper footslopes (volcanic hills or mountains) and low limestone hills	53,66	1,660	0	0	4,323	13,363	4,630	23,977
Low shalestone hills (undulating to very steep, slight to moderate dissected)	76 - OST	0	21,240	0	0	0	0	21,240
Low pyroclastic hills	78,78N-OS	0	8,696	11,476	14,122	3,883	1,680	39,857
Low andesitic hills	82	0	0	0	0	135	0	135
Low dioritic hills	83	0	0	0	0	659	0	659
Low volcanic complex hills	80	0	0	360	0	0	185	545
Low basaltic hills	79	0	0	0	0	1,429	0	1,429
Broad alluvial valleys	43,43EF	10,209	5,916	0	0	0	0	16,125
Lower footslopes (sedimentary hills or mountains)	52	43	0	0	0	8,159	0	8,202

TABLE 4.3 PEDOECOLOGICAL ZONES AND LAND MANAGEMENT UNIT (LMU); (3/3)

area in ha (source GIS database of present study)

LMU	CODE	N_ECIJA	TARLAC	ZAMBALES	PAMPANGA	BULACAN	BATAAN	REGION 3
WARM COOL HILLYLAND (> 18% slope, < 500 m elevation, > 22.5 C)		**83,852**	**48,743**	**152,608**	**8,084**	**49,845**	**43,090**	**386,221**
High pyroclastic hills (rolling to steep, severely dissected)	114,114P-QU	0	1,106	0	0	0	1,329	2,435
High pyroclastic hills (rolling to very steep, severely dissected)	114P-RU	0	9,378	38,240	7,653	0	1,386	56,658
High pyroclastic hills (moderately steep to very steep)	114P-RT	0	0	0	431	0	0	431
High dioritic hills (steep to very steep, rugged, moderately dissected)	120P-RST	0	2,064	0	0	0	0	2,064
High limestone hills	111	0	0	171	0	1,049	0	1,220
High dioritic hills	120	6,622	0	0	0	4,711	0	11,332
High andesitic hills(steep to very steep, rugged, moderately dissected)	116PRST	0	26,722	742	0	0	0	27,464
High andesitic hills	116	22,982	0	930	0	11,349	0	35,261
High ulrabasic hills	118	0	9,472	112,103	0	0	0	121,575
High volcanic complex hills	117	917	0	422	0	32,736	40,374	74,449
High meta-volcanic hills	124	43,487	0	0	0	0	0	43,487
High metamorphic hills	125	9,845	0	0	0	0	0	9,845
COOL HIGHLAND (> 500 m elevation, < 22.5 C)		**68,876**	**39,481**	**94,746**	**9,052**	**38,892**	**16,396**	**267,443**
Pyroclastic mountains (very steep, severely dissected)	157RU	0	532	0	825	0	0	1,357
Pyroclastic mountains(strongly sloping to steep, severely dissected	157P-QU	0	2,836	19,222	3,237	0	0	25,294
High meta volcanic mountains	161,161Q-RU	40,621	0	0	694	0	0	41,315
Metamorphic mountains	162	9,848	0	0	0	0	0	9,848
Andesitic mountains	164	12,522	0	0	0	6,776	0	19,298
Ultrabasic mountains	165,165P-RU	0	32,990	71,825	0	0	0	104,815
Complex volcanic mountains	168	3,482	0	0	0	32,116	0	35,598
Dioritic mountains	166	1,715	0	0	0	0	0	1,715
Volcanic cone Non-active	170,170PRU	688	3,123	3,700	4,296	0	16,396	28,202
MISCELLANEOUS		**43,219**	**23,838**	**22,914**	**18,511**	**28,459**	**3,363**	**140,304**
Built up areas/urban areas	180	14,403	7,432	7,040	12,535	23,383	2,490	67,284
Beach sand	183	0	0	3,660	0	0	776	4,436
Rocksand	184	0	0	0	0	1,631	0	1,631
Riverwash	186	12,723	14,708	11,409	3,640	1,286	0	43,766
Canyon and gorges	189	0	0	0	0	421	0	421
Quarry	190	0	0	0	2,336	0	97	2,433
Escarpment	191	0	0	0	0	1,467	0	1,467
Water reservoir, major rivers, Inland lakes	192,193,194	16,093	1,697	806	0	270	0	18,866
	TOTAL	**537,883**	**303,445**	**365,302**	**200,344**	**264,931**	**128,807**	**1,800,712**

Table 4.4 Land Area Covered by Lahar, Prone to Lahar Deposit and Prone to Siltation in Land Management Units

(Unit: ha)

Land Management Unit	N. ECIJA			TARLAC			ZAMBALES			PAMPANGA			BULACAN			BATAAN			CENTRAL LUZON		
	LA	LP	SP	LA	LP	SP	LA	LP	SP	LA	LP	SP	LA	LP	SP	LA	LP	SP	LA	LP	SP
Warm Lowland	41	2,054	4,405	6,660	18,410	74	6,686	10,032	8,577	11,181	8,633	16,597	0	0	153	223	16	281	24,791	39,145	30,087
Warm Cool Upland	0	0	0	1,261	1,474	0	106	15	0	1,156	75	9	0	0	0	0	0	0	2,523	1,564	9
Warm Cool Hilly Land	0	0	0	585	377	0	6,293	1,352	1,097	644	0	0	0	0	0	0	0	0	7,522	1,729	1,097
Cool Highland	0	0	0	338	4	0	6,357	0	0	1,429	0	0	0	0	0	0	0	0	8,124	4	0
Miscellaneous	0	0	252	2,706	1,366	100	4,522	2,720	1,487	2,131	1,096	2,024	0	0	0	0	0	0	9,359	5,182	3,863
TOTAL	**41**	**2,054**	**4,657**	**11,550**	**21,631**	**174**	**23,964**	**14,119**	**11,161**	**16,541**	**9,804**	**18,630**	**0**	**0**	**153**	**223**	**16**	**281**	**52,319**	**47,624**	**35,056**

LA : Lahar affected
LP : Lahar prone
SP : Siltation prone
Source: GIS database for the JICA Study

TABLE 4.5 CROP GROUP DEFINITIONS

GROUP	NAME	CROPS
A1	LOWLAND PADDY	Paddy rice irrigated, paddy rice-non-irigated
A2a	GRAINS	Upland rice, corn, sorghum
A2b	VEGETABLE CROPS	Soybeans, cowpea, string beans, legumes, eggplant, tomato, ampalaya, okra, mung beans, cabbage, pechay, leafy vegetables, water melon, melon, cassava, sweet potato, turnips, root crops, onion, garlic, pineapple, mixed fruits, ginger, garlic onion, cucumber etc.
A2c	INDUSTRIAL/COMMERCIAL CROPS	Cotton, tobacco, coconut, oil palm, banana, abaca, coffee (robusta), coffee (arabica), tea, black pepper, sugarcane etc.
A3	MANAGED PASTURE/ AGROFORESTRY	Bamboo, ipil-ipil, rattan, paragrass, pasture
A4	TREE CROPS	Mango, cashew, papaya, santol, tamarind, atis, jackfruit, guava, citrus, guyabano, chico, Durian, marang, lanzones, ramputan, avacado, rubber, etc.
A5	FISHPONDS	

Table 4.6 Land Use Potential for Different Crop(s) Cultivation (1/3)

LMUs	A1	A2			A3	A4	A5
		A2a	A2b	A2c			
Warm Lowland							
09J, 09JM, 18	P1	P1	P1	P1	P1	P1	P2
12	P1	P1	P1	P1	P1	P1	P2
12EJ-k, 125, 12 DEJ	P1	P1	P1	P1	P1	P1	P2
13J, 13, 13k	P1	P1	P1	P1	P1	P1	P2
19	P1	P1	P1	P1	P1	P1	P2
25,26	P1	P1	P1	P1	P1	P1	P2
09 FK, 09 K	P1	P1	P1	P1	P1	P1	P2
09 FL, 09L, 12k	P1	P1	P1	P1	P1	P1	P2
12L, 17	P1	P1	P1	P1	P1	P1	P2
16	P1	P1	P1	P1	P1	P1	P2
09FJ, 09FJ-k, 09F	P1	P1	P1	P1	P1	P1	P2
09EF	P1	P1	P1	P1	P1	P1	P2
09	P1	P1	P1	P1	P1	P1	P2
27	P1	P1	P1	P1	P1	P1	P2
04	NS	NS	NS	NS	NS	NS	P1
10J, 10, 10k	P1	P1	P1	P1	P1	P1	P2
17E - FJ	P2	NS	P2	P2	P2	P1	P2
10L	P1	NS	P2	P2	P2	P2	P2
01	NS	NS	NS	NS	NS	NS	P1
02	NS	NS	NS	NS	NS	NS	P1
08	NS	NS	NS	NS	NS	P2	NS
09D	P2	P2	P2	P2	P1	P2	P2
09DE, 09D-EJ	P1	P1	P1	P1	P1	P1	P2

P1 : Good land use potential

P2 : Moderate to marginal land use potential

NS : No potential or not relevant

A1: Lowland paddy
A2a: Grains
A2b: Vegetable crops
A2c: Industrial/Commercial crops
A3: Managed pasture, agroforestry
A4: Tree crops
A5: Fishponds

Table 4.6 Land Use Potential for Different Crop(s) Cultivation (2/3)

LMUs	A1	A2			A3	A4	A5
		A2a	A2b	A2c			
Warm Cool Upland							
67	P2	P1	P1	P1	P1	P1	NS
69	P2	P1	P1	P1	P1	P1	NS
49,49N	P2	P1	P1	P1	P1	P1	P1
49N, OS	P1	P1	P1	P1	P1	P1	NS
75,75N-OS	P2	P1	P2	P2	P1	P2	NS
76	P2	P2	P1	P1	P1	P1	NS
77	P2	P1	P1	P1	P1	P1	NS
96	P2	P2	P2	P1	P1	P1	NS
44	P1	P1	P1	P1	P1	P1	P2
81	P2	P2	P2	P2	P1	P2	NS
51							
53, 66							
76 - OST							
78, 78N-OS	P2	P2	P2	P2	P1	P2	NS
82							
83							
80							
79	P2	P1	P1	P1	P1	P1	NS
43, 43EF	P1	P1	P1	P1	P1	P1	P2
52	P2	P2	P2	P2	P1	P2	NS

P1 : Good land use potential

P2 : Marginal land use potential

NS : No potential or not relevant

A1: Lowland paddy
A2a: Grains
A2b: Vegetable crops
A2c: Industrial/Commercial crops
A3: Managed pasture, agroforestry
A4: Tree crops
A5: Fishponds

Table 4.6 Land Use Potential for Different Crop(s) Cultivation (3/3)

LMUs	A1	A2			A3	A4	A5
		A2a	A2b	A2c			
Warm Cool Hillyland							
114, 114P-QU							
114P-RU							
114P-RT	NS	NS	NS	P2	P2	P2	NS
120P-RST							
111							
120							
116 PRST	NS	NS	NS	P2	P2	P2	NS
116	NS	NS	NS	P2	P2	P2	NS
118	NS	NS	NS	P2	P2	P2	NS
117	NS	NS	NS	P2	P2	P2	NS
124	NS	NS	P2	P2	P2	P2	NS
125	NS	NS	NS	P2	P2	P2	NS
Cool Highland							
157RU	NS	NS	NS	NS	P2	NS	NS
157P-QU	NS	NS	NS	NS	P2	NS	NS
161, 161Q-RU	NS	NS	NS	NS	P2	NS	NS
162	NS	NS	NS	NS	P2	NS	NS
164	NS	NS	NS	NS	P2	NS	NS
165, 165Q-RU	NS	NS	NS	NS	P2	NS	NS
168	NS	NS	NS	NS	P2	NS	NS
166	NS	NS	NS	NS	P2	NS	NS
170, 170PRU	NS	NS	NS	NS	P2	NS	NS
Miscellaneous							
180	NS	NS	NS	NS	NS	NS	NS
183	NS	NS	NS	NS	P2	NS	NS
184	NS	NS	NS	NS	P2	NS	NS
186	NS	NS	NS	NS	P2	NS	NS
189	NS	NS	NS	NS	P2	P2	NS
190	NS	NS	NS	NS	NS	NS	NS
191	NS	NS	NS	NS	P2	NS	NS
192, 193, 194	NS	NS	NS	NS	NS	NS	P1

P1 : Good land use potential
P2 : Marginal land use potential
NS : No potential or not relevant

A1: Lowland paddy
A2a: Grains
A2b: Vegetable crops
A2c: Industrial/Commercial crops
A3: Managed pasture, agroforestry
A4: Tree crops
A5: Fishponds

Table 4.7 Agricultural Development under Alternative Scenarios

	LOCALIZATION	GLOBALIZATION	GLOCALIZATION
PADDY	Maximum production by using all the potential paddy area (irrigated and non-irrigated)	Self sufficiency by yield increase with minimal area	Maintaining some export margin
OTHER CROPS	Vegetables and pulses for local market under mixed farming; corn and other crops for upland crop area	Specialization in a few commercial crops mainly for export markets	Vegetables, pulses and corn under mixed farming with paddy; few commercial crops; coffee, cashew and fruits in combination with vegetables and pulses under multi-storey farming
LIVESTOCK AND POULTRY	Backyard livestock and poultry with local feed	Commercial scale livestock and poultry with artificial feed	Organized livestock and poultry with managed pasture for livestock and local feed

Table 4.8 Summary of Proposed Agricultural Land Use in Various Scenarios (lahar affected, potential lahar hazard and potential siltation/flood prone areas deducted); area in '000 ha

	NUEVA ECIJA			TARLAC			ZAMBALES			PAMPANGA			BULACAN			BATAAN			REGION 3		
	LOCAL.	GLOBAL	GLOC.	LOCAL.	GLOBAL	GLOC.	LOCAL.	GLOBAL	GLOC.	LOCAL.	GLOBAL	GLOC.	LOCAL.	GLOBAL	GLOC.	LOCAL.	GLOBAL	GLOC.	LOCAL.	GLOBAL	GLOC.
PRIME LOWLANDS																					
IRRIGATED PADDY	146	145	145	57	55	55	2	2	2	31	31	31	38	38	38	11	11	11	284	281	281
MIXED FARMING	93	0	49	6	0	6	28	0	27	33	0	22	33	0	12	6	0	0	199	0	117
DIVERSIFIED CROPS	7	0	7	28	0	28	2	0	2	28	0	28	1	0	0	0	0	0	67	0	65
COMMERCIAL CROPS	0	99	43	0	35	0	0	30	0	0	61	11	0	33	21	0	6	6	0	265	82
PRIME UPLANDS																					
MULTI-STOREY FARMING	22	22	22	34	34	34	8	8	8	0	0	0	12	13	13	18	18	18	92	96	96
MANAGED PASTURE*	0	0	0	0	17	17	0	7	7	0	9	9	0	33	33	0	17	17	0	84	85
MODERATE/MARGINAL UPL.S																					
MULTI-STOREY FARMING	1	0	0	17	0	0	9	0	0	9	0	0	33	0	0	18	0	0	88	0	0
PRODUCTION FORESTS																					
TREE CROPS/AGROFORESTRY	21	21	21	33	33	33	129	129	129	6	6	6	16	16	16	19	19	19	223	223	223

* also moderately to marginally suitable for multi-storey farming;
S prime pasture land suitability

Table 4.9 Existing and Potential Urban/Industrial Areas

(Unit: ha)

CODE	NUEVA ECIJA	TARLAC	ZAMBALES	PAMPANGA	BULACAN	BATAAN	CENTRAL LUZON
POTENTIAL AREAS							
Lowland (< 8 %)	2,660	0	1,644	1,000	77	9	5,390
Upland (8-18 %)	2,509	4,573	3,822	2,141	14,255	4,581	31,881
TOTAL	**5,170**	**4,573**	**5,466**	**3,141**	**14,332**	**4,590**	**37,272**
EXISTING AREAS	**14,403**	**7,415**	**6,863**	**11,813**	**23,383**	**2,490**	**66,367**

Source: GIS analysis by the JICA Study Team